The Wisconsin engineer. Volume 54, Number 4 January 1950

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

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The Wisconsin

engineer

January, 1950

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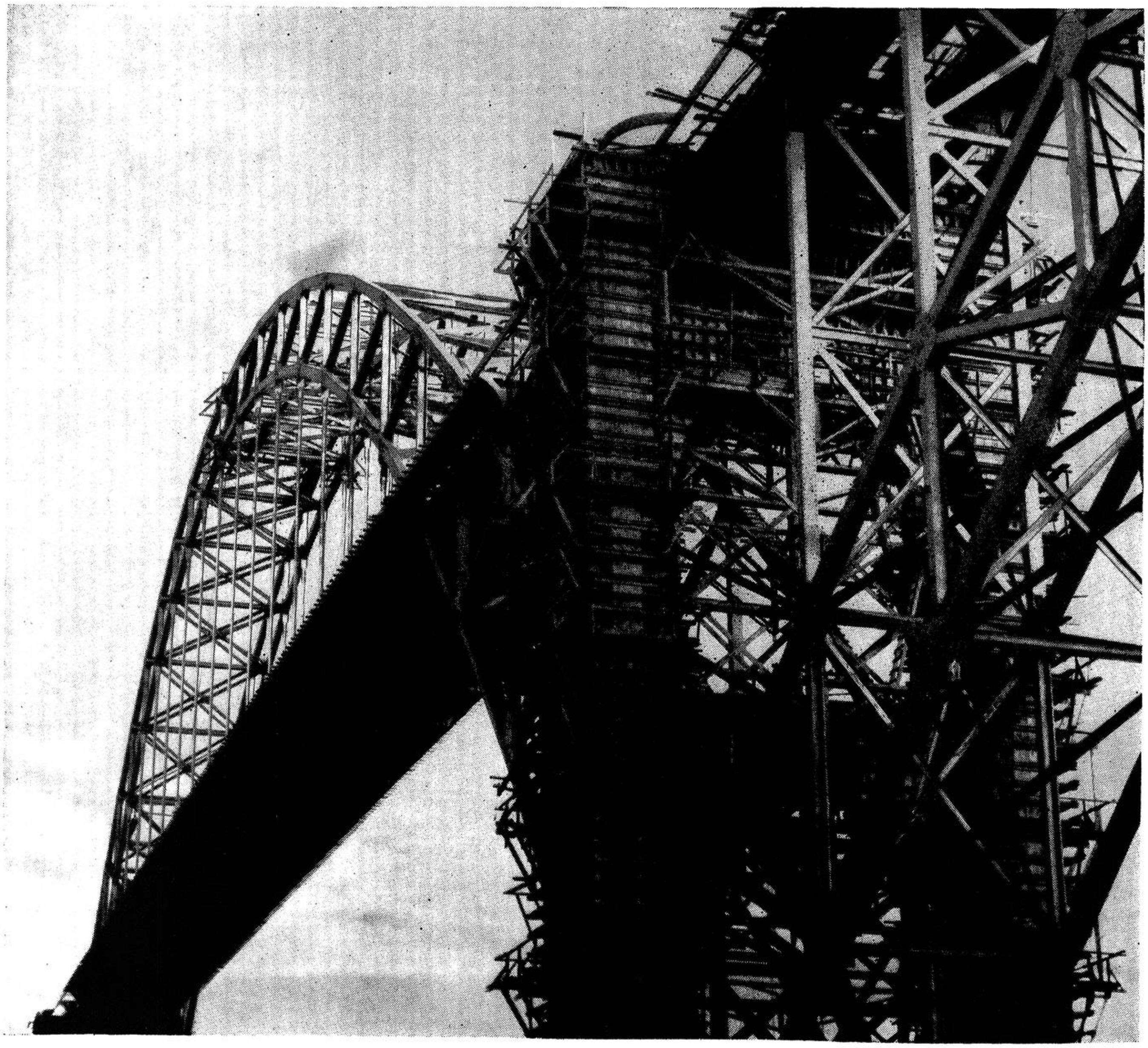
Cross a bridge and make a wish



NEXT time you cut ten or twenty or fifty miles off a weekend trip home by taking the short way over a bridge—give a thought to the days when the bridge wasn't there, when people *had* to take the long way around.

