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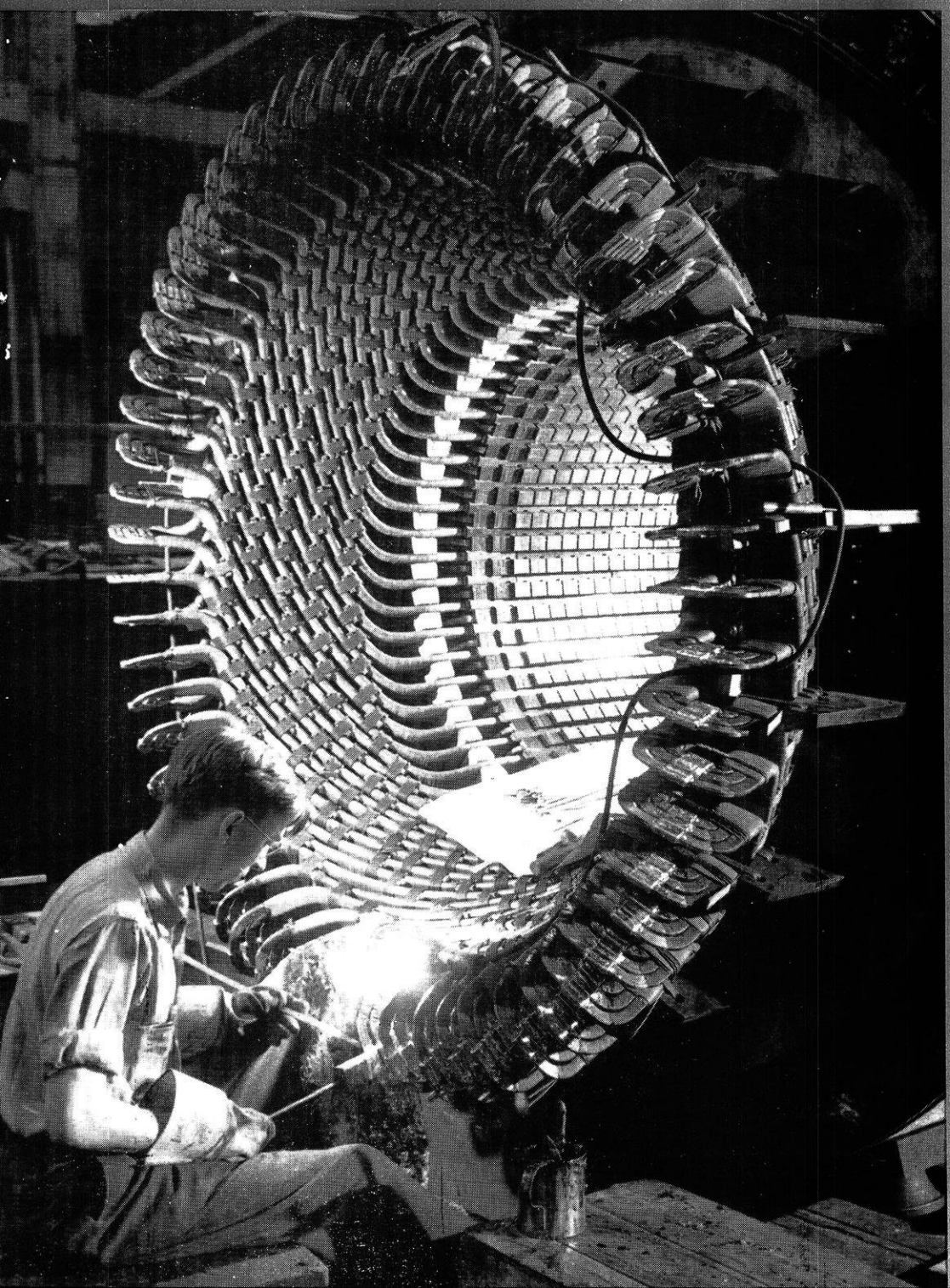
he Wisconsin

engineer



January, 1953

25¢

How two inches of steel made a yardstick

HERE is one of the busiest machines in our research laboratories. It is a *constant-pressure* test lathe that quickly provides an indication of how fast a steel can be machined.

This unique testing device consists of a standard lathe fitted with special control equipment by which the horizontal pressure on the cutting tool is kept constant during the machining operation. By actually machining a test bar on this lathe and measuring the number of revolutions necessary to advance the cutting tool exactly two inches, we obtain—in a matter of minutes—a precise record of the steel's machinability.

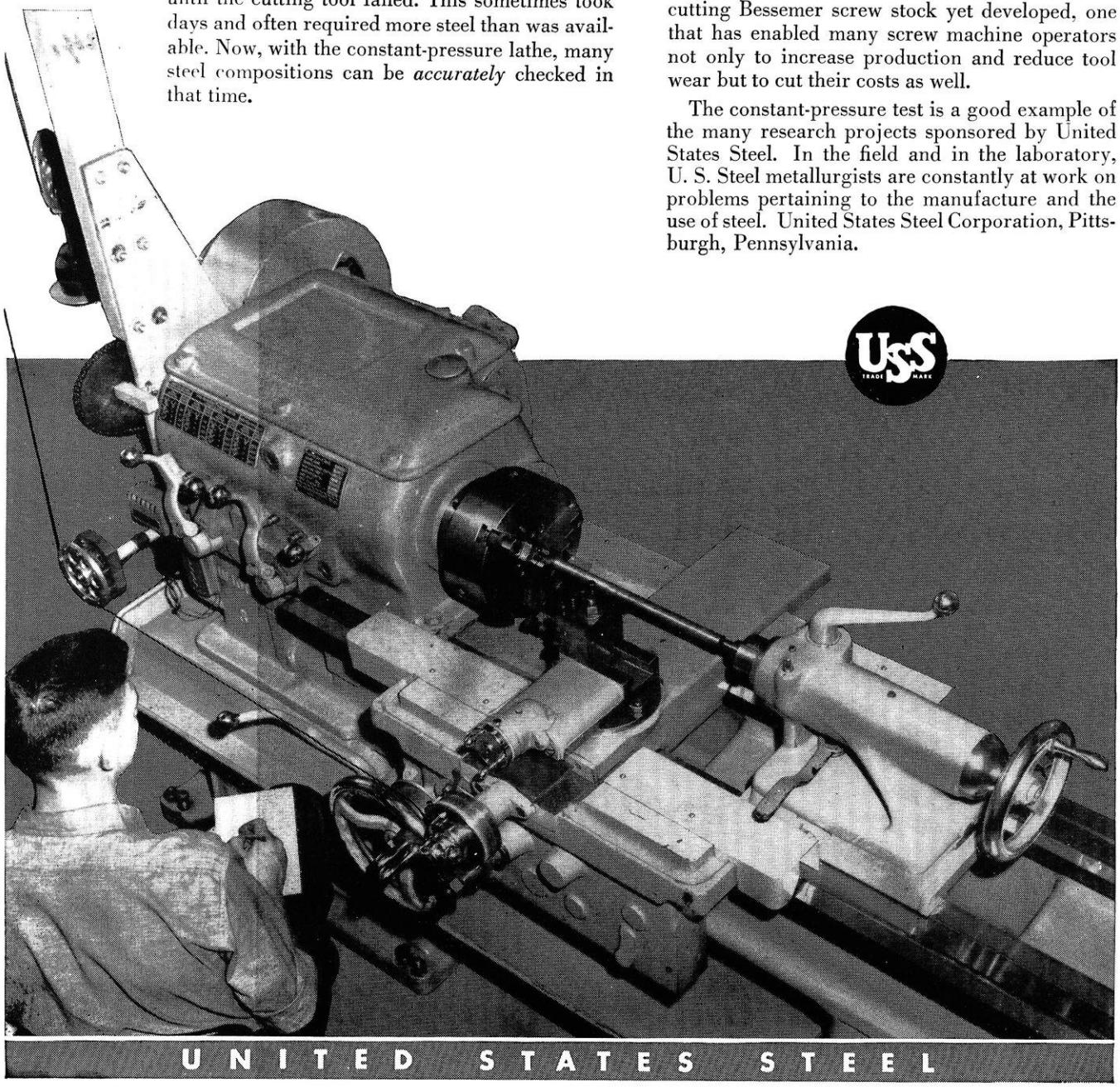
Before this development, the normal way to test machinability was to machine a sample of steel until the cutting tool failed. This sometimes took days and often required more steel than was available. Now, with the constant-pressure lathe, many steel compositions can be *accurately* checked in that time.

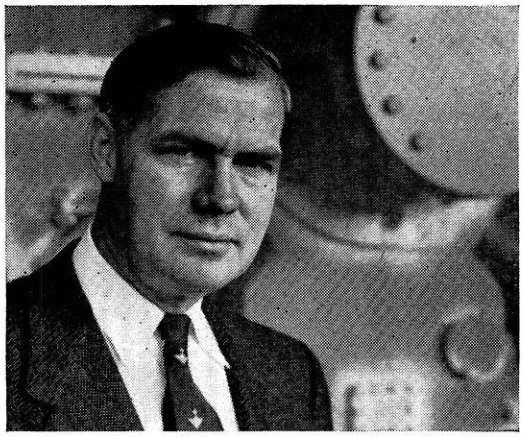
Typical of what this has meant to steel users is our development of MX Free-machining Bar Stock.

Bar stock is used in producing the millions of machine parts that are made on screw machines—those high-speed automatic machines that can simultaneously perform many operations such as drilling, forming, threading, chamfering and tapping at a rate of 1000 or more parts per hour. Here, machinability is of first importance, and often spells the difference between profit and loss.

So when we set out to give the screw machine industry steels that would have the utmost in machinability, we called on the constant-pressure test lathe to speed up this research. With its help, hundreds of compositions were quickly and accurately screened. The result was MX—the fastest-cutting Bessemer screw stock yet developed, one that has enabled many screw machine operators not only to increase production and reduce tool wear but to cut their costs as well.

The constant-pressure test is a good example of the many research projects sponsored by United States Steel. In the field and in the laboratory, U. S. Steel metallurgists are constantly at work on problems pertaining to the manufacture and the use of steel. United States Steel Corporation, Pittsburgh, Pennsylvania.



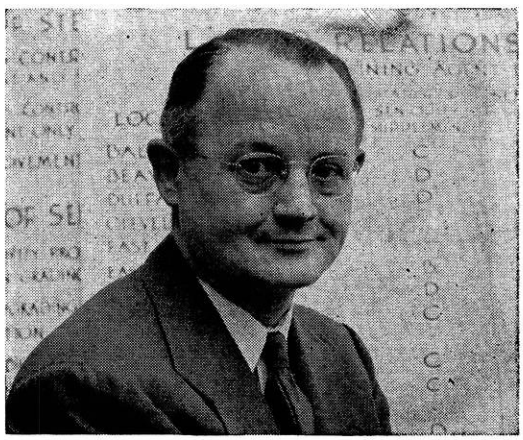


LEE A. KILGORE, *Assistant Manager*
Westinghouse Generator Engineering

A graduate of the University of Nebraska, he enrolled in the Westinghouse Graduate Student Training Course in 1927. He has contributed much to the design and development of large generators, motors and rectifiers and has authored many technical articles on these subjects.

W. H. DICKINSON, *Director*
Westinghouse Headquarters Manufacturing Engineering

Enrolled in Westinghouse Graduate Student Training Course after graduation from Texas A & M in 1930. He came up through a variety of manufacturing positions in the company and was appointed to his present post in 1951.



CLARK C. FRAME, *Director*
Westinghouse Labor Relations

Enrolled in the Westinghouse Graduate Student Training Course after graduation from Penn State in 1930. Prior to appointment to his present post, he was Manager of Industrial Relations for Westinghouse East Pittsburgh divisions.

Their formula for success will work for you

"Find out early what your talents are, what you want to do, and set your sights accordingly." That, essentially, is the success formula practiced by these Westinghouse executives.

But how do you put this formula to work? How can you be sure of choosing the right career? At Westinghouse, you'll find the answer in the Graduate Student Training Program . . . the same program that launched these men on their careers. This program gives you a clear understanding of the company and its products . . . lets you try out many types of work through planned work assignments . . . and offers the benefit of personal counsel in selecting the right field for your career.

Your Opportunities at Westinghouse

Westinghouse offers you a double-barreled opportunity for building a successful future: the Graduate Student Training Program which gets you off to a sure start . . . and the Graduate Study Program which enables you to continue your education toward M.S. and Ph.D. degrees while on the job. When you join the Westinghouse team, you get the training you need to forge ahead in the field of your choice.

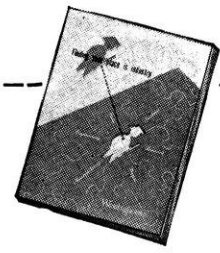
For information on opportunities at Westinghouse in engineering, research, manufacturing, sales and business administration, send for our 34-page book, "Finding Your Place in Industry".

G-10251

EDUCATIONAL DEPARTMENT

YOU CAN BE SURE... IF IT'S

Westinghouse



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

Mr. L. J. Dunlap
District Educational Co-ordinator
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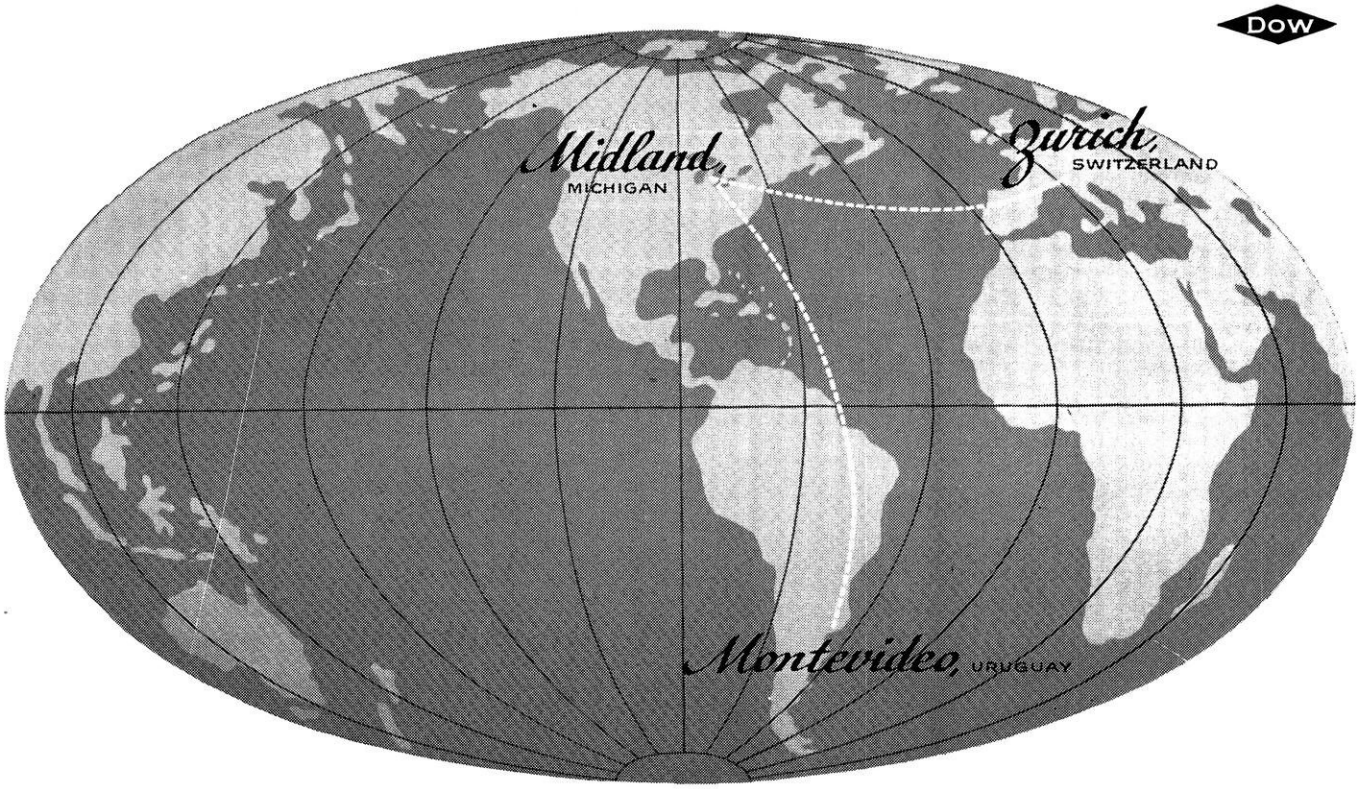


DOW ADDS NEW EXPORT COMPANIES

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

Field Procedure Memorandum—No. L, 234-753-Q12

1. It has been brought to our attention that many employees are dying and refusing to fall over after they are dead. This practice must stop:
2. On or after 1, February 1952, any employee found sitting up after he has died, will be dropped from the payroll at once (that is within 30 days). Where it may be proved that the employee is being supported by a desk or other property marked "U.S. Govt." an additional thirty days will be granted. The following procedure will be strictly followed:
3. If, after several hours, it is noted that a worker has not moved or changed position, the supervisor will investigate. Because of the highly sensitive nature of Government Employees and the close resemblance between death and their natural working attitude, the investigation will be made quietly, so as not to disturb the employee if he is only asleep. If some doubt exists as to the true condition of the employee, extending a Government check is a fine test. If the employee does not reach for it, it may reasonably be assumed that he is dead. In some cases the instinct is so strongly developed, however, that a spasmodic clutch or reflex action may be encountered.
DON'T LET THIS FOOL YOU:

4. In all cases, a sworn statement by the dead person must be filled out an Special Form PU 65, 498334, giving special attention to the tenth page. Fifteen copies will be made. Three copies are sent to Washington, three go to the deceased and the remainder go to the wastebasket file.
5. Form 228, application for permanent leave must also be filled out by the employee. Be sure to include the correct forwarding address. If he cannot write, his signature must be witnessed by two others—preferably alive. Complete case by pushing body to one side to make room for the next incumbent.

BY ORDER OF:
Rigor Mortis, M.D.

Graduate Engineers!

ENJOY GOOD SALARY FROM THE FIRST DAY... INTERESTING CHALLENGES RIGHT AWAY!

At Sperry you can apply your knowledge immediately and keep on learning—with pay—in research, product development, or field work. Salary increases come as you progress.

You enjoy the advantages of working with the leaders in their fields. You are expected to use originality and a fresh approach. Every project is a creative challenge to the brain-work and the team-work of the Sperry engineering staff.

VARIETY OF OPENINGS

There are opportunities for aeronautical, electrical, electronic, mechanical engineers – physicists – technical writers and field engineers for applied engineering.

ATTRACTIVE LOCATIONS
GOOD WORKING CONDITIONS

Long Island—In pleasant suburban atmosphere but convenient to New York. Modern plant. Well equipped laboratories. Excellent working facilities.

In the Field—There are excellent applied engineering opportunities in various sections of the United States and abroad.

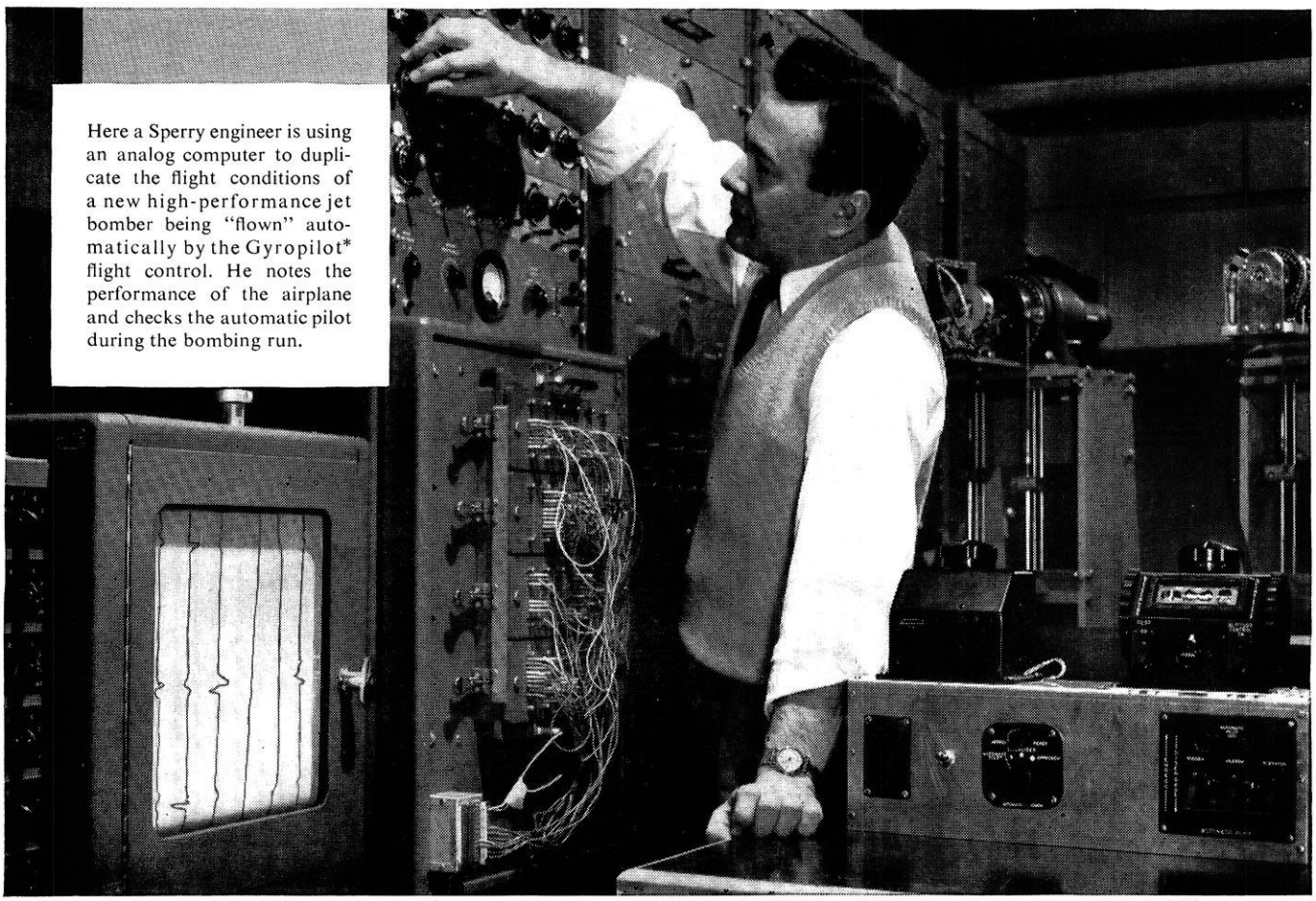
In All Locations—The way is clear for steady advancement. You are encouraged to continue your education while you earn. And liberal employee benefits are provided for all.

RESEARCH LEADERSHIP...
A FORTY-YEAR TRADITION

Today Sperry is the recognized leader in developing automatic controls for navigation. From Sperry's work in gyroscopics and electronics have come the Gyropilot* flight controller, Zero Reader* flight director, radar, servomechanisms, computing mechanisms and communications equipment.

Sperry sponsored the development of the klystron tube—the first practical source of microwave energy. From Sperry pioneering has come a complete line of Microline* instruments for precision measurement in the entire microwave field.

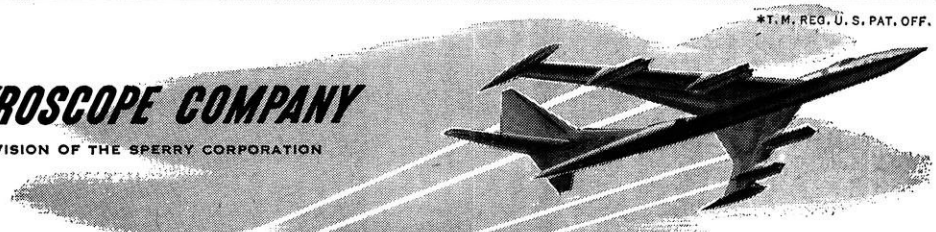
CHECK YOUR PLACEMENT OFFICE FOR DATES WHEN SPERRY REPRESENTATIVES WILL VISIT YOUR SCHOOL...OR WRITE SPERRY EMPLOYMENT SECTION 1A5.



Here a Sperry engineer is using an analog computer to duplicate the flight conditions of a new high-performance jet bomber being "flown" automatically by the Gyropilot* flight control. He notes the performance of the airplane and checks the automatic pilot during the bombing run.

*T.M. REG. U. S. PAT. OFF.

SPERRY GYROSCOPE COMPANY
DIVISION OF THE SPERRY CORPORATION



GREAT NECK, NEW YORK · CLEVELAND · NEW ORLEANS · BROOKLYN · LOS ANGELES · SAN FRANCISCO · SEATTLE
IN CANADA – SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

THIS-n-THAT

The WISCONSIN ENGINEER has received an announcement from the Union Carbide and Carbon Corporation concerning the Oak Ridge School of Reactor Technology. Applications for admission to the course starting next September will be accepted until March 1, 1953. Those interested in the program are invited to write to the School at Post Office Box "P", Oak Ridge, Tennessee.

It surely would have been nice to have a Rose Bowl victory for a New Year's gift to the Big 10 — but it was a good game to watch. Television really puts you on the 50 yard line. Note to manufacturers: It would have been a much better show in color television!

Well, finals are about upon us again. I hope all the students have reviewed as hard as I was planning to.

R. A. L.

to the

ELECTRICAL ENGINEER

or

PHYSICIST

with an interest in

RADAR

or

ELECTRONICS

Hughes Research and Development Laboratories, one of the nation's leading electronics organizations, are now creating a number of new openings in an important phase of their operation.

Here is what one of these positions offers you:

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar systems, electronic computers and guided missiles.

THE NEW OPENINGS

The positions are for men who will serve as technical advisors to government agencies and companies purchasing Hughes equipment—also as technical consultants with engineers of other companies working on associated equipment. Your specific job would be essentially to help insure successful operation of Hughes equipment in the field.

THE TRAINING

On joining our organization, you will work in the Laboratories for several months to become thoroughly familiar with the equipment which you will later help users to understand and properly employ. If you have already had radar or electronics experience, you will find this knowledge helpful in your new work with us.

WHERE YOU WORK

After your period of training—at full pay—you may (1) remain with the Laboratories in Southern California in an instructive or administrative capacity, (2) become the Hughes representative at a company where our equipment is being installed, or (3) be the Hughes representative at a military base in this country—or overseas (single men only). Compensation is made for traveling and moving household effects, and married men keep their families with them at all times.

YOUR FUTURE

In one of these positions you will gain all-around experience that will increase your value to our organization as it further expands in the field of electronics. The next few years are certain to see large-scale commercial employment of electronic systems. Your training in and familiarity with the most advanced electronic techniques now will qualify you for even more important future positions.

How to apply:

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Engineering Personnel Department
Culver City, Los Angeles County, California

See your Placement Office for appointment with members of our Engineering Staff who will visit your campus. Or address your resumé to the Laboratories.

The Student Engineer's Magazine

WISCONSIN ENGINEER

Founded 1896

Volume 57 JANUARY, 1953 *Number 4*

In This Issue . . .

Cover

Welder working on Westinghouse electrical equipment.

Frontispiece

Jet engine tail cones lined up on General Electric's receiving and inspection area.

Articles

Departments

Entered as second class matter September 26, 1910, at the Post Office at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

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editorial

MEDALS OF HONOR

The first Medals of Honor were awarded by the United States Government in March, 1863 to six men of a party of twenty which had attempted to cut the railroad between Marietta, Georgia and Chattanooga, Tennessee. Undoubtedly more of these medals will be earned in 1953 by American fighting men.

For ninety years, usually by dying heroically or by destroying vast numbers of the enemy, men have won this medal.

In the same ninety years, engineers and scientists have made remarkable progress with inventions, discoveries and means of application so that a large number of people benefit from their work. We all realize the importance of such discoveries as the laws of alternating current by Steinmetz in 1892; the invention of high speed internal combustion engines by Gottlieb Daimler in 1885; the invention of the linotype machine by Ottmar Mergenthaler in 1884 and the development of a successful camera in 1888 by George Eastman. These are but a very few of the technological advances upon which industrial empires have been established to employ and serve millions of people throughout the world.

Great development in many other fields, especially medicine, is characterized by the use of scientific methods and specialized equipment as stepping stones for progress.

Man's life span has been increased with more pleasure added and less physical exertion required. Still, we find it necessary to award Medals of Honor — medals which represent the battle field deaths of fathers and brothers all over the globe. The only real accomplishment in the field of warfare is the ability to effect more destruction and to kill more men in less time than ever before.

American technical men have proved they can design weapons sufficiently effective to enable us to win battles. When the war is over, too often we lose the peace. Perhaps 1953 is the year for men trained in technical affairs to bring their abilities to bear on the problems of the world. Undoubtedly an engineered solution for the problem of establishing world peace would develop a workable answer.

Remembering that the Carnot cycle does not cause an explosion when sensibly modified for practical use, let all of us attempt to solve the problem of engineering a practical cycle for international peace.

R. A. L.

University of Wisconsin Photography Laboratory pictures of past Engineering Expositions.

In March, 1941, nearly twelve years ago, the University of Wisconsin's College of Engineering held its last Engineering Exposition.

The idea for such an exposition evolved from the feud over St. Patrick's chosen occupation—was he lawyer or engineer? Each year, on or about St. Patrick's Day, the engineers held a parade, celebrating the fact that he was undoubtedly an engineer—not a shyster. Being spring, with the men of the slide rule loose after a long winter, this historic procession took on a very unpredictable, usually non-constructive nature. In 1938, for instance, with esprit de corps running high, it ended up in all-out warfare, after certain lawyers tried breaking up the party with uncooked eggs. Almost everyone agreed that these parades weren't accomplishing anything, so an effort was made to organize a celebration which would be worthwhile as well as energy consuming—and the ideas seemed to center around an exhibition. In 1936, the University had held an exhibition as part of the Wisconsin Centennial commemorating the founding of Wisconsin as a territory. An integral part of the program had been the engineering displays, and so the idea developed "Why can't the College of Engineering hold an exposition for themselves?" Other colleges had successfully run such an event before, which made the idea all the more plausible. Finally, in November of 1939, Polygon Board, official engineering representative body, voted to set in motion the necessary machinery to carry through the first Engineering College Exposition.

Because of the nature of the undertaking, the emphasis of the exposition was on student exhibits; the purpose, to show what students were doing. But to round out the program, and give a more complete picture of what was going on in the whole engineering field, industrial exhibits were secured from companies all over the U. S. The Chrysler Corporation, for instance, demonstrated its new method of hydraulic transmission, the Fluid Drive. The Dow Chemical Company presented some of the interesting and unusual features of "Dowmetal," at that time the lightest structural metal known. United States Steel Coporation, Pan American Airways, Incorporated and the Standard Oil Company provided continuous movies.

Student exhibits provided an insight into the skills they were developing in school, and in many cases illustrated the lighter side of engineering. An electromagnetic levitator not only suspended metal pots and pans in mid air, but effectively prevented them from slipping from the field. Electroplating, liquid air demonstrations, receiving and transmitting radio signals with a book-sized portable "transciever," transmission of pictures by radio, and testing the passion power of a best girl's kiss by an electronic "kissometer" (wired with a circuit breaker for extreme cases)—these were just a fraction of the 65 displays constructed by student clubs, engineering societies and fraternities, and free lance individuals.

EXPOSITION *EXPLORATION*

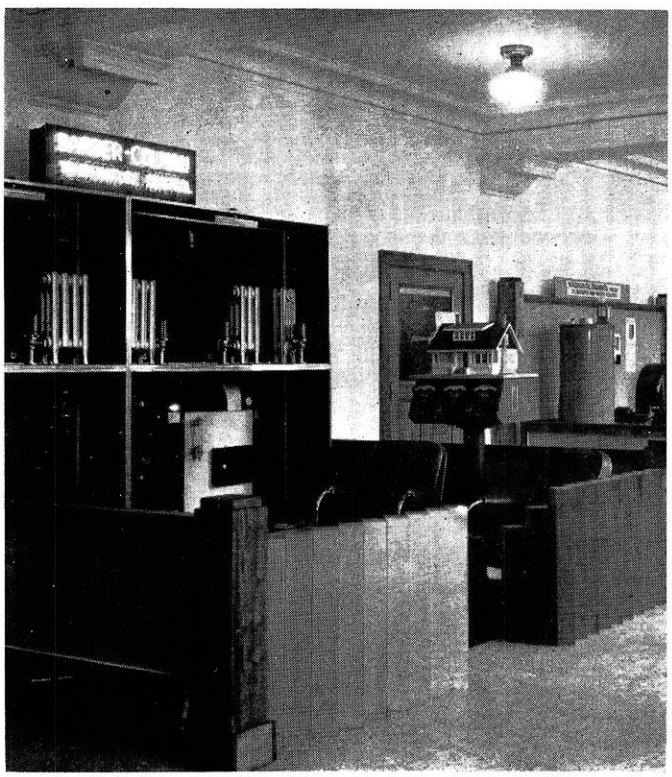
by

Richard Groth, e'55

Governor Heil, opened the three day affair. A program of lectures, movies, and conducted tours fascinated over 7,500 people and showed how engineering fit into everyday living, as well as into the technical occupations.

The exposition turned out to be a great success, as proven by the number of exhibitors and their enthusiasm. Financially, the exposition cleared over $1000, after all expenses and prizes were paid. The biggest share of this bought new furnishings for the lobby of the M. E. Building; the remainder was split among the engineering societies. Probably the most important single outcome was the realization that there were men who could, without faculty urging, instigate, organize, and with the help of the whole engine school, carry out an exposition of this size. The engineers developed so much confidence that Polygon Board decided to sponsor a second exposition the following year, 1941.

Built according to the pattern set up in its first year, the second exposition blossomed out with new exhibits, a more inclusive program, and over 9000 spectators. Triangle Fraternity built a miniature Panama Canal, and took the first prize money from over 75 competing student exhibitors. Of special interest to those not familiar with the school were tours conducted through the foundry while castings were poured, through the machine shops, where automatic-screw cutters and turret lathes were in operation, and through the high voltage atom-smashing lab in Sterling Hall. Some of the student engineers probably got a look at their future work when they saw exhibitions ranging from the new Du Pont Nylon products to "The new and glamorous fluorescent tubes" developed by General Electric.

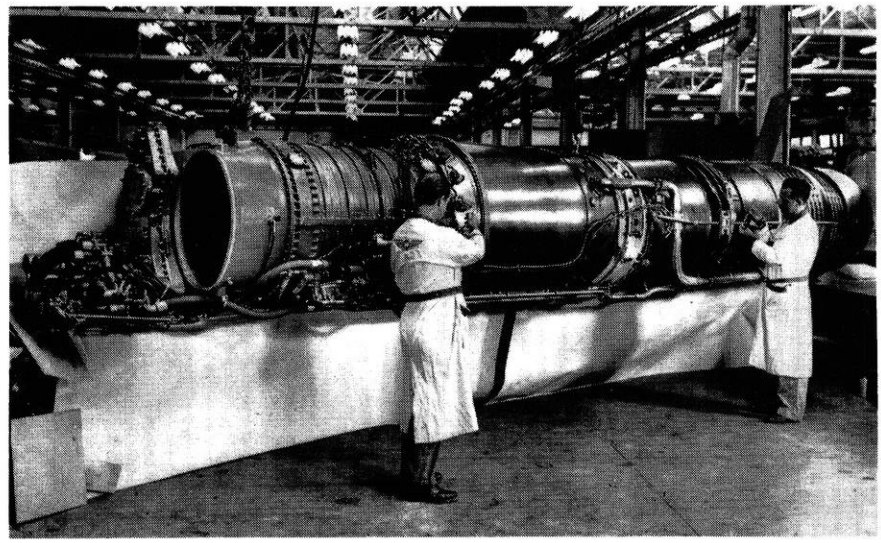


After 1941 plans were tentatively made to make it a bi-annual affair—then came Pearl Harbor, and sudden death for all expositions. That's the story of the Engineering Exposition up to the present. Now Polygon Board feels the time is ripe for the College of Engineering to put on a show that will be beneficial to all its members and to anyone interested in engineering applications and to do it as well as was done eleven years ago. The wheels are set in motion. Selected as co-chairmen are Ken Schneck and Tom Haas. Subchairmen are: Dick Crago (industrial exhibits), Jack Miller (student exhibits), Walter Pasciak (finances, Jack Burke (incidentals), John Hickman (program), and Dick Groth (publicity).

What will the Exposition of 1953 consist of? No one knows exactly, for plans are now being formulated. Undoubtedly, the exposition will be built around the skeleton of its ancestors—contacts are being made with 60 to 70 companies searching for industrial displays. Student exhibits by societies, fraternities, and individuals interested in science, are being solicited, and programs are being drawn up. There are three things concerning this exposition, however, that are certain: (1) The public, and employers in particular, are more interested and concerned with the engineer's work than ever before, because of the role he plays in our increasingly technical society. (2) The facilities for responding to this interest have vastly improved since 1941, due to the additional space provided by the new E. E. and CH. E. buildings, and (3) no matter how good a job the chairmen and their staffs do in formulating the policies, the final success or failure of the exposition lies in the hands of the engineers themselves—it will depend on the amount of student support. With everyone in the College of Engineering pushing the Exposition, it can't help matching or exceeding the success attained by its predecessors.

HIGH SCIENCE

Edited by Gene Worscheck, m'55



The J-40.

NAVY REVEALS NEW JET

The Navy has announced the world's most powerful turbojet aircraft engine has been developed with a thrust equivalent to approximately 25,000 horsepower at today's jet flight speeds.

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

The new aircraft power plant has just successfully completed the Defense Department's grueling 150-hour qualification test, which all new engines must pass to be eligible for quantity production. The test was equivalent to more than 75,000 miles of actual flight, or three times around the world at the equator.

Several new fighter planes, all of which are scheduled for early production for the U. S. Navy, are expected to be powered by the new engine. These will include the McDonnell F3H "Demon" and the Douglas F4D "Skyray."

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

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

This single engine is two and one-half times as powerful as the combined four engines on a B-29 Superfortress, but its weight, approximately 3,500 pounds, is less than that of only one of the famous bomber's engines and propellors.

LIGHTS

MIDGET X-RAY UNIT

A new midget-type industrial 250,000 volt X-ray machine, less than half the size and less than 1/8th the weight of the conventional quarter-million-volt unit has been developed by GE engineers.

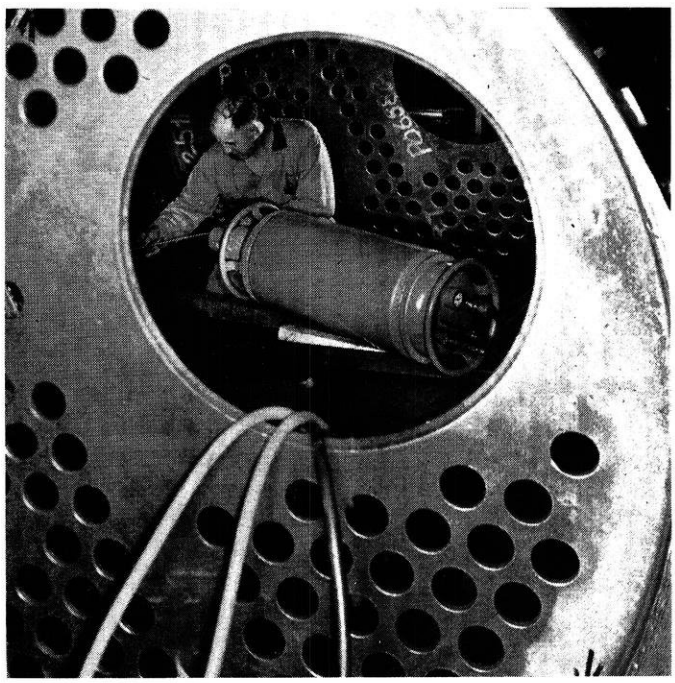
This lightweight, mobile unit, although capable of X-raying steel up to 3½ inches in thickness, can be easily carried around in foundries, welding shops, shipyards, building projects and on many other jobs where X-ray inspections are needed to control quality and safety.

The unit is less than 15 inches in diameter and 44 inches long. It weighs only 150 pounds, as against 1,150 for conventional units.

The first major application has been made in U.S. Navy shipyards where it is used to inspect critical welded seams and stressed areas in ships during and after construction.

A feature of the unit's versatility is its protruding "snout" from which the X-rays are emitted, which makes possible the taking of "inside-out" X-ray pictures. This, according to GE engineers, will greatly speed up the process and reduce problems now faced in making X-rays.

In setting up for the inspection of a weld joint connecting two sections of a pipe, for example, the X-ray technician can bring the X-ray unit inside the pipe and change its position for each exposure area without disturbing the pipe. He can also use it inside large castings and other areas difficult of access, or insert the snout inside a smaller casting.



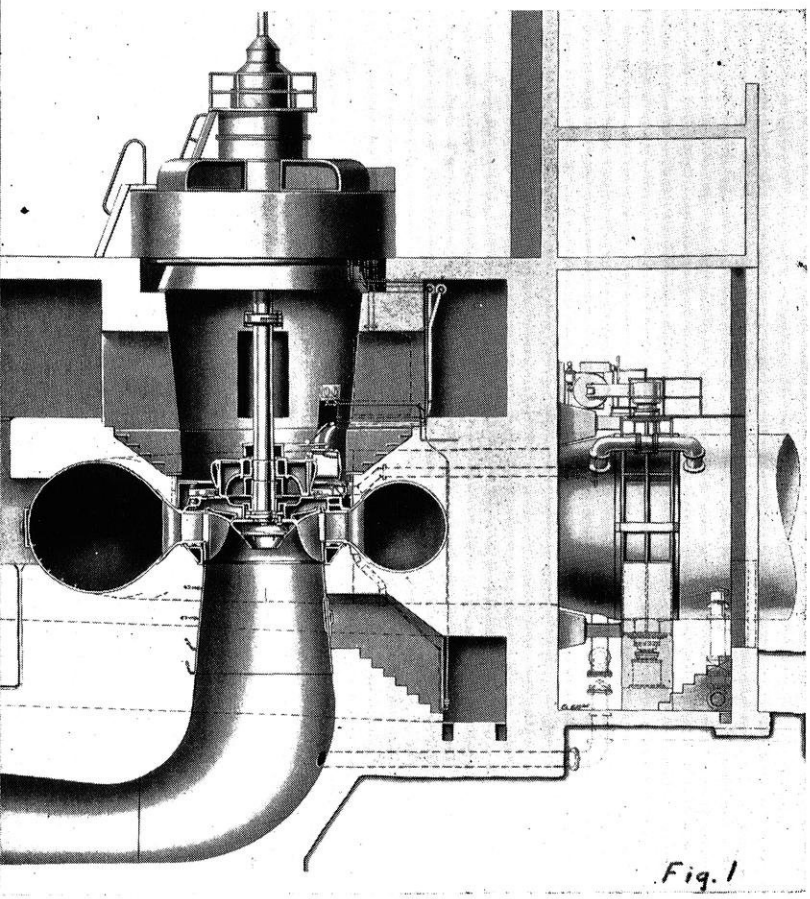
New G.E. midget industrial x-ray unit can easily be brought inside boiler drums to inspect welds from inside out which greatly reduces radiation hazard and simplifies radiography.

Cuts courtesy General Electric and Westinghouse

Operating at anywhere from 75,000 to 250,000 volts, the new unit can be used on anything from magnesium to steel. Use of the machine on light metals is also aided by the beryllium "window" of the X-ray tube, which allows the escape of softer, less penetrating X-rays from the tube.

(please turn to page 28)

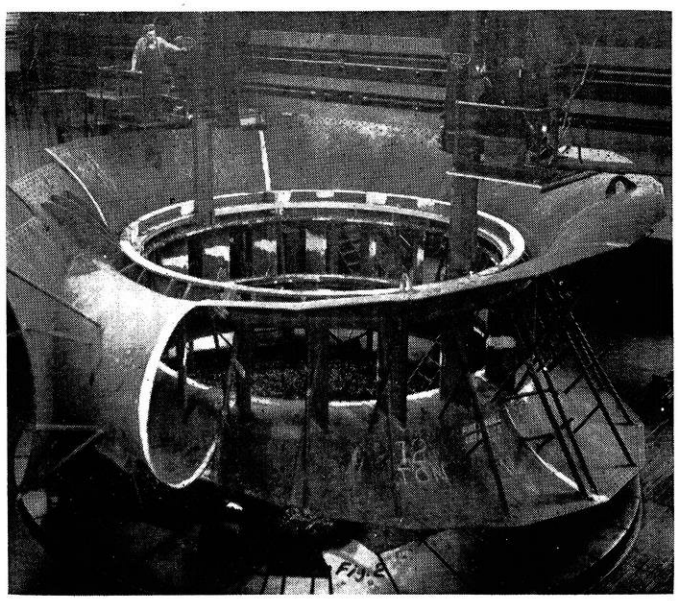
PUMPED HYDRO-ELECTRIC



Figs. 1, 2. and 3 show the combined turbine generating unit and pumping unit.

Alfred J. Casser is an alumnus of the University of Wisconsin (M.E. '51), now employed in the advertising and Industrial Press Department of Allis-Chalmers.

This article won first prize is the Allis-Chalmers Engineering Societies' authors' contest. It is now being printed in the **Ingenieria** magazine, published in Madrid, Spain.

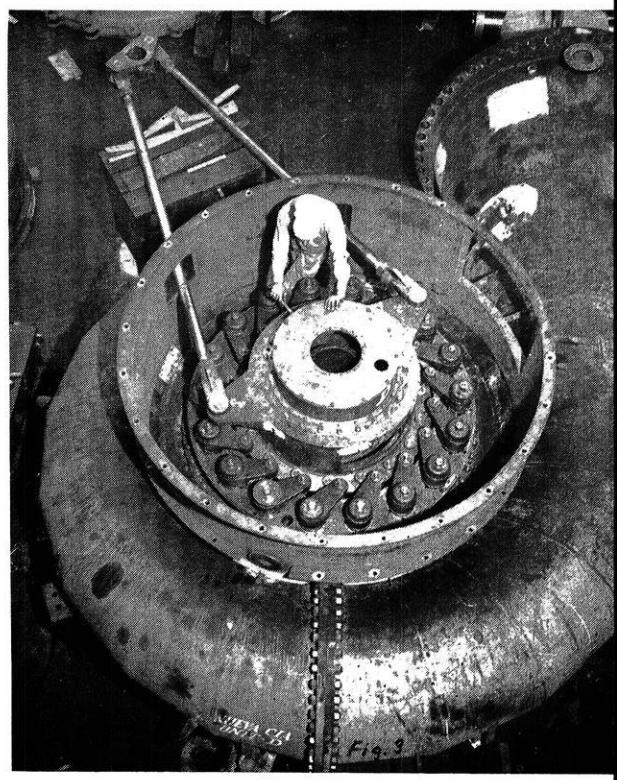


Pictures courtesy Allis-Chalmers

STORAGE POWER

by

A. J. Casser



THE development of a pump turbine unit that can serve as either a pump or turbine for power generation has brought forth new interest in pumped storage systems. These new units hold considerable promise in future power generation planning.

Pumped storage, like a storage battery, utilizes low cost power to store energy, a differential head of water which is used to generate hydro-electric power for peak load periods. The power used for pumping can be made at a low cost and the power generated in return can be sold at a much higher rate, making the process self-sustaining and profitable in spite of the normal losses in pumping and generation. The pump turbine is economically feasible because power can be sold for more at one time of the day (or week, or year) than another and because all generating systems, and particularly fuel-electric systems, have periods where much surplus power is available.

When tied in with a pump turbine unit, the load factor, efficiency and operating characteristics of a fuel-electric plant are all improved because the pumping load takes up where the peak load drops off. When needed, pumped storage can furnish reserve capacity through additional pumping to anticipate an abnormal temporary load.

Pumped Storage Has Long History

Until recently, most of the developments have taken place in Europe, where pumped storage units have increased from two plants in 1892 to fifteen plants in 1920 ranging from 300 hp to 6000 hp. By 1935, pumped storage had taken root, and Spain, Italy, Austria, Germany, France, Sweden Chile, and the United States have constructed more than fifty plants of various types ranging from 200 hp to 198,000 hp. Total world horsepower capacity in pumped storage plants is over 1,500,000 hp and about 825,000 hp in pumps. At present, we have three operating plants in the United States. The largest is located on the Rocky River in Connecticut consisting of a separate turbine and two separate pumps. The turbine is rated 33,300 hp under a 215 ft. head and the pumps are each rated 270 cubic feet per second under 225 ft. head. The other installations are the Lake Lamoka Plant in New York State and the Buchanan Plant in Texas. The Lake Lamoka Plant consists of two separate turbines and three separate pumps operating under a 400 ft. head. The pumps have a capacity of 35 cfs.

A new hydraulic turbine generating unit and pumping unit incorporated in a single reversible machine was announced in June, 1950 by the Allis-Chalmers Manufacturing Company. This improved pump turbine consists of a single runner enclosed in a casing with stay ring and movable wicket gates similar in construction to turbine units in Figures 1, 2 and 3.

(*please turn to page* 38)

W.S.P.E.

Edited by

Stephen Carter, m'55

SECRETARY'S OFFICE
201 Kensington Drive
Madison 4, Wis.
W. G. Youngquist, Secretary

ENGINEERS ELECT KEHOE

L. F. Kehoe, Electrical Engineer with Dairyland Power Cooperative, was elected President of the Western Chapter of the Wisconsin Society of Professional Engineers at its annual meeting at the Hotel Linker Tuesday evening.

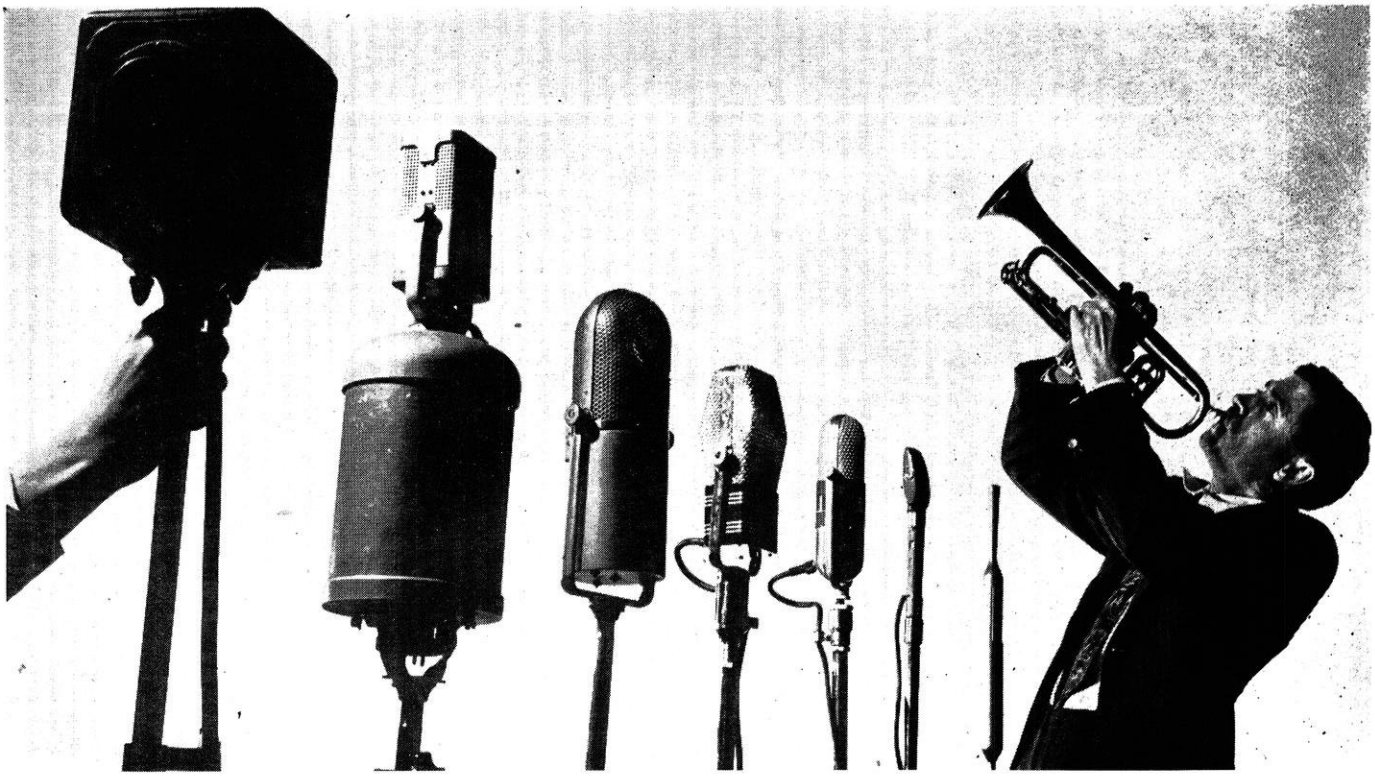
Kehoe is a graduate of the University of Illinois and a member of the American Institute of Electrical Engineers, serving as president of the Madison Chapter in 1947. Prior to coming to La Crosse he was a partner with Bernhard C. Lueders, Consulting Engineers of Baraboo, Wisconsin.

Other officers elected were Merlin Eklund, Distribution Engineer with the Northern States Power Company, Vice President; Fred Hayden, Highway Commission Engineer, Secretary-Treasurer; and Andrew Esser of the Trane Company, Director for a three year term, succeeding Frank Davy whose term expires this year. All of the above officers will take over their duties July 1, in accordance with recent changes in the by-laws which permits the incoming officers ample time to make preparation for their offices.

Carl Wahlstrom, President, welcomed as guests Arthur Moody and Robert Olson, engineers of the Trane Company and Joe McGlothlin of the Milwaukee Road. Arrangements were discussed for a combined meeting with the neighboring Minnesota engineers, a popular event for the past few years.

Speaker of the evening was Allen C. Menke, engineer of the Trane Company, introduced by Kenneth Zurn, Program Chairman. Menke discussed "Human Comfort and Air Conditioning," using slides to illustrate parts of his talk. Thermal balance, Menke stated, between man and his environment depend on several human factors and on various agents of heat exchange. A marvelous body mechanism serves to maintain the body temperature at 98.6°. During the question and answer session, Menke went into further detail regarding air conditioning for optimum health. Mr. Menke holds baccalaureate and master's degrees in Mechanical Engineering from Purdue University, is a member of the A.S.H.V.E. Committee on Sensations & Comfort and is a registered professional engineer in Wisconsin.

Editor's Note: This is the only material to reach us by the January deadline.



Musician hits a high note on his trumpet to test the performance of seven different microphones introduced by RCA since 1928. Microphones shown from left to right are: condenser type (1928), ribbon type (1930), universal ribbon type (1936), velocity type (1932), polydirectional ribbon type (1944), "Bantam" velocity type (1948), and the "Starmaker" ribbon pressure type.

RECORDING AND REPRODUCTION OF SOUND

by

James Collins, e'53

True reproduction of sound is determined by the elements of the entire amplification system and is dependent upon the quality of each individual component. The ideal amplification system would be one such that its existence would remain undetected when in operation.

The last few years have produced amazing advances in the recording and reproduction of sound and have presented to the American "high fidelity" lover a broader field of high fidelity components for the construction of his own recording and reproducing system.

If you have ever contemplated buying a magnetic recorder, for example, have you wondered whether you would desire a magnetic wire or a magnetic tape system? Or in the realm of the lateral disc recording field, which system of reproduction do you prefer, the 33 1/3 rpm CBS system or the 45 rpm RCA system? These questions have been prevalent in many thoughtful persons' minds after these new devices became available and on the market in the past few years.

IN RETROSPECT

It would be unfitting if we did not pay tribute to the forefathers of this important industry who did much to initiate the recording and reproduction of audio.

In 1877, Thomas Edison, the great American inventor, stumbled across what was to become the first recording and reproducing system. His method was the acoustical method utilizing a wax roll or cylinder. It was around 1881 that Alexander Graham Bell developed his dictaphone. About 1888 a new idea appeared that has been handed down through the ages—that of recording on a flat, lateral disc as devised by Emil Berliner. Later he discovered a method of reproducing several facsimile copies from one master record. Developments in regard to speed regulation and horn and sound box ensued. No explanation for the use of 78 rpm turntable speed can be found except that it happened to be the speed created by one of the earlier machines.

The year 1927 opened the way to the electrical recording field due to the development of radio, vacuum tubes, and the microphone.

Three types of recording are prevalent today: lateral disc, optical and magnetic recording.

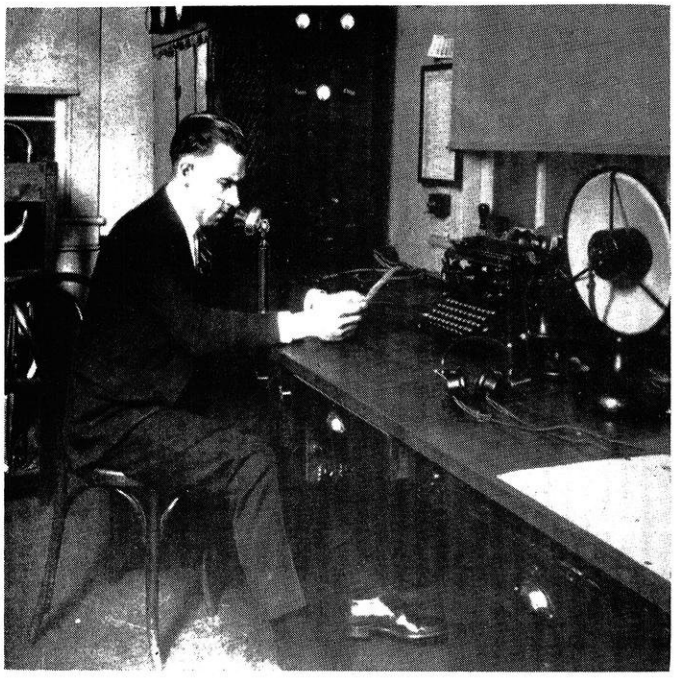
LATERAL DISC RECORDING

Lateral disc recording is still in the picture and is certainly not a "has-been". New developments in this field of recording have kept it in the foreground. The old standby is the 78 rpm disc which is still in prevalent use today.

Several problems confront disc recording. Among them is the problem of turntable speed. When one speaks of constant turntable speed they mean that the plate or turntable revolves due to a constant speed axial or rim drive. Mention is made of the two main types of power transmission because the former was used mainly in the earlier stages of recording while more recently the rim drive has been used to greater extent. In the case of the rim drive, the transmission of power to the turntable is achieved by means of an idler wheel between the inner rim (underneath the plate) and a vertical motor shaft. In both instances, however, the turntable revolves at a constant speed. This means that as the distance from the center to the various portions of the disc changes, so changes the linear velocity of the record grooves. Hence the outer-most groove of the recording, travels faster than the inner-most groove. This results in varying amounts of distortion of the original sound. One means of effectively eliminating this problem is to have the groove immediately below the recording needle travel at a constant rate of speed. One concern developing and producing a commercial lateral disc dictating machine utilizes one such system by employing a roller drive at the stylus (needle) head to drive the disc past the pickup point at a constant velocity.

Cutters, or recording cartridges, have in themselves several problems. Two predominate types of cutters are available, the magnetic and the crystal. Magnetic cutters are low impedance devices and hence can be connected directly to the voice-coil side of the output transformer of the amplifier. These cutters are exceptionally rugged and stable in operation. The crystal cutter, on the other hand, when connected to the output of an amplifier, represents a capacitive load in which the impedance decreases as the frequency increases.

Another problem is that of disc materials. Comparison



During the early 1920's, telephone transmitters were used instead of microphones at pioneer broadcasting stations such as the one pictured here. The telephone transmitter was not well suited for broadcast use since it was subject to distortion and limited in the frequencies it could handle. Investigation of these problems led to many improvements in the design of microphones.

of the noise level of different types of disc materials shows that the old shellac recordings had a noise level of minus ten decibels, the new shellac materials, minus twenty decibels, vinylite, minus thirty to forty decibels, and lacquer, the most expensive material, minus fifty decibels.

The reproduction or playback of sound from lateral discs is achieved by using the reverse process—using a tone arm with a cartridge or pickup rather than a cutter cartridge. The problems encountered in this phase are the tracking error and reproducing stylii. Tracking error means that the pickup cartridge and needle do not form a right angle with the direction of travel of the disc. Groove skating results from improper tracking; then one side of the groove becomes worn resulting in faulty reproduction. By use of offset heads on the tone arms and light-weight cartridge elements, this problem is effectively reduced. There is no cure-all for eliminating record wear and distortion. However, use of several precautions will minimize the troubles encountered. For example, use of a perfectly level turntable, free from mechanical vibration, a pickup having a tone arm with an offset head, and use of a properly designed reproducing stylus will permit a minimum degree of tracking error, thereby reducing distortion and prolonging record life.

A most excellent reason for the presence of lateral disc recording in spite of new magnetic recording methods is the recent development in high quality microgroove records as produced by CBS and RCA. Several advantages of these new recordings are the longer playing time (LP) with improved dynamic range yielding a high-fidelity frequency response. Utilization of light needle pressure eliminates a great deal of needle scratch and background noise which effectively prolongs the record life. The microgrooves are one third the size of the old standard record grooves. Vinylite, with its low noise level has been used as the microgroove disc material.

The Columbia Broadcasting System has developed the 33 1/3 rpm reproducing system. This system utilizes ten and twelve inch size discs much like the conventional 78 rpm disc except that the grooves are microgrooves and light-weight playback arms and heads are used. These LP discs average somewhere between 224 to 300 lines per inch as compared to 96 to 120 lines per inch of the 78 rpm transcriptions. Playing time per side is about 22 minutes. Several selections are generally recorded on one side with the result that a whole symphony or concerto, for example, may be recorded on one LP recording rather than on four or more 78 rpm recordings.

The Radio Corporation of America has developed the 45 rpm reproducing system which uses a seven inch disc with a one and one-half inch diameter center spindle hole. The inner collar portion is slightly raised to prevent contact of the playing surfaces and grooves. These discs average about 275 lines per inch. The playing time per side is approximately 5 minutes. Only one selection is recorded per side rather than a group of selections. RCA developed their own reproducer for this new disc.

Robin Chandler is shown using an RCA "Starmaker" microphone during NBC's television coverage of the political conventions at Chicago. The "Starmaker," designed not to hide the faces of speakers or singers, is a non-directional, ribbon-pressure type microphone with a slender 7/8-inch diameter horn for increasing response in the high-frequency regions. It weighs only 15 ounces and handles equally all tones between 50 and 15,000 cycles.

To attempt to say that either one of these two relatively new types of disc recording was better than the other one in regard to one feature would meet with a complete reversal of decision in regard to another feature upon comparison of these two systems. A solution to this problem may be the three speed record changer developed to handle any of these three systems.

OPTICAL RECORDING

The second method of recording sound is the optical method. Sound-on-film is an excellent example. Sixteen and thirty-five millimeter films have a sound track along one edge of the film itself. This strip, for the audio portion of the film, may be one of two basic types, the variable density or variable area, optical type. The variable density method has a constant width audio track but the spacing of the lines used to interrupt the light source varies much like the frequency modulation signal where the amplitude of wdith of the signal is constant but the spacing or density between the waves is variable. The other type of optical recording is that of variable area. Here the density of the sound track is fixed but the area changes, much like the upper half of an amplitude modulated wave.

Magnetic recording of the audio portion of a film sequence has recently been adapted to the sixteen millimeter films by Bell and Howell. Evaluation of the optical and magnetic methods of recording sound on film reveals certain advantages and disadvantages of each.

(*please turn to page* 36)

Home appliances made of special cold-rolled stainless steel.

Pictures courtesy U. S. Steel News and General Electric

for THE SURFACE SUPER

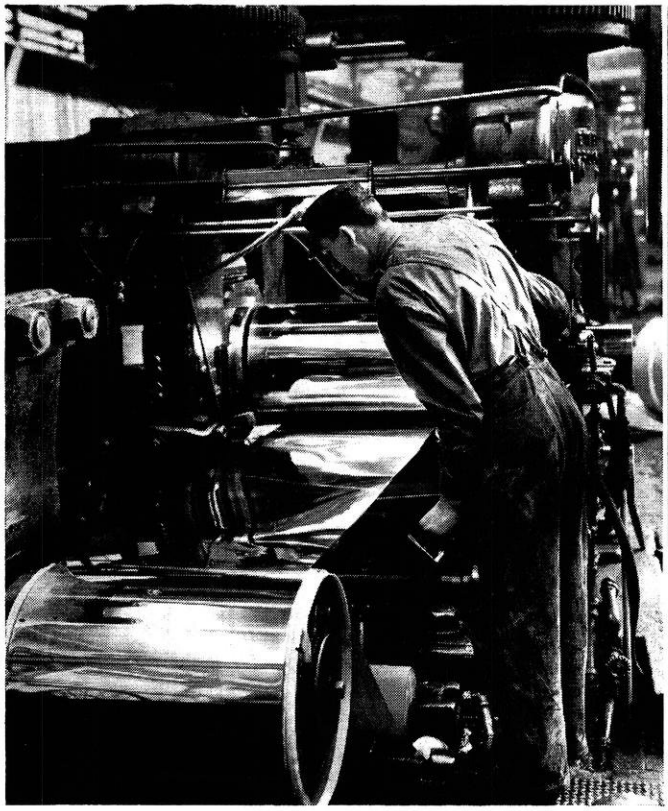
by

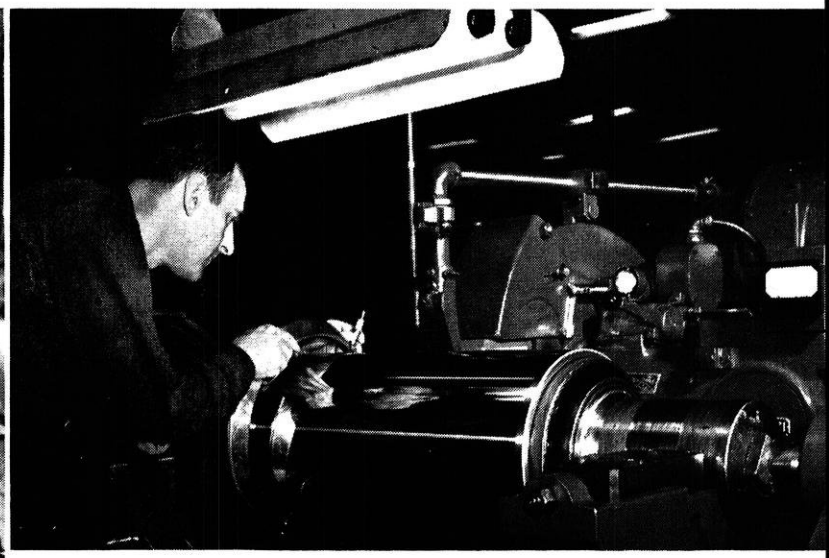
Stephen Carter, m'55

A steel man will readily admit that a brilliant surface on steel would be an extravagance for most purposes. But some strip, or both stainless and fine grain carbon steel, is rolled with a "super finish", for use in kitchen utensils, electrical appliances, automobile trim and a variety of objects where a beautiful surface appearance is a "must". Though such a finish could be produced on polishing machines, it would require a prohibitive amount of rubbing and buffing. Therefore this strip is given a bright finish by a rolling operation.

Steel is brought to the cold rolling mills in the form of hot rolled coils. As the steel is passed from one set of rolls to another, it is toughened and its thickness is progressively reduced. Strip approximately 24 inches wide and 83 thousandths of an inch thick can be reduced in a four stand continuous mill to 31 thousands of an inch in thickness. If such a coil at the beginning of the operation were 800 feet long, through a reduction in gauge it would become 2000 feet long. Cold rolling improves the surface of all strip, but with the meticulous and scientific control exercised in rolling bright finish strip, the surface of the strip has hardly a scratch or imperfection which is visible to the naked eye. There is little variation in its thickness greater than one thousandth of an inch.

The work rolls for the superfinishing lines are forged steel, of a quality as fine as that in today's surgical steels. They are forged from alloy steel containing chromium, vanadium and molybdenum. Under the teriffic pressures necessary, the rolls impart to the strip any defect in their surface. A single scratch or other imperfection on a work roll surface would transfer and create thousands of defects on the strip surface. Without a smooth set of work rolls during the last critical rolling, a perfect coil of strip is impossible. The work rolls in the first two finishing





Above: A roll grinder is shown measuring the diameter of a work roll. The roll has been ground and polished to a mirror-like finish. The abrasive grinding wheel is back of the roll in the center of the photograph.

Left: A workman has stopped the cold rolling mill to examine the quality of the bright finish on the strip. The work roll which can be seen, center, is as flawless as the strip it rolls. Note the roll of protective paper at the bottom, which is drawn into the coil as it is formed.

YOU LOVE TO TOUCH FINISH

passes can be used for approximately six hours before resurfacing, while those used in the last pass can sometimes only be used for two hours.

Recently the scientists at General Electric turned to glass as a near approximation of a liquid surface. The glass is coated with vaporized gold resulting in the smoothest solid surface found so far. The surface is used for tests to determine why various insulating materials break down under high electric voltages. These surfaces must be free of invisible bumps and dust particles. Housewives might be interested in achieving a similar high polish to reduce dusting chores in the home. But scientists harbor few illusions about their wanting glass and gold furniture for dining room suites.

A roll is resurfaced by grinding thousandths of an inch from the roll diameter. Its diameter must be uniform to within .0005 of an inch. If roll surface imperfections do not disappear after a short period of grinding, the abrasive wheel itself may need dressing or resurfacing with a diamond studded tool.

The deficiencies of the usual commercial methods of producing shapes and dimensions usually fall into one or more of the following classifications:

1. Short pitch geometrical defects such as grinding or turning ridges.
2. Longer pitch defects such as chatter marks, feed spirals, grinder flats, and other waviness due to machine tool inaccuracies.
3. Metallurgical changes in the surface layer of metal caused by the heat produced in grinding. The average mechanic refers to this condition as "burning" or "annealing". By the use of a fine grit, hard bond wheel, it is easily possible to produce sufficient heat

(*please turn to page* 44)

HOW TO *a* *B* *O* *S* *S*

NO graver responsibility confronts the job seeker, young or old, than the careful, thorough and intelligent selection of a boss.

Able, well-trained, satisfied employers are essential to successful careers. They are the men who are alert to spot new talent, develop it and put it to use. They are the men who guide a company's destiny skillfully, thus holding the ladder steady while you climb. They are architects of personnel policies that inspire you to your best effort.

The second-rate boss, whether he knows it or not, is just collecting second-rate people. Why waste your time with him?

Recently it has been somewhat difficult for employes to get first-rate employers. They have frequently had to settle for what they could get, and then wait for the chance to jettison the second-rater in favor of a better man.

Now, however, you can be a little more choosy in picking your boss. Something called a manpower shortage is tipping the balance a little further your way. Get ready to tighten up your boss-selecting procedures.

Be sure when you interview a prospective boss, you will find him still possessed of the quaint notion that he is selecting you. Do not attempt to disabuse him of this notion, for the attempt might produce serious emotional disturbances. Just play along with the gag while you quietly size things up.

To help you in making this appraisal, the following check list for the screening and selection of employers has been compiled. On the basis of personal observation and judgment, plus discreet inquiries among those familiar with the man and his organization, answer the following 12 questions as best you can. These answers will give you a pretty good line on how good a boss the man behind the desk is.

1. Does he appear to have adequate skill and experience for the job?

Take a good look at this company of his and see how well he's running it. Your prime requirement is a boss with the proved know-how to steer his company successfully, keep it humming and moving forward. The man you want is the one with concrete results to show for his leadership.

CHOOSE

Reprinted courtesy Changing Times
The Kiplinger Magazine — January 1951

If he is qualified for his job, the company should show a satisfactory financial and competitive position and, above all, it should be making progress. Its record will show traces of innovations, fresh ideas, adjustments to keep pace with changing times.

A company that is dragging its feet, however, implies a boss that is doing the same. Better just take his phone number and tell him you'll let him know next week. No good jockey wants to ride a broken-winded horse.

2. Does he have good references?

Any man who has reached boss status is bound to have some reputation, both in his field of business and in the community. He may, in fact, have a wider reputation than he suspects. Check up on that reputation.

Is he known and respected by competitors and colleagues? Does he indicate an interest in and natural aptitude for his work by active membership in the appropriate business associations and professional societies? Or do others in the field speak of him politely, but rather vaguely?

Nonbusiness references count, too. Your best bet is the man who takes a reasonably active role in community affairs, whose name crops up now and then in connection with drives and civic projects, whose interests are not limited to one narrow field. Such a man probably takes his position and obligations seriously. He seems to have the necessary aptitudes for leadership and responsibility. He seems to be broad-gauge.

Finally, see what reaction you get around town when you mention that you are considering Old Man Snodgrass as an employer. Is the idea endorsed? Or does it bring forth a round of horror stories about what kind of man he is to work for? Such tales are probably exaggerated. But either there is a grain of truth behind them, or else the employer is fumbling the important job of public and employe relations.

3. Does he make a good impression?

Certain personality traits are very important guideposts in the selection of a good employer.

Your man should leave an impression of decisiveness of being one who can weigh evidence, make a decision, and stick by it. Pass over the prospect who looks as though he will be timid and excessively cautious in making decisions; pass over, too, the one who impresses you as a man of hasty, snap judgments.

The better grades of bosses impress you as being self-confident, ambitious, self-controlled. They have the air of men who know exactly where they are, where they are going, and how they propose to get there. They know how to listen to other people, as well as make other people listen to them.

How does the Great Man talk? Shun the one whose conversation is loaded with I, my and me, and take the one who speaks of we, our and us. Avoid the man who rasps out orders like a sea captain turning out the fo'c'sle gang. Favor the one whose attitude is that of a team captain, whose voice of command is quietly authoritative, and who turns loose an occasional "please" and "thank you."

4. Has he handled your application for a job with reasonable care and intelligence?

If this man puts you on his payroll, he is, in effect, investing a fair sum of money in you. If he is a smart businessman, he is careful about his investments.

Be wary of the employer who passes out jobs too easily or without examining your qualifications very closely. Give the nod to the one who, personally or through his staff, puts some time and effort into finding out ahead of time whether you will fit into his organization and where you will fit in.

In the first place, he is obviously interested in getting top-grade, permanent employes and in seeing that they get a chance to work where they work best.

In the second place, he is judging you in advance. He isn't likely to discover a couple of months from now, after wasting your time and his, that he guessed wrong.

And in the third place, he seems to understand people, as a proper boss should. He is proceeding on the sound assumption that they are all different and all complicated, and not to be ordered in wholesale lots like so many rivets or boxes of carbon paper.

(*please turn to page* 40)

Science - -

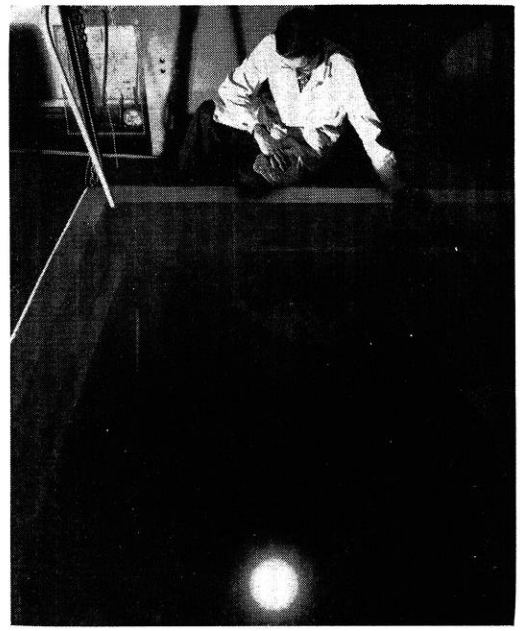
(continued from page 17)

DECK-EDGE ELEVATORS

The Elevator Division of the Westinghouse Electric Corporation has received a $3,500,000 contract for installation of deck-edge elevators on the world's mightiest aircraft carrier, the U.S.S. Forrestal, now under construction. They will move planes between the flight deck and the hangar deck, such as shown on the U.S.S. Midway. Old type inboard elevators left large vacant spaces on the flight deck when taking on planes from the hangar deck. The deck-edge type leaves the flight deck intact so that planes can take off and land while others are being moved.

In size, the elevators will measure 60 by 60 feet. They will extend out over the water at approximately the midpoint of the carrier. They will be raised and lowered by Oildraulic engines. An undisclosed number of them will be capable of moving more planes per minute than on any previous carrier.

Deck-edge elevator on the carrier Midway.



Eerie glow is produced nine feet under water by a radiation source twice as powerful as the world supply of radium.

COBALT 60

Twice the world's present supply of radium, which if obtainable would cost $130,000,000, would be needed to equal in intensity the rays from a powerful radiation source recently installed at the Knolls Atomic Power Laboratory.

So intense is this radiation that it causes a bluish-white glow in the nine-foot depth of protective water under which the source is kept. When the room is darkened, the tank and the surrounding area are illuminated by this glow.

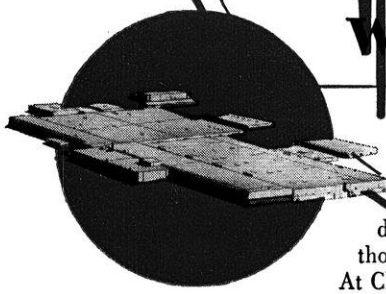
The source consists of about 2.5 pounds of a radioactive form of the metal cobalt, known as cobalt 60. The radiations emitted are gamma rays or high-energy X-rays.

The laboratory will use the new installation in connection with its work on the design and construction of a full-scale land-based model of an atomic power plant for U.S. Navy submarines.

Physical properties of many materials to be used in constructing such a plant may be altered by the powerful rays generated in the atomic reactor, or "furnace." By lowering samples of these materials into the water, and exposing them to rays from the cobalt 60, such effects may be tested on a small scale.

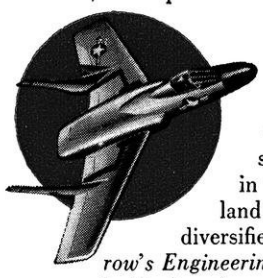
(please turn to page 46)

Greater Opportunity for the Creative Engineer with Chance Vought



Never before in the history of the aircraft industry has there been greater opportunity and greater demand for the young engineer with thorough training and creative ability. At Chance Vought you can join an engineering staff in one of the largest plants designed for the manufacture of military aircraft. Centered in the second largest aircraft production area in the U. S., this modern air conditioned plant is especially designed and equipped with adequate facilities for aircraft research, development and integrated production.

Security restrictions prevent a full discussion of the guided missile projects at Chance Vought, but growing requirements in all phases of development and production are creating new demands for all types of engineers and scientists. These missiles are in production for intensive experimental uses and presently are being flight tested with excellent results.



For thirty-five years Chance Vought's position in the aircraft industry has been one of pioneering and leadership. One of the latest achievements is the tailless swept wing F7U-3 "Cutlass" now in full scale production. This twin jet fighter, in the "more than 650 miles per hour category," is designed to operate from both land bases and aircraft carriers. For further information about Chance Vought and its diversified opportunities in engineering, consult a copy of our publication titled "*Tomorrow's Engineering*" now on file in your college placement library. If you are receiving a degree in Engineering, Mathematics or Physics, contact your Placement Director for an appointment with the Chance Vought Aircraft representative who will visit your campus soon.

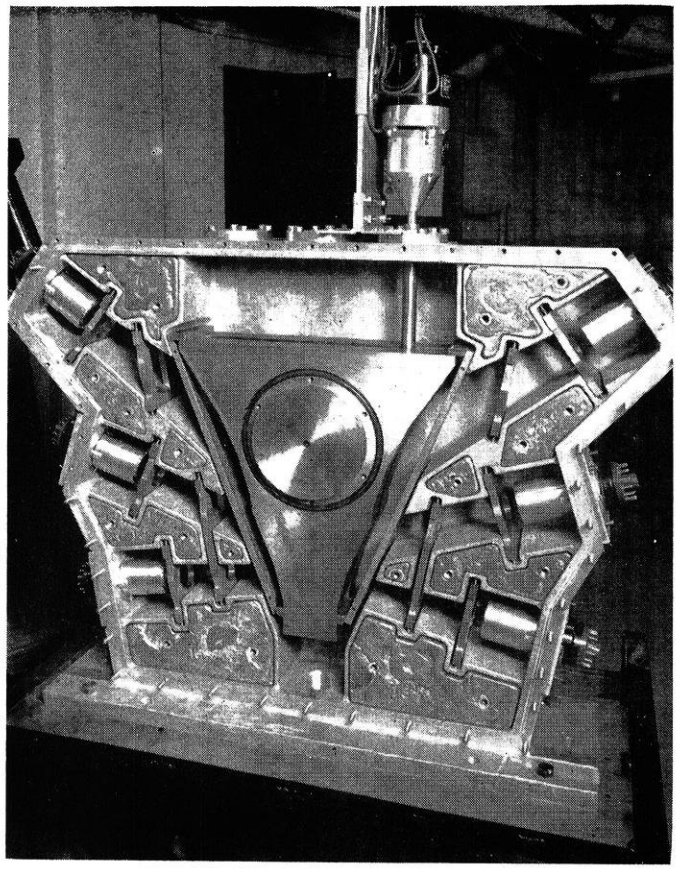
CHANCE VOUGHT AIRCRAFT

CHANCE VOUGHT

Dallas, Texas

DIVISION OF UNITED AIRCRAFT CORPORATION

NATIONAL BUREAU MAGNETIC COMPTON



Inside view of the NBS magnetic Compton spectrometer. The collimated beam of x-rays impinges on a beryllium foil placed inside the narrow end of the wedge-shaped pole pieces. The ejected electrons leave the foil at an angle and at an energy dependent on the incident radiation. The combined effect of lead baffles and magnetic field is to focus the electron beam so as to strike a scintillation counter (at the exit ports of the aluminum chamber). The motor at the top of the spectrometer and the rod extending into the space between the pole faces is part of a fluxmeter used to adjust the magnetic field. The channels for each scintillation counter are shielded from each other by lead inserts.

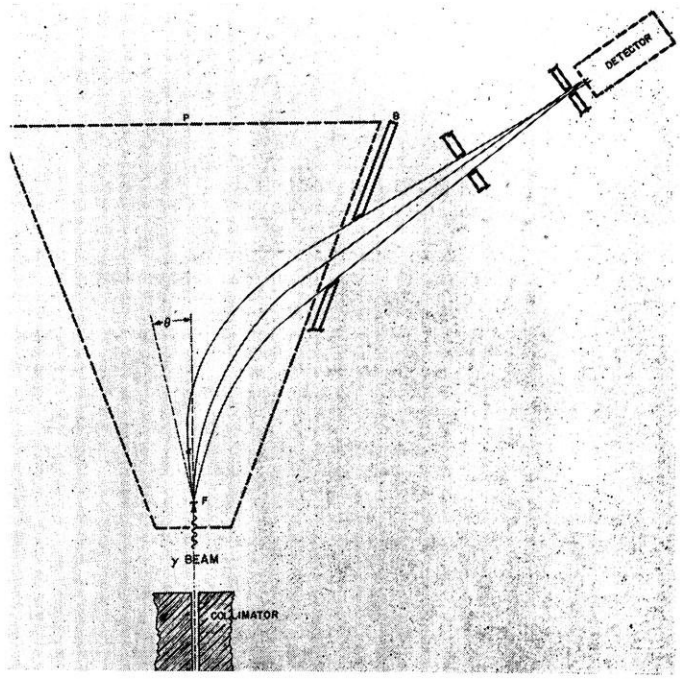
A new spectrometer developed by the National Bureau of Standards makes possible the accurate analysis of X-rays having energies between 0.2 and 12 million electron volts. The magnetic Compton spectrometer, designed and constructed under the direction of Drs. H. O. Wyckoff, **J. W. Motz***, and W. Miller of the NBS staff, operates in an energy range that bridges the gap left by other types of X-ray spectrometers. The data obtained with the spectrometer are used in studies of the X-ray absorption properties of various materials. It is expected that the spectrometer will also provide information leading to a better understanding of the nature of X-ray production.

The X-ray intensities and energies measured by the NBS magnetic Compton spectrometer are used in a determination of the amount of shielding required for protection against the dangerous radiations from high voltage machines and nuclear reactors. The Compton spectrometer was used in an analysis of the gamma-rays emitted from a U^{235} slug at the center of the Los Alamos water boiler and from the core of the "fast reactor". The results included a determination of the total energy release of gamma radiation from the U^{235} slug and the gamma-ray spectra from both reactors. The spectrometer also has been used to determine the X-ray spectrum from the Naval Ordnance Laboratory 11-Mev betatron.

The NBS magnetic Compton spectrometer consists essentially of an evacuated chamber composed of the wedge-shaped pole faces of an electromagnet. A collimated beam of X-rays is made to impinge on a window of beryllium foil. As a result of the interaction of the X-rays with the foil material, electrons are ejected from the foil with an energy and angular distribution dependent upon the energy of the incident photons. Only those electrons that are contained within a small solid angle in the forward direction of the beam are focused on a detector-counter by the magnetic field between the pole faces. The X-ray intensity and energy, is then computed from measurements of the magnetic field and the number of electrons striking the detector.

*Dr. Joseph W. Motz, physicist in the Bureau's nucleonic instrumentation section, received his B.S. degree in physics from the University of Wisconsin in 1941, his M.S. degree in physics from Cornell University in 1941, and his Ph.D. degree in physics from Indiana University in 1949. From 1942 to 1943 he was a junior physicist engaged in research on UHF triode generators in the Signal Corps Radar Laboratories, and from 1943 to 1946 he was a physicist at the Armour Research Foundation. He has written several technical papers in his field and is a member of the American Physical Society and Sigma Xi.

# of STANDARDS SPECTROMETER



Schematic diagram of the NBS magnetic Compton spectrometer. The collimated x-ray beam impinges on the beryllium foil F. Those electrons contained in a small solid angle θ in the forward direction of the beam are focused at the detector (right) by the wedge-shaped pole faces P. The baffle B may be adjusted to further restrict the angle of acceptance.

The pole faces and the window through which the incident photons are admitted are arranged so that the magnetic field is perpendicular to the direction of travel. The incident collimated radiation enters the evacuated chamber through an aluminum window. Auxiliary permanent magnets remove stray electrons produced in the aluminum window by the X-ray beam. The beryllium foil is located directly behind the aluminum window. As the X-ray beam impinges on the foil, electrons and positrons are ejected in all directions. The higher the energy of the incident photon, the greater is the concentration of the ejected particles in the forward direction.

The spectrometer is provided with a system of baffles so that only electrons ejected within certain angular limits are detected. The combined effect of the baffles and magnetic field is to focus the electron beam so that it can be detected by a scintillation counter. The magnetic field, which is measured by a rotating element and a fluxmeter, can be adjusted to known values. Knowledge of the magnetic field, the number of electrons striking the counter per unit time, and the solid angle through which they travel is sufficient information for computing the intensity and energy of the incident X-radiation.

The calculations required for a determination of the X-ray energies and intensities apply only to the electrons produced in the Compton process. At energies above 2 MEV, corrections to the measured counting rate must be made to account for the pair-production electrons, which are also ejected from the foil and detected along with the Compton electrons. Such a correction can be made at a given magnetic field strength by reversing the field and measuring the number of positrons.

The X-ray intensities and energies are determined on the basis of calibration measurements made with the gamma rays from a 10-curie source of Cs^{137} (0.661-Mev gamma rays) and a 1-curie source of Na^{24} (1.37 and 2.76 Mev). The effect of electron scattering in the beryllium foil and the geometry effect introduced by the foil width and length have been evaluated from studies of the line shapes obtained from different foil sizes when monoenergetic photons of the radioactive materials were incident on the foil. The absolute intensity of the collimated gamma-ray beam for each source was measured with an ionization chamber, and the measured values agreed within 5 percent with the values computed from the spectrometer measurements.

One of the significant factors in the performance of the NBS magnetic Compton spectrometer is the small acceptance angle of the spectrometer baffle. Because of this small angle, the Compton electron energy can be related uniquely to the incident photon energy. Another significant factor concerns the detection sensitivity of the spectrometer. To achieve a reasonably good counting rate with a small beryllium foil requires relatively high X-ray intensities. The resolution of the spectrometer, as determined by the 10-curie cesium source, can be varied from 3 to 30 percent by changing the geometry and the foil size.

On The Campus

by

Kneeland Godfrey, c'55

SAE

The December meeting of the Society of Automotive Engineers, held on the 16th, was highlighted by a talk by Mr. J. W. Vollentine which was entitled "Why Heavy-Duty Oil for Automotive Engines?" Mr. Vollentine is a staff engineer in the research department at the Caterpillar Tractor Co. He told the reasons why more thorough lubrication is provided by heavy-duty oils in today's high performance automobiles and unfolded the story of research that has gone into modern lubrications and oils. At this meeting an election was held for the purpose of selecting an SAE candidate for the Mechanical Engineers' representative to the Engineering Exposition to be held April 10, 11, and 12.

The fourth meeting of the group was held on January 14. The gathering was a combined meeting of the ASME and SAE.

Back in November, SAE got together in the Top Flight room in the Union to hear Mr. J. W. Collins from the Milwaukee office of the Aluminum Company of America speak on "Light Metal Applications in the Automotive Industry." He illustrated his talk with samples of Alcoa castings, such as pistons, clutch housings, carburetor bodies, etc. The group also saw a color movie entitled "The Old Curiosity Shop" and in the business meeting elected David S. Vinton as Polygon Board representative.

The Badger picture for the organization was taken November 12 together with ASME in order to reduce overhead and to meet the November 14 deadline for pictures.

James M. Karth was elected treasurer at the October meeting to replace Bob Traver, who didn't return to school this fall.

ASCE

Approximately 40 members of ASCE on December 10 heard Mr. Herried, the Chief Engineer at the Wisconsin Aeronautical Administration speak on "Airport Construction." He brought a movie of projects and complete airports to illustrate the talk. Election of officers was the main order of business, and the results are as follows: President, Harvey Elmer; Vice-President, Howard Anderson; Secretary, Fred Culver; Treasurer, Charles Fischer; Student Exhibits Chairman, Isaac Senior; Publicity, Robert Miller, Ed Zeeb, and Ed Garling.

The following meeting featured Mr. Adolph Ackerman, who will speak on a projected dam and power project in Brazil. The members wish to extend an invitation to all engineers to attend the meeting, which will probably be very interesting.

On November 20, seven members of the Society attended the regional conference of the ASCE. Mr. William Hart, regional representative of the American Institute of Steel Construction, spoke on trade associations and recent developments in the AISC. The members who attended are: Joe Been, Ed Olson, Elizabeth Jackson, Robert Weigand, Dave Hanke, Albert Isberner, and Jack Burke.

"Consultant Engineering Problems," a talk by Mr. Henry Hunt of Mead and Hunt Consulting Engineers, was given at the November 19th meeting. He related to his listeners the program engaged in by his firm and with this discussion kept all highly interested. Pictures were taken for the Badger—as a result attendance was very good, with 60 members and 3 faculty members present.

POLYGON

Polygon Board is the engineering students' representative on campus. It sponsors the St. Pat's Dance and this year for the first time since 1941 is sponsoring an Engineering Exposition. The Exposition will be held April 10, 11, and 12, in the several engineering buildings. The board screened candidates for co-chairmen and for six other positions to determine the directors of the event.

Private industry is being invited to show its wares before the student body and the visitors to the Exposition. Invitations are being sent to from 50-75 companies, which, it is

(*please turn to page 46*)

Using an electron tube developed by RCA, automotive engineers have perfected an instrument which automatically controls automobile headlights.

Out of the stars – a cure for headlight glare!

When RCA scientists developed an electron tube so sensitive that it could respond to flickering starlight, astronomers promptly put it to work in their studies of the Universe.

Called a *multiplier phototube*, RCA's invention now "takes to the road" in an instrument which will add to your safety when driving at night. The multiplier phototube is now being used in an *automatic control for automobile headlights.*

Here's how it works. RCA's tube, in a new system, sits behind your windshield where it can "see" approaching headlights. A car comes, and the multiplier phototube activates a system which shifts your headlights to low beam—returns them to high when the other car has passed. It's simple. It's completely automatic. And what's most important, it lets you keep your undivided attention where it belongs... *on driving your car.*

Development of the multiplier phototube is another example of how RCA research benefits you. RCA research assures you finer performance from any product or service of RCA and RCA Victor.

* * *

See the latest in radio, television, and electronics at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

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

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

Write today to College Relations Division, RCA Victor, Camden, New Jersey. **Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

RCA® *RADIO CORPORATION OF AMERICA*

World leader in radio—first in television

Takes a lot to lay a carpet in the jungle

The scene is "darkest Africa".

But Africa is lightening. Man's quest for minerals, for new areas for agriculture and trade, is slashing ultra-modern, glaring-white air strips in once impenetrable jungle.

Those pavers, portable air compressors, pumps and air tools—such as you might see working a city street—are Worthington Blue Brutes going to "lay a carpet" in that hole in the jungle.

Thus, Worthington, a major producer of equipment for public works, industry and farm, brings the fruits of American technical genius to the strange places of the world.

And illustrates, too, how the unique American talent of *diversification* helps public, employees and stockholders. For Worthington makes many things—not just construction equipment and pumps, but also engines, water works machinery, power transmission, petroleum equipment, air conditioning and refrigeration, many others.

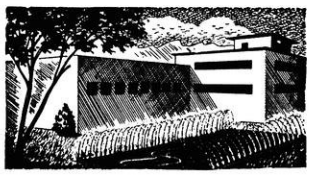
Such diversification builds *stability* . . . makes Worthington, 112 years old, a strong link in the chain of American business.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Harrison, New Jersey.

WORTHINGTON

The Sign of Value Around the World

1.14



Good Water and Sanitation—engines pumps • water treatment • comminutors air compressors • air tools

Lower-Cost Manufacturing—pumps compressors • steam turbines • motors power transmission • air conditioning

Petroleum Products—compressors engines • pumps • chilling equipment refrigeration • decoking systems

More Abundant Food—compressors fertilizer mixers • air conditioning refrigeration • pumps

MEET YOURSELF— 10 YEARS FROM NOW

Ever wonder what you'll be like when the class of '53 holds its 10th reunion? If you started to work for one of the Bell System telephone companies after graduation, we can give you a pretty good idea.

POSITION IN THE WORLD: On the way up! A Development Engineer with the Bell Laboratories. Perhaps exploring the application of fundamental new electronic inventions to telephone communications. A Transmission Engineer, helping to provide the telephone needs of an entire state. A Supervisor in the Traffic Department, responsible for the speed and quality of local and long distance service in several cities and for the personnel relations of a large number of employees. In the telephone company, jobs such as these are held by relatively young men and women.

FUTURE: Unlimited! The Bell System continually progresses and expands and its personnel grows with it. In the past 25 years, the number of telephones has almost tripled. In the past 5 years, telephone companies have introduced such things as network television transmission, radio-telephone service and dialing of Long Distance calls. And the best is yet to come.

FRAME OF MIND: Confident and proud! You'll be satisfied because you have a rewarding job . . . not only in pay and security . . . but in service. You'll be proud of your share in helping provide and develop a telephone service vital to the country's social and economic life.

Like the picture? For further information see your Placement Officer. He will be glad to give you details regarding the opportunities for employment in the Bell System.

BELL TELEPHONE SYSTEM

Sound - -

(continued from page 23)

Optical recording yields a better high frequency response at a given speed than magnetic recording on film. Another advantage is that no direct contact of the recording and playback head on the film is necessary and hence no wear or clogging can result. The sound track is easily duplicated by contact printing.

However, there are disadvantages to the optical system in light of the new magnetic methods. In order to play back the recording, the film has to be developed and hence no immediate monitoring of the recorded sound track is available. This system is relatively more expensive than magnetic systems.

The magnetic recording of the audio track has several advantages such as simplicity, immediate monitoring if desired, no processing, easily edited, and is economical due to both lower initial cost and the possibility of re-utilization of the same magnetic track.

The main disadvantage of this magnetic system as compared to the optical system is the fact that the head contacts the film with the possibility of wear. While magnetic recording systems may eventually become the method employed for recording sound on films, the optical method has a slight edge in regard to technical performance.

MAGNETIC RECORDING

Magnetic systems have broadened the horizons of audio recording and reproduction. Two types of magnetic recorders are prevalent, magnetic wire and magnetic tape. Magnetic wire consists of a stainless steel alloy drawn to a diameter of 0.004 to 0.0036 inches. Magnetic tape is the other type consisting of a special magnetic powder affixed to a paper or plastic base with a binder.

Several comparisons may be made between these two types or recorders in regard to various important factors that should be considered whenever an attempt is made to choose between the two.

Recording and playback speed and frequency response are related. Wire recorders have the wire travel at twenty-four inches per second while tape uses several different speeds, seven and one-half, fifteen, and thirty inches per second. The frequency response varies with the speed of the media, tape or wire, in that the faster the rate of travel of the media, the better is the frequency response. Experimentation has proven that while the response of wire at 24 ips is slightly better than tape at 7½ ips, tape with speeds of 15, 30, and now even 60 ips, is far superior in regard to frequency response.

The life expectancy of wire systems is longer than that for tape because tape is much more dependent upon the nature of the base material.

Along the same reasoning, atmospheric effects will tend to bother tape more than wire due to the nature of the plastic base material.

Drive techniques in both wire and tape systems are important much as in the lateral disc recording systems. However, here the media, whether tape or wire, must travel at constant speed, otherwise no true record of the actual event can be had. Also, editing could never be done if a constant drive were not employed. If the media were driven by the reels only, the linear velocity of the tape or wire past the recording head would increase as the take-up reel became larger due to continuous addition of material. Attempts to splice a leading portion of a recording into a later portion on the same reel or spool would meet with severe trouble since the speed at that point would be faster than that of the leading few feet of tape or wire. Therefore, capstan drive mechanisms were developed whereby the tape or wire is drawn between a driving spindle and an idler roller insuring that every inch of the media passes the recording head at exactly the same speed. Thus splicing and editing may be done anywhere on the reel or spool.

Magnetic recorders may be classified into two types, general purpose and special purpose recorders. The general purpose recorders are, for example, those used in homes, for secretarial work, and any others for use where the frequency range is not critical. Special purpose magnetic recorders, however, are the more expensive, exacting, and responsive to a wider range of frequencies than the other type. Their use is found in telemetering, shock and vibration recording, and computer work. Up to the date of this writing, a model with the frequency span of 200 to 80,000 cps has been produced by The Ampex Electric Corporation. Multichannel recording is another feature of these special purpose tape recorders wherein several channels or sources of information may be recorded simultaneously on one strip of tape. A very special arrangement using a multichannel machine has been devised such that the affect is almost true realism upon playback. This system will be discussed at greater length later.

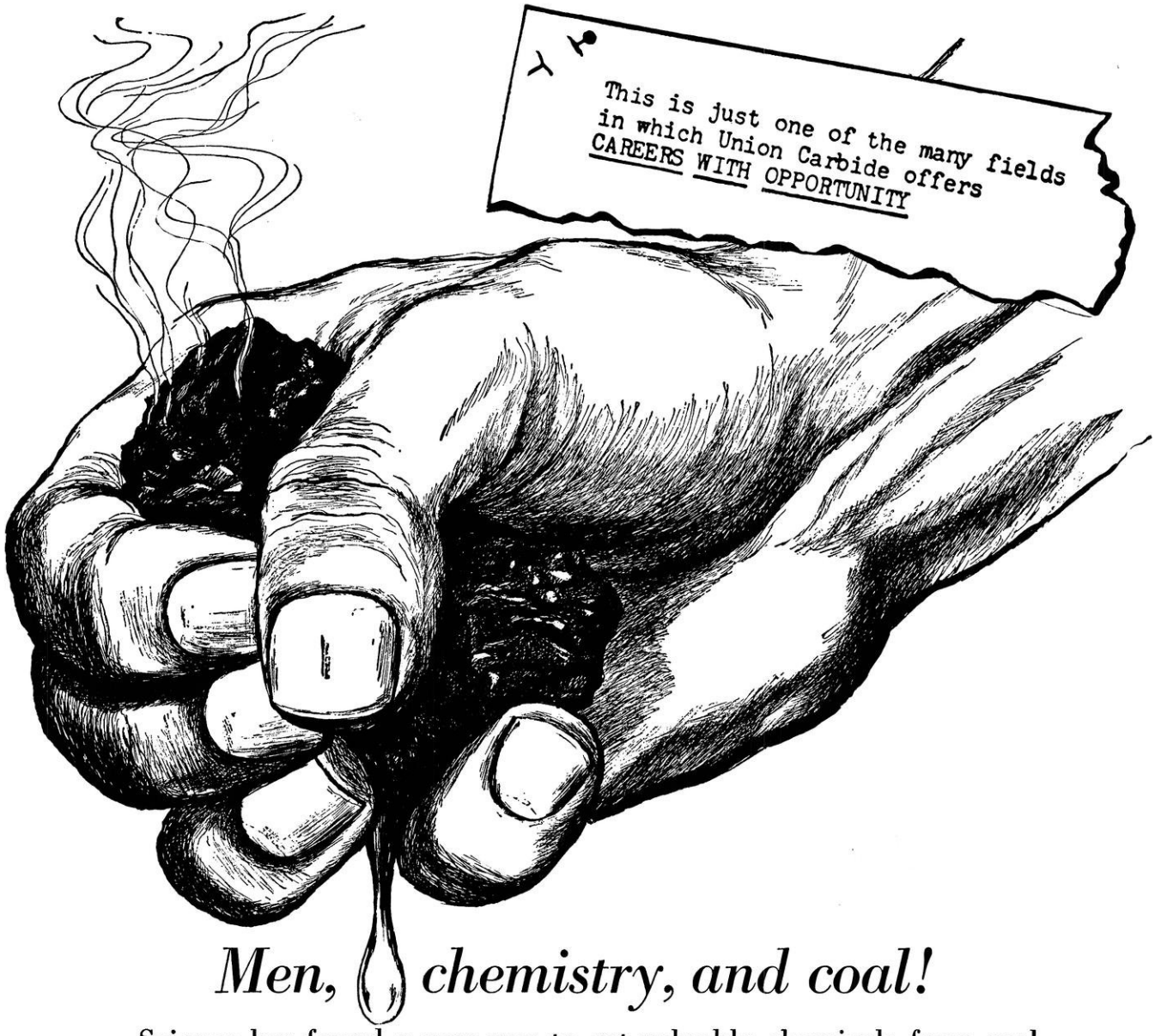
MICROPHONES

The chain of components in the recording and reproduction of sound has another portion composing the "input" link. This portion is the microphone which converts sound energy into electrical energy. Several types of microphones are available and these can be classified into three main types, the carbon, the crystal, and the dynamic.

Carbon microphones, similar to the telephone transmitters, operate on the basis that as the pressure of the sound waves cause the diaphragm to compress and release the carbon granules, the resistance decreases and increases accordingly, thus allowing more or less current to flow through the circuit. The carbon mike is quite rugged and has a high output level.

Crystal microphones use Rochelle salt crystals in the form of two slabs. These slabs, then, respond to a bending stress. The output of this type of microphone can be fed directly into the grid of an amplifier tube. One main objection to the use of the crystal microphone is its temperature limitation. Operation is ceased above 130 degrees Fahrenheit due to the softening of the crystals.

(please turn to page 44)



Men, chemistry, and coal!

Science has found a new way to get valuable chemicals from coal

Science has at last found a practical way to convert coal into the host of valuable chemicals that nature locked into it.

The people of Union Carbide have developed a way to bring coal and hydrogen gas together under carefully controlled heat and pressure. In minutes, this revolutionary process—called *coal hydrogenation*—converts the coal into a mixture of gases and liquids that are rich in useful chemicals.

A WEALTH OF RAW MATERIALS—Among them are hitherto scarce, and even completely new, chemicals. Some are raw materials for plastics and synthetic rubber, or are vital to medicine and vitamins. Some are valuable in rocket propulsion. Others are necessary in insecticides, surface coatings, and many other important uses.

A NEW SOURCE OF SUPPLY—Today, Union Carbide's coal-hydrogenation process promises steady and vastly increased production of chemicals for these needed materials. What's more, it will provide a host of chemicals that may become the basis of many new products.

A UCC ACHIEVEMENT—With the first coal-to-chemicals plant of its kind in operation, the people of Union Carbide are now well on the way to making abundant coal a source of chemicals important to us all.

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Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of ALLOYS, CARBONS, CHEMICALS, GASES, and PLASTICS. *Ask for booklet A-1.*

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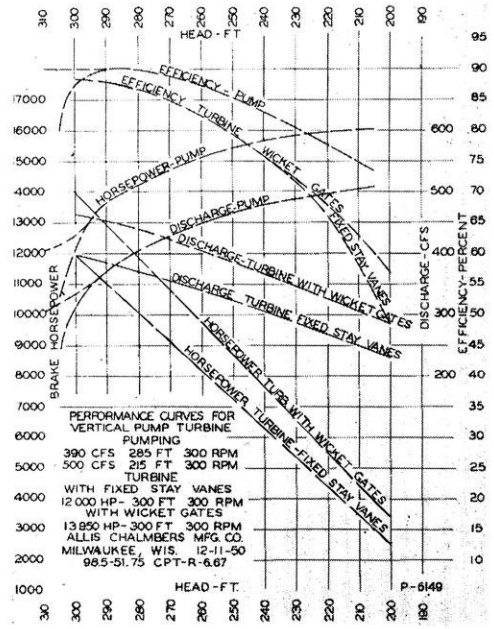
EVEREADY Flashlights and Batteries • NATIONAL Carbons • ACHESON Electrodes • PRESTONE and TREK Anti-Freezes

Pumped Hydro-Electric--

(*continued from page 19*)

The pump turbine consists of a single runner hydraulic unit connected to a single motor/generating unit. It is designed to operate as a centrifugal pump rotating in one direction for pumping water from a lower pond or suction pool to an upper pond or storage pool and then operating as a hydraulic turbine rotating in the opposite direction using the stored water under the head between the two pools and converting it into hydro-electric power. The generator used for generating power is also used as a motor for pumping.

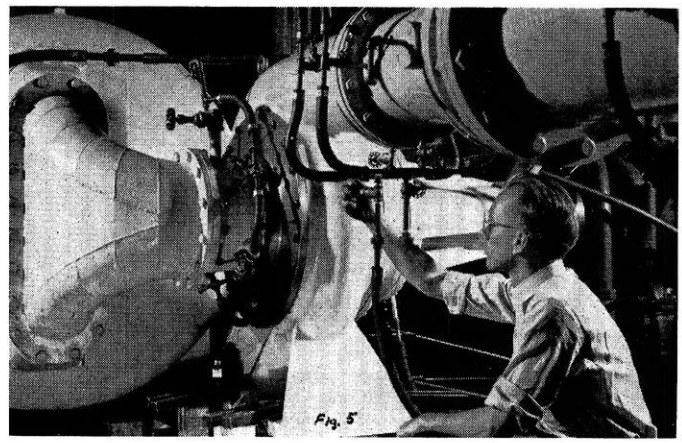


Performance curves for pumping and turbine operation for a reversible turbine rated 390 cubic feet per second at 285 ft. head, or 13,950 hp at 300 ft. head are shown in Figure 4. Due to the inherent design of the runner, the generator/motor and turbine can be designed to operate safely at 75 percent overspeed. This gives an ample margin over the maximum overspeed expected and results in a saving as compared to the convention hydro-generator that is usually designed for 100 percent overspeed.

Model tests of a reversible pump turbine being built by Allis-Chalmers Manufacturing Company for the United States Bureau of Reclamation's Flatiron power and pumping plant on the Colorado Big Thompson project have been completed. The pump turbine model, figure 5, has shown creditable efficiencies as a pump and turbine. Higher efficiencies are expected in the prototype under actual operating conditions.

Need Varies With Location

The site can be located on or near any stream where sufficient head can be developed and have enough flow to make up evaporation and leakage losses due to operation. The power plant can be constructed across the stream or parallel to the stream and the reservoir can be formed by a dam across the stream or by excavating the earth on top of some bluff. Pumped storage is ideal for power plants located along the shore of a large lake



View of model test reversible turbine from draft tube side. Prototype rating 370 cfs, 240 ft hd, 300 rmp as a pump; 12,000 hp, 290 ft hd, 257 rpm as a turbine, for U. S. Bureau of Reclamation Flatiron Power and Pumping Plant.

where water is plentiful and the bluffs are naturally adapted for reservoirs. The only limiting factor of capacity for the pumped storage unit is the amount of pumping water that is available.

Flexibility of the pumped storage unit makes it possible to be located near the load center whereas, the cost of construction of a conventional hydro-plant would be economically unsound.

Flatiron Is First U.S. Reversible Pump Turbine

The first large reversible pump turbine unit to be used in the United States is now being built at Allis-Chalmers. This unit will be installed in the Flatiron Power and Pumping Plant of the Bureau of Reclamation, Colorado Big Thompson Project. In this power and irrigation project, water is pumped from the headwaters of the Colorado River on the west side of the Continental Divide and flows through a tunnel to the east slope where a series of hydro power plants utilize the 2,800 foot available head.

The reversible pump turbine will be used primarily for irrigation and will pump water from the tail race of the Flatiron power plant into the project's Carter Lake reservoir. During periods when the pump turbine is not used for irrigation, it will operate as a turbine and supply peaking power to the electrical system in northern Colorado, Wyoming and Western Nebraska.

The reversible pump turbine is rated to pump 370 cubic feet of water per second at 240 ft. dynamic head and will be used over a range of head from 170 to 300 feet. When operated as a turbine, it will generate about 12,000 horsepower at 290 ft. head and will operate over a range of head from 290 down to 140 feet.

The unit is unique in that it will operate at 300 rpm when pumping and 257 rpm when generating power and will have a motor to drive the pump which will also serve as a synchronous generator. It is scheduled to be placed in operation in 1953.

The Flatiron power and pumping plant is situated in the foothills of the Rocky Mountains about 11 miles southwest of Loveland, Colorado.

(*please turn to page 42*)

How to Choose a Boss--

(continued from page 27)

5. Is the appearance of his establishment satisfactory?

Take a look around and decide whether this is the kind of place you want to work in. Look to see whether the equipment is reasonably up to date and efficiently utilized. Look to see whether work rooms are clean and at least halfway attractive—places where some effort has been made to put employes in surroundings that encourage good work habits. Is it a place that looks cared for with pride or is it run down or neglected?

6. Is he thinking of your future?

This job that he is discussing may be a dead end, or it may lead somewhere. Which it will be depends largely on you, of course, but the boss is a factor to reckon with, too. Keep an ear cocked to see whether opportunities for advancement are mentioned. If he's a smart boss, he'll see to it that you know of them. Then check up on these points:

First, will you be put through some kind of training program? If so, a point in his favor. He is interested enough in you to equip you to do a good job, and he probably considers you a permanent acquisition.

Second, where does he get his supervisors and high brass? If they've come up from the ranks, good. You'll have a chance to do the same. But worth-while employes don't stick around very long with an outfit that always imports the high-priced talent from outside.

7. Is he a clock watcher?

You can expect any boss to require you to start, eat lunch, and quit at fixed times. But find out just how persnickety he's going to be about it.

Will it take an act of Congress to get you out of the office long enough to catch that all-important once-a-year department store sale? Will it cost you an hour's pay to have a flat tire on the way to work in the morning? Will every trip to the water cooler produce a frown and a harumph?

Then turn him down. Don't expect to find a boss who will let you do as you please or wink at frequent rule infractions. But do look for one who tempers his time clock with common sense.

A petty point? Nope. Look it up in the personnel books under M for morale. A good boss knows the value of morale.

An institution is the lengthened shadow of one man.
—Emerson

8. Does he have a stable employment record?

He'll be scanning your employment record, to see whether you've had too many employers in too short a period of time. Now you take a look at his employment record—to see whether he has had too many new employes in too short a period.

The turnover rate is the technical name for what you are investigating. If it is high—if a large number of employes are always leaving and a large number of new ones constantly coming in—that's a black mark for the boss. Makes no difference whether the exodus is due to firings or quittings.

A high turnover may mean that the boss is careless about selecting, placing and training employes. It almost certainly means that employee morale is shabby.

So pick the employer with a low turnover rate. He hires people he is pretty sure he wants; and once hired, they stick by him.

9. At your interview was he punctual and poised?

Make a few allowances because bosses are sometimes busy people who can't always control their own time. But in general:

Beware of the man who keeps a 2:30 appointment at 3:20, who is harassed and hurried, distracted by constant interruptions, overloaded with work.

Pick the one who greets you approximately on time and proceeds to a calm, efficient, well-conducted interview.

Why? Because a good boss is on top of his job, not under it. Chances are that your harried and hurried prospect isn't as good as he should be at planning and organizing. Chances are that he doesn't know how to delegate responsibility properly and is bogged down in too much detail. Perhaps he hasn't got that all-important knack of keeping cool and collected during heavy going. Perhaps he just isn't suited, by temperament and personality, for a boss's job and hence has difficulty keeping up with it.

You'll be safest with the man who seems to have an executive talent for keeping things running smoothly and without strain.

10. Will he pay you what you are worth?

Well-almost as much as you're worth, anyway.

Pay isn't the most important consideration in the world. Pick your boss by his wage scales alone and you may be disappointed. But it is far from being the least consideration, either.

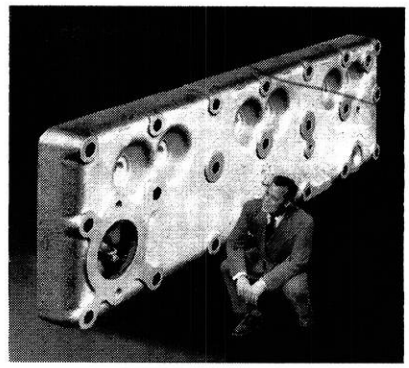
First of all, a good rule of thumb is to pick the man who pays approximately the going rates for various job classifications, and explains how pay is determined. Be suspicious of the one who offers too much—at least until you find out why he's so free with his cash. Spare yourself the character who grimaces with pain at the mere mention of money and lectures you on how he was happy to get $4 for a 75-hour week when he was starting out. During Grover Cleveland's second administration, it was.

In the second place, try to find a boss who has established machinery for keeping track of how much you are worth after you go to work for him, and for adjusting pay accordingly. In other words, look for the man with some kind of formal or informal merit-rating system. He, too, is out to identify and reward the better-than-average employee.

Skip the boss who passes out raises and promotions on the basis of guess, impulse and office politics. He's out of style and doesn't know it.

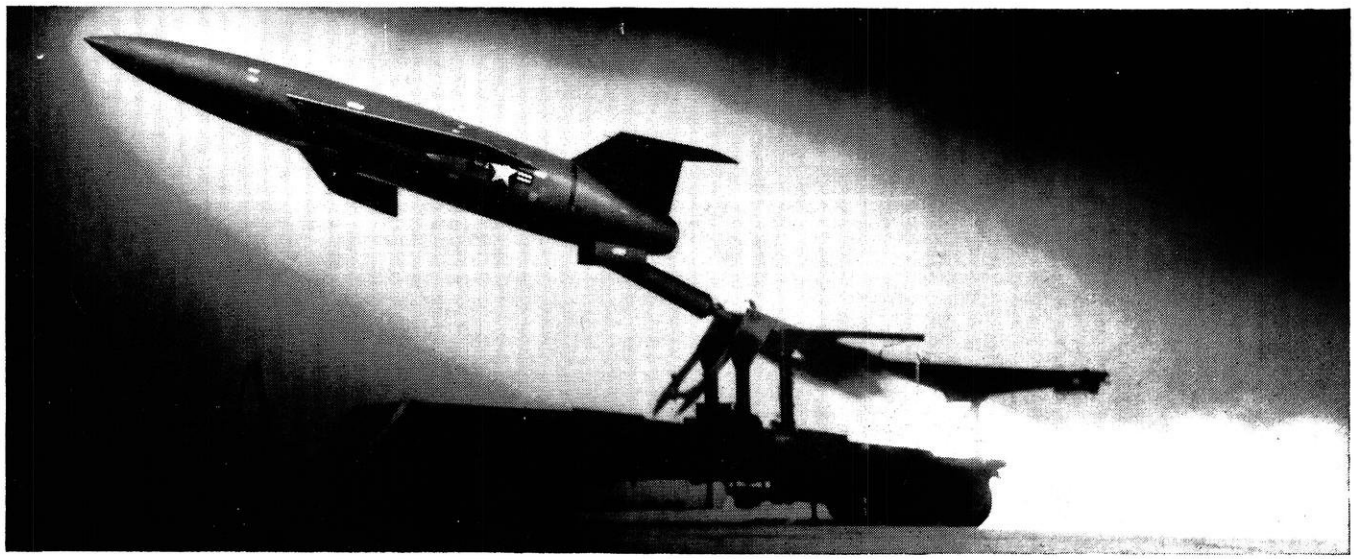
(please torn to page 56)

Here's where CARBORUNDUM *is going with "man-made minerals"*



CASTINGS ARE IMPROVED in machinability when FERROCARBO, a deoxidizer used in metallurgical processes, is added to the molten metal. This product by CARBORUNDUM is effective in producing the clean castings essential to today's unusual requirements.

Made by the Bonded Products and Grain Division



ROCKET EXHAUST LINERS are among the developments by CARBORUNDUM that take over where ordinary materials are inadequate to the task. Produced from *"man-made minerals,"* this super refractory product is highly resistant to the extremes of abrasion and high temperature produced at the rocket nozzle. Super Refractories have been developed by CARBORUNDUM to increase output and reduce operating costs where high temperatures, resistance to abrasion, corrosion or erosion are important factors.

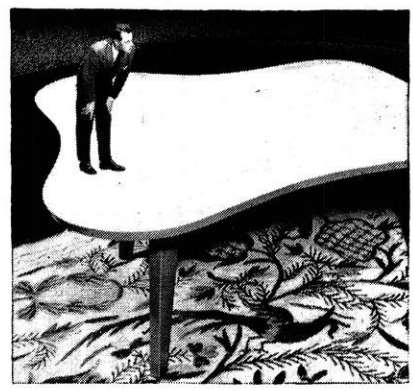
Made by the Refractories Division

POWDER METALLURGY is a field of interesting new developments. These gears are produced by sintering powdered metal in furnaces equipped with GLOBAR silicon carbide electric heating elements. Having extremely high electrical resistance and no known melting point, the heating elements make it possible to attain high heats under accurate control.

Made by the GLOBAR Division

FURNITURE MAKERS are now using the new extra-hard finishes for increased beauty and durability, aided by RED-I-CUT Waterproof Abrasive Paper developed by CARBORUNDUM. This tough new paper cuts faster, gives a better finish and, as an enthusiastic shop owner expressed it, "more mileage than anything we have ever used."

Produced by the Coated Abrasives Division



Searing flame and erosive gases make life incredibly short for uncooled rocket blast tubes.

Problem without precedent: how to protect the tubes without using costly alloys. Experiment, testing and imaginative thinking resulted in a solution by CARBORUNDUM—molded super refractory liners. Molded, then baked, they must emerge from the oven with tolerances of which a machinist might be proud.

Problems without precedent are the kind we like. In fact our business was born with the invention of a material without precedent, the first "man-made mineral." This was silicon carbide, a product of the electric furnace, which has since become familiar the world over in products by CARBORUNDUM.

Your own concern with "problems without precedent" is the reason why we bring you this message here. Whether you are a potential customer of CARBORUNDUM or a potential member of our great engineering staff, we welcome your interest—and your inquiries.

Look to* CARBORUNDUM** TRADE MARK ***for the real news about "man-made minerals"

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Products by CARBORUNDUM include Grinding and Cutting-Off Wheels, Discs and Sticks... Coated Abrasive Sheets and Belts... Waterproof Abrasive Paper ... Abrasive Grain and Powders and other abrasive products... Electric Heating Elements and Ceramic Resistors... Grain and Briquettes for deoxidizing steel and iron... Super Refractory Bricks, Special Shapes and Cements... Porous Filter Media and Diffusers—and are marketed under the following trademarks:

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Pumped Hydro-Electric--

(continued from page 38)

Power Market Analysis

The pumped storage system is an economically feasible method of supplying additional premium price power during peak load periods. In an average installation the ratio of return from generated power will be about 200 percent due to the inherent high efficiencies and the price differential between peak and low demand periods.

The first installations will probably be made in large industrial areas having a saturation of hydro plants, in hilly regions where land for reservoirs can be bought cheaply, and in arid or semi-arid regions where water is at a premium. Pumped storage systems have seen considerable usage in South America. The mountainous terrain, abundant waterfalls, and high water heads favored such installations although multi-stage pumps often had to be employed. It is interesting to note that one experimental model of a single, reversible pump turbine was installed in Brazil shortly before World War II.

Many cost computations are compared on a per kilowatt hour basis without due regard to peaks, in spite of the fact that the peak demand practically determines the cost per kilowatt hour. The plant factor or capacity factor is the ratio of the average load to the rated capacity of the plant and the utilization factor is the peak load expressed in percent of capacity. The load factor, however, is the ratio of the average power to the peak power and has no relationship to the capacity of the plant. The shape of the load curve that shows the distribution of the demand during the year determines the load factor. It also determines the peak capacity of the required installation and the size of the pond necessary to regulate the flow properly.

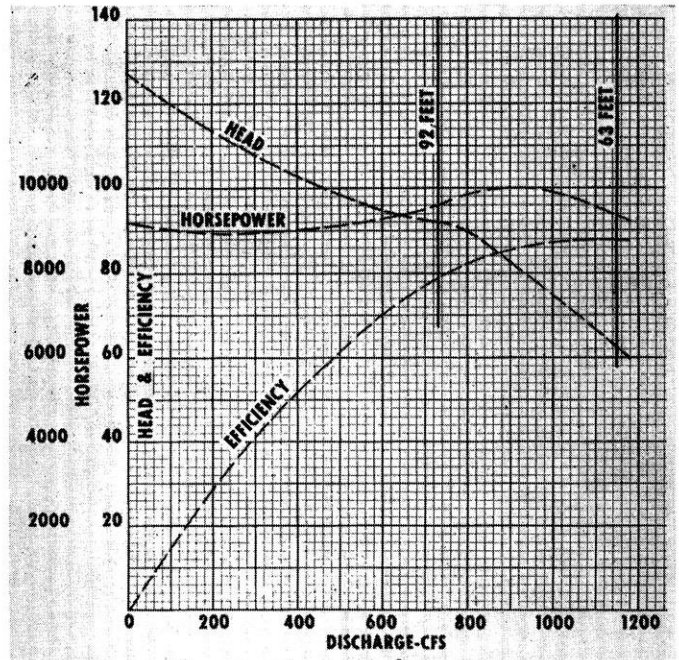
Example Shows Economic Advantages

As an example of the pumping and generating cycle, suppose there is a unit required to supply an average of about 5,000 kw at 163.6 rpm for an eight hour period. There is a static head of 90 ft. between the full storage pond and the suction pool when it is drawn down to its lowest level.

The friction loss on the system is about 3 feet. The net head at the start will then be 87 feet. The expected output of the unit at the beginning of the period will be 9,450 hp or 6,750 kw at 96 percent generation efficiency and the discharge 1,100 cubic feet per second. The expected turbine efficiency would be 87 percent and the generator efficiency about 96 percent at 0.9 power factor. Figure 6 shows the performance curves.

At the end of the period, the static head is 60 ft. with storage pool drawn down and the suction pool now filled. Assume the system friction head is two feet which gives a minimum net head of 58 feet.

At the end of the power period, generation will be 4,825 hp or 3,450 kw and discharge 910 cubic feet per second.



Expected pumping performance curves for pump-turbine at 1150 cfs, 63 ft. head and 163.6 rpm. Fig 6

Thus, during the eight hour period, the output will gradually vary from 6,750 kw to 3,450 kw and will develop an average of 5,100 kw or a total of 40,800 kilowatt hours. The amount of water used during the eight hour period will vary from 1,100 cfs to 910 cfs, or an average of 1,000 cubic feet per second or 3,600,000 cubic feet per hour. For an eight hour period, this would require 660 acre feet of water.

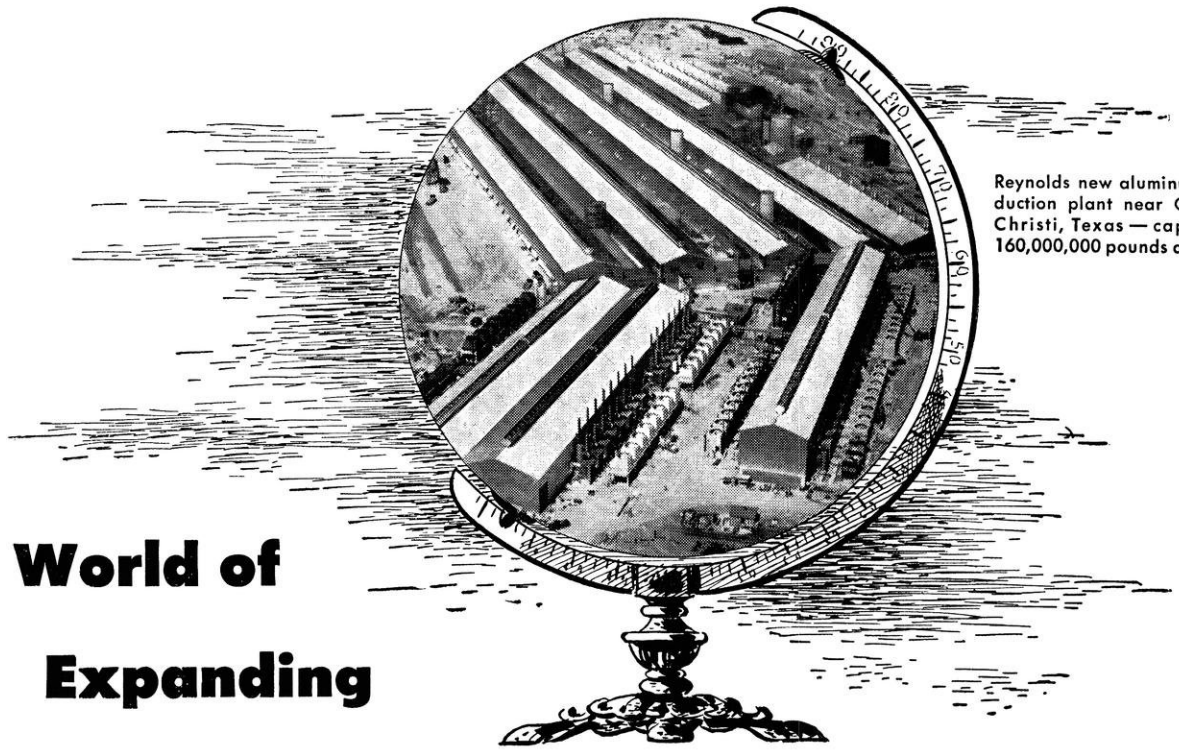
At the start of the pumping cycle, the static head is 60 feet plus three feet friction loss so the dynamic head is 63 feet.

At the end of the pumping period, the static head will be 90 feet plus a two foot friction loss or a dynamic head of 92 feet. The discharge against 63 ft. will be 1,150 cubic feet per second and at 92 feet, 730 cubic feet per second. The average discharge pumped will be 940 cfs, or 3,380,000 cubic feet per hour. The pumping period would have to be 3.6/3.38 times eight hours or 8.53 hours.

The average power required for pumping will be about 9,700 brake horsepower. During 8.53 hours, 82,700 horsepower hours or 64,300 kilowatt hours will be consumed at 1.0 power factor. The motor efficiency is assumed at 96 percent. If the power for pumping costs four mills per kilowatt hour, the total cost for pumping will be $257.00.

The generated power can be sold for about 1.25 cents per kilowatt hour during peak load. Then 40,800 kilowatt hours of generated power will be worth $510.00 or the ratio of return from generated power will be about 200 percent.

(please turn to page 50)



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

A World of Expanding Opportunity!

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

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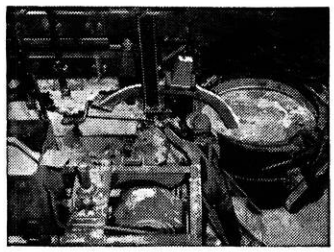
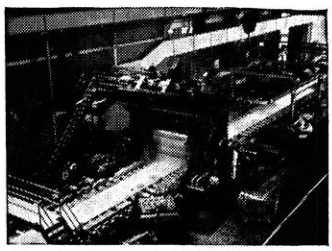
On-the-job training is the Reynolds policy—after preliminary orientation which may include basic experience in production plants for sales personnel, and sales office work for technical trainees. Liberal insurance, hospitalization and retirement programs are maintained.

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

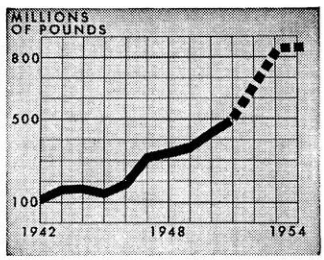


Tapping one of huge battery of electrolytic cells



Sheet rolling—reverse hot mill in operation

REYNOLDS ALUMINUM



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

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Sound - -

(continued from page 36)

Dynamic microphones are moving coil instruments used where good frequency response, case of handling, and ruggedness are important. Essentially these mikes are pressure microphones.

Following the trend of the times, the present microphones have become attractively streamlined objects, no longer resembling a "pie-plate on a stick".

The placement of microphones is an important factor to keep in mind in connection with the use of sound systems, especially so when attempting to use an audio system to its extreme capabilities and still have quality reproduction. A microphone may be non-directional, hence used for all group pickup, or it may be bi-directional, picking up sounds from both the front and the rear, or the microphones may be uni-directional and thus used for stage and auditorium operation. Recently television has created new demands on microphone development such that a microphone might not be objectional in appearance in front of the camera. The result of research and development was the "Starmaker" microphone which is a slim, easily concealed, light-weight microphone.

Present development trends are toward microphones that are more highly directional and as such will allow longer range pickup and, especially in television, allow greater freedom of camera action. The objective of microphone design has always been to meet the conditions established by usage.

Pictured are five different RCA microphones showing design progress from 1938 to 1952. Top Row—Left: 1938, the RCA 77-C universal (ribbon type) microphone, a predecessor of the famous "77-D"; center: 1944, the popular RCA 77-D ribbon type, which may be used as a bi-directional, non-directional or uni-directional microphone; right: 1948, the RCA KB-2C "Bantam" velocity microphone, designed for studio or remote use. Bottom Row — Left: 1950, the RCA KB-4A "Starmaker" microphone, a ribbon-pressure type, designed especially for television use; right: 1952, the latest RCA microphone to be introduced is the BK-1A pressure type, successor to the "88-A".

Superfinish - -

(continued from page 25)

to render the surface plastic, when the peaks of the roughing grinder ridges may actually be flowed into the valleys. Steel mill rolls, for example, have very often been found subject to this condition.

4. The torn condition of surface due to the inefficient cutting angles of grits, which is called "fragmentation" and "splintering".

In contrast to the "superfinishing" process of cold rolling steel, objects are not Superfinished for appearance as much as for reduction of wear and efficient operation of machinery. While the lustre and shine of cold rolled steel appliances are apparent in everyday use the smooth finish of the Superfinished bearings and pistons do not go unnoticed by the engineer who realizes the importance of longer machine life and more efficient operation.

Superfinish is an abrasive process which is used in the surface refinement of cylindrical, flat, spherical, conical, and tapered parts. In Superfinishing a considerable area contact is used. For example, it is usual to employ a stone for cylindrical work that is 60 to 75 % of the part diameter in width and often the same length of the surface to be finished. With such a large area of contact, the imperfections of grinding, such as chatter and feed marks, are completely removed, along with metallurgical defects, such as "burning".

Instead of employing abrasive speeds exceeding 6000 feet per minute, as in the case of grinding, 80 feet per minute, is seldom exceeded in Superfinishing. Also positive pressure is not used; the abrasive is held in contact with the work under flexible pressure of 10 to 40 pounds per square inch of area. The usual work speed is 50 to 60 feet per minute accompanied by a flood of low viscosity liquid. Under these conditions there is no appreciable production of heat to alter the metallurgy, nor of violence to disturb and fragment the crystaline structure of the metal surface.

A unique feature of Superfinish, is the fact that it will remove the roughness of a ground surface, produce any reasonably selected smoothness, then automatically cease removing metal. Thus, if it is desired to produce the smoothest kind of surface there is an automatic cycle of rapid stock removal, followed by a progressive production of reflectivity. Application of the stone to another rough part will repeat the cycle.

The abrasive is either a bonded stick for cylindrical or conical shapes or a bonded cup wheel for spherical or flat work. The stone is somewhat softer than the wheels used in grinding. As the operation proceeds the stone is worn to the average radius of the part. This feature is not found in any other form of surface finishing and is the most valuable one concerned. With Superfinish the surface has none of the irregularities of the ground finish, as

(please turn to page 56)

Let's keep the record straight

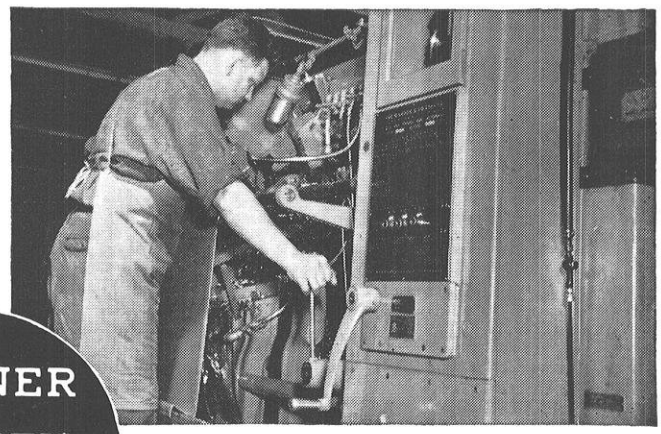
There has been too much loose talk about prices, wages, dividends, taxes. Let's see.

Compare 1939 (the last normal year before the war) to 1951 (the last year for which there are figures).

Prices have gone	**up**	**86%**
Weekly earnings of production workers	**up**	**172%**
Dividends of corporations	**up**	**148%**
Federal Taxes	**up**	**843%**

By the use of more efficient machines, industry has been able to increase wages twice as much as prices have risen, and has increased dividends to its millions of owners. If you don't feel that much better off, put the blame where it belongs . . . on taxes. Authorities say 10 billion dollars could be cut out of those taxes without affecting government safety or service a particle.

Remember the figures. Just for the record.



WARNER & SWASEY
Cleveland
Machine Tools
Textile
Machinery

Sources: Tax Foundation; U. S. Department of Labor; Annual Report of the Secretary of the Treasury and The Budget for the Fiscal Year, 1953.

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY TURRET LATHES, AUTOMATICS, AND TAPPING MACHINES

Campus - -

(continued from page 32)

hoped, will prepare displays to represent their products. The ME building, with its large central floor space, where advanced work on wind velocity and refrigeration is now being done, is going to be cleared of its equipment to make way for exhibition displays, as will the lobby, if found necessary.

The profits will be divided up in the following manner: One-third is to be kept by Polygon to pay for trophies to be awarded to individual exhibits and another third will be split up among the seven engineering societies after each has put a minimum amount of work into the exposition. The remaining third will be given on a merit basis to the five engineering schools, the school putting in the most time above the minimum receiving the largest share. At press time it had not been decided how much work will constitute a minimum, but at any rate it will be considerable, so each man in the societies will be needed to complete his group's work. Polygon plans to lend money to any society which needs it in order to complete its display, so the societies have no reason to hold back for lack of funds.

A Button Contest in connection with the exposition is to be held, with prizes being awarded for the first, second, and third choices. Chairman Richard Potts, EE 4, can offer assistance to those needing it in selection of a subject. The theme desired is something on scientific lines such as a rocket to the moon or any other clearly depictable idea. Anyone interested is invited to compete in the contest.

The St. Pat's Dance is to be held March 14th following a basketball game the night before. Again this year Polygon will conduct a contest to determine the best and biggest beard on the engineering campus. Challengers from the several engineering schools will vie for honors to succeed Charles Yderstad, a Civil Engineer, who was last year's champion. Since buttons are being sold in connection with the exposition this year, there will be none for the St. Pat's Dance.

Each society will be expected to sell as many tickets for the dance as possible, since it is the only source of revenue from the dance. The method of picking the beard contest winner is still unsettled, for there are several contradicting viewpoints. Dave Vinton, a Sophomore ME, is general chairman of the dance.

At the December 9th meeting, Polygon elected the following officers for the second semester: President, Allen Schmidley, EE4; Secretary, Bob Hanke, CE 4; Treasurer, John Frenck, M&Met. 4.

Science - -

(continued from page 28)

AUTOPILOT ON NEW JETS

The first automatic pilot with unlimited maneuverability is installed in the new F-94C Starfire jet warplane that the Lockheed Aircraft Corporation announced recently. It was developed by the Westinghouse Electric Corporation in cooperation with the Air Material Command's Armament Laboratory, Control Equipment Branch.

These gyroscopes, spinning at 12,000 rpm, follow the plane's movements during all maneuvers without any possibility of tumbling. They differ in this respect from the ordinary 'position' gyro that is not locked to the plane and hence stubbornly resists any effort to change its direction of motion. As a result, former gyros were sensitive only to changes in angle of the plane, whereas the new autopilot equipped with 'rate' gyros responds to the rate at which such changes take place.

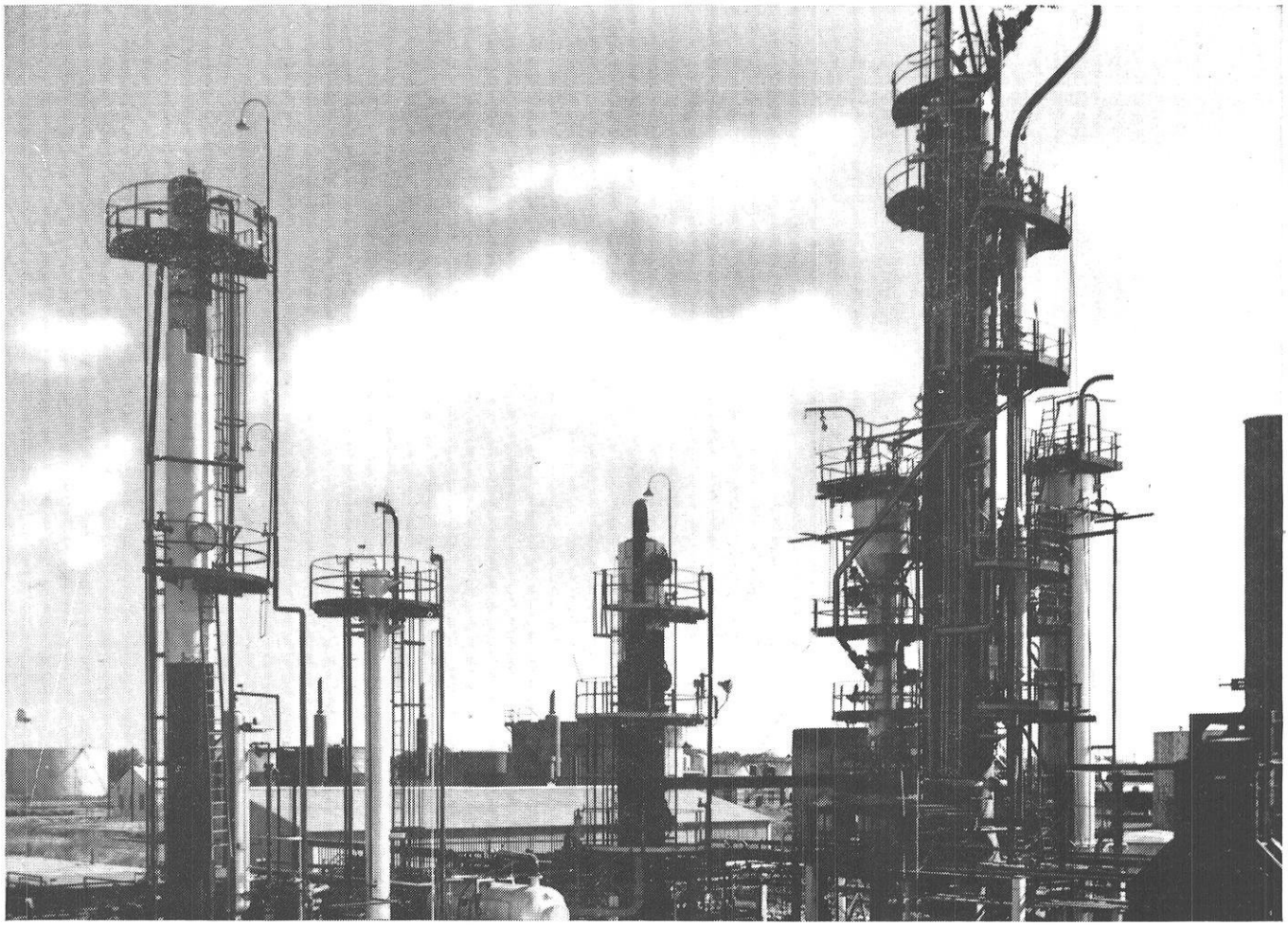
Virtual finger-tip control, consisting of a single control knob, is provided by the flight controller of the autopilot. For normal flying, the autopilot is arranged for completely coordinated flight. To climb, the pilot simply pulls the knob back and the plane climbs at a constant rate, regardless of external conditions. To turn, he rotates the knob either right or left, the rate of turn depending on the amount the knob is turned, and the correct bank angle being automatically set.

For combat tactics, the pilot switches the autopilot to a stage of complete maneuverability. The control reacts to the pilot's signal in less than one-fifteenth of a second. At the high speed of modern planes, considerable force is required to move control surfaces such as elevators, ailerons, and rudder. To aid the pilot in manual flight, hydraulic controls multiply the pilot's effort some 15 times and convey it to the control sufaces.

The autopilot works through this same system in automatically piloting the aircraft. It is tied into the plane's radar and instrument landing system, helping it to track enemy targets automatically and to land in bad weather.

The autopilot is suitable not only for military aircraft, but also for large and small commercial planes. Radio-controlled, it can also serve to direct the flight of guided missiles and pilotless aircraft.

The F-94C jet plane, now being produced by Lockheed for the U. S. Air Force, has a top speed of "more than 600 miles per hour," and is the first U.S. fighting plane ever to have all-rocket armament. It carries 24 2.75-inch rockets.



THE WORLD'S FIRST fluid hydroformer went into operation in November at Destrehan, Louisiana — an important event in the history of civilian and military fuels. It produces high-octane aviation gasoline blending stock.

A Marriage of Engineering Techniques

ENGINEERING INGENUITY has been, and will be, a key to American industrial progress. In the petroleum industry, a specially shining example of such ingenuity is the recent marriage of two already successful techniques.

Issue of this union is a rewarding off-spring —the fluid hydroforming process.

Fluid hydroforming's genealogy stems from two processes with long-established success in refinery use:

FLUID CATALYSIS—First applied to catalytic cracking. The uniform bed temperature inherent in the fluidized-solids technique permits selection of just the right reaction conditions.

HYDROFORMING—Used to upgrade virgin naphtha by converting naphthenes and other low-octane materials into high-octane aromatics. Has always employed catalyst in fixed beds.

It wasn't easy to combine these two processes, with their widely different histories. But eventually petroleum chemists and engineers perfected fluid hydroforming, a new process with the advantages of both its ancestors. It produces large yields of high-octane gasoline.

Since Standard Oil helped pioneer the two parent techniques, it is fitting that a company subsidiary, the Pan-Am Southern Corporation, should be the first to put the combined method to commercial use.

Fluid hydroforming is another example of the many opportunities for the company's research and development staff to apply their technical training—and to gain a sense of real accomplishment from their work.

Standard Oil Company

910 South Michigan Avenue
Chicago 80, Illinois

STANDARD

Sound - -

(continued from page 44)

THE AMPLIFIER

The main link in the chain of audio recording and reproduction is the amplifier. While there are several components in the sound system, the amplifier is the most important. The function of the amplifier is to build up the electrical energy received from the input, microphone, phonograph, or other source.

So many types of amplifiers exist, whether voltage amplifiers—to boost the voltage, or power amplifiers—to sufficiently increase the power of the input signal in order to operate a loudspeaker, that it would be a textbook in itself to try to analyze the amplifier in this rather birdseye view of the whole recording and reproduction industry. One main precaution should be kept in mind when assembling one such high fidelity recording or reproducing system; the frequency range of the amplifier should be sufficient to cover the needs of its particular applications.

However, while the amplifier is the main link of the chain or components of the audio system, it has to be supported by the remaining link.

SPEAKERS

The last link or component in the recording and reproduction of sound is the loudspeaker which converts the electrical energy back into sound waves.

Before this electrical energy from the amplifier can appear as sound waves eminating from the speaker, some means of connection must be employed. Transmission lines and transformers serve to relay the sound to the final component load. Low impedance lines (low resistance to the flow of energy) may be used directly to connect the speakers to the amplifier. However, for longer lines, where high resistance to the flow of energy is encountered, transformers are used. Long lines would create appreciable power loss, possibly total power loss due to the high impedance, if transformers were not used. Matching transformers serve to reduce power loss to a minimum attainable. Several precautions should be observed when using transformer matching. The power rating of the matching transformers must be adequate for the power consumed by its associated speaker load. Along the line of proper matching, a transformer secondary winding must be terminated by an equivalent speaker load.

Many types of speakers exist for various and special purposes. Trumpet speakers serve to direct the sound. Radial projector speakers radiate the sound over 360 degrees. Cone speakers are the general purpose radio, phonograph, television, and sound system audio reproducers, generally. Dual purpose speakers are units consisting of two speakers, each one designed to carry only its range of frequencies for which it is most faithful and efficient.

The housing of loudspeakers is an important item when considering quality and power of reproduction. Baffles, or speaker housings, are necessary for good frequency response and serve as sounding boards for the various sound waves. Placement of speakers is equally as important as that of microphones.

STEREOPHONIC SOUND

The ideal amplification system would be one such that its existence would be unnoticed by anyone when in operation. A close approximation to this ideal has been achieved by a process called stereophonic sound. The proof of a good reproduction system is measured by the amount of "presence" that is felt upon playback of a recorded event. For example, the recording of an orchestra playing in a large auditorium will illustrate the process. If upon playback of that recorded event, one can feel that he is actually a member of that audience stated in that auditorium, then, true realism has been effectively achieved.

(please turn to page 52)

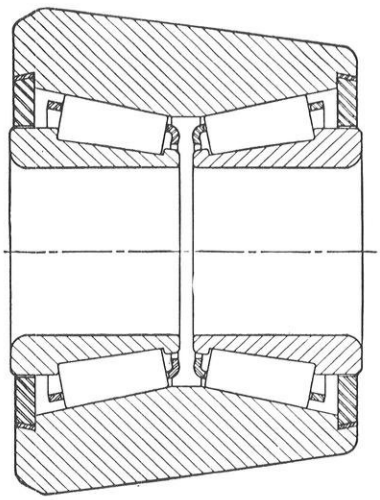
Another page for **YOUR BEARING NOTEBOOK**

Makes short work of tall timber

Motorized log-loaders speed their way over rough terrain to get to a cutting site. Once there, they load cut timber in a hurry, then head for the next place they're needed. To keep them on the go without costly interruptions, designers specify Timken® tapered roller bearings in the wheels, cone rollers, swing drums, steering pivot and other vital moving parts. Timken bearings have extra load-carrying capacity. They prevent wear, reduce maintenance. Assure continuous, trouble-free operation.

How to mount log-loader cone rollers on TIMKEN® bearings

This special roller bearing assembly has two single-row extended bearing cones mounted directly into the roller. The outer race of the bearing is actually the roller itself with the tapers ground to the proper angle for the bearing cone and roller assemblies. Closures are pressed into each end of the roller with running clearance at the extended cone rib.



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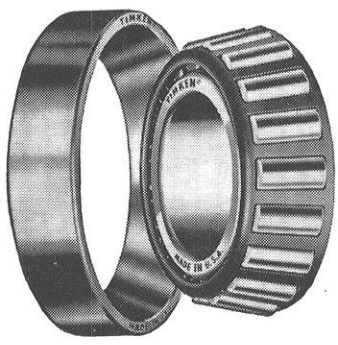

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Pumped Hydro-Electric - -

(continued from page 42)

Analyzing the Feasibility of Pumped Storage

Studies and research have shown the pump turbine unit to have these promising advantages: (a) Pumped storage utilizes low value off-peak power to store potential energy that later is converted into high value peak load power. (b) It increases hydro generating capacity in areas of hydro power development saturation or in arid and semi-arid regions. (c) It assists in running thermal stations at continuous uniform load. (d) Installation work required is comparable to a Francis type turbine of equivalent rating. (e) It is applicable for 10,000 hp to 100,000 hp range at heads of 50 to 1000 feet. (f) Few additional electrical equipment items are needed for dual motor-generator operation. (g) It adds to the reserve capacity of the system. (h) Pumped storage is adaptable for a stream of low average flow and can take the best advantage of the topography at the site.

Disadvantages Should Be Considered

Under certain conditions however, pumped storage is not economically feasible: (a) The systems are primarily used in peaking plants; they must depend upon some other source of off-peak pumping power. (b) The unit is primarily a base load machine, and does not lend itself for load regulation. (c) Starting into the pumping sequence may require some additional equipment and assistance from other sources. (d) The pump storage unit lacks the flexibility of separate pump and turbine units. (e) in some cases the total cost of the installation may approach that of two separate units.

Pumped Storage Solves Problems

The information required for designers to analyze the feasibility of pump turbines is as follows: (a) Elevation of suction pool with pool filled. (b) Approximate drawdown of pool in meters during pumping cycle. (c) Elevation of storage reservoir with water at lowest level—at beginning of pumping cycle. (d) Elevation of storage reservoir with water at highest level—at end of pumping cycle. (e) Size and length of penstock to be used from storage reservoir to pump-turbine. Estimated friction loss in the system. (f) Output per unit in kilowatts desired over the average generating period of eight hours.

From this data the manufacturer can determine the size of unit required and specify the rpm. Expected performance curves for generating and pumping can also be furnished with the head range indicated by pool elevations.

In the past, much of the world has had a surplus of natural water power sites available, and the need to utilize pumped storage has not been so urgent. Today the power situation in many places has become acute, and engineers are directing their efforts to extract the last bit of energy from natural sources. Against this background the future of pumped storage does indeed look promising.

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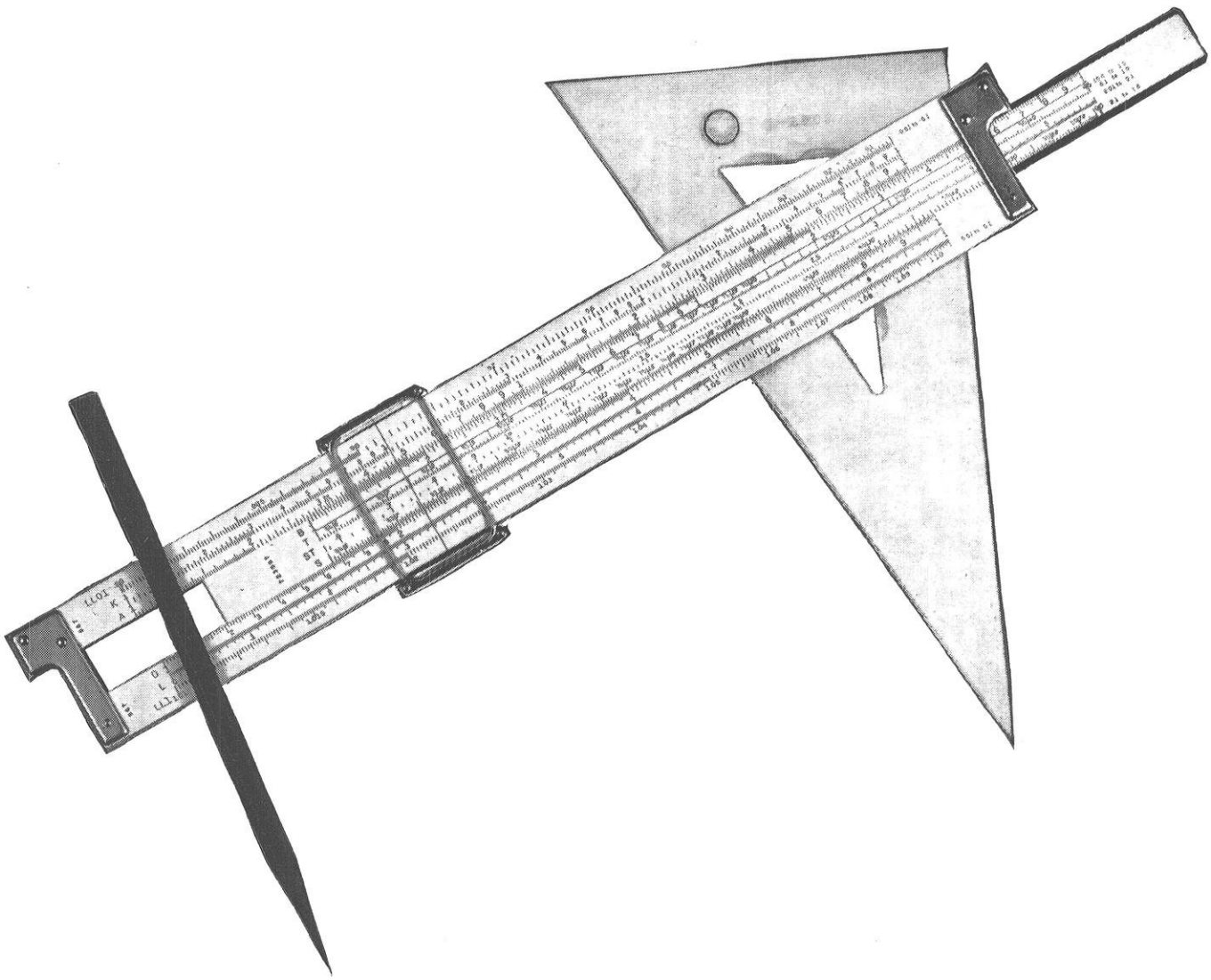
17. "Seven Years at Rocky River," Power, March 1936, page 140.



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

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

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

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

Plan *now* to build your career as a member of Boeing's distinguished Engineering personnel after graduation. Boeing has present and future openings for experienced and junior engineers in aircraft

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also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

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

JOHN C. SANDERS, Staff Engineer — Personnel
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BOEING

Sound - -

(continued from page 48)

Physically, the system is composed of as many microphones, amplifiers, and speakers as necessary, one set to each individual recording channel or head. If the full orchestra were used, and the tape recorder to be used was capable of handling three channels, then three microphones, equally spaced on the stage, would be employed. These three microphones are connected to three individual amplifiers and thence to the three separate recording heads. Upon actual recording, three individual lines of pickup would be recorded from three "electric ears" placed near the orchestra.

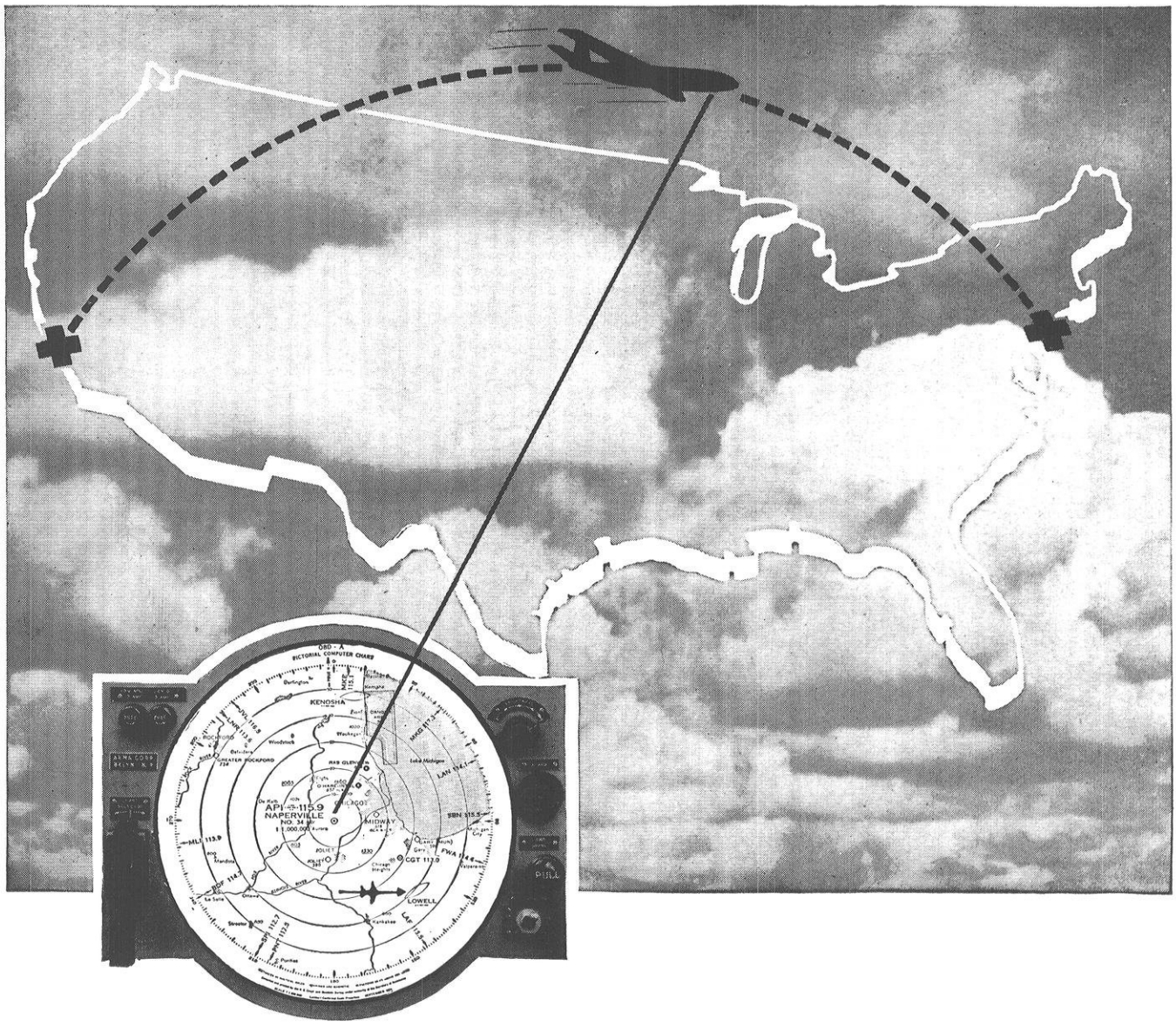
Upon playback of the recorded event, the three individual recording heads, now pickup heads, would send their three different signals to their own amplifier. Each individual amplifier must have its own speaker. These speakers would then reproduce what the three "electrical ears" had heard from their particular vantage point on the stage.

The basis of the stereophonic sound system is founded on the fact that hearing, as well as sight, is done by two ears, or eyes. The use of two "inputs" for both of these senses gives us the perception of depth.

In the actual physical system the affect is a feeling of actual "presence" in the audience while it is only the recorded event. If, however, at any place in the line of any one of the three individual inputs or outputs there had been any mixing, or cross-connection, the whole purpose would be utterly defeated. Sound from a radio eminates only from the one speaker, even though we still hear it through two ears. Hence it is important to keep the three channels separate.

Any number of channels could have been used, ranging from two up to the limit of the tape recorder. Three complete channels serve to illustrate the dependency of the final result, regarding quality and realism, upon each individual component and is only as true and faithful as is the weakest link in the process.

In the use of two dimensional photography, a skier racing down a mountain slope, for example, is seen to be plastered up against the background upon development and printing. However, this same picture, when taken by a three dimensional camera, and viewed through a three dimensional viewer or projector, makes the picture come alive. The figure stands out from the mountainside and gives the illusion of depth and realism. Stereophonic sound creates this same illusion by creating that feeling of "presence" with depth, solidity, and full realism—the goal of the recording and reproduction of sound.



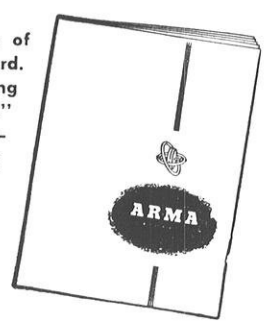
Now! Arma puts the plane on the map...

Arma's new Pictorial Computer tells a pilot his exact location and heading, continuously on a luminous screen—throughout a given flight. Here's how it works:

A film strip shows the various OMNI stations over which the aircraft will pass. During flight, the Arma Computer automatically indicates position and heading of the plane on a TV-like screen. In other words, the Computer shows continuously and exactly where the plane is, in respect to the ground, at every moment of flight—regardless of weather, altitude or speed.

Arma has worked closely with the Air Navigation Development Board and the Civil Aeronautics Administration in developing this pictorial computer for use in proposed advanced systems of air traffic control. For over 34 years Arma has cooperated with the Army, Navy and Air Force in developing important military equipment — and recently with the Atomic Energy Commission. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y. Subsidiary of American Bosch Corporation.*

If you would like a detailed description of Arma's Pictorial Computer, just drop us a card. We will send you further information, along with the booklet "Engineering at Arma," which describes the opportunities of an engineering career with this outstanding leader in electronics. Write to Engineering Division, Arma Corporation, 254 36th Street, Brooklyn 32, N. Y.



ARMA ADVANCED ELECTRONICS FOR CONTROL

The AUTOMATIC FACTORY

ENGINEERING INSTITUTES

The reality of 'The Automatic Factory" through the use of automatic controls will be discussed with men from Wisconsin industries at an engineering institute on automatic controls to be held at the University of Wisconsin.

The program, scheduled for February 10 and 11, 1953, at the Electrical Engineering Building on the University campus, describes recent developments in the field of industrial automation.

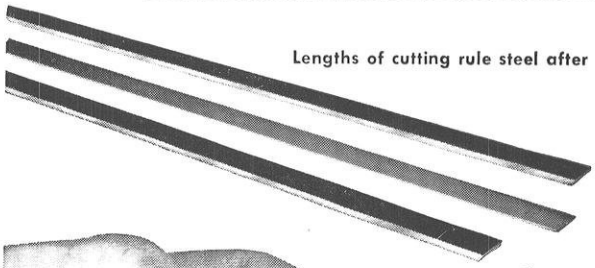
Speakers include: Profs. Kurt Wendt, Thomas Higgins, Vincent Rideout and R. C. Tegtmeyer of the University of Wisconsin; H. W. Griesbach, Minneapolis-Honeywell Company; Richard S. Falk, The Falk Company; Leonard Hesse, Gisholt Machine Company; Berc Marks, Globe-Union Company; David M. Boyd, Universal Oil Products Company.

Among the topics are: Historical Background of Automatic Controls, An Analogue Computer Demonstration of the Principles Underlying Automaticc Controls, Industrial Instrumentation, Automation in the Machine Tool Industry, Automation in the Manufacturing Industry, Automation in the Chemical Industry, and Social Implications of Automation.

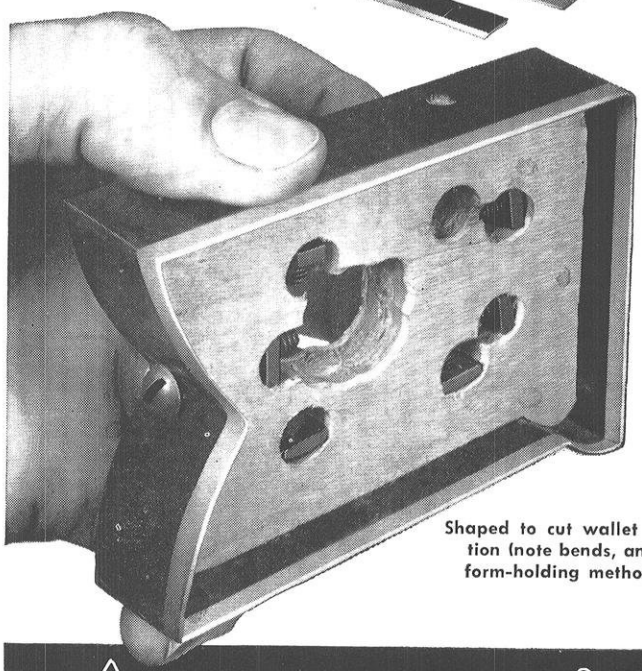
The institute is sponsored by the University Extension Division and the College of Engineering.

What's Happening at CRUCIBLE

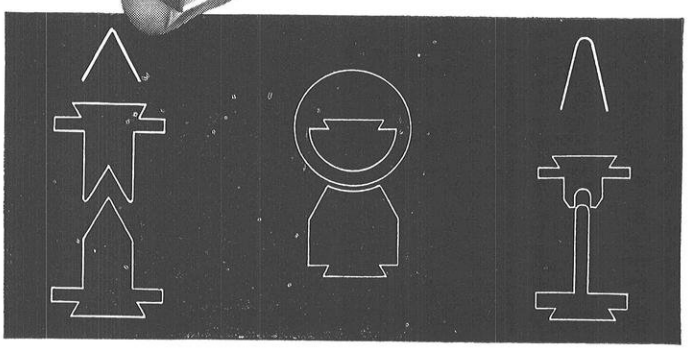
about scoring and cutting rule steel



Lengths of cutting rule steel after edging



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



Some examples of the many shapes of bends needed

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

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

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

engineering service available

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

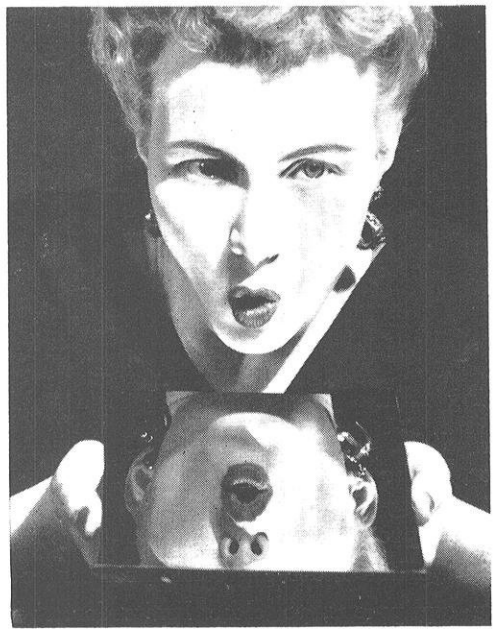
CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

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

Superfinish--

(continued from page 44)



Pair of Smoothies — A pretty housewife dusts off with her breath one of the world's smoothest surfaces, achieved by scientists of the G.E. Research Laboratory.

the stone wears too slowly for any of the hundreds of these defects to have an appreciable effect on its perfection in curvature. The stone is originally dressed in by one of two methods. One is quicker, but not so accurate. A strip of emery cloth is placed over the work. The stone is contacted on the strip and is drawn over it until the approximate shape is obtained. The other method is to run a diamond studded tool over the stone in the exact place where the work is to be done.

While industry is not interested in a beautiful shine which is produced by a smooth surface, it is interested in the mechanical possibilities of such a surface. A growing realization that Superfinish offers the most definite possibilities for the reduction of wear has caused many manufacturers, of a wide variety of products, to turn to this process. In a number of cases, it has made the operation of mechanisms possible that would not function without the quality of the surface produced. It has also resulted in reduction of costs.

From the automotive industry alone Superfinish is used in the manufacture of crankshafts, clutch plates, valve stems, piston pins, tappet heads and bodies, brake drums and many other essential parts. In other industries Superfinish products are bearings, valves and certain types of tools. Without the Superfinish process many of these parts would not be able to function properly or the costs to keep them functioning would be enormous. That smooth, lustrous shine is not only easy to look at but essential to industry.

How to Choose a Boss--

(continued from page 40)

11. Does he confine his bossing to the office?

As one writer on the subject has so aptly phrased it, a good boss doesn't care what you do on your own time as long as it doesn't involve company funds, company cars or company stenographers.

Avoid like the plague the Great White Father who thinks he is entitled to run your private life for you.

12. Does he tend to be secretive and unsociable?

Strangely enough, many competent and well-adjusted bosses display this tendency. They keep secrets from their employes; they never get acquainted with their employes. They dwell in isolation, behind the brass curtain, and it never crosses their minds that company policy and progress are of any interest or concern to the hired help.

Such men are not for you. Choose instead the employer who is more than a name to his employes, and who sees to it that his employes are fully informed about their company.

If you can manage it, mouse around a bit among the personnel. Do they get copies of the company's annual report? Do they understand how their particular jobs fit into the company's total operation? Do they have straight information on company plans and policies? Do they know the reasons for the various rules and procedures that are in force? If there is a company magazine or newspaper, do they respect it as an honest source of information or scorn it as a gossip sheet or propaganda? Do they know who the company's customers are, who the competition is, how the product is used? Are rumors infrequent and short-lived? Do workers know the boss, or do they just know that there is one someplace?

Let that check list be your guide when shopping for a boss. There is no scoring, of course, no "approval" or "unacceptable" rating. It is just a matter of making appraisals and then taking the best man you can get.

As you can see by sifting over the questions, the ideal candidate shapes up something like this:

He is qualified for the job of boss, both on the basis of business knowledge and on the basis of personality and aptitude. He is ambitious for success, both for himself and the company. He is a good organizer and a skillful executive. He has a reputation, and a good one, in the community, in the industry, among his employes.

His personnel practices are smart—designed to find and keep top-flight employes, to encourage and reward good work, to develop tomorrow's executive talent. He gives his people a chance to do their best, and an incentive.

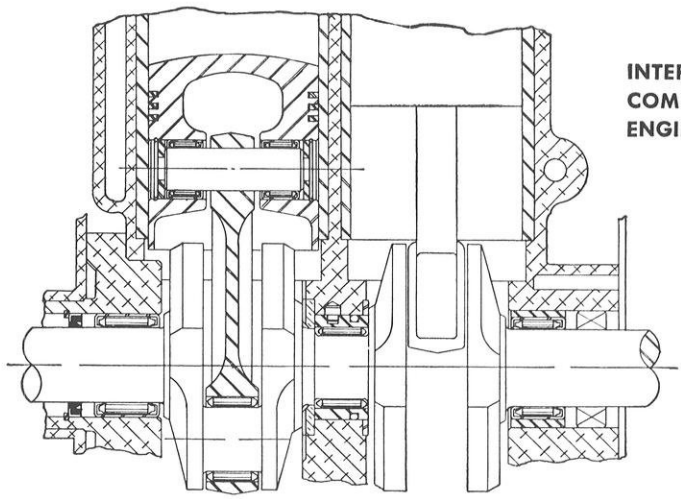
Or, briefly, a guy who's going places, who knows his stuff, who's easy to get along with, and who won't be underfoot all the time.

He should go far in this world. If you find him, sign him up.

The Torrington Needle Bearing...

for designs where light weight is important

Reducing weight without sacrificing performance is one of the major considerations in many modern products. Designs are streamlined to pare off excess weight. New and lighter materials are being used. Components which save even a few ounces frequently contribute greatly to product success.



INTERNAL COMBUSTION ENGINE

Needle Bearings reduce weight and size while providing high radial load capacity.

Light Weight Plus High Capacity

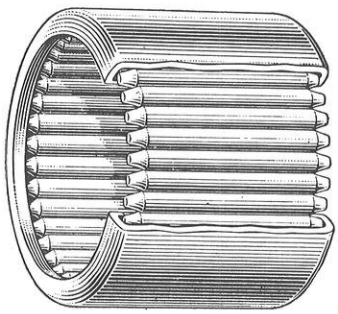
The unique design of the Torrington Needle Bearing makes it ideal for a wide variety of product uses. It consists of two components — a thin, hardened outer shell and a full complement of small diameter rollers. Its many lines of contact give the Needle Bearing a greater rated radial load capacity than any other type of anti-friction bearing for its size and weight. Conversely, for a given load capacity, a Needle Bearing is the lightest, most compact bearing available.

Weight Savings In Related Assemblies

In addition to the light weight of the Needle Bearing, its design permits sizable reductions in the size and weight of the related assemblies. Its small outside diameter allows the use of smaller housings. And, since a press fit in a simple straight housing bore is adequate to locate the bearing, no complex shoulders or housing modifications are required. The hardened shaft usually serves as the inner race, saving additional space and weight.

These advantages, plus its high radial capacity, have made the Torrington Needle Bearing particularly attractive to the designers of aircraft, portable power tools, small gasoline engines and many other products where weight and space are important factors.

In future advertisements of this series, other features of Torrington Needle Bearings will be discussed. The new Needle Bearing catalog will be sent on request.



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TORRINGTON NEEDLE BEARINGS

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

STATIC

BY I. R. DROPS

LETTER TO A MANUFACTURER (X)*

SIR: I have just been carefully following your directions. After half an hour's preliminary work, I pushed the spindle R through the apertures BB[1]. Then I pulled the arm L sharply downward (Page 2) and, retaining my hold on R, worked DD gently past E, W and Q until clicked into position at S. Keeping L depressed as instructed, I now attempted, by means of the knurled knob at T at the side, to raise the pinion at O until it engaged the horizontal worm F.

But there is no knurled knob at the side.

This example of correct assembly features Orris Walters.

Photo by Dave Dauterman

Did you know that? There is a knob, fairly well knurled, at the back, but how can that be T? you can't reach it, for one thing, while still depressing L, unless you let go of the end of spindle R. And you know very well—assuming you have ever tried to assemble this thing yourself—what happens then.

On the off chance that I had all along been mistaking the back for the side, I unclipped the two brackets U_1 and U_2 from what in that case would no longer be the bottom, and fixed them on the old top—or front, rather. This, of course, necessitated reversing the slotted panel HH (Page 1), and while I was doing that, DD slipped out of S and a small bright part rattled down. As far as I can tell by shining a torch through the floor boards, it is either G or V.

At this stage I turned to Page 3 and at once became convinced that Diagram 9 is upside down. It is impossible to secure W to K, since the so-called J_6 would obviously be in the way if it had not already—through my following Page 1 too carefully—been wrenched clean out of its socket. Putting J_6 back the other way round, so that the bent bit is on top, simply forces a small spring—would it be N or M?—out of the slot YY, and there is a clang from inside that body which is, in my limited experience of this kind of mechanism, no good. I had every right, in my opinion, to find out whether, by putting my foot on L, gripping R with my teeth and at the same time giving a slight twist to this knurled knob of yours, I could induce the spring to return to its original position. No one could possibly have foreseen that this would cause the whole base plate,—now, of course, on top—to buckle upward and spew a number of brass screws into the fireplace. Nor was this all. Even the worm F turned—and as to the pinon, all one can say for certain is that it was no longer at O.

When this happened, I took a cold chisel CC—not included in the outfit—set it at about the point P and drove it through the apparatus from A to Z, maintaining "a firm even pressure throughout" (Page 4). Then I carefully tossed your directions out of a fourth-floor window.

May I suggest that it is now your turn to follow them?

—H. F. Ellis

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THE DU PONT DIGEST

THE TECHNICAL MAN IN Production Supervision

Scientists who know both people and processes are needed to keep Du Pont's 71 plants humming

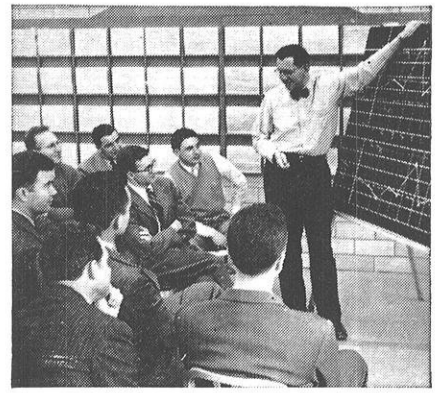
H. D. Tallman, *B. S. in Industrial Administration, Yale '37, checks on product loading methods in Du Pont's Belle, West Va., synthetic urea plant.*

Keeping production rolling in a modern industrial plant is a job that appeals to men trained in many branches of science and engineering. If you are looking for opportunities in this field, you won't have to look far at Du Pont, where nearly half the entire technical force is assigned to production supervision.

To qualify, a man must have the ability to understand both the mechanical and chemical phases of production. In addition, he should be a good planner and, above all, have a knack for handling people.

The production supervisor—there are several levels at Du Pont—has three important areas of responsibility. The first is to the men working for him. He must be able to appraise them skillfully and assign duties accordingly. He must train them not only in the efficient operation of equipment but in safe working practices as well.

A second responsibility is to the customer. He must get the product out on time and provide uniformly high quality at the lowest possible cost. When demand for a product is subject to rapid fluctuations, he must be prepared to make quick readjustments in the scheduling of both manpower and materials.



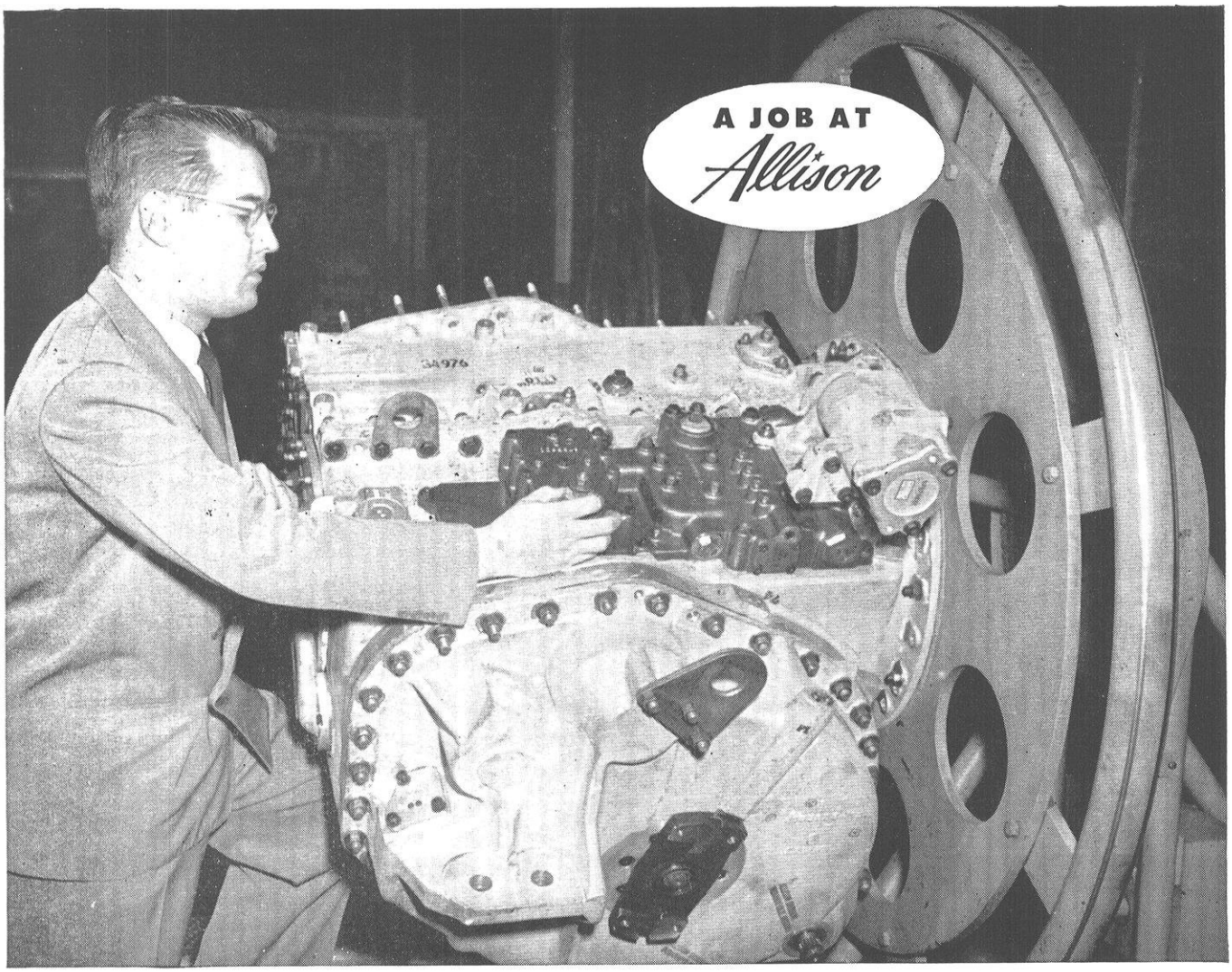
William Chelgren, *B. S. in M. E., Armour Institute of Technology '38, explains quality control methods to a group of Du Pont production supervisors.*

The supervisor's third responsibility is to the higher management. Here, again, quality and cost are important factors. He is expected to prepare forecasts, to justify unusual expenditures, and to suggest process improvements leading to greater yield and better quality at lower costs.

One of the toughest nuts a production supervisor has to crack is the scheduling of preventive maintenance for minimum interference with production. In some companies where products are turned out in small-unit operations, a program of breakdown maintenance suffices. At Du Pont, however, where large-unit operations are the rule, unscheduled downtime is costly and something to be avoided whenever possible.

Since it makes over 1200 products and product lines, Du Pont can offer to men interested in production supervision opportunities in many types of operations. In the next issue of the *Digest*, we will describe a specific production operation in one of our 71 plants.

36-PAGE BOOK, "The Du Pont Company and the College Graduate," describes opportunities for men and women with many types of scientific training. For copy, write: 2521 Nemours Building, Wilmington, Delaware.



● Robert F. Karcher, a 1951 Mechanical Engineering graduate from Purdue University, is another Allison engineer who is pioneering in an advanced field of mechanics. He is playing an important role in the Research and Development group of the Transmission Engineering Section.

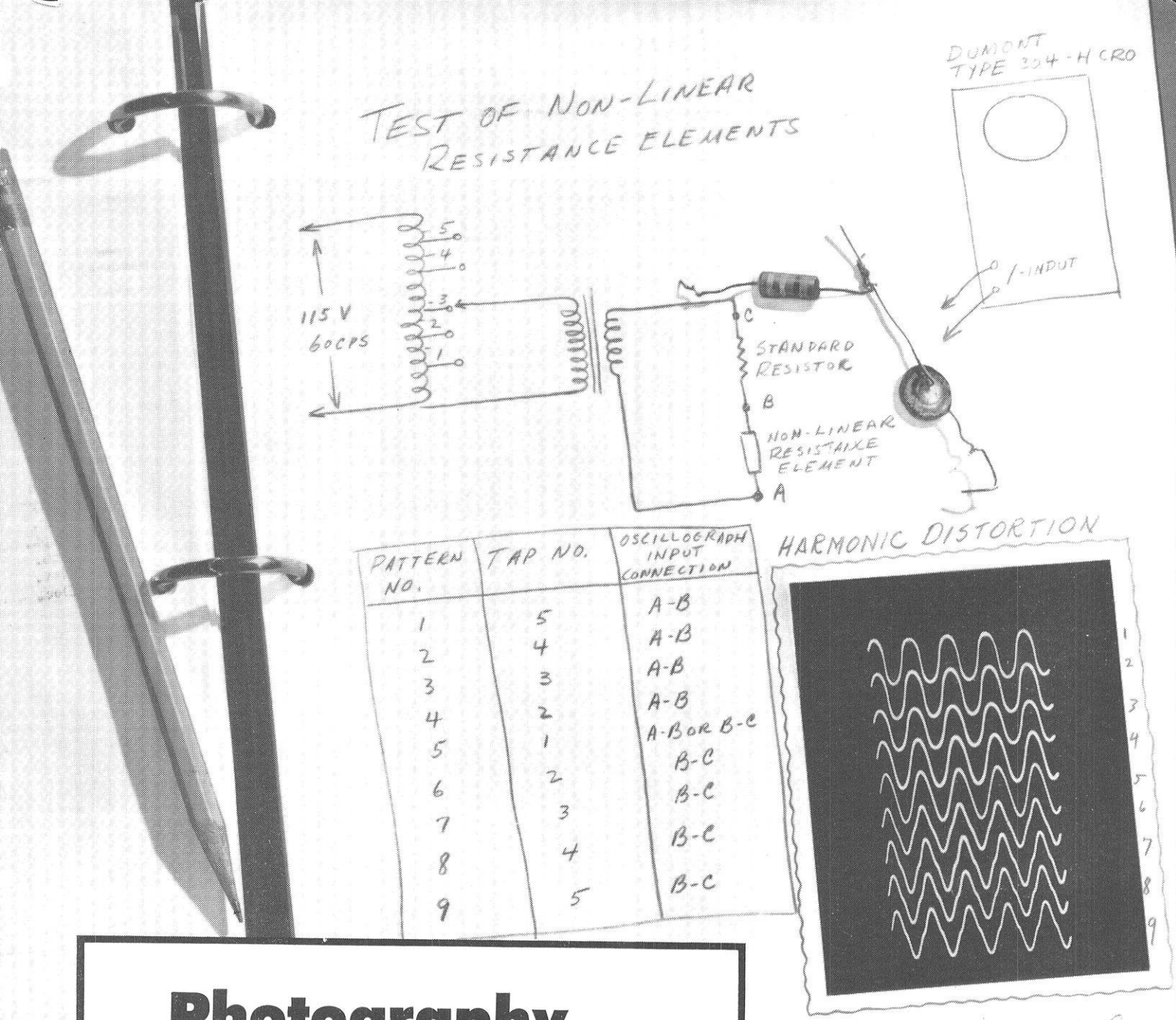
Allison is the world's largest manufacturer of torqmatic drives for heavy-duty Ordnance and commercial vehicles and equipment. These transmissions serve a purpose far broader than a unit in the power train. All the steering and braking of the vehicle also are accomplished in the transmission. These operations are controlled by hydraulic circuits which consist of clutches, pumps, governors and necessary valving to make them operate in the proper sequence. The assembly of the valving system is often termed the "brain box" of the transmission since it determines how the transmission will operate to provide maximum performance and maneuverability with finger-tip control.

Bob, shown above examining a CD-500 transmission, is involved in developing a new improved system of governing automatic control systems of many Ordnance and commercial transmissions. This involves basic analysis, design and testing of pilot samples. These hydraulic controls provide proper sequence for clutch operation to determine speed range, convertor or lock-up operation. They also provide steering control for the vehicle when this function is included in the transmission.

Bob and other Allison engineers are continually applying their knowledge, experience and imagination to find successful answers in the never-ending search for product improvement. There is a real engineering challenge at Allison and lifetime opportunities for engineers.

Allison DIVISION, GENERAL MOTORS CORPORATION • Indianapolis, Ind.

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



Photography...

the engineer's partner all along the way

Photography proves itself an important and valuable ally all through engineering.

Its speed in copying and reproducing data saves valuable time. Its use in radiography and instrument recording improves manufacturing processes and finished products. High speed movies help solve design problems.

Applications of photography in science and industry are steadily multiplying. This has attracted graduates in the physical sciences and engineering to find positions with the Eastman Kodak Company. If you are interested, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

FUNCTIONAL PHOTOGRAPHY

serves industrial, commercial, and scientific progress

Here photographic oscillograph traces become an indisputable part of an engineer's notes, recording the effect of a new electronic circuit element on wave form. This record of performance stands ready for new evaluation at any time.

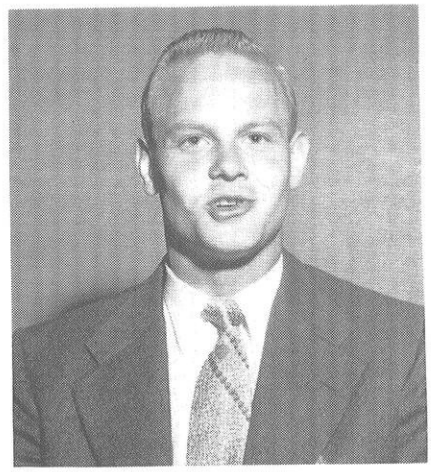
Kodak

TRADE-MARK

MY QUESTION TO THE G-E STUDENT INFORMATION PANEL:

"What qualities do I need for a successful career with a company like General Electric?"

... HARRY K. LEADER, Lafayette College, 1954



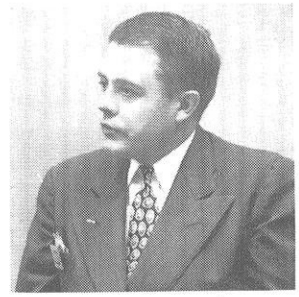
Two answers to this question, given at a student information meeting held in July, 1952, between G-E personnel and representative college students, are printed below. If you have a question you would like answered, or seek further information about General Electric, mail your request to College Editor, Dept. 221-6, General Electric Co., Schenectady, N. Y.

G. C. HOUSTON, *Manufacturing Services Division* . . . While this is a rather broad question, I am sure it is one of real importance to any young man starting out in industry and looking forward to a position of responsibility in any of our successful industrial enterprises.

The mere asking of this question indicates that the individual has a definite goal or objective. This is important since progress can be made only if we attempt to reach a well-defined objective—even though it may be modified to some extent in the light of later experience. In G.E. we are looking for young men who have not only determined their objective but who are ready to work for it—who accept responsibility and have ability to get things done—who work well with others—to be a part of the team.

This calls for other qualities essential to long range success. We look for the enthusiastic individual, one not easily discouraged, and who can inspire the confidence of his co-workers. We desire individuals who show imagination and good judgment—particularly the ability to look ahead and maintain perspective beyond the immediate situation. Finally, we cannot overlook the qualities of loyalty and dependability since these are important in steering the individual through periods of discouragement which occur in every career.

When you decide on your business affiliation, make sure you associate yourself with a company that is soundly managed, that has a good business future, and that is the kind of company you would like to be a part of for the long pull.



E. S. WILLIS, *Corporate Services Division* . . . A successful career with a company like General Electric is built on the same qualities that contribute to success in any endeavor. However, in G.E., there is additional opportunity to develop these qualities because of the wide variety of training sources and openings which are available.

Basic qualities needed for any successful career include an open mind, willingness to accept responsibility, persistence, adaptability, co-operativeness, and common sense intelligence. Others such as physical well-being, ability of expression, and sound inquisitiveness also go to make up a truly qualified individual.

Most important is the fact that General Electric offers a wealth of opportunity to develop special capabilities and talents. The broad selection of training courses, in any chosen field, gives you a chance to sharpen your basic training and abilities. By decentralizing operations into about 70 different businesses, there is opportunity to see—in comprehendable dimensions—the full operation of the business. It means, too, that senior managers and young employees are more closely associated—a real advantage for the young man on his way up.

Also, our business requires specialists as well as managers. Thus, there are equal chances for success for those who concentrate in particular fields such as research, design, accounting, and planning.

So set your cap for a goal. And capitalize on your native qualities, which fortunately are different with each of us.

You can put your confidence in—

GENERAL ELECTRIC