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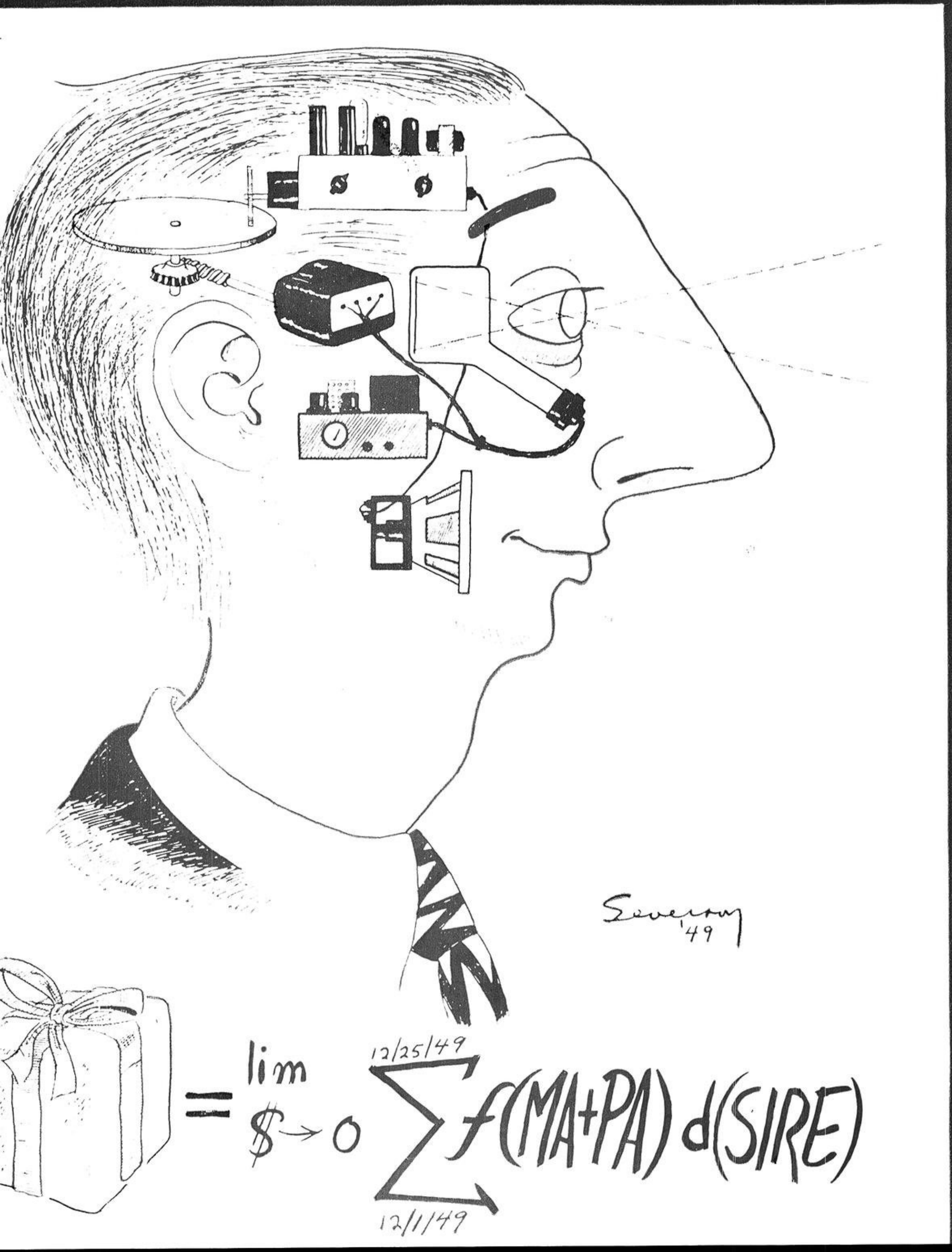
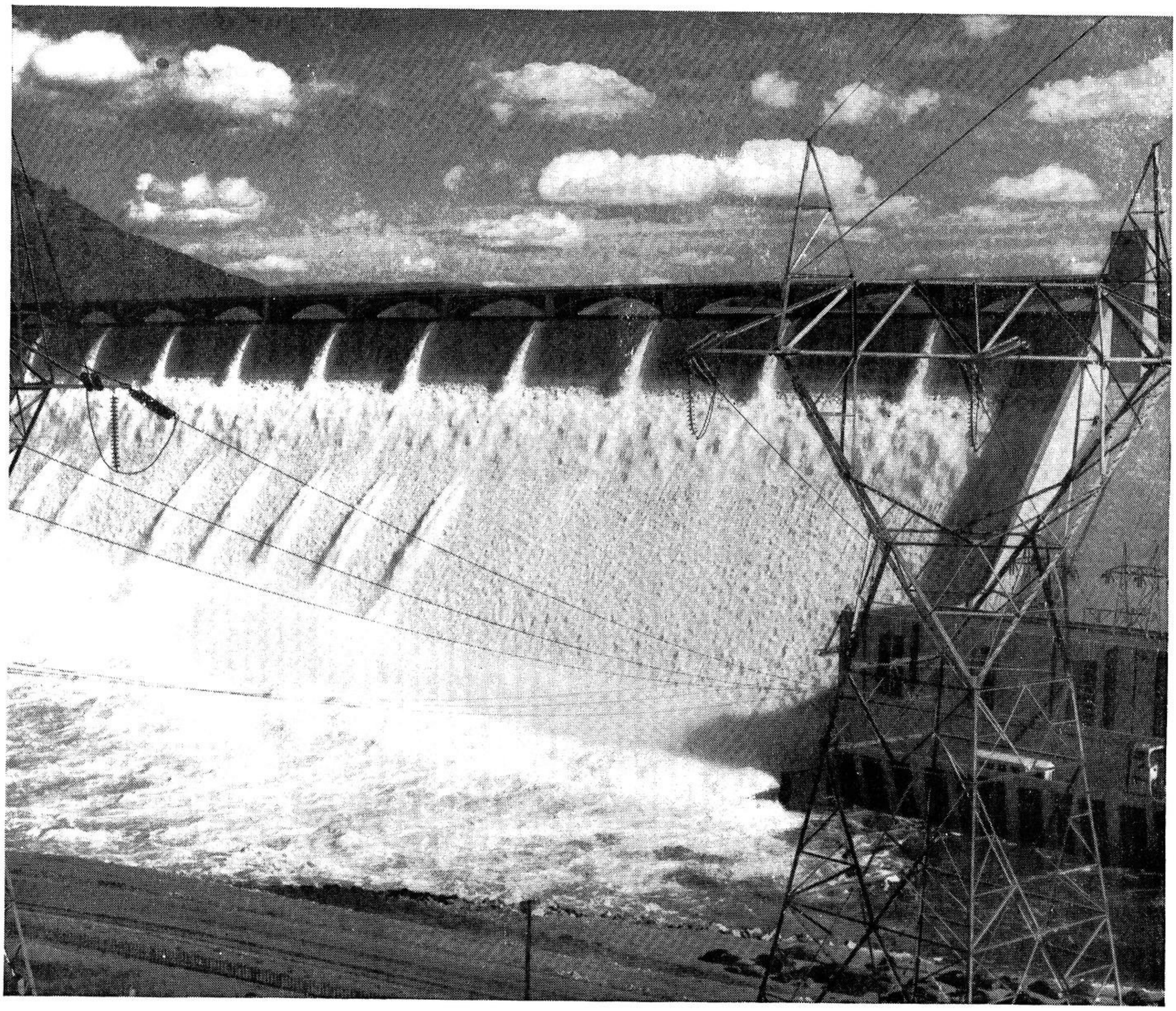
The Wisconsin engineer

December, 1949



15¢

Making the "juice" that makes life easier!



DIRECTLY and indirectly, the average family in America consumes more electricity yearly than families in any other country in the world. The demand for more "juice" has grown with unbelievable rapidity, and it's *still* growing. By 1955, the electrical generating capacity of our nation is expected to reach 90 million kilowatts!

Steel is a vital material in the production of electricity. Central power stations and great power dams are made of steel and concrete. Special steels are required for turbines and other generating machinery. Steel towers carry steel-reinforced transmission lines across mountain and prairie alike.

Helping to meet America's constantly growing demands for more "juice" is only one of the big jobs ahead for United States Steel. There are many others. And they all call for the services of thousands of carefully-trained, technical specialists. For steelmaking today is a precision operation, as dependent for success on the knowledge of metallurgical, mechanical, chemical, electrical, mining, civil and ceramic engineers, as upon the plant workers themselves.

To assure employees opportunity for maximum personal development and provide a sound foundation for advancement in the organization are fundamental objectives of U. S. Steel. Employees participating in educational activities of U. S. Steel comprise a group exceeded in size only by the student bodies of a few of the nation's largest universities. In these educational programs, particular attention is given to the development of college graduates and other technically trained men.

For men who can qualify, a career with United States Steel offers a promising future.

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UNITED STATES STEEL

THE DU PONT DIGEST

FOR STUDENTS OF SCIENCE AND ENGINEERING

CARBON MONOXIDE... FRIEND OF MAN

Thanks to high-pressure synthesis, it now leads a useful life

To the man on the street, carbon monoxide is just a poisonous gas that sometimes causes tragic deaths when it escapes from the exhaust of an automobile or from a poorly tended furnace.

Outside of the chemical field, few people are aware that, properly used, it is a very real friend of man. In the last 25 years, during which catalytic

A. H. Emery, Jr., *M.S. Ch.E., M.I.T. '49 and M. J. Roedel, Ph.D. Org., Michigan '40 inspecting a high-pressure batch reactor taken from the shaker tube assembly after a run to make 3,5,5-trimethylhexanol.*

and high-pressure chemical techniques have been highly developed, carbon monoxide has become a keystone of industrial synthesis.

Scientists have found that under the proper conditions of high pressure and temperature, carbon monoxide, in combination with other substances, can be converted to a variety of useful products. These or their derivatives range from an acid used in tanning hides to the sparkling plastics in milady's boudoir.

You'd hardly associate carbon monoxide with anti-freeze. But at temperatures from 300 to 450°C. and under pressures of 1500 to 15,000 pounds per square inch, carbon monoxide and hydrogen unite to form methanol—a colorless liquid from which is made "Zerone" anti-rust anti-freeze for automobiles. From methanol and carbon monoxide as raw materials, ethylene glycol for "Zerex" anti-freeze is produced.

Plastics *and* Anti-Freeze

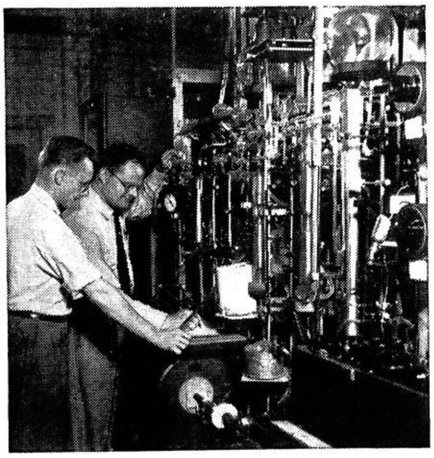
Methanol is used also to make a large number of compounds such as formaldehyde and methyl methacrylate. The former goes into urea- and phenol-formaldehyde plastics for light fixtures, radio cabinets, hardware, utensils, and electrical equipment. The latter is the basic material for "Lucite" acrylic resin with its many uses.

R. L. Stearns, *B.S. Ch.E., Yale '49 and H. Peterson, B.S. Ch.E., Northeastern Univ. '42 checking a multi-stage carbon monoxide compressor used in semi-works operations.*

The reaction of methanol with carbon monoxide leads to acetic acid, which is a well-known industrial chemical. By the same synthesis but substituting ethanol for methanol, propionic acid is obtained. From it come the "Mycoban" sodium and calcium propionates that retard mold and rope in bakery products.

Synthesis in the Future

Today Du Pont manufactures some 120 different items that are partly or wholly dependent upon elevated



A. J. Hill, Jr., *Ph.D. Org., Yale '44 and F. F. Holub, Ph.D. Org., Duke '49 carrying out an experiment on a new method for purifying carbon monoxide. The large furnace in this apparatus operates at 1200°C.*

pressures. However, the possibilities have by no means been exhausted. Just recently, for example, chemists have been learning how to use carbon monoxide in "up-grading" certain petroleum hydrocarbons to give interesting alcohols. One of these, 3,5,5-trimethylhexanol, is prepared from diisobutylene by reaction with carbon monoxide and hydrogen.

College-trained men and women interested in working in this field at Du Pont may share in discoveries as outstanding as any yet achieved.

Because of the wide scope of Du Pont's activities, young graduates in many different fields have opportunities to select the careers that prove to suit them best as their abilities and interests develop.

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WISCONSIN ENGINEER

Founded 1896

Volume 54 DECEMBER, 1949 *Number 3*

In This Issue . . .

Cover:

E. E. 6 computing his Christmas gifts for his parents. A mechanical-electrical thinking machine is portrayed doing his cogitating. (*Artist—David Severson*)

Articles:

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THE WISCONSIN ENGINEER

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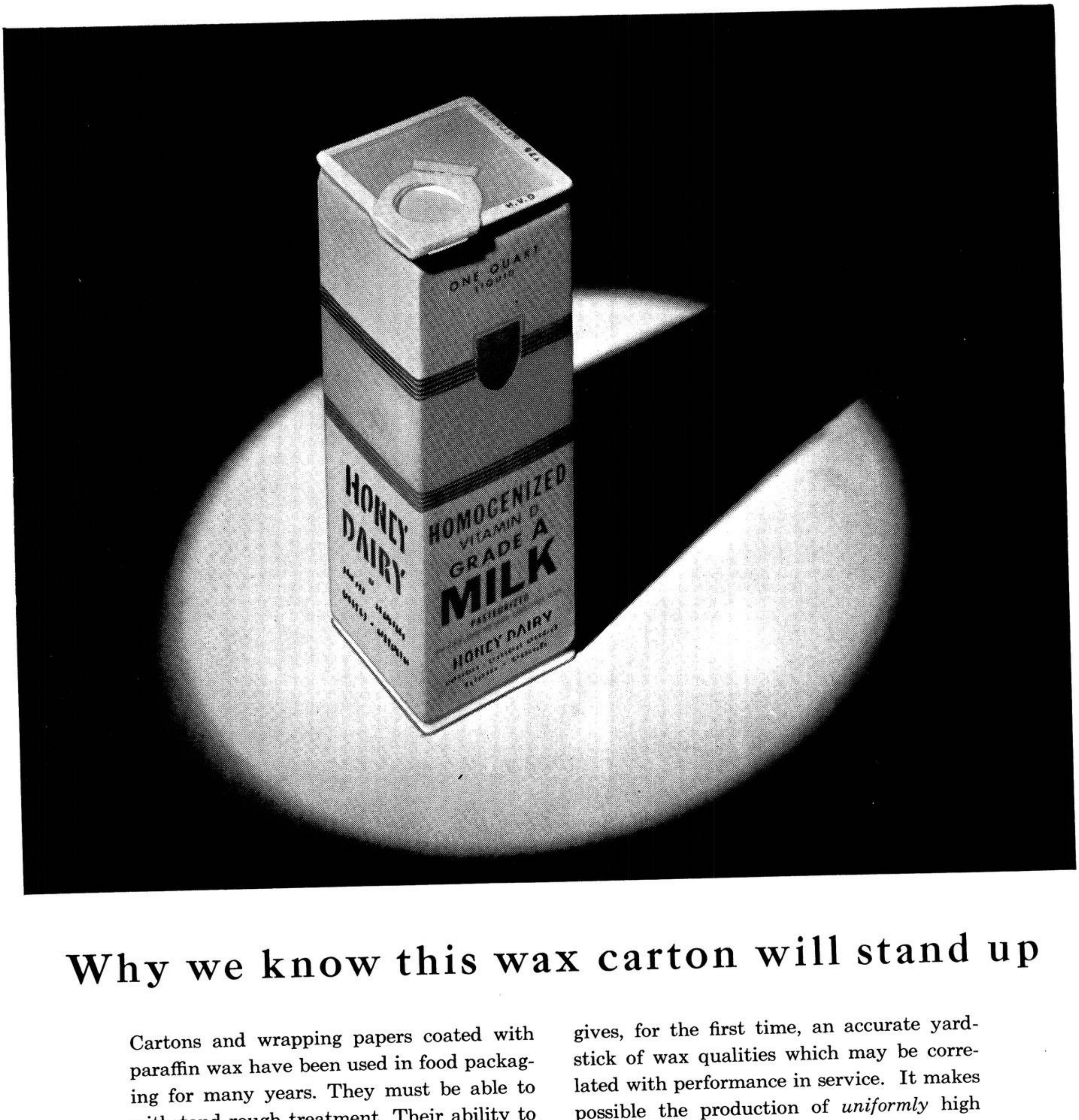
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(Foton Foto)

moder

lial telephones

by robert evans e'50

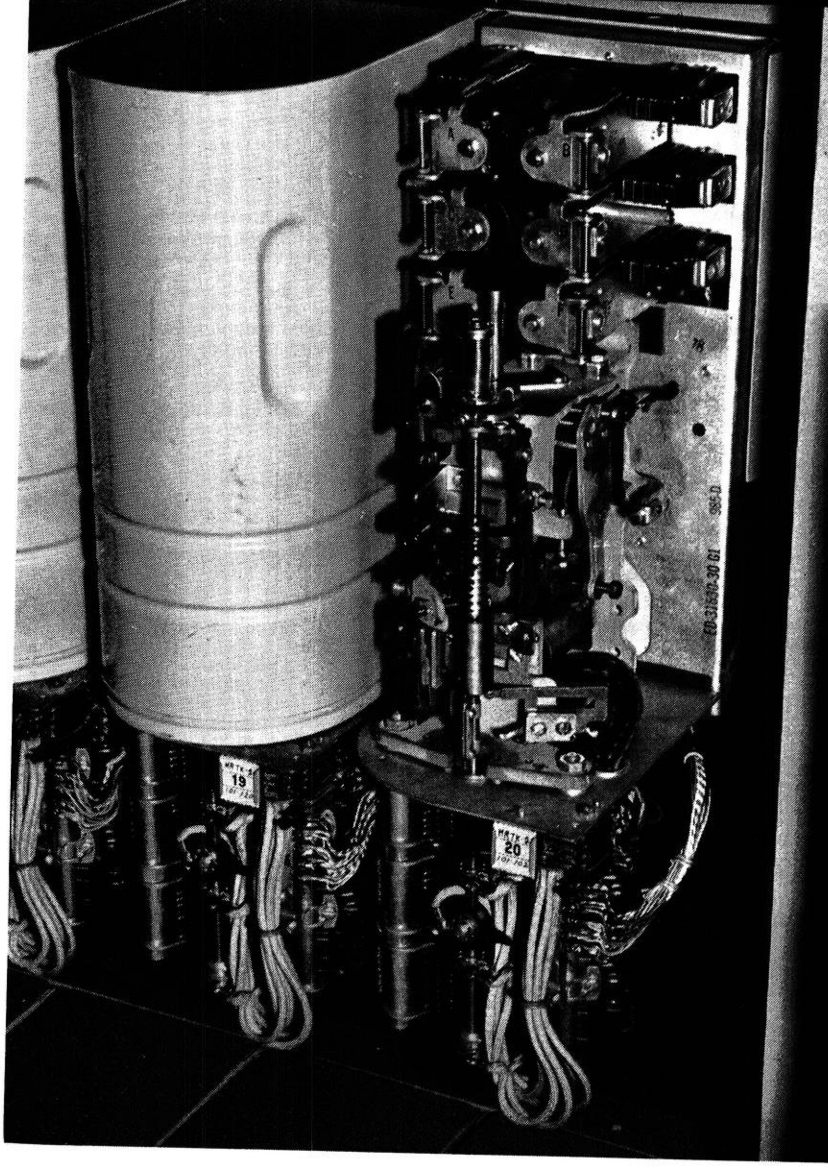
This is the story of the dial telephone. Its history dates back to the 1880's.

In 1889 Almon B. Strowger, a businessman, had an idea that, by arranging a metal finger on a central shaft and rotating it by some electrical means, he could evolve a mechanism that would replace the manual switchboard. He visualized his idea by placing pins around the edge of a collar box. The system, later to be perfected by the Automatic Electric Co. of Chicago, bears the name of its inventor and is now known as the Strowger Step by Step Automatic Dial System.

The Strowger system is not the only automatic type of dial switching, however. There are several, of which Western Electric Co. has developed two. These are the Crossbar system, which utilizes relays in almost all of its operations, and the Panel.

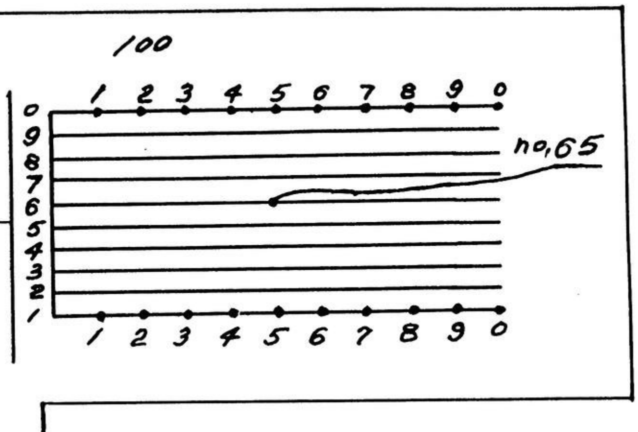
International Telephone and Telegraph Co. has introduced in the United States a system which uses a rotary switch. This had been developed in Europe before it was brought to this country. North Electric Co. and Leich have developed systems which are primarily all relay systems. The Stromberg Carlson Co. has a system which makes use of the "X-Y" switch. It is so named because it travels along quadrature coordinate axes.

This article will deal with the Strowger system because it is easy to understand and forms a good background for the study of other systems. There is considerable local



(photo by Miller)

The Strowger Linefinder Switch



interest because this is the type of equipment presently in use in the city of Madison.

Historical Development

It is rather interesting to see how the Strowger system has developed through the years. Alexander Graham Bell spoke his first words over his crude telephone in the year 1876; a scant thirteen years later men were looking forward to the day when calls could be completed without the use of human labor. Three years after Strowger had his idea, the first automatic switching system was installed in LaPorte, Indiana. It was not a dial system as we know it today, for instead of dialing a number you "spelled out" the number you wished to call with a series of push buttons. The impulses thus created operated a switch in the central office which completed the connection to the called phone. In order to release the equipment after the call was completed another button was pushed.

Prior to 1896 each switch would give access to all the phones in the exchange. As the number of phones increased it became evident that switches could no longer be built with adequate capacity. In answer to this problem, small unit design was concentrated upon, and since the late nineties the basic Strowger switch has had 100 outlets.

In order to build exchanges, grouping and trunking methods were developed. In the early 1900's some exchanges grew as large as 10,000 lines.

The United States Government used Strowger systems as early as 1893; by 1919 had more than 20 such systems in use.

Foreign extension arrived in 1898 with the installation of a 200 line system in London and a 400 line system in Berlin.

In 1904 the system was adopted to a common battery system. Before this the talking current had been supplied by batteries in each telephone. The current for the switches had been supplied at the central office, however. In 1905 the first installation was made in South Bend, Indiana, using the common battery. This made possible the development of a small desk size phone.

In 1905 fifty pay stations were installed in Fall River, Mass. The method of identifying the coins dropped into the box was the same as it is today; the coins falling through different size holes landed on tone gongs.

In 1915 the modern type switch was developed and has changed but little since that time. This switch is pictured in figure one.

In 1919 the Bell system began using Strowger equipment. They use

(*please turn to page* 42)

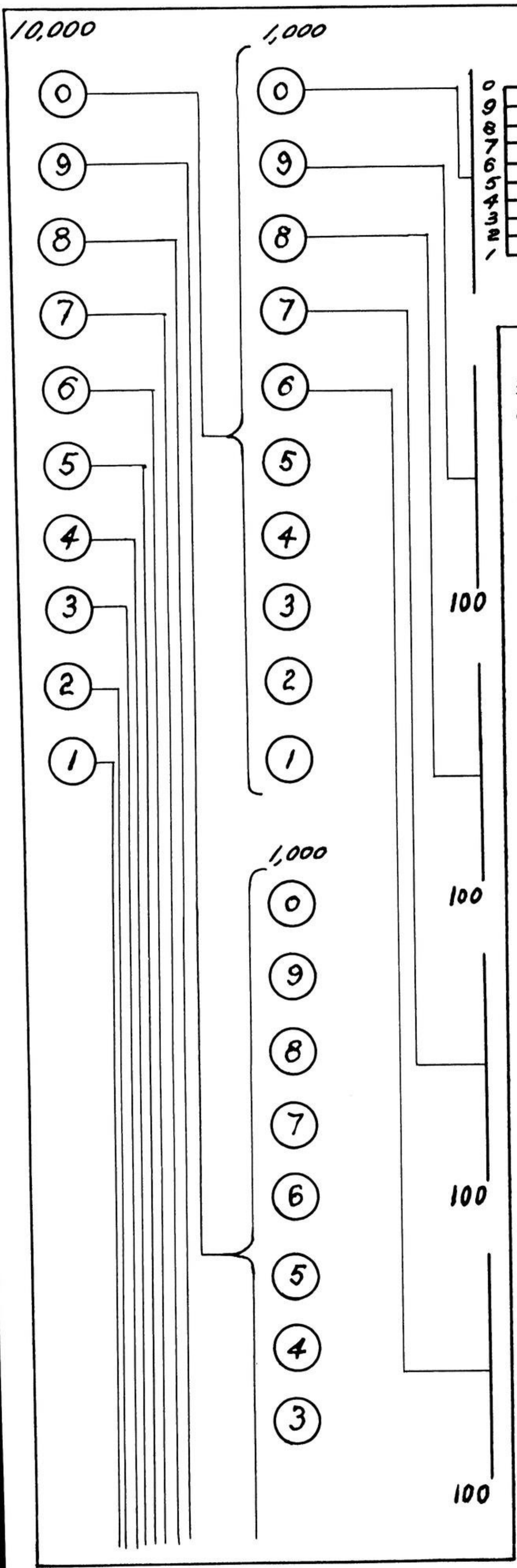


Figure II

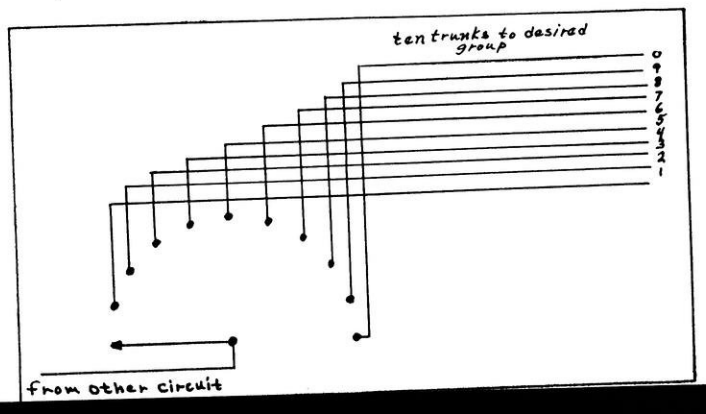


Figure III

"MACHINE DEFEATS WORLD CHESS MASTER IN TOURNAMENT AT MANCHESTER"

a thinking machine!

IS IT POSSIBLE?

by robert gesteland e'52

Such might be the results of activity of several groups of engineers, physicists, mathematicians and biologists in this country and abroad. The possibilities of machines that think beyond the minds of its designers have fascinated people for many years, and recent research and development has brought us a little closer toward this goal.

Much of the background in this field has been set forth in a recent book called **Cybernetics** by Dr. Norbert Wiener, a mathematician associated with MIT. The book relates the theory and practical developments in the study of the physics of the human mind, as formulated by Dr. Weiner and Dr. Artur Rosenblueth of the National Institute of Cardiology of Mexico.

Closely allied with this study is the work being done on electronic computers, such as ENIAC and BINAC, and other highly developed automatic calculating machines.

The example most often used to illustrate the lines of thought now being persued which lead toward a thinking mechanism is the fire control apparatus used with anti-aircraft artillery during World War II. This sytem was capable of tracking the curving course of a plane, and from this data to predict its future position and aim the gun at the required point. This system depended heavily upon the application of inverse feedback. The amplified signal indicating the position of the plane (radar) was fed into a vacuum tube, and a similar signal indicating the sport toward which the gun was pointed was used as feedback into the tube. The gun was then moved till the difference between these two signals was zero. Thus the position of the shells just shot are used to aim the next ones, thereby relying entirely on negative feedback.

The human nervous system works in a way that is almost identical to this. For example, when a person reaches to pick up an apple, the impulse from the muscles of his arm is impressed on his brain along with the impulse from his eye telling him how far his hand is from the apple. The brain then selects a feedback circuit that will tend to make the difference between these two impulses zero by sending a pulse to the muscle to move it to accomplish this goal.

The simple animals such as insects have their feedback patterns set by heredity. They do the same thing the previous generations did and cannot adapt themselves to changing environment. A baby kitten, or any of the higher order of animals, is born with many of its feedback circuits undecided. Thus the kitten may run towards both red meat and red fire at first, but it won't take many burns to set up a feedback circuit in the kitten's brain that will keep it away from fire. The goal in the construction of a thinking mechanism is to achieve a machine that can construct its own feedback patterns so they may be determined by the effect that they produce.

Actually, a larval version of such a machine has been constructed. Called a Hemeostat, it was demonstrated by W. A. Ashby of the Department of Research of Barnwood House in Gloucester, England. The demonstration took place before the Electroencephalographic Society at the Burden Institute in Bristol on May 1, 1948. This mechanism is comparatively simple in its construction and operation, but because it is composed of only four units,

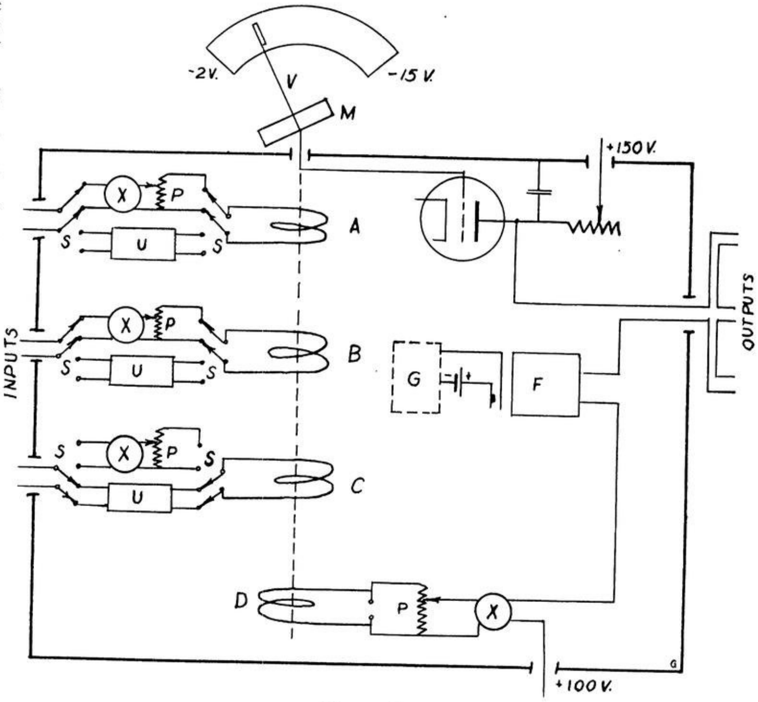


Figure I

comparable to a very small number of brain cells, its use is limited to demonstrations and experimentation.

The circuit for one unit of the Homeostat is shown in figure 1. It is arranged for the interconnection of three similar units.

The center of interest of the unit is the semicircular trough (T) and magnet (M) at the top of the diagram. The trough contains water and has an electrode at each end, at potentials of -2 and -15 volts respectively. The vane (V) attached to the magnet swings in the trough and picks an electrical impulse out of the water in propor-

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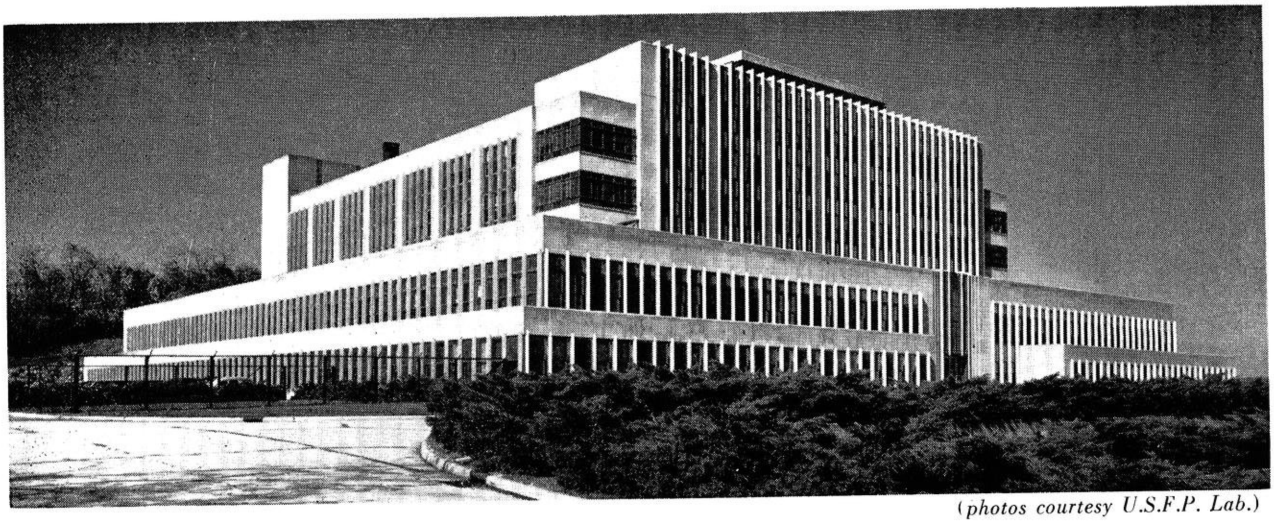


(photos courtesy U.S.F.P. Lab.)

UNITED STATES

FOREST PRODUCTS LABORATORY

by cecil royce e'50

In these days, Wisconsin is advertised as a dairy state. The state has rich milk, delicious butter, unsurpassed cheese, fresh eggs and poultry—plus other dairy products that will satisfy any epicure, with the best of beer to go with them. The state is a vacationist's heaven, and a sportsman's paradise; having vivid scenery abounding with game, and beautiful lakes and rivers full of big fish, just waiting for the "sportsman" to come and take them.

Before all this propaganda was started, history shows that Wisconsin at one time led all the states in the production of lumber. This was back in the time when Wisconsin butter was referred to as "Western grease", and Wisconsin cheese had to be sold under trade names that disguised the point of origin if it was to be sold at all.

The lumbering industry started in Wisconsin about 1870, and reached a peak in 1900, when Wisconsin was the United States' leading producer of lumber. Lumbering was Wisconsin's leading industry until about 1910, when lumbering gradually declined. As the lumbering declined, wood products gradually rose to a position of importance. Paper and wood pulp was the state's fifth industry in 1947. Furniture manufacture is another important Wisconsin wood products industry.

The people in the early days were not much interested in conservation, but they were interested to some extent in making the best use of the wood, and discovering the actual properties of the different types of wood. Under the leadership of Gifford Pinchot, the U. S. Forest Service organized various research and testing groups. These small research units were operated in connection with several colleges and universities, notably Yale, Purdue, and the University of Washington.

The disadvantages of this arrangement soon became apparent. There was no central control group, and work was sometimes duplicated. Consulting an authority in a related field was a major problem; involving much correspondence and loss of time. The scattered groups could not join forces in acquiring and economically using equipment required for the tests, so discussion was started by the Forest Service on a central research unit location.

The University of Wisconsin offered to provide a suitable building and land, and furnish the required heat, power, and light. The offer was accepted, and the Forest Products Laboratory was started in 1910, in what is now the Mining and Metallurgy building. This location, plus some additional space supplied as necessary, was used until 1932, when the present building was occupied.

Congress was finally convinced that a permanent, adequate site was needed, and money was appropriated. Again the University of Wisconsin provided the land, and agreed to supply the light, heat, and power. The present building is the result.

The Forest Products Laboratory and the University of Wisconsin are separate institutions, but a high degree of inter-cooperation is maintained. The facilities of each unit are available for use by the other, and personnel of the Laboratory act as instructors in some U.W. courses. The Forest Products Laboratory is part of the U. S. Dept. of Agriculture, and is a unit of the research organization of the Forest Service bureau of that Department.

The present building is a U-shaped structure, five stories high, containing approximately four acres of floor space. The Laboratory has means for testing, processing, and handling wood in any form from the log to the finished product, such as lumber, turpentine, paper, or molasses.

The Forest Products Laboratory is the only Federal government institution in the U. S. concerned wholly with the investigation of wood, and wood products and their adaptation to a wide variety of uses. It was the first unit of its kind, though other governments, notably the British Empire, Norway, and Sweden have since built similar laboratories. There are some smaller units similar to the Forest Products Laboratory, but they are part of colleges in areas where lumber is an important product, such as California and Oregon. The National Lumber Manufacturers' Association has a small laboratory near Washington, D. C.

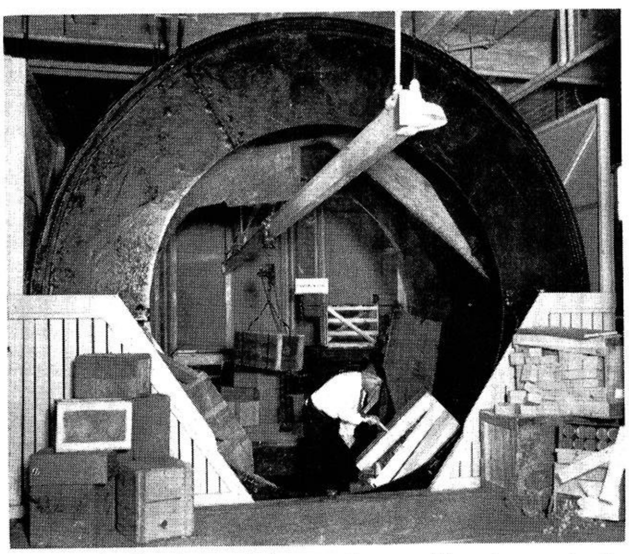
Stating the purpose of the Laboratory, and what it hopes to accomplish, has been done very well by Mr. G. M. Hunt.

"Early in the Laboratory's history its specific aims were defined as follows: The purpose of the Forest Products Laboratory is to aid in protecting and enhancing the value and utility of forest products. To this end the research at the Laboratory is directed toward more profitable wood utilization—toward elimination of waste and reduction of costs in logging, in manufacture, and in the use of wood products; toward increasing the serviceability and satisfaction of forest products to the user; and toward the development of new and useful products from wood.

"This work does not involve problems of growing timber, except in studies of the effect of growth upon wood properties, nor in economic or administrative problems involved in the management or marketing of timber, nor in protecting the forest against fire and the hazards of insect attack and decay. The task is one of exploring the physical and chemical nature of wood itself so as to make it possible to suggest means of using wood more completely and profitably.

"The primary job of the Forest Products Laboratory is research. The Laboratory does not engage in the manufacture, promotion, or sale of any commodity.—

"The secondary job of the Forest Products Laboratory, but a vital one, is the dissemination of the results of research. The need throughout the United States for technical information on the use of wood is vast. The impact of this need on the Laboratory comes through thousands



Scientifically designed box testing machine in use in the Laboratory.

Typical wasteland left by the early lumbering interests.

of letters and from a constant stream of visitors, ranging from home owners and farm woodlot and sawmill operators to executive and technical personnel of great wood using corporations. The Laboratory's problem is to adequately service the need for information already at hand while at the same time going ahead vigorously with research aimed at new information equally in demand by wood users and processors in all ranks."

The program of the Laboratory and the problems accepted by the Laboratory depend upon a variety of factors. The program is subject to the approval of Congress. The prime factor during the war periods was the demand of other government agencies; army and navy problems, such as ordnance containers of all kinds, and wooden aircraft sections, were an important item; in normal times, industrial problems of general interest are considered, such as building codes, and improvement of building materials. Suggestions and questions by the appropriations committee, and questions asked by Congressmen for their constituents may be investigated. The acceptance or rejection of a particular problem depends upon the probable benefits to be derived from the solution. When a choice must be made between two problems, the one believed to have the widest application will be investigated. The work done at the Laboratory is not subject to patent unless the patent is in the government's name, or a "people's patent" for free use of any citizen.

The Laboratory does no routine testing, except in wood identification. Some cooperative work with industry is undertaken if the results will be of substantial public benefit. The cost to the industry depends upon how the problem fits the Laboratory program. The cost may be paid entirely by the company, or if the problem fits the Laboratory program, the cost is split between the company and the Laboratory. An interesting fact is that about 5% of the cost of the Laboratory's operation may be paid by industry in this way. Many times the problem of the industry can be solved, or solutions suggested, by information already at the Laboratory.

All the information that the Laboratory has is available to the public. All results are published in the form of mimeographed reports, and if interest is general enough,

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Editor's Note: Another in our series of articles describing jobs which may interest you.

Aviation has come a long way since that December morning forty-six years ago when Wilbur and Orville Wright astounded the world by completing the first successful flight by man. It seems hard to believe, when one looks at our modern complex commercial aircraft, that any one industry could grow so fast.

At the beginning, one man could handle the "flying-machine"; and he was looked upon as a dare-devil character swaggering around in the perennial get-up of a six-foot white scarf, goggles, leather jacket and helmet, breeches and riding boots. As the airplane grew in size and complexity however, this character began to assume a more business-like appearance.

Soon the size of the planes got to the point where the pilot required assistance to fly the "iron-bird" and a co-pilot was added. With the birth of four engine aircraft and all its intricate instruments and gadgets, the pilot and co-pilot found themselves taking a mechanic along to act more or less as a trouble shooter in flight.

Today the modern four engine commercial aircraft offers an example of one of the most complex pieces of machinery that man has yet produced. To operate these airplanes, the modern flight crew is made up of three skilled technicians and craftsmen, two pilots, and a flight engineer. Everyone is familiar with the pilots' trade, but the flight engineer is the member of the crew that few people even know exists.

The flight engineer's position was created primarily to remove some of the strain and responsibilities of the pilots.

Duties of the Flight Engineer

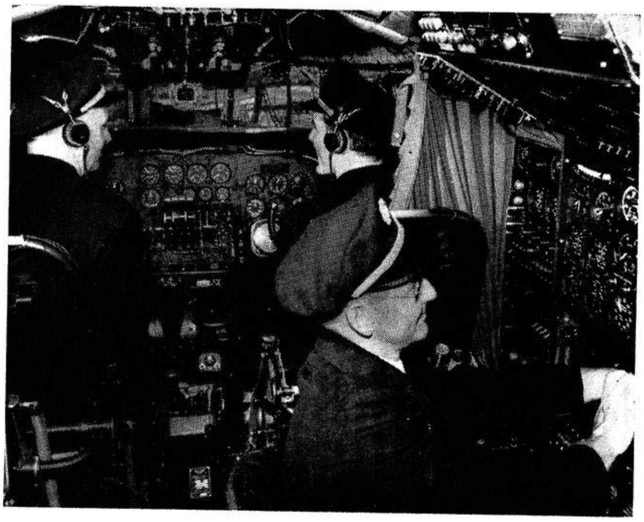
The flight engineer has taken over a large share of the duties and responsibilities that were once considered part of the pilot's job. The pilots no longer have to keep an eagle eye on all the engine instruments, worry about cruise control, power settings and other related problems.

Under the organization plan as used by Eastern Airlines in the operation of their Lockheed Constellations, the pilots are free to concentrate all their efforts and skills on actually flying the airplane. This system of using engineers greatly increases the safety factor in airline operation. As one old pilot once so amply put it: "A flight engineer is the best insurance a ship can have."

The work of an engineer falls into two classes: that which is done on the ground, and that which is performed in the air. On the ground the engineer is responsible for inspecting and checking his airplane prior to each flight. These inspections include checking to see that all the required maintenance has been completed, and that the ship has ben properly serviced.

On of the main concerns of engineers is to know if the ship he is about to fly is properly loaded and that passengers and luggage will be distributed properly about

Hello there - meet the



Pilots and flight engineer at their stations in a Constellation.

(photos courtesy EAL)

the "CG" in order to maintain safe flying characteristics. When the engineer has made certain the aircraft is ready for flight he proceeds to set up his flight plan. This consists of preparing a log to be kept during the trip and calculating the power settings and fuel consumption for the flight.

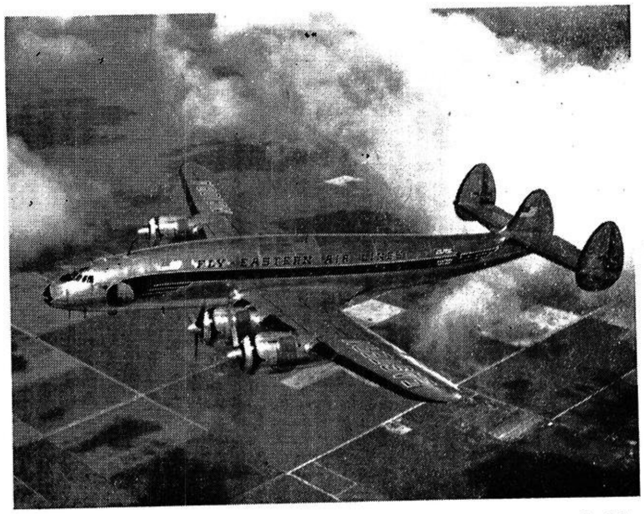
Once the crew is ready to go and the all clear has been received from the ground crew the engineer starts the engines. As soon as the starting procedure is completed, the engineer checks all engine pressures and temperatures to make sure they are up to normal. He then notifies the pilots that he is ready to taxi out for take-off. Immediately prior to take-off, the pilots and engineer will run a swift but efficient power check on all the engines to make sure there are no malfunctions and that the engines are delivering the proper power.

Take-off is one of the times that the utmost cooperation and coordination must exist between the pilots and the engineer. It has often been said that an octopus is the only living creature that could adequately perform the duties of a flight engineer during take-off. Along with some 15 instruments to watch, the engineer must stand ready to take over all the power controls from the pilot as soon as he has obtained directional control with the rudder.

Once the ship is in the air, the engineer starts what many refer to as the gage watching. It is at this time that he starts his brain work. The engineer has to be ever alert to the slightest indication from his instruments of trouble. He has to be able to interpret the engine instruments so that he can act quickly to remedy any trouble that may arise. All during the time of flight he keeps calculating his fuel consumption and keeps adjusting the power to fill the demands of his cruise control.

At times he may be required to transfer fuel from one tank to another by means of transfer valves in order to maintain the weight and balance of the ship correctly. He must also stand ready to give the pilot the gross weight of the ship and the fuel remaining and how far the ship can go on this fuel.

Along with all these routine duties, the modern commercial aircraft has introduced a new task, that of a pressurized cabin. The pressure controls and instruments for the cabin must be watched constantly as they maintain the cabin near sea level pressure while the ship cruises along at an altitude of anywhere between ten and twenty thousand feet.



An EAL Lockheed Constellation. This is one type of ship on which flight engineers are used.

Upon landing the engineer gets in touch with the maintenance crew and gives them a detailed report on the condition of the ship. This report is one of the more important phases of the engineer's work as he must be ready to explain intelligently to the chief mechanic the disposition of the ship. If there is any maintenance that has to be done, it can be greatly expedited by a clear report by the flight engineer.

Requirements for Flight Engineers

It is understandable that a position as a flight engineer must have some somewhat rigid requirements. These may be broken down into two classes. First there are the federal government requirements that must be met as set up by the Civil Aeronautics Administration. It is a federal regulation that no one may operate as a flight engineer unless they have passed all the qualifications and tests for a CAA Flight Engineer's Certificate. Before an applicant can be considered for this certificate he must be able to pass a physical exam and be able to meet one of the following requirements pertaining to experience:

(1) Have three years experience in maintenance of aircraft engines, one year of which must be on multi-engine aircraft.

(2) Graduate of at least a two year specialized aeronautical training course in maintenance.

(please turn to page 40)

by charles white m'50

flight engineer

Freshman Awards

by charles e. manske ce'50

(photo by Hull)

William C. Smith

Before the war an annual engineering Award Day was held in freshman forum. Awards were presented to the top ranking freshmen of the preceeding year in their respective engineering fields by the honorary fraternities such as Tau Beta Pi, Eta Kappa Nu, Chi Epsilon, and Pi Tau Sigma. The chairman of Polygon Board and the editor of the Wisconsin Engineer also gave talks to acquaint the freshmen with their opportunities in engineering activities. But since 1946 only Tau Beta Pi and Eta Kappa Nu have resumed their traditional presentations; however, it is hoped that Award Day will be fully reinstated next year.

William C. Smith

The winner of the annual Tau Beta Phi award for the most outstanding freshman scholastic record during 1948-1949 is William C. Smith, a chemical engineer from Wauwatosa. In recognition of his fine work, Bill was presented with a K. & E. Log-Log Duplex Vector slide rule.

He is just eighteen because he skipped a grade in the school he attended while living on Milwaukee's south side. But at the time he was in seventh grade his family moved to Wauwatosa, where he found the scholastic competition much keener. During high school much of his spare time was spent in choir and band work. He also picked up some extra cash playing in Wauwatosa High's dance band.

Bill decided on chem engineering early in high school because of his aptitude in science and mathematics. Although his father has been in accounting for twenty-six years, and serves as secretary and treasurer of the Heavy Duty Electric Company of Milwaukee, he encouraged Bill's interest in engineering, which he considered a worth while field.

In addition to maintaining his high scholastic average here at Wisconsin, Bill also serves as social chairman for Showerman House in the Kronshage group.

Orrin C. Kaste

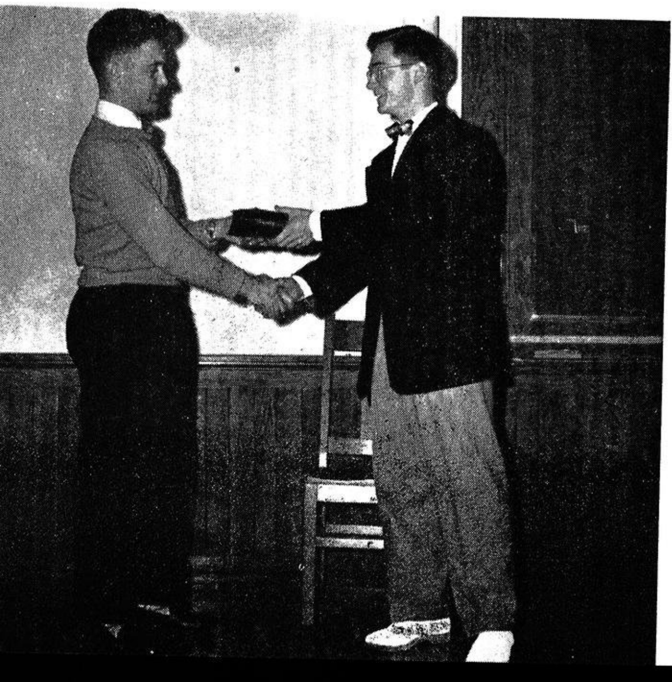
The annual Eta Kappa Nu freshman award was won by Orrin C. Kaste. His high scholastic record of last year made him the top freshman electrical engineer and earned him an electrical engineer's handbook.

Orrin, who originally hailed from Alma, Wisconsin, out near the Mississippi River, now keeps house here in Madison with his wife. He attended high school in Alma, while living on his father's farm. After graduation in 1944 he worked on the farm for two years, and then enlisted in the army. He had decided to study engineering before he entered the service, so he considered himself fortunate to be assigned to anti-aircraft electrical control. He served as instructor at various stations throughout the United States. It was while he was stationed at Aberdeen Proving Grounds in Maryland that he met his present wife. They were married in July 1948, shortly after he was discharged.

Orrin says that married life, along with his studies, really keeps him busy. His main outside activity is membership in the Young Adults' Club.

Congratulations!

These two men were selected as the top students in their respective engineering fields, and the school is looking forward to further achievements from each of them. These awards will be given again next year, and all freshmen are eligible to compete for them; but these are only stepping stones to further scholarship awards, election into the engineering societies, and possible fellowships for graduate study. There is plenty of opportunity for good men in engineering, and these two men show promise of going to the top of the ladder.



(photo by Hull)

Orrin Kaste receiving the handbook award from R. R. Johnson, president of Eta Kappa Nu.

Alumni Notes

by hank williams e'50

Stephen B. Severson (E'07) was the subject of a lengthy article in the October 1949 issue of the SERVICE magazine put out by Cities Service Co. Mr. Severson is now located in Buffalo, New York; he is president, director, and general manager of Republic Light Heat and Power Co., Inc., and Dominion Natural Gas Co., Limited, of Canada; Stoughton, Wis. is Mr. Severson's home town, and the University of Wisconsin is his alma mater: he graduated here in 1907 with a degree in Electrical Engineering.

E. E.

Richard Holcombe ('49) is doing sales work for the Interstate Power Company of Dubuque, Ia.

Ray Hyink ('49) is a Research Engineer for the Cutler Hammer, Incorporated, of Milwaukee, Wis.

S. G. Katsekes ('49) is doing design and construction work for the S. & T. Construction Company, General Contractors of Milwaukee, Wis.

Harry L. Skiles ('49) is in the design department of the Gisholt Machine Company of Madison, Wis.

Robert J. Derber ('49) is employed with the Northern Indiana Public Service Company of Hammond, Ind.

M. & M.

Henry P. Ehrlinger ('Min, '25) was recently appointed Treasurer and General Manager of the Bonita Mining and Development Company, Incorporated, of Silverton, Colo.

John J. Gibbons is a Petroleum Engineer for the Shell Oil Company. He was recently sent to Centralia, Ill.

Julian D. Conover (EM'21) is Secretary of The American Mining Congress.

Marion Harbaugh ('23) is Secretary of the Lake Superior Iron Ore Producers Association.

J. F. Wolff (EM'11) was recently made General Mining Engineer for Oliver Iron Mining Company of Duluth. He succeeded **T. B. Cronk,** (EM'14) who retired July 1.

Lloyd J. Severson ('36) took over Mr. Wolff's position as assistant to the General Mining Engineer of the Oliver Iron Mining Company.

C. E.

George Zeisler ('08) is Vice-President of the Henry W. Horst Company of Philadelphia. His company is engaged in the inauguration of a construction program in pre-tested concrete.

Phillip F. Morgan ('33;MS'35) has been Associate Professor of Sanitary Engineering at the State University of Iowa since September, 1948. Phil was with the Chicago Pump Company for several years. From 1945-48 he was with the National Council for Stream Improvement, an organization of pulp and paper companies.

James P. Michalos ('38) is an Associate Professor at Iowa State College, teaching structures. Jim has taught also at Montana State College and Syracuse University.

Robert L. Reisinger, Jr. ('43) has rejoined the Robert L. Reisinger Company, General Contractors, in Milwaukee. For the past year and a half, Bob has worked with W. C. Krueger and Associates, Architects and Engineers, of Santa Fe, N. M., for the Atomic Energy Commission at Los Alamos.

John E. Parsons ('49) is on his way to the 124th Naval Construction Battalion at Adak, Alaska. He has been attending the Civil Engineer Corps Officers School at Port Hueneme, Calif., and the Chemical Warfare and Radiological Safety School in San Francisco.

Ch.E.

Harold J. Patneaude ('49) is on the training program of the Allen-Bradley Company of Milwaukee.

Glenn W. Huebner ('49) is on the technical supervisor's staff of the Anaconda Wire and Cable Company of Marion, Ind.

Calvin W. Pipal ('49) is on the training program for the General Electric Company.

Coe J. Rost ('49) is an engineer for the Humble Oil and Refining Company of Baystown, Texas.

John H. Kleinschmidt ('49) is in research for the Marathon Corporation of Rothschild, Wis.

M.E.

Jerome Federer ('49) is working in the design department of the Kohler Company of Kohler, Wis.

Rudolph R. Teichman ('49) is doing design work for the Link Belt Company of Chicago, Ill.

Clark R. Hibbard ('49) is in the Engineering and Design Department of the Yates American Machine Company of Beloit, Wis.

Harvey E. Burkman ('49) is on production for the J. I. Case Company of Bettendorf, Ia.

Neal C. Wogsland ('49) is doing sales work for The Alstan Company of Milwaukee, Wis.

Richard L. Barter ('49) is in sales for Cadillac Motor Car Division of the General Motors Corporation at Los Angeles, Calif.

Gale R. Reimer ('49) is doing design work for the Western Condensing Company of Appleton, Wis.

Albert O. Hardrath ('49) is in the Design and Research department of the New Holland Machine Company of New Holland, Penn.

Douglas E. Holt ('49) is in design for The Heil Company of Milwaukee, Wis.

Kenneth H. Ladd ('49) is in the design department of the Singer Manufacturing Company of South Bend, Ind.

Russell Pipkorn ('49) is a development engineer for the Cleaver Brooks Company of Milwaukee, Wis. Russ was formerly a feature writer on the WISCONSIN ENGINEER.

Benjamin D. Thomas ('49) is in production work for the Chrysler Corporation of Detroit, Mich.

ON the Campus

by fred m. kohli e'50

BEARDS, BEARDS, BEARDS—AND MORE BEARDS!

The first stubble of the season will appear January 3, 1950, on the 14 assorted chins of Polygon Board. Although not eligible for competition, each Polygon member has pledged to grow a beard in an all-out effort to encourage the biggest crop of beards ever assembled on the Wisconsin campus.

By growing a beard you will help elect your candidate for St. Pat. Points will be given for the number of beards on the same basis as the number of tickets and buttons sold.

Beards may be started at any time WITH ONE EXCEPTION. **Those persons competing for the longest beard must appear cleanshaven on January 3, 1950.**

The tentative plans are to award prizes for the best, longest, curliest, thickest, best colored, and most original beards.

The judging, as in past years, will be done by a bevy of Badger Beauties. However, the judges' decisions will be based on preliminary scientific measurements taken shortly before the end of the contest. The best obtainable precision instruments such as vernier scales, micrometers, spectrum analyzers, and calipers for measuring the radius of curvature will be used.

A new service to beard-growing engineers is being offered by Polygon Board this year. Polygon members will willingly devote their time to arguing on the behalf of any engineer whose "little woman" might be so uncooperative as to try to stop him from growing a beard.

ST. PAT BUTTON DESIGN CONTEST

Attention all potential draftsmen, artists and persons interested in COLD CASH! Entries in the St. Pat Button Design Contest will be accepted between December 1, 1949 and January 6, 1950. All designs must be drawn on white cardboard and must be six inches in diameter. There must be no name or identification on the front to insure impartial judging.

The designs may be turned in through your organization's Polygon representative. The winning design will appear on the 1950 St. Pat buttons, and will bring an award of $15 to the designer. The awards for the second and third best designs will be tickets admitting one couple to the St. Pat's dance on March 17, 1950.

FALL SMOKER

Comedy, music, door prizes, cigarettes and beer were merely the sidelights of the Fall Engineering Smoker, sponsored by Polygon Board on November 2. The principal speaker of the evening was Mr. E. H. Burners, senior partner of Fuller, Shober, Burners, Safford and John, the Green Bay architects who designed the new Engineering building. Mr. Burners presented slide and an interesting explanation of the building plans and the problems encountered in designing the building.

Bob Peterson, popular master of ceremonies whose sideline is electrical engineering, introduced a varied program consisting of: Sid Wright, baritone, accompanied by John Toussaint; Charles Jellison, comedian and pianist; and Doc Edmunson, popular mimic who rendered such old favorites as "Chloe" and the "Sow Song."

Five door prizes were presented to the lucky number-holders by Keith Jensen, program chairman.

The starting dates and rules of the St. Pat Button Design Contest

Keith Jensen and Bob Peterson relaxing after the award of the five door prizes at the Polygon Smoker on November 2.

(photo by Bellgraph)

and the Beard Growing Contest were announced by Fritz Kohli, contest chairman.

CAMPUS CARNIVAL

"Hey, hey, come in and see your own voice," cried the man in the checkered vest in front of the Polygon Engineering Arcade.

Bob Wilson, the barker, was referring to the oscilloscopes that were connected to tape recorders. Marshall Hughes and Leonard Snyder from IRE and LaVerne Stelter from AIEE operated this section of the Arcade.

A special attraction, designed for the booth by Dick Pieri, was a photoelectric shooting gallery. The sharpshooting customers fired an "electric ray" gun at a phototube concealed in a clown's tooth. Each successive bull's eye was rewarded by a glimpse at a more "revealing" picture.

Souvenirs were made before the patrons' eyes by Clyde Plaskett, Dave Sands, Jim King and Jim Spindler from AIChE. The process consisted of molding bakelite and lucite around coins or keepsakes.

The booth was erected by members of Polygon Board under the direction of Committee Chairman Carl Dralle.

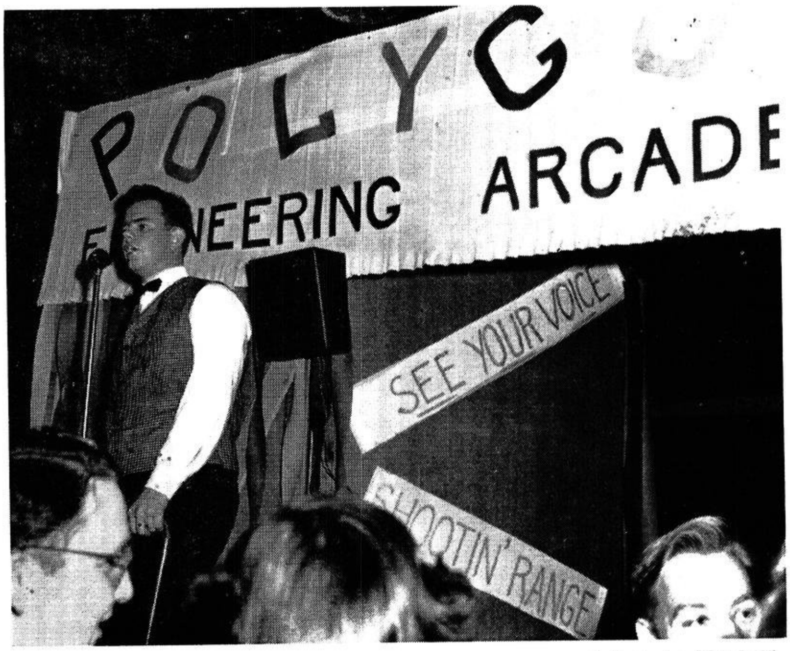
SPECIAL INVITATION

All engineers are invited to attend the AIChE meeting on December 15. Dr. Ralph Lee of General Motors will present a talk of vital interest to all engineers, entitled "Human Engineering."

Look for the meeting announcements in the engineering buildings for the time and place of the meeting.

CHI EPSILON

Chi Epsilon, honorary civil engineering fraternity, has elected the following officers for the current school year: Wilbur Holley, president; Leonard Guth, vice-president; Robert Craig, secretary-treasurer; Donald Near, corresponding secretary; and Arthur Broshot, associate editor of the **Transit,** the national magazine of Chi Epsilon.



(photo by Mitchell)

Bob Wilson and the Polygon Booth at Campus Carnival.

PI TAU SIGMA

The following men were initiated into Pi Tau Sigma, honorary mechanical engineering fraternity, at its fall initiation banquet, November 30:

R. J. Bertling
J. W. Bolender. Jr.
D. L. Borden
W. K. Chipman
F. T. Coldwell
O. T. Conant
W. R. Gehr
R. C. Jung
F. P. Klatt. Jr.
J. A. Kremers
J. Luening
D. W. Ruess
J. Sidwell
C. D. Srothman
F. Szczesny
M. Velguth
J. B. Wagner

The speaker was Mr. F. M. Young, president of the Young Radiator Company, Racine.

TAU BETA PI

Those fellows running around the engineering buildings last month sporting maroon and white ribbons were not the umpteenth prize winners in a stock show, but were Tau Bate pledges wearing the traditional badges of pledgeship.

These pledges were busy carrying out projects designed to bring their sterling qualities to the surface. Each pledge carried an available supply of cigarettes for the pleasure of the actives, and was subject to a ten cigarette fine for being caught without his pledge badge.

In addition, the pledges competed with mental and technical skills for the $5 prizes awarded for the best plaque and the best 1,000-word essay. Don Jarosh, Bob Cattoi and Bob Johnson, the contest judges, awarded the prizes to Don F. Miller for the best plaque, and Bert Erickson for the best essay.

The fall initiation was held at Tripp Commons on December 1. Toatsmaster Prof. Kurt Wendt, head of the Engineering Experimental Station, introduced the guest speaker, Mr. Charles M. Wilson, director of the State Crime Laboratory, who spoke on "Methods of Crime Detection."

The new members are:

A. B. Fontaine, A. J. Paul, Jr., Robert R. Wiethaup, Donald O. Barth, S. Campbell, Bert Erickson, E. A. Ohm, W. B. Drewry, Robert G. Craig, Arthur A. Gruetjen, John E. Gonce, Charles E. Manske, Donald F. Miller, L. J. Bastian, Charles E. Klotz, Donald W. Derber, L. J. Schlimgen, James W. Hare, Harry J. Kauffman, Roger A. Thiede, Frederick C. Hengst, Donald W. Reuss, George W. Drew, John J. Gill, William C. Manske, Herman J. Hovelsrud, Robert G. Johnson, Harold Bell, Jr., John F. Watson, Arthur F. Kopisch, Frederick H. Riedel, Theodore J. Iltis, Edward O. Busby, John L. Cleasby, Richard J. Priem, Rudolph N. Krueger, Ronals Weiss, C. L. Olsen, Sumanrai R. Doshi, John A. Kremers, J. F. Bultman, James B. Wagner, Fred H. Jaeger, D. J. Petranek, James W. Coonen, Cedric L. Iverson, Paul B. Dapper, Gilbert C. Lamb, Frank P. Klatt, Edgar M. Jaehnke, R. J. Fuchick, L. E. Stieghorst, J. G. Franchini, D. W. Grainger, Carl R.

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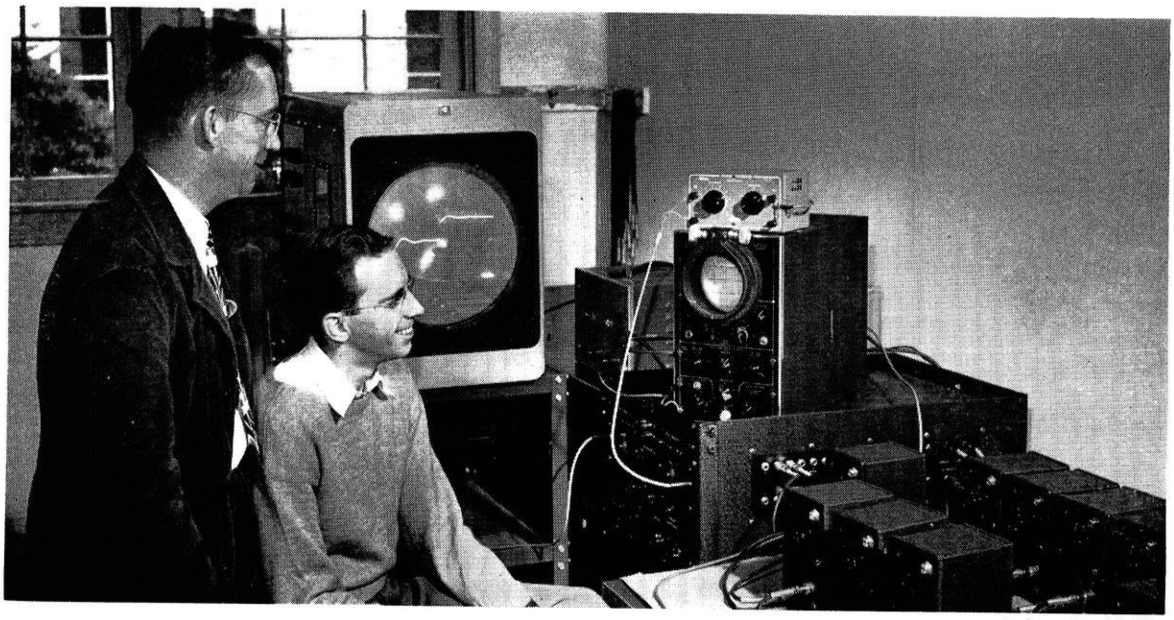


(photo by Hull)

R. K. Ausbourne and B. J. Norris operating the electronic analog computer.

It is surprising what a little snooping will do! While poking our noses into the various room of T-23 and T-24 looking for a subject of potential interest to "Wisconsin Engineer" readers, we found the most activity centered about a new instrument — the electronic analog computer. The efforts of no less than half a dozen individuals were found to be concentrated on this newest addition to the engineering department, and the enthusiasm of these individuals convinced us that we had our story.

In the not too distant past, it was possible for the engineer to get by with a little theory and a lot of practical experience; the trial and error method of development predominated.

However, with the advent of the industrial era, the demand for machines and processes to lighten man's physical load became increasingly difficult to satisfy by this time-consuming method. More emphasis was placed on theoretical or "drawing board" design from which a working model could be constructed. This method worked very well up to our present era, an era of revolution in technology.

In this era the working model has become a bottleneck in production. The engineer's solution to this problem, and his key to high speed production, is the electronic analog computer.

An analog computer employs a system whose known characteristics can be made analogous to those of the unknown system being considered; that is, the unknown is described in terms of the known. For example, many comparisons can be made between the properties of electrical, mechanical, thermal, hydraulic, and pneumatic systems, i.e., voltage and pressure, heat flow and current, inductance and inertia, or friction and resistance.

It is also known that certain combinations of mechanical or electrical elements are capable of multiplying, integrating, differentiating, etc. For instance, an amplifier, transformer, or gear train can multiply or divide; an automobile speedometer or resistor-condenser can integrate. It is these facts which form the foundation upon which modern computers are built.

Because of the versatility, compactness and high speed operation made possible by electrical analogies, the elec-

by noel hogue e'50 and robert cattoi e'50

Wisconsin's Analog Computer

tronic analog computer has been one of the most widely developed types of computers.

These computers consist essentially of a series of amplifiers and associated circuit elements arranged so as to perform various mathematical operations. These operations are restricted to linear functions only. However, many problems encountered in practice are of a linear type so that this computer finds wide application.

The information which is fed into the computer is in the form of a voltage whose magnitude represents the independent variable in a physical system to be investigated. The dependent variables are also in the form of voltages, the instantaneous magnitudes of which represent the prescribed variables. It is merely necessary to break into the circuit at the proper point to investigate any unknown since the information is produced continuously.

The first step in the operation of the computer is to obtain a set of equations which completely describes the operation of the system under study. These equations then make it possible to set up a block diagram for the problem in which each block represents a unit in the computer which is to carry out a specific mathematical operation. When this has been accomplished, the computer may be connected up according to the diagram and the solution obtained.

For instance, consider a simple problem in which one end of a coil spring is subjected to a force which varies with time. Suppose that a body of mass "M" is suspended from the other end and that viscous damping is applied through a dash pot arrangement, as shown in Fig. 1. The force equation for this system is:

$$f(t) = MX'' + K_1X' + K_2X$$

where X is the displacement at any instant and X′ and X″, respectively, are the first and second derivatives of displacement with respect to time. In order to set up the computer, it is convenient to write the equation in the form:

$$f(t) \quad K_1X' \quad K_2X \quad MX''$$

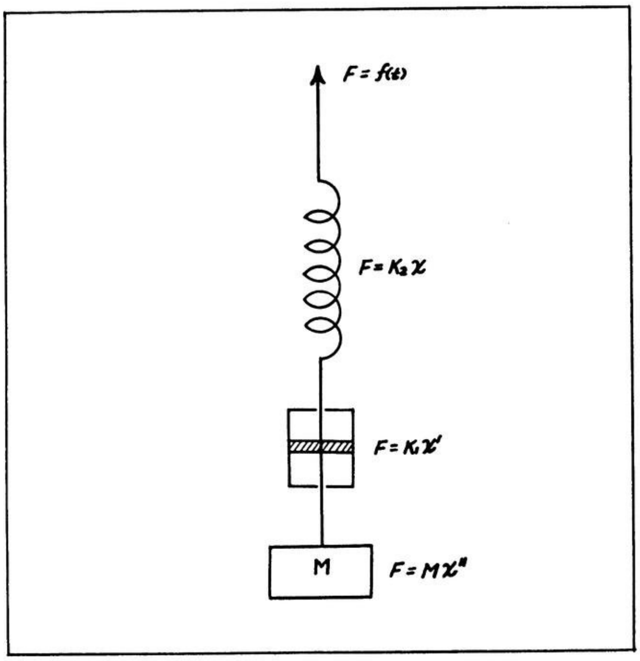


Figure 1

Examination of the equation shows that the mathematical operations to be performed are integration, multiplication, and addition. Figure 2 shows a block diagram of the computer set up for solving this equation. Each of the blocks represents one of the three main units of the computer—an integrator, an added, and a multiplier. These are designated in the diagram as $\int$ (integrator), Σ (adder), and $\times$ (multiplier). In the lower right corner of Fig. 3, a series of such units is shown connected together to solve

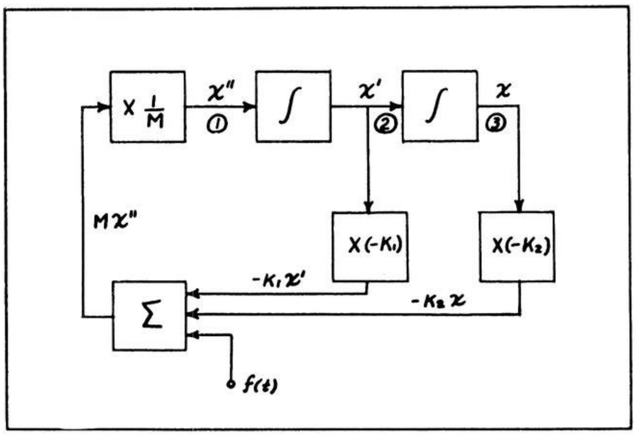


Figure 2

a similar problem. Great flexibility is offered in this particular computer since each operational unit is separate, making it possible to interconnect any number of them in any desired order.

It will be noted that the diagram in Fig. 2 forms a closed loop; this is a requirement except in a very few cases. The computer is then connected up according to this diagram and actuated by applying a suitable function f(t).

An oscilliscope may be used to view the acceleration, velocity, and displacement by connecting into the circuit at points 1, 2, or 3, respectively. In this way the solution. appears as a stationary plot on the oscilloscope screen and may easily be photographed if a permanent record is desired.

The great advantage of such an arrangement is that the effect of changing any physical constant in the system being studied may be observed instantaneously by the mere twist of a dial.

For instance, the effect on displacement, acceleration, or velocity by varying the stiffness of the spring in the problem just considered may be observed directly by varying the dial setting of the multiplier unit which represents the spring constant K_2.

This procedure is quite similar to the use of indicator diagrams in the study of engines. It is apparent that the choice of optimum valves is greatly expedited; cut and try methods are eliminated.

Although each variable is plotted against time by the computer, oscillographical viewing makes it possible to plot any variable against any other by introducing one into the horizontal amplifier and the other into the vertical amplifier. Time is thus eliminated except as a parameter along the trace. The resulting trace may be compared to

(please turn to page 24)

Seniors
EMPLOYMENT OUTLOOK

by robert wilson m'51

In recent months many junior and senior engineers have wondered considerably about their possibilities of getting a position in the field for which they have been trained—or a job at all.

This article will discuss the three problems of placement: opportunities, personal factors employers consider, and employer contacts. The sources of information are the speakers from the "Job Forum"; Mr. Grover C. Neff, President, Wisconsin Power and Light Co.; Mr. L. A. Wetlaufer, E. I. duPont de Nemours and Co.; Mr. F. F. Lafferty, Assistant Personnel Supervisor, Carnegie Illinois Steel Co., and Mr. Kenneth A. Meade, Director of Technical Employment, General Motors Co.; and Prof. H. Goehring, Director of Placement.

OPPORTUNITIES:

For the most part, the positions created by the lack of engineering graduates during the war and the expansion period immediately following have been filled.

Many graduates will be hired as replacements for positions left open by the resignation, promotion or death of the former holder. A few men will become part of a planned expansion program which many companies have.

Mr. Neff stated that the electric power industry will not catch up with present demands for engineering personnel until 1952. After this time one billion dollars per year have been allotted for expansion.

The chemical industry, according to Mr. Wetlaufer, is still expanding very rapidly. The need is for technical men, especially those with Master's and Doctorate's. The ratio of technical men to the total staff is growing larger.

The present high level of production will continue for some months to come, in the automotive industry, feels Mr. Meade. As a result there will be a limited number of openings.

There were not very many interviews given here this fall partly due to the high number of job acceptances last spring as compared with those expected. As a result, many companies hired men who had to be located in positions which did not open up until late this fall. Normally these positions would have been filled by the January graduates. Another big factor was the unsettled labor situation.

The number of openings this year is going to be considerably under those available in the first post-war years. Many graduates will have to be content with less important jobs and those not directly connected with engineering with the hope of working into the desired position.

The indications are that more interviewers will be on campus this winter and spring than this fall — the ratio of interview vs. job seeker will be greater.

PERSONAL FACTORS EMPLOYERS CONSIDER:

The most highly stressed point, at the Job Forum, was personality — the ability to get along with and deal with people. Grades are very important especially for those men who want to enter research fields.

Outside activities indicate to the interviewer the student's interests outside of the classroom. This interest pattern is very important since the employee usually follows traits set up during his college years.

Interviewers are very interested in any indication of an ability to write, speak, and lead, for these are the famous shortcomings of many technical people. Offices held in any campus organization offer valuable training in these desired assets.

Summer jobs (of any type) are very important even if they are not connected directly with the interviewer's field. A summer spent setting posts is far more valuable than one spent at a summer resort sleeping.

Your marital status has very little to do with your chances of getting a job. A few companies prefer single men due to the nature of the work while others prefer married men with families because they offer more potential stability.

EMPLOYER CONTACTS:

Personal contacts and family friends are perhaps the best source of jobs, but, unfortunately, few of us have them.

The Placement Office has tried to place as many graduates as possible, and last year managed to place 81% of the graduating class. However, it must be pointed out that only a small percentage of companies hold interviews on our campus and normally hire from 55% to 60% of the graduating class. The balance must find employment by themselves.

Last fall the Placement Office, in order to be as fair and impartial as possible, asked for all 1950 graduates to indicate their general interest as to the type of work desired, and to check off a number of companies with whom they wanted to have an interview.

Individual placement forms were then drawn up and will be sent to companies specified by the students. The concern is requested to submit a list of men they especially want to see. Any vacancies in the schedule then will be filled from the men remaining on the placement list. If any openings are still evident the lists will be posted on the bulletin boards.

Many companies are interested in hiring only a limited number of men and therefore would not be interested in interviewing an excessive number of men.

The Placement Office would like to stress that all seniors make sure that their mailing address, telephone number (even if out of town), and date of graduation be turned in to Room 261, ME Building, at once.

Campus . . .

(*continued from page* 17)

Wilhelmsen, Wellington E. Pederson, Arthur Gennrich, John A. Keymar, S. J. Schwartz, Howard C. Washechek, Wayne I. Thisell, James B. Borden, Donald H. Ferrell, D. C. Gardner, George K. Klinge, Gerald K. Reen, Howard J. Wright, John F. Munson, Robert C. Benning, Ronald R. Fieve, J. C. Van Caster, Curtis D. Strothmann, Orin T. Conant, Donald L. Borden, Geo. F. Schuning, William Woelfer, A. J. Jacobson, Phillip C. K. Wu, Ronald Bertling and Arnold Berg.

ETA KAPPA NU

Coke and doughnuts, and two movies, "Touchdown Thrills of 1948" and "World Series of 1947," were the features of the November 2 meeting of Eta Kappa Nu, honorary electrical engineering fraternity.

The following new initiates were elected during the business session:

Honorary initiate, Prof. Vincent C. Rideout; and student initiates, Harold Bell, Jr., Donald W. Dodge, Ronald R. Fieve, Robert J. Fuchiek, Harry J. Kauffman, John A. Keymar, George K. Klinge, Gilbert C. Lamb, John F. Munson, Charles L. Olson, D. J. Petranek, James C. Van Caster and Carl R. Wilhelmsen.

These men were formally initiated on December 8 in the Memorial Union. Mr. Ed Kallevang of the Wisconsin Power and Light Company was the main speaker at the initiation banquet. The toastmaster was Mr. Bert E. Miller, director of the Methodist Hospital of Madison.

AIEE—IRE

The two electrical organizations, AIEE and IRE, have teamed up this fall for a series of joint meetings. On October 25, Mr. Sorenson and Mr. Wilerd of the Wisconsin Electric Power Company presented a discussion and movies of "Power Transmission Between Port Washington and Milwaukee." The business session included committee reports and a discussion of the proposed national consolidation of AIEE and IRE.

Mr. Harold Winograd, engineer in charge of rectifier design at Allis-Chalmers, presented a talk, "Power Electronics and Its Industrial Applications," at the November 16 meeting.

ASCE

Two movies, "Rail Steel" and "The Manufacture of Portland Cement," were presented at the November 22 meeting of ASCE. Following the movies, a business meeting was conducted by President Robert Craig.

At the December 14 meeting, the Milwaukee office of the United States Geodetic Survey will furnish a program explaining their activities.

SAE

"Your Future in Production Engineering" was the subject of a talk given by Mr. Ralph Holt at the November 17 meeting of SAE.

A joint meeting with ASME was planned for the month of January. Beer was served after the meeting.

ASME

Guest speaker at the November 8 meeting of ASME was Mr. J. R. Vernon, sales promotion manager for the John Service Company of Milwaukee.

Mr. Vernon, a Wisconsin engineering graduate, spoke on sales engineering as a career for technical men. He stressed that a sales engineer must like people, and be loyal to his company.

The new constitution of the student branch was amended to provide that a quorum consist of one-third of the membership.

AIChE

Prof. H. G. Goehring spoke to the members of AIChE at their November 10 meeting. His subject dealt with the methods of contacting companies who don't send representatives to the campus, and the qualities looked for in the job applicants.

The yearly AIChE scholarship award for the highest grade point during the first two years was awarded to Jesse Crump, a junior chemical engineer.

Business at the November 22 meeting included a discussion of plans for the St. Pat contest, and plans for a hayride to be held in January.

Prof. K. V. Smith of the psychology department is to speak on the psychology of an engineer in industry, and the human part of engineering at the December 8 meeting.

Officers for the '49-'50 school year are: Clyde Plaskett, president; James King, vice-president and treasurer; Walter Houghten, secretary; and Prof. C. C. Watson, faculty advisor.

AIME

Dr. L. E. Young, national president of AIME, attended the Mining and Metallurgy Club's banquet on October 27. A ham dinner was prepared by the students in the basement of the Mining building and served in the foundry.

Guests among the 90 persons attending were: Dean M. O. Withey, Prof. George Barker, Prof. E. R. Shorey, Asst. Profs. William Rundle, Phil Rosenthal, and Richard Heine, Dr. Dane Mack, Prof. Emeritus O. L. Kowalke, and Mr. E. C. Bean of the State Geological Society.

Asst. Prof. William Rundle and the AIME student members plan to attend the AIME regional meeting at Chicago on December 7.

(*please turn to page* 29)

C.E. Senior Field Trip at Allis Chalmers in Milwaukee. (*photos courtesy A-C*)

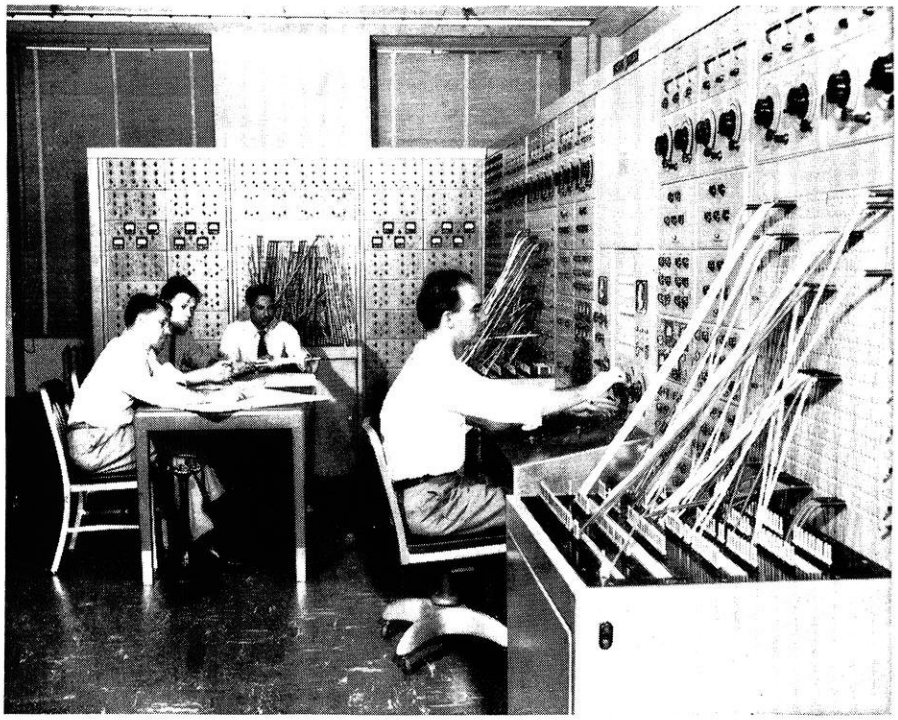
Science Highlights

by donald miller, m'50

A-C NETWORK ANALYZER

A machine which can duplicate in miniature hundreds of miles of transmission lines in vast electric power networks, and solve in minutes network problems ordinarily requiring weeks to solve, has been built by General Electric Company.

A power network can be simulated on the analyzer by plugging lines into the plug and jack boards to form small scale versions of the real power network. Small generators representing power stations send current through the simulated network, and engineers can study the network's behavior at any point under a variety of conditions.



G.E.'s a.c. network analyzer.
(cut courtesy G.E.)

The analyzer helps determine what would happen in any part of a network if new lines were added, if a line were broken, or if the source of power were changed. The network analyzer can also be used to solve many other scientific problems capable of expression in electric equivalents, such as the study of vibration in machinery, or the flow of air over an airplane wing.

One of the instruments has been shipped to the Bureau of Reclamation in Denver, Colo., where it will be used in the design of projected power systems and to determine the effect of alterations on existing systems. Two others will be shipped to the University of California at Los Angeles and to the India Institute of Science, in Bangalore, India.

COLOR ANALYZER

Millions of different colors of light beams can be distinguished by an instrument developed by General Electric Company.

The color - sensitive instrument, known as a "recording spectro-radiometer," has been designed for use in comparing and recording the colors of light sources. It breaks up beams being studied into the various colors of which they are composed, measures the intensities of these colors, and makes a permanent record of the measurements in the form of a graph.

It was developed in the search for new phosphorescent materials where it was necessary to have far more accurate means of measuring color values than the human eye can provide. By the use of this instrument it may be possible to set up specifications for phosphors. As well as being sensitive to the same colors as is the eye, the spectro-radiometer is also sensitive to ultra-violet light.

The instrument draws a curve showing the distribution of colors in a given light source in less than a minute. Production of such curves by methods used in the past required a series of measurements and long tedious point by point plotting.

The spectro-radiometer complements another color measuring device called the spectro-photometer which draws the same type of curves for light that is reflected or transmitted from non-luminous materials such as inks, paints, and textiles.

RECTIFIER WELDER

A d-c arc welder operating from an a-c power system has been achieved by means of selenium rectifiers. This welder, having no rotating parts, is an advancement because it combines good d-c welding characteristics with the numerous advantages of a-c welding machines.

The unit is very simple; the operating parts consist of a three-phase transformer, which results in a balanced power load, an adjustable three-phase reactor of the moving-core type, which gives stepless current control, and six banks of selenium rectifiers, which give full three-phase power rectification. A fan driven by a fractional horsepower motor provides the necessary ventilation. The 300-ampere version is about two feet square and three and a half feet high and weighs 510 pounds. Only about 40 per cent of the space required by a comparable

(please turn to page 30)

Newsworthy Notes for Engineers

ACTUAL SIZE

Mighty Midget of Microwaves

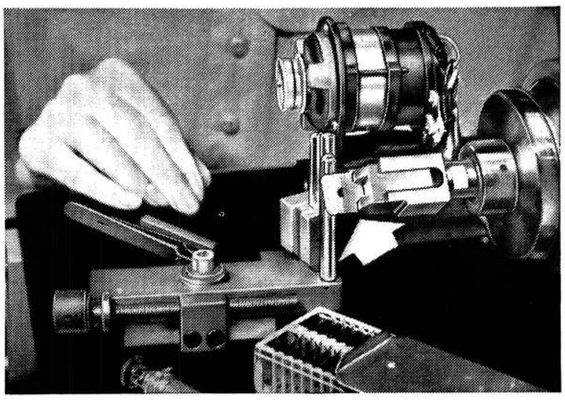
This little electron tube is called the 416A. It's the very heart of the latest radio relay repeater equipment for telephone and television transmission over long distances. Bell Telephone Laboratories scientists designed it—with elements spaced five times closer than in any previous microwave tube—and made the first samples under laboratory conditions.

Could such a tube ever be factory-produced in quantity? It seemed almost impossible—but Western Electric engineers tackled the ticklish problem. Here's the sort of thing they had to deal with.

Between the grid, which controls the flow of power in the tube, and the cathode, which produces the electrons, must be a space 6/10 thousandths of an inch. The oxide coating on the cathode must be 5/10 thousandths of an inch—no more, no less. The grid wires —3/10 thousandths of an inch in diameter —must be wound around the grid frame one thousand times to an inch!

The tiny parts would have to be made with laboratory precision. Much of the work would have to be done under microscopes. All parts would have to be kept surgically clean—for a speck of lint or a trace of perspiration could mar the efficiency of such sensitive tubes. New machines would have to be designed—new techniques developed—people trained to assemble the minute parts with utmost accuracy.

Could it be done? Well, Western Electric is making 416A tubes in quantity today—and with an amazingly low percentage of rejects.



This machine winds wire 1/8 the thickness of a human hair around the grid (arrow)—1000 turns per inch—maintains tension of 60% of wire's breaking strength.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Engineering problems *are many and varied at Western Electric, where manufacturing telephone equipment for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*

Computer . . .

(continued from page 19)

the familiar Lissajous diagrams and provides useful information concerning the phase relationships existing in the system.

The computer finds its main use in furnishing information on the stability and performance of a proposed system; but incidental to this use, it shows just how critical any component of the system may be. This makes it possible to assign tolerances in the constants of the system with reasonable confidence.

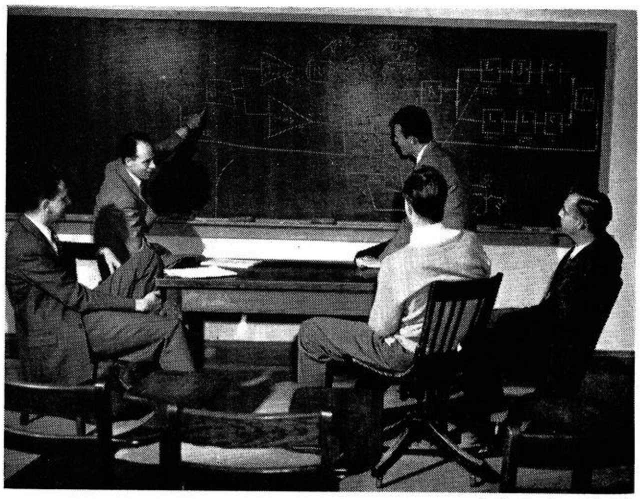
The computer here at the university was obtained mainly through the efforts of Prof. H. A. Peterson. Prof. Peterson was associated with General Electric for a number of years where he was intimately associated with the design and operation of mechanical differential analyzers and network analyzers. The bulkiness and cost of these larger units convinced him that the smaller analog computer was much more suited to general engineering research and design both in industry and educational institutions.

The engineering department's computer is one of the more versatile types—the Philbrick High Speed Analog Computer. Fig. 3 shows R. K. Ausbourne and B. J. Norris inspecting this equipment.

Under the direction of Prof. V. C. Rideout, considerable research is being carried out in the electronics lab to increase the scope of operation of the computer. R .K. Ausbourne and R. J. Medkeff are at present designing arbitrary function generators which will make it possible to extend the range of the computer to non-linear functions.

At the present time, the multiplication capabilities of the unit are restricted to multiplying a function by a constant only. However, B. J. Norris is designing a function multiplier which may make it possible to multiply a function by another function. If successful, this multiplier will be the first of its kind. Mr. C. A. Halijak, labeled by one of his fellow workers as the "mathematician of the group," is using the computer to study various back-lash mechanisms. Others connected with computer research here at Wisconsin are R. C. Lathrop and Prof. R. J. Parent.

The truly high speed electronic analog computer was developed during this last war where variations of the principle were used in such equipment as radar, gun sights, navigation instruments, and so forth. One of the first industries to realize its labor saving potentialities was the aircraft industry. It is surprising to note that not one single airplane which was used during the last war was designed during the war. This can be appreciated when it is realized that in the design of a turboprop aircraft engine there are more than one million combinations of parameters which must be investigated. This would require months of ex-

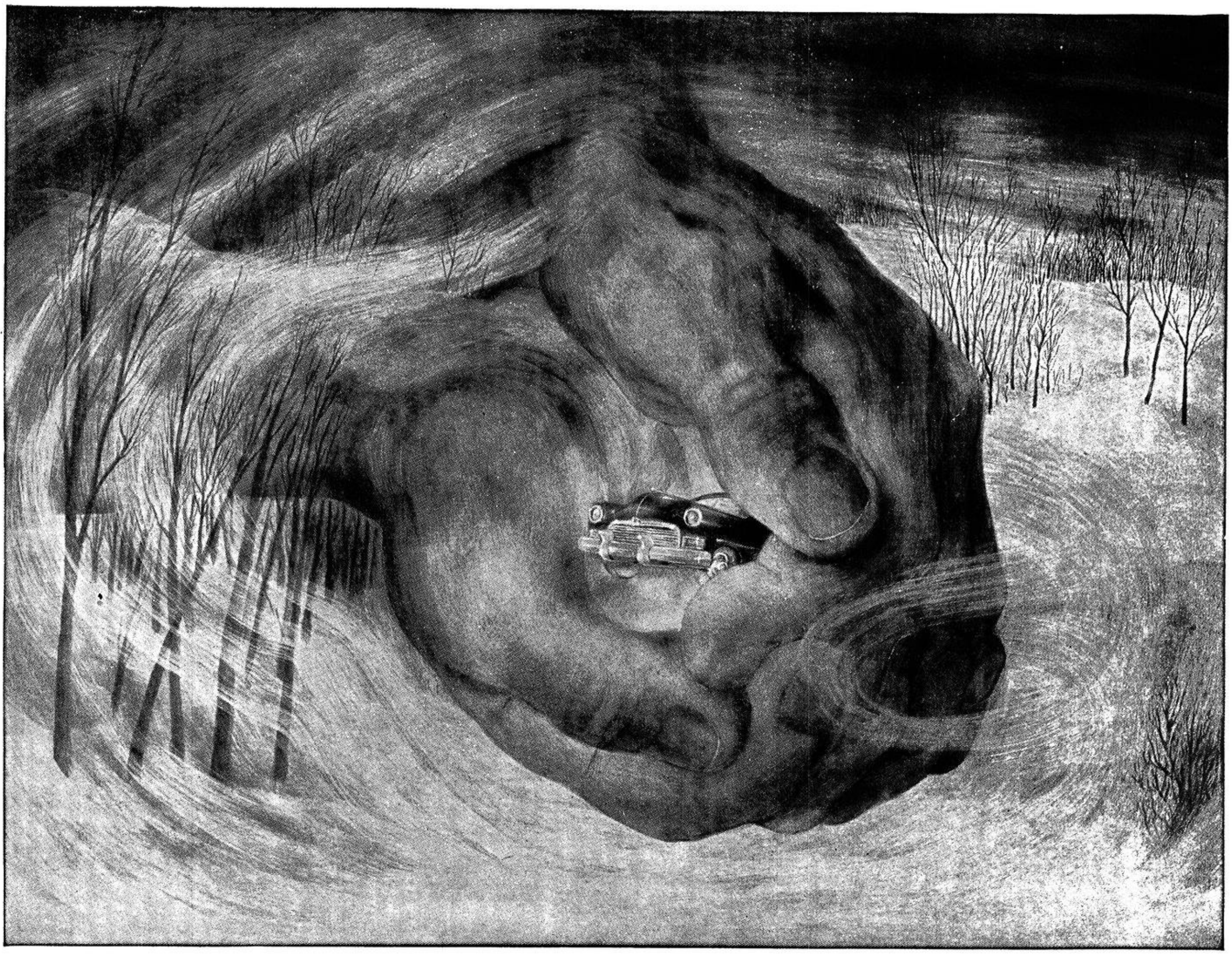


(photo by Hull)

Prof. Rideout explaining the block diagram of a double loop servomechanism problem.

haustive work by a large staff of people if recourse were taken to analytical methods. In contrast, an electronic analog computer can be set up to represent completely the operation of the engine and the required design data obtained in a comparatively short time. This is possible because the computer furnishes continuous information and it is necessary to check only the critical values.

With constant improvement in the design and versatility of electronic analog computers, it seems certain that industry will come to rely upon them more and more. However, their use is not restricted to industry; they may be used very effectively in classroom demonstrations to enhance theoretical material with visual proof. Thus, the computers will be an invaluable aid to the engineering student as well as the practicing engineer.



In safe hands . . . even at 60 below!

Do you remember when winter meant storing the family car till spring? Not so many years ago, a car owner's fear of an ice-shattered motor was a dread reality . . . if he *didn't* drain his radiator and store his car once cold weather hit!

What was needed—acutely—was an automobile anti-freeze that would prove always *dependable* yet *economical.* One that would hold up under any operating temperature. That wouldn't foam and boil away. That would resist rust and corrosion to the *nth* degree.

That's where Union Carbide *research* entered the picture. The result? "Prestone" anti-freeze. Since then this product—the first all-winter anti-freeze—has assured millions upon millions of motorists of ever-improved driving performance, with assured safety . . . throughout the bitterest weather.

This is but one example of the way the people of Union Carbide are helping to better our daily living. And UCC stands ready to help solve other problems . . . wherever better materials and processes are needed.

FREE: *If you would like to know more about many of the things you use every day, send for the illustrated booklet, "Products and Processes." It tells how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics. Write for free Booklet I.*

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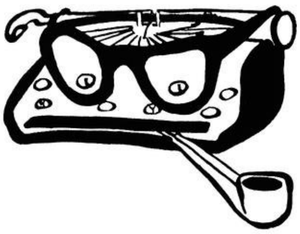


Have you tried this crossing?

The Way We See It

CO-ED KILLED CROSSING AVENUE!

This might be a headline on the **Daily Cardinal** of December 18, 195X. The name could be that of your girl friend, or even yourself!

Traffic on University Avenue is extremely heavy, especially during the early morning and late afternoon rush hours. Almost a solid stream of cars three or four lanes thick flows along this main thoroughfare in Madison.

Since this street cuts across a major portion of the University campus, it is necessary for those students whose classes or homes lie on the south side of University Avenue

to penetrate this mass of steel and rubber moving at high velocities. To facilitate these movements, the city has installed concrete safety islands and traffic lights to aid pedestrian crossings at nearly every critical crossing point —EXCEPT AT THE MECHANICAL ENGINEERING BUILDING.

This is the only large building the University has at present on the south side of the Avenue, and it accommodates a large number of students.

Nearly every one of these students has to cross University Avenue at a point where there is no traffic light or safety island.

The men's residence halls are located directly across the Avenue from the M.E. building; students by the hundreds flock across this busy street dodging cars and trucks.

Why doesn't the University recognize this problem and do something before someone is hurt? A great many safety precautions are already observed by the University: speed limits and limited traffic over the hill are but two. In fact, the administration has already taken cognizance of the severe danger by painting two yellow cross-walk stripes across University Avenue directly in front of the M.E. building.

How much attention does even one life merit? Don't you think something should be done to PREVENT one of us from getting hurt? Such things do happen, and two yellow stripes don't mean much to a fellow with a broken pelvis.

Several remedies for the situation are available:

1. Safety islands.
2. Traffic signals.
3. An overhead cross-walk.

Safety islands would be a good start. At least one would have a place to jump when a big bus comes careening down upon you. If these islands were built in conjunction with traffic lights, the hazard involved in crossing to classes would be diminished.

The only real solution, however, is an honest-to-goodness steel and concrete overpass. The cost would probably be greater than that of the islands and the traffic lights, but the advantages are likewise much greater:

1. Traffic would flow unimpeded.
2. The crossing of students could go on constantly without waiting for the lights to change or for a lull in traffic.
3. There would be no danger from traffic; one would have to fall off the overpass to get in front of a car.

Jay-walkers of course would be subject to their own risk. The University is now practically forcing every student with a class in the M.E. building to be a jay walker.

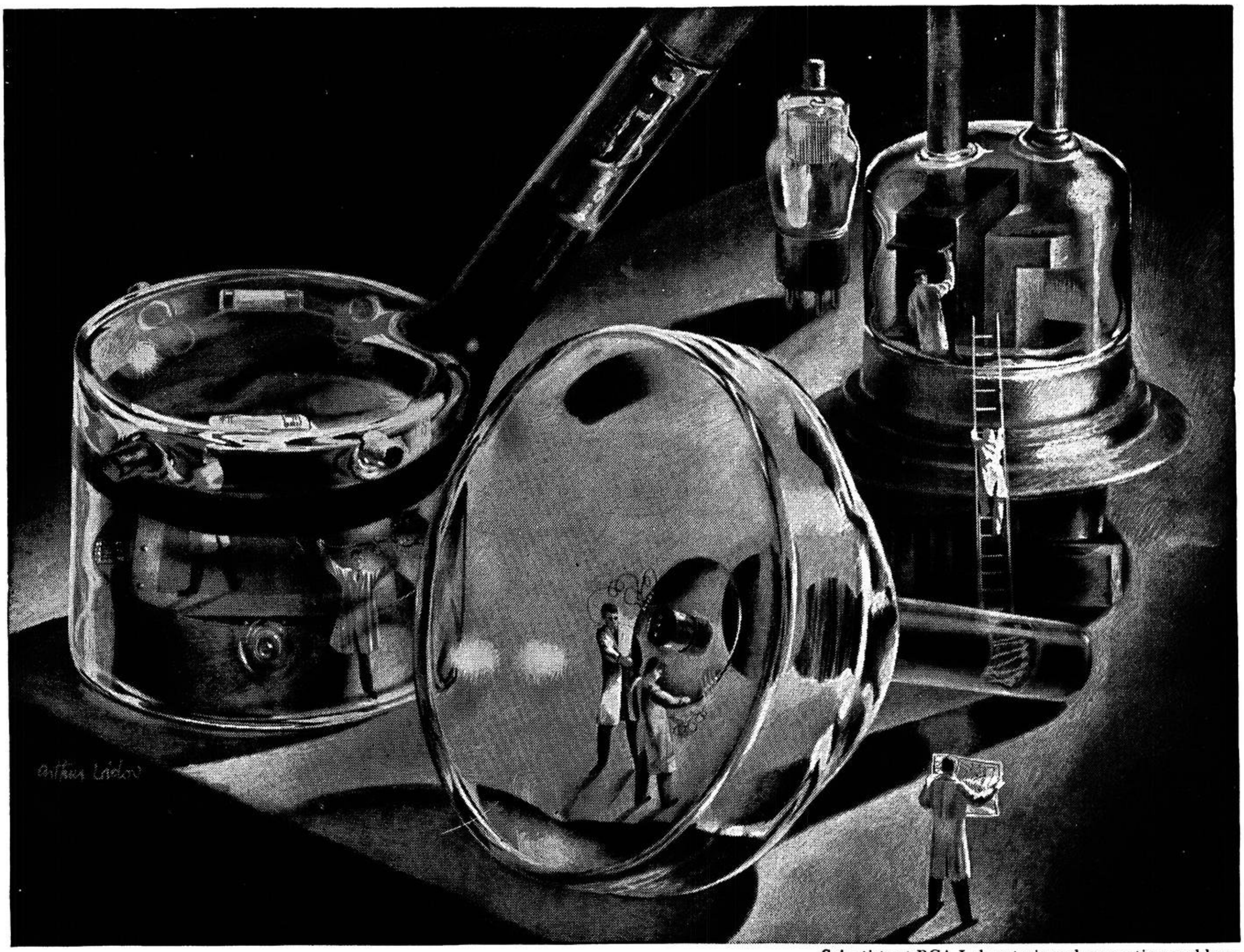
Shown here is a photograph of the overpass at the University of Minnesota in Minneapolis. There is another bridge similar to this one a hundred yards up the street. The street here is also a busy thoroughfare cutting across their campus. These bridges are located directly in front of their Union building.

Such an installation would be very feasible here. Only one overpass in front of the M.E. building would help tremendously, two would be a luxury. The cost would be small, the possible savings tremendous.

How about some constructive work being done here? The University is planning for large expansions across University Avenue; the new engineering building is but one of several buildings planned in the near future.

Something will have to be done eventually to handle the problem of getting the student body across this busy street. Let's start now; experiment a little, and find out the best way to get across this busy street.

R. R. J.



Scientists at RCA Laboratories solve exacting problems within the "nothingness" of vacuum tubes.

Inside story of Better Television

Now television is flashing *visual* entertainment, news, and educational material to millions of people daily. The "inside story" of its rapid growth is the history of some remarkable tubes. Inside these tubes, electrons are put to work—to perform, for your benefit, the miracle of long-distance vision.

The screen of your direct-view television receiver is actually the face of a tube—the kinescope developed by Dr. V. K. Zworykin and his colleagues of RCA Laboratories—on which electrons in motion "paint" pictures. A tube, too, is the "eye" of RCA's Image Orthicon television camera, which can "see" clearly by the light of a match.

And since you asked for big-picture television, they developed projection receivers—also a way to "weld" glass and metal, thus speeding the production of 16-inch direct-viewing tubes . . . at lower cost.

To these basic "firsts," RCA scientists have added advance after advance, which are daily bringing television into the lives of more and more people.

How you profit

Advanced research in television tubes is just one way in which RCA Laboratories work in your interest. Their leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

Examples of the newest advances in radio, television, and electronics—in action—may be seen at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, Radio City, New York 20.

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).
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- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

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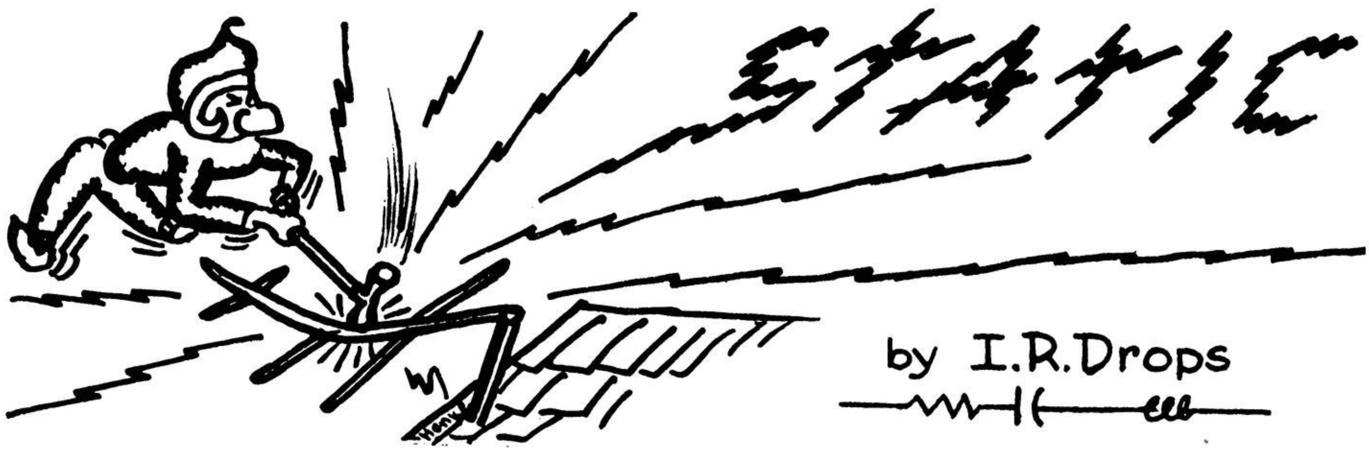


Familiarity breeds attempt.

* * *

I think that I shall never see
A girl refuse a meal that's free;
A girl with hungry eyes not fixed
Upon the drink that's being mixed;
A girl who doesn't like to wear
A lot of junk to match her hair;
But girls are loved by guys like me
'Cause I don't like to kiss a tree.

* * *

Conscience: Something that gets a lot of credit which really belongs to cold feet.

* * *

Attention Engineers. A pinch of salt can be greatly improved by the addition of a stein of beer.

* * *

"May I come in," he said, "It's the room I had when I was in college in '09."

"Yes sir," he said lost in reverie. "Same old window. Same old view of the campus. Same old closet." He opened the door. There stood a girl, greatly embarrassed.

"This is my sister," the student quickly said.

"Yes sir, same old story."

* * *

Helpful Coed: "Isn't it funny that the length of a man's arm is just equal to the circumference of a girl's waist?"

C.E.: "Let's get a piece of string and find out."

* * *

M.E.: That girl shows distinction in her clothes.
E.E.: You mean distinctly, don't you?

* * *

The Engineer is a great "magazine"(?)
The College gets all of the "fame." (?)
The printer gets most of the money,
The staff gets all of the blame.

* * *

Book Salesman: "Young man, you need this book. It will do half your college work for you."

Engineer: "Fine, give me two."

* * *

She was only an architect's daughter, but she had designs on everybody.

Well built gay-decievers
May turn to retrievers—
Strong men of uncommon restraint;
But you risk disillusion
And utter confusion
For though they look real, they ain't.

* * *

The best angle from which to look at any problem is the try-angle.

* * *

T'was the night before deadline, and all through the tower,
The editor's voice boomed out like a flower.
Where is that story that filled in the back?
We can't run an issue that hangs like a sack.
The assistant editor groaned with despair,
As he glanced in a file to find 'Twas quite bare.
The rest of the staff was by now on their knees,
To see if the story had flown with a breeze.
The telephone jangled, and over the wire,
The printer's "hello" was a ball of fire.
Then into this chaos Chuck Strasse dripped cheer,
As he waltzed in and said, "Can I help out here?"
HE DIED WITH HIS SLIDE RULE ON.

* * *

Don't take life seriously, you can never get out of it alive anyway.

* * *

Kiekhofer: "Why aren't you taking notes?"
Econ. student: "I don't have to, I've got my grandpa's."

* * *

Confucious say: "Wash face in morning, neck at night."

* * *

True, the modern girl is a live wire. She carries practically no insulation.

* * *

If George Washington was so honest, why on his birthday do all of the banks close?

* * *

A vulgar man is one who stares at a co-ed's figure when she's doing her best to display it.

Campus . . .

(continued from page 21)

ATTENTION:

REGISTRATION FOR PROFESSIONAL ENGINEERNG STATUS

A qualifying examination for February engineering graduates who wish to obtain Wisconsin "Engineer in Training" status will be given on the campus soon after final exams. The examination may also be given on the Marquette campus. While the subject matter will be basic, the examination itself will be comprehensive, and will require some preparation.

The new Wisconsin law conforms with the laws of most of the other states and "Engineer in Training" registration here will be recognized by them.

The registrant must retain the "Engineer in Training" status for four years in order to qualify for registration as a professional engineer.

The registration office recommends that February graduates who intend to take the examination inform prospective employers that they will not be able to report for work immediately after final exams.

A $10.00 registration fee will be due in the middle of December. Watch the bulletin boards and the Daily Cardinal's Slipstick Chatter column for further details on payment of this fee.

The January issue of THE WISCONSIN ENGINEER will contain an article on this subject. Watch for it!

KAPPA ETA KAPPA

Prof. L. E. A. Kelso and Mr. Robert M. Peterson were initiated as honorary members of Kappa Eta Kappa on November 5. Six electrical engineering students, Edward Casada, Harold Fischer, Thomas Maresca, Howard Miller, Robert Poetsch and Hilbert Siegfried, were initiated as active members.

Mr. Gerald Keppert, president of the Milwaukee Alumni of Kappa Eta Kappa, presided as master of ceremonies at the initiation banquet.

Officers for the current school year are: Fritz Kohli, president; Harold Cork, vice-president; Don Barber, secretary; Clint Knee, treasurer; Charles Navratil, executive board member at large; Glenn Petersen and James Maier, executive board directors.

Gamma chapter of Kappa Eta Kappa, the national professional electrical engineering fraternity, was host to the annual national convention at the University of Kansas, Lawrence, Kansas, during Thanksgiving vacation.

In attendance from the University of Wisconsin's Delta chapter were: Bill Beranek, official delegate; Fred Kohli, Delta president; Bernie Sword, past Delta president; Bob Feutz, Jack McCoy, and Lon Nordeen.

AIEE-IRE

Mr. J. S. Kilby of the Central Lab Division of Globe Union spoke on "Aspects of Printed Circuits" at the December 7 meeting.

(please turn to page 38)

Science . . .

(continued from page 22)

motor-generator welder is needed.

The welder has many desirable characteristics that are not obtainable in any other type of d-c welder. Its speed of response is almost instantaneous, resulting in extremely stable welding conditions over its entire current range. The small ripple in the d-c output results in somewhat reduced arc blow in comparison with the unvarying direct current obtained from a generator.

Because of its simplicity of design and its excellent welding characteristics, its low no-load losses, high efficiency and power factor, small size and weight, and freedom from noise, these welders fill a distinct need where d-c welding is desired but only three-phase alternating current is immediately available. The unit is a development of Westinghouse Company.

IMPROVED TURBOJET

Design refinements are improving the performance of the J-47, the most powerful turbojet engine in production in this country. The development has made it the first all-weather jet engine for military aircraft.

The engine is protected from icing conditions by heated parts at the nose. The heated parts include the inlet guide vanes, fairings, and forward frame struts. Hot air is supplied to these parts from the engine's compressor preventing the formation of large deposits of ice at the inlet which shut off air flow and might even break off and enter the engine to cause severe damage.

In addition, other design improvements have resulted in greater power output without any increase in fuel consumption or size, and in reductions in the use of scarce alloys, like tungsten and cobalt, without sacrificing efficiency or life of parts.

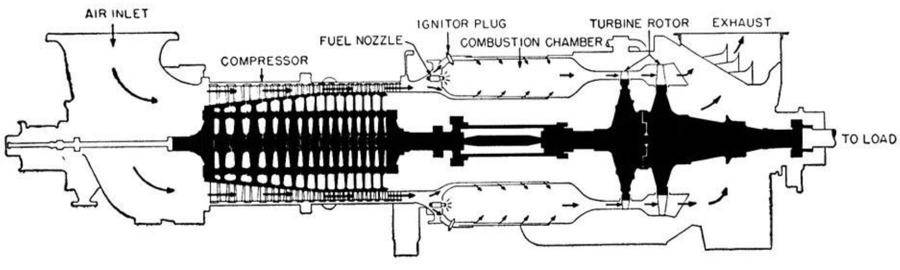
The engines are now used in the North American F-86 and B-45, the Boeing B-47, and the Republic XF-91. Four will be used in the new B-36.

GAS TURBINE LOCOMOTIVE

The nation's first gas turbine-electric locomotive has been manufactured by General Electric Company and has been turned over to the Union Pacific railroad for test.

The turbine-electric locomotive outwardly looks similar to the existing diesel-electric units, but instead, is powered by a 4,800 hp. turbine, 4,500 hp. being available for traction at the rails.

In the development of the locomotive, the prime objectives set forth were: (1)—The power plant should burn economically low grade fuels, especially coal, (2)—Give higher horsepower output per pound and per cubic foot of locomotive, and (3)—Have greater reliability and lower maintenance cost. The developmental unit exerts about twice as much horsepower at the rails as a diesel-electric locomotive of comparable size. At present it burns low grade bunker "C" oil, but it is hoped that continued research may lead to a successful means of burning coal.



(cut courtesy G.E.)

General Electric's Locomotive Gas Turbine

The compressor, combustion chamber and turbine are of in-line construction. The turbine shaft drives both the power plant compressor and the generator. It is the power from the generator which drive the eight traction motors, each of which drives one of the eight axles.

The locomotive develops 53 horsepower per foot of length, weighs 500,000 pounds and has a tractive effort of 68,500 pounds at 20 miles per hour. Geared for operation at 79 miles per hour, the locomotive carries enough fuel for 12 hours of operation at full horsepower.

HIGH FREQUENCY CRYSTALS

The increasing interest in high frequencies for radio communication is accompanied by a demand for very thin quartz crystal oscillator plates having fundamental frequencies up to 100 megacycles or higher. The usual grinding methods and machinery, however, have proven inadequate for grinding plates of a thickness of .001 inch with a high degree of parallelism and flatness.

In the ordinary grinding method the crystals are carried in a planetary path between two abrasive-charged lapping plates by a thin apertured disk called a nest. The thinnest nest that is practical is .005 inch, any thinner would not have the strength to carry the crystals. Because the nest must be thinner than the crystal, the crystals produced by this method have a minimum fundamental frequency of about 20 megacycles.

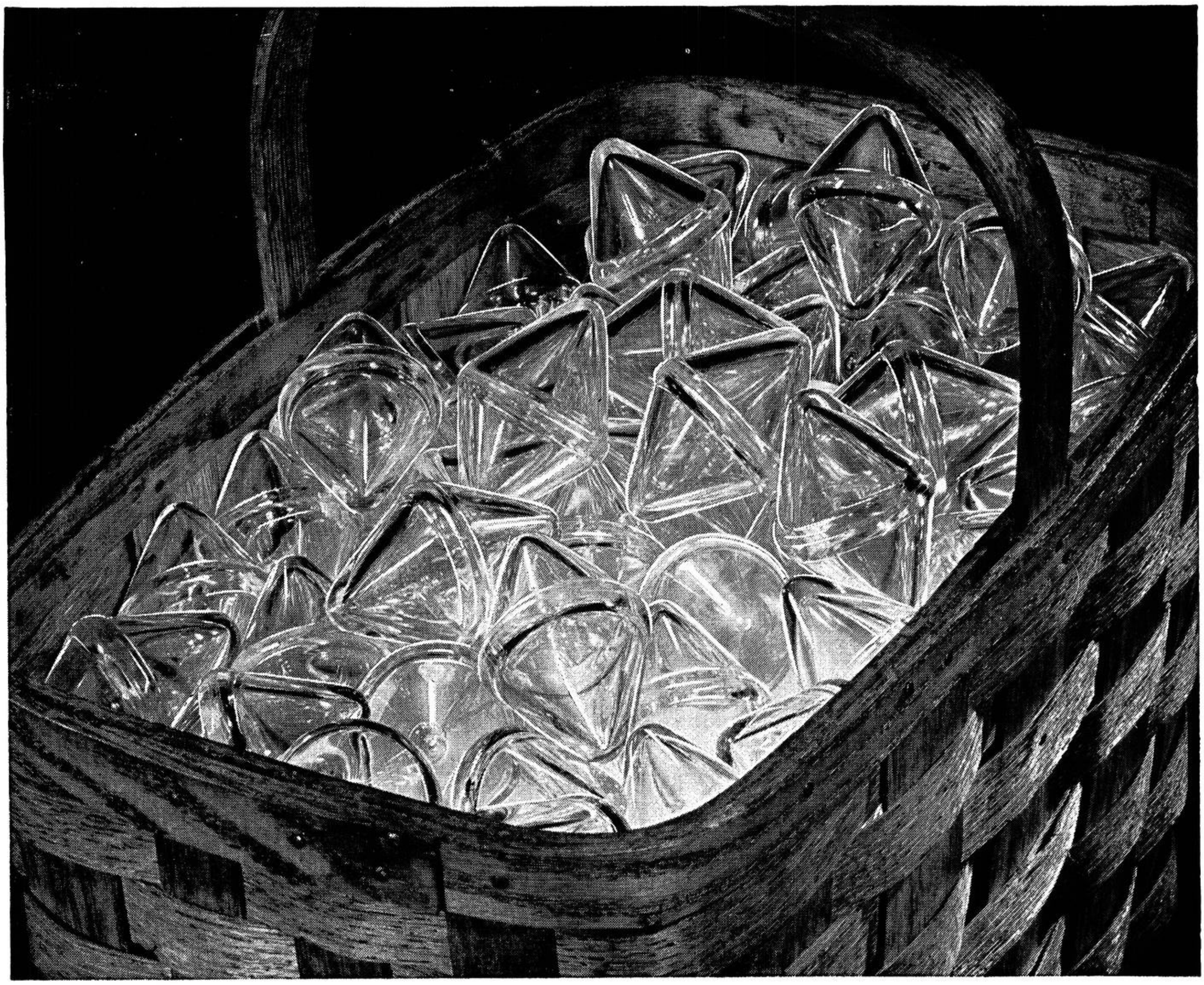
In the new grinding method the apparatus consists of a cylinder fitted with a plunger, the crystal being held against the plunger by a drop of oil. The unit is then driven over the lapping plate, the crystal being confined between the piston and plate by the cylinder walls. A nest drives a number of such units over the lapping plate.

Crystals have been lapped at the National Bureau of Standards to .001 inch, breakage being almost non-existent. The surfaces are flat and parallel. The limiting thickness has not yet been reached, since the difficulties of handling and properly measuring such crystals impose many new problems which remain to be solved.

FATIGUE LIMIT OF CHROMIUM PLATED STEELS

In addition to providing many decorative effects, chromium plating is widely used on gages, cylinder walls, piston rings, and other ma-

(please turn to page 36)



These glass eggs make TNT behave

The traditional way of shooting an oil well is to lower cans of nitroglycerin into the hole and explode them at the depth where traces of oil have been found.

Now, petroleum engineers, using double-ended glass cones made by Corning, can shape and direct these explosions to penetrate oil-bearing rock with a rifle-like charge.

These pointed glass eggs, with shells no thicker than a pop bottle, are set in the ends of cylinders of TNT and the charges are arranged in a case for lowering into the well.

Miraculous as it may seem, the glass egg—as it is liquefied by the explosion—acts as a gun barrel to aim the tremendous blast and concentrate it in a thin stream. The TNT charge—shooting directly outward—rips a hole in the rock to let the oil flow.

And this hole penetrates some sixteen times farther than one made by an unshaped charge.

Because they are sometimes used in wells two miles or more deep, these Corning glass charge-directors are built to withstand heavy subterranean pressures.

And although the eggs are hollow, they'll stand up under a pressure of 20,000 pounds per square inch.

But if that seems strong to you, we'd like to point out that a one-inch cube of this same glass has a compressive strength of 250,000 pounds.

Throughout industry, *Corning means research in glass* because a multitude of Corning developments—such as finding ways to increase its strength—have helped make glass one of today's most versatile engineering materials.

You'll find—when you're out of school and concerned with planning new products and processes, or changes in old ones—that it's a good thing to keep *glass* in mind.

Then, we hope you'll call in Corning before your planning reaches the blueprint stage—to learn how this material, which has so many varied uses, can best serve you. *Corning Glass Works, Corning, New York.*

CORNING
means research in glass

Mechanical Brain . . .

(continued from page 9)

tion to its distance from either end of the trough. This potential is the negative bias on the grid of the vacuum tube. Magnet (M) to which the vane is attached is wound with four coils, A, B, C, and D which move the vane magnetically in response to the currents from the other units. The resistor (E) is adjusted so that the magnet and vane are in the center of the trough when the output of the unit is zero.

When the power is turned on, all of the units begin reacting upon each other because a change in the position of the magnet of one unit will change the output to all of the other units, causing their vanes to move and react on the rest of the units, like the familiar vicious circle.

These reaction can be controlled, however, by changing the values of the constants in the circuit. The potentiometer (P) determines what fraction of the input current goes through the coil and the switch (X) will reverse the polarity of the current.

When set in a particular way, the magnets show a definite pattern of behavior, and these patterns are different for each constant setting. If these settings produce a stable arrangement, the magnets move to a central position where they actively resist any attempt to displace them. If they are displaced, a co-ordinated activity brings them back to center, much as an animal seeks its optimal conditions. Some settings, however, give instability in which case the magnets diverge from center. In this case the feedbacks are producing vicious circles, which would be like driving our animal friend from the above example away from its optimal conditions.

The feedback can also be controlled by a uniselector. (In the diagram the values selected are at U and the motor coils are G.) This is a type of servo machanism which when a voltage is applied to it, will randomly select a new resistor and/or change the polarity. The resistor values in the unit were randomized to eliminate the possibility of building in any possible sequence of patterns. Therefore when controlled by the uniselector the feedback loops depend on the values provided by the uniselector at that particular moment. Twenty-five positions on the uniselector on each of the four units provide 391,625 possible feedback patterns. The uniselector coils (G) are energized only when the output of the unit exceeds the value sufficient to close the relay (F).

When the control is diverted by the switches S-S so that not the hand controls but the uniselectors determine the hand settings, then a new feature emerges in the behavior of the system. As before the units start acting on one another, but the uniselectors change whenever the system is unstable, i.e., whenever the magnets diverge far from the central position. In other words, the machine starts to hunt for a combination of uniselector settings giving a stable system. i.e., giving the proper feedback. When it finds a combination with the right feedback, it holds that combination and will then demonstrate that it has assembled that feedback system which results in a co-ordinated maintenance of its variables at optimal values, like a living thing. The important point is that it finds its own arrangement of feedbacks, the designer having merely provided it with plenty of variety.

Not only will it find the appropriate feedback initially, but if we alter the basic conditions in any way it will proceed to re-adapt itself to the new conditions. Thus we may use hand controls on two of the units, setting them at arbitrary values to represent some "environment" to which the other two units, representing "nervous system" must adapt, i.e., find combinations of their two uniselector settings which in relation to that particular "environment" forms a stable system. This would be the system to present the brain with problems. The brain would have to have enough units to hold all factors affecting the problem, and enough to introduce any new factors that might be necessary in the solution.

The question now arises, is the Homeostat a brain? In its present state, no. But the principle of its operation can be extended to almost limitless bounds, affected by the engineering aspects of its construction and some very long mathematical computations to determine the proper circuit constants. Its chief fault in its present form is that it is not large enough to hold all aspects of the problem nor can it retain the solution of a problem that it has already solved. To learn something new it must obliterate the settings that it has just determined for a preceeding

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Forest Products Lab . . .

(continued from page 11)

in the Dept. of Agriculture Farm Bulletins; laboratory processes are also explained in the scientific papers and magazines. In response to inquiries on specific problems, letters of advice are sent with such pamphlets that may help. People may visit the Laboratory and spend from one day to two weeks getting the information they desire. Occasionally the Laboratory conducts short courses in kiln drying of woods to help dry kiln operators improve their methods and so reduce seasoning losses in lumber manufacture.

The work of the eight research divisions in the Laboratory involves: timber harvesting and conversion; silvicultural relations; chemistry, composition, and derived products of wood; timber mechanics and structural research; wood seasoning and moisture control; wood-treating processes for protection and service; wood pathology; and pulp and paper.

The timber harvesting divisin is concerned with getting better values from existing resources, preventing waste, and utilizing waste products, guarding future timber crops by selective logging, development of better logging and saw-milling machinery and machinery suited for the small operator, and developing methods of using woods now considered unacceptable.

The division called silvicultural relations is concerned with the factors affecting the structure of the wood, such as growing conditions, and the suitability of a wood for a particular use. For example, dogwood is used for shuttles because of its uniform wear characteristics. But dogwood has become very scarce. This division discovered that open-grown maple had similar characteristics, though forest-grown maple did not. This section takes care of the wood identification that the Laboratory does. The wood may come to the Laboratory in the form of pulp or charcoal, and be identified to settle some lawsuit.

The use of much wood waste is dependent upon the chemistry of the wood. Thus the primary job of the chemistry and derived products section is to learn more about the cellulose and lignin that make up wood. Much work has been done to develop sources of plastics, lacquers, photographic films, etc., but much remains. The possibilities of hydrolysis and fermentation are being studied. This unit, building on the work of many cellulose chemists here and abroad, developed a cheaper method of making molasses from sawdust. Most processes developed by the Laboratory do not reach the pilot plant stage while at the Laboratory, but the plant for making wood sugar is an exception. This plant is now turning out thousands of pounds of wood molasses that is being used by agricultural schools in studies of cattle feeds using molasses. Hydrogenation of wood is being developed as a means for breaking down lignin into useful chemicals. More uses of lignin are being sought, to prevent having to throw it away. The toxicity of the various preservatives is being studied to determine their efficiency as a preservative.

The division of timber mechanics is working on problems concerning the strength of wood, and wood fastenings, since the joint is a critical part of wood construction. The structural problems of prefabricated houses has received attention, and a plywood unit has been developed. The Laboratory pioneered in the development of skin load baring, rather than frame load bearing buildings. The use of laminated construction for beams and plywood has resulted in the better use of wood, besides stronger and better looking shapes obtainable with this type of construction. Curved roofs, and barns, gymnasiums, and hangers without cross beams are possible with this type of building. Design data for laminated beams was worked out by the timber mechanics division.

Wood seasoning is one of the most important problems of preparing wood for use. Besides improving the air- and kiln-drying methods, the Laboratory has developed a chemical seasoning. The wood is steeped in a salt solution, which for some woods, makes drying more uniform and reduces loss from checking.

The division of wood preservation is studying the effectiveness of various treatments to reduce, or eliminate decay, fungi, and fire hazard, and the attack of insects and marine borers. The use of various glues in laminated construction and plywood is being investigated.

The U. S. is the largest user of paper and pulp. Pulp and paper is an important importation of the U. S. The pulp and paper division is concerned with reducing the need for these imports through the use of trimmings and the more plentiful American woods, developing better methods of making paper; getting higher yields from the pulp, using more varieties of wood for pulp, and adapting the pulp to the requirements of paper. The Laboratory developed a semi-chemical process of making paper which gives about one and a half times as much paper from a given amount of wood. Work is being done on the recovery of chemicals from the waste liquor, which will eliminate river pollution by paper mills.

Two other significant accomplishments of the Laboratory are the development of a high strength resin-impregnated paper plastic much used for airplane parts, and a laminated, resin-treated compressed wood, having much greater dimensional stability and hardness. It was used for airplane propellers and masts.

The Laboratory is now engaged on similar projects: the adaptability of wood to panel heating, vibration characteristics of wood, improved veneer manufacturing techniques, sandwich panels for fire doors and walls, better and cheaper laminated construction for large structural beams, and the fundamental mechanics of wood-cutting, such as power requirements of saws, saw teeth shape and the like.

During the nearly forty years of its existence, the laboratory has given the United States world leadership in wood processing technology. Savings in wood and dollars resulting from only a few of its major accomplishments would pay for the cost of the Laboratory's operation from its founding to the present time.

Mechanical Brain . . .

(*continued from page 32*)

part of the problem. It is like a child in school that could learn what is two times three only by forgetting what is two times two. It is possible that the addition of a large number of similar units together with a selector that would pick out only unused circuits and those that pertain to a new problem to solve the problem would cure the memory deficiency.

The ultimate goal of the men who are working on this problem can be best illustrated by comparing the chess game that an electronic computer could play with the game that (theoretically completed) a Homeostat could play.

The computer could be provided with a table of legal moves, yet it could not play them in correct sequence to win the game any better than its designer. He must build into the machine criteria for determining smart moves, and naturally he could not make these criteria any better than he could figure them out for himself.

On the other hand, the Homeostat needs no information other than a method of being informed of illegal moves and a method of finding out when it lost a man, or lost the game. Its first game would be very poor; but as it lost, it would set up feedback patterns that avoid these moves in its next game. Each game would be progressively better, to the point where it could even beat the man who designed the machine.

Should the homeostat be developed to the degree theoretically possible, its usefulness in exploring the problems of our present day life would be almost unlimited. The machine would have an insight into the problems far deeper than any human could think or learn. Its ability to learn would be limited only by how fast it could solve practice problems to develop its feedback combinations, and it would never forget anything that it had learned in the past.

One rather subtle difficulty would become very important at this point. In building the brain, features like anode voltage and wire length would have to be set with out knowing what effect that they would produce. This would manifest itself in a form too complex and subtle for its designers or users to understand. This temperament could be in man's favor or against him; and the result of following the machine's orders could lead unknowingly to either mastery or destruction.

That is far enough to carry this interesting but rather useless conjecture. The development of the Homeostat and other thinking mechanisms is progressing rapidly, but the scope of the designer's problem is tremendous.

One expert recently stated, "The more I deal with these machines, the more I am impressed with the capabilities of the human brain and how little we've done toward duplicating it."

Science . . .

(continued from page 30)

chine parts where resistance to wear is an important factor. However, the advantages of chromium plating, in the absence of proper precautions, may be offset by the adverse effect of the plating on the fatigue limit of the base metal.

An extensive study of this problem has recently been made at the National Bureau of Standards. In all cases chromium plating was found to reduce the fatigue limits of the steels studied, although the effect was less pronounced under some conditions than others. In general, the reduction in fatigue limit increased with increased hardness of the steels. For steel of a given hardness, the fatigue limit decreased with increased temperature of the plating bath.

The possible causes for the adverse effect of chromium plating upon the fatigue limits of steels were the embrittling effect of hydrogen deposited with the chromium, cracks in the plating, and residual stresses in the plating. It was generally agreed, however, that the residual stresses in the chromium had the most effect. It was found through experiments that when the plating was heated above 400°C. the fatigue limit was only decreased slightly. The chrome plating had contracted to such an extent that the stresses produced caused plastic flow in the chromium plate and thus relieved the residual tensile stresses.

This investigation has provided aircraft manufacturers and other industries which produce chromium plated machine parts with valuable information for the treatment of these parts.

METAL FILMS

Films, so thin that they can be used as supporting membranes for electron microscope studies without showing visible structure, are being made by an interesting new process. A piece of glass is covered with a thin layer of water-free glycerine and placed in a vacuum chamber where a small amount of beryllium or aluminum is flash - evaporated. The glass carrying the metal film is transferred to a vessel where the metal film is washed with distilled water; the metal film being floated off to the surface of the water. The film is then dried on a metal grid.

FAST TEMPER

A tempering process which heats a metal surface from room temperature to a bright red 1600 degrees Fahrenheit and cools it again to room temperature, all within less than five seconds, is now being used.

The process uses an electromagnet to hold the part to be tempered within the field of a powerful electronic heater. As soon as the part has been heated to the proper temperature, an automatic timing switch shuts off the heater. At the same instant the current is removed from the electromagnet and the part drops into the cooling bath of oil.

Campus . . .

C.E. INSPECTION TRIP

(continued from page 29)

A group of 105 civil engineering students accompanied by Profs. W. S. Cottingham, L. F. Rader, L. W. Crandall, and A. T. Lenz, and instructors R. C. Mertz and B. M. Davidson inspected industrial and public service plants during a 3-day inspection trip, October 17-19.

The group inspected highway, bridge and dam construction projects, and city sanitary plants in and near the cities of Milwaukee, Oshkosh and Wisconsin Rapids.

ANNUAL MEETING—ASEE

The annual meeting of the North Mid-West Section of the American Society for Engineering Education was held at Iowa City on November 4 and 5.

The agenda included inspection trips and the annual dinner on the first day, and division meetings the second day.

Faculty members from the University of Wisconsin who spoke on subjects in their various divisions were: W. M. Christmas, Glenn Koehler, D. J. Mack, W. R. Marshall, Jr., H. A. Peterson, R. A. Ragatz, G. A. Rohlich and C. C. Watson.

Prof. Kurt F. Wendt from the engineering experiment station at Wisconsin was elected the new vice chairman of the society at this meeting. The chairman is Prof. E. W. Johnson from the University of Minnesota.

This article has been a sketch of one of the many different automatic telephone systems. It is the one from which most of the different kinds have grown. In a future article the operation of the Strowger switch will be discussed; it is an intricate, precision instrument designed to give years of unattended service. It is really and truly a "Modern Miracle."

SOPHOMORE HIGH HONORS

Chemical Engineering	
Johnson, Wm. C.	2.616
Civil Engineering	
Kaneshige, H. M.	2.689
Electrical Engineering	
Bell, H. Jr.	2.814
Fieve, R. R.	2.704
Litterst, R. S.	2.630
Munson, J. F.	2.800
Van Caster, J. C.	2.652
Wilhelmsen, C. R.	2.675
Mechanical Engineering	
Reen, G. K.	2.972
Wright, H. J.	2.808
Metallurgical Engineering	
Zimmerman, D. L.	2.726

SOPHOMORE HONORS

Chemical Engineering	
Ambrose, E. A.	2.267
Biever, V. M., Jr.	2.253
Borcherding, J. L.	2.362
Burkhalter, R. E.	2.516
Crump, J. M.	2.619
Crump, J. K.	2.492
Grochowski, J. E.	2.535
Koenecke, M. M.	2.541
Lenz, J. R.	2.211
Marquardt, J. C.	2.567
Sawle, D. R.	2.260
Schowalter, W. R.	2.549
Wendt, K. W.	2.253
Civil Engineering	
Bodenstein, N. F.	2.257
Debbink, J. P.	2.536
Gerschke, F. R.	2.376
Hall, J. R.	2.446
Kronholm, H. O.	2.375
Safford, R. D.	2.283
Tessen, A. F.	2.185
Wichman, R. H.	2.565
Electrical Engineering	
Arndt, R. H.	2.323
Gruetzmacher, L. H.	2.485
Jerome, R. H.	2.300
Kopp, R. W.	2.171
Lange, J. R.	2.428
Langemak, J. A.	2.223
Newcomb, D. A.	2.385
Ohm, K. D.	2.444
Olson, C. L.	2.567
Reichel, E. H.	2.491
Schwartz, E. R.	2.200
Slotten, E. K.	2.268
Mechanical Engineering	
Bolender, J. W.	2.549
Burton, J. C.	2.257
Frank, C. E.	2.300
Kast, H. B.	2.301
Koehne, J. A.	2.140
Priem, R. J.	2.486
Mining Engineering	
Babler, M. R.	2.238
Engeldinger, K. J.	2.391
Werren, E. G.	2.276
Metallurgical Engineering	
Anderson, J. E.	2.454
Pitt, C. H.	2.465

FRESHMAN ENGINEERS
(Based on 2 Terms)

HIGH HONOR RATE

Smith, William C.	2.882
Harms, Keith L.	2.853
Kaste, Orrin C.	2.853
Weber, John P.	2.853
Hendrickson, Kenneth L.	2.828
Pope, Charles R.	2.765

HONOR RATE

Hanson, Donald B.	2.742
Hegna, Earl T.	2.706
Geraldson, David A.	2.697
White, Donald L.	2.679
Forsyth, James D.	2.676
Ryan, Donald P.	2.647
Tibbitts, Lewis W.	2.628
*Teletzke, Gerald H.	2.611
*Howard, Philip H.	2.588
Johnson, Gordon J.	2.571
Hilden, Jack G.	2.559

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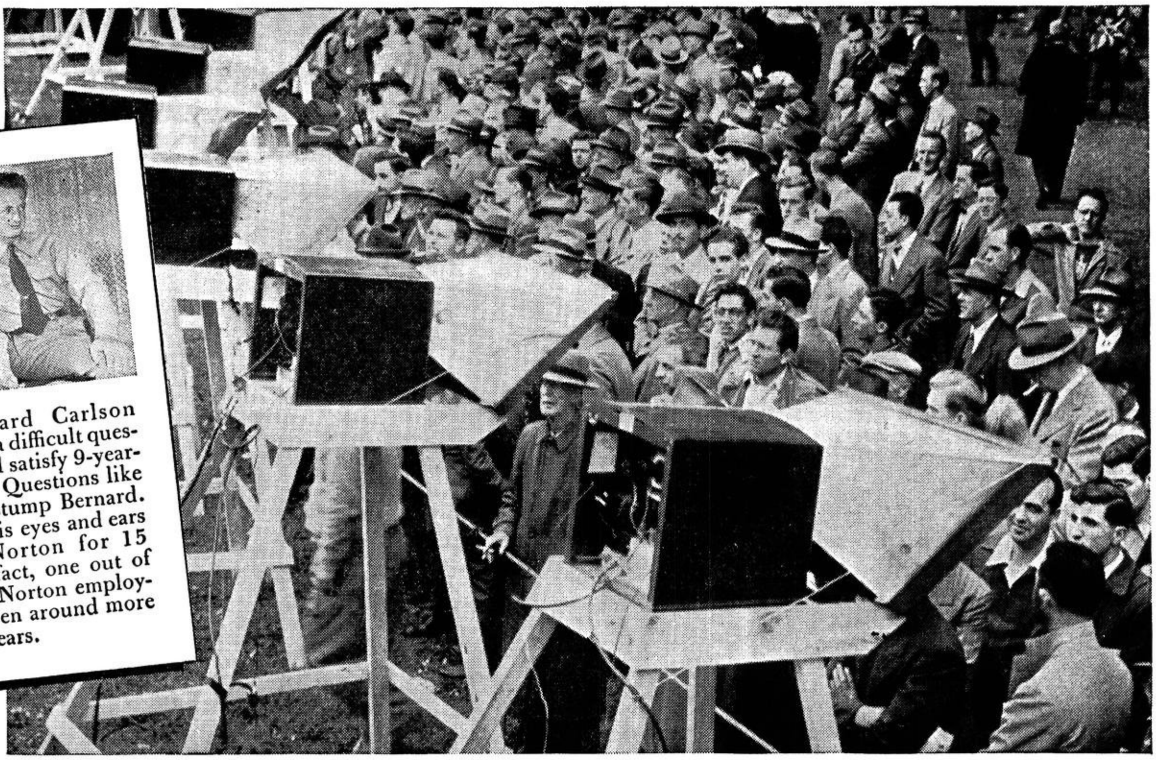


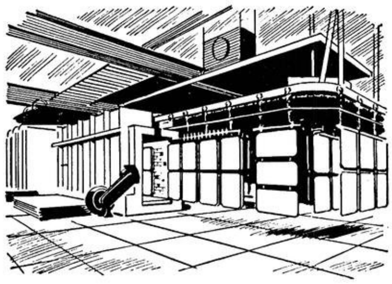
How Bernard Carlson might duck a difficult question and still satisfy 9-year-old Jackie. Questions like this don't stump Bernard. He's had his eyes and ears open at Norton for 15 years. In fact, one out of every two Norton employees has been around more than 10 years.

News photo of crowds watching television on Boston Common.

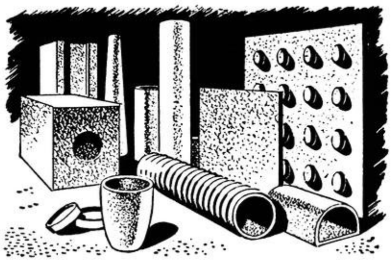
BUT, DAD, WHAT MAKES TELEVISION SO CLEAR?

"Lots of things, Jackie! But mostly brains. The brains of men who know how to make electrons behave in tubes. Electrons are tiny particles of electricity. They're boiled out of metal wires by heating units. Much the same way as an electric stove boils water. But if the heating unit isn't right, everything goes wrong."

"The tube people are smart, son. They make sure the heating units give off the right heat and last longer by coating them with a fine Norton refractory. Alundum 38900 grain, we call it. It's so fine that ten grains end to end equal the thickness of a piece of paper.



'Alundum refractory grain is great stuff. Its melting point is 2015°C. That's real hot! Made into corrugated baffle plates, it doubles the efficiency of enameling ovens. That's why the surfaces of such things as refrigerators and electric stoves come so hard and smooth.



"Some people know Norton only as the world's largest maker of grinding wheels and machines, Jackie. But refractories in many sizes, shapes and materials are important Norton products, too. They're used in kilns, furnaces and ovens whenever industry wants to get the most out of high temperatures... safely."

"So, you see, son, from television tubes to refrigerators, Norton Products help make all kinds of products better. That's why the experienced heads and willing hands that make up the Norton team try a little harder to make Norton products better."

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

ABRASIVES · GRINDING WHEELS · OILSTONES · ABRASIVE PAPER & CLOTH

GRINDING AND LAPPING MACHINES · LABELING MACHINES · NON-SLIP FLOORING

REFRACTORIES, POROUS MEDIUMS & LABORATORY WARE · NORBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

Meet the flight engineer . . .

(continued from page 13)

(3) At least 100 hours of flight engineer experience.
(4) Completed an adequate flight engineers' training course.
(5) At least 200 hours as a first pilot of four engine aircraft.

If an applicant is fortunate enough to meet one of these experience requirements he must then prepare himself to take a written exam that takes anywhere from four to eight hours to write. This exam consists of four parts. One section is on CAA regulations, another the theory of flight and elementary aerodynamics, and the third section covers aircraft performance and engine operation. The last section is called mathematical calculations and covers those calculations that would be used in engine operation, fuel consumption and weight and balance. After successfully completing this exam the applicant must pass a practical or flight test which covers normal and emergency operations and trouble shooting while in flight. The requirements are then finally completed by taking an oral examination from a CAA examiner.

Meeting government regulations is only the beginning however, as company standards have to be met next. Before a man can go on the run for Eastern Air Lines, he must be able to pass a rigid company physical exam. Passing this physical exam, he is placed in training to learn the company's operational methods. After sufficient time, he is given a check ride by a regular check flight engineer of the company. If an applicant can meet all these requirements, he is then placed on the regular flights as a full fledged flight engineer.

Pay and Future

The pay scale for flight engineers runs higher than most other engineering positions at the start. The present contract of Eastern Air Lines with their engineers starts at $275 a month for student engineers. As soon as he checks out he gets $410 a month with raises every six months of $25 until a top wage of $560 a month is reached three years later. Eastern also offers its employees other personal benefits, the most outstanding of which is a very generous retirement plan. Most other air lines have the same pay scale with those that fly foreign runs usually paying $100 a month more.

The future for flight engineers is expanding right at the present time. Some leaders in the aviation industry feel that there are still numerous openings for experienced men. The production of each four engine aircraft means another position is open. At the present time there are twenty major air lines are using ships that require engineers. Aircraft companies also use flight engineers in test and development although the demand here is for experience only.

Background Required

Students often ask what a company wants in a man. Most companies when they start looking for flight engineers look for a good technical background coupled with some practical experience. Back in 1947 when Eastern first started to hire engineers, they took men from all over the country for training. These men were made up of students out of engineering schools with air force experience and former airline mechanics and maintenance men.

The strong trend today in modern commercial aircraft is toward more and more electrical devices. From this it can be seen that an engineer with a strong electrical background has his foot in the door. It is often said throughout the industry that the best flight engineering background is a mechanical engineer with a thorough understanding of electrical principles, coupled with a year or so of practical experience in aircraft operation and maintenance.

Along with the education and experience an individual should remain cool in an emergency. There is no place in airline operations for the excitable person who blacks out under pressure. Eastern Air Lines had somewhat this same thought in mind when they put the following note in their Flight Engineers' Manual:

"In an emergency any quick, intelligent action is better than delay in search of the ideal."

Dial telephones . . .

(continued from page 8)
it almost exclusively today except in certain very large exchanges.

Not only is the dial system convenient, but certain restrictions of manual operation make it very desirable. There is a maximum number of lines that can be connected to one manual switchboard. As more lines are added to a system, more boards must be added; this makes for complicated trunking. More operators are needed, and the time necessary for the completion of the call increases. The dial system not only requires the use of fewer people, but it requires no additional personnel for substantial increases in the number of circuits. The completion of the call is as accurate as the person dialing the number. The switches seldom make mistakes. The called party is rung just as soon as the dial returns from its last rotation. The switch operates while the dial is moving. The Strowger system has the advantage of being able to integrate new circuits into its existing network with a minimum of work.

Operation of Dial Systems

From the American Standard Definition of Electrical Terms we have the following definition of a dial telephone system: "A dial telephone system is a telephone system in which telephone connections between customers are ordinarily established by electrical and mechanical apparatus controlled by manipulations of dials operated by the calling parties." To this end the following functions must be performed by the automatic system:

1. Connection and disconnection of the calling and called lines.
2. Ringing a subscriber even though he be a part of a party line.
3. Detection of a line already in use and returning a busy signal.
4. Connection to trunk lines to other offices and through them performance as described in 1, 2, and 3.
5. Performance of other operations necessary for telephone service.

Before describing the equipment, we should make a distinction between two types of circuits. We often times speak of **trunks** and **circuits.** These may seem like identical terms but the usual distinction is this: circuits are usually connections within a particular switch, panel, or apparatus. Trunks are used to interconnect circuits. In this article we shall make this distinction.

The Strowger system includes the following equipment (this is not necessarily all that may go into a particular system but will suffice for an example):

1. Line and Cutout Relays: these operate when the handset is removed from the hook and start the automatic switches working. They also guard the switch from being acted on by some other subscriber once it has been seized.

2. Line Finders: these find the calling telephone and connect it to an idle selector switch. It is a non-numerical switch because it does not need pulses to operate it. It may be of rotary or Strowger type.

3. Selectors: these are switches of the Strowger type which are connected in reverse of the line finder switches. They are similar in appearance to the line finders but are numerical in operation. They do not function until pulses generated by the dial reach them.

4. Connectors: These are the final switches of the train used in completing a call. They are numerical in operation and are similar in appearance to the line finders and selectors.

5. Special Services: these are the busy tone and other special services necessary in the system.

6. The phone itself: this includes the dialing mechanism, governor, make and break contacts, bell, handset, and a special circuit that distinguishes between alternating ringing current and D-C talking current.

7. Power equipment: charging equipment with batteries floating on the line, general power source, ringing power generators, and any other auxiliary sources of power desired.

Switching System

The Strowger switch is the heart of the entire system. A linefinder switch is pictured in **figure one.** The different parts of the switch may for most part be found on the picture. Basically the switch consists of the following: 1. Relays. 2. Switch mechanism including shaft magnets, and frame. 3. Bank assemblies.

A relay is a device which responds to electrical changes (initiation and cessation of current), and it in turn controls one or more electrical circuits, or relays. Strowger switch relays are mounted on the top of the switch as can be seen in the picture. They are labeled A, B, C, D, E, and F. The shaft can be seen extending about ¾ of the height of the switch and has mounted on it 3 sets of wipers at the bottom, vertical and horizontal movement ratchets above the horizontal plate, and a return action spring at the top.

Various stepping and release magnets are hidden from view by the shaft and its accessories. The bank assembly is shown at the bottom of the shaft. It consists of three groups of ten levels each. They are arranged in a semicircular manner opposite the wipers. Cables and trunks are connected to lugs on the rear of these banks.

The switch makes connections by "stepping" up to a desired level and rotating until the wipers contact the desired lug. It will remain in this position until a release magnet sends it back to its normal position. The switch can connect an incoming trunk associated with its wipers to any one of 100 outgoing trunks associated with its banks. (This switch is of the 100 point, or contact, variety. Other switches are made with 200 points).

At this point a system of simplified grouping will be interjected. We

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Dials . . .

(*continued from page 42*)

will discuss a 10,000 line system. It can be followed on **diagram two.** The 10,000 phones are broken down into ten groups of 1,000 each. They are numbered from one to zero, beginning from the bottom. This group comprises the first digit of the telephone number being called. In a system of this size four digits must be dialed each time, even if the first digit is a zero. A number could be 0637 for instance. Each thousands group is further broken down into ten groups of 100 phones each. They are also numbered from one to zero beginning from the bottom. This group comprises the second digit of the number. The last two digits of the number are found within each hundreds group. This is shown plainly on the diagram. Each group of 100 represents a Strowger switch with 100 phones connected to its terminals. Thus we have a straight decimal numbering and grouping system.

Trunking System

Having a basic knowledge of switches and grouping, we should understand a little about simple trunking before a call can be followed through. A selector has been defined as a switch in which the brushes have access to 100 trunks represented by the lugs on the semicircular banks. A selector completes a connection from one trunk (from a phone, linefinder, or other connector) to a particular group through one of its trunks associated with its banks. Each of the ten levels represents a group. Each of the ten radial contacts on a particular level represents a trunk to the desired group.

In diagram three consider the ten circles as representing the ten contacts on **one** level looking down from the top. When the wiper has been raised to the correct level, it automatically sweeps across the ten available trunks and comes to rest on the first free one. Those that are busy are by-passed.

This system has limitations, however. Only one trunk associated with the particular wiper has access to the ten trunks pictured. What if more than one call was being placed to that particular group? In order to remedy this situation we multiply several switches together. When we multiply, we merely connect in parallel. **Figure four** shows three selectors multiplied to the same ten trunks in the same manner. Thus we see that three, and not one, conversations could be carried into the desired group. The only thing that limits the number of switches to be connected in multiple is the number of available trunks to the group following. Each of these **trunks** would terminate on the wiper of another selector if additional groups remain to be selected. Previous and following selectors may be multiplied in the same manner.

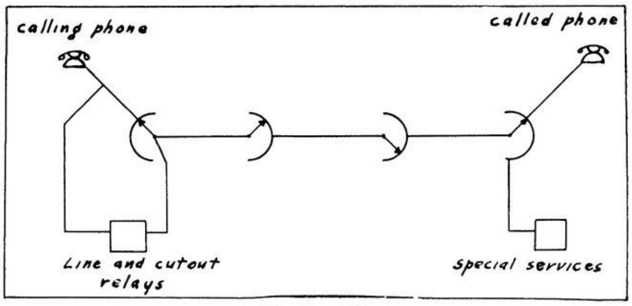


Figure V

We now have enough information to understand how a call proceeds through this complicated network of switches and trunks. **Figure five** will be of help in following the call. What seems to be one line on the diagram may represent hundreds of lines in reality. The single line is used for simplicity.

Figure two represents the arrangement of the individual **telephones** on the linefinder or connector switches. These switches are the same except that they are **connected** into the system in opposite directions. Say that phone 26 **of the switch pictured in figure two** wanted to place a call to phone number

(*please turn to page 46*)

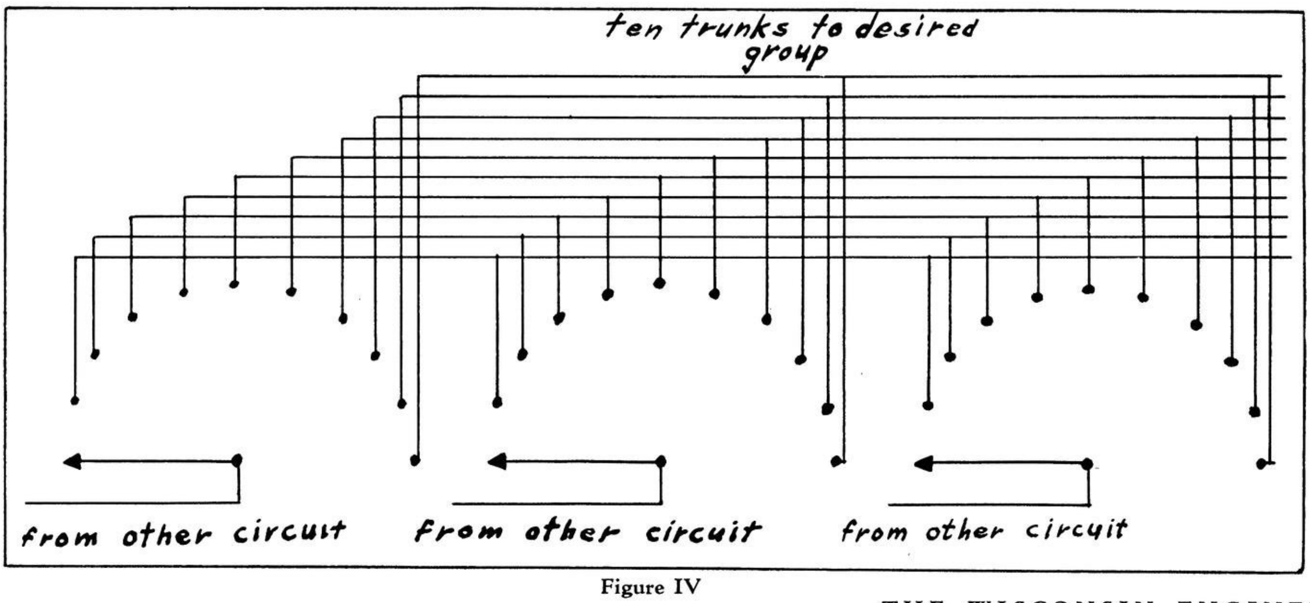


Figure IV

Dials . . .

(continued from page 44)

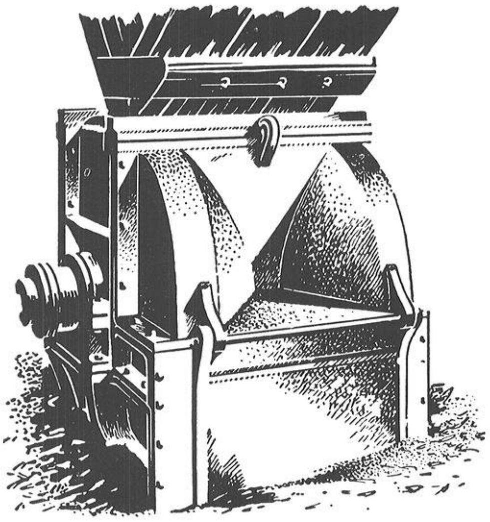
7429. When he removed his handset from the hook the line relays would start the linefinder working. The line finder would "step" up to the second level of the switch pictured in figure six and then "step" around to the sixth contact.

When it reached this contact, it would stop; and phone 26 is connected to the wipers of the first selector. No dialing has been done as yet. When the "7" is dialed seven pulses will be sent out to the first selector and "step it up to the seventh level. When the wipers reach this level, a buzzer action relay will cause the horizontal stepping magnets to operate and rotate the wipers until they come to rest on the **first idle trunk.** This trunk will lead to the wipers of the second selector. When the "4" is dialed, the second selector will "step" up to the second level and rotate horizontally until it comes upon the first idle trunk to the connector. I say the first idle trunk because through the system of multiplying, one or more of the trunks served by a particular switch may be in use. This trunk connects the calling party to the wipers of the connector and all 100 telephones served by this connector are made available. When the "2" is dialed the connector "steps" up to the second level, and this is where the selector differs from the connectors, but does not automatically sweep over the contacts. It waits for the last digit to be dialed, in this case "9," and then "steps" around to the ninth contact. This is the contact that leads to the twenty-ninth phone of the 4th hundreds group of the 7th thousands group. Its position on the bank may be found on diagram six.

It should be pointed out, however, that the calling phone and the called are not necessarily on the same switch unless they are members of the same hundreds and thousands groups. More relays cause ringing to begin when the last digit has been dialed and to stop the ringing as soon as the called party lifts his handset off of the hook. When the call is completed and the calling party replaces his handset on the hook, release magnets cause all of the switches and relays to revert to their original positions. If the called party had been busy, the wipers on the connector would have detected a previous connection and passed on to an eleventh contact (not previously mentioned) on the bank which would have sent a busy tone back to the calling party. The busy tone and dial tone are functions of the special services section mentioned previously.

The editor wishes to thank Mr. Erwin P. Bettinghaus of the Illinois Bell Telephone Co. for his many helpful suggestions which led up to this article.

Another page for **YOUR BEARING NOTEBOOK**

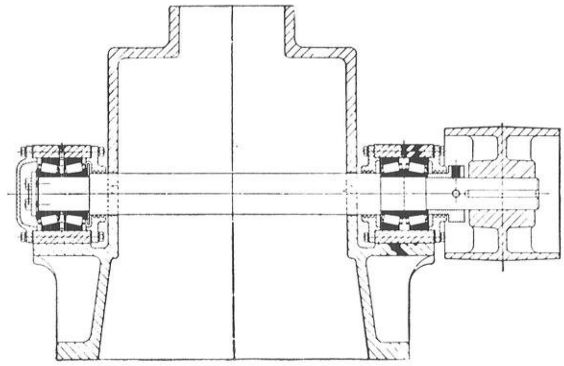


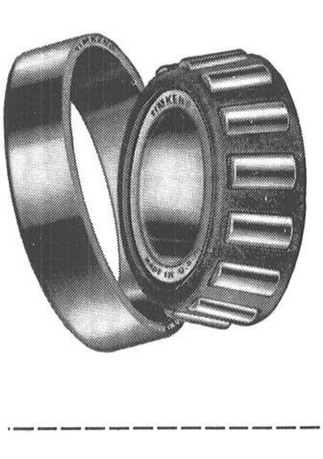
How to improve a wood hog's appetite

The wood hog shown here chews up logs for paper pulp like a giant pencil sharpener. As they chip away at the logs, the revolving cutter knives impose heavy shock loads on the bearings. To carry these shock loads, engineers specified that the cutter shaft be mounted on Timken® tapered roller bearings. Due to the line contact between the rolls and races, Timken bearings have extra load carrying capacity —take the heaviest shock loads.

Here's how engineers use TIMKEN® bearings for heavy shock loads

To give extra support to the wood hog's main shaft, double-row Timken bearings are used. The tapered construction of the rolls and races enables Timken bearings to carry both radial and thrust loads in any combination. Shafts are held in rigid alignment, end movement eliminated. Because Timken bearings permit the use of effective closures, lubricant stays in and dirt and moisture are kept out.





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On the Campus . . .

(continued from page 38)

THETA TAU

Theta Tau's program was highlighted this semester by: a talk, "How to Pick Your Job," presented by Mr. John Jefferies on September 26; the Founders' Day banquet, October 15, featuring Mr. A. L. Steinhaus with a talk on "Fire Prevention in Industry"; and "Research in the Universities, Industry and Government," presented by Prof. E. M. Larson of the chemistry department on November 15.

The present officers of Theta Tau are: Joe Vinette, regent; Dick Priem, vice regent; Mark Wallesz, scribe; Ferd Anderholm, treasurer; Ed Baugh, corres. secretary; Chuck Pitt, historian; Clyde Plaskett, marshal; Dave Sawle, inner guard; and Hilbert Teske, outer guard.

TRIANGLE

The members of Triangle fraternity have started the new year with their usually large stack of text books, the contents of which have by now been whittled down considerably. This does not mean that its members have kept their noses in their books continuously, for the social and athletic season has been a busy one.

Shortly after school started, a rushing smoker was held and was well attended by a group of new engineers. Prof. Benjamin Elliott of the mechanical engineering department was the main guest. The evening was rounded out with refreshments and singing.

There has been a series of house parties following some of the home football games, climaxed by the party following the Homecoming game. The Homecoming party was put on by pledges: Harry Bridwell, Ned Breuer, Robert Gramoll, Raymond Greisback and John Middleton. It was a great success and was well attended by alumni and guests. Chaperons were Mr. and Mrs. Paul J. Grogan. Mr. Grogan is an instructor in the M.E. department.

Recently the membership of Triangle was increased by six new pledges: William L. Filbey, Kenneth R. Wright, Richard E. Hayward, Jr., Robert J. Roeber, Richard J. Davies and Harold J. Day.

SAM

This semester the Society for the Advancement of Management has been having great success with its program. On one occasion a program was headed by Mr. Borth, manager of community relations for the General Electric Co. Mr. Borth commented on the need of informing every person associated with a company as to the conditions and circumstances which arise affecting the status of the company.

He cited the policy of G.E. in regards to negotiations for contracts. A day by day account of the proceedings is sent or posted to all employees and occasionally is even sent to the housewife. Mr. Borth also cited the efforts of his company to teach the workers and the community people the basic, unbiased principles of economics; for when these principles are understood by the people, then the people will accept as fair and necessary some of the decisions made by management.

On a later date, October 26, Mr. Ralph Ells, management consultant, presently working for the Allen Bradley Co., discussed the field of job evaluation in its relationship to a student graduating from college. His ideas were presented in such an interesting fashion that he was considered by all to be one of the best speakers heard by the group. Mr. Ells brought out the very strong point that students think a college degree gives them the right to a good job, whereas ability and true knowledge are the necessary traits for business success and do not necessarily go with the sheep skin. He pointed out the necessity of determining the true capacities and motivations of a person so that that person will not climb the ladder of success to his doom. A pitiful state is that of the person who is working in a job requiring more ability than he possesses. It is this type of person who gets ulcers and a weak heart, and leaves this world at an early age.

Mr. Ells, as did Mr. Borth, also brought out the economical infeasibility of many of today's pension or "security" plans. He advocated a pension plan tied to profits of a company and completely independent of the actual pay wage. The pay wage should be determined entirely from the variables of ability, proficiency, and supply and demand. With an independent pension plan the worker will be able to make much more in a given time, for if a company must guarantee any given sum, it must necessarily place that sum at a value conforming with the ability of the company to pay during its poorest years. To do otherwise would put the security of the company itself in jeopardy.

Mr. Ells' greatest stress was on obtaining the right job, a job that you will enjoy, a job with people you will like, and in a town that you like. When you find such a job, you will naturally climb the ladder to your capable level because of sincere motivations.

An even later meeting was held by the SAM in the Old Madison room of the Union on November 9. A variety show followed a dinner, and after the entertainment, Mr. George Johnson, president of Gisholt, discussed the industrial conditions of Europe. His talk brought out the necessity of making Europe an industrial producer again—particularly Germany, for most of the know-how lies with them. He also pointed out that it may be necessary to hurt, at least a little, a few small industries here in the States if the trade balance for this country is to be brought within economically sound limits.

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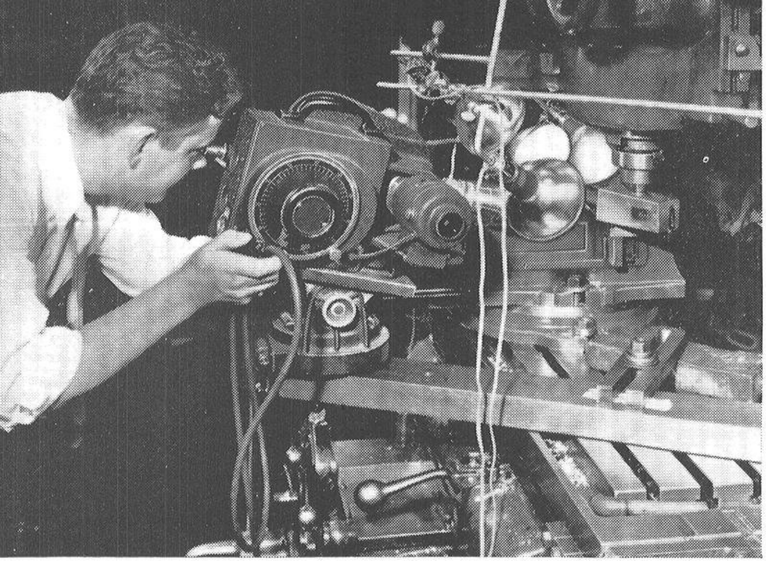

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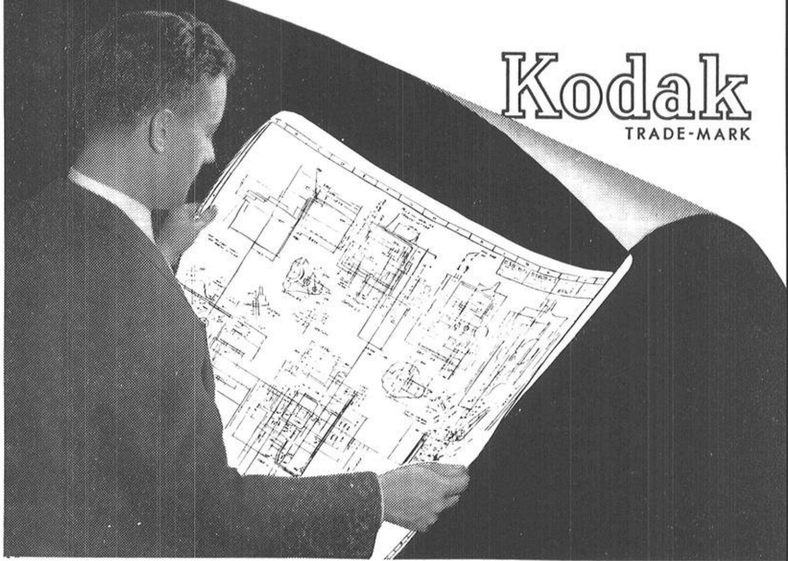

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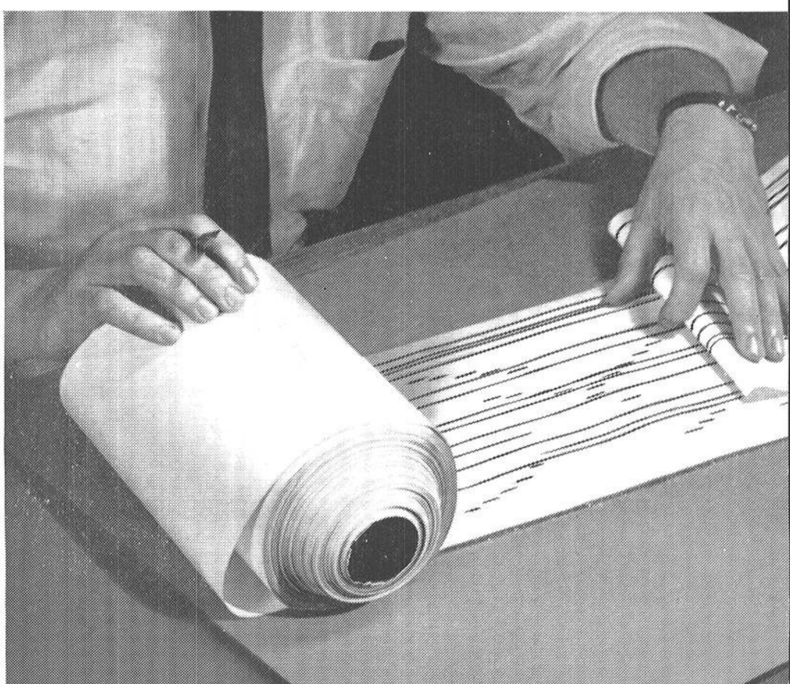

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