Right then would be a good time to make your wish . . . a wish that you will soon be able to put your engineering knowledge to work in helping to plan and build the things that make America great.

The steel industry offers hundreds of possibilities in this direction. From the mining of raw ore to the fabrication of the finished product, steel-making is directed by technically-trained men. Specialists in every phase of engineering play a vital role in the many and varied steps in making steel. Thousands of other engineers supervise the transformation of finished steel into structures like this mighty bridge.

United States Steel recognizes the need for carefully-trained specialists and pays particular attention in its educational program to the development of college graduates and other technically-trained men. This program has as fundamental objectives providing employees a sound foundation for advancement and assuring them opportunity for maximum personal development.

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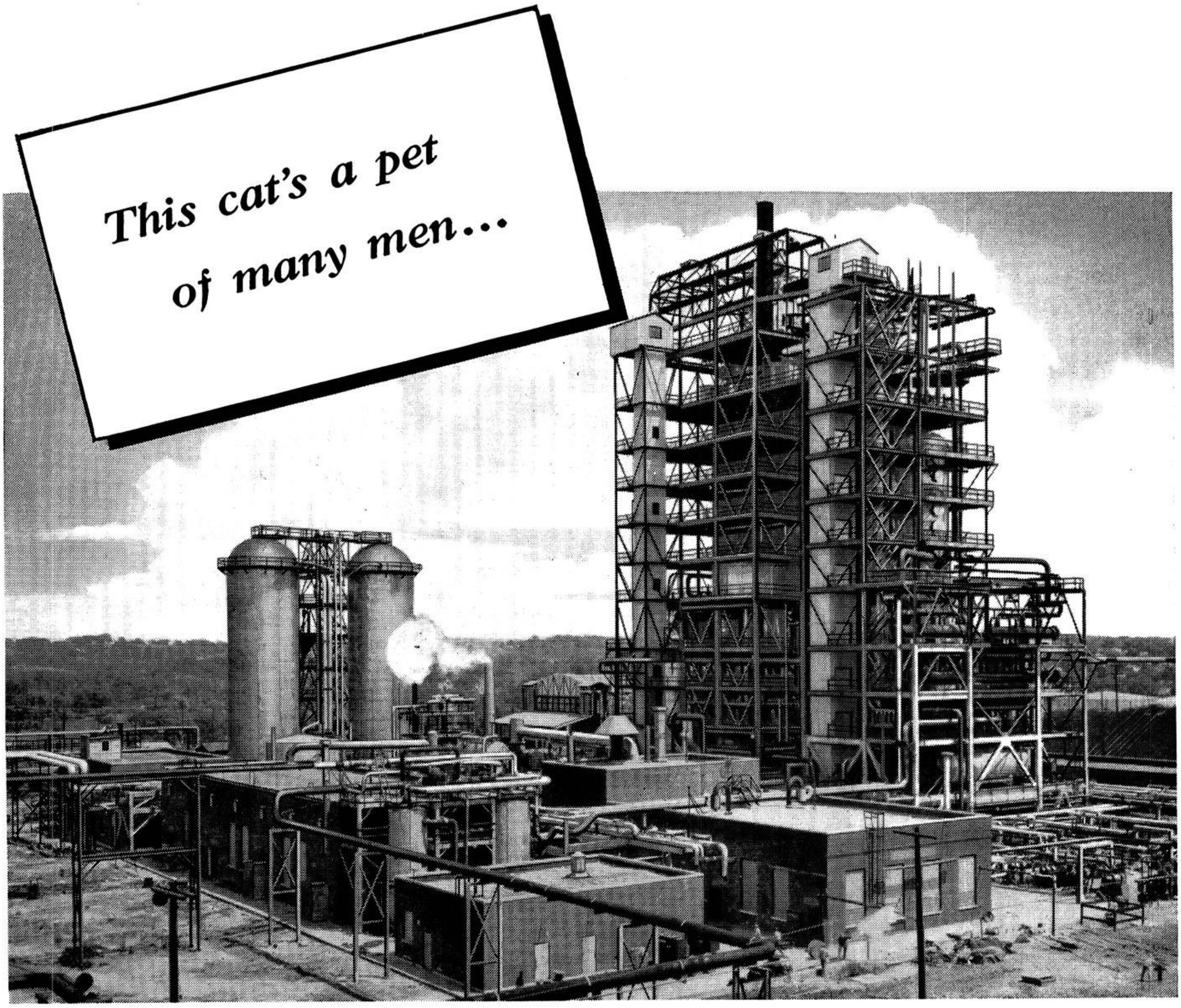

