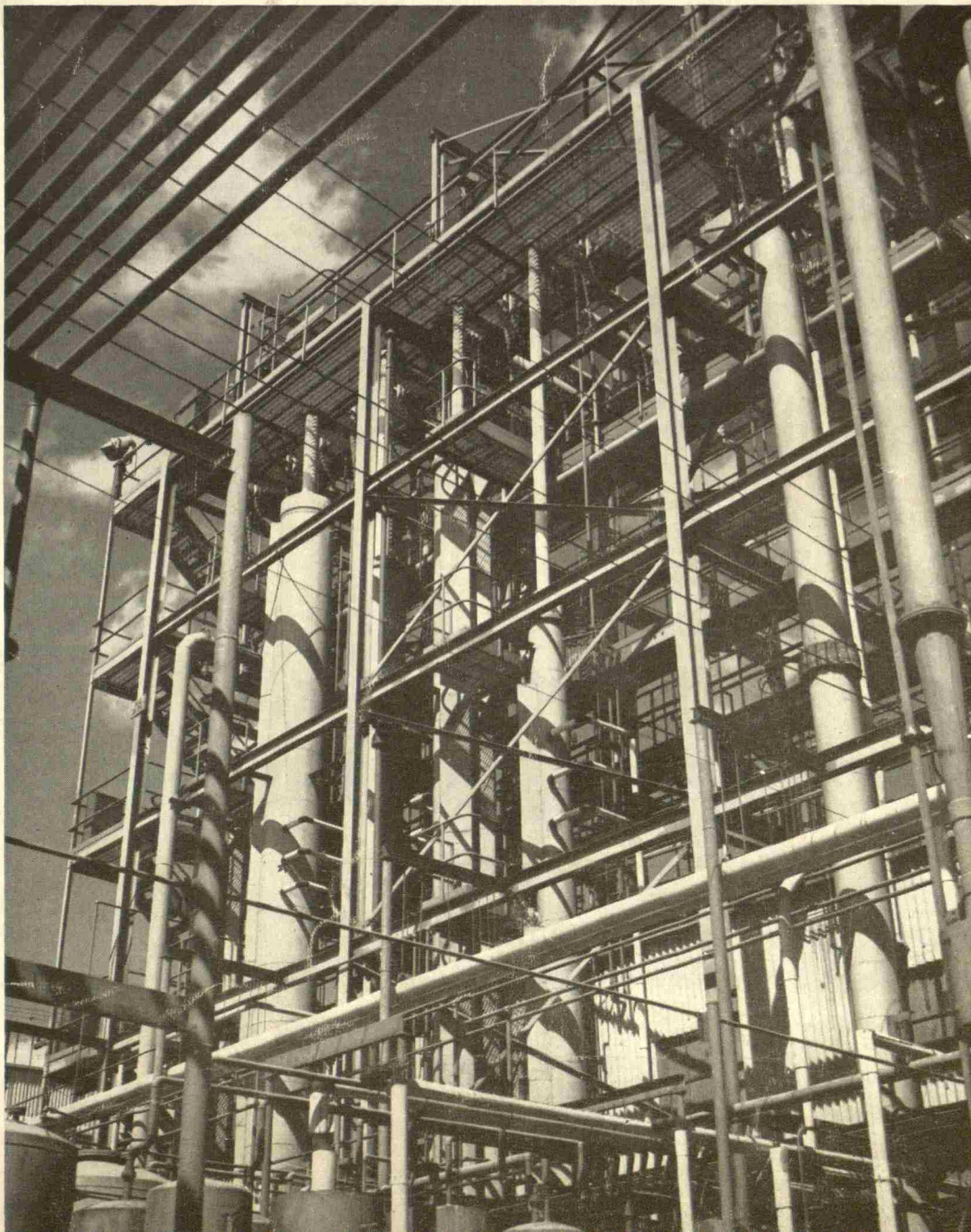
Spartan ENGINEER



IOVEMBER

1952

Vol. 6

No. 1

Twenty Five Cents

To keep steel strip on the straight and narrow → → → →

. . . at 1000 feet per minute!

● Threading its way through a gigantic continuous-annealing furnace at speeds up to 1000 feet per minute, steel strip behaves erratically. It tends to wander and weave. It fouls the rolls. Sometimes it breaks. Then production on a multi-million-dollar unit, designed for high-speed operation, slows down or stops dead . . . a very costly business.

To solve this problem—to keep strip from running crooked—all sorts of schemes have been tried; crowned rolls, higher tension on the strip, side guides. None of them worked as hoped for. Each merely added new problems of its own. To make matters worse, with recent trends to longer strip, to higher speeds and longer processing lines, these tracking and aligning difficulties were further aggravated.

But the answer has been found. In the development of the Lorig Aligner, United States Steel has come up with a novel, yet surprisingly simple solution. For these rolls, named for the inventor—a U. S. Steel engineer—are *automatically* self centering. Set in the continuous-annealing line shown here, they now track the strip—no matter what its speed—relentlessly toward the center of the roll. These remarkable rolls even *anticipate* trouble and realign wayward strip 30 feet *before* it reaches the roll.

The result? Clean, bright strip, flat and undamaged, uniformly and perfectly annealed, reeling off the delivery end at the rate of 1000 feet per minute.

The U·S·S Lorig Aligner—a brilliant application of basic engineering principles—is full of promise not only for continuous strip lines of all kinds, but wherever production depends on accurate tracking of the material. In other words, if centering and alignment is the problem, the Lorig Roll is literally the key to continuous high-speed production.

The Lorig Aligner is another example of United States Steel's active research program which has enabled countless manufacturers to improve their production methods and make better products in the bargain. In the field and in research laboratories, trained U. S. Steel engineers and metallurgists are working to help make the manufacture of steel—and its use—more efficient. United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pa.

THE U·S·S LORIG ALIGNER consists of a divided roll (conical effect exaggerated at the right) with each conical half running on a common rotating axle that is slightly deflected in the center so that the upper surfaces of the cones form a straight surface. As the strip passes over the roll, strongly converging lateral forces are set up to exert a powerful centering action on the strip that immediately corrects any deviation and keeps the strip running straight and true.

USS TRADE MARK

UNITED STATES STEEL

DR. CLINTON R. HANNA, *Associate Director*
Westinghouse Research Laboratories
Enrolled in Westinghouse Graduate Student Training Course after graduation from Purdue University in 1922. Dr. Hanna, with over 100 patents to his credit, is one of the nation's leading authorities on gyroscopically controlled regulating devices.

CARROLL V. ROSEBERRY, *Manager*
Westinghouse Electric Utility Department
Upon graduation from Oklahoma A & M in 1934, he enrolled in the Westinghouse Graduate Student Training Program. Assigned first as a salesman, he was advanced to district Assistant Electric Utility Manager, branch Electric Utility Supervisor, and in 1951 was appointed to his present post.

DR. EDWIN L. HARDER
Westinghouse Consulting Engineer
Enrolled in Westinghouse Graduate Student Training Course after graduation from Cornell University in 1926. Dr. Harder has become nationally known for his analytical and development work in power systems. He is co-developer of the Anacom, an electric analogue computer.

They did what you can do to achieve success

These Westinghouse executives have several things in common . . . a desire to excel, intense enjoyment of their work, and early training in their fields of specialization. All entered Westinghouse through the Graduate Student Training Program . . . the same program that today is launching young engineers on careers with Westinghouse.

You can do what these men did to achieve success. They found out early what their likings and talents were, what they wanted to do, and set their sights accordingly. With the help of the Westinghouse Training Program, you, too, can get off to a sure start on the career of your choice.

The Westinghouse Graduate Student Training Program

This program has been carefully developed through 50 years to enable top men, selected in leading colleges, to choose their careers wisely from the wide variety of opportunities available at Westinghouse. The program gives you a clear understanding of the company and its products . . . lets you try out many types of work through planned work assignments . . . and offers you the benefit of personal counsel in selecting the field for your career. The Westinghouse Graduate Student Training Program helps supply the answer to that all-important question, "Which is the *right* career for you?"

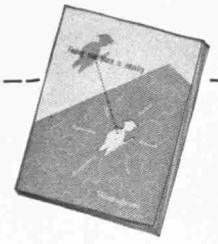
For full information on the Westinghouse Training Program, send for our 32-page book, "Finding Your Place in Industry."

G-10250

EDUCATIONAL DEPARTMENT

YOU CAN BE SURE...IF IT'S

Westinghouse



To obtain copy of "Finding Your Place in Industry", consult Placement Officer of your university, or mail this coupon to:

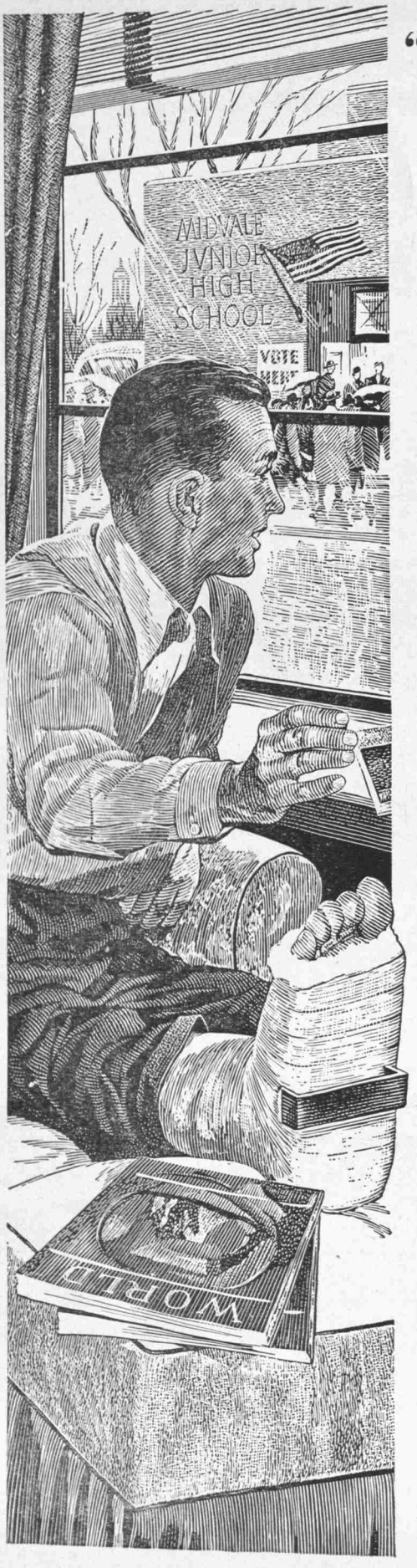
Mr. R. A. Warren
District Educational Co-ordinator
Westinghouse Electric Corporation
306 Fourth Avenue
Pittsburgh 30, Pennsylvania

Name_____

School_____ Year_____

Street_____

City_____ Zone____ State_____



"Hand me my crutches, Mary!

"Doc or no Doc . . . no wounded leg is keeping ME home on Election Day! When I was over in Korea, *one* of the big things we figured we were fighting for was the right to vote as we please.

"Just look at that crowd! Seems like *everybody* in town's turning out to vote today. In fact, it's been predicted that more than 55 million people all over the nation will be voting!

"Heard a fellow the other day call it 'National *Beef* Day'. Says he, we *all* beef at one time or another about our local, state, or national governments, or certain people in them. *And today's the day we get a chance to back up those beefs with ballots!*

"Whether we squawk about corruption by public officials . . . about wasteful squandering of our hard-earned tax dollars . . . about government interfering in public utilities and private business . . . about overloading government payrolls with un-needed workers . . . or about government employees with red sympathies—Election Day is the big moment for us citizens to get it off our chests with those votes our Constitution guarantees us.

"I say, thank God we don't live in one of those commie countries where people have only hand-picked red candidates to vote for. Those poor devils just don't get a chance to vote for anybody else. Sometimes, Mary, I think we don't fully appreciate how lucky we are. *We* vote for whom we honestly think best . . . and nobody on God's green earth knows *how* we vote!

"So hand me those crutches, Honey. And get *your* hat and coat on, too. We're going to vote together . . . bum leg or no bum leg."

REPUBLIC STEEL

Republic Building • Cleveland 1, Ohio

REPUBLIC STEEL

Republic BECAME strong in a strong and free America. Republic can REMAIN strong only in an America that remains strong and free. To answer the urgent needs of Defense Production, Republic is taking a significant part in the development of Titanium . . . whose structural strength compares favorably with that of many steels, and whose corrosion-resistance ranks it with some of the stainless steels. *Yet Titanium is only 56% as heavy as alloy steel.* No development project (except that of atomic energy) has commanded as much attention and research in so short a period as has Titanium . . . the metal of the future. Keep your eye on Republic Titanium and Titanium Alloys!

* * *

For a full color reprint of this advertisement, write Dept. H, Republic Steel, Cleveland 1, Ohio.

8 ways up with Phillips Petroleum Company

★

Scientific and technical graduates looking for a "career with a future" will find that Phillips offers many and varied opportunities for qualified men.

Petroleum is a young and progressive industry—and Phillips is a young and progressive company. In addition to our production of motor fuels and lubricants, Phillips is an important manufacturer of such diversified products as carbon black, chemical fertilizers, synthetic rubber, and many other compounds derived from petroleum hydrocarbons.

In most phases of the company's operations we offer supervised on-the-job training for new men to prepare them for assignments of responsibility and importance.

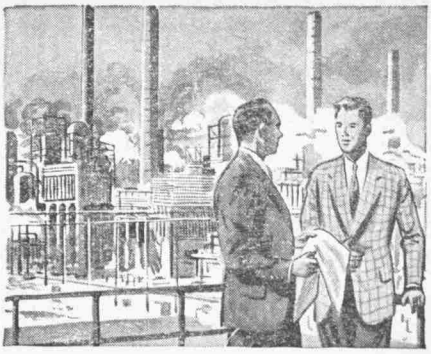
We invite qualified men to write to our Employee Relations Department for further information about opportunities with our company.

Phillips 66

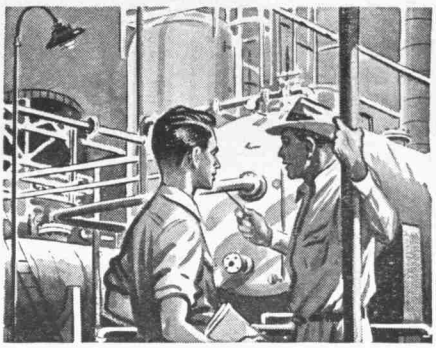
PHILLIPS PETROLEUM COMPANY

Bartlesville, Oklahoma

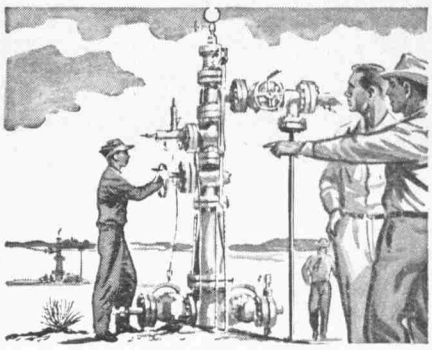
OIL PRODUCTION DEPARTMENT drills wells and produces crude oil. It is also the responsibility of this department to unitize oil fields for highest economic recovery.



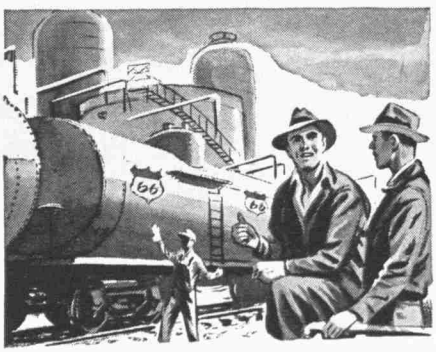
REFINING DEPARTMENT converts crude oil to finished marketable products. Utilizes advanced technology for maximum upgrading of raw petroleum.



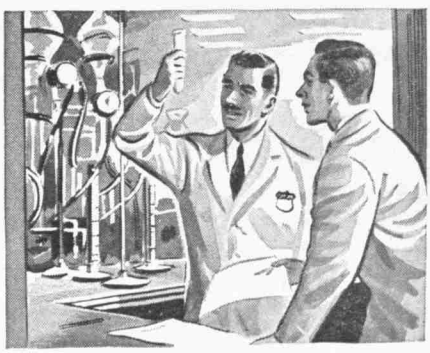
NATURAL GASOLINE DEPARTMENT extracts light hydrocarbons from natural gas. Phillips is the world's largest producer of natural gas.



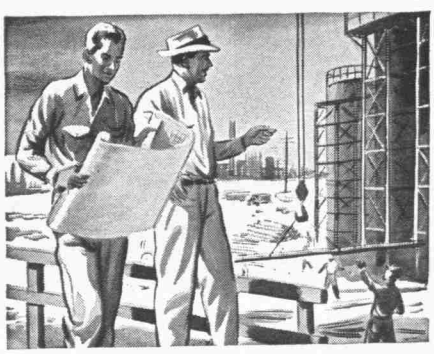
NATURAL GAS DEPARTMENT produces, gathers and sells natural gas in the development of one of the world's largest gas reserves.



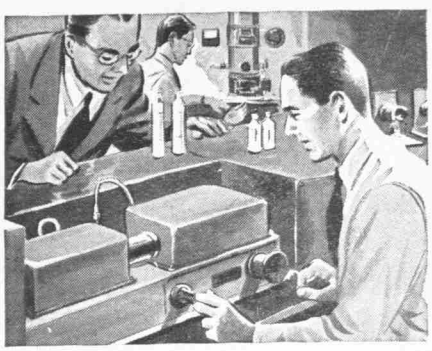
SUPPLY AND TRANSPORTATION DEPARTMENT operates pipe lines, tank cars, barges and motor vehicles . . . purchases, sells and gathers crude oil.



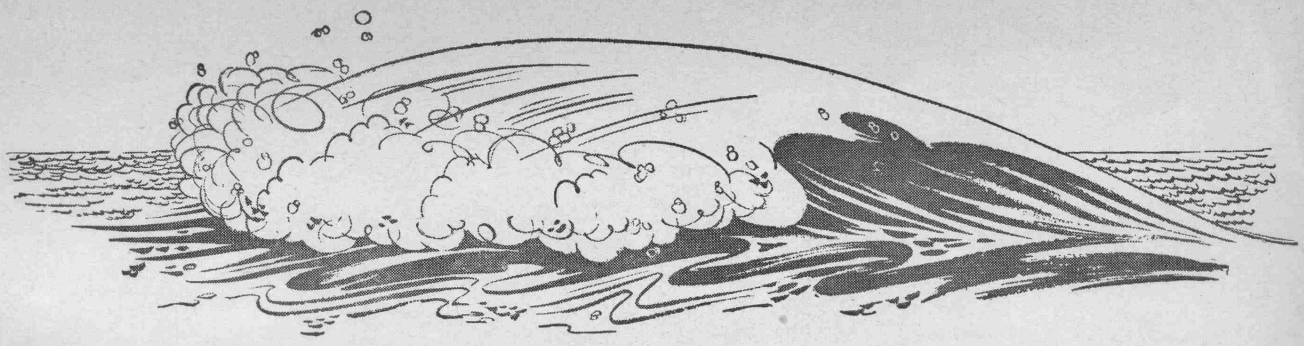
PHILLIPS CHEMICAL COMPANY is a leader in fast-developing field of petrochemistry . . . manufactures and sells nitrogen fertilizers, carbon black, monomers and high polymers.



ENGINEERING DEPARTMENT designs, constructs and inspects new facilities, tests materials and operates the company's communication systems.



RESEARCH AND DEVELOPMENT DEPARTMENT conducts research, pilot plant and semi-commercial development, procures patents and surveys markets for new products.



Ever Wonder Why a Wave Rolls?

MAYBE it's a long step from the rolling ocean waves to an Aircraft Corporation — and maybe *not.*

Here at Goodyear Aircraft, the step is a short one. For we do many things besides build aircraft and other defense items. Typical of the many outstandingly different fields into which our engineers are free to "dig" is the recent study of ocean waves and their effects, completed for a group of offshore oil-drilling companies. Or the study of fish and how they swim—of importance, finally, to submarine and ship designers.

All this because Goodyear Aircraft Corporation is more than a major supplier of armament components—more than just a specialized organization in the aircraft field. Today, Goodyear Engineers are working with plastics, metals, wood—in fields ranging far from the aeronautical activities implied in the GAC name.

As a result, Goodyear Aircraft Corporation offers every engineer an opportunity to specialize in the field of his own choice—on projects with normal times applications as well as the current defense projects. As a part of the world-wide Goodyear organization, Goodyear Aircraft is a division of the world's largest rubber company — a world-known engineering organization that is *production-minded.*

There's a place for YOU in the Goodyear Aircraft picture—whatever your field may be. So check over the list of opportunities in the panel—see for yourself the many unique opportunities for progress and advancement—*with an assured future*—at Goodyear Aircraft.

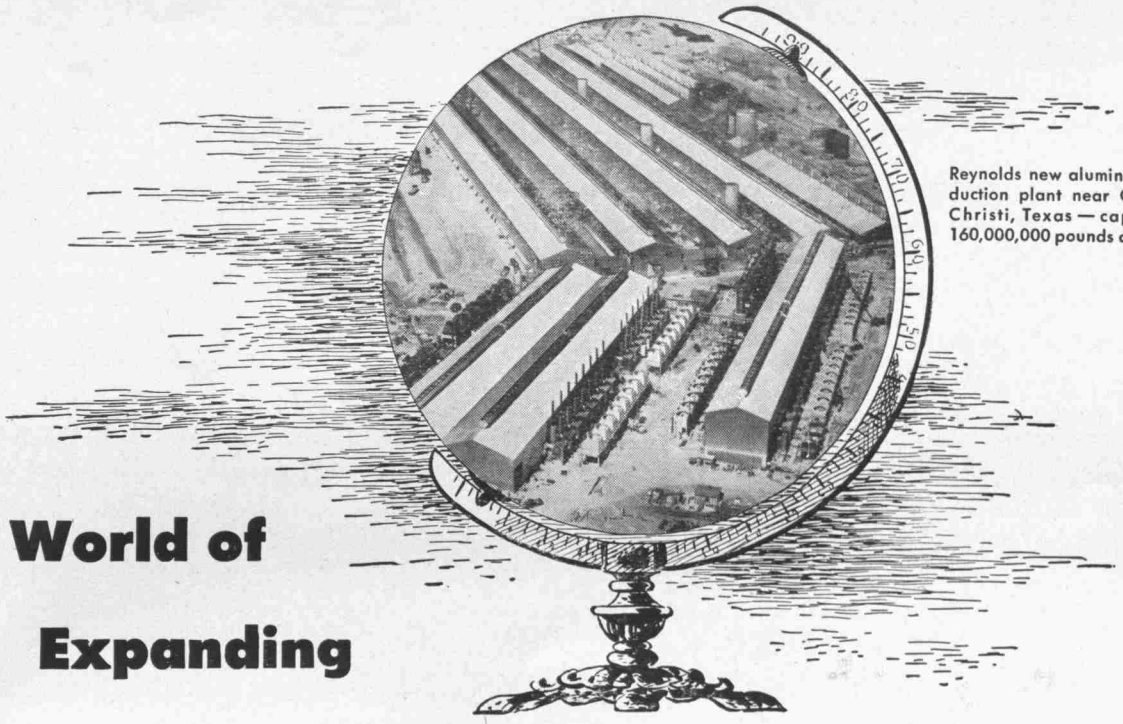
GOODYEAR AIRCRAFT

ENGINEERS WANTED *to investigate the opportunities in research, design, development and production of:*

AIRPLANES, AIRSHIPS, HELICOPTERS, GUIDED MISSILES, ELECTRONIC COMPUTERS, AIRCRAFT COMPONENTS, GUIDANCE SYSTEMS, RADOMES, TRANSPARENT ENCLOSURES, REINFORCED PLASTICS, BONDED SANDWICH STRUCTURES, WHEELS AND BRAKES, RADAR STRUCTURES and many others.

Submit a brief resume of your qualifications and experience. Or write us today for an application blank and further information. Prompt consideration is assured. Address SALARY PERSONNEL DEPARTMENT, GOODYEAR AIRCRAFT CORPORATION, Akron 15, Ohio.

GOODYEAR—The Company with COMPLETE Coverage of the Aeronautical Field



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

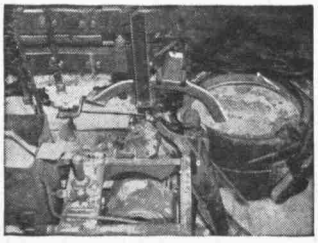
A World of Expanding Opportunity!

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.

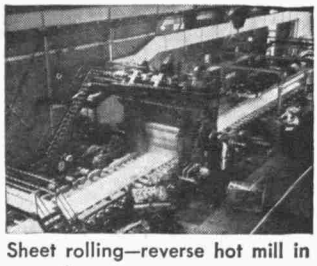
Reynolds operations include bauxite mining in domestic and foreign locations...chemical and electrolytic processing to produce aluminum pig ...sheet rolling...drawing and extrusion of mill and structural shapes ...foil rolling and printing...powder and paste production...finished parts and products fabrication. 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.

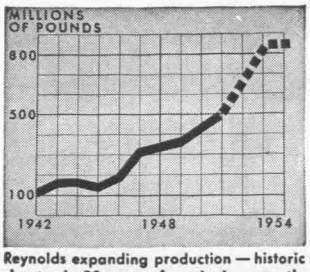


Tapping one of huge battery of electrolytic cells



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_____

WANTED

New Ideas

To Keep America Strong in the Air

Aviation progress requires new ideas—and plenty of them. And that's why North American always has career opportunities for young engineers who do fresh thinking. North American is a company that thinks in terms of the future. That's why it has been an industry leader for 24 years, designing and developing the leading planes of World War II, the B-25 Mitchell and F-51 Mustang, and America's present day front-line fighters, the F-86 *Sabre* Jets. Today, North American is pioneering in many new fields—guided missile, jet, rocket, electronics, atomic energy—thinking ahead to keep America strong in the air.

When you are prepared to enter the engineering profession, consider the career opportunities at North American. In the meantime, feel free to write for any information you might want concerning a career in the aircraft industry.

Write D. R. Zook, Employment Director, 5701 W. Imperial Highway, Los Angeles

NORTH AMERICAN AVIATION, INC.

LOS ANGELES, CALIFORNIA • COLUMBUS, OHIO

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

Spartan ENGINEER

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COVER PICTURE

This month's cover shows a view of the new construction at the Dow Corning Plant, one of the leaders in silicone research. See Page 10.

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605 W. Michigan Avenue, Chicago

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Single copies 25 cents.

Opportunities at General Motors:

a real chance—
a real challenge!

OUR continuous talks with you engineering seniors in schools from coast to coast convince us of one thing:

Most of you hope to find a job in a company of sufficient stature in its industry to supply a real challenge to your brains and to your technical training.

A General Motors job in many ways gives you just such an opportunity. And here's why.

First—GM makes all kinds of products requiring all kinds of engineering talents—mechanical, electrical, metallurgical, chemical and industrial. These products range from automobiles, refrigerators, and fractional horsepower motors to Diesel engines.

And, as a leading defense contractor, GM runs the production gamut from shells, bombsights and range finders to tanks and jet and Turbo-Prop engines.

Second—all this huge variety of work is decentralized among GM's 34 manufacturing divisions, its 112 plants in 54 towns and cities throughout the country. And each division operates as an independent unit with its own engineering department. Yet each can draw upon the resources of GM's central research and engineering laboratories.

Thus you have—at one and the same time—the friendly, personalized setup of a smaller company and the opportunities and facilities of a large successful organization—a leader in many major fields.

All of this naturally spells out a real chance and a real challenge for the man who has the get-up-and-go to make the most of what GM has to offer. Many engineering graduates now in top jobs at GM testify to that fact.

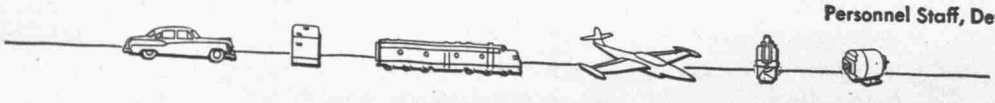
So why not check with your College Placement Office and arrange for an interview with our GM College Representative the next time he visits your campus or write direct to us.

GM POSITIONS NOW AVAILABLE IN THESE FIELDS:

Mechanical Engineering • Electrical Engineering
Metallurgical Engineering • Industrial Engineering
Chemical Engineering • Business Administration

GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan



The Editor's Page

DESIGNING YOUR FUTURE

THE ENGINEER'S PROBLEM

Many of you freshman and sophomore engineers are wondering, "What does the future hold for me?" This is a problem that the great majority of engineering students have had to face at one time or another.

For each individual the answer is different, but many people are trying to help.

In 1951, the National Electrical Manufactures Association took a step to insure your future. They set up the "NEMA Committee on Engineering Talent." The NEMA Board of Governors assigned the following scope to the Committee:

1. To analyze the situation which faces the industry during the next ten years in the highly competitive recruiting market which will result from the great decrease in the number of graduating engineers.

2. To consider and recommend what can be done by NEMA directly with the colleges by providing information for use of member companies, to bring to the attention of graduates the opportunities in the electrical manufacturing industry.

3. To estimate the probable cost of any program which may be recommended.

Although this committee was set up mainly for the electrical field their analysis of the problem is applicable to all other fields of engineering.

Summarized, it is as follows:

Our nation is faced with a critical shortage of engineers, not limited to mechanical, electrical, or any other field, and unless effective counter-measures are employed, this shortage will precipitate a national crisis. A survey of the needs of 378 companies and government agencies showed that about 80,000 engineers were needed then, exclusive of the needs of the military. When the current graduating class of 38,000 is absorbed, there will still be an unfilled demand for 42,000 engineering graduates. The military may take 19,000 engineering graduates this year, leaving an unfilled demand of more than 60,000 engineers.

This situation is expected to become more acute in the years ahead, and the problem will remain until 1960.

Therefore engineer, take a look at your future. It looks a little brighter, doesn't it?

KNOW YOUR SOCIETY

I have a few words for you engineers, be you basic or upper school.

A question please, "Engineer what is your major society and honorary?" You say you don't know. I thought so. We will help you a little bit.

Agricultural Engineering
- American Society of Agricultural Engineers

Civil Engineering
- American Society of Civil Engineers
- Chi Epsilon

Chemical Engineering
- American Institute of Chemical Engineers
- Alpha Chi Sigma

Electrical Engineering
- American Institute of Electrical Engineers
- Institute of Radio Engineers
- Eta Kappa Nu

Mechanical Engineering
- American Society of Mechanical Engineers
- Society of Automotive Engineers
- Pi Tau Sigma

Metallurgical Engineering
- American Foundry Society
- American Society of Metals

That is about it. Now do you know your society and honorary?

You ask me, "Why should I know my society?"

One of the greatest aids that you can have as a young engineer is the knowledge and experience of the society and the people in it. Many of the societies have a service whereby, if you come up against a problem that you yourself can not solve, you may send it to a member that specializes in that particular type of problem.

Just a parting word. The next time that you see there is going to be a meeting of one of your professional societies, drop in and take a look around. You're always welcome.

TECHNICAL WRITING

Have you ever thought of technical writing as a career? The field is wide open to the engineer with the proper background in English and writing.

Many of the old established firms, that have not had technical writers on their staffs, are now setting up whole departments with but one function—to write technical publications for and about their products.

Several companies, such as McGraw-Hill publish innumerable periodicals devoted only to the engineering field. Most of the professional societies have their own publication, in which they publish papers and reports pertaining to their particular field.

The Sperry Gyroscope Company, a few months ago, published a paper in their Engineering Review on Publications Engineering. They pointed out in this article the infinite possibilities for an engineer in the publications field.

If you have asked yourself, "What am I doing in engineering?" why not look into the technical writing field? It may possibly be the solution to all your problems.

SILICONES AS ENGINEERING MATERIALS

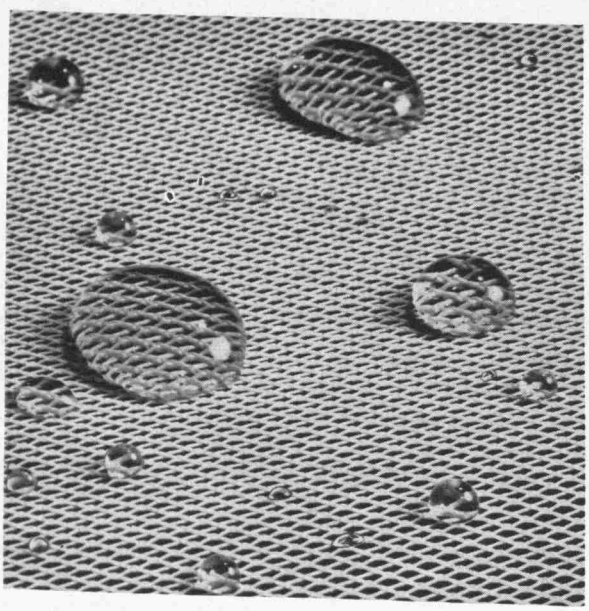
By TOM CLARK
Chemical Engineer '54

Does your engineering problem require a material that is water-repellent, heat resistant, or arc resistant? If so, perhaps a silicone can solve your problem.

Silicones are a new class of materials that resist heat and cold, repel water, insulate electricity, and outlive at least ten times the life-span of comparable organic materials. Just what then are silicones and how can they be used?

Silicones are the chemical cousins of glass. They may even be called a chemical hybrid: a cross between organic and inorganic materials. Silica, the element from which the name comes, is a brother to carbon in the periodic arrangement of elements. For this reason, silicones look like many carbon materials, but have an unusual combination of properties.

Silicone materials take on such forms as oils, greases, rubber and resins. Such products as water-repellents, fluids, release agents, lubricants, defoamers, rubber, protective coatings, and electrical insulations made from silicones are all available to the engineer. Here are some of the many ways in which they may be used:



This DeCetex treated fabric looks and feels exactly like any ordinary nylon marquisette with a weave as open as a window screen. But water rolls around on the fabric like blobules of mercury, unable to wet the fibers; repelled so strongly that it can't even squeeze through the open squares unless it is briskly shaken through them.

LIQUID SILICONES

At the top of the list are the water-repellents. They are important to the engineer where parts may be exposed to harmful moisture. For example, a silicone water-repellent is used to keep water from forming a continuous film that conducts electricity over the surface of the glass insulator. Water-repellents of silicone also protect concrete and masonry walls from white efflorescence that spoils the appearance of the walls. The silicone water-repellents have the unusual property of being completely invisible. They do not change the color or the texture of the surface, and they do not prevent breathing.

Silicone fluids are even more unusual in their properties than are the water-repellents. Unlike most fluids, silicone fluids do not thicken and become more viscous as the temperature drops, nor do they evaporate until they reach temperatures well above 500° F. Silicone fluids also oppose breakdown in their structure from mechanical action. On top of all this, these fluids will not conduct electricity and they are not affected by time and weather because they resist oxidation.

With these properties in mind, engineers have used silicone fluids as hydraulic fluids, instrument fluids, liquid dielectrics, lubricants, and release agents. The fluttering of instrument pointers on the dash board of cars has been dampened by using a fraction of a drop of silicone fluid on the pointer bearings. Silicone fluids are used in overload relays because they do not thin out at high temperatures and allow the motor to be cut out needlessly, or become so thick at low temperatures that the circuit is not broken soon enough to save the motor. The use of silicone fluids are limitless in that they are readily adaptable to almost any situation requiring a fluid that will do an unusual job. At present, silicone fluids are available in viscosities from 0.65 to 1,000,000 centistokes.

A by-product of the fluids is the silicone lubricants in the forms of oils and greases. These lubricants have the same unusual properties as the fluids in that they are resistant to high and low temperatures and are non-volatile and non-sludging. They are used where parts are permanently pre-lubricated, since time has little effect on them. These lubricants are used in electric motors that are operated at high temperatures. As a result, the amount of work done by these motors can be doubled. Silicone lubricants are used on fans inside ovens that remain at 500° F. indefinitely. Conveyors that carry automobile parts through ovens at 700° F. are lubricated with a silicone. As another example for a use of a silicone lubricant, bearings have been made to work at 70° below zero when lubricated with a silicone grease. Everyday, engineers are finding new uses for the silicone greases and oils.

Fluids, oils, greases, and some forms of silicone resin have been used as mold releases. The advantage of a silicone mold release is that it retains its structural and lubricating properties even under the high temperatures and high pressures of hydraulic presses. Most of the rubber tires made in this country are released from their molds with a silicone mold release agent. Before the use of silicone release agents, tire producers used an organic lubricant that left the mold covered with a carbon-like scale that was hard to remove. The use of the silicone release agents reduced the cost of mold cleaning and maintenance by as much as 90 per cent. One rubber tire manufacturer reported that before using the mold release agents, his factory had about 1,000 scrap tires a day. After this factory adopted the silicone mold release agent, almost no scrap tires were produced.

One of the unusual and unexpected properties of silicones is that of defoaming. Defoamers are important in industry to reduce the loss and the hazard created by foam. Foam will fill up fermentation vats, tanks, stills and reactors. If these vessels overflow, materials are wasted. If these materials are flamable, a fire hazard is created. Overflowing can be prevented only by slower processing, by partially filling the vessels, or by using a defoamer. Silicone defoamers are inert, neutral and non-toxic, and are among the most effective and versatile of defoaming agents. Only a few parts per million of a silicone defoamer are required. Its usefulness ranges from deflating bloated cows to eliminating the need for a multi-million dollar expansion of a "cold-rubber" plant. It is commonly used in processing thousands of different materials ranging from adhesives and asphalt to wine, yeast and zymes.

SILICONE RUBBER

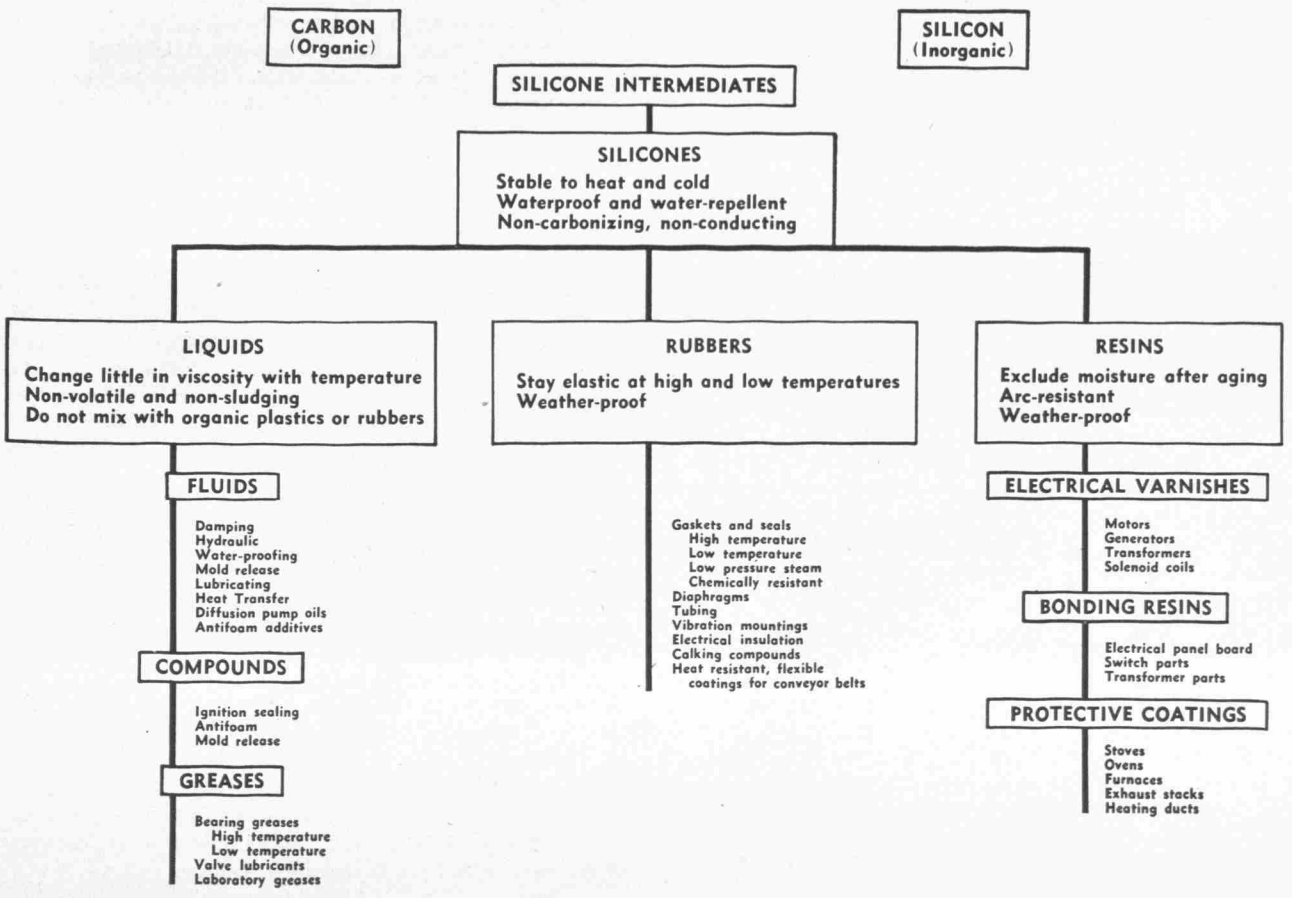
Silicone rubber is a product that has gained a wide variety of uses. This new type of rubber started about ten years ago with a bit of bouncing putty and has now developed into the only kind of rubbery material that retains its properties from -100° to over 500° F. Silicone rubber withstands shocks and vibration, dissipates heat rapidly, and will not crack or break while aging at high temperatures. It also is used to seal bomb bay doors at -100° F. and anti-icing systems at 350° F. in airplanes. The durability of silicone rubber in oil has made it possible to simplify and to increase the reliability of fluid-drive systems in many automobiles. In diesel-electric locomotive engines, silicone rubber O-rings are used to keep hot water from leaking out of the cooling jacket and into the crank case. Failure of ordinary rubber seals used to run up large maintenance bills because engines had to be almost completely taken apart to replace the O-rings.

SILICONE RESINS

Research chemists have taken silicone resins and made protective coatings with properties lying between those of vitreous enamels and a good alkyd or melamine paint. Silicone coatings withstand temperatures in the range of 500° to 1000° F., temperatures that would blister organic paints in a few hours. They also have a high degree of water-repellency, weather resistance, and

(Continued on Page 32)

SILICONES, what they are and how they are used.



THE DEAN'S PAGE

TO MEET THE NEW CHALLENGE

By LORIN G. MILLER
Dean of Engineering

Engineers need constantly to be reminded that their profession is vastly broadening its scope. In fifty years the ratio of Engineer to Workman has increased from one in two hundred-fifty to one in sixty. This ever increasing ratio has been largely responsible for the revolutionary increase in the man hour output of American industry. More leisure, better transportation, and more abundant comforts place our standard of living above that of the rest of the world. The engineer's vista cannot, therefore, remain the narrow technological view but must increase its scope to include worldwide consumption.

With increased outlook the engineer must expect to see a challenge in new responsibilities. Can new purchasing power be created to match the increase in productive capacity? What reasonable incentives can be devised to induce motives for work and human cooperation in productive effort? Will the engineer endeavor to achieve cooperation by working directly with individuals or by working through organizations of trade unions? Can engineering specifications be written to emphasize ethics and morals? The engineer finds himself in the best position to devise answers to these challenging problems.

Michigan State College was established to make possible the education of the children of the producers; to provide an education that would help them achieve individual success in a chosen vocation. It was the thought of the time that if students could be given the technical and vocational training they demanded even at the expense of a liberal education, that they could go on and become successful individuals. Then as individuals were successful and built up their own fortunes they were also building up the country. It is now clear that we can no longer afford this extravagance. The increase in "shady" politics, "kickbacks" on contracts, and "mink-coat" bribes makes it evident that we must take more than a side glance at ethics, morals and politics. With the establishment of the Basic College, Michigan State has taken a long positive step toward providing a training in how the other half lives.

Mass training, mass movements, evolution or revolution will not and cannot produce a glorious new morality. It is inconceivable that the Russian people will permanently lose their human individuality or remain forever docile even under the rule of ruthless materialism and denial of the rights of individuals. Out of those masses of submerged personalities will come some pure minds with clean thoughts and high ambitions. As a corollary we must expect that from our struggle for universal literacy some individuals, or a clan, will emerge who are barbaric. Even now we see the shadow. Clowns and blackguards make the headlines while the work of countless good citizens goes unnoticed. We spend more money on institutions of correction than upon education. W. H. Auden describes this character:

> "the new barbarian is no uncouth
> Desert-dweller; he does not emerge
> From fir-forests: factories bred him;
> Corporate companies, college towns
> Mothered his mind, and many journals
> Backed his beliefs. **He was born here . . .**"

In other words he is a product of the education we have given him. It is our duty as individual engineers to reshape our education to such a form that we stand as morally correct citizens as well as able technologists!

In order to properly shape our education to this expanded scope, it is necessary to leave at intervals the ivory tower and make little journeys into lands where our neighbors dwell. We must leave behind for brief periods the problems which can be solved by formulae and slide rule. Itineraries for these trips should include memberships in professional and social societies, trips to legislative halls, concerts and lectures, participation in student government, work on the college journals and last but certainly not least the church of your choice. It should be held without reservation George Washington's position expressed in his farewell address "Of all the dispositions and habits which lead to political prosperity, religion and morality are indispensable supports—and let us with caution indulge the supposition that morality can be maintained without religion."

THE BLUEBERRY HOE
AN MSC DEVELOPMENT

By RALPH KONDAL
Agricultural Engineer '54

The back-breaking chore of cultivating and weeding blueberries is but a memory, thanks to Dwight Kampe, a graduate student at Michigan State College, who has developed the Blueberry hoe.

Cultivating and weeding automatically as the tractor travels along the rows of bushes eliminates expensive —and almost unavailable—hand labor. Since the hoe operates between the bushes, an ordinary cultivator is pulled behind the tractor to work between the rows as has been done in the past.

The essential parts of the hoe are the head, shield, bumper and hydraulic system, and frame.

The head extends from the side of a tractor and is constructed and rotates similarly to the rotating blade of a lawnmower. The principle difference of the two is the heavier construction of the hoe head. As the head rotates, it chops the weeds and makes a fine mulch of the soil to a depth of one inch, the maximum safe depth of cultivation around shallow rooted bushes.

Different types of heads, two feet wide and six inches in diameter, are used for varied soil conditions. Since the space between rows which the drag type cultivator does not reach is eighteen inches, there is ample over-lap of cultivation when the row is worked from both sides. This allows the operator to travel faster without excessive care in steering the tractor.

The shield, constructed of sheet metal, covers the head to prevent the soil from being thrown around and serves as a mount for the bumper. It also protects anyone from coming in contact with the rotating head.

The bumper is a metal rod which upon coming in contact with a bush will open a valve to the hydraulic cylinder that pulls the head from between the bushes. It is bent to the shape of the resultant of the velocity of the tractor forward and the velocity of the head toward the tractor. Thus the head is moved around the bush, neither hurting the bush nor missing any excess ground. A different shaped bumper must be used for different tractor speeds as the resultant will change direction. They are easily changed and are inexpensive.

The bumper is mounted on a pivot so there will always be a minimum lever arm of six inches between the point of contact of bush and pivot pin. This assures adequate leverage for the translation of bumper movement to the hydraulic valve. A tension spring returns the head to its original position after the bumper passes the bush.

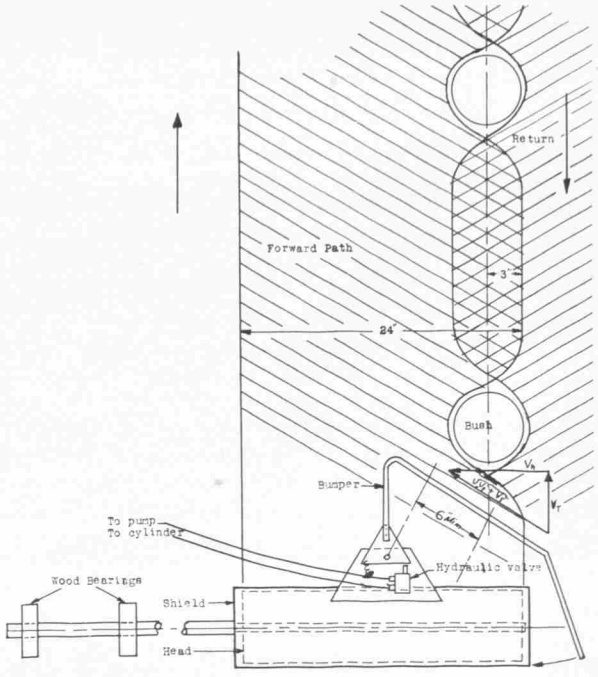
A pump mounted on the frame of the hoe and driven by two Vee-belts from the tractor crankshaft supplies the pressure for the hydraulic system. Since the pump runs continually, there is an oil line from it to the tank to eliminate pressure when not needed. When the bumper opens the valve on the shield, the oil pressure is transmitted to the cylinder which pulls the head in. When the head is returned to its extended position the oil flows from the cylinder to the storage tank to be used again.

The standard hydraulic life system on a tractor will raise the hoe at the end of the rows by means of a cable and pulleys.

The frame is constructed of pipe and is mounted on the front of the tractor frame with bolts to ease mounting and dismounting operations. The two arms supporting the head are held with pins allowing them to be pulled toward the tractor when the bumper touches a bush.

The rotary head shaft bearing, on the lower end of the arms, is constructed of hard wood, such as maple. Since they will be operating in the dirt they will need replacing often. The wood is cheap to replace and any farmer with access to a wood lathe can turn his own bearings if necessary.

The Blueberry hoe is not limited to blueberries, but can be used for many kinds of small bushes, vineyards, and nurseries, as long as the rows are more than five feet apart.



A working drawing best illustrates the hoe's operation. As the bumper hits a bush it causes the hoe to move, making clearance for the bush.

HOW A TURBOJET OPERATES

Courtesy
Westinghouse Electric Corp.

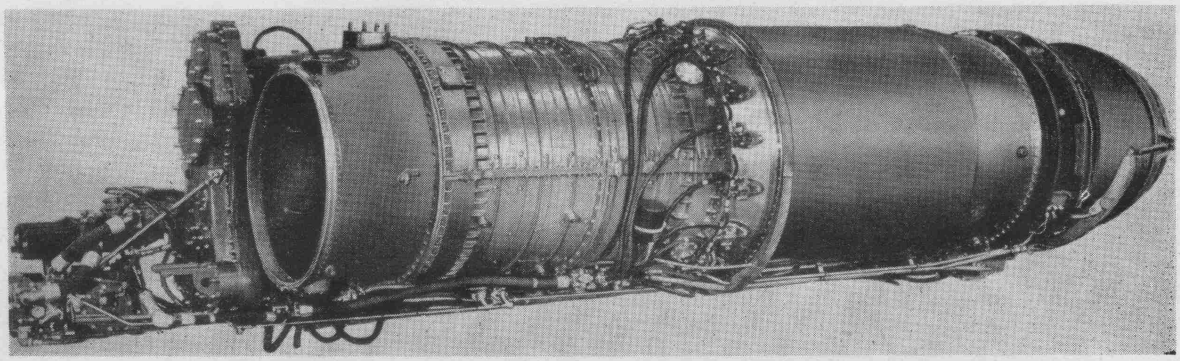
A boy on roller skates pushing on a wall to get started; a man pushing down on the arms of a chair so that he can stand up; an automobile tire trying to push the pavement backward so that the car can move forward—all use the same basic principle of propulsion as does the turbojet engine. This principle is stated by Newton's Third Law of Motion: "For every action there is an equal and opposite reaction." Although in each of these examples movement in one direction is gained by directing a force in the opposite direction against a relatively immovable mass, Newton's Law applies equally well in cases wherein the opposite force is directed against an easily movable mass.

For example, consider the oarsmen in a racing shell, who impart forward motion to the shell by applying a rearward force to the water. Actually, they gain motion by increasing the rearward velocity of the water through which they are passing. Since the speed of the shell depends upon the size of the oars and the frequency of strokes, the reaction that moves the boat forward—called "thrust"—must depend upon the amount of water, or mass, handled and the extent to which its velocity is increased.

To more easily explain the phenomenon of gaining forward motion by increasing the rearward velocity of a fluid—water, air, or gas—Newton's Third Law of Motion was expanded and restated in the Momentum Law. The Momentum Law states that "the resultant of forces acting on the boundaries of any arbitrary region is equal in magnitude and direction to the summation of the time rate of change of momentum of the particles or bodies within the region. The region (not necessarily rigid) must contain the same particles during the differential time dt." In other words, the thrust developed by the men and their oars, the propellers of a plane or ship, or the turbojet engine, is equal to the change in momentum they impart to the fluid through which they are moving.

Utilizing the definition of momentum, thrust is shown to be equal to the mass of the fluid being acted upon multiplied by the change in velocity imparted to the mass. Therefore, to increase the forward speed of its craft, the engine must either handle a greater mass, or it must propel a given mass faster. It is easy to see that the thrust of propeller-driven craft can be increased by using a larger propeller, or by driving a given propeller at higher rpm, just as the oarsmen in a racing shell would have to increase the effective size of the oars, or row faster.

Actually, the turbojet engine is a mechanized version of the racing-shell-oarsmen engine, converting the chemical energy of fuel into the mechanical energy needed to increase the momentum of a portion of the fluid through which it is passing. It, too, may increase its thrust by accelerating a greater mass of air to the same velocity, by accelerating the mass to a higher velocity, or a combination of both. To see how this may be accomplished, it is first necessary to have an understanding of the operation of a turbojet.



The exterior view of the J-34 engine shows its simple lines and streamline design. This is the type of engine that is placed in wing pods on all jet and jet-repercussion engine power air craft.

As shown in Figure 1, the basic components of a turbojet are (1) an air inlet diffuser, (2) an air compressor, (3) a combustor, (4) a turbine, and (5) an exhaust nozzle. The compressor and turbine are directly connected by a shaft.

Depending upon the speed of the airplane, atmospheric air is either drawn or rammed into the inlet diffuser. This diffuser changes a part of the velocity of the air into pressure and directs the air into the compressor. The compressor then increases the pressure of the air to the point where, upon entering the combustion chamber, the air may be at a pressure of anywhere from 3 to 16 times that in the inlet diffuser, depending upon the designed compression ratio of the engine.

In the combustion chamber, about 25 per cent of the air is mixed with fuel and the mixture ignited. The balance of the air is used to cool the metal parts of the combustion chamber and to provide sufficient turbulence for complete combustion of the fuel. The

(Continued on Page 30)

AGRICULTURAL ENGINEERING

By CARL F. ALBRECHT
Asst. Prof. Agr. Eng.

Agriculture is America's largest nondefense industry. It is estimated that more than twice as much primary horsepower is used in agriculture as in industry and that about 85 per cent of the problems in agriculture involve engineering.

Agricultural engineering is the application of engineering principles to these problems in the areas of farm power and machinery, farm buildings and conveniences, rural electrification, soil and water management, and the handling and processing of farm products. Thus the agricultural engineer has an opportunity to help man raise his standard of living by helping to make farm life more enjoyable, remove the drudgery from farm operations, reduce the hazards of farming, reduce the cost of production, retain and improve the quality of farm products, profitably use farm by-products and surpluses, and conserve and efficiently use our natural resources.

Michigan State College has one of the newest, largest, and most modern agricultural engineering buildings in this country. The building has over 60,000 square feet of floor space, most of which is devoted to laboratories in which teaching and research activities are carried on in the five fields of agricultural engineering.

A well-qualified staff of about fifty members has been selected by the college administration for their special training, experience, and abilities in the various fields of teaching, research, and extension work. Most of the staff have earned advanced degrees in their fields and many of them have had considerable experience in industry and government service. Several staff members are national authorities in their special fields and are the authors of textbooks which are widely used throughout the country.

The Curriculum

Students of agricultural engineering receive the same basic engineering training as those in the other engineering fields. These courses emphasize fundamentals of engineering and include mathematics, engineering physics, chemistry, and mechanics. In addition to this, they receive training in the agricultural field in courses in soils, animal husbandry, farm crops, dairy, and horticulture. General studies in the social sciences, English, and economics are also required.

Special agricultural engineering subjects which utilize the foundation courses in engineering and agriculture are taken in the junior and senior years. All agricultural engineering students get the same basic training at Michigan State College and then choose one of the five specialized fields of study, namely: (1) farm power and machinery, (2) farm buildings and conveniences, (3) soil and water management, (4) rural electrification, or (5) processing farm products.

Upon completion of this course series the student receives the degree of Bachelor of Science in Engineering and will be eligible for membership in the American Society of Agricultural Engineers, the recognized professional organization in this field. Graduate agricultural engineers have the same status in the engineering world as do those men in other recognized engineering fields. The technical curriculum in agricultural engineering is administered jointly by the Schools of Agriculture and Engineering. Michigan State College's curriculum has been accredited by the U. S. Engineering Council for Professional Development.

Wide Range of Opportunity for Employment

After graduation the student will find opportunity for many different kinds of employment. He may be employed by private industry, such as farm machinery manufacturing companies, building materials manufacturers, trade associations, food processing companies, irrigation equipment manufacturers, or electric power companies. Here he may develop and test new machines, equipment and processes and introduce them to the public, or he may be involved in sales, public relations, or the supervising of service work.

Some graduates of the Michigan State College Agricultural Engineering Department are employed in all of these types of industry, while others have elected to do research work in federal and state governmental agencies, and still others have found employment in teaching and extension work in colleges both in this country and abroad. More recently there has also been considerable demand for agricultural engineers in advertising and by farm publications.

The demand for well-trained agricultural engineers has been steadily increasing in the past several years, and this trend will probably continue for several years.

Graduate Work

Michigan State College's Department of Agricultural Engineering has a well-recognized program of graduate study and research with students from many other states and nations enrolled.

Graduate students have an opportunity for further special study in their chosen fields and to gain experience in research procedures. The degrees of Master of Science or Doctor of Philosophy are granted to students completing the proper requirements.

(Continued on Page 40)

1952 DEVELOPMENTS IN ATOMIC ENERGY

Courtesy General Electric

SHIPBOARD REACTOR

In April, 1950, the AEC and the General Electric Company agreed that development of a power breeder reactor should be deferred, and that work should be shifted to a Ship Intermediate Reactor (known as SIR), for use on U. S. Navy submarines. Such a plant would have great tactical advantage for a naval vessel, since the small bulk of atomic fuel would permit it to cruise for extended periods without need for refueling. This would be particularly advantageous for a submarine. It was estimated that from 65 to 75 per cent of the research and development work previously done on the power-breeder reactor would be applicable to SIR. The chief difference between the two is that SIR will be a single purpose machine designed specifically to produce large amounts of heat which will then be employed for generation of power. No effort will be made to breed new fuel. It is planned to construct the land-based prototype at West Milton. As of late 1952, the project is "well along." A large portion of this work is expected to be useful in the further development of peacetime atomic power plants.

Such a reactor differs considerably from the Hanford "piles," which operate with neutrons of relatively low, or "thermal," energies. It is possible also to use a thermal reactor to generate power, and the AEC has another independent program for constructing one of these for shipboard use. SIR, however, as the middle part of its name indicates, will utilize neutrons of intermediate energy.

For efficient power generation, a reactor must operate at temperatures considerably higher than those of the Hanford units. No feasible way is known at present of converting atomic energy directly into electricity, so the reactor will be a source of heat. This will be carried by a liquid metal to a heat exchanger, where water will be converted to steam. The steam, in turn, will be used to produce useful power, in the same way as if it came from a conventional coal or oil-fired boiler.

SODIUM A PRACTICAL HEAT-TRANSFER MATERIAL

Extensive experience had confirmed that liquid sodium is a practical heat-transfer medium to remove heat from the SIR power reactor, transfer it to steam, and hence drive a turbine. Compared with water, it has the advantages of low pressure at high temperature and superior heat-transfer properties. Sodium metal will melt at a temperature a little below that of boiling water.

An interesting development that utilizes the metallic properties of liquid sodium makes possible the pumping of sodium by direct application of electromagnetic forces. This so-called "electromagnetic pump" is similar in principle to an induction motor, the main difference being that the electromagnetic forces are exerted on the sodium in a duct rather than on a conventional rotor. A pump of this type is very good for use with radioactive fluid as it avoids possibility of even small leakage through seals and has no moving parts to require service.

PRELIMINARY PILE ASSEMBLY

On April 28, 1948, KAPL scientists began operation of the "preliminary pile assembly," generally referred to as "PPA," which was the first controlled chain reaction producing atomic energy in the northeastern part of the United States. Such a device, also called a "zero power reactor," because it operates at very low power for safety reasons, makes possible the quick testing of mock-ups of different reactor designs.

It is primarily an experimental tool, for testing those phases of reactor design which are not connected with the generation of large amounts of power. This required that it be taken down and reassembled in 11 different combinations between its initiation and the time it was announced, in the autumn of 1950. It has now been redesigned and housed in a new building.

PPA has proved a useful tool for obtaining accurate numerical data about atomic nuclei which are important in reactor design, both for the structural material and the nuclear fuel. In addition it supplied the first demonstration of a new method for the control of nuclear reactions which is particularly adapted to reactors of this type.

AIRCRAFT NUCLEAR PROPULSION PROJECT

The General Electric Company became actively engaged in the problem of nuclear-powered flight when the U. S. Air Force and the Atomic Energy Commission in February, 1951, asked the Aircraft Gas Turbine Division to undertake the further development of a nuclear power plant for aircraft.

This followed the conclusion of the NEPA (Nuclear Energy for Propulsion of Aircraft) project which was described as the first phase of a study leading to an atom-powered plane. The NEPA project was directed by the Fairchild Engine and Airplane Corporation. Nine other engine companies participated.

Ten years ago G.E. built the first turbojet engine in this country and the G-E Aircraft Gas Turbine Division now produces the J-47, No. 1 production engine for the Air Force. In the nuclear research field, available when needed to consult with the G-E engineers and scientists working on the aircraft project, are the scientists and engineers of the Knolls Atomic Power Laboratory, the Research Laboratory and the General Engineering Laboratory, all at Schenectady, and other Company groups throughout the nation.

(Continued on Page 36)

GENERAL ELECTRIC GRADUATE FELLOWSHIPS

EDITOR'S NOTE: In reply to several requests, the Spartan Engineer today publishes information concerning three graduate fellowship and scholarship awards. Information about the first of these is below, while news of the other two awards is on the following pages.

If news of any other such awards is brought to the attention of the editors in the future, the Spartan Engineer will print information about them as soon as possible.

FELLOWSHIPS FOR GRADUATE STUDENTS

The terms of the General Electric Educational Fund established with assets of $1,000,000 by the General Electric Company make provision for the use of the annual income from 80 per cent of its assets for Fellowships to graduates of the universities, colleges, and technical schools of the United States who need financial assistance, and who have shown, by the character of their work, that they could, with advantage, continue their education by undertaking or continuing research work in educational institutions either in this country or abroad.

Since 1952 with each Fellowship the General Electric Company has made a grant of $1200 to the College or University where the fellowship winner does his graduate study.

These Fellowships are awarded to graduate students for work in the fields of Physical Science, Engineering, and Industrial Management. Since 1923 when the Charles A. Coffin Fellowships were established, 201 such awards have been made. The Gerald Swope Fellowships were begun in 1945, and 50 have been granted since then.

GENERAL PROVISIONS APPLICABLE TO BOTH THE CHARLES A. COFFIN AND GERALD SWOPE FELLOWSHIPS

(1) The amount of each Fellowship granted shall be $1400 for an unmarried Fellow and $2100 for a married Fellow. There will be no change in the stipend granted because of any change in marital status occurring after enrollment in the Fall term of study.

(2) In addition to the award to the Fellow, a grant of $1200 will be made for each Fellowship to the College or University at which the Fellow is studying, this grant to be applicable to expenses of the Fellowship including tuition, equipment, and other costs.

(3) These Fellowships are not intended for those who hold, or expect to hold, any other Fellowship.

(4) The Committee requests that all applications from students now in attendance at an educational institution first be sent to the Dean or Department Chairman of such educational institution at which the applicant is, or has been, in attendance within the year. The Committee desires that the Dean or other College executive in turn file all the applications received by him at the same time, together with a statement naming the two applicants who in his opinion or the opinion of the faculty are best qualified to receive the award.

(5) The applications will in turn be submitted to a committee consisting of representatives from the following organizations: National Academy of Sciences, American Chemical Society, American Physical Society, American Institute of Electrical Engineers, American Society for Engineering Education, and the American Society of Mechanical Engineers.

(6) Applications must be filed with the Committee by January 1 and should be addressed to Secretary, General Electric Educational Fund, Schenectady, New York.

WHERE OUR ENGINEERS COME FROM

Perhaps you, too, have wondered where all your engineering classmates come from. Are they mostly local men, rural lads, or from the larger cities in Michigan?

Did you know that students from 25 foreign countries (and three provinces in Canada) made up five per cent of your engineering classmates last year? Did you know that 20 different states were called home by your fellow lab partners? It may also surprise you, as it did me, to learn that 71 per cent of our men came from cities and 24 per cent of them were from places of less than nine thousand in population.

One of the other four men sitting in your row in class came from outside Michigan. Nearly every county seat in Michigan is represented too. The following table will give you a summary of the home towns of your classmates.

SUMMARY OF MSC ENGINEERING STUDENTS

AS OF JUNE 1952

	HOME AREA							
	Lansing Area	Detroit Area	Other Major* Michigan Cities	Smaller Cities** and Rural Areas	Out of State	Foreign	Totals
Basic Engineers	82	88	72	50	137	57	21	517
Engineers (Upper School)	96	103	105	41	131	75	30	581
Totals	178	191	177	91	268	142	51	1098
Percentage	16%	17%	16%	8%	24%	13%	5%	

*Cities included in this group (50,000-200,000): Saginaw, Bay City, Flint, Pontiac, Grand Rapids, Kalamazoo, Battle Creek, Jackson, Muskegon.

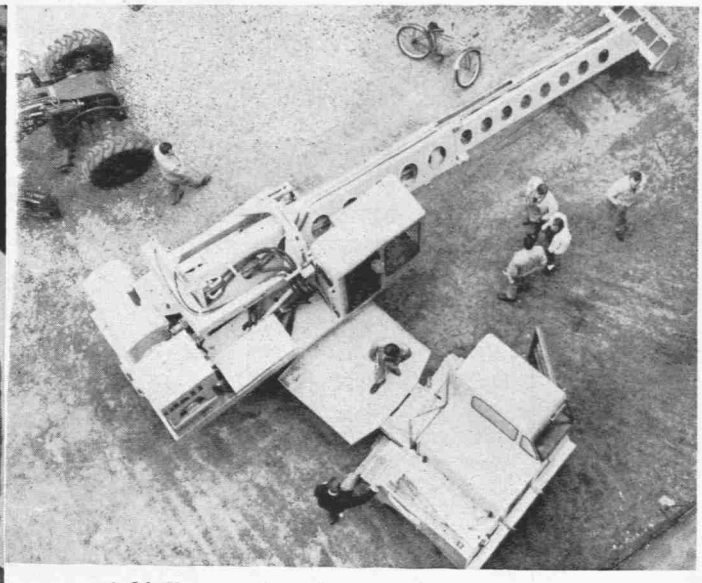
**Smaller cities, etc. (9,000-45,000): Benton Harbor, Ludington, Port Huron, Ann Arbor, Niles, Monroe, Traverse City, etc.

The countries represented by your fellow students are: Brazil, Awali Bahrein, China, Mayagues P. R., Jordan, Poland, Turkey, Russia, Iran, Iraq, Columbia, Canada (Quebec, Ont., Sask.), Gold Coast Africa, Guatemala, Venezuela, Lebanon, Hawaii, Norway, India, Latvia, Ramallah Pal, Bolivia, Cuba, Siam, Malaya.

MSC engineers from New York, Pennsylvania, Ohio, Illinois, New Jersey, Wisconsin, Colorado, Arkansas, Massachusetts, California, Kentucky, Oklahoma, Connecticut, West Virginia, Texas, Tennessee, Nebraska, Indiana, and South Dakota were enrolled here last year.

VIEWS OF THE '52

The winner! Dean Miller of Engineering receives the congratulations of Dean Wyngarden of Business and Public Service. Dean Miller copped first place in the antique car race by taking more oranges from the top of coke bottles on his way around Circle Drive, although both finished their heats in equal times.



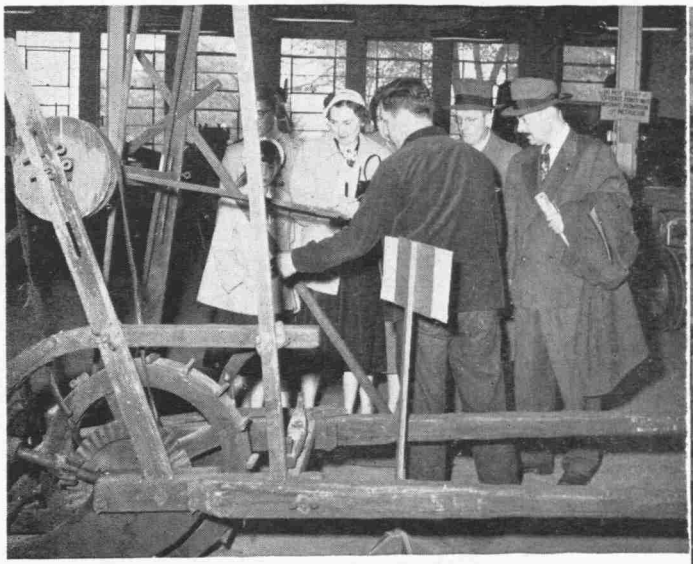
A bird's eye view of excavation equipment.

Pictures by

Power Lab. proved very interesting to many of the visitors.

Rubber from a bottle. A demonstration of the manufacture of synthetic rubber at the General Motors' Previews of Progress show.

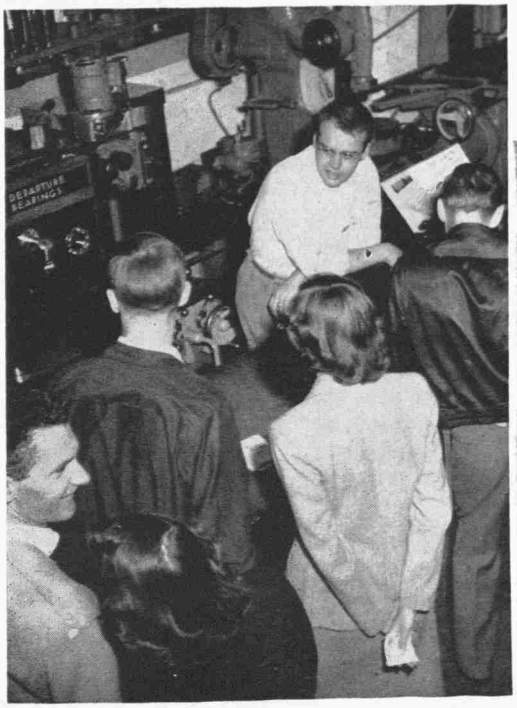
ENGINEERING EXPOSITION



Visitors looking over the oldest reaper known to exist.

Miss Mary Lee Backhurst, Miss Engineer for 1952, receiving a bouquet of roses from Miss Marilyn Thompson, a member of the Queen's court.

Carl Romick



Visitor's looking over a bearings display.

View in front of Shops building. Excavating equipment is in the foreground, while in the background is a Diesel switching engine and way car.

Sixth Annual Competition of the Engineering Undergraduate Award Program

James F. Lincoln Arc-Welding Award

Engineering Undergraduate Award and Scholarship Design Program

The purpose of this ten-year series of Design Programs is to encourage engineering undergraduates to study the value of arc welded design in machinery and structures. The Program encourages this study through the preparation of papers on welded design by students of engineering in institutions of higher learning. All undergraduate students of engineering are eligible to compete.

The Program contains two interdependent plans:

Award Plan

Under the Award Plan, engineering undergraduates will compete for cash awards by submitting papers describing the arc welded design of either a machine, machine component, structure or structural part. Under the Award Plan, 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.

No. of Awards Each Division	Amount of Each Award	Total Awards Each Division		
		Mechanical	Structural	Total Awards
1—First	$500	$500	$500	$1000
1—Second	250	250	250	500
1—Third	150	150	150	300
4—Fourth	75	300	300	600
6—Fifth	50	300	300	600
10—Sixth	25	250	250	500
23		$1750	$1750	

Total: 46 Awards $3500

In addition to the 46 awards offered in the two separate competitions, 3 Grand Awards will be 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. Grand Awards will be:

First Grand Award	$750
Second Grand Award	500
Third Grand Award	250
Total	$1500

The top award of the Program is First Divisional Award of $500, plus First Grand Award of $750, or a total of $1250.

If sufficient papers of merit are not presented to warrant the making of all awards, the awards as announced will be increased proportionately to their respective amounts in order to utilize the entire $5000.

Scholarship Plan

Under the Scholarship Plan, scholarship funds will be granted to the schools in which were registered the three recipients of the Grand Awards under the Award Plan. These scholarship funds are to be used for scholarships in the departments in which the award winning students were enrolled.

The department of the institution in which the First Grand Award winner was registered will receive $1000 for four scholarships of $250 each.

The department of the institution in which the Second Grand Award was registered will receive $500 for two scholarships of $250 each.

The department of the institution in which the Third Grand Award winner was enrolled will receive $250 for one scholarship of $250.

The $1500 to be granted in scholarship funds is in addition to the payments made to the students submitting the winning papers in the Award Plan.

The only requirements prescribed by the Foundation for these scholarship funds are: (1) that these funds are to be administered by the head of the department concerned of the institution to which they are paid; (2) they are to be awarded on the basis of scholastic attainment, imagination, ingenuity, ability and character, without regard to the financial need of the student; (3) each of these scholarships is to be known as the "John Doe Scholarship (using the name of the student whose paper received the award) of the Lincoln Foundation." Schools receiving funds for more than one scholarship may either give all of the $250 scholarships in one year or extend them over a number of years. In the latter case, there is no objection to the same student receiving $250 scholarships in more than one year.

All Branches of Engineering May Participate

The Foundation desires to encourage students in all branches of engineering (including Agricultural Engineering and Architecture) 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.

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 receives a cash award. "Design for Welding" is the book published by the Foundation as a result of its industrial "Design-for-Progress" Award Program.

RULES AND CONDITIONS

Eligibility

Resident engineering undergraduate students registered in any school, college or university in the United States, which offers a curriculum in any branch of engineering (including Agricultural Engineering and Architecture), leading to a degree, and cadets regis-

tered in the United States Military, Naval and Coast Guard Academies, are eligible to submit papers in this Award Program.

A. A paper may be submitted by any student or a group of students who shall have actually organized and developed the design described in the paper.

B. No one student or group shall participate in the writing of more than one paper each year.

C. The student must have been registered as a resident student within the period June 29, 1952 to June 29, 1953. (Need not be registered for the full time.)

D. Papers may cover a class project or thesis started before June 29, 1952, but all papers for entry in this Program must be completed within the period June 29, 1952 to June 29, 1953, even though the thesis or project is not completed until later in the academic year.

E. Students who are receiving their bachelor's degree prior to June, 1953 shall submit their papers within 30 days following their graduation dates. Students graduating in June 1953 may complete their papers following graduation provided the paper is submitted before June 29.

Officers, employees, distributing agents, dealers, or advertising agencies of the founder of the Foundation shall not be permitted to contest for any award or benefit of the Program and no award shall be given to any such person.

Subject Matter of Papers

Students may prepare a paper for this Program on any type of machine or structure which can be classified in either one of two subject categories:

1. Mechanical Design
2. Structural Design

Papers should present a design for an arc welded machine component, complete machine, truss, girder, structural part, or complete structure. The machine component, structure or part designed and described need not actually be built. Since the central theme of this Program is arc welding design and its value, subject matter should be a design in which welding is of major importance. Designs in which welding is only of minor importance will be rated accordingly by the Jury of Award.

Suggestions for subjects are given on page 15. Also listed are titles of award papers from previous competitions. The list is furnished simply as suggestions for the student. Any subject with which the student may be familiar through observation, reading or experience is eligible so long as it conforms to these Rules and Conditions.

Papers must be students' own design effort: A student may not submit a report which only reviews the work of others. The student should use his imagination and ideas in applying arc welding to a design of his own creation, thus demonstrating his engineering design ability.

The above stipulation does not preclude the inclusion in the paper of a resume of the appropriate literature in preparation for a design, provided the resume is shown to be preparatory for the student's own creative work which is the subject of the paper.

If a paper is written concerning a welded design by a commercial organization with which the student may have been associated, he should clearly differentiate between his own contribution to the subject and the contributions made by others in that organization.

Treatment of Subject Matter

It is the particular aim of the Foundation to encourage the preparation of the type of paper which will not interfere seriously with the student's regular college activities. The Foundation encourages the preparation of papers on design executed by students in regular class or thesis work provided they conform to the Rules and Conditions. To further encourage participation within the restriction of time available in the normal curriculum, each entry must not be longer than 20 pages. If a longer paper on the subject has been prepared, a digest not exceeding 20 pages should be prepared as an entry for the Program. Entries will be judged on quality, not quantity of material presented.

In rating the merits of papers, the Jury of Award will give consideration to the following general requirements, but not necessarily in the order given:

1. Clarity of exposition of design
2. Practicability of the results
3. Technical completeness
4. Statements of advantages, such as savings in time or money or improvements in performance
5. Ingenuity and originality displayed
6. Presentation: correct use of English, quality of drawings, sketches or illustrative material, neatness, succinct expression and adherence to the Rules.

Papers should in general present the problem to be solved, the method of approach to the solution of that problem, the solution made and the results achieved. The student will want to consider the function and the principal design requirements; how the design performs the required function; what problems were solved in arriving at the final design, including material selection as to type and size, placement, how arc welding contributed to the design solution and what problems were solved for fabricating.

Students should carefully avoid all possible reference to trade products and trade names as such, in line with good professional practice in technical writing.

Presentation of Subject Matter

All papers must conform to the following requirements in the matter of presentation of subject matter:

Only the original copy of the paper shall be submitted. Text must be clearly legible, typed, double spaced, or hand-written in ink (preferably typed), on one side only, on bond paper approximately 8½" x 11" in size, not more than 20 pages in length, bound in standard report folders. Calculations will be considered as part of the text with regard to the number of pages submitted.

Original drawings, sketches, or copies in the form of blueprints or photostats, or other illustrative matter, may be used but the total number of such exhibits shall not exceed five, nor shall the size of any one be greater than 24" x 30". If original drawings are submitted with paper, they must be in ink. When welding is shown on drawings, the size, type and length of welds should be indicated.

(Continued on Page 42)

HELI-COIL ENGINEERING STUDENT DESIGN AWARD PROGRAM

Heli-Coil Corporation of Danbury, Conn.—manufacturer of screw thread inserts for the protection and repair of tapped holes in all materials—announces the 1952 Heli-Coil Engineering Student Design Award Program.

This award program is open to resident engineering under-graduate students registered in any school, college or university in the United States and Canada which offers a curriculum in any branch of engineering leading to a degree. Cadets registered in the United States Military Academy, Naval Academy and Coast Guard Academy are also eligible.

Cash awards will be made for the most original or unique new uses for Heli-Coil thread inserts, as follows:

First Award	$1000
Second Award	500
Third Award	250
Merit Awards	100

The number of merit awards to be made will be determined by the contest judging board.

The purpose of the award program is two-fold: (a) to encourage inventiveness and ingenuity among student engineers, and (b) to supplement class work with practical industrial problems that will help prepare them for their transition into industry.

Students desiring to participate in this program must apply by postcard or letter to "Design Award Program," Heli-Coil Corporation, Danbury, Conn. They will then be registered as official participants and will receive complete engineering data and other necessary information by return mail.

The award program period is from October 1, 1952 through December 31, 1952. To be eligible for judging entries must be postmarked not later than midnight December 31, 1952. A distinguished contest judging board—made up of design magazine editors, industrial designers, educators and industrialists—will appraise the entries on January 21, 1953. All participants will be notified promptly of the judges' decision.

Each entry must contain a sketch of the student's original or unusual design on 8½ x 11-in. paper and must be accompanied by a hand or typewritten description on 8½ x 11-in. paper. Descriptions should be kept as short and "to the point" as possible. Any number of entries may be submitted, but only one award will be made to any entrant.

Entries will be judged on their original or unusual approach. In case of a tie between similar entries, the award will go to the one bearing the earliest postmark.

Heli-Coil screw thread inserts are coils of precision-formed stainless steel or phosphor bronze wire having a diamond-shaped cross section. When installed in tapped holes, they provide conventional threads with higher loading strengths and greater resistance to wear than unprotected threads. They eliminate stripping, seizing, galling and corrosion.

They are available in the following standard sizes and thread classifications.

(a) 4-40 to 1½-6 sizes in the National and Unified Coarse Thread Series.

(b) 6-40 to 1½-12 in the National and Unified Fine Thread Series.

(c) 10-1. Omm to ⅞-18 in the Automotive Spark Plug Series.

(d) 14-1.25mm to 18-1.5mm in the Aviation Spark Plug Series, and

(e) ⅛-27 to 1-11½ in the Pipe Thread Series.

They are supplied in standard, 1, 1½, 2, 2½ and 3-diameter lengths. For special applications, non-standard lengths and sizes can be supplied.

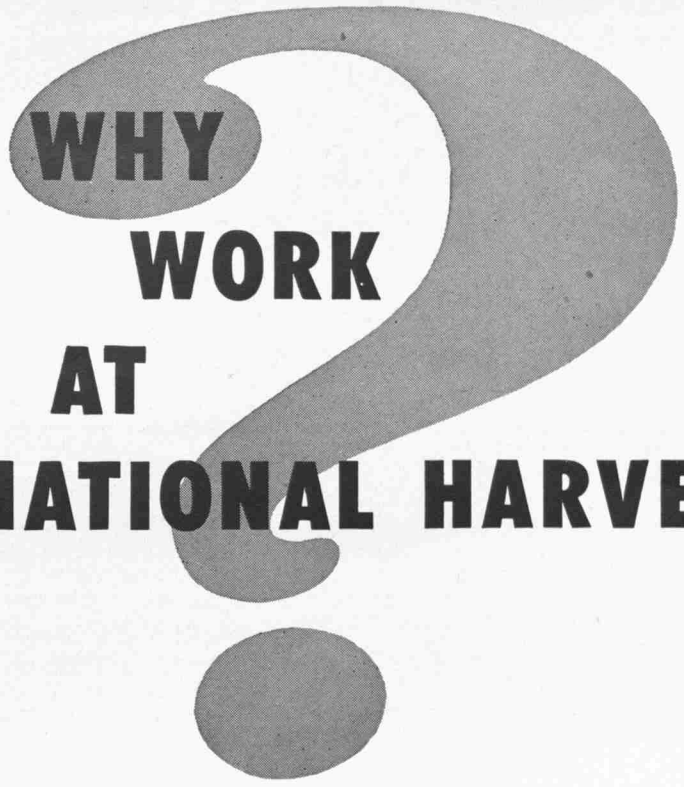
Heli-Coil screw thread inserts have a slightly larger free diameter than the hole into which they are installed. They are compressed before installation in an inserting tool for quick seating in the tapped hole. For this reason, they are self-locking. No amount of vibration or screw turning will loosen them. However, they can be quickly and easily removed with an extracting tool if this should become necessary.

Heli-Coil inserts are installed in aluminum, magnesium, die cast metals, iron, steel, brass, bronze, wood, plastics and other materials with hand or power tools—depending upon the production rate desired.

When assembled in tapped holes, these thread inserts conform with standard specifications for screw threads as published by the National Bureau of Standards. They will provide Class 3, 3B, 2 or 2B fits.

Installation is as follows: The thread insert is positioned in the inserting tool so that its tang can be engaged by the slotted mandrel of the tool. (The tang is a simple driving member formed by one end of the insert wire which has been bent into a radial position.) Turning the mandrel, either by hand or power, threads the insert through a prewinder in the nose of the tool, then into its tapped receiving hole. (Tapped threads are produced with Heli-Coil taps to provide standard pitch but oversize diameters.)

Whether in through holes or in blind holes, tangs are left on inserts after installing except when tang removal is necessary for screw clearance or product appearance. If tangs must be removed, notched inserts and a tang break-off tool are used. The notch, located adjacent to the tang, provides a clean fracture point when the tang break-off tool is used after installation.



WHY WORK AT INTERNATIONAL HARVESTER?

Stable, essential industry: The products manufactured by Harvester are basic, essential products that pay for themselves in use. The farm equipment, trucks, industrial power, and refrigeration products bearing the Harvester name are essential to our economic well-being. *This kind of basic industry offers challenging careers to its employes.*

Job opportunities: Harvester has had steady growth; today it is an industrial leader. As such, it offers many fine and diversified job opportunities. Today, more than 90,000 people call Harvester their working home.

Kinds of opportunities: Special heed is paid to constant improvement of products already manufactured. New products are constantly being developed. Harvester pays special heed to progressive engineering and research. *It needs, wants, and is looking for capable young people in these fields.* Sales production, and administration also offer opportunities.

How about advancement? There is no limit to advancement with this company. The president and eleven others of today's officers of International Harvester Company came up through the ranks. Encouragement is given the young person with ambition and ability. One's future can be excellent indeed with International Harvester.

INTERNATIONAL HARVESTER

Chicago 1, Illinois

Builders of farm equipment for easier, more profitable farming . . . trucks for better transport . . . industrial power for road-building and earth-moving . . . refrigeration for better preservation of food.

NEW DEVELOPMENTS

By JACK HARPER

WORLD'S MOST POWERFUL JET ENGINE

The world's most powerful qualified turbojet aircraft engine develops thrust equivalent to approximately 25,000 horsepower at today's jet flight speeds.

The new power plant will be the first jet engine in the world to provide constant speed drive for airplane accessories as an integral part of the engine. This revolutionary feature will permit designers to make substantial savings in weight and space in new planes, both vital factors in maintaining aircraft superiority.

The tremendous power of the new J40 is partly developed through the use of an afterburner which reheats the exhaust gases after they leave the turbine but before they emerge as a jet stream.

The new engine is of the axial flow or straight-through design. Almost 25 feet long and about 40 inches in diameter, it is exceptionally light and produces more thrust per square inch of frontal area than any other turbojet.

This single engine is two and one-half times as powerful as the combined four engines on a B-29 super fortress, but its weight, approximately 3,500 pounds, is less than that of one of the famous bomber's engines and propellors. Still more powerful versions of the J40 are under development.

DRILLING OF CURVED HOLES

A new method has been developed for drilling holes along an arc. Using this method—an electric arc method—holes of a diameter larger than 0.04-inch have been drilled in cast iron along an arc of a radius from about 1 to 4 inches. The electric arc method was developed in order to place thermocouple junctions inside a casting at a point not accessible by a single straight hole.

The curved hole drilling device uses the electrical circuit and cooling fluid of a disintegrating machine. These machines remove metal in the hole to be drilled by electric arcing and subsequent quenching of the molten metal by a cooling fluid passed through the center of the hole-drilling electrode. The electrode is generally a circular tube; however, any shape hole can be drilled by using triangular, square, or other shaped electrodes. The arc at the tip is produced by vibrating the electrode.

NEW DEVELOPMENT SIDELIGHTS

That old high school physics book is still pretty helpful in this complex world of ours. Take the case of our modern scientific measuring devices with their flashing lights, spinning dials, or rasping buzzers—the things that make them tick are usually principles out of an elementary physics book. Tailored to fit specific needs they're helping man to see, touch and hear far beyond his human power.

Although many modern instruments are supplementing man's senses to a large degree, they'll probably never occupy his seat at the dinner table. This may be of some consolation to the connoisseur of fine foods, who can still delight in exploring tasty dishes, safe in knowing that he has no rival in a robot palate. But engineers are even working on this!

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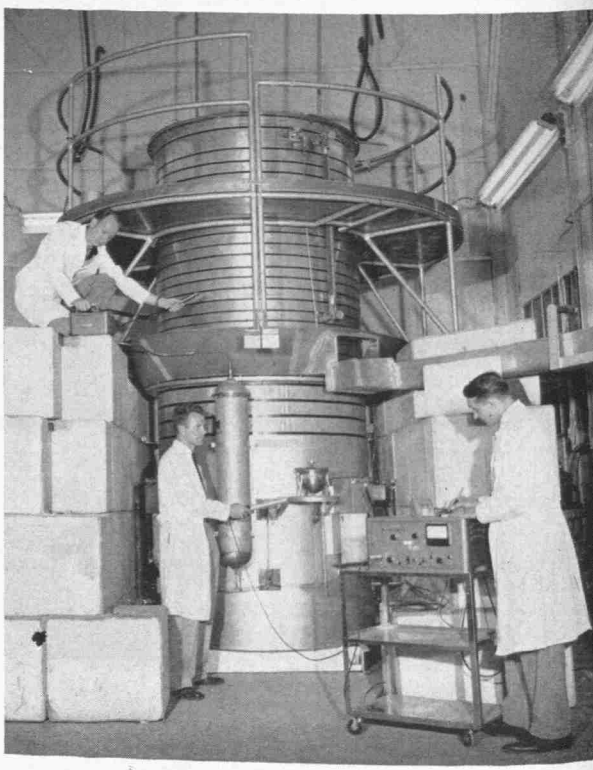
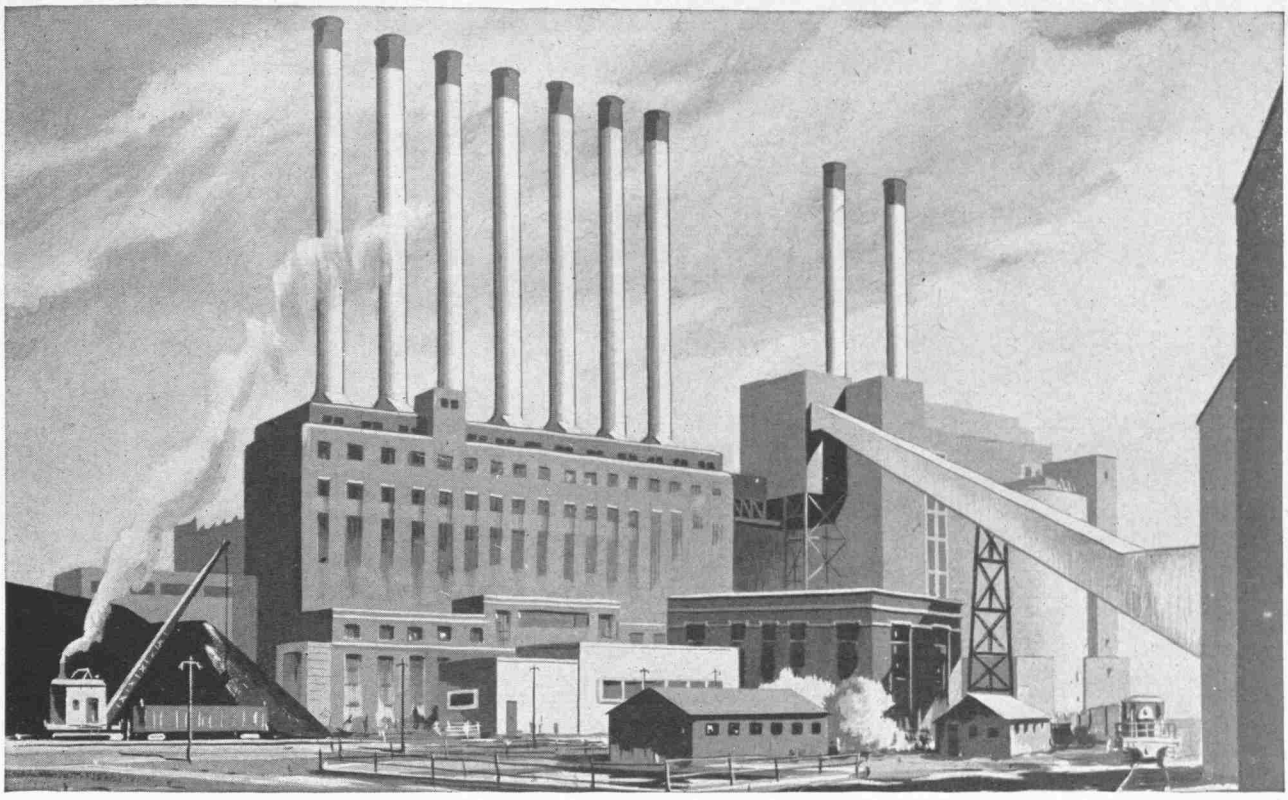


Water boiler type of atomic energy reactor. The superstructure is not part of the reactor, but is one of the test units which can be used with the boiler for experiments and study in the field of general reactor development.



The two new stacks at the right of this artist's drawing of Detroit Edison's Conners Creek plant mark the addition of two new turbo-generators that increased the plant's capability to 582,000 kilowatts, and brought the system capability to 2,000,000 kilowatts.

Southeastern Michigan Grows on Firm Foundations

The population of Southeastern Michigan has grown to almost 3,500,000. Ever mindful of the need for keeping well ahead of Detroit's and Southeastern Michigan's growth, Detroit Edison continues with its never-ending expansion of power generating and distributing facilities.

Now, working together as one of industry's four atomic research teams, Detroit Edison and Dow Chemical Company engineers are investigating the use of nuclear heat in thermal electric generating plants . . . an investigation pointing toward better ways to provide electric power for the nation.

Edison's customers have confidence in the supplier of their electric power . . . confidence that whatever, whenever, wherever their power needs may be, Edison will fill them. And Detroit Edison, through its expansion program, is making certain that Southeastern Michigan will have a firm, dependable foundation for future growth.

The Detroit Edison Company

PROGRESS IN THE FOUNDRY

By C. C. SIGERFOOS

Associate Professor of Mechanical Engineering

A recent survey of graduating engineers shows a sharp increase in the number of Michigan State College men attracted to the metal casting industry. Placement records in the Dean's Office indicate that during the years 1948 and 1949 only one percent of the total engineering graduates entered the foundry industry. During the year of 1950 the percentage increased to two and in 1951 three percent of the engineering graduates or a total of twelve men entered the industry. A few of the important reasons underlying this trend should be carefully considered by the undergraduate engineering student.

Perhaps the most important reason for the above trend is that recent graduates have found the foundry an interesting as well as profitable place to apply scientific principles to a very old process. The founding of metal as an art has held man's interest from practically the dawn of history. In fact, the art of pouring molten metal into a desired shape by the use of a mold has fascinated man for approximately five thousand years. From the time of the pouring of the copper frog shown in the picture to the making of our present day complicated castings, man has found an interesting challenge to his ingenuity and his skill. At the present time a few foundries still produce metal castings as an art and make such items as bronze plaques, statues, etc. However, the bulk of the industry today is devoted to the casting of duplicate parts to supply the increasing demand for machines, engines, hardware, guns and thousands of other casting applications.

The cast metals industries as a whole have been somewhat slow to apply scientific knowledge to their processes. The acute need for technological advancement coupled with the fact that most foundries have not been successful in upgrading their production workers means that the graduate engineer has an ex cellent opportunity to apply his professional knowledg and at the same time expect rapid advancement. An other favorable aspect of this industry is its offer employment security. The foundry is basic, i.e. a other industries rely either directly or indirectly upo the production of castings and this fact tends to giv

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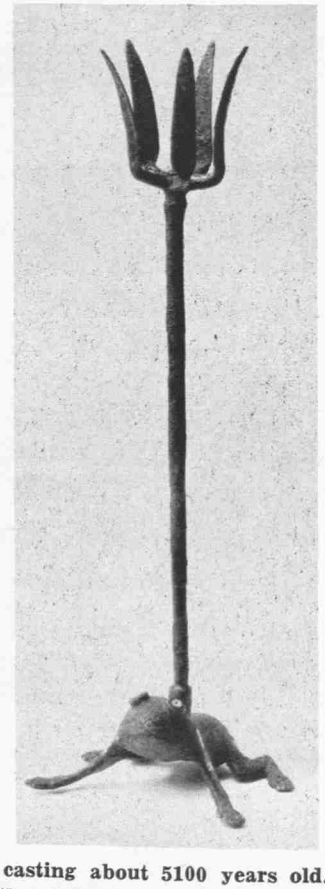
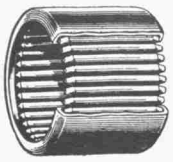


Copper frog casting about 5100 years old. This is b lieved to be the oldest casting in existence.
—Courtesy Chicago Natural History Museu

The Torrington Needle Bearing ...designed for easy, effective lubrication



The Torrington Needle Bearing offers many design and operational advantages. High rated radial load capacity is combined with compact size and light weight. Installation is simple and fast. And one of the major advantages inherent in the Needle Bearing design is the ease with which it can be lubricated.

The full complement of small diameter rollers continuously carries a thin film of lubricant to all contact surfaces. The turned-in lips of the outer shell act as a retainer for lubricant within the bearing and effectively seal out foreign matter. Needle Bearings in many applications run for long periods of time without further attention to original lubrication.

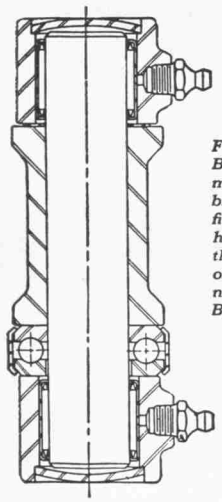


Figure 1. The Needle Bearings in this automobile king pin are lubricated with Alemite fittings through an oil hole in the center of the outer shell. These oil holes can be furnished on all Needle Bearings.

Methods of Relubrication

When Needle Bearings are shipped, they are normally protected with a high-grade slushing compound which has lubricating value at ordinary temperatures. This compound is left in the bearings in most applications.

There are several methods of providing additional lubricant to Needle Bearings:

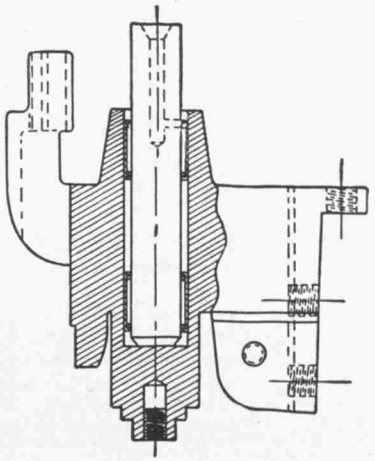


Figure 2. A hole along the axis of the shaft with a cross hole opening under the lip of the upper bearing provides lubrication to the Needle Bearings in this textile machine spindle swing bracket.

1. When lubricant is to be delivered through the housing, as in Figure 1, an oil hole is furnished in the middle of the outer shell. Care should be taken to place this hole outside the load area.

2. If it is necessary to lubricate through the shaft, a hole drilled along the shaft axis with a cross hole leading under the lip of the Needle Bearing is satisfactory. (See Figure 2.) This hole is located under the lip of the bearing rather than in the roller contact area.

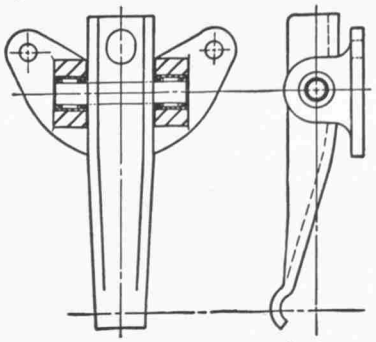


Figure 3. The Needle Bearings in the fingers of an automobile clutch are packed with grease before assembly. No additional lubrication is needed.

3. When speeds are low and loads light, Needle Bearings may be packed with grease, which often lasts for the life of the unit. Such an application is shown in Figure 3.

4. For high speeds and heavy loads, a circulating oil system is preferred, as it aids in carrying away heat as well as in providing a continuous supply of lubricant for the rollers to carry to the bearing contact surfaces. (See Figure 4.)

Selecting A Lubricant

While oil is the best lubricant, it is difficult in many cases to retain it in the bearing housing. In such cases,

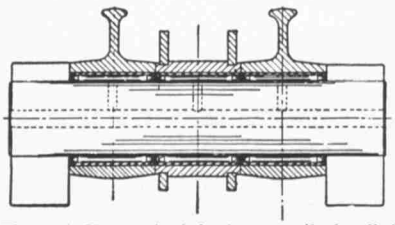


Figure 4. Heavy shock loads are easily handled by the Needle Bearings in this valve rocker arm of a large Diesel engine. Circulating oil lubrication assures a steady supply of lubricant.

grease offers the best means of lubrication. In general, a soda base grease is used in the absence of moisture and a lime base grease when moisture is present. It is usually advisable to consult with a grease manufacturer before making a final decision for a particular application.

If you would like more information on the use of Torrington Needle Bearings, our engineering department will be happy to help you.

THE TORRINGTON COMPANY

Torrington, Conn. • South Bend 21, Ind.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON NEEDLE BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

Hughes Fellowship 1952 winners Truman O. Woodruff (left) and Allen I. Ormsbee (right) are welcomed to the campus by Dr. Lee A. DuBridge, President, California Institute of Technology.

THE HOWARD HUGHES FELLOWSH

in science and engineering

Semiconductor research is one of the important projects of the Laboratories. A development of immediate value is the Hughes Germanium Diode employed in miniaturized airborne electronic equipment. The apparatus shown in the photograph is a vacuum furnace constructed to produce single crystals of germanium. Discussing its operation are (left to right): Hughes Fellow Allen I. Ormsbee; Dr. H. Q. North, Head of Semiconductor Department; Dr. Allen E. Puckett, Head of Missile Aerodynamics Section; and Hughes Fellow Truman O. Woodruff.

reparation of men for mod-
n industrial research ideally
ould involve both advanced
udy and practical experience
an industrial laboratory
der the guidance of stimula-
ng associates.

The Howard Hughes Fel-
wships in Science and En-
neering at the California
stitute of Technology were
tablished to provide such
ucation and training.

Any American citizen is
gible for a Fellowship who
alifies in graduate standing
the California Institute of
chnology for study toward
e degree of Doctor of Phil-
ophy in physics or engin-
ring *and* who will have
mpleted one year of gradu-
e work before the beginning
te of Fellowship. Applicants
ould plan to pursue research
the fields of electronics en-
neering, microwave physics,
rodynamics, electronic com-
puting, physical electronics, propulsion engineering, solid state physics, mechanical engineering, electron dynamics, analytical mechanics, or information theory.

Each appointment is for twelve months and provides a cash award, a salary, and tuition and research expenses. A suitable adjustment in the amount of the award is made when this will aid in the education of a promising candidate whose financial responsibilities might otherwise preclude participation in the program.

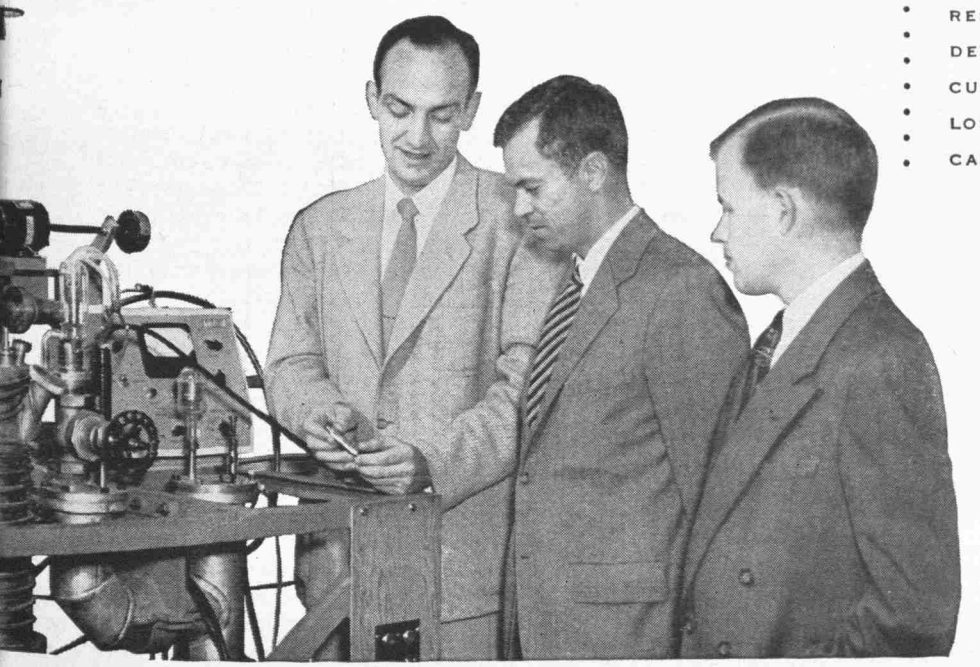
Salary provision is for the portion of time spent on advanced work in the Hughes Research and Development Laboratories. Here the holder of the Fellowship is in close personal association with many scientists and engineers who are acknowledged leaders in their fields.

HOW TO APPLY FOR A FELLOWSHIP

Write Howard Hughes Fellowship Committee, Hughes Research and Development Laboratories, Culver City, Los Angeles County, California, for an application form and a brochure giving all details. Completed applications must be received by the committee *not later than January 7, 1953.*

HUGHES

RESEARCH AND
DEVELOPMENT LABORATORIES
CULVER CITY
LOS ANGELES COUNTY
CALIFORNIA



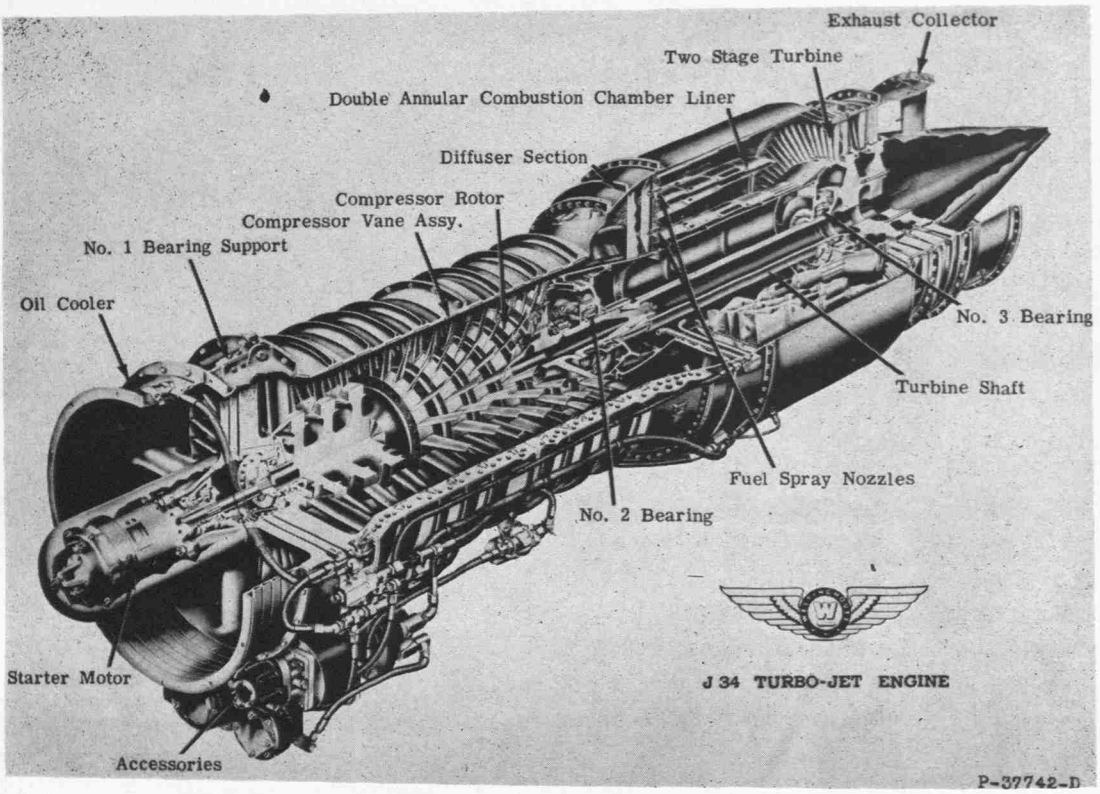
(Continued from Page 14)

greatly expanded hot combustion gases and the cooling air are then mixed to prevent excessive temperatures at the turbine and directed by the turbine nozzles against the turbine blades. The force of the gases against the blades and the reactive force of the gases as they leave the blades imparts sufficient torque for it to drive the air compressor and the engine accessories. Unlike the turbine of the turboprop engine, which tries to extract almost all of the gas energy for shaft torque, the turbojet turbine is designed to take just enough energy to do this work and thereby allow the gases to retain a maximum amount of energy for conversion into jet thrust.

To give the engine thrust—by changing the momentum of the particles of air passing through it—the gases are ejected out the rear of the engine at great speed, through an exhaust nozzle of relatively small cross-sectional area. Some of the larger turbojets currently undergoing design may eject from 100 to 400 tons of air per hour at speeds of approximately 1200 to 1400 miles per hour.

As previously stated, the thrust of a turbojet can be increased by redesigning it either to handle a greater mass of air, or to eject a given mass at a greater velocity. To handle a greater mass of air, the engine must have a larger effective air inlet area. To increase the velocity of the air being ejected, it is necessary either to expand the gases more by adding more heat, or to increase the pressure ratio of the engine.

It is interesting to note that all of the new, more powerful turbojets are depending mainly upon increased mass, rather than increased jet velocities, to develop additional power. The reasons for this trend are (1) the metals used in turbine nozzles and blades cannot withstand the greatly increased turbine temperatures that would arise by adding more heat to gain greater jet velocities, and (2) wake efficiency—that percentage of the jet power that actually results in useful thrust power—increases with increased mass, and decreases with increased jet velocities for a given flight speed.



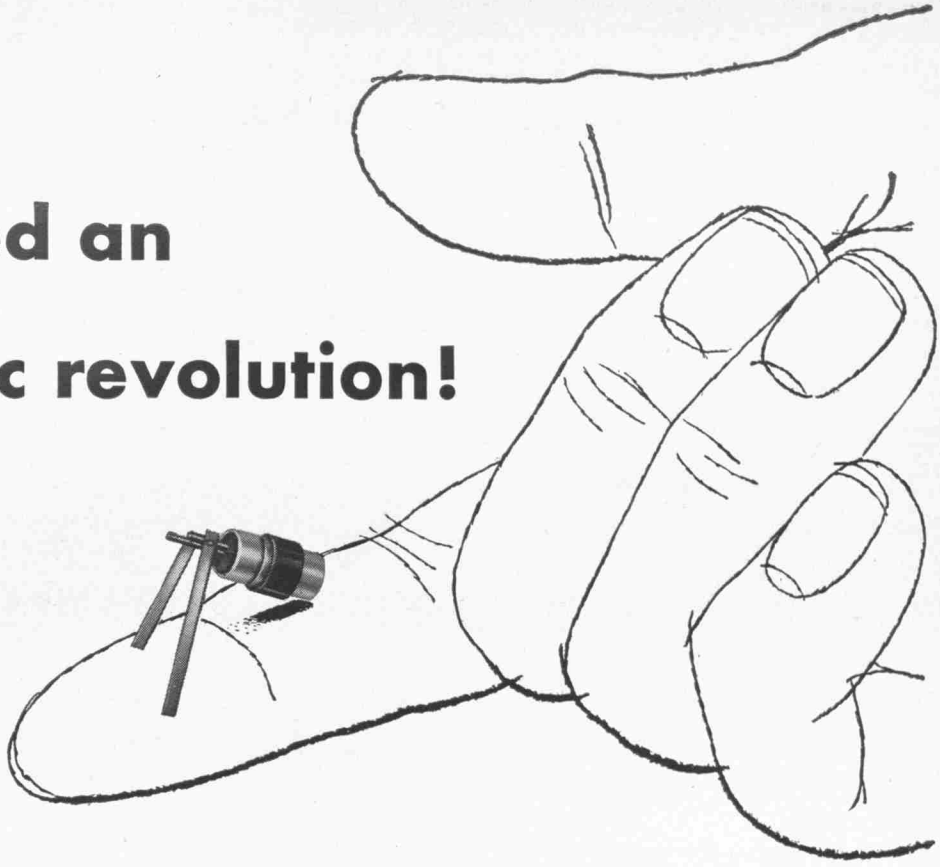
Cut away view of the J-34, axial flow turbo-jet engine. The illustration shows the component parts of the comparatively simple designed axial flow engine.

The fact that wake efficiency is proportional to mass and inversely proportional to the change in velocity of the fluid also explains why a jet plane needs a longer runway for take-off than a propeller-driven plane of similar power.

Since the reciprocating engineer propeller handles a great mass of air and increases its velocity only moderately, the propeller has a high wake efficiency for take-off—most of its thrust is useful thrust. Conversely, the turbojet engine handles a relatively small amount of air and increases its velocity tremendously, resulting in a low wake efficiency at take-off. Therefore, in a test between a turbojet plane and a reciprocating-engine-propeller-driven plane of equal thrust, the low wake efficiency of the turbojet plane would result in its requiring more time (or a longer run) before it could reach flying speed. Actually, the turbojet does not enjoy a wake efficiency of 50 percent or more until the speed of the plane equals or exceeds one-third the speed of the jet exhaust stream.

However, as the two planes gain altitude and higher flight speeds, the wake efficiency of the reciprocating engine propeller tends to decrease, whereas the wake efficiency of the turbojet engine increases. As a result, the turbojet engine, besides being much smaller and ligher, soon produces more useful thrust and becomes the more efficient engine.

It sparked an electronic revolution!



The 2A Transistor illustrated is designed to fit a plug-in socket. In one use in the Bell System, ribbon leads are employed as shown above.

Perhaps you've heard something about the transistor—a tiny and mechanically simple electronic device based on an entirely new principle. It can do many things a vacuum tube can do—yet its greatest possibilities may lie in applications where vacuum tubes have *not* been used.

A few years ago this revolutionary device was invented and experimentally made by scientists at Bell Telephone Laboratories. Today, several types of transistors are in production at Western Electric—manufacturing unit of the Bell System.

This didn't just happen! Its manufacture is the result of a lot of teamwork by Western Electric engineers of varied skills and training.

Transistors are unimpressive looking little things, but don't let that fool you! The most delicate metallurgical and manufacturing skills are required in their production. In one type of transistor there are three thin adjacent regions of germanium, each region containing chemical elements in exact quantities, the whole unit being no larger than the head of a match! Suitable leads, or wires, must be positioned in proper relation to these layers with utmost accuracy, using microscopes and oscilloscopes.

Transistors can do many things: transform radio energy for driving a telephone receiver or loudspeaker—amplify weak signals—generate a-c current—convert a-c to d-c—respond to light—increase, decrease or halt the flow of current. Small and rugged, they're going to work today in the Bell System and in varied types of military equipment.

Quantity producing these mighty mites—with laboratory precision—is typical of many forward-looking engineering projects at Western Electric.

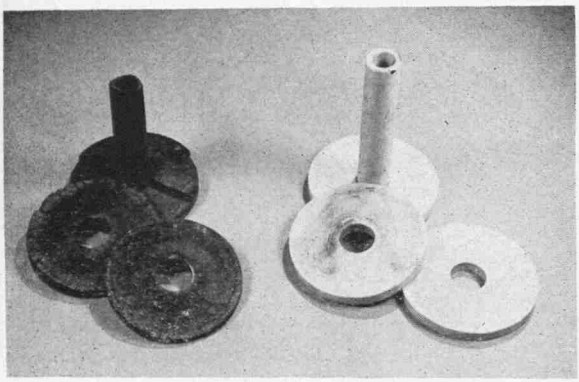
Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

SILICONES

(Continued from Page 11)

color retention. Silicone aluminum paint was found to have over 10 times the life of the best organic finishes on an oil heater that operated continuously at temperatures from 400° to 600° F. Engineers from a motorcycle manufacturer approved a silicone-based aluminum finish for motorcycle cylinders only after the finish survived emersion in water after heating at 1000° F. and a road test of 1890 miles.



Cotton-phenolic tube and dish insulators shank and charred out in less than a month on the switches of a 45,000-ampere graphitizing transformer. The switches had to be tightened daily and each replacement meant several hours down time. The silicone-glass laminate insulators were installed in November of 1950. Still in excellent condition, they are expected to last several more years.

Silicone rubber, varnish, resin, and glass cloth have created a new class of electrical insulation known as Class H insulation. Silicone insulation has enabled electrical engineers to decrease the size and weight of electrical equipment by 50 per cent, and to make electric motors last up to 10 times as long as they ever did before. This new insulation gives ten times more wet-insulation resistance than any other class of insulation under comparable conditions. Class H insulation is able to maintain its dielectric at high temperatures over an indefinite length of time. Tests have shown that silicone insulated motors, with a life expectancy of at least seven years at 220° C, may last up to several hundred times as long as Class B motors at the same temperature.

Laminates made from glass cloth and a silicone bonding resin are capable of withstanding temperatures in the range of 500° F and still retain their flexural strength and dielectric properties. Finished laminates weigh less than aluminum or magnesium and are stronger than either at 500° F. These laminates are smooth, non-porous and easily machined. They are highly water-repellent and resistant to most commonly used chemicals. A counterpart to the silicone laminates is a silicone moulding compound which will soon be on the market.

Silicones seemed to have done the impossible for the engineer. They are resins that keep brick walls dry in the rain. They are compounds that keep radar from going blind on a foggy night. They are fluids that polish without rubbing. They are mold lubricants that eliminate 90 per cent of the scrap in the rubber industry and save 80 per cent of the cost of cleaning molds. They are greases and oils that make permanent lubrication possible; foam killers that save millions of dollars a year. They are also rubber materials that won't melt on hot aircraft engine parts, or freeze on switches that operate bomb bay doors at 100° below zero. And they are electrical resins that double the power of electric motors or multiply the life of electric machines ten times.

Silicones are relatively new and most of them are expensive. Many silicones are still unavailable in large quantities. For example, there is some variation in the availability of the many forms of silicone resins, though in general the design engineer can count on getting any of them in a reasonable time. Varnishes for electrical purposes will soon be readily available. Silicone rubber, which has been in heavy demand for specialized military applications, is rather tight, but it is obtainable.

They Blame The Engineer

We could never do without the man
Who figures stress and strain,
Whose diplomatic files are full
Of children of his brain.
But no matter how well he does his job,
And though his work is clear,
If there's anything that goes "haywire,"
They blame the engineer.

Now the carpenter may nail a board
In some improper place,
Or the plumber put his greasy pipes
Through the furnace man's clear space.
Or if any worker pulls a "bone"
To throw things "out of gear,"
It has never yet been known to fail—
They blame the engineer.

If the architect should muff the deal
And draw a faulty plan,
And the contractor should build the thing
Correctly as he can,
The abusive owner rants and raves,
In language quite severe,
At the man who is just the goat—
They blame the engineer.

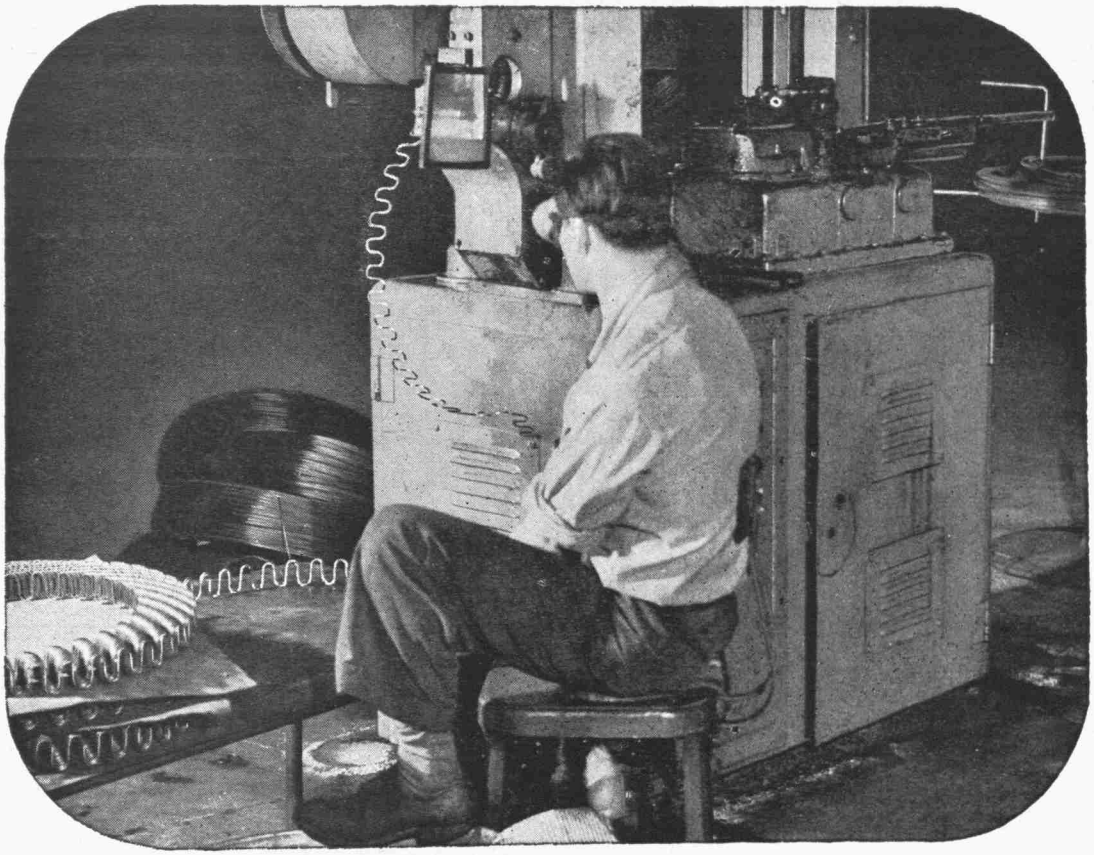
THE FIFTH ANNUAL

ENGINEERING EXPOSITION

IS COMING

MAY 1 and 2

SPRING WIRE



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NEW DEVELOPMENTS

(Continued from Page 24)

WATER BOILER NEUTRON SOURCE

A new atomic energy reactor, known as a water boiler neutron source, is being used to further the development of reactors and associated projects.

While the water boiler is quite small in comparison with reactors for producing fissionable materials or useful power, from it may be obtained information of value in designing improved reactors for various purposes. The water boiler is a part of a facility for making reactor physics measurements to enlarge the basic information upon which reactor development is based. The water boiler neutron source will supply the neutrons, minute particles of matter, needed for these measurements.

The exterior of the reactor is shielded by a housing of two-foot thick concrete blocks each weighing 1,000 pounds. The concrete surrounds a cylindrical graphite reflector five feet in diameter and six feet high. The reflector surrounds the reactor core, a stainless steel sphere one foot in diameter. The production of atomic energy takes place inside this sphere which contains a Uranium 235-enriched uranyl nitrate solution. It is from the nuclear fission of this material in a water solution that the reactor derives its power—and its name "water boiler."

Materials to be bombarded by neutrons and thus made radio active can be placed inside the core by means of a "glory hole" which connects through a channel to the outside of the reactor. An instrument panel near the water boiler records the amount of radiation for these experiments. The control rods to regulate the rate of power production are also operated from the instrument panel.

★ ★ ★

Care to take a spin? A new human centrifuge can spin its passenger from a standstill to a mile-and-a-half per minute clip, in approximately one and one-half seconds. The new machine is being used to study reactions of pilots under extreme gravitational conditions at sonic speeds.

IN THE JANUARY

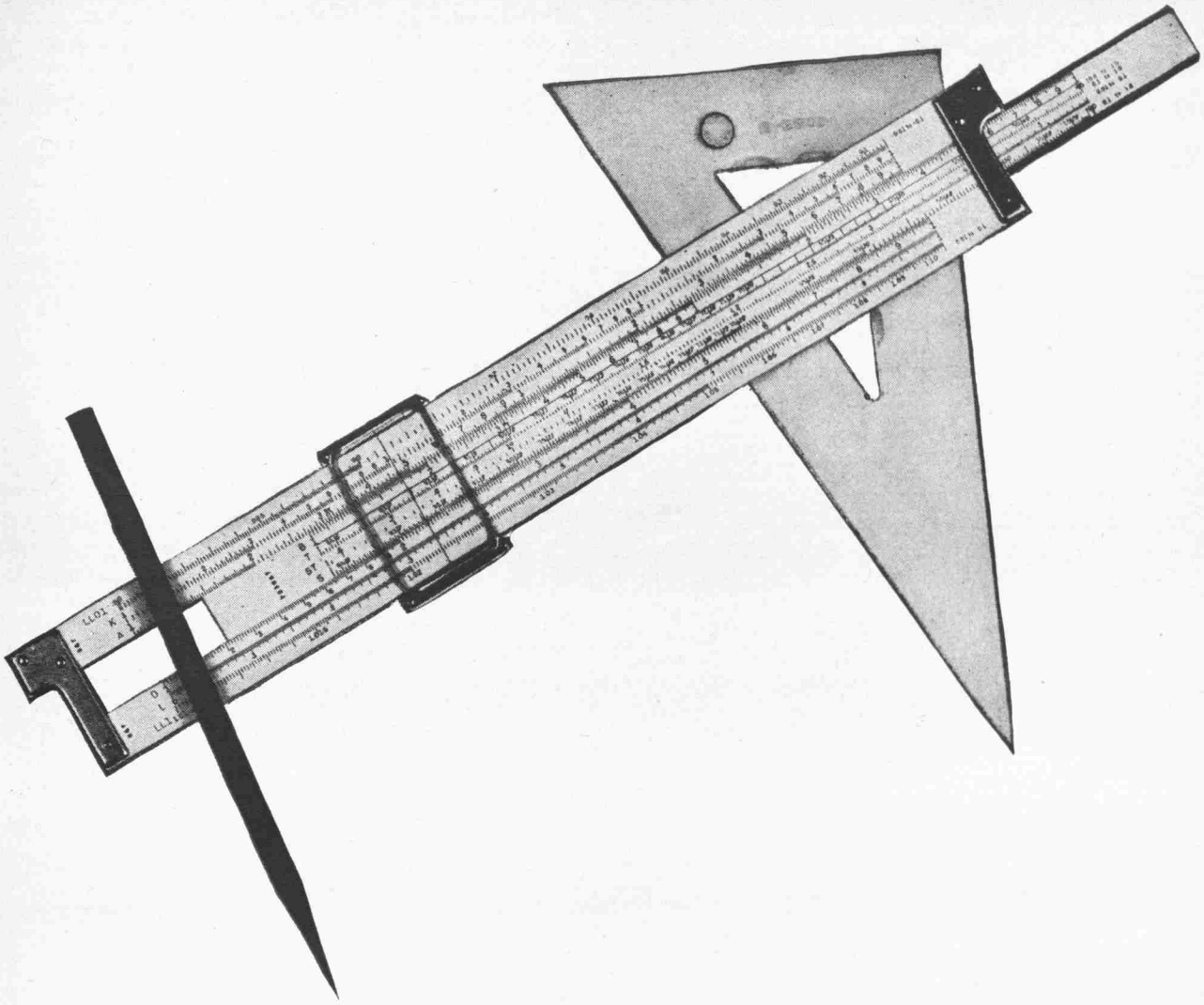
SPARTAN ENGINEER

"Operation Cirrus"

The Dean's Page

Engineering Awards

Clubs and Societies



You'll find classmates—and a future—at Boeing!

Men from more than 120 top engineering schools are building rewarding careers at Boeing. So chances are, you'd be working with some of your classmates here. And in addition you'd be a member of an Engineering Division renowned for its trail-blazing contributions to both military and civil aviation.

If that's the kind of engineering prestige you'd like to enjoy, look into Boeing opportunities. This company has been growing steadily for 35 years. It provides the finest research facilities in the industry. It offers you work on such exciting projects as guided missiles and the fastest known bomber in the world: the B-47 six-jet medium bomber, as well as the still-classified B-52 eight-jet heavy bomber.

You can work in Seattle, in the Pacific Northwest, or in Wichita, Kansas. Boeing provides a generous moving and travel allowance, gives you special training, and pays a good salary that grows with you.

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For further information, consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Washington

BOEING

ATOMIC ENERGY

(Continued from Page 16)

Upon being given responsibility for development of the nuclear aircraft power plant, the Aircraft Gas Turbine Division established an Aircraft Nuclear Propulsion project (ANP), with headquarters at Lockland, Ohio. Meanwhile, work went on at Oak Ridge, Tenn., where NEPA had been headquartered, by a nucleus of highly trained scientists and engineers who had been associated with NEPA and who were asked by General Electric to continue as members of its ANP program.

Appointed as manager of the project was D. R. Shoults, who while on a mission to England in 1941, became the first American civilian in an official capacity to see Britain's then top-secret Whittle jet engine. Following the report to the late General H. H. Arnold by Schouts and an Air Force technical liaison officer, General Electric was given the task of producing America's first turbojet.

In September, 1951, the Air Force announced that the Consolidated Vultee Aircraft Corp., San Diego, Calif., had been given responsibility for development of an air frame for an atomic-powered airplane. The announcement said that both General Electric and Consolidated Vultee would work closely with the Air Force and the Atomic Energy Commission on the nuclear aircraft project.

SECURITY REGULATIONS

In accordance with the policies and rules of the Atomic Energy Commission and the requirements of the Act of Congress which established it, all the locations used by the General Electric Company at the Hanford Works, the Knolls Atomic Power Laboratory, etc., are subject to strict security regulations. All personnel have been carefully investigated. Protection is afforded by a highly trained uniformed patrol, provided with such aids as patrol cars equipped with two-way FM radio.

THE OUTLOOK FOR ATOMIC POWER

Most people probably think atomic energy as a potential source of vast amounts of cheap industrial power. Ultimately, considerable amounts of our power may be produced atomically but, in the foreseeable future, it seems certain that any such production will be subject to some fundamental limitations.

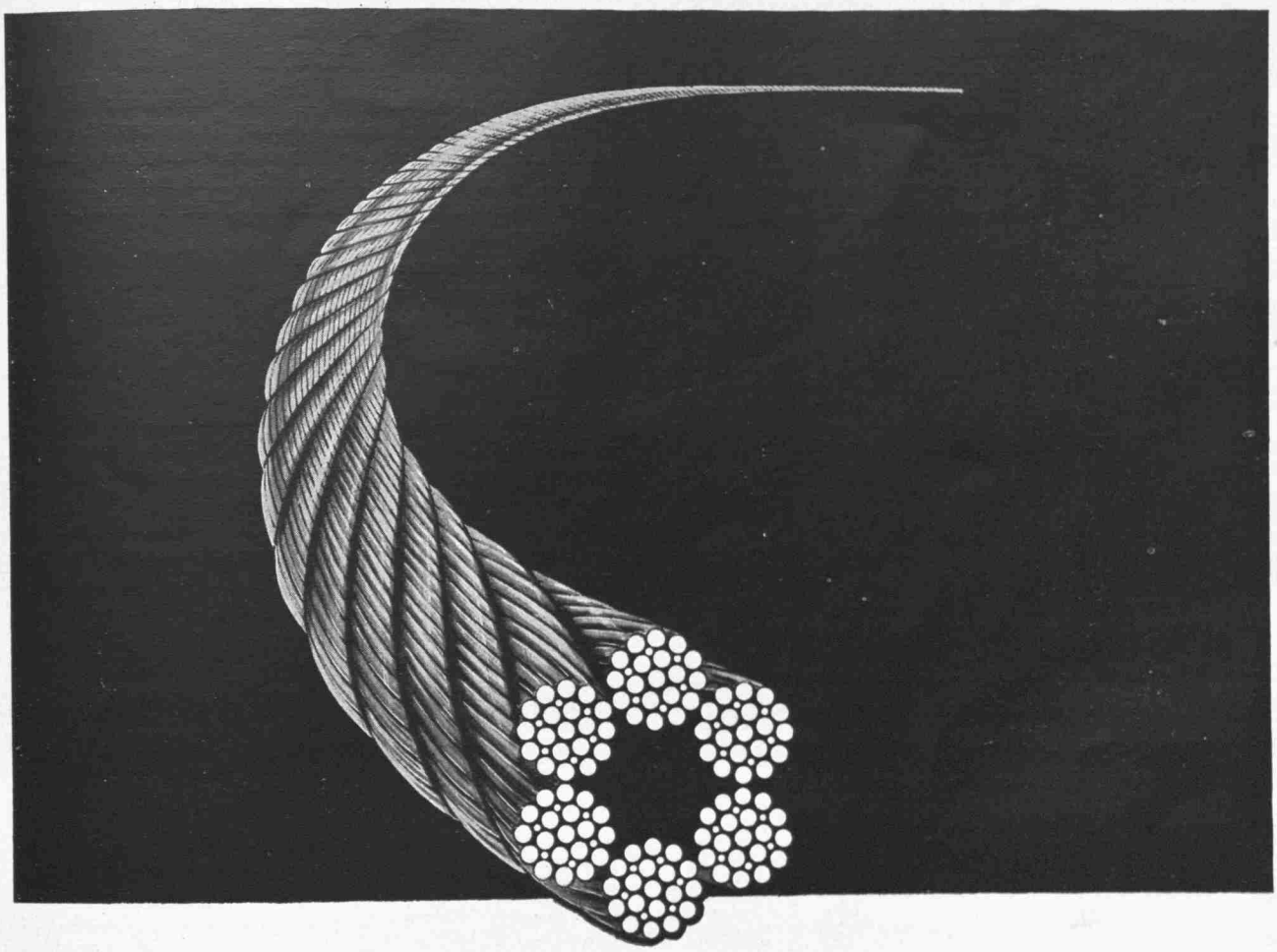
No practical method is now known or contemplated for converting atomic energy directly to electricity. The energy released from the splitting atom would appear as heat, which could then be carried by a liquid or a gas to a heat exchanger, or boiler, where steam would be generated. The steam would then drive a steam turbine-generator to produce electricity.

Thus, in an atomic power plant, the atomic reactor and some auxiliary equipment, including the heat exchanger, would merely replace a fuel-fired steam boiler. From that point on the atomic plant will be essentially the same as one burning coal or oil as a fuel.

COSTS OF ATOMIC POWER

Consequently, it seems that the first cost of an atomic power plant will be at least as high as that of a fuel-fired plant under normal conditions. It is believed to

(Continued on Page 52)



HOW MANY FEET TO A FOOT...

A one-foot length of this six-strand, steel-sinewed piece of wire rope has 150 or more feet of wire. And each wire in this precision product must be accurate within a thousandth of an inch.

It wasn't always so. But deeper mines and oil wells, higher buildings, greater logging, shipbuilding and construction projects called for stronger, safer rope . . . without increase in diameter. So rope engineering became a science.

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Special steels with the right combination of fatigue and abrasion resistance . . . skillful wire drawing . . . lubricant-saturated fiber centers . . . and scores of sizes, grades and "constructions" are necessary to meet today's wire rope requirements.

Wire rope manufacture represents the contributions of countless craftsmen whose challenge was industry's need . . . whose accomplishments, industry's gain.

AMERICA WORKS LIKE THAT...

Keeping alert to the needs of business and industry . . . and meeting them under competitive conditions . . . has characterized America's growth.

And keeping people abreast of these developments is the job of America's all-seeing, all-hearing and reporting Inter-Communications System.

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HEADQUARTERS FOR BUSINESS INFORMATION

McGRAW-HILL FOR BUSINESS

CLUBS AND SOCIETIES

A. S. C. E.

The American Society of Civil Engineers held a business and organization meeting Thursday, October 16. Plans are under way to welcome many new members at their next regularly scheduled meeting under the direction of program chairman Ethan Axtman.

Officers for this year are:

President—Harold Jantzen
Vice President—Walter Huss
Secretary—Richard Couture

A. I. Ch. E.

The first meeting of the year for American Institute of Chemical Engineers was held Oct. 14. It was well attended and membership covered the range of all four classes.

The purpose of the meeting was to iron out plans for the activities carnival and discuss plans for future meetings. A committee was appointed to select a speaker and a movie for forthcoming meetings.

This year's officers are:

President—Harry Schiefer
Vice President—Robert Somerville
Secretary—James Otis
Treasurer—Billie G. Simpson

PHI LAMBDA TAU

Plans are under way to make this a productive year for Phi Lambda Tau. The objectives of this engineering honorary are to serve the school of engineering in any way possible. At the present time several projects are being discussed and a formal initiation of new members is being planned.

Phi Lambda Tau's officers are:

President—Burton Fierstine
Vice President—John Loerch
Secretary—Harry Schiefer
Treasurer—Ralph Dean

S. A. E.

The Society of Automotive Engineers endeavors through the use of lectures and publications to promote technical skill and social usefulness of students looking forward to a career in the automotive and aeronautical industries.

Officers for SAE for the coming year are:

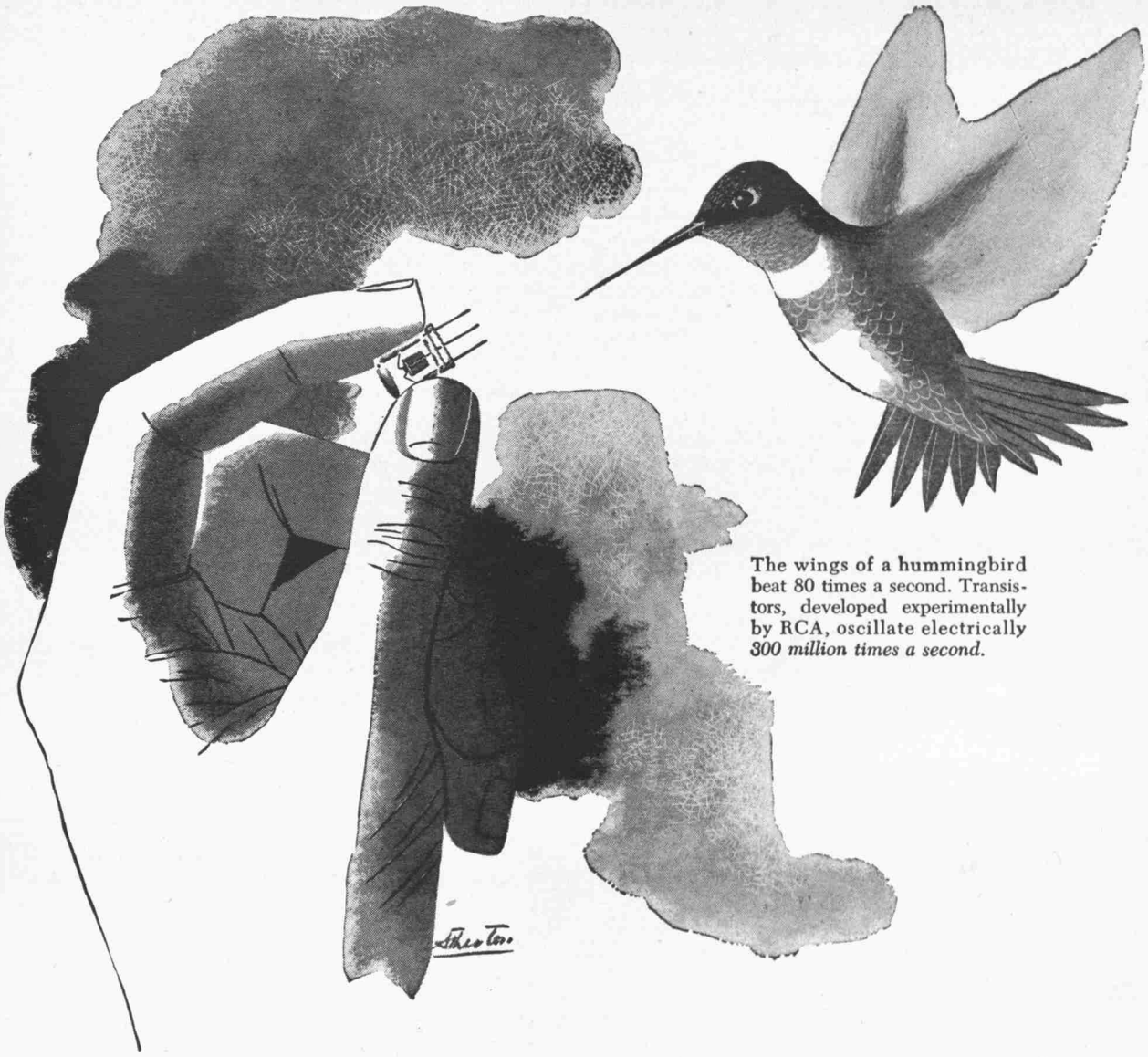
President—Kurt Behrens
Vice President—Dale Randall

All regularly enrolled students expressing an interest in automotive or aeronautical engineering management or education are eligible for membership in the society.

A. S. A. E.

The Michigan Section of the American Society of Agricultural Engineers held their fall meeting October 25 in the Agricultural Engineering building on the Michigan State College campus. Approximately 75 members attended the meeting, which was presided over by R. L. Maddex. Members of the local student branch served a luncheon following the meeting.

On November 5, the student society held its annual Faculty-Student Mixer. About 175 students and faculty members attended the dinner, which had been prepared for and furnished by the faculty wives.



The wings of a hummingbird beat 80 times a second. Transistors, developed experimentally by RCA, oscillate electrically *300 million times a second.*

300 million times a second!

Now science has discovered a new tool—a major advance in electronic research—*the transistor.* Tiny as a kernel of corn, a speck of germanium crystal embedded with wires in plastic performs many of the functions of the electron tube.

Because it has no heated filament, no vacuum, requires no warm-up and little power, the transistor is a device which has long been needed. It is also rugged, shock-resistant, unaffected by dampness and—properly made—it will serve for many years.

Despite these advantages, the transistor, until recently, was limited to a frequency region below 50 million oscillations a second. Experimentally RCA has now increased this to *300 million times a second* and even higher goals are sought—to increase the transistor's uses.

Higher frequencies for transistors point to their use in television, radio, communications and more efficient electronic controls for airplanes and guided missiles. The small size, long life, and low power requirements of transistors suggest entirely new electronic devices—as well as use of transistors as working partners with electron tubes.

* * *

Expanding the research in electronics of solids, and the possibilities of transistors, is another example of RCA pioneering at work for your benefit. This leadership means finer performance from any product or service of RCA and RCA Victor.

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- 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.**

AG ENGINEERING

(Continued from Page 15)

The Research Program

The Agricultural Engineering Department has an extensive program of research carried on by the regular staff members assisted by graduate students. In this program the department cooperates with nationally known manufacturers of farm machinery, farm equipment, and building materials, many of which are located in Michigan. Other agencies, such as farm service companies, farm organizations and federal and state governmental agencies, are also important cooperators.

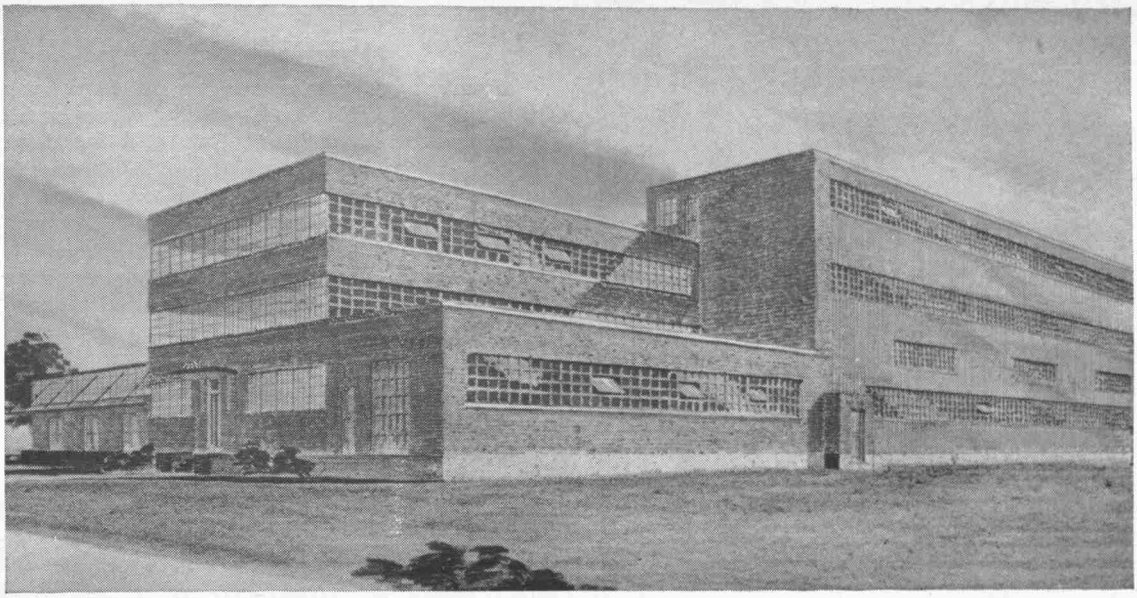
One example of current research is the electrostatic dusting project. In this experiment insecticide and fungicide dusts are charged with electricity as they leave the dusting nozzle, and are thus attracted to the vegetation, providing more complete, efficient, and uniform coverage.

The pen barn research project is another interesting and important one. Here methods are being worked out which require only a fraction of the usual labor for housing and handling dairy cattle.

Other projects include experiments with mechanical harvesting of sugar beets; hay, bean and other crop drying; frost control; electrical treatment of seeds for disease control; and many others. Now, only five years after research on the mechanical harvesting of sugar beets was begun at Michigan State College, over one-half of the Michigan beet crop is being harvested mechanically.

The Extension Program

Such application of the results of study and research help to make it possible for American agriculture to maintain the standard of living of this country's large and rapidly growing population at a high level. In order to accomplish this, a staff of five extension engineers is constantly working to carry these results to the people in agriculture and industry through group meetings and individual conferences throughout the state. For many years radio has been used as another means of carrying new practices to the people, and now the Agricultural Engineering Department at Michigan State College has also added television programs to help serve the people of Michigan.



NEW

DOW PLASTICS PLANT TO SERVE EASTERN INDUSTRY

Bright, colorful Styron (Dow polystyrene), the plastic that adds new eye-appeal and utility to many different products, will now be more easily available than ever to the Eastern molder. For Dow, the pioneer and producer of Styron, as well as other plastics, has just completed a large new Styron plant at historic Allyn's Point, Connecticut.

This plant has 2,000 square feet of production space on each of four floors, along with a large warehouse and administration building. Because past experience has proved that rapid growth is a condition normal to Dow operation, the plant has been constructed to allow for future expansion.

This Styron plant is located on an 80-acre plot on the Thames River. Dow also built an 800-foot dock to handle ocean-going vessels. Here they will receive many raw materials from their Texas Plant and ship Styron to Eastern markets and many export markets throughout the world.

This new Styron plant is but one of the many new developments at Dow. The increasing demands of industry for chemicals necessitate continued expansion in every sphere of Dow operation . . . expansion that requires new plants, new technical facilities, as well as a continual increase in personnel talented in varying phases of science.

Dow's Booklet, "Opportunities with The Dow Chemical Company," especially written for those about to enter the chemical profession, is available free, upon request. Write to The Dow Chemical Company, Technical Employment, Midland, Michigan.

THE DOW CHEMICAL COMPANY
Midland, Michigan

DOW
CHEMICALS
INDISPENSABLE TO INDUSTRY AND AGRICULTURE

JAMES F. LINCOLN

(Continued from Page 21)

When papers involve the use of terms or words which are peculiar to a certain locality or industry and are not in general English or engineering usage, it is well to describe or define what is meant in the text and illustrations so that the text will be understandable to engineers outside of that particular locality or industry.

Authors should refrain from mentioning in the paper their own names or the name of the institution in which they are registered. All such identifying marks should also be removed from all exhibits submitted with the paper.

Use of Title Page

Papers must be judged by the jury without their knowledge of the identity of the author or his school. To make this possible all papers must give identifying information only on an easily removable title page. A uniform title page has been prepared by the Foundation and is included in this Rules booklet on the inside of the back cover. This page or a copy of it must be used on all papers.

The information requested on the title page sheet must be filled in completely and the title page removed from the Rules booklet. This title page should be attached to the paper so that it can be easily removed and the paper submitted with this as the only title page. The title of the paper, however, shall appear on both the removable title page and at the top of the first page of the text.

Upon receipt of the paper in Cleveland, the title page will be removed by the Secretary of the Foundation and the paper bearing only an identifying number will go forward to the Jury of Award.

The envelope containing the paper shall be addressed:

Secretary
The James F. Lincoln Arc Welding Foundation
Box 3035
Cleveland 17, Ohio

The envelope must be mailed and postmarked during the period June 29, 1952 to June 29, 1953, but not later than midnight, June 29, 1953.

CLOSING DATE: JUNE 29, 1953

Jury of Award

The Jury of Award will be drawn from engineering education or industry, or both. Selection of the jurors will be under the direction of the Chairman of the Board of Trustees of the Lincoln Foundation, Dr. E. E. Dreese, or in case of his failure to act, a person selected for the purpose hereof by the Trustees of the Foundation.

The decision of the Jury of Award, as certified by the Chairman, shall be final.

Payment of Award

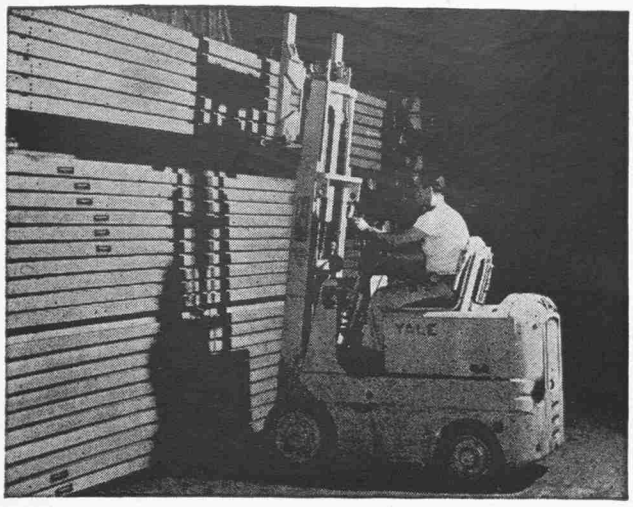
Announcement and payment of each award and scholarship fund will be made at the beginning of the fall semester following the closing date.

The depositing in the mail of an envelope containing a check payable in the amount awarded to the name, or names, given on the paper as author, or authors, and addressed as directed on the title page of the paper, shall constitute full payment of the award therefor.

Publication of Papers

All papers become the property of the Foundation and may or may not be published at the Foundation's discretion, but authorship and author's institution will always be indicated in the event of publication.

Another page for **YOUR BEARING NOTEBOOK**

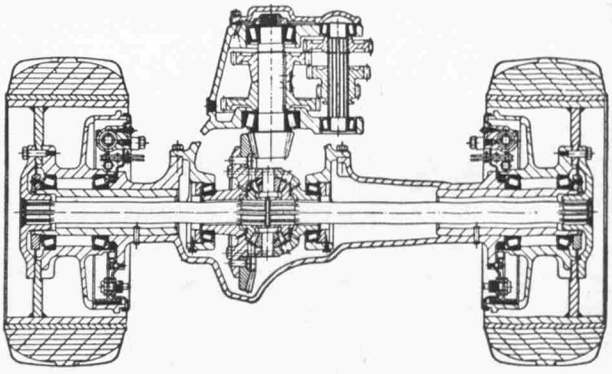


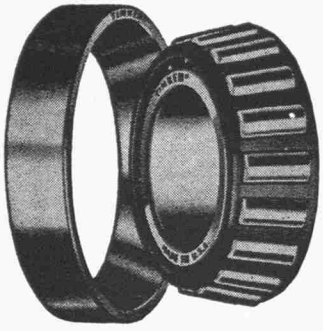
Weight-lifter is no dumbbell— it uses TIMKEN® bearings

When designing a lift truck that would handle like an automobile and lift two-ton loads, Yale and Towne engineers wanted to be sure of smooth, easy operation. That's why they mounted the wheels, pinion, differential and steering pivot on Timken® bearings. They take the high gear loads imposed by sudden starts, stops and changes in direction. Trouble-free operation is insured and maintenance time reduced. Trucks stay on the go.

How to mount a lift truck drive axle and differential on TIMKEN bearings

Two single-row Timken bearings, cone adjusted, are used in the pinion assembly. Cup-adjusted bearings are used in the differential assembly. The wheels use a standard single-row bearing mounting. The bevel pinion adjustment is obtained by the use of shims back of the cup adjacent to the pinion.



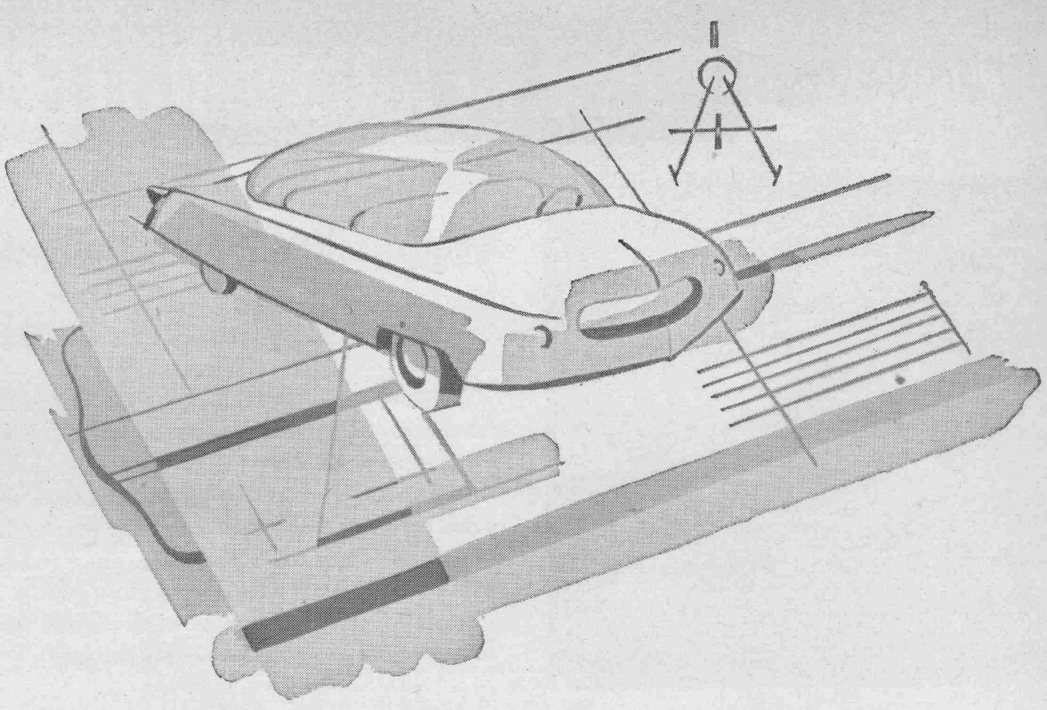


TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Like to learn more about bearings?

Some of the engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help you. For a copy of the 270-page General Information Manual on Timken Bearings, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

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



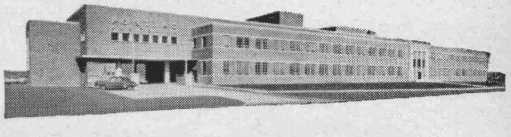
The car you'll drive tomorrow

— *is on the boards today!*

Tomorrow's finer cars are on the drawing boards today—and the young men who are working at these boards today are the engineers of tomorrow who will provide better performing, better riding, more economical cars.

There are no finer engineering facilities in the world than those found in the automobile industry—and none finer in the industry than those of the Pontiac Motor Division.

The future of the automobile industry is practically unlimited with more than 60,000,000 cars seen on the road by 1975—and because of its unsurpassed public acceptance and reputation, no car faces a brighter future than Pontiac. This continual growth calls for a steady flow of young men with new ideas, young men who want an engineering career based on opportunity, future advancement and liberal compensation and employment benefits.



Pontiac's huge new engineering building is the industry's most modern with every conceivable facility for designing better and better Pontiacs.

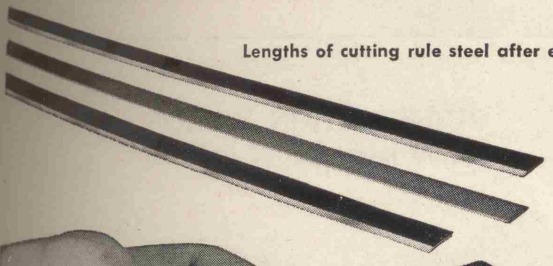
PONTIAC

MOTOR DIVISION • PONTIAC, MICHIGAN

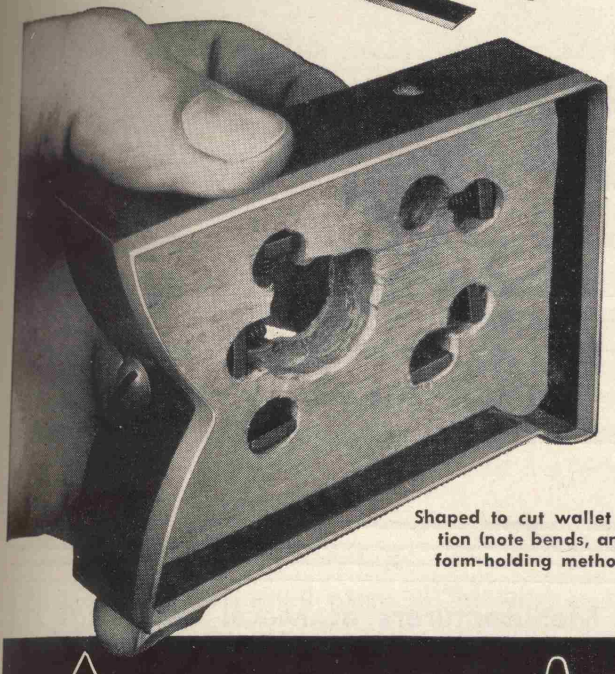
GENERAL MOTORS CORPORATION

What's Happening at CRUCIBLE

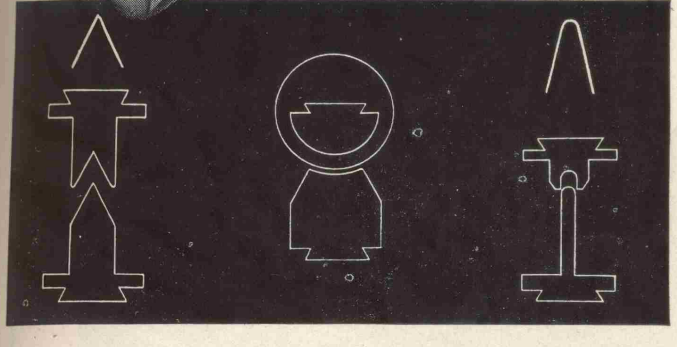
about scoring and cutting rule steel



Lengths of cutting rule steel after edging



Shaped to cut wallet section (note bends, and form-holding method)



Some examples of the many shapes of bends needed

Scoring and cutting rule steel is a cold-rolled specialty steel for use in preparing dies for cutting paper, leather, rubber and other materials.

It is a pre-tempered product manufactured by skilled workmen, using precision rolling and hardening equipment, to close limits for chemistry, grain size and hardness. This product must also be capable of meeting intricate bend requirements in the hardened and tempered condition.

This specialty is furnished with round edges and in coil form to the rule manufacturer who grinds the edges — the one edge square and the other to a knife edge as well as cutting the material into desired lengths. This is sold to a die-maker who bends the rule to the required shape. This is then the nucleus of a pre-hardened die, which when properly brazed and supported is used to cut out material for display cards — aircraft parts — pocketbooks — wallets — gloves — gaskets — washers.

engineering service available

Since there is a great diversity of cold-rolled products, our staff of field metallurgists can help you apply what you require. Take full advantage of Crucible's more than 50 years experience as the first name in special purpose steels. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

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

There's something here somewhere about laying an egg...

ONCE UPON A TIME there were two farmers. Each had a hen that laid 20 eggs a month.

Both farmers liked eggs, so one ate his. But the other did without, and put his eggs in an incubator which he bought by borrowing money. In no time he had 200 chickens from his one. A shocking profit! (Before taxes.)

He sold some to pay down the loan on his incubator; he ate some as a reward for all his labor in raising the brood. And he sold a good many to pay his income tax.

He still had some left. Profit.

So the farmer who had eaten all his eggs got a law passed. The neighbors divided up the chicken-raising-farmer's "profits" and ate them. After all, they said, he had more than he needed, and they were hungry.

So, of course, the farmer wasn't going to raise any more chickens just to have them taken away from him; he ate his eggs, too.

In due time both the farmers' original hens died of old age, and then there weren't any eggs for anybody. No chickens either.

The neighbors were quite sure it was somehow the chicken raiser's fault.

Did the farmer, who used to eat all his eggs, enjoy his now-eggless meals any more for realizing that the farmer next door wasn't enjoying any chicken?

FOUNDRY

(Continued from Page 26)

foundry employees a job security not enjoyed in many of the newly developed or the unstable industries.

In a united effort to inject new blood into an old industry a group of far-sighted foundrymen established the non-profit organization known as the Foundry Educational Foundation for the purpose of establishing scholarships and offering free placement service to college and university men especially in the field of engineering. In the past five years this organization has received wide support by the industry and has been responsible for attracting hundreds of graduate engineers into the foundry. In 1950 Michigan State College was taken into the Foundry Educational Foundation program. Under this program the F.E.F. provides five thousand dollars per year to be used for M.S.C. scholarships and for teaching aids directly connected to the foundry program.

The trend of the graduating engineers to be attracted in greater proportions to the cast metals field has led to the establishment of the Foundry Option in the new Mechanical Engineering curriculum. Students electing this option will have an opportunity to follow a sequence of courses that cover the various branches of Foundry Engineering as well as other closely allied subjects.

Another valuable asset to the M.S.C. Foundry program has been the organization of the Student Chapter of the American Foundrymen's Society. In the past four years this group has established the reputation of being a very active technical society by organizing inspection trips and by planning on campus programs that include industrial leaders from the cast metals industry.

Michigan State College engineers at the Albion Malleable Iron Company. Left to right: Donald Huizenga, '51, Core Room Foreman; Richard Dobbins, '51, Service Engineer; Xelle Wyble, Mold Development Engineer; John T. Ehman, '49, Industrial Engineer; John Kruse, '50, Associate Quality Control Engineer; Donald Davis, '52 (not shown), Engineering trainee.

The photograph of the M.S.C. engineers employed recently by the Albion Malleable Iron Company, Albion, Michigan, is an outstanding example of the manner in which one group of young men have moved rapidly into highly responsible engineering positions.

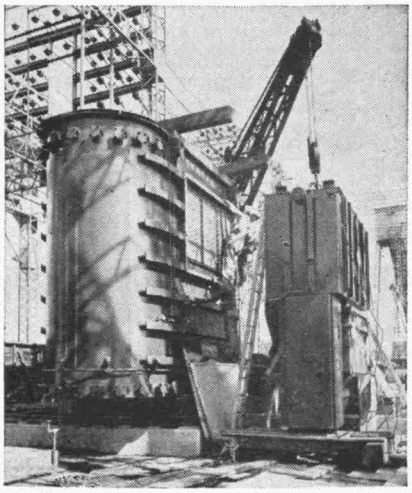
Make the First Job Count!

by PAUL CLARK
Application Engineer, Electric Control Section
WEST ALLIS WORKS
(Graduate Training Course 1950)
Iowa State—EE—1949

IT SUDDENLY occurred to me while I was a senior, looking for a job, that my first job would be all important. In a way, it was going to be almost as much a part of my schooling as my last year at "State."

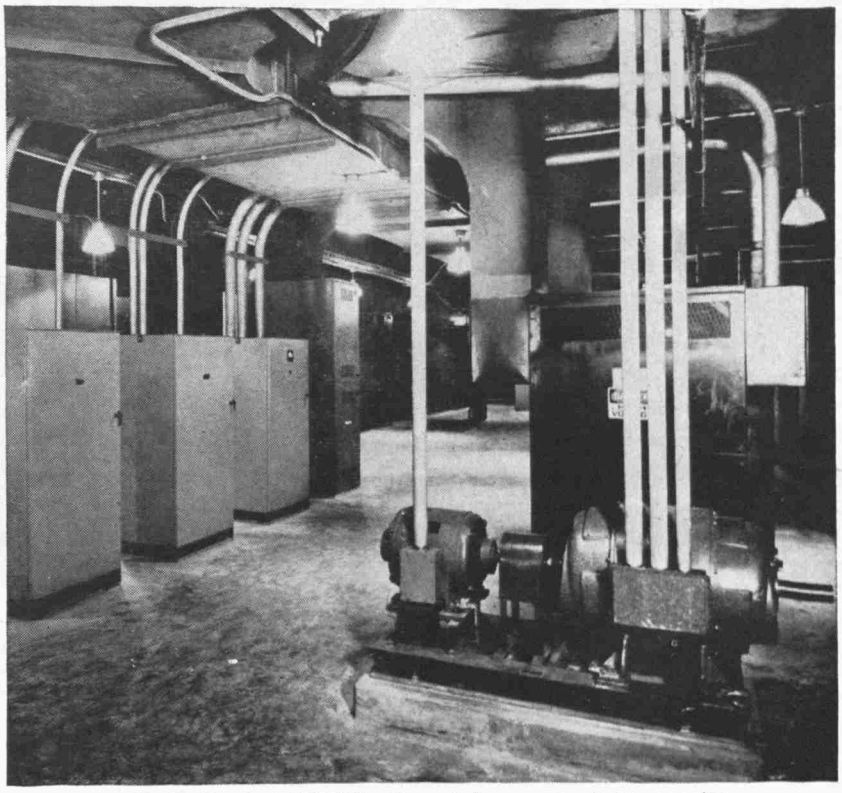

PAUL CLARK

Since then, I've been glad I thought of it that way, because that's what the first year and a half was . . . schooling. Among other things, I learned what I wanted to do, and learned a lot about products and industry problems. But I give much of the credit for the great amount I learned to the Allis-Chalmers Graduate Training Course and consider myself very lucky to have chosen Allis-Chalmers. Perhaps a quick review of my own experience will show why I feel that way.


Power Transformer being installed in Midwest utility.

After graduating from Iowa State in 1949

I started the Allis-Chalmers Graduate Training Course on the Steam Turbine erection floor. From there I went to the switchgear and pump departments to familiarize myself with other utility equipment; and from there, to the Motor and Generator section, which at the time was my goal.


Brain of a giant 107,000-kw steam turbo-generator is this complex *Regulex* voltage control. Clark finds such control a fascinating problem.

Arrange Your Own Course

From this, you begin to see the freedom a GTC student has at Allis-Chalmers. You not only have complete freedom in arranging your course, but you can change your course as you go along and your interests develop. Best of all, you have a wide choice, because Allis-Chalmers builds such a wide line of products.

Even after getting to the Motor and Generator section, which had been my original goal, I had a chance to change my mind. While I found a certain glamour to the big motors and generators, I became *really* intrigued by the electrical brains of these giants, and decided to go to the control section to learn more about them. I have been working there ever since.

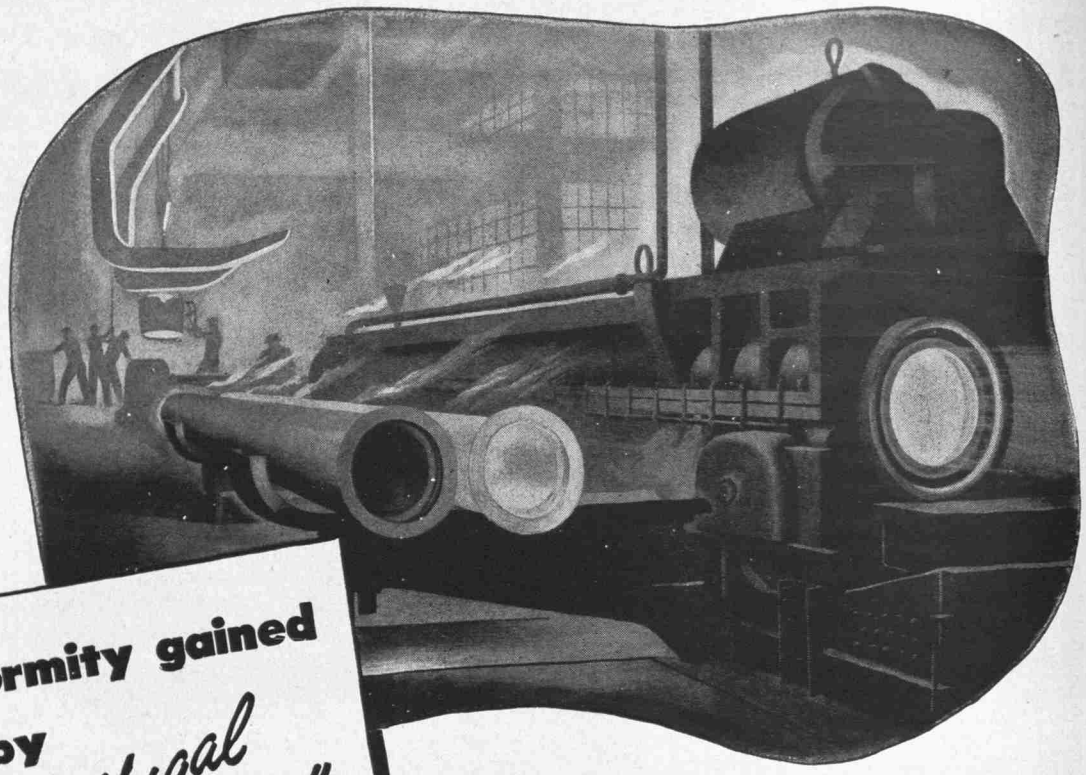
Today, I am in charge of pricing, applying and promoting the sale of three lines of control devices: *Rocking Contact* voltage regulators; *Regulex* voltage regulators; and liquid rheostats. Part of my time is spent traveling . . . visiting customers and helping district office salesmen.

The time spent in other departments has paid off too. It not only helped me find the work I liked best, but I met people in departments all over the plant that I now work with in coordinating jobs for utilities. Even time on the Steam Turbine erection floor proved valuable, because it helps me in talking shop to utility men.

Wide Choice at A-C

One reason you have such a wide choice is the fact that Allis-Chalmers makes equipment for every basic industry, including electric power, cement, mining, rock products, flour milling, and steel. Just to give you an idea, here are some of the products you might some day redesign, build or sell: transformers, steam condensers, pumps, motors, blowers, unit substations, steam and hydraulic turbines and generators, crushers, kilns, grinders, coolers, rolling mills, sifters, and many others.

That diversity can mean a lot to you in helping you find the job you want. It certainly helped me make my first job count.



Uniformity gained by "Centrifugal Casting"

The great majority of cast iron pressure pipe produced today is cast centrifugally, in metal or sand-lined molds.

When this mechanized process was introduced 27 years ago, its potentialities for improved production controls were evident. For human fallibility was largely replaced by machine accuracy based on scientific principles.

The improved production controls made possible by the centrifugal casting process have long since been realized. Hundreds of millions of feet of centrifugally-cast-iron pressure pipe are now in service. All of this pipe is more uniform in metal structure, in wall thickness, and in concentricity, than pipe not centrifugally cast.

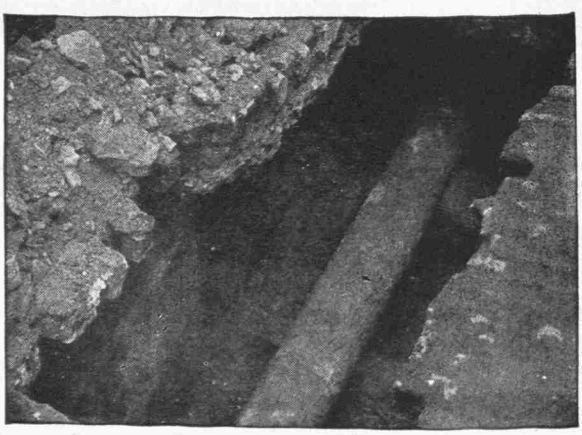
Better production control means better pipe; it results in greater uniformity of quality.

Production controls in cast iron pipe foundries start almost literally from the ground up with inspection, analysis and testing of raw materials; continue with constant control of cupola operation by metal analysis; and end with rigid tests of the finished product.

By metallurgical controls and tests of materials, our members are able to produce cast iron pipe with exact knowledge of the physical characteristics of the iron before it is poured into the mold of a centrifugal casting machine.

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 Avenue, Chicago, 3, Illinois.



Section of 114-year-old cast iron gas main still in service in Baltimore, Md.

CAST IRON PIPE SERVES FOR CENTURIES

THE DU PONT DIGEST

Production for M.E.'s

Du Pont's manufacturing side offers opportunity to mechanical engineers

The young mechanical engineer interested in production finds plenty of opportunity at Du Pont. His skills are in great demand because so many of this Company's products are made in equipment which must operate continuously on automatic controls.

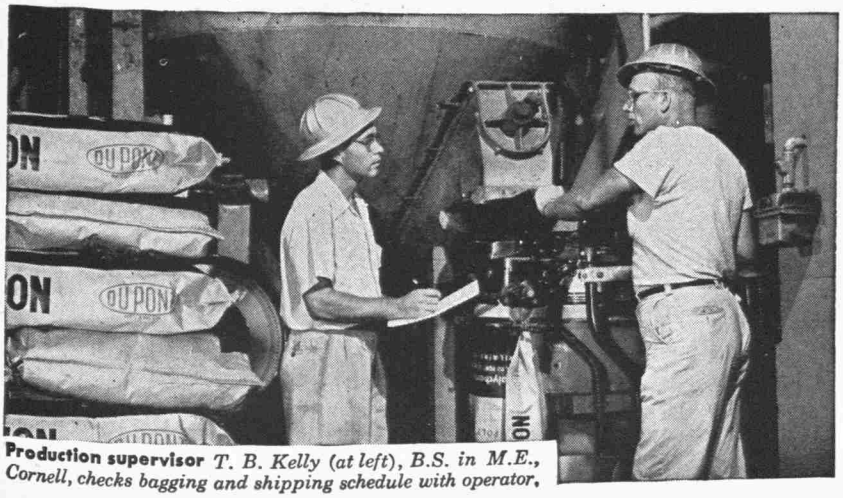
More than half of Du Pont's M.E.'s are currently engaged in some phase of production work. There are three main categories.

1. MAINTENANCE SUPERVISION. Resourcefulness and initiative are needed in men selected for this work. Among their many duties are the scheduling of preventive maintenance and emergency repairs to minimize down time, suggesting equipment improvements to reduce the maintenance load, and estimating costs of changes or major repairs.

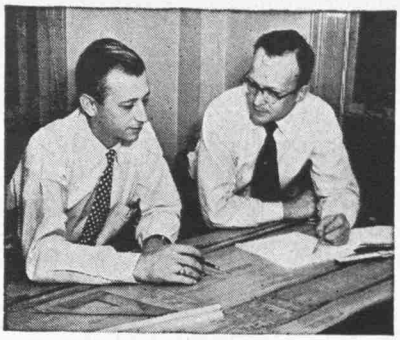
Normally, the supervisor establishes maintenance procedures, directs transfer of personnel from one group or area to another, and assigns duties. He sets up office and field work methods and controls the supplies of spare parts and stores.

The importance of this work is emphasized in some Du Pont plants where more men are needed to maintain the equipment than to operate it. At one plant, the division maintenance superintendent, a man with several years experience behind him, is responsible for 1,500 pieces of equipment and 100 miles of pipe. He has 120 men under him, including 10 foremen.

2. PRODUCTION SUPERVISION. Other mechanical engineers at Du Pont use their knowledge of mechanical equipment in solving production problems. They must see that raw materials are on hand, that maximum yields are obtained with minimum loss, and that the products meet rigid specifications. In addition, they must train men in proper equipment operation and maintain good personnel relations.



Production supervisor *T. B. Kelly (at left), B.S. in M.E., Cornell, checks bagging and shipping schedule with operator.*



J. D. McHugh *(at right), B.S. in M.E., Rochester '50, and draftsman discuss working drawings for plant equipment improvement.*

One area supervisor, also an experienced man, usually has charge of from 125 to 150 people, including 6 to 10 foremen.

Keeping compressors *in top running condition is a typical maintenance-group problem.*

3. PLANT TECHNICAL. Other M.E.'s at Du Pont are assigned to the teams of plant technical men responsible for process and production improvements. In this work, they help solve problems on machine design, strength of materials, control instruments, packing materials for high-pressure equipment, etc.

Actually—in maintenance, production and development—the possibilities are almost unlimited at Du Pont for the M.E. who likes the manufacturing side of industry.

HAVE YOU seen "Mechanical Engineers at Du Pont"? 32 pages of facts about opportunities for mechanical engineers. For copy, write: 2521 Nemours Building, Wilmington, Delaware.

ATOMIC ENERGY

(Continued from Page 36)

be entirely possible that the cost of nuclear fuel may eventually become competitive with that of coal or oil. At present no reliable estimate of its cost can be given, for there are so many factors concerning which we do not have the knowledge and experience to evaluate properly.

In areas where electricity is now readily available, at reasonable cost, it is hardly likely that the advent of atomic energy will cause any revolutionary reduction in the cost of power. Of the total price now paid by the consumer for fuel-generated power, only 20-25 per cent goes to pay for the fuel itself. Hence, even free nuclear fuel would cause a reduction in power costs of only 20-25 per cent. While this would be significant, it is hardly in keeping with some of the more fanciful pictures that have been drawn as to the effects of atomic energy.

The great advantage of atomic fuel is that it is so concentrated a source of energy. This makes it seem quite likely that atomic energy may bring economical electric power to areas where the transportation costs on conventional fuels are extremely high.

LARGE PLANTS NEEDED

This does not, however, mean that small atomic power plants will spring up in every isolated area. An atomic power plant will necessarily be of large capacity, perhaps a hundred thousand kilowatts or more. In addition, to reclaim the potential energy remaining in the partially used fuel, a large supporting chemical plant may have to be associated with the power plant.

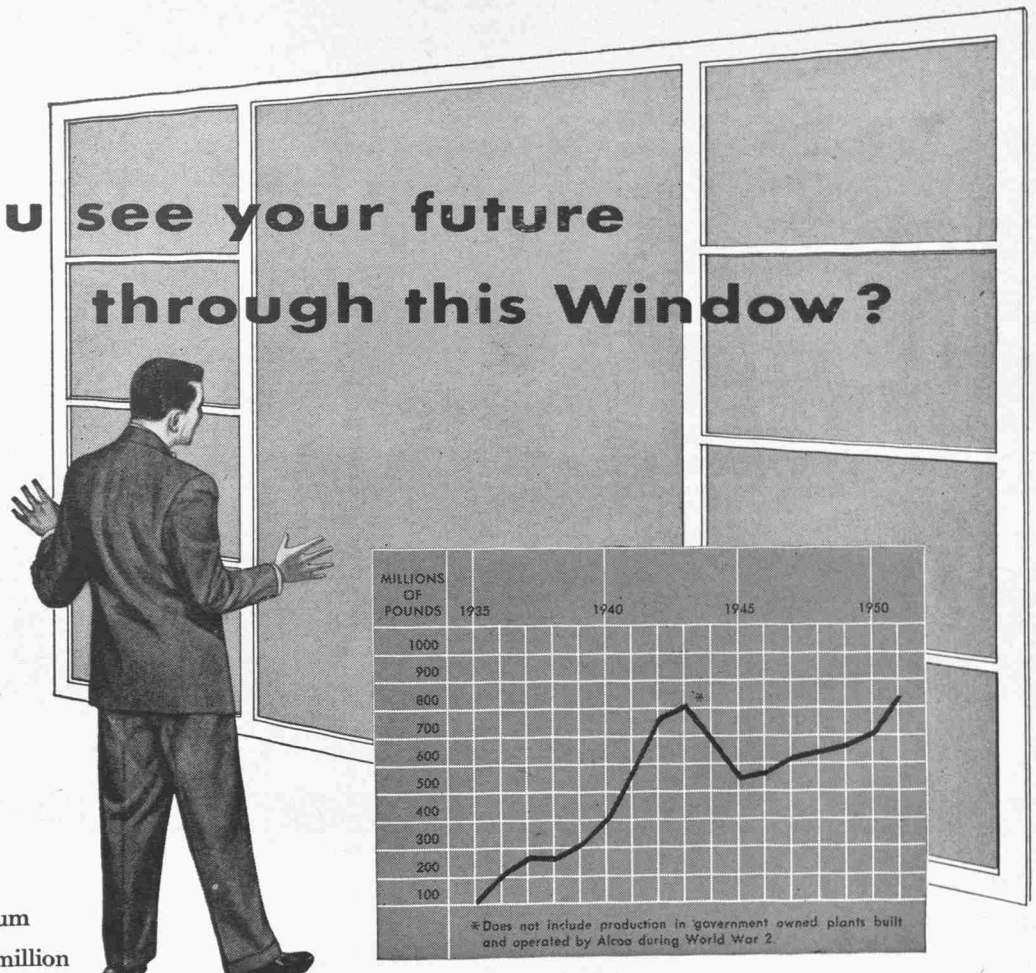
In other power applications, the requirement of a radiation shield around the atomic reactor is a serious restriction. In the light of present knowledge, such a shield would weigh many tons, far beyond what a truck or automobile could carry. Possibly it could be built within the confines of a locomotive, which would then be capable of running for a very long time without refueling. The same is true for an airplane. A ship could easily carry an atomic plant, as far as weight and space are concerned. That is why it seems likely that the first major application of atomic power, in a unit specifically designed for its purpose, will probably be for ship propulsion.

WHEN?

The Atomic Energy Commission's Fourth Semi-Annual report, issued in 1948, stated that it seemed impossible, even "under the most favorable circumstances, to have any considerable portion of the present power supply of the world replaced by nuclear fuel before the expiration of 20 years."

Nothing has developed since then which would shorten this estimate materially; in fact, the statement still seems quite optimistic. The development of atomic power will be gradual, over a long period of time, and will be evolutionary rather than revolutionary. It may also be profoundly affected by military demands for nuclear fuel as a material for atomic bombs. In any case, it seems at present that atomic energy will only supplement, and not supplant, present sources of power.

Can you see your future through this Window?



This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1951. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

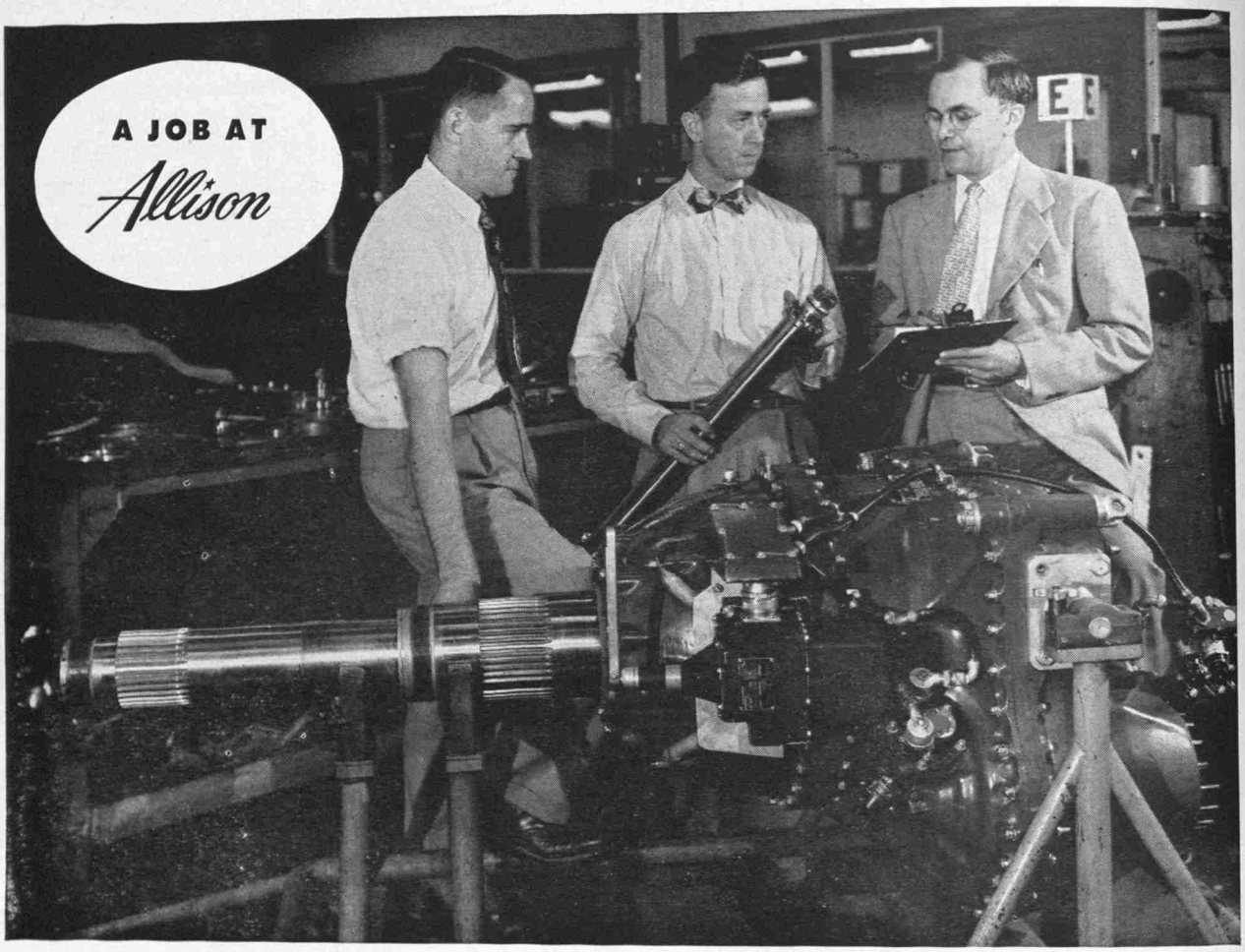
Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director.

The best things in aluminum come first in

ALCOA ALUMINUM

By ALUMINUM COMPANY OF AMERICA • Pittsburgh, Pennsylvania



Left to right—C. Mead Hawkins, U. of Toledo, B.S., Mechanical Engineering 1948, M. H. Thomas, Kansas State College, B.S., Mechanical Engineering 1939 and V. W. Peterson, B.S., Mechanical Engineering, Rose Polytechnic Institute.

● V. W. (Pete) Peterson, who was graduated from Rose Polytechnic Institute in 1939, is one of the modern day pioneers in the design of jet and turbo prop engines. His particular job is to supervise a group of engineers responsible for the basic detail design of reduction gear boxes and extension shaft systems for Allison Turbo-Prop Aircraft Engines.

Each engine consists of a pair of turbine power sections which revolve at more than 14,000 r.p.m. Two extension shafts transmit this high rotative speed to a gear box which reduces the shaft speed in the order of 16 to 1 to drive two contra-rotating co-axial propellers. Some airplane installations require extension shafts as much as 14 feet long. Thus, the problem is more than harnessing the engine output of 5500 horsepower to a propeller. The long shafts, rotating at high speeds, must be delicately balanced with flexible bearing mounts so they will not set up destructive vibration even though they are subject to many kinds of bending and twisting motions through various attitudes of flight.

This is another of the interesting problems at Allison which represent a challenge and an opportunity for young engineers. Every day men at Allison are making a new contribution to the science of jet engines. And, at the same time they are adding to their own experience in a field which offers life-time careers for qualified young men.

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.

The practically solid gear lubricant used in diesel locomotives and the thin, soft lubricant used in a station clock are as different as are the two mechanisms. Yet both are greases—products of research that has developed thousands of other special greases.

It takes more than elbow grease to make the world go 'round!

So different in other ways, the locomotive and the silent electric clock have in common one absolute essential: grease—a special grease for each mechanism.

And this merely hints at the wide range of needs. Coke-oven grease must stand temperatures of 600° F. Airplane grease must lubricate at both desert heat and sub-zero cold. Stamping compounds keep metal from welding to dies. Naval greases prevent corrosion by salt spray. Almost any kind of machinery embodies its own special lubrication challenge.

Chemists and engineers apply their knowledge, experience, and imagination to finding successful answers. Such research holds a wealth of interest and satisfaction for young technical men at Standard Oil.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

SIDE TRACKED

The Southern father was introducing his family of boys to a visiting governor.

"Seventeen boys," exclaimed the father, "and all Democrats—except John, the little rascal. He got to readin'."

★ ★ ★

"It's quite simple" explained one of the seniors in EE442, "to hook up an electric power circuit. We merely fasten leads to the terminals and pull the switch. If the motor runs, we take our readings. If it smokes, we sneak it back and get another one."

★ ★ ★

"Have your fiancee's people accepted you yet?"

"They sure have. I was bawled out yesterday for using a guest towel."

★ ★ ★

Worried freshman to hardened senior: "How do you manage to keep on drinking that dormitory coffee?"

Senior: "I take a heaping teaspoon of Draino once a week."

Purdue Engineer

★ ★ ★

I serve one purpose in this school
Upon which no one can frown—
I quietly sit in every class
And keep the average down.

Purdue Engineer

★ ★ ★

A spinster was shocked by the language used by workmen repairing a telephone near her home, so she wrote the company.

The foreman was requested to make a report. The report read as follows:

"Me and Spike were on this job. I was up on the pole and I accidentally let the hot lead fall on Spike—right down his neck. Then Spike looked up at me and said, 'Really, Harry, you should be more careful'."

Purdue Engineer

★ ★ ★

If exercise will eliminate fat, how in the world does a woman get a double chin?

Okla. Covered Wagon

★ ★ ★

"How did Herbert manage to inherit so much of his uncle's estate?"

"He married the daughter of his uncle's lawyer."

There is a great difference between the right word and one that is similar but all wrong. For instance, you can call a woman a kitten, but not a cat; a mouse, but not a rat; a chicken, but not a hen; a duck, but not a goose; a vision, but not a sight.

Chats (Clark-Sprague Printing Co.)

★ ★ ★

Woman driver to companion after parking car: "That's close enough . . . we can walk to the curb!"

Dave Eastman in *The Saturday Evening Post*

★ ★ ★

The modern co-ed's hair may look like a mop, but that doesn't bother her—she doesn't know what a mop looks like.

Penn State Engineer

★ ★ ★

It Can't Happen Here

"Beg Pardon, but aren't you one of the college boys?"

"No—it's just that I couldn't find my suspenders this morning, my razor blades were used up, and a bus just ran over my hat."

Duke Engineer

★ ★ ★

The old engineer pulled his favorite engine up to the water tank and briefed the new fireman. The fireman got up on the tender and brought the spout down all right but somehow his foot caught in the chain and he stepped right into the tank.

As he floundered in the water, the engineer watched him with a jaundiced eye.

"Just fill the tank with water, Sonny," he drawled. "No need to stamp the stuff down."

Rose Technic

★ ★ ★

She was a hula dancer
He was a guy from the fleet—
He forgot the sugar he left at home
When she shook her shredded wheat.

Duke Engineer

★ ★ ★

"I'll bet you woudn't marry me," he said.
She called the bet and raised him five.

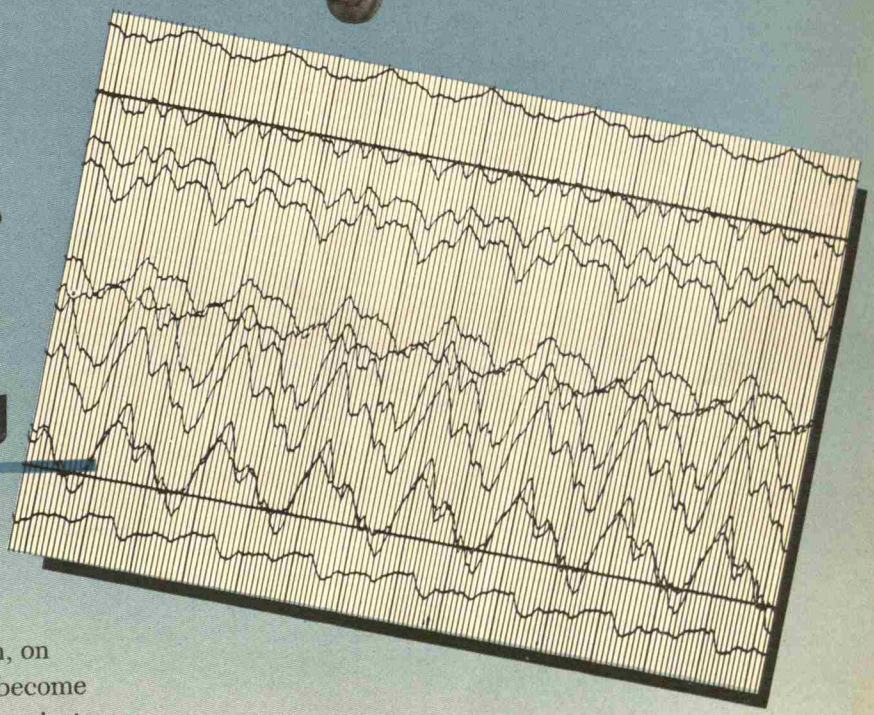
Montana Engineer

★ ★ ★

Football coach: "You're out of condition, Buck. Whatta you been doing, studying?"

Pacific Weekly

Photography... an able helper all through engineering



These traces provide helicopter engineers with information about blade stresses during flight. Strain gages pick up bending at different locations. Photography with its perfect memory catches the whole story as fast as it happens.

In the laboratory, in the drafting room, on the production line, photography has become a most important tool. It records fleeting instrument traces for study. It examines metal structure through electron micrography, x-ray diffraction, and microradiography.

The use of photography in engineering, business, and industry is increasing steadily. This has led graduates in the physical sciences and in engineering to find positions with the Eastman Kodak Company. If you are interested, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

FUNCTIONAL PHOTOGRAPHY

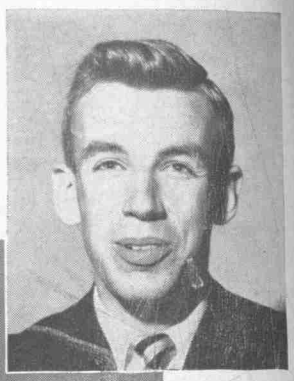
serves industrial, commercial, and scientific progress

Kodak

TRADE-MARK

"What is General Electric's policy on employment in light of the draft?"

. . . John C. Bennett, University of Rochester, 1953



The answers to John Bennett's question - - excerpts taken from the panel discussion - - are given below.

R. J. CANNING, *Business Training Department* . . . Basically, the Company is interviewing and considering college students for employment without regard to their draft status. We're not passing over men because they are eligible for the draft—we're hiring them if they have the qualifications we want in our employees. We are looking at the area of employment on a long-range basis, and we think we are going to carry a perpetual inventory of men in the armed forces for a considerable period of time. It's true we lose some men, but we get many back, and with this in mind our policy is based on personal qualifications, not on draft eligibility.

J. L. MICHAELSON, *General Engineering Laboratory* . . . We are experiencing a growing appreciation of the importance of an adequate supply of well-trained professional people to this country's immediate and future welfare. Although this situation creates excellent opportunities for you students for future employment, the draft may leave you plagued by uncertainty for the present. But, remember this, we are not only considering college people for employment entirely for the year 1952. We are also thinking ahead to the years '54, '55, and '56, and if we find a good man now, knowing he is going into military service, we will still make long-range employment plans for him. We still would like to have him come with us after he has completed his military service.

M. M. BORING, *Engineering Services Division* . . . Whether or not you are called into military service you can reasonably expect to follow your profession for approximately 30 or 40 years. Your solution to the many problems, such as this one, which arise during your entire productive period, will be a lifetime undertaking. A period spent serving your country in a military way will represent a relatively small part of your total professional life. The way you handle a problem such as this, and the information you get to help in its solution, will determine to a large extent your ability to handle future problems.

Now, where does General Electric stand in regard to this draft situation? This is our policy. Regardless of military status, we desire to interview all students who are interested in our Company. And, irrespective of military status, we will make employment offers to all who have the qualifications we are looking for, and whom we would like to have become members of the General Electric family. If any of these people are called into service before starting work with us, business conditions permitting, our offers will be waiting for them when they return. Those with us before being called into service will maintain continuity, and, barring unforeseen circumstances, will be assured of employment upon return.

Following World War II we did not have to go back on a single promise. When the present world situation is concluded we hope our record will remain the same.

Do you have a question—or seek further information? If so, write to College Editor, Dept. 221-6, General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC