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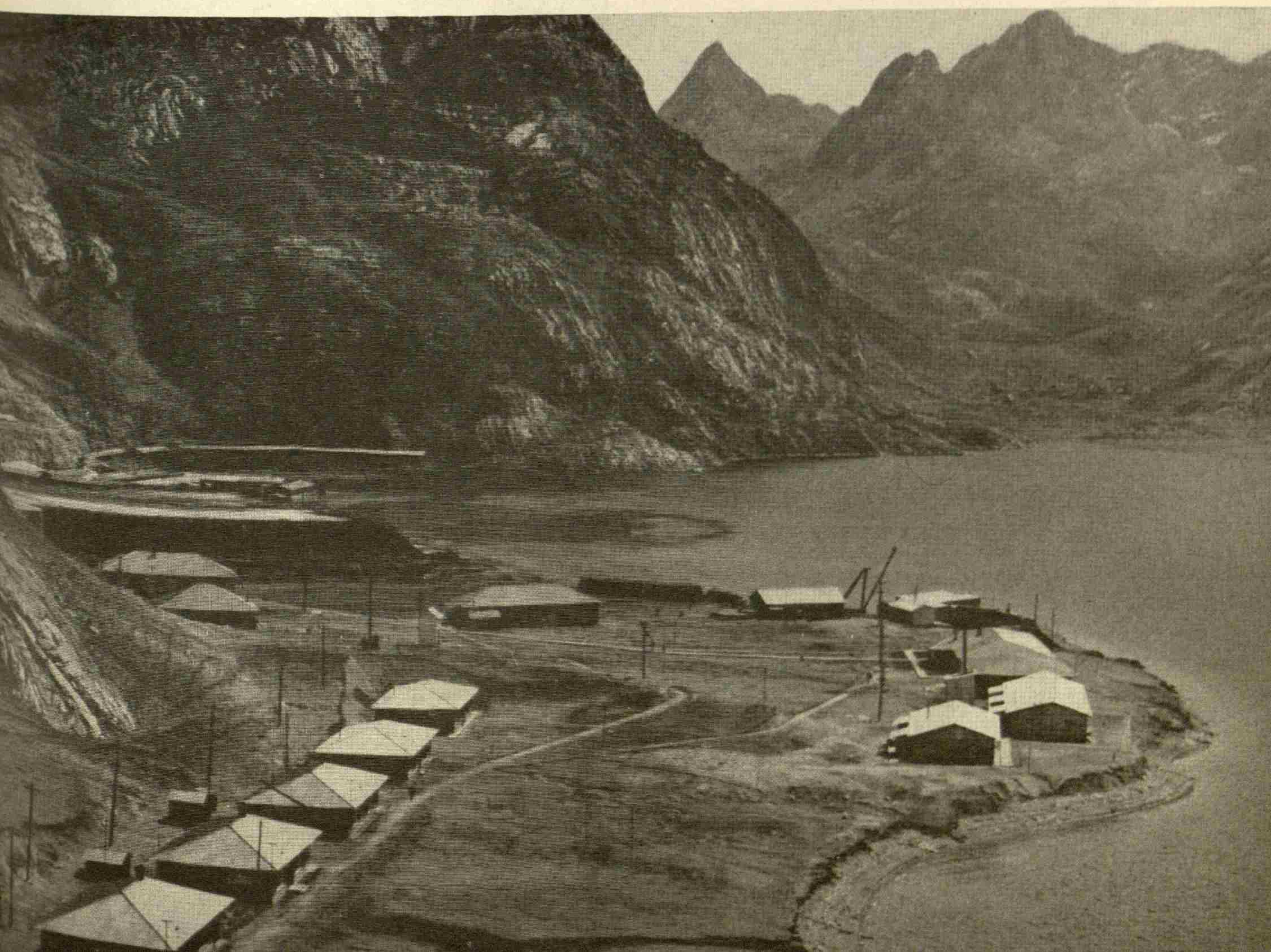
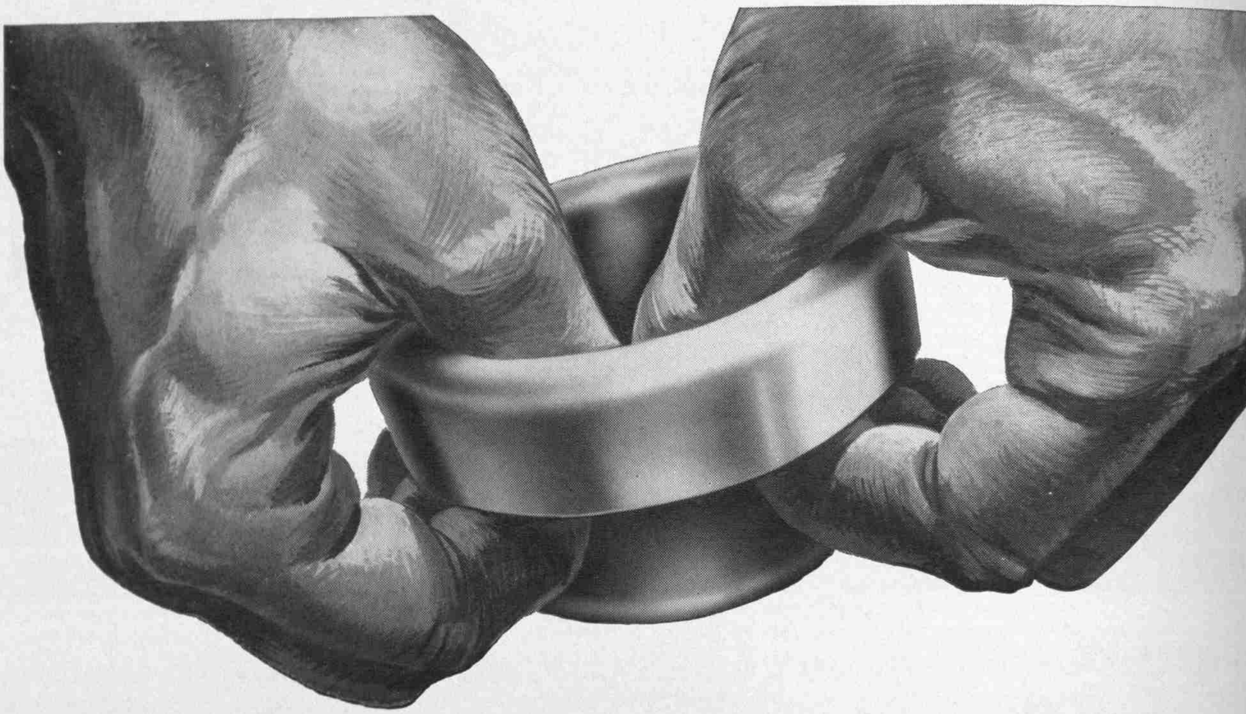
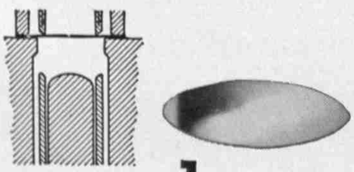
Spartan ENGINEER

Vol. 6 No. 3 MARCH 1953





How to turn a high strength steel cup inside out, cold



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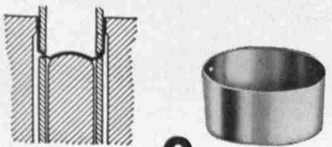

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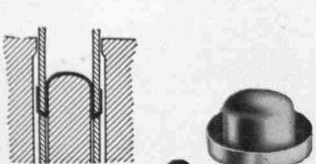

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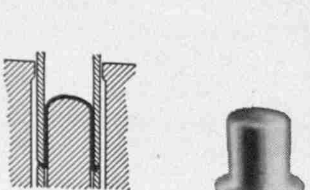

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OFFHAND, anyone familiar with high strength steels would say it couldn't be done. But one of our customers does it every day.

Employing a unique reverse-drawing method and using a U·S·S High Strength Steel especially adapted for this process, they turn out cylindrical containers of various kinds that are not only stronger than those made from carbon steel but weigh substantially less.

To accomplish this, the steel has to meet two entirely opposite requirements. It has to be so strong that it can be used in thinner gages to reduce weight, and yet must have enough ductility to satisfy the drastic fabrication method that would be considered severe even for carbon steel.

This method is used to draw cups for large, low-pressure cylinders. These cups, 14½ in. in diameter and 24½ in. deep, are drawn cold, from 12-gage steel blanks in one continuous stroke in a reverse draw press. The diagrams at left show how it is done.

Starting with a 38 in. diameter steel blank (Fig. 1) the press first draws the steel into a shallow cup (Fig. 2). As the stroke continues, the cup is literally *turned inside out* (Fig. 3) to form the finished cup (Fig. 4) which has very uniform wall thickness. Two of these cups are then welded together to make a cylinder.

Made with high strength steel, cylinders weigh about 20 lbs. less. The maker gets 26% more cylinders from each ton of steel used. Lighter weight makes cylinders easier to handle, and also pays off in lower freight costs—both on the steel from our mills and on cylinders shipped. (A customer 500 miles away saves as much as $100 per carload.)

Developing special steels for special customer needs is an important job of United States Steel metallurgists and engineers. With their tremendous background of practical experience, they are ready to work on any problem that involves the more efficient use of steel. United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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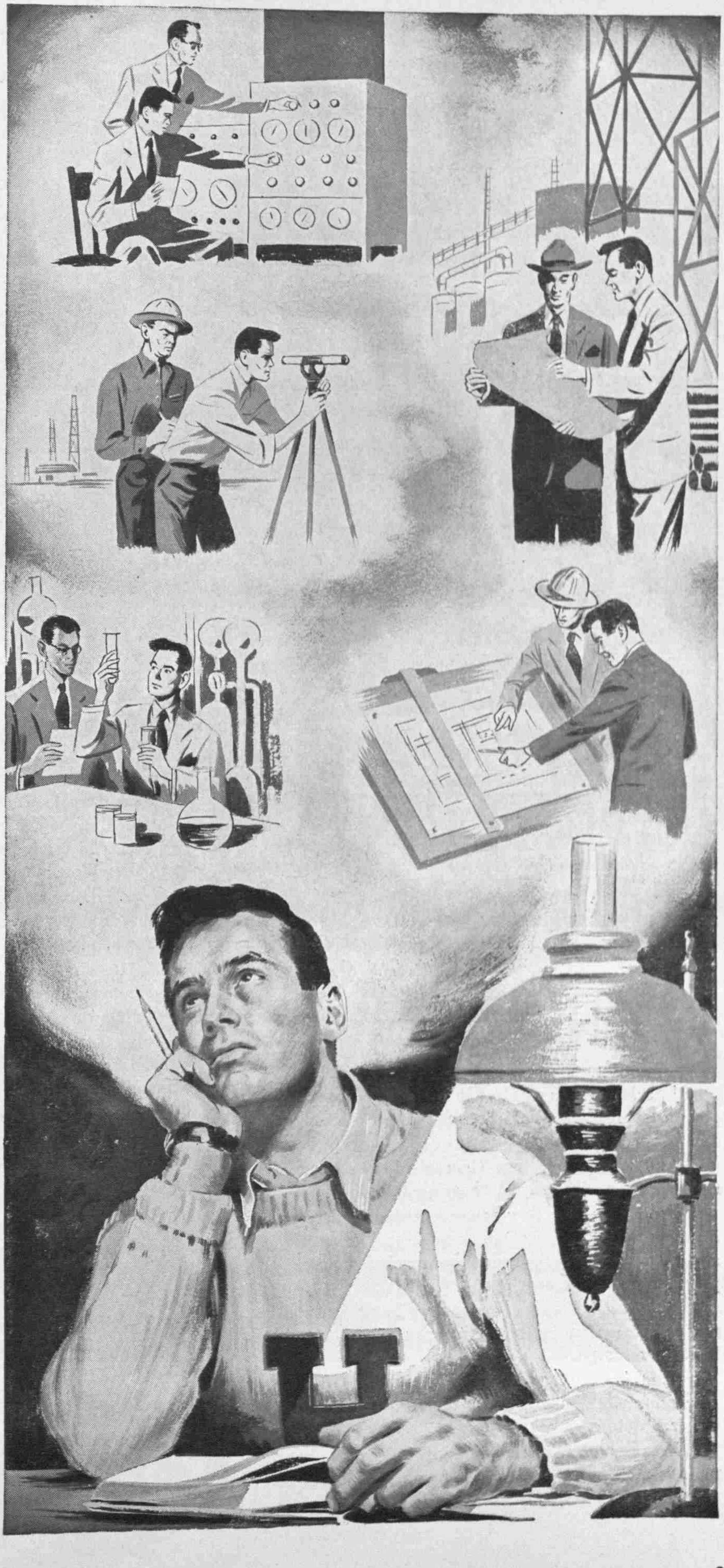

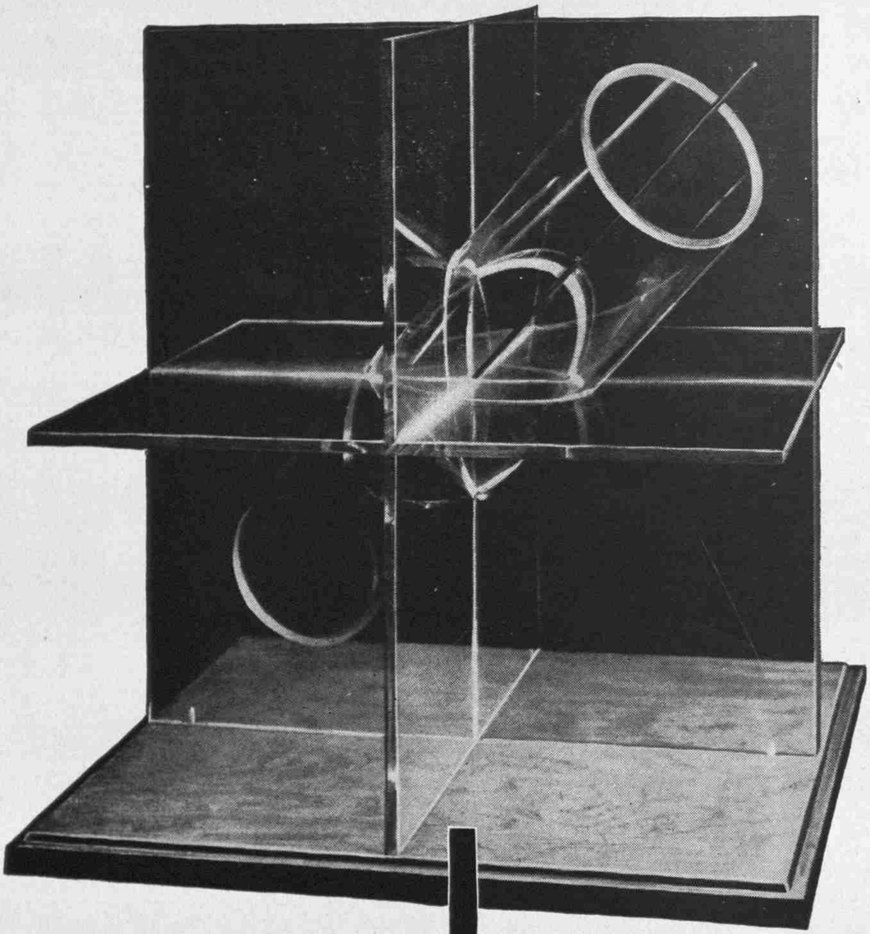

Spartan ENGINEER

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COVER

Operational headquarters for the Mina Ragra mine on Lake Pun Run. —Courtesy of Vanadium Corporation of America.

Published four times yearly by the students of the SCHOOL OF ENGINEERING, MICHIGAN STATE COLLEGE, East Lansing, Michigan. The office is on the third floor of the Union Building, Phone ED 2-1511, Extension 251. Entered as second class matter at the Post Office in Lansing, Michigan, under the act of March 3, 1879.

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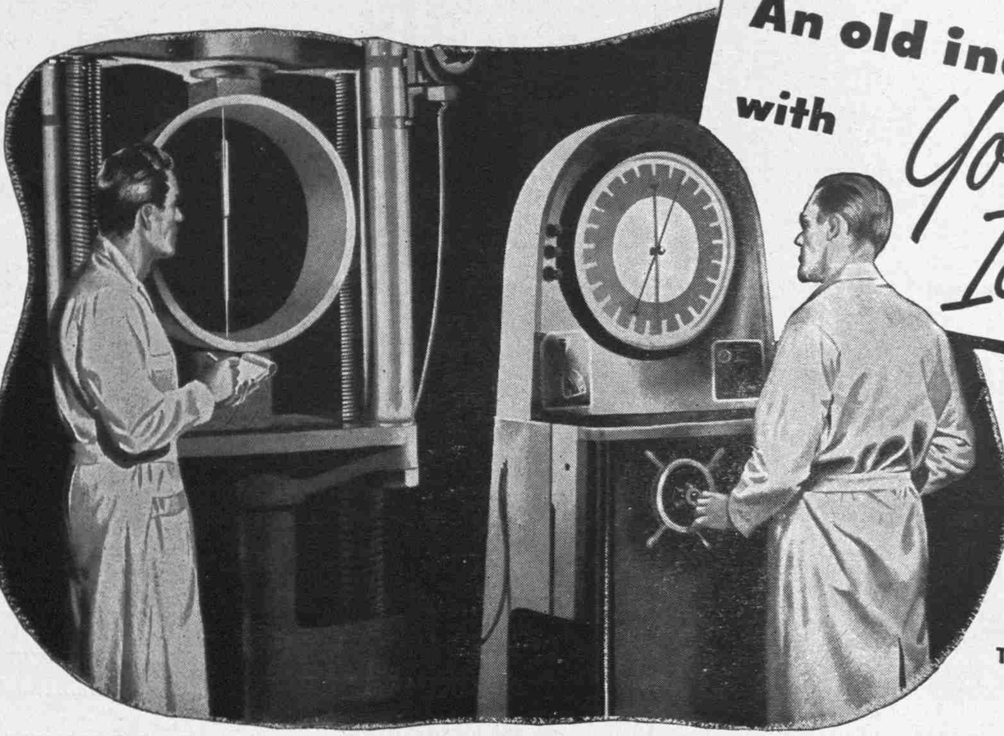
An old industry with *Young Ideas*

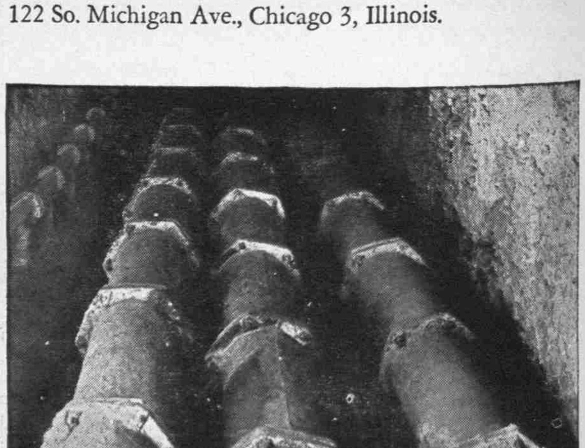


The Ring Test

The ring test, shown above, is a scientific method for determining the modulus of rupture of pipe. It is not a required acceptance test but one of the additional tests made by cast iron pipe manufacturers to ensure that the quality of the pipe meets or exceeds standard specifications.

A ring, cut from random pipe, is subjected to progressively increased crushing load until failure occurs. Standard 6-inch cast iron pipe, for example, withstands a crushing weight of more than 14,000 lbs. *per foot.* Such pipe meets severe service requirements with an ample margin of safety.

Scientific progress in the laboratories of our members has resulted in higher attainable standards of quality in the production processes. By metallurgical controls and tests of materials, cast iron pipe is produced today with precise knowledge of the physical characteristics of the iron before it is poured into the mold. Constant control of cupola operation is maintained by metal analysis. Rigid tests of the finished product, both acceptance tests and routine tests, complete the quality control cycle. But with all the remarkable improvements in cast iron pipe production, we do not forget the achievements of the early pipe founders as evidenced by the photograph below of cast iron pipe installed in 1664 to supply the town and fountains of Versailles, France and still in service. Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 285-year-old cast iron water main still serving the town and fountains of Versailles, France.

CAST IRON PIPE SERVES FOR CENTURIES

By LORIN G. MILLER
Dean of Engineering

Don't Look Now, But . . . We're Being Followed

"There is a load every man lugs behind him, heavy, invisible, sealed, concealed, perfumed, a package of dead things he drags along never opened save to put in some horror of the mind—some horror of his own doing—to seal up and rot in secret. He pretends there's no such thing. He tries to walk as if he had no burden." This quotation from Maxwell Anderson's "Anne of a Thousand Days" is an apt description of the mental load we carry, drag or push which lowers our efficiency and cuts down our power. This load need not be so bulky, so heavy or so odorous if we exercise a little care concerning the nature of the items we seal, conceal, perfume and ignore within the burden.

One of the heavy items in the load the new graduate carries is the whispered comment "young," "immature," "inexperienced." The load should be lightened immediately with the knowledge that Galileo at 17 discovered the isochronism of the pendulum, William Cullen Bryant wrote Thanatopsis at 18, Braille, blind since 3 years of age, had developed the Braille alphabet before he was 20, one of the stellar contributors to the Los Alamos project was a youth not old enough to vote and Edison was only 31 when the Edison Electric Light Company was formed and named for him. Youth as such is no handicap and should be purged from this apparent "load."

Another of the "inertia" items we drag along is unwillingness to proceed with the material or personnel or methods at hand toward a completion. Ingenuity as a word comes from the same root as Engineer and as a talent should be a real feature of the engineer. To produce requires ingenuity to which a measure of aggressiveness and imagination must be added. The world is looking for men who get things done. In the words of Shakespeare

> "The wisest thing we suppose
> That a man can do for his land
> Is the work that lies under his nose
> With the tools that lie under his hand."

This load can be further lightened by removing the faculty of unwillingness to accept responsibility. All human beings grow in dignity and self-respect by reason of accomplishment and the assumption of responsibility which has ever been recognized as the builder of men. The talent for responsibility starts with the development of self confidence. It begins to be evident in small circles, then spreads to larger and larger influence. It should not be confined to a professional area but allowed to expand into services to school, community and church. With the acceptance of responsibility, comes the complementary function, the delegation of responsibility. No such division of labor should be made without an accompanying authority. Mere disposition of tasks will not lighten this load. A man develops by standing on his own feet. He does not wax strong by having others do for him what he can and should do for himself, his community, his state and his nation.

Burdens are always lighter when shared. Cooperation or "getting along" with fellow workers is an important feature of progress. Working as a team always accomplishes more than as a group of individuals. To antagonize fellow travelers, even in a good cause, is very seldom good policy. Be unprejudiced in judgment and respect judgment of others. Except in rare cases is it wise to stubbornly insist on "rights." Consider the case of Mr. O'Day whose epitaph read

> "This is the grave of Mike O'Day
> Who died maintaining his right of way.
> His right was clear, his will was strong,
> But he's just as dead as if he'd been wrong!"

Don't mix personal troubles with your work. Take pride in your work. Be willing to correct your mistakes but remember that others make them also. Be active in cooperation. Practice the admonition in the Sermon on the Mount "Whoever compel thee to go one mile, go with him twain."

And finally, these dead, decaying faults of omission and commission will be less offensive to the olfactory nerves if the individual moral conduct is above reproach. Morals are associated with living and living is exemplified by physical behavior. To be clean and to act clean will do much to convince associates that intentions are clean. Intrinsic honesty, intellectual fairness and sincerity increase the moral stature and strengthen the moral fibre. The engineer's works are largely public and depend upon an honest and upright treatment. There is no greater danger to civilization than in training engineers whose skills enable them to be leaders but whose minds are indifferent to their responsibilities as citizens in a democratic society.

Geology and Engineering

By JUSTIN ZINN
Professor of Geology

Several groups in the engineering profession either work directly on the earth's surface or else are vitally interested in certain aspects of this surface. By the earth's surface, we mean the uppermost several thousand feet of the solid material on which we live. There is no question as to the role of the mining engineer who must design and dig the shafts and drifts that enable us to recover the mineral wealth from the rock of the earth. The metallurgical engineer likewise is involved with the earth, for his raw materials come from this source. The various works of the civil engineer are built on the earth's surface and in building his monuments here, he likewise deals with this surface though he may not be very well acquainted with it.

Many others who aren't ordinarily called engineers are also primarily interested in the earth's surface. The soils, of course, are vital to the agricultural scientists and the general surface as the site of human habitation concerns the geographers. The geologists are the scientists who really study this earth of ours, however, and it is their efforts that have provided us with the facts we now have about the origin, composition and structure of the earth's surface.

In a general way, it can be pointed out that two rather distinctive groups of professional men are primarily concerned with the earth's surface. One of these groups comprises men who are known as engineers and the other those generally called earth scientists. And this observation leads us to the principal reason for this article. The objectives, points of view and the training of these two groups is so different that if it weren't that both are primarily concerned with the earth's surface, one would find little in common among them. Let us simplify the discussion somewhat by considering just the civil engineers from the engineering group and the geologists from the earth scientists and compare these two bodies of specialists as to their work, point of view and scholastic training.

The civil engineer is the one who builds things. He directs the construction of buildings, roads, bridges, tunnels and dams, to list a few of his accomplishments. The technical part of his work consists of calculating stresses, loads, materials needed, dirt to be moved and so on, and his directing of the construction itself is largely the culmination of a great deal of preliminary work. The engineer is the one who builds, and this probably directs his general point of view. The dirt or rock which must be moved in order to build holds little interest for him; it is like the brush the farmer must remove in order to clear new farm land. The engineer does realize that his foundations must be firm so he must examine the material around and below these foundations. He should know its properties, and in large projects its extent and structure, and here is where he sometimes has trouble. The scholastic training he got in college may have omitted any geology in his schedule of courses. Actually the engineer is well trained in mathematics, design, structural materials, surveying, etc., and is a very competent man in the construction field but he may not know the ground on which he expects to build.

Now what is the geologist made of? In the first place, the geologist studies the earth's surface in order to classify and determine the origin of the various features found there. Where he can, he studies beneath the surface also, in order to delineate such things as ore deposits and the structure of the rocks. Most geologists are true scientists in that they are curious and continually try to find relationships, origins and the reasons why. Such inspiration has enabled them to garner enough facts about the earth's surface to make reasonably accurate predictions about positions, continuations, sizes, etc., of rock bodies, faults and other structures. The geologist likes to see things built too, but he is more interested in the foundations and has the knowledge to predict the effects of rock and structure on such foundations. In school the geologist masters a good deal of science where terminology and physical laws are stressed, but he may get little or no training in typical engineering courses. He turns out to be theoretical while the engineer is a practical man. Of course, there are exceptions to these statements, but the writer has tried to describe the average person in each field.

It is true that the professional work of the engineer and that of the geologist is quite different, but there is a fair amount of common ground, particularly in background training. This might be pointed out by some examples. One might take the case of the bridge which is being planned across the Straits of Mackinac. The engineering problem of spanning the water gap there with an adequate bridge is no more difficult than those connected with a number of other bridges already built in this country. However, the geology existing at the Straits presents a somewhat more touchy problem. Adequate footings for the bridge supports depends upon the geological conditions. One

(Continued on Page 52)

A MEANS OF REDUCING BLIND LANDING HAZARDS

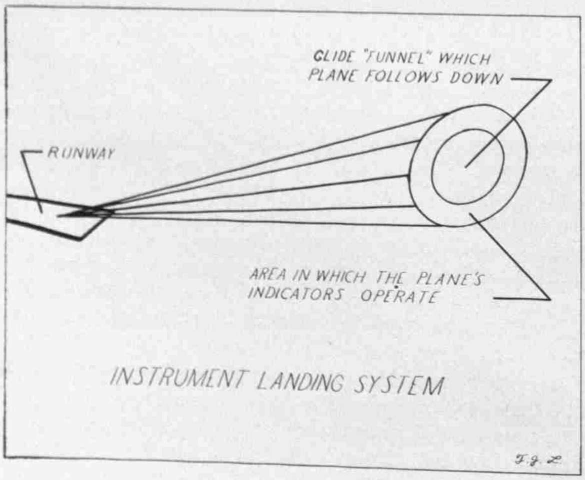
By LESLIE G. WOLSEY, E.E. '54

Drawings by Thomas J. Linton, E. E. '56

The recent accidents which have befallen the commercial airlines of this country stress an old and irksome fact of aviation and add new emphasis to a frequently asked question. The fact is that bad weather is the greatest single obstacle and hazard in aviation. The question is, "What about the blind-landing systems everyone has read and heard so much about? Do they work or don't they?"

If the answer to the question were yes, the fact would no longer be true. The truth is that systems for literally blind landings—by which a plane's wheels are brought in contact with a fog covered runway the pilot cannot see—are some years from perfection. But there are effective low-weather approach aids which are used to guide a pilot until he breaks out of the overcast and then lands his plane visually. The weather conditions have to be considerably better than zero-zero—which means no ceiling, no visibility. For example, at Newark airport and New York International at Idlewood the aids are not supposed to be used when the ceiling drops below 400 feet and visibility below three-quarters of a mile.

There are several different types of systems that could be used, one of which is based on radar. In order that one may fully appreciate radar and become acquainted with what it can accomplish, it would be better if one knew some of the basic principles on which radar operates.



Almost as soon as radio was invented, methods were devised for finding the origin of radio signals. This was possible by finding the direction from which the waves were coming.

But this was not radiolocation. Radiolocation depends on the reflection of radio waves from objects and makes it possible to detect the location of an object merely by reflection of radio waves. Radio silence, darkness, or fog will not prevent an object from being located.

The first fundamental physical principle of radiolocation is the use of the echo made by radio waves when they have been projected against an object—known as radio reflection. The second physical principle is the measurement of the time taken by the echo to travel from the reflecting object to the receiver.

Utilization of the radio echo method for the location of airplanes, and its utilization as a military weapon, involved a great effort of applied science. This development of technique has been given the name, radar. Radar—radio detection and ranging—may now be defined as the art of detecting, by means of radio echoes, the presence of objects, determing their direction and range, recognizing their character, and using the data obtained in the performance of aviation problems or other functions.

At the present time there are two bad-weather approach systems approved by the Civil Aeronautics Administration for use by the commercial airlines. Many of the major airports of the nation already are equipped with both these devices.

One aid is the Instrument Landing System (ILS). In this system, special radio apparatus is installed along an airport's instrument runway—the runway lying in the direction of the prevailing winds of the area so that the pilot making an instrument landing generally will be headed into the wind.

This radio apparatus sends out two beams. One establishes the direction in which the pilot should be flying; the other slants down toward the end of the runway and indicates the glide-path the pilot should follow in descent. The pilot can tell when he is on the beam by glancing at his ILS gauge on his instrument panel. When he is on the beam showing him his correct direction, a needle in the middle of the instrument remains vertical. And when he veers to either side, this needle veers also.

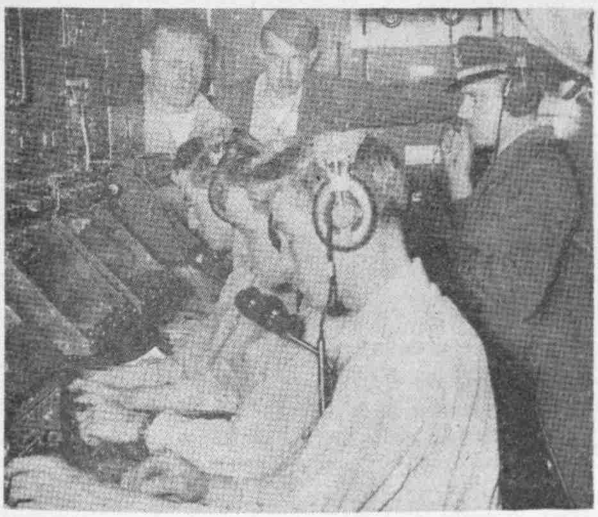
Another needle, actuated by the guidepath transmitter, operates horizontally. When the plane is on the glidepath beam, the horizontal needle lies in the middle of the instrument. But if the plane is above or below the glidepath, this needle lowers or raises itself. Thus when the aircraft is heading in the exact direction it should be and is descending correctly along the glidepath, the two needles are crossed in the middle of the gauge at right angles.

Additional radio beams help the pilot. These beams, called marker beacons, indicate, in the form of flashing lights on the instrument panel, how far the plane is from the point where it will touch down. There are three marker beacons: the first flashes in the instrument panel when the plane is about five miles from the runway; the second, about half a mile away; the third, about 200 feet away.

If the approach is successful and the ceiling is 400 or more feet high, the pilot of the plane breaks out of the fog and picks up the runway approach lights, then the runway light, and from that point on he flies visually. Up to that time, however, he has been flying the plane while his eyes constantly scan instruments on the panel —the ILS needle, air speed indicator and other gauges.

The other low-weather aid now in use is called Ground-Controlled Approach (GCA). This is a radar system which was given its first real test by the British Royal Air Force during the Battle of Britain. On the airfield a radar unit, constantly revolving, sends a beam out and up to approaching planes. The images of the planes appear in the form of little blips of lights on the radar scopes. Two radar scopes are used—one, called the search indicator, picks up a plane when it is from 30 to 90 miles from the runway; the other, the precision approach indicator, takes over when the plane enters the approach zone, about 6 to 8 miles from the end of the runway.

Usually when an approaching plane contacts an airport control tower under bad flying conditions, the pilot is asked by the tower operators if he wants to come in by radar. If he does, the radar operations take over and talk to him by very-high-frequency (VHF) radio, which generally can pierce storms without static. To make certain which blip represents his particular plane, the pilot is told to make several turns; his plane is thus



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Navy men operating Ground-Controlled Approach radar, which guides planes to perfect landings during bad weather.

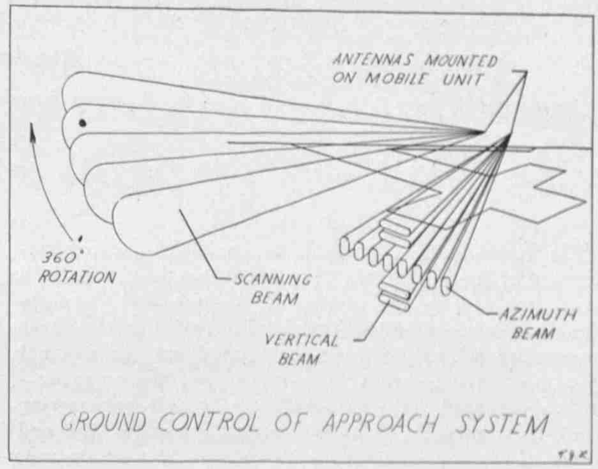
followed on the scope and identified. Then the pilot is talked down. He is told the direction to fly, the altitude and rate of descent to maintain. If everything goes right, the ground operator's voice tells him: "You're over the end of the runway—take over visually. And everyone in the cockpit and in the GCA unit relaxes—strenuously.

The Berlin Airlift indicated that GCA will aid in reducing bad weather cancellations, disruption of schedules under instrument flying conditions, and stacking delays at airports.

Most pilots with experience in ILS and GCA landings will tell you that both systems have proved to be dependable, when used by well-trained pilots. However, many pilots prefer ILS to GCA because they don't see why they should turn their planes over to a man down on the ground.

In actual practice, both systems are often used together. That is, a pilot making an ILS approach will be monitored on the ground by the GCA radar operators. If the pilot is off the beam, the radar man informs the pilot.

Research on improved techniques for low-weather approaches is, of course, going on. For example, the Sperry Gyroscope Company and the Civil Aeronautics



Administration have been flying instrumental planes to make landings in the New York area in the worst weather possible—when all commercial planes are grounded and even the birds are walking.

One concrete thing the low-weather approach experiment has proved is that there must be changes in the current methods of observing and reporting weather. For example, if ceiling and visibility readings are taken at or near the control tower, they may have little or no relationship to the weather at the end of a long runway or over the approaches to it. The ceiling may be 400 or 600 feet at or near the tower and only 300 feet at the end of the runway. That can be extremely bad for the pilot coming into what he has been told was a higher ceiling.

The people working on air safety are confident that in time all-weather landings will be practically as routine as night flying is now. But that time is distant.

TECHNICAL WRITING GROWS

By ROBERT T. HAMLETT

Reprinted from
Sperry Engineering Review

The tremendous expansion in the size and productiveness of the engineering profession has been due, in a large measure, to the ability of research and development engineers to enlist other engineers for special tasks or services related to their basic problems. It was not so many years ago that an engineer was **the** engineer—he was charged with responsibility for all engineering work on a project. This was possible because the end result of his engineering work was usually a single unit or instrument which operated without "tie-in" or reference to other equipment. He found time somehow to solve all of the engineering problems that arose in connection with his "brain child."

But the modern era of **systems** rather than **instruments** has changed the engineering approach to a very marked degree. One hears now about systems engineers, product engineers, project engineers, standards engineers, administrative engineers, test engineers, field engineers, production engineers, packaging engineers, industrial engineers, etc., etc. What has happened? Simply that the individual engineer can no longer carry all the burdens of the job of engineering a system or even a single instrument which ties into a system. While a very gifted engineer, possessing high skill in many branches of engineering, may still be able to visualize and guide the work on his project, he is no longer able to carry on the many individual investigations, attend the frequent engineering conferences, plan the fiscal and field testing programs, solve the production and packaging problems, etc.

This ability of the engineer to pass on responsibility to other engineers has given rise to still another field of specialization within the engineering profession—that of **technical writing.** The products of this new field are instruction books, training manuals, engineering reports, technical data sheets, and many other types of technical information. The workers in this field are variously referred to as technical writers, engineering writers, specification writers, technical report writers, etc. This author prefers to call the workers in this field **publications engineers** in keeping with other well-established titles such as standards engineer, test engineer, field service engineer, etc. This new title will be used throughout the article.

What Is A Publications Engineer?

The principal reason why this author prefers the new title publications engineer to that of technical writer is that it more clearly designates the duties of such a worker, and also places him in a proper professional status with fellow engineers, where he rightfully belongs. For he is an engineer first and a writer second. The term technical writer, as commonly accepted, refers to a person who writes material on technical subjects to various levels of intelligence but is not usually concerned with the actual publication processes and problems.

The publications engineer is an engineering specialist who relieves other engineers of the major portion of the responsibility for production of all publications required as a result of the engineers' work (Fig. 1). The publications engineer writes technical material, plans and directs preparation of copy, and carries through on all details concerned with actual production of the publication. It is necessary to repeat that he is first an engineer, then a writer, and finally a publications man.

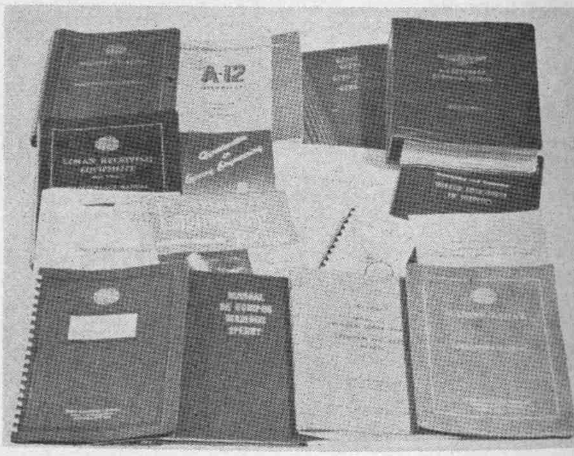


Fig. 1—Publications engineers produce a variety of matter requiring skills of both engineer and writer.

Engineers have always labored under the stigma that they cannot write well. It is a common attitude, even in pre-college education, to assume that because the student is superior in mathematics he must be inferior in English. This affects the student's attitude and he very naturally uses it as an excuse for not seriously studying the subject in which he is prejudged to be inferior. When the "superior" math student goes to engineering school it is a foregone conclusion that there is very little that can be done to help him there. However, he is given one or possibly two courses in English (especially "arranged" for engineers) early in his college work. Usually no further attempts are made to help him overcome a deficiency which will handicap him throughout his entire career.

There is no doubt that some engineers cannot write well—but some lawyers, some accountants, and some doctors cannot write well! Some doctors do not develop a pleasing "bedside" manner, so they become fine surgeons or specialists. So some engineers do not write well, or simply do not have time to write well—and because of this, other engineers now find an interesting and well-paid profession.

The publications engineer must be an engineer who has writing aptitude. This aptitude may have become

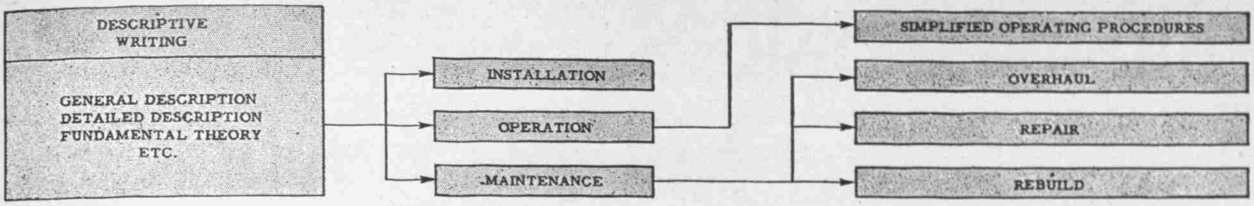


Fig. 2—Publications engineer's writing begins early with a project and follows product into the field.

very obvious because of the lack of encouragement received during his education. The author has seen many engineers, who felt certain that they were below average in writing aptitude, develop into excellent writers of technical material. No one can doubt that the engineering profession would be in a much better position if there were more effective writers amongst engineers. (The same might be said for effective speakers.)

The publications engineer must be an engineer with unquenchable thirst for learning. If he is a mechanical engineer he must be learning more about electronics; if he is an electrical engineer he must be learning about aero-dynamics, hydraulics, etc. He is constantly challenged to describe something about which he knows practically nothing. But with his basic engineering education under his hat, he tackles each unknown with some confidence that he can understand and interpret the facts for others who may know more or less about it than he does. Many fine technical descriptions result when engineers who are educated in one field begin to write on subjects in other engineering fields—they use analogies which greatly aid the reader in applying the description to his own experience.

The publications engineer must have a working knowledge of the advantages and disadvantages of many types of reproduction processes such as spirit duplication, mimeograph, Photostat, blueline and blueprint, Ozalid, offset printing, and letterpress printing. He is familiar with type faces, paper stock, cover materials, binding methods, etc. He understands the problems involved in production of copy by typewriters, Varitypers, typesetting, and Phototype. He has a practical knowledge of the arts of photography and retouching, and he guides technical illustrators in visualizing and rendering special illustrations for use with his written words.

All of his talents and acquired knowledge are combined in the process of preparing a publication that must meet government or commercial specifications covering content, format, practicability, and literary standards. He is at the same time an engineer, a writing specialist, a publications expert and a student of psychology!

Variety of Work

When the young publications engineer has developed confidence in tackling new writing projects, he finds the variety of writing assignments to be one of the most attractive features of his job. It is a familiar complaint among engineers that they become too specialized and know too little of what is taking place in the scientific world around them. While no scientist can hope to keep abreast of the tremendous evolution of technical achievements now taking place, the publications engineer finds real satisfaction in testing and adding to his knowledge in many different fields. As an example, at Sperry the skilled publications engineer develops a descriptive knowledge in such varied fields as radar, hydraulics, servomechanisms, gyroscopics, computing mechanisms, ballistics, optics, navigation, and aerodynamics. When the occasion demands he becomes, for a time, a writing specialist in one or more of these fields.

In addition to the variety of writing from the product standpoint, there is also much variation in the material

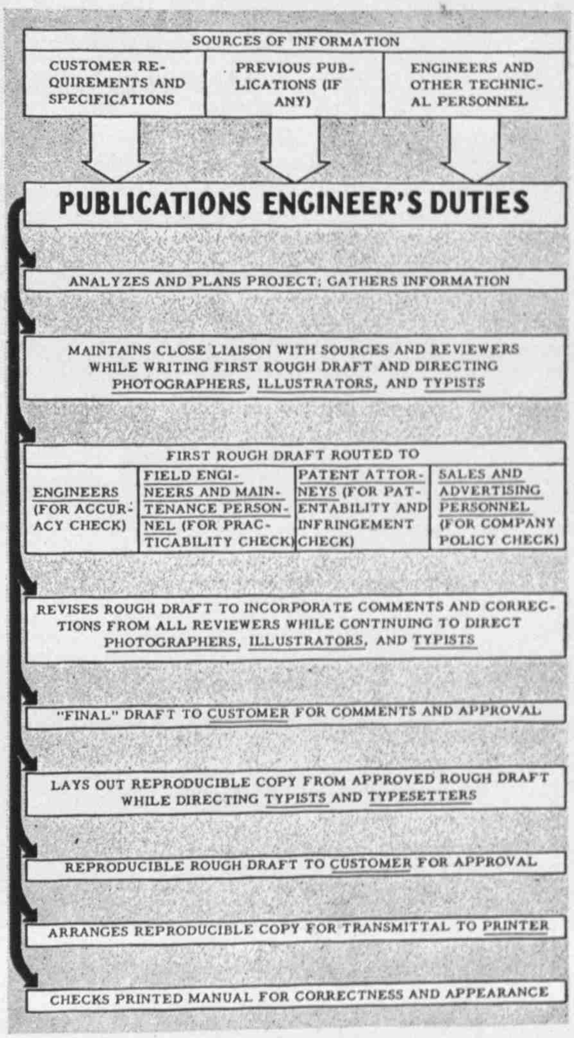


Fig. 3—Publications engineer gains broad knowledge of product: its engineering, manufacture, and application. Persons with whom he consults directly are underscored in this diagram of manual's life cycle.

to be gathered on any one product or system (Fig. 2). Some of the assignments require the publications engineer to work intimately with the equipment; in some cases he completely disassembles and reassembles the units. In other cases, he accompanies the equipment on trial runs or field tests. These experiences give a "practical" satisfaction to those who like to feel that they are not just "theoretical" writers.

Another attractive feature of the publications engineer's work lies in the variety of contacts which he makes in the course of the development and approval of a publication. A typical life story of an instruction book prepared for the Armed Services (Fig. 3), gives an indication of the many individuals concerned in the preparation or approval of the publication prior to its final printing; the publications engineer works constantly with all of those shown.

(Continued on Page 44)

ENGINEERING'S MIGHTY MIDGET

By D. D. McGRADY
Metallurgical Engineering Department

A thermocouple is constructed of two unlike metals joined together in a circuit such as shown schematically in Fig. 1. A very small direct-current voltage is produced when the measuring junction (or hot junction) is at a different temperature from the reference junction (or cold junction).

The amount of the voltage that is developed by a thermocouple is small and depends upon the metals used and upon the difference in temperature from hot to cold junction. At most a maximum of about 0.05 volt (50 millivolts) is obtained at 2200°F.

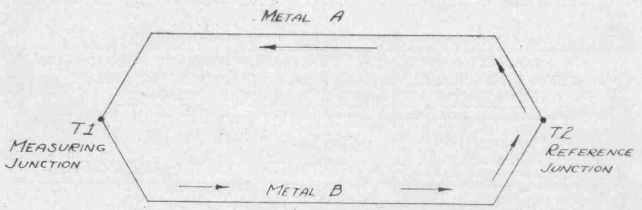


Fig. 1—Simple Thermocouple Circuit.

A tabulation of the four most commonly used types of thermocouples follows:

A. Base Metal Thermocouples.
  1. Copper-Constantan. (Type T)
  2. Iron-Constantan. (Type J)
  3. Chromel-Alumel. (Type K)

B. Noble Metal Thermocouples.
  1. Platinum-Rhodium 10%, Platinum 90%. (Type S)

The temperature-voltage relationship of these thermocouples is shown in Fig. 2, from which it is seen that the voltage increases rather uniformly with the measured temperature. The curves in Fig. 2 are drawn on the basis of the cold junction remaining constant at 32° F.

Table I shows the composition and properties of thermocouples, together with their recommended useful temperature range and approximate limit of error.

A satisfactory thermocouple must meet certain general qualifications, namely:

1. The metals must reasonably resist oxidation, reduction, and corrosion at higher temperatures.

2. As large a voltage (e.m.f.) as possible should be produced by a unit temperature change.

3. The temperature-voltage relationship should follow a straight line over the useful range of temperature.

(Continued on Page 48)

TABLE I

Composition and Properties of Thermocouples

Type	Alloy Composition	Polarity	Range, °F.	Standard Error	Identification
Copper	pure	plus	-300 to 700	±1%	
Constantan	40% nickel	minus			
	60% copper				
Iron	pure	plus	0-1400	±¾%	magnetic
Constantan	40% nickel				
	60% copper	minus			nonmagnetic
Chromel	90% nickel				
	10% chromium	plus	0-2300	±¾%	nonmagnetic
Alumel	94% nickel	minus			slightly magnetic
	3% manganese				
	2% aluminum				
	1% silicon				
Platinum	pure	minus	0-2700	±½%	very soft
Platinum-Rhodium	10% rhodium	plus			
	90% platinum				

Push-Buttoning Bossy

By WILLIAM H. FRIDAY
Agricultural Engineer '53

One does not have to go far back into history to find the beginning of farm mechanization. The late 19th century saw the dawn of a new era of farming, but the farmers were slow in adopting the new inventions and ideas. In fact the real mechanization of farming did not start until World War II when the American farmer was presented the greatest challenge he had ever faced. Increased production requirements were coupled with a man power shortage. This stimulated the application of engineering principles to the farming industry, and though mechanization is not complete a man hour today is twice as productive as in the nineteen twenties.

But where did this mechanization occur on the farm? The development of combines, hay balers, field choppers, and other machines of this type have been the major noticeable equipment, for field operations seemed to be the bottleneck on many farms. However, this has tended to shift peak labor loads to the buildings where a dairy farmer spends approximately 50 per cent of his time. And better than three fourths of this time is spent with the actual dairy chores. Smaller and less noticeable strides have been made in saving labor in the barns, but the trend toward systematic operation is on the upswing.

One of the greatest labor saving mechanisms for the barn, the milking machine, which was invented in the late 19th century, is still undergoing face lifting. Today new methods applied to milking machines are making them more than just a means of extracting milk; they are also transporting it to the milk can. New pipe line systems which send the milk directly from the machines to the milk house remove the walking from milking and create greater barn efficiency. These systems are easily adapted to the milking parlors or the stanchion type barn, and this pipe line application can save about one third of milking time. The engineering adaptations involved have not changed the original principle of alternating suction but have increased the size of the vacuum line to give the desired results. Further engineering challenges in this field are chemical in nature because they involve finding solutions that will keep the vacuum line in a sanitary condition without tearing the pipes down daily, thus increasing efficiency as extra labor time would not be needed for cleaning.

Milking is not the only phase of barn work that mechanization has affected, for labor saving experts scrutinized the feeding of animals and realized that considerable labor could be saved through the use of carts and grain bins. The major engineering development in this area is the silo unloader. The silo unloader has a radial beam with scrapers that collect silage and take it to the center of the silo where it is picked up by motor driven, air, or mechanical conveyor and delivered to the silo shoot. This saves not only considerable time in handling the silage but also conserves much energy. On some of the latest unloaders disks have replaced scrapers, and the results are better with grass silage.

Still one of the biggest jobs around the barn is cleaning. The manual removal of manure requires about 10 per cent of the farmer's time. The labor saving device for mechanical cleaning of barns depends upon what type of barn is used. An application of hydraulic cylinders was used in the creation of the front end manure loader which was a great stimulus toward loose housing stabling, releasing the potentialities of the labor saving Penn-type barn.

In answer to the request for a mechanical device to remove manure from the stanchion type barn, the mechanical gutter cleaner was developed. Four types manufactured today are: the continuous chain; the reciprocating; the chain pull-out, and the belt pull-out. Usage of the gutter cleaner saves untold amounts of time, but the acceptance of the machine was relatively slow until farmers began thinking about saving their backs as well as money. Research has proved that both time and energy are saved resulting in capital gains for the farming enterprise. An indication of the amount of time saved is noted in that less than one fourth of the former cleaning time is needed with the gutter cleaners.

The future of the barn cleaner rests with the engineer. As Kenneth L. Turk of Cornell University has stated, "The equipment we have needs improved engineering, but the principles of barn cleaners is sound, and there is a real need for them."

Agriculture borrowed an important labor saver from industry when it applied the use of mechanical conveyors to farm units. As in industry these conveyors are used to shift the location of materials. Grains and hays can be moved into storage and transferred to other locations as needed with a minimum of labor and handling.

Speaking of borrowing, even the housewife's vacuum cleaner has been borrowed and applied in principle to the grooming of cows. Because the farming industry as a whole is behind in the mechanization that many other industries have utilized, any device that can be reapplied to agriculture is readily acceptable to agricultural engineers and far sighted dairymen.

Probably the nation is past the midway mark in its farm power revolution, exclusive of possibilities related to atomic energy, but continued invention of useful machines and farm implements and increased electrification should give further impetus to mechanization. The trends in labor saving machinery for dairy barn application is not entirely toward the invention of new machinery, for much of the research is aimed at improving present machines. Time and motion studies are being made on farms to group several operations in one, and the results of these experiments will mean that there will be further development of machinery doing a variety of tasks in one unit. Although it will never be entirely possible to push-button dairy stable operations due to inconsistencies of the living creatures involved, agricultural engineers today are working diligently to approach the maximum dairy enterprise efficiency.

Where Do I Fit?

By ROBERT G. KITCHEN

Spartan Engineer Editor

Where do I fit?

How many times have you, as an engineering student asked yourself this question? How many different answers have you come up with?

Unless you are the exception to the rule, the times have been many and the answers have varied considerably.

Let's start at the bottom and work our way up.

When you were in high school, your marks in math, chemistry, and physics were very good. You either saw your counselor or figured in your own mind that engineering was your field. So you decided to go to college.

In your first two years you studied English, history, and other basic courses. You began to wonder if you were ever going to have a real engineering course.

Then in your junior year they gave you many of the courses that you were beginning to wonder if you were ever going to receive.

Now you are a senior and wondering where you are going to fit in the machinery of America or what ever your home country is.

First of all get the idea out of your head that you are better than the man that did not go to college but has four or five years experience in the field. In the beginning he is much your superior. You have to accomplish something before you are better than he is.

Put it this way. When you graduate, you have in your possession many shiny tools. You can use these tools and through their use become apt in handling them. On the other hand you may not use them and they will rust. You have put too much time and effort into acquiring them, don't let them go to waste.

One of the best ways to start out is to take the first part of the registration examination. This part of the examination is the same for all the fields of engineering and consists of problems. These problems are from all the different fields and it will make it easier if you take it while these out-lying fields are still fresh in your mind. If you get the passing grade on the first try you are well on your way in your chosen field.

If you have decided upon a particular type of work in your field, try to get a job of that type. Stick with it until you know whether you are satisfied or not. If you find that you are not satisfied, get into another line. You are not helping yourself or your organization if you are not content with the work that you are doing.

If you haven't decided just what you want to do, here are a few suggestions.

Maybe the sales field is what you are looking for. If you have a pleasing personality and what is known as the gift of gab, try it, it was made to order for a man like you.

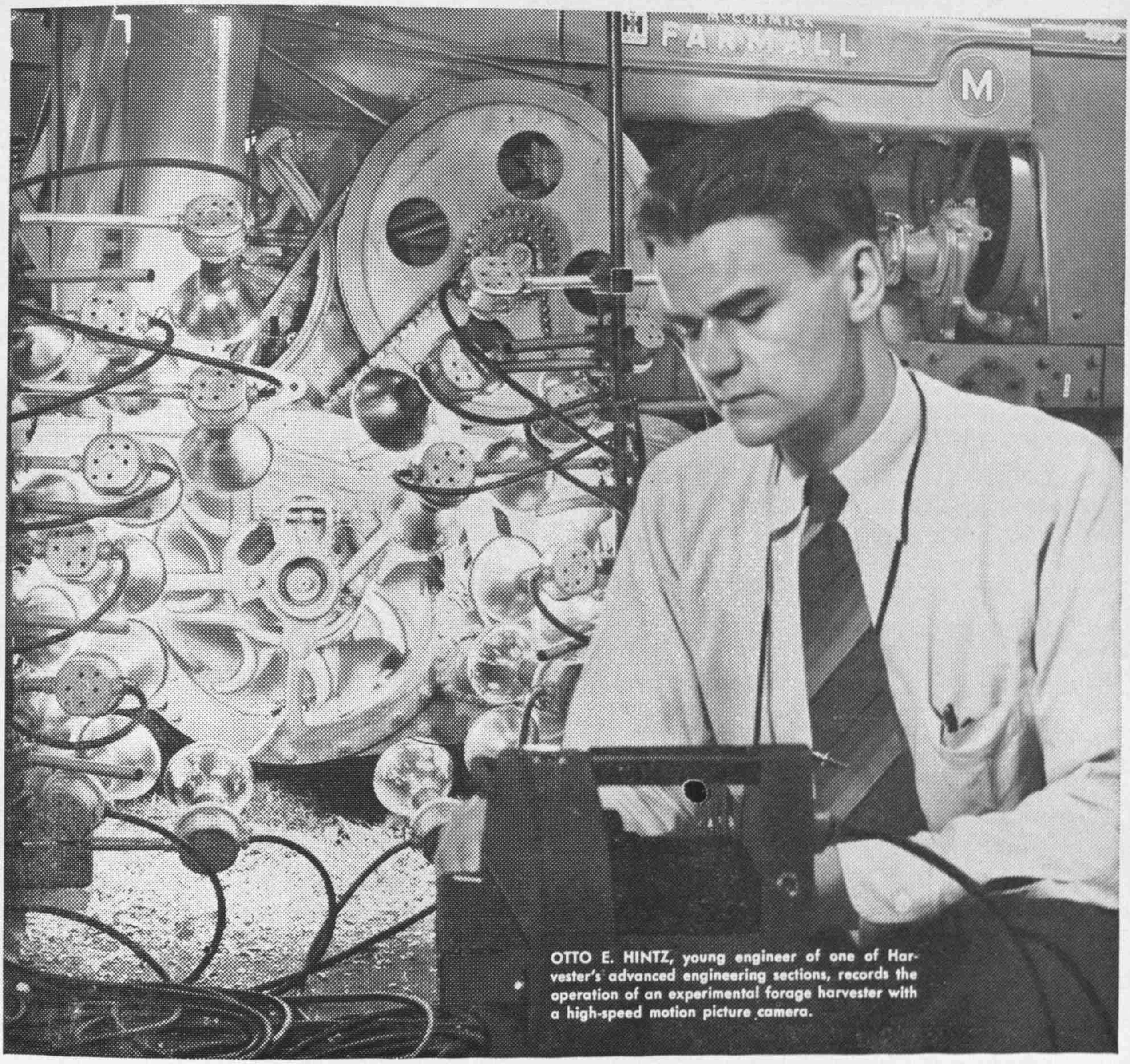
There are sales opportunities in every major engineering field.

Research may be the field you are looking for. There are many openings here, especially in the chemical and metallurgical branches. It is a great chance for the fellow that likes to have the things he does change quite often.

A wide open field for engineers is the technical publications field. There are many journalists around that would like positions of this type but they lack the background necessary for the job. Industry is looking for men that are trained in the various fields to write instruction manuals, work on periodicals, and perform many other writing jobs that can not be done by the common layman.

These are just a few of the many opportunities that await the engineer. If you are still undecided, see one of the instructors that you have had for several of your courses. Talk it over with him, he will probably be of much greater help to you than you can imagine.

What ever you decide to do upon graduation, if you are going to stay in your chosen field, join your professional society. That can be one of your greatest assets.



OTTO E. HINTZ, young engineer of one of Harvester's advanced engineering sections, records the operation of an experimental forage harvester with a high-speed motion picture camera.

The Story of Vanadium

HIT IT AGAIN

By

ROBERT C. OLIVER
JOSEPH G. MYERS
Junior Metallurgical Engineers

Away back in 1911, a customer of a certain foundry ordered some special castings and insisted that **vanadium** steel be used. The foundry, lacking experience with this new-fangled alloy, poured the castings without much faith or enthusiasm.

When the castings were solidified and broken from the molds, a workman went over them using a heavy hammer to knock off the sprues, or projecting points. Usually one or two blows were enough. But not this time! The workman hit once, twice, and again. After 40 blows he called the foreman.

The foreman braced himself and hit squarely with all his strength. Nothing happened. Again the sledge came down, and again. The foreman's face grew red and his arms tired. After 50 blows he dropped the sledge on the floor and stalked over to the superintendent's office.

Courtesy of "Vancorum Review"

View of the Mina Ragra mine showing white porphry dike which cuts the orebody in two in the middle. Vanadium ore pits are shown on each side of the dike.

The superintendent, obviously irritated and annoyed, arrived on the scene and slugged the casting with 150 mighty blows.

The sprues were then sawed off.

Today we know that vanadium is perhaps the most powerful alloying element commonly added to steel—two pounds per ton, or even less, has remarkable effects on the steel's hardness and strength.

In 1906 vanadium was worth five times the value of gold, and it was in January of that year that an American geologist struggled up onto a windswept plateau at the very crest of the Peruvian Andes some 15,400 feet above sea level to discover a bonanza of vanadium ore. Vanadium at that time was the world's rarest metal. The development of Mina Ragra which followed opened the way for revolutionary changes in the properties and applications of cast irons and steels.

Although deposits of Vanadium have been found in Naturita, a small town of 200 tucked away in the southwestern corner of Colorado; Mina Ragra remains the world's largest source of the metal.

The ore taken from this mine has to travel four and one-half miles down a heavy grade. Here at Jamushan on Lake Pun Run are modern plants for the concentration of the ore. The concentrate is loaded into barges and towed six miles across Lake Pun Run to Casa Laguna. Then by railroad it is taken to the seaport of Lima where it is loaded on freighters bound for the ports of Eastern United States. Upon arrival in this country the ore is taken to Bridgeville, Pa., where it is further processed in plants operated by the Vanadium Corporation of America.

Vanadium is usually marketed as ferrovanadium containing 35-45 per cent of the metal. This alloy used in vanadium steels has been a key factor in the development of the modern airplane, automobile and locomotive, and is widely used in the field of high speed and other tool steels and dies. Boasting a melting point of 3119°F, and an even more remarkable specific heat value of 0.1769 cal./gram/°C as a pure metal makes it possible for extreme conditions to be met in connection with resistance to very high temperatures. The ferrovanadium also imparts high resistance to shock and fatigue.

The properties of vanadium alloyed steels amazed the first steelmen to use it. For example: a vanadium steel razor honed only once, was used to shave 605 men in a month and a half; and bars of the same steel have been bent double without cracking. The reason for this toughening effect is seated in the carbide of vanadium, which is the hardest and most stable carbide found in alloy steels. 0.1 to 0.25 per cent vanadium in a car spring will permit it to snap back into shape after being compressed for one year.

Vanadium increases the well known effects on the properties of steel of other alloying elements such as nickel, chromium, manganese, and molybdenum.

This metal's history has no more dramatic contrast than its price. Today ferrovanadium sells for $2.70 to $3.00 per pound of contained vanadium, a decrease of $4,789 from the price of the metal fifty years ago.

Indeed, this metal has helped to modernize many of the industrial achievements that have placed the United States among the leading producers of iron and steel commodities in the world.


USAF

Rare Earth Metals

By

WILLIAM POLLARD
RICHARD LAMBERT
KENNETH HERRICK
Met. E's, '54

Rare earth metals are now only "medium rare"! These rare earth metals, through the new uses developed for them since the second World War, now enjoy a greater abundance and importance than ever before. Before World War II no practical uses had been developed for these metals and, as they were difficult to obtain in their pure state, they seemed destined to remain a sort of scientific curiosity—hence their classification as rare earth metals. Some of these metals were Zirconium, Germanium, Hafnium, Beryllium, Lithium, and Cerium.

The increased demand for new metals and metal alloys, brought on by World War II, sent the research engineer into his laboratory to reinvestigate the few previously known facts about this rare metals group. This intensified investigation showed that these supposedly useless metals had a great many uses indeed. These new uses meant that new and more efficient recovery processes had to be developed to economically obtain these metals in their pure state.

The rare earth metals are not rare in the sense that they constitute a small percentage of the earth's crust. They are quite abundant on the earth. Germanium occurs in the earth's crust in about equal amounts as the common metal zinc. There is as much Zirconium in the earth as there is carbon. The point of importance is that the rarity of these metals arose from processing difficulties and the fact that very few concentrations of the ores of these metals can be found in the earth's crust.

Most of the Germanium and Hafnium is obtained as a by-product of other extraction processes. For example, most of the Germanium is obtained as a by-product of the Zinc extraction process. The Zinc ore, containing only 0.01 to 0.1 percent Germanium, is roasted to volatilize the Germanium. These vapors are then condensed to bring about the recovery of Germanium. It can be seen that only a very small amount can be recovered by this process. An even smaller amount of Germanium is obtained from its principle ore "Germanite;" but this process is not in general use today. Hafnium is associated with Zirconium in ore, and it is obtained as a by-product of Zirconium recovery.

Zirconium, on the other hand, is recovered from the mineral Zircon ($ZrSiO_4$). Zircon is an accessory mineral in igneous rocks. As is true of Germanite and other minerals containing the rarer metals, Zircon is found in a lot of places in the earth; but not much is found in any one place. Before the war, Zirconium was produced only in the powdered form, but now it can be produced in the ductile form. One of the problems of research engineers was to obtain the metal in the pure form. Only in the pure form can the metal be of any use today. The Atomic Energy Commission made the first request for large quantities of Zirconium and Hafnium from the Foote Mineral Company. In order to supply the new demand in conjunction with the development of atomic energy, new processes had to be developed. Science came through with the new methods that were needed. Although these methods are still very expensive and complicated and need more development, they are meeting the present need fairly well.

Before the intensified research program of World War II, Zirconium existed only in a powdered form. This powdered Zirconium was found to be more fiery and violent than Magnesium and found a use in incendiary bombs. After it was learned how to produce Zirconium in the ductile form, the temper of the metal was changed to a docile one. In this solid form it can be used as a structural material in rockets and aircrafts because of its low weight and high strength. It is used in the chemical industry because it will not corrode under the action of HCl and HNO_3 acids, and in steel making as a purifying agent. It is also used in modern surgery because the metal is not affected by body fluids. Because of its ease of formability, high melting point, low tendency to absorb slow neutrons, and high corrosion resistance, Zirconium finds a key use in atomic energy research. The atomic submarine is now a possibility because of Zirconium.

Metallurgically, Germanium has little use as it is an extremely brittle metal and cannot be used for any structural or tool purposes. With the development of radar and radio in World War II, the need arose for a very good semi-conductor which would be easy to work with. Research showed that Germanium had the desired properties and because Germanium fulfilled these needs so well, it has changed from a curiosity to an important element through its use in the field of electronics. It was found that single crystals of Germanium, the size of a kernel of corn, could replace complicated vacuum tubes. This property of Germanium makes Dick Tracy's wrist watch radio a reality.

Cerium is finding an increasing use as an alloying agent with non-ferrous metals, particularly Magnesium. This is also true of Beryllium, which is now an alloying agent with Copper.

Up to the present time no commercial applications have been developed for Hafnium, except in the atomic energy program, where specific applications have not been revealed. One of the suggested uses of this metal is in the manufacture of electronic tubes.

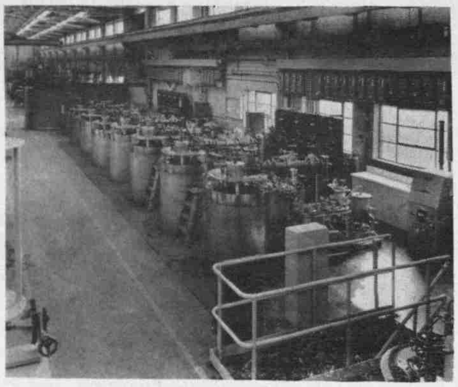
As occurs with the introduction of each new metal, suitable applications appear only after its physical and chemical characteristics have been fully evaluated. With the rapid advancements in the Atomic Energy Program, Jet Engine Development, and Electronics, these metals and others will receive much more research and attention. From each new metal comes problems of mining, extraction, forming, joining, heat treatment and cleaning and finishing. This opens other areas to the Metallurgists and Metallurgical Engineers of the present and future. To be sure, to the solution of the current problems in these fields confronting America, the Metallurgist or Metallurgical Engineer will make a substantial contribution.

Zirconium A Vital Material

Reprinted by permission of Westinghouse Electric Corporation

Scientists of the Westinghouse Electric Corporation have revealed how zirconium — a long-known but little-used metal — has been brought into mass production: how now it is linked with uranium in importance as a material for construction of a submarine "nuclear reactor."

When Westinghouse atomic scientists tackled the assignment of building the first submarine reactor, there was not enough usable zirconium to do the job. Then the Atomic Energy Commission gave Westinghouse the green light to undertake mass production on its own. The story of how the bottleneck was broken and high quality zirconium produced by the ton in time to meet the need, wrote another chapter in the book of atomic-age engineering accomplishment.



ZIRCONIUM PRODUCTION AISLE—These large tanks are furnaces in which the zirconium deposition process was begun at the Westinghouse Atomic Power Division. The tanks were evacuated, then heated, to begin the chemical reaction which ultimately resulted in production of zirconium "crystal bars" 99.9 per cent pure.

Dr. W. E. Shoupp, director of development for the Westinghouse Atomic Power Division, explains the sudden demand for zirconium this way:

"For water-cooled nuclear reactors — such as the Westinghouse submarine reactor — zirconium is one of the best materials that will work," he said. "Iron, steel, aluminum and the other metals of normal strength and permanence simply won't do at all."

Zirconium metal is lighter than steel. It has remarkable corrosion-resistance, an extremely high melting-point, and is a fine structural metal in that it is quite strong and workable. Most important for its use in a nuclear reactor is the fact that it does not "waste" neutrons — the atomic particles that split uranium atoms and keep the atomic engine "running." Whereas some metals "absorb" these neutrons and thus interfere with atomic fission, zirconium offers no such interference.

"These qualities make zirconium only second perhaps in importance to uranium in the building of the Westinghouse submarine reactor," Dr. Shoupp explained. "The urgency of this work, of course, has concentrated scientific attention on zirconium and the result has been astonishing.

Startling Progress in Three Years

"More progress has been made in the development of zirconium within the last three years than was made during a whole generation in the development of iron and steel."

And why wasn't this long-known but little-used metal brought into mass production long ago?

"Simply because it was extremely difficult to produce in pure form," Dr. Shoupp explained. "When none of the common metals met the requirements the hunt was on for something better."

The search led to the sandy beaches of Florida on the East Coast and Oregon on the West Coast. Zirconium ore is found in the sands that wash ashore, not only in these two states but in many locations throughout the world. In one fortunate respect, zirconium is much more plentiful than uranium.

The problem, since zirconium first was discovered in 1789, has been how to produce the metal in pure form, free from many impurities with which it combines in nature. Several different processes were developed many years ago, but only to a point where small quantities of pure zirconium could be produced—and these at a high cost.

The program to make zirconium a cheap, safe material for atomic energy work really began in 1948. At that time Capt. H. G. Rickover threw Navy support behind the process development work then being carried out by the Bureau of Mines in Albany, Oregon as he was looking forward to the days when the Navy would require zirconium for nuclear power plants on ships. About this same time, the Atomic Energy Commission developed an interest in the metal and many of the AEC laboratories and contractors began studying and working with zirconium in earnest.

Supply Urgently Needed

When the requirements for the Westinghouse submarine reactor became evident, it was apparent that pieces of zirconium the thickness of a lead pencil and costing $250 a pound were not going to be sufficient. So it became necessary in July, 1950, for Westinghouse to step into the zirconium processing business.

With its scientists — headed by Dr. Z. M. Shapiro and Alexander Squire — frequently working more than 15 hours a day and usually seven days a week, a Westinghouse zirconium refining plant was set up, staffed and in full production within 14 weeks. In that period production of pure zirconium "crystal bar" was boosted from several hundred pounds per month to thousands of pounds per month.

"We were able, through these efforts, to produce a zirconium metal of superior quality without which successful completion of our submarine reactor project was deemed impossible," Dr. Shoupp declared. "Equally important, was the fact that we also were able to produce sufficient quantity of the metal to do the job.

"We achieved quantity production of zirconium that is 99.9 percent pure. Purity with respect to certain elements is the key to zirconium's resistance to corrosion and to the ductility of the metal."

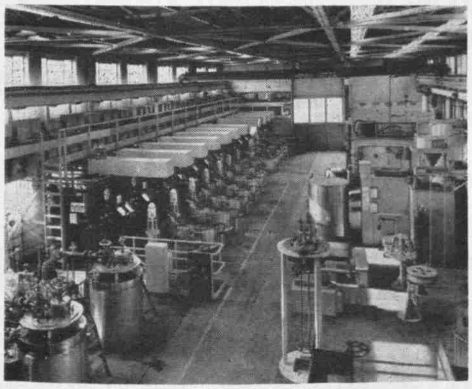
Nothing was overlooked or left untried in the race to achieve high-quality, volume production of the vital metal, Dr. Shoupp related. At one step of the process, the scientists were momentarily stumped. The stickler: to achieve a positive, air-tight seal for various large metal caps and valves which operated at very high temperatures and had to be removed frequently.

"Several important steps in the process took place in large metal evacuated tanks," Dr. Shoupp said. No ordinary gasket that would stand up under extreme operating conditions could be used to seal off the caps and valves at the top of these tanks. So the material finally selected for use as gaskets was pure gold.

"Pure gold," Dr. Shoupp explained, "was the cheapest, satisfactory material we could find. It is soft enough to make a perfect seal and stands up well under heat and corrosive conditions."

Unlike other possible materials, strands of gold wire were cheap for this purpose because they could be reprocessed after being used once, and again drawn into wire. Although costing $35 an ounce at the start, the gold could be used over and over again.

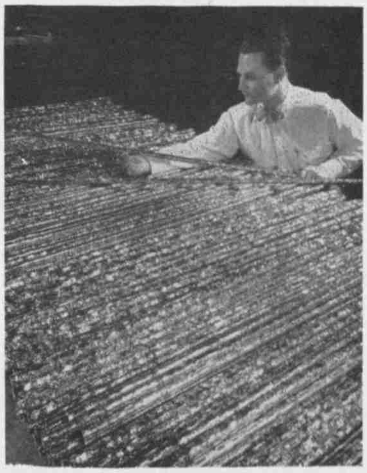
Westinghouse scientists devoted considerable time to the problem of making zirconium a corrosion-resistant, as well as a cheap material for atomic power plant use. They explain that it is indeed a paradoxical metal: If handled properly it is a strong, stable and corrosion-



14-WEEK JOB—To meet the urgent need for pure zirconium in quantity, this Westinghouse zirconium production aisle was designed, equipped and put in operation within 14 weeks. The sunken tanks at the far end of the aisle to the left are where the zirconium crystal bars were "grown" by deposit of pure zirconium on hairpin-shaped zirconium wire "filaments." At right foreground can be seen the "insides" of a deposition tank with the zirconium wire strung from top to bottom.

resistant material; but if handled improperly, it is brittle, unworkable and corrodible. In some forms it may also be inflammable.

If chips from zirconium being machined ignite, water will not put out the fire. The hot zirconium combines with the oxygen from the water to cause the zirconium to burn even more vigorously. In addition, hydrogen is liberated which also burns or may even explode in air. Strangely enough, however, one reason pure zirconium is used in nuclear reactors is because of its great resistance to water even at the high temperatures involved.



PURE ZIRCONIUM BY THE TON—Westinghouse engineer Alexander Squire examines a stock of zirconium crystal bar produced at the firm's Atomic Power Division plant. Slightly lighter than steel and highly resistant to corrosion and heat, the glistening metal plays a key role in the construction of the first atomic power plant for submarine propulsion.

Before the fundamental characteristics of this long-known but little-used metal were established, fires were not infrequent. Westinghouse scientists and engineers did much to bring an end to these exploratory-stage hazards so that zirconium is now a useful metal.

The Westinghouse zirconium production process began with what is called zirconium "sponge" — porous chunks of metal that look like coke. The sponge, produced by the Bureau of Mines at Albany, Oregon, is the result of a six-step reduction process that begins with the zirconium-bearing sands from the ocean beaches. While relatively pure, zirconium sponge still contained impurities which had to be removed before the metal could be used successfully in the first submarine nuclear reactor.

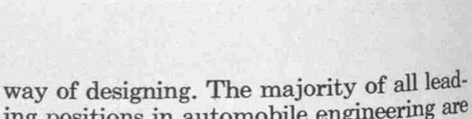
The sponge was loaded into a big tank which also held a container of zirconium tetra-iodide — a combination of zirconium and iodine. The "head" or top cover of the tank from which was suspended a series of four-foot-long hairpin-shaped zirconium wire filaments then was put in place. After the tank had been heated in a salt bath and evacuated, electric current was passed through the zirconium wire. This started a chemical reaction.

The brick-red substance known as zirconium tetra-iodide vaporized and deposited pure zirconium on the hot wire filaments. The freed iodine then migrated back to the remaining sponge material and the cycle began once again until a considerable thickness of zirconium was deposited on the wire "hairpin." When the hairpin was finally removed, it was an irregular, hexagonal bar of super-pure zirconium that shone like silver.

These four-foot-long "crystal bars" were rolled, then chopped into small pieces and melted down into ingots. The ingots themselves eventually were forged and rolled.

Today, the value and safety of zirconium are proven and the complicated processes for making it are well

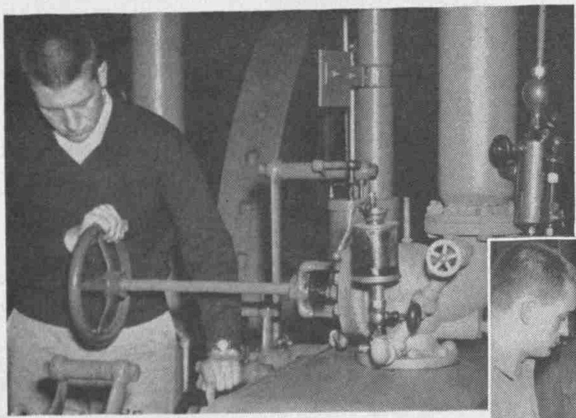
(Continued on Page 40)



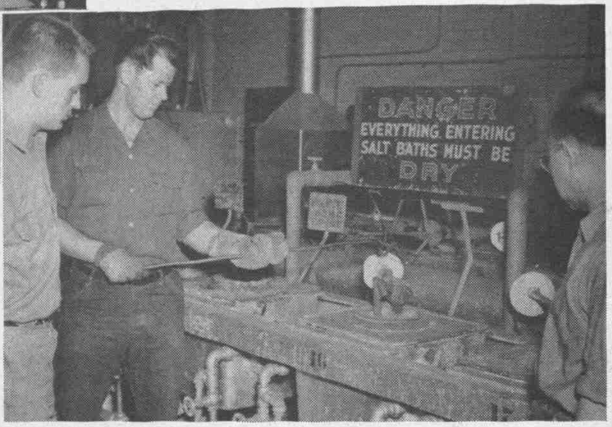
Pontiac's huge, new engineering building is one of the industry's most modern with every conceivable facility for designing better and better Pontiacs.

Basic research and engineering advances make RCA Victor's 1953 TV receivers the finest you can buy.

Action Shots Of



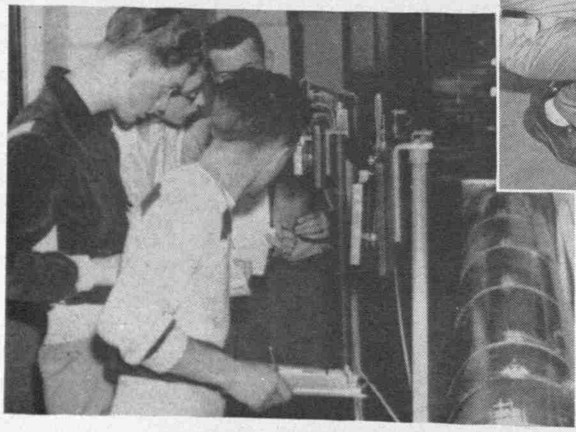
M. E. Power Lab



Heat Treatment Lab

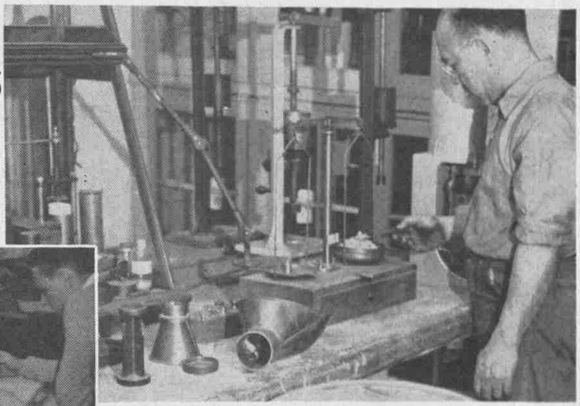
Photos by

Foundry Lab

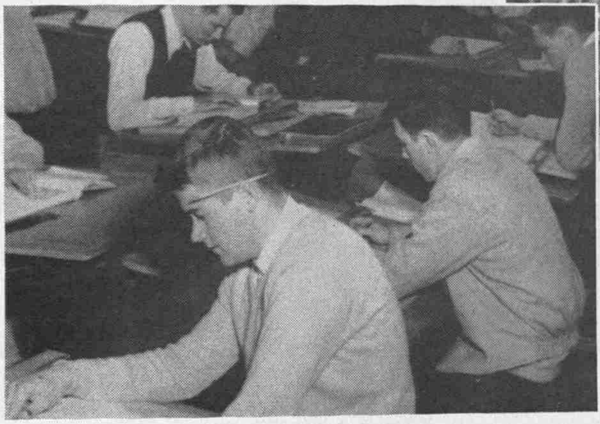


Air Flow Testing

Engineering Laboratories

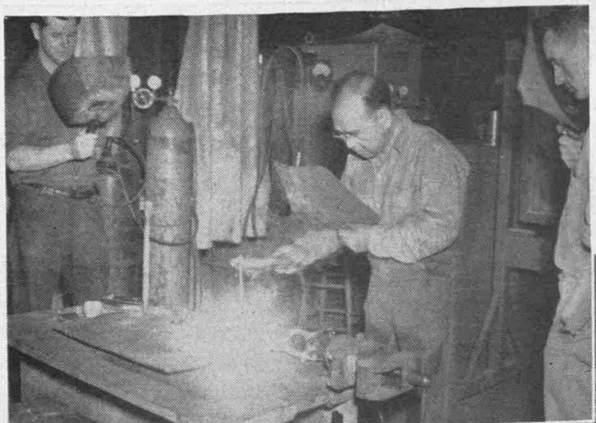


Sand Testing Lab



Engineering Drawing Lab

Ray Steinbach



Welding Lab

Machine Shop

Inferno Tamers

By VAN W. BURMEISTER
Metallurgical Engineer '54

Without refractories, with their ability to tame fire and render high temperatures usable for the benefit of mankind, there would be no light, heat, or power, no metals, no transportation, no manufacturing as we know it today. Although refractories lack the surface glamour that characterizes the very industries they serve, they wield a tremendous influence on the entire economy of the world. Every processed material of modern civilization—oil, glass, chemicals, iron, copper, aluminum, steel—requires the use of refractories. The unheralded refractories industry has contributed immeasurably to vast industrial progress, so much so, that it probably ranks second to agriculture in basic necessity.

Ancient Egyptian artisans developed the art of molding bricks long before 3,000 B.C. when the oldest known pyramid was erected near Cairo of sun-dried clay brick. Burned silica brick were used as early as 500 B.C.

The birth of the refractories industry was signaled about the middle of the eighteenth century when fire-brick were made in England by common brickmaking methods, and of special fire-clays then available.

Today refractories are essentially heat-resistant clay and mineral products used primarily as lining for furnaces that heat or melt materials at temperatures ranging up to 3,100°F and above. The metallurgical industries, particularly the steel industry, is the largest user of refractories.

Approximately 3,000,000 refractory bricks are used in a blast furnace with its stoves and piping, around 3,500,000 in a battery of coke ovens, and 1,000,000 in an open hearth furnace. The price of these high grade bricks ranges presently from $2.00 to $5.00 apiece and the way they stand up under heat, steel men consider them well worth it. Using poor bricks at a cheaper price would present the time-consuming work of replacing them often and thus slow down production. The making of substances that stand up under fire is a complex and difficult science. Heat and chemical reaction will eventually wear any substance away. Still, refractory men are continually improving their products and many of the important advances in the steel industry have come as the result of tougher and more durable refractories.

In one blast furnace a refractory lining has lasted through 15 years of almost continuous operation involving heat of some 3,000°F without repair. Refractory bricks not only have to be made to withstand high temperatures without softening, but they must also resist chemical actions. This calls for a very complex brick. The chemical action of molten slag and steel could dissolve some substances as if they were a cube of sugar.

Refractories are classified as to what they are used for. Silica and fire-clay resist acids. Basic refractories are used primarily because of their resistance to the alkalies of steel slags and their resistance to intense heat. Fireclay, silica, chrome, and magnesite are the most widely used refractories in the steel industry. Most refractory products are produced in brick form—in a myriad of shapes and sizes.

There's a definite art to making a really compact brick. After the particles of raw material are crushed they are passed over screens of progressively smaller mesh in order to sort them into various sizes. Certain amounts of each size are all put in together and mixed up. Then the mixture is fed into molds and pressed into bricks. If the bricks are basic they may have only a chemical bond holding them together. Most bricks are fired in kilns before delivery.

Not long ago the piers of bricks between the doors at the front of an open hearth furnace lasted through as few as 25 heats of steels. Now modern piers in an open hearth furnace last as many as 150 heats. These advances are due to the use of modern science in making and testing bricks. With new equipment, new methods, and new men the refractories industry will continue to improve its product thus providing longer furnace life and more economical production for the industrial infernos of America.

I once had a classmate named Jessar
Whose knowledge grew lesser and lesser.
It at last grew so small
He knew nothing at all
And now he's a Thermo professor.

★ ★ ★

A drunk opened the doors and fell to the bottom of the elevator shaft. Staggering to his feet and brushing himself off he indignantly muttered, "I said up."

It took a lot of engineering to make a better "grasshopper"

Engineers at Western Electric's St. Paul Shops are well pleased with their new-style "grasshopper" fuse—a small fuse used in Bell telephone central office equipment. The former model—in production for years—had been gradually refined 'til it seemed almost beyond further improvement. It was simple, inexpensive, efficient, came off the line fast. But . . .

It's an old Western Electric engineering custom to keep trying to make Bell telephone equipment still better, at still lower cost. The "grasshopper" was studied by a young engineer out of the University of Minnesota, Class of '40, who joined the Company in 1946. His studies indicated the most effective way to improve efficiency and cut costs further was to change the design.

Pursuing this lead the engineer and his group saw their opportunity to make an important contribution. They investigated the latest tooling techniques, new metals, finishing materials and methods, all of which are constantly under study by engineers at Western Electric plants. A simplified design, which permitted the use of the most modern tooling methods, resulted in a better fuse at lower cost that is saving thousands of dollars a year for Bell telephone companies.

There's an endless stream of such challenging assignments at Western Electric. Engineers of varied skills—mechanical, electrical, civil, chemical, metallurgical—find real satisfaction in working together on the important job of providing equipment for the best telephone service on earth.

How the grasshopper fuse works

Small fuses like this are used by the millions to protect certain telephone central office circuits against current overloads. Odd in appearance, the fuse is called the "grasshopper" because of its spring which is released when the fuse blows, displaying an indicator "flag" in open view and tripping an alarm so the trouble can be spotted and corrected at once.

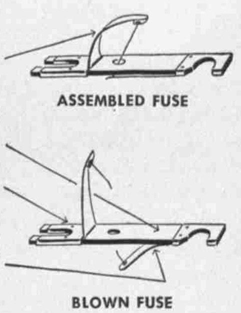
NEW DESIGN

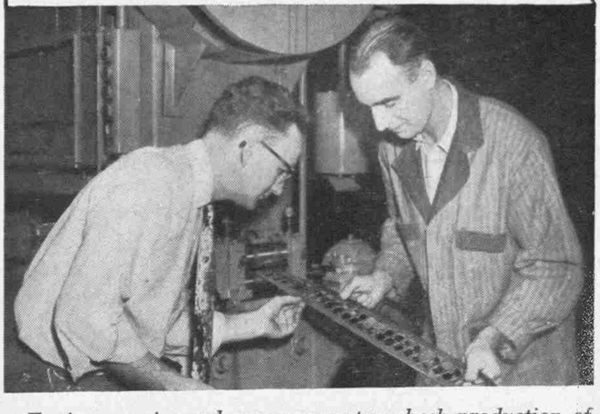
ONE-PIECE FORMED SPRING WITH INDICATING FLAG—MADE BY STANDARD PUNCH PRESS METHODS.

FIBRE STRIP SPRAYED WITH COLORED LACQUER FOR CODE IDENTIFICATION.

INDICATOR SPRING HELD BY AND STAKED TO FLAT TERMINAL—SOLDERING ELIMINATED.

PRE-FORMED RADIAL BEND IS NOT VULNERABLE TO DEFORMATION BY IMPROPER HANDLING—NO ADJUSTMENT FOR TENSION NECESSARY.





• *Engineer and punch press operator check production of parts for newly designed grasshopper fuse.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

New Developments
News of What's New in Industry

Edited by

RALPH POWELL, E.E. '55

THE NEW SOUND, INAUDIBLE

A new industrial sound that can't be heard is making industry sit up and take notice. High-powered ultrasonics, or inaudible sound waves, is offering the best means yet devised for industrial cleaning of small parts.

By directing the high-pitched sound waves through a liquid solvent into tiny corners and crevices of small machine-parts, the cleaning action of the solvent is more effective in removing dirt, grease, lapping compound, and metal particles than any other method.

The compactness of ultrasonic cleaning equipment, in addition to its more effective and faster cleaning also offers a great saving in industrial floor space.

The new cleaning method is not limited to small parts, such as watch parts, electric shaver heads and parts for airplane instruments. The only remaining question is how far the method can be extended to include different kinds of parts, and how large a proportion of the total metal-cleaning business can be profitably handled with ultrasonics.

★ ★ ★

NEW SYNCHRONOUS CONDENSER FOR EDISON

A new 60,000/72,000-kva synchronous condenser is a 13,800-volt, 600 rpm, totally-enclosed hydrogen cooled unit with an overhung exciter on the main shaft and an indoor buck boost Rototrol m-g set to regulate the voltage on the machine. The condenser was supplied with hydrogen control equipment, surface-type coolers for 30 degrees C. cooling water, and two oil-ring lubricated water-cooled bearings.

★ ★ ★

WORLD'S LARGEST AUTOTRANSFORMER NOW HELPING TO SUPPLY POWER FOR ATOMIC ENERGY PROJECT

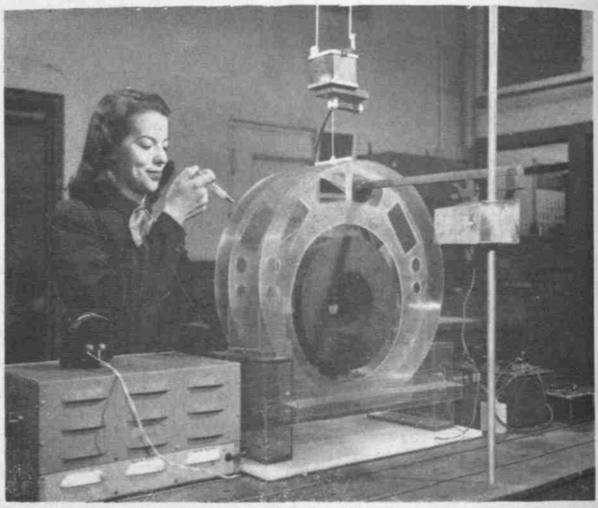
A 156,000-kva, three-phase, 60-cycle autotransformer, believed to be the largest operating unit of its kind in the world, is now at its West Frankfort, Illinois, site where it is helping to supply power for an atomic energy project near Paducah, Ky.

The autotransformer weighs more than 200 tons and measures more than 30 feet long, 17 feet wide and 22 feet high.

It was shipped upright in its own one-piece tank on a special drop-frame railroad car.

The unit is being used to step up voltage from 138 kv to 230 kv.

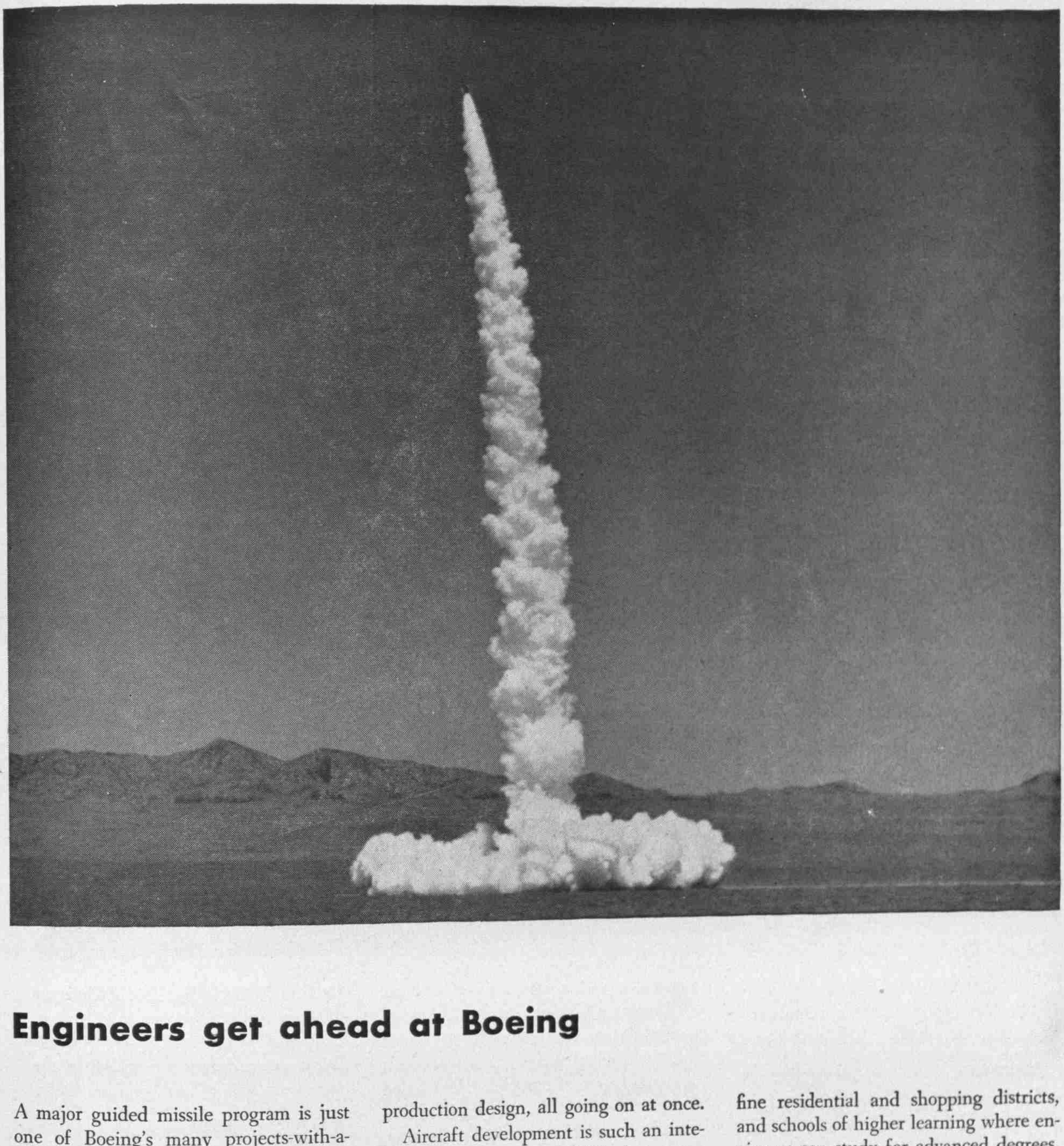
PLASTIC MODEL AIDS VIBRATION ANALYSIS



This young lady demonstrates a new use for the standard medical hypodermic syringe, cementing together parts of a plastic model used for investigating effects of vibration on generators and other large electrical machines before the actual units are built. The "shot" of acetone and plastic cement is injected into holes drilled through both parts to be joined. This novel method helps insure a better job of fixing sections of the model which must withstand vibrations from the electro-magnetic driver shown at the top of the plastic frame of the first picture.

In the second picture she is recording the vibrations of a generator frame model with the aid of a crystal phonograph pickup. In testing, a varied range of vibration frequencies are applied by the electro-magnetic driver.

The method may be used to investigate vibratory effects on any large complex machinery where it is impossible to get such information by mathematical computation. Similar in shape to the actual machine, the models are inexpensive and save costly design changes later.



Engineers get ahead at Boeing

A major guided missile program is just one of Boeing's many projects-with-a-future. Other programs, which offer *you* plenty of room to get ahead in engineering, are America's first-announced jet transport project, research in supersonic flight and nuclear-powered aircraft, and development of the B-47 and B-52 jet bombers, the airplanes that have given Boeing more experience with multi-engine jets than any other company.

No other industry approaches this one in offering young engineers such a wide range of experience, or such breadth of application — from pure research to production design, all going on at once.

Aircraft development is such an integral part of our national life that young graduates can enter it with full expectation of a rewarding, long-term career. Boeing, for instance, is now in its 36th year of operation, and today employs more engineers than at the peak of World War II.

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

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

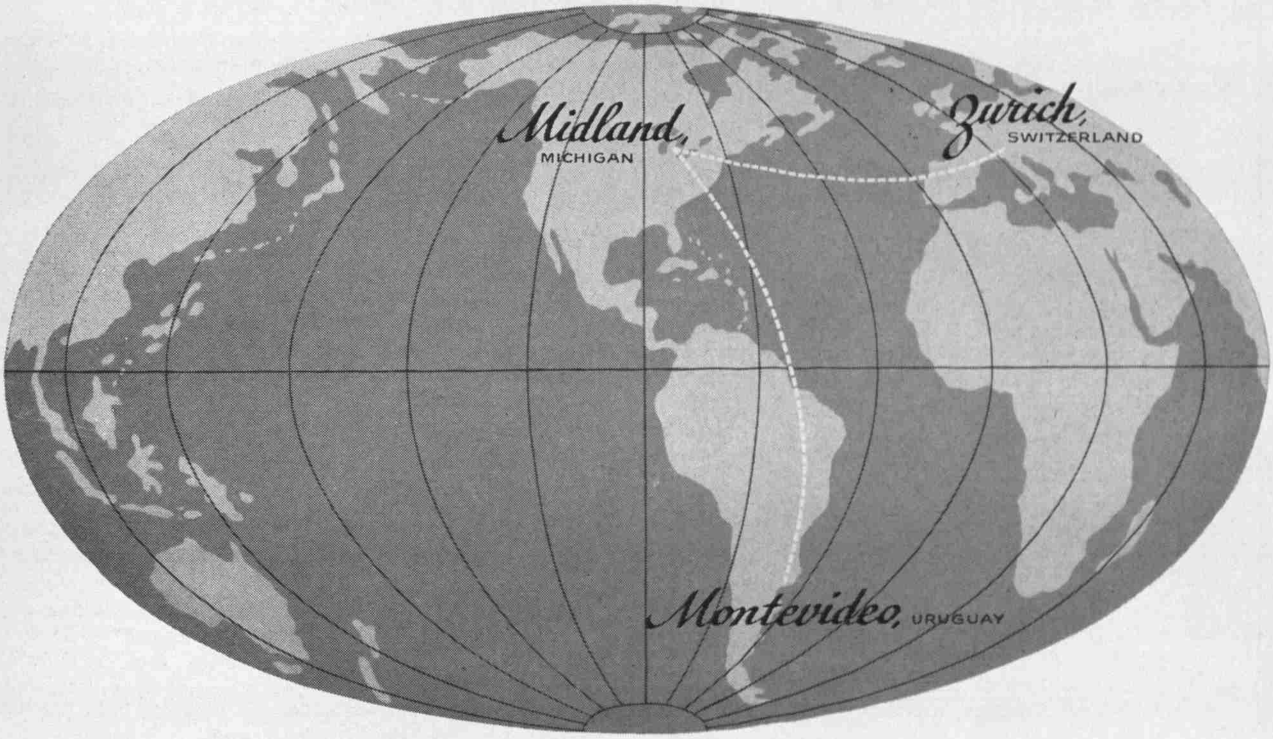
For further information, consult your Placement Office, or write:

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

BOEING

DOW ADDS NEW EXPORT COMPANIES

Dow has recently formed two subsidiary export companies to serve foreign industry's increasing demands for high-quality chemicals.



In the Western Hemisphere, Dow Chemical Inter-American Limited with sales offices in Montevideo, Uruguay will supply chemicals to Mexico and to many countries in Central and South America.

Industries in other continents—Europe, Asia, Africa, and Australia—will be served by Dow Chemical International Limited. Its first sales office will be in Zurich, Switzerland.

These two new export companies are only one example of the continued growth taking place at Dow. Each year finds new Dow plant facilities, increased production, new products developed . . . an over-all growth and expansion that requires a steady influx of men of varying talents, as well as providing excellent opportunities for those within the Dow organization.

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.

you can depend on DOW CHEMICALS

DOW

READ

"Operation Cirrus"

Education in Arabia

"Engineering Research—Cum Laude"

New Developments

These and other features

in the May issue

of the

SPARTAN ENGINEER

Clubs and Societies

ETA KAPPA NU

The Gamma Zeta Chapter of Eta Kappa Nu held its winter term initiation and banquet March 14, 1953.

Initiated into the electrical engineering honorary fraternity along with ten undergraduate students was Edward E. Kinney, of the Building and Utilities Department of Michigan State College.

The ten student initiates were John O. Cheney, John E. Clark, William M. Crampton, David L. Cummins, Leo Jedynak, Lee Mah, Clifford C. Mosher, Howard R. Newcomb, Hugh A. Phillips, and Leslie G. Wolsey.

Speaker for the evening was Mr. Claude E. Erickson of the Board of Water and Light in Lansing.

★ ★ ★

TAU BETA PI

The Michigan State College chapter of Tau Beta Pi elected new officers for 1953-54 at its last meeting, March 12. The men elected were Leo Jedynak, president; Lee Mah, vice-president; David L. Cummins, corresponding secretary; Wayne D. Erickson, recording secretary; Rolland Z. Wheaton, cataloguer, and Delbert R. Elliot, representative to the Engineering Council.

The society has planned to invite outside speakers in to talk on engineering subjects during the spring term.

Angry father: "What do you mean by bringing my daughter home at 3 o'clock in the morning?"

Mild suitor; "Well, sir, I have to be at work at 7."

★ ★ ★

"You down there!" shouted Father from the head of the stairs! "It's two-thirty! Do you think you can stay all night?"

"Er, thank you," said the callow lover, "but I'll have to phone home first."

General Electric's
"HOUSE OF MAGIC"

Bell Telephone's
"SWITCHING CIRCUITS"

at

THE FIFTH ANNUAL MICHIGAN STATE COLLEGE

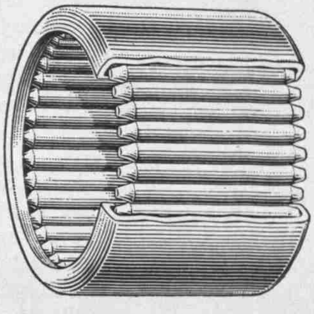
Engineering Exposition

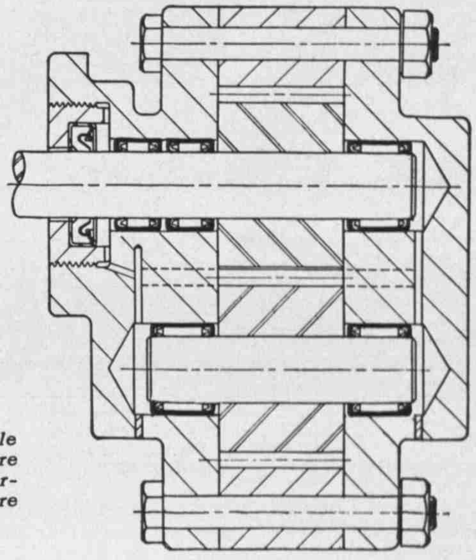
MAY 1

MAY 2

The Torrington Needle Bearing

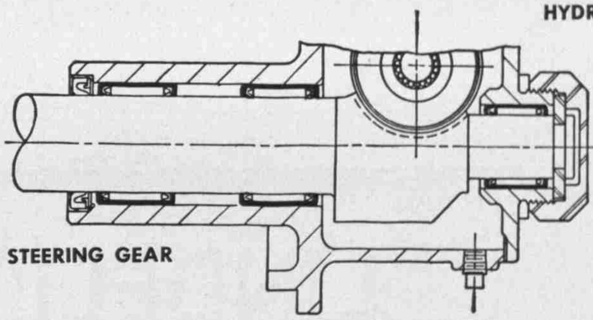
proper housing design is essential to proper performance





HYDRAULIC PUMP

Needle Bearings require simple housings. If the housing bores are held to proper size, accurate operation and high radial capacity are assured.



STEERING GEAR

The Torrington Needle Bearing offers many design and operational advantages for a great variety of products and equipment. For example, a Needle Bearing has greater rated radial load capacity in relation to its outside diameter than any other type of anti-friction bearing. It is extremely light in weight. And it is easy to install and lubricate.

Housing Maintains Bearing Roundness

The housing is an essential part of the Needle Bearing assembly. Care should be taken to provide a straight, round housing bore to the recommended tolerances.

The thin, surface-hardened outer shell of the Needle Bearing acts as the outer race surface as well as a retainer for the rolls. This shell assumes the shape of the housing into which it is pressed. Consequently, the housing bore should be round, and the housing so designed that it will carry the radial load imposed on the bearing without distortion.

Housing Material Determines Bore Size

The specified housing bore dimensions for any given material should be maintained in order to give the proper running clearance between the needle rollers and the shaft, and to assure sufficient press fit to locate the bearing firmly.

When designing housings of materials that are soft or of low tensile strength, allowance should be made for the plastic flow of the material when the bearing is pressed into place. Bore dimensions in such cases should be less than standard. Needle Bearings can be pressed directly into phenolic or rubber compounds, although metal inserts are recommended.

The new Needle Bearing catalog will be sent on request.

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

Zirconium

(Continued from Page 23)

enough known that it no longer is necessary to produce it in laboratories and pilot plants. It no longer need be carried to the "crystal bar" stage. Thanks to the ingenuity and hard work of many scientists and engineers, ways for using the cheaper zirconium sponge have been discovered. Future reactors will be built from zirconium sponge, so operation of the crystal bar plant is no longer necessary.

The AEC recently announced that it had given a five-year order for zirconium sponge to the Carborundum Metals Company at a unit price of less than $15 per pound. Although the quantity of zirconium to be produced is small when compared to the tonnage of iron and aluminium made, the fact that reactor-grade zirconium now is to be produced in industrial plants instead of laboratories, is definite evidence that it has passed the long-known but little-used stage and is now a readily recognized member of the great family of metals available to American industry.

THE

ENGINEERING EXPOSITION

May 1, 1953 May 2, 1953


1958
JULY
1958

Technical Writing

(Continued from Page 13)

Young engineers often raise the question as to the future of technical writing or publications engineering. There are several factors which appear to be of importance in attempting to predict the future—but to the author they all look favorable toward increasing opportunity for this new profession. First, the complexity of equipment and systems certainly will continue to increase—automatic control is the ultimate goal of nearly all future instrumentation, and with such control always comes increased technical complexity. With increasing complexity there is greater need for more complete instructional material. As one associate put it: "The equipment becomes more complex but the intelligence of the average user remains the same." Second, granted that complexity will increase, there is the immediate following condition that the equipment will be much more costly and must be repaired rather than replaced. This adds again to the need for publications which will be adequate for the purpose. The funds allocated for publications will necessarily increase but will still be a very small portion of the total cost of the equipment. Third, if the caliber of engineering graduates coming into publications engineering is maintained or raised, there will be a broadening in the scope of their work since they themselves will develop opportunities for using their special skill to supplement the work of other engineers. This is a very important responsibility in any new profession—to develop and broaden particular skills and to offer them to others. If the publications engineer pursues his new profession with a spirit of genuine service to other engineers, there can be little doubt that the engineering profession will welcome and encourage this newcomer to its ranks.

Conclusion

Publications engineering is a new profession which has grown rapidly in the past few years because of the increasing complexity of equipment and the inability of the research and development engineers to undertake the extensive writing projects which have become necessary.

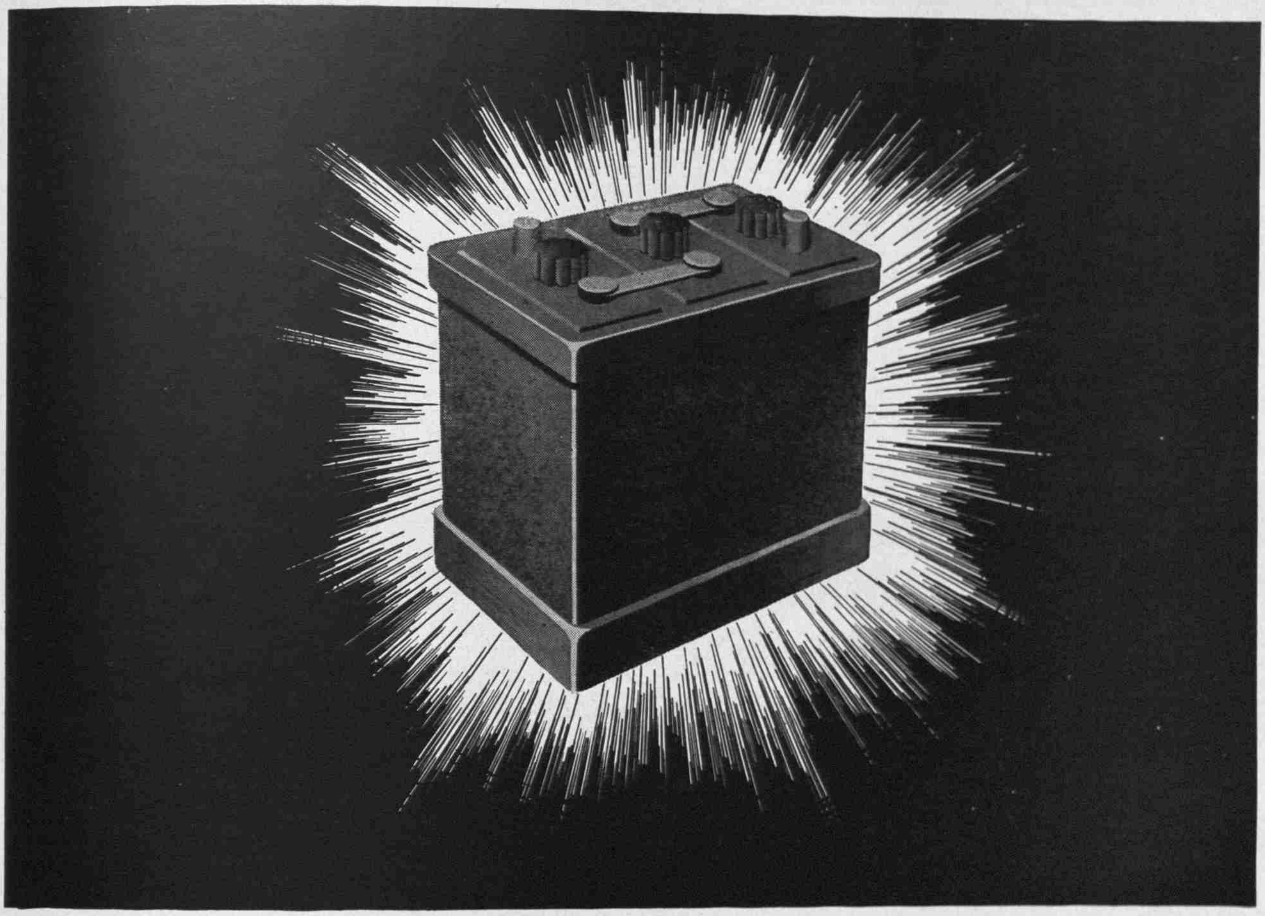
The publications engineer must have a sound engineering education and must possess writing aptitude—although it is pointed out that many young engineers possess this aptitude and may not be conscious of it.

The publications engineer has a thorough knowledge of the reproduction and printing processes, and can guide the publication through all of its various stages from rough draft to its printed form.

The variety of work assignments and the personal contacts appeal greatly to certain engineering graduates. Some of the writing assignments cover theoretical aspects, while others are along practical lines where the writer works closely with the equipment in the factory or in the field.

The personal satisfaction is quite high for the publications engineer since his assignments are usually of short duration, compared to those of the engineer, and he sees the final results of his labors at more frequent intervals.

Finally, the future of this new addition to the engineering profession looks promising because of the trend towards more complex equipment and the accompanying requirements for more complete handbook and engineering report coverage. The future will also depend upon the efforts which publications engineers make to find new areas of service to the engineering profession.



Mighty Midget

(Continued from Page 14)

4. The thermocouple should be reproducible in large numbers so that uniform accuracy is obtained and interchangeability allowed.
5. The cost of the materials should be moderate.

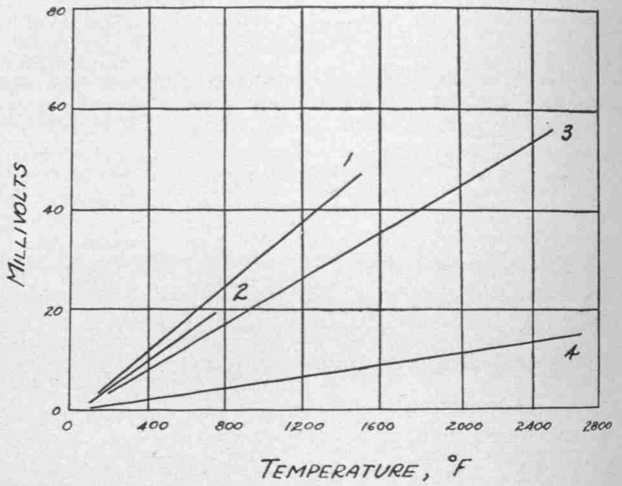


Fig. 2—Voltage-temperature relation for some common thermocouples. Reference Junction at 32 F. (1) Iron-Constantan. (2) Copper-Constantan. (3) Chromel-Alumel. (4) Platinum—Platinum, Rhodium.

The schematic diagram of a thermoelectric pyrometer system, shown on Fig. 3, reveals that the thermocouple pyrometer consists of three essential features—(1) The thermocouple, comprising: two dissimilar metals, electrical insulation, and usually a protecting tube; (2) Lead-wires to connect the thermocouple head and the instrument; and (3) An e.m.f.-measuring instrument such as a millivoltmeter or potentiometer, with provision for controlling or compensating for reference junction temperature.

★ ★ ★

Many industrial manufacturing processes require the accurate control of temperature. Such temperatures may range all the way from refrigeration at -200°F. to the heat treating of new alloys at 2500°F., or higher.

The study of temperature measurement is called Pyrometry, and one of the very useful tools in this field is the usually unseen and unheralded "Mighty Midget" of engineering—the thermocouple.

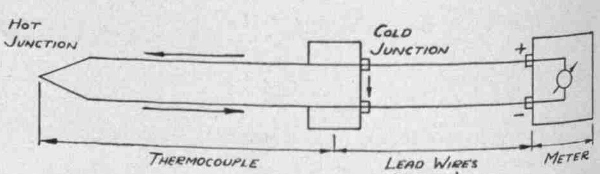


Fig. 3—Schematic diagram of a thermoelectric pyrometer system.

Then there was the case of the young Army doctor in the South Pacific, who had diagnosed the ailment of a sergeant, but knowing he could do little with his limited facilities, he wired the base hospital: "Have a case of beriberi. What shall I do?"

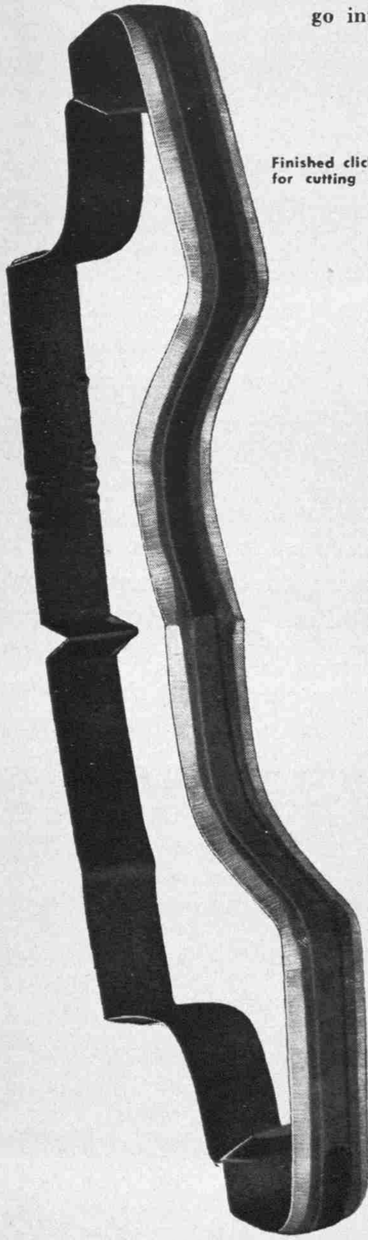
The message was taken by a young technician at the base who wired back: "Give it to the engineers. They'll drink anything."

What's Happening at CRUCIBLE

about clicker die steel

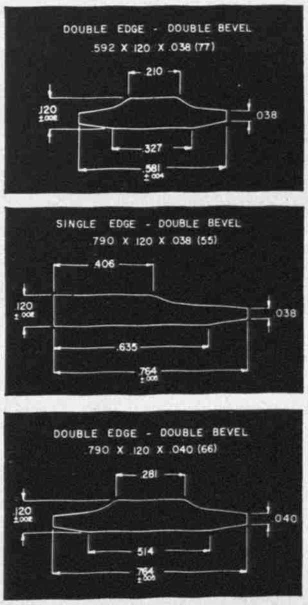
what it is

Clicker die steel is a special cold rolled alloy steel. It is used in making clicker dies for cutting leather, rubber, plastic, felt and fabrics of other compositions that go into the making of shoes and similar products.



Finished clicker die ready for cutting shoe leather.

Some of the clicker die steel standard shapes.



Wider shapes are used when dies are sized by surface grinding after forming and welding. Standard widths are provided when the dies are not to be surface ground.

how it is used

Clicker die steel is furnished to the die maker in either single or double edged form in one of several standard shapes. The die maker first shapes the die by bending the die steel to a pattern that provides the desired configuration, and then welds the two ends at a corner. He finishes the die by grinding a bevel on the outside of the cutting edge and filing the inside edge. Before the finished die is hardened and tempered, the die maker forms identification marks – combinations of circles and squares – in the cutting edge so that the material cut from it may be easily identified as to its size and style.

In the cutting operation, the leather or other material is placed on an oak block in the bed of the clicker machine. Then the die is placed by hand on the material which is cut as the aluminum faced head of the machine presses the die through it. The clicking sound which the head makes as it strikes the die is where the term "clicker machine" derived its name.

what it is composed of

Clicker die steel as produced by the Crucible Steel Company of America is a controlled electric steel in which the combination of carbon and alloy is designed for maximum toughness and proper hardness after heat treatment.

Experience has proved that cold finished clicker die steel is superior to hot rolled material for sizes approximately ¾ inch and narrower because of its lower degree of surface decarburization which permits the use of slightly thinner sections. Cold finished material also has a better surface finish with closer width and thickness tolerances and thinner edges that require less grinding and filing to complete the die.

CRUCIBLE'S engineering service

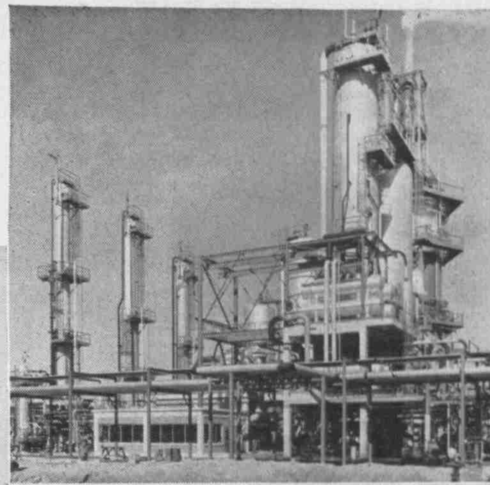
As with clicker die steel, the Crucible Steel Company of America is the leading producer of special purpose steels. If you have a problem in specialty steels, our staff of field metallurgists with over 50 years experience in fine steel making is available to help you solve it. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

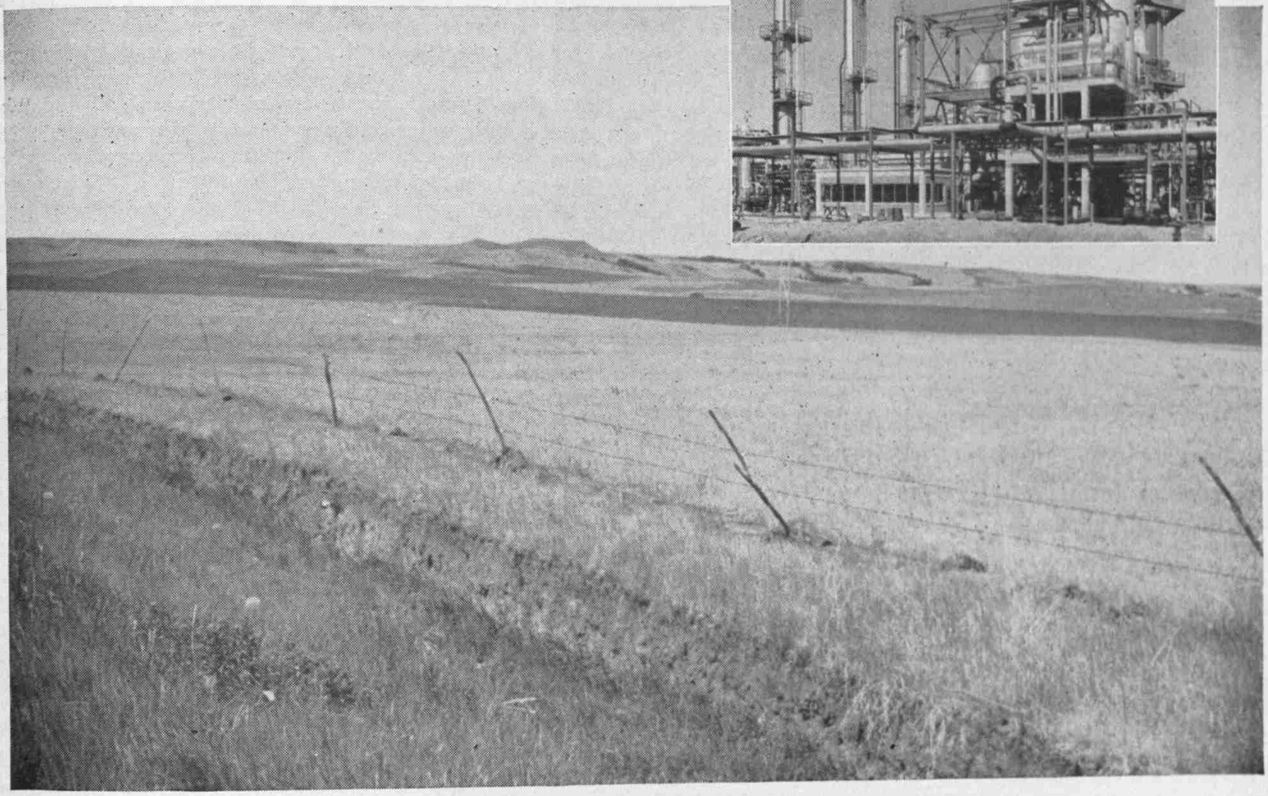
CRUCIBLE first name in special purpose steels

53 *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

ENGINEERS are planning to transform this flat Dakota prairie into what probably will be North Dakota's largest industry. A new Standard Oil refinery, with equipment similar to that shown, is scheduled to be operating at this Mandan site before the end of 1954. Capable of refining 30,000 barrels a day, it will provide the first major outlet for the Williston Basin production.





OIL is making a prairie plant grow!

Before the close of 1954, a new Standard Oil refinery is scheduled to be operating at Mandan, North Dakota.

Behind this lies a story of Standard Oil's willingness to back its scientists' judgment with millions of dollars.

Two years ago oil was discovered in the Williston Basin. How much oil this basin eventually will produce is anybody's guess, but the current rate is only about 10,000 barrels a day. However, geologists, geophysicists and engineers, working in field and laboratory, have estimated that the basin holds a total of two and a half billion barrels.

On the basis of this estimate, Standard Oil has let a contract for the construction of a new refinery at Mandan and a 215-mile products pipeline from Mandan to Moorhead, Minnesota. A crude oil pipeline of 170 miles will be completed by the time the refinery is ready for operation and a pipeline gathering system of about 40 miles already has been built.

Construction activities such as these and the tireless search for oil are jobs that never end in the petroleum industry.

Young technical men at Standard Oil have found that there still are many exciting frontiers to explore with a company that is constantly building, constantly looking to the future.

Standard Oil Company
910 South Michigan Avenue
Chicago 80, Illinois

STANDARD

Geology and Engineering

(Continued from Page 9)

wouldn't expect an engineer to know enough geology to plan the footings for this bridge without expert geological advice but an engineer who has training in general geology should have a better concept of the real problems occurring here, and he should also have more confidence in the geological advice given him.

Actually this bridge will have its footings in a limestone breccia which is firmly cemented in some places but otherwise generally loose. Beneath this breccia is a layer of soft shale. These materials underlie the whole Straits area so it wouldn't make much difference where the bridge is to be located. Another problem, invisible because it is covered with water, is the presence of a comparatively deep valley running through the Straits between Lake Michigan and Lake Huron. This is an old river valley, carved at a time when the lake waters were much lower than they are now. How close to this valley edge can the bridge supports be placed?

Many geologists, however, are prone to theorize beyond the limits of their information. One example of this is the continental drift theory generally accepted by many of the European geologists and some in America. When studying the east and west edges of the Atlantic Ocean, one notes an interesting correspondence of curvature of the east coast of South America and the west edge of Africa. This observation probably started the theory, though some additional evidence is cited in support of it. The belief is that the land masses were all adjacent at one time in the geological past but have gradually drifted apart to their present positions today. A good understanding of the principles of mechanics would make the continental drift theory untenable, but most geologists do not have a sufficient

(Continued on Page 54)

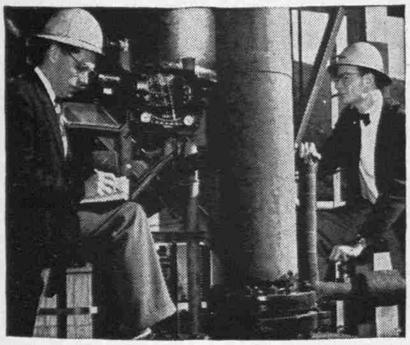
THE DU PONT DIGEST

John Purdom, *B.S. in Ch.E., Ohio State '49, and Kenneth Kehr, North Carolina State '50, discuss diagram of a process for improved recovery of an intermediate for high polymers.*

THE ENGINEER'S PLACE IN

Plant Development

Another phase of Du Pont production activities offers challenging work for the technical man



E. H. Ten Eyck, Jr., *B.S. in Ch.E., Syracuse '43, Ph.D. in Ch.E., Brooklyn Polytech '50, and W. H. Stevens, Jr., B.S. in Ch.E., Yale '50, take recordings on a new nylon unit.*

D. S. Warner, *B.S. in M.E., Purdue '47, and G. R. Prescott, B.S. in Met. E., Columbia '49, discuss improvements for stainless steel liners in tubes carrying corrosive materials.*

In most Du Pont manufacturing plants you'll find two groups of engineers working side by side to make operations more efficient—to reduce costs and improve quality. The specialized work of one group, the production supervisors, has been rather fully discussed in the *Digest*.

Equally vital is the work of development men—the men responsible for advising management when operational changes should be made for economic or technical reasons.

Engineers from several fields of training are employed in development activities at Du Pont. It seems to have a special appeal for the man who can take on a big problem, analyze its parts, and come up with a thoughtful, reasoned solution.

Individual development studies may begin in a number of different ways. Often they are sparked by the imagination of the engineer himself, who, of course, must be familiar with production costs, activities of competition, and recent or impending technical improvements.

Studies also may be inspired by suggestions of production supervisors or sales personnel, obsolescence of equipment, advances in competitive products, or the presence of unsatisfactory profit margins.

In a single study, the engineer may draw data from laboratories, semi-works and plant-scale experiments, prepare an estimate of profits and investments and consult with numerous specialists on various phases of the problem, both within the Company and outside.

Having collected data from these many sources and perhaps from an independent study of his own, the plant development engineer must then assemble and evaluate the material and prepare a recommendation that is based on sound engineering judgment.

Whether a product or process improves from the standpoint of competition, profit and efficiency depends, in great degree, on the quality of its plant development work. The development engineer's job is a responsible one at Du Pont, and the work of a good man is soon noticed.

HAVE YOU seen "Chemical Engineers at Du Pont"? New book describes initial opportunities in many fields, tells how experiences are varied to prepare men for administrative and management positions. For copy, write 2521 Nemours Bldg., Wilmington, Delaware.

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Geology and Engineering

(Continued from Page 52)

engineering background to decide such issues in their own minds.

It seems obvious that civil engineers need some geological background to be better engineers and likewise geologists need some engineering to be better geologists. Actually this fact has been well demonstrated to the writer by a few living examples. The two best practical geologists he has ever known both started out in college in the engineering school. On the other hand, a couple of good mining engineers the author knows were trained as geologists. In each of these instances, the person appears to have his superior ability because of his additional background training.

At this college there is a little liaison between the geological and engineering faculty, in fact, they hardly know each other. This probably arises as a result of the aims and points of view of each which are certainly quite different. The student groups don't see each other much either since the geology majors take only surveying in the engineering school while only an occasional engineering student takes any geology at all. It is hoped that a vigorous course in geological engineering, now being planned, will give each of these student groups additional background training that will almost certainly make them better professional men when they get out into the world.

SIDE TRACKED

Freshman: "I don't know."
Sophomore: "I'm not prepared."
Senior: "I don't believe that I can add anything to what has already been said."

★ ★ ★

Employer: "Are you looking for work, young man?"
Engineering Student: "No, but I would like a job."

★ ★ ★

Engineer in a drug store: "Is your ice cream pure?"
Clerk: "Pure as the girl of your dreams."
Engineer: "Gimme cigarettes."

★ ★ ★

"Shay, Lady, you're the homliest woman I ever saw."
"Well, you're the drunkest man I ever saw."
"I know, lady, but I'll get over it in the morning."

★ ★ ★

Student: "I thought it was very well covered. Everything that wasn't covered during the term was covered on the final."

★ ★ ★

Customer: "Have you a book called 'Man, the Master of Woman'?"
Salesgirl: "The fiction counter is to your left, sir."

★ ★ ★

The poet: "My heart is in the ocean."
His seasick friend: "You've gone me one better."

★ ★ ★

He: "Why do most of the important men on the campus always get the prettiest girls?"
She: "You conceited thing!"

★ ★ ★

Some of the new cars have scarcely enough clearance to pass over a pedestrian.

★ ★ ★

Two glamour girls boarded a crowded bus. One of them whispered to the other, "Watch me embarrass a man and make him give me his seat."

Pushing her way through the standees she bore down on a gentleman who looked substantial and embarrassable.

"My dear Mr. Brown," she gushed, "fancy meeting you here. Am I glad to see you . . . you're getting to be almost a stranger."

The sedate gentleman looked at the girl he had never met before and as he rose he said for all to hear, "Sit down, Bertha, my girl, we don't see you often on wash day. No wonder you're tired. By the way, don't deliver the washing until Wednesday. My wife's going to the district attorney's office to see if she can get your husband out of jail."

★ ★ ★

College man (finishing a letter to a friend): "I'd send you that five I owe you, but I've already sealed the envelope."

Bureaucrat: "If we are unable to figure out a way to spend that two hundred and twenty million dollars, we lose our jobs."
Secretary: "How about a bridge over the Mississippi River lengthwise?"

★ ★ ★

"Sir, I have a question of great importance to ask you—have I your consent to marry your daughter?"
"Do you drink, young man?"
"Thanks, Pop—but let's settle the other thing first."

★ ★ ★

Patient: "I'm in love with you. I don't want to get well."
Nurse: "You won't. The doctor saw you kissing me, and he's in love with me, too."

★ ★ ★

Shortly before the invasion started, a general and his staff were watching a troop-carrying glider go by. From it came a carrier pigeon. Powerful field glasses followed the bird to a nearby coop. A colonel raced over, got the message attached to the bird's leg, bounded back breathlessly, and handed it to the general. The general opened it with trembling hands, read it, cursed, and threw it on the ground. Then he walked away, his face bright purple. The colonel waited a moment, then picked up the message. It read: "I have been sent down for being naughty in my cage."

★ ★ ★

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

★ ★ ★

Getting out a joke column is fun, but it's no picnic.
If we don't print jokes, we are too serious.
If we do print jokes, we are silly.
If we take them from other magazines, we are too lazy to write them ourselves.
If we don't print contributions, we don't appreciate true genius.
If we do print them, the pages are full of junk.
And now, like as not, someone will say we stole this from some other magazine.
We did.