A fluid catalytic cracker is the realization of the plans and the work of many men. It costs many millions of dollars—but it owes its efficiency to catalyst studies that begin in beakers that cost only thirty cents each.

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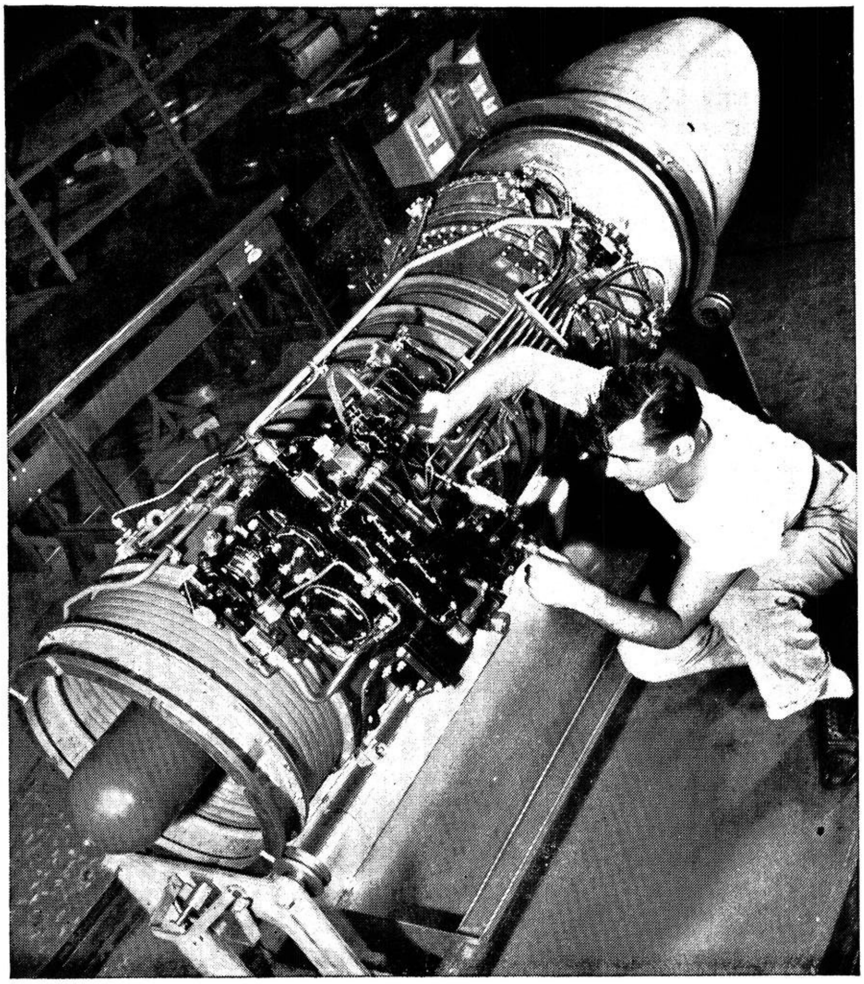

When you measure a name, there are many "dimensions" to consider, such as: integrity, capacity, vision, strength and skill. These qualities constitute a yardstick for professional and public recognition.

There will be many times in your career when you can increase the "dimensions" of your name by the development of a product, a method or through a decision you make.

Some idea of the dimensions of the name Westinghouse, for example, may be gained by a few facts about one of its many activities . . . building turbines.

In this field is the Westinghouse J-34 jet engine which is setting a new pace in aircraft propulsion in the much-discussed Navy "Banshee" and the Army Lockheed F-90, as well as in many other airplanes of both services—as yet unannounced.

Such developments require a rich background of experience, technical knowledge and creative skill gained through constant search for more efficient, economical sources for power . . . qualifications needed to attain the eminent position the name Westinghouse holds as a leading producer of power equipment for land, sea and air.

This is but one of many fields in which the name Westinghouse has been indelibly written over the years.

In your career you will measure many names and products in industry. As you do, you will find the name Westinghouse prominently identified with practically every one.

Whether those products are turbines or toasters, locomotives or lamps, electric stairways or x-ray machines, we will welcome the opportunity to share our experience . . . our sureness in designing and manufacturing that adds a new dimension to a name . . .

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WISCONSIN ENGINEER

Founded 1896

Volume 54 JANUARY, 1950 *Number 4*

In This Issue . . .

Cover:

The first wing of the new engineering building to house the electrical and mechanics departments. Classes are expected to be held here in the fall of 1950. *(Foton Photo)*

MEDICAL ELECTRONICS 7
Edward Ohm e'50

MAGNETIC FLAW DETECTION 10
Bert Erickson e'50

PROFESSIONAL ENGINEERING REGISTRATION 12
John McCoy e'50

PROFESSOR J. W. WATSON 13
Douglas Schinke e'50

HAMBURG: INGENIEUREN SCHULE 14
Hans J. Thiede

CONVEYORS 16
Robert Lea m'50

SCIENCE HIGHLIGHTS 15
Donald Miller m'50

ON THE CAMPUS 18
Fritz Kohli e'50

ALUMNI NOTES 19
Hank Williams e'50

STATIC 22
John McNall e'52

THE WAY WE SEE IT 26

THE WISCONSIN ENGINEER

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

Published monthly from October to May inclusive by the Wisconsin Engineering Journal Association, 361 Mechanical Engineering Building, Madison 6.

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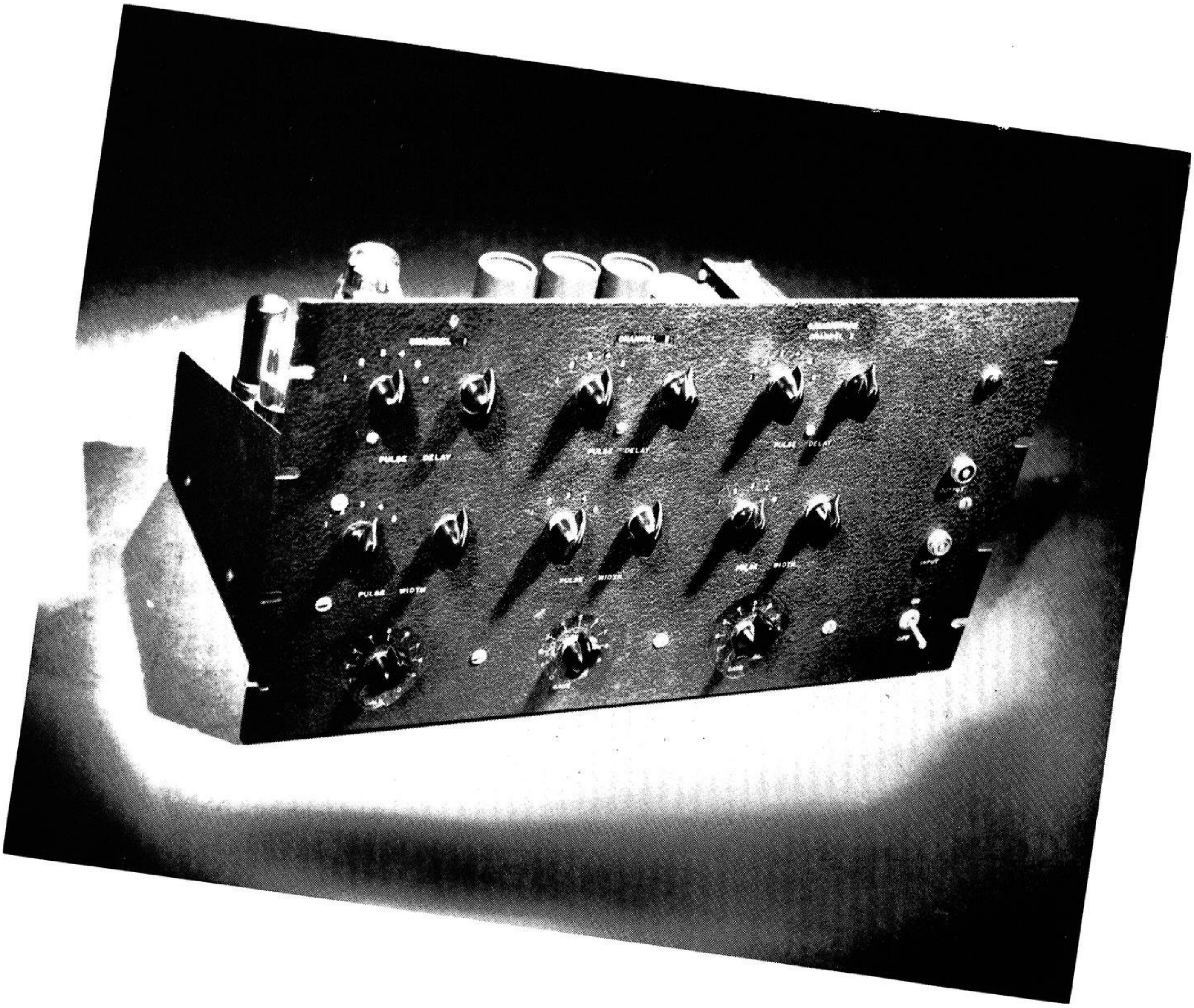


The electronic stimulator, the heart of the brain mapping process.

(photo by Hull)

medical ele

ronics

by edward a. ohm e'50

The senses as we know them are all connected to the brain with a complex system of nerves and nerve centers. The ear, for example, receives sounds and translates them for the brain to interpret. This is effected by the cochlea, the sense organ in the ear which is connected to the intricate network of nerves and nervous tissue of the brain by the auditory nerve.

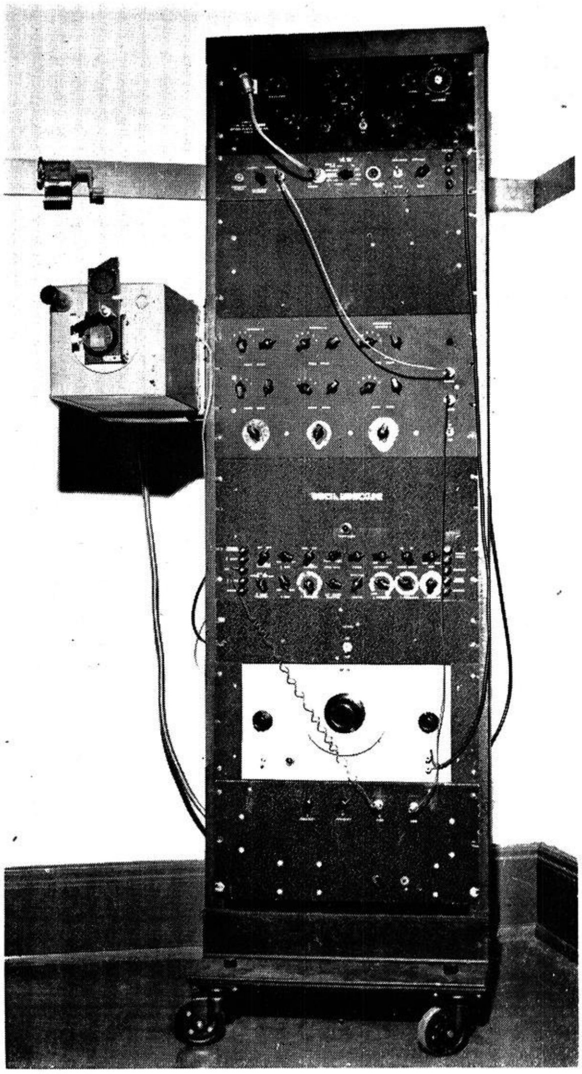
An auditory stimulus of the ear produces an electrical reaction in the entire network. The ear reaction is concentrated in two areas, and the reactions of the other senses are also concentrated in certain definite regions. Thus by the proper audio, visual, and tactile stimulation of the senses, the parts of the brain that deal with specific parts of the body can be accurately determined.

Definite knowledge of this may make it possible to localize brain tumors and injured areas, to study how the senses are associated with the brain and with each other, and ultimately to understand better how the brain functions.

A thorough study of these nerve connections has been hampered by the lack of proper equipment. Today at the University of Wisconsin Medical School an intense investigation is under way.

One of the methods used in mapping the brain is shown in Figure 1. The oscilloscope sweep circuit oscillator (or any sharp negative pulse) triggers the pulse generator at the same time the sweep is initiated. After a time delay (so the signal will appear at the center of the sweep) the pulse generator produces a square wave variable in distance for T - O, variable in amplitude (100 volts maximum), and variable in duration. Two other channels of the pulse generator also produce pulses. It is possible therefore to stimulate the ear or other sense organ with a series of pulses of various sizes and shapes. These pulses

(photo by Hull)



The complete stimulator and recording apparatus. Note the camera mounting which closes over the oscilloscope screen.

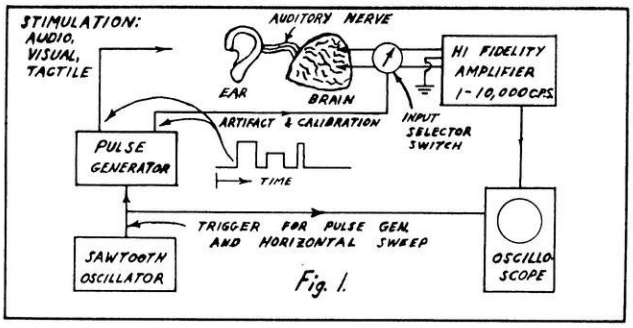


Fig. 1.

can be used directly, converted to audio power, applied electrically using a Schmidt stimulator, or fed to other special stimulators.

At any rate, this information is translated and transmitted to the brain where it produces local pulses of 0-2000 micro-volts depending upon the area investigated. This information is amplified and forwarded to the vertical deflection plates of an oscilloscope where it can be viewed and recorded.

An electrical stimulus applied at a certain point on the cochlea will produce a typical pattern on the brain as shown in Figure 2.

The shape of the pulse transmitted to the brain as well as its delay from the stimulus may play an important part in unraveling the nerve connections. Therefore it is necessary to separate the physiological from the electrical circuit distortion. This is done by feeding a replica of the stimulus (or artifact) to the vertical deflection plates. There it can be seen on the screen with the incoming signal for comparison purposes. Other input selections make it

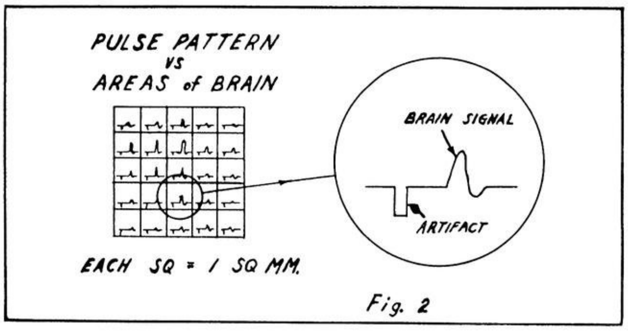


Fig. 2

possible to calibrate signal durations, delays, and amplitudes very accurately. This is accomplished respectively by connecting a calibrated oscillator to the Z axis and applying 50, 200, 500, 1,000, or 2,000 micro-volt square waves to the amplifier input.

The heart of the mapping process is the pulse generator. Its electrical characteristics and requirements will be the main topic of this paper.

The pulse generator furnishes:

1). The stimulus
2). The artifact or replica of stimulus to determine distortion
3). A calibrated square wave for checking the amplifier gain and the amplitude of the brain signal.

In Figure 3 the multivibrators form the basic parts of the pulse generator and the type shown in this circuit was chosen mainly for its capacity to produce a nearly perfect square wave. The other components merely assist and insure its operation throughout the range of the instrument.

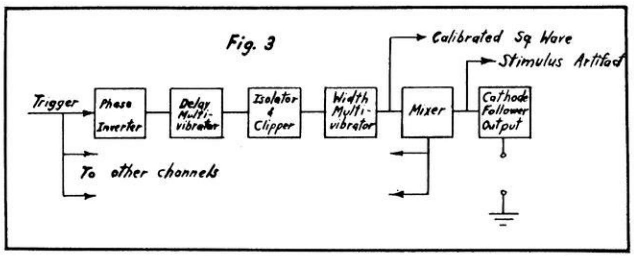


Fig. 3

The sequence of operation in Figure 4 is as follows:

1). V_{10}^{b} initially cut off by the voltage distribution across R_1, R_2, and R_3; V_{11}^{a} conducting heavily, low plate voltage due to large drop across R_3.
2). Sharp positive pulse applied to V_{10}^{b} grid, V_{10}^{b} conducts, its plate voltage drops causing C_1 to discharge R_4 and R_5. This cuts off V_{11}^{a}, its plate voltage goes positive, voltages across R_1, R_2, and R_3 are instantaneously redistributed, and the grid of V_{10}^{b} allows this tube to conduct and continue conducting after the trigger pulse has terminated.

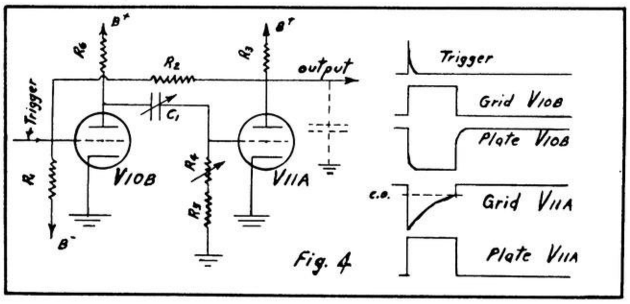


Fig. 4

3). C_1 continues to discharge across R_4 and R_5 holding V_{11}^{a} cut off. The time of cut off can be varied by switching in different condensers or varying R_4. This allows a very wide range in time delay (250 microseconds to 0.5 seconds).
4). As soon as the grid voltage of V_{11}^{a} increasing along the R.C. discharge curve (i.e., going in the positive direction) reaches cut off, V_{11}^{a} starts to conduct, its plate voltage falls, the grid of V_{10}^{b} goes negative, its current falls, its plate goes positive, C_1 charges, and V_{11}^{a} immediately conducts heavily. This is a cumulative process (as was the leading edge), and it results in a sharp trailing edge if a few precautions are observed.

Note that in this type of multivibrator there is very little capacitance at the output plate to slow its instantaneous swings. That present, the interelectrode and wiring capacitances, can be held to a negligible amount.

Multivibrators are simple in theory and reliable in operation when properly designed, but every application has its specific problems.

For instance, the ratios of R_1, R_2, and R_3 must be such that when V_{10}^{b} is conducting the grid voltage is not operating the tube in its saturation region. If it is, the feedback when V_{11}^{a} starts to conduct is slowed until

V_{10}^{b} changes its plate current. This results in a rounded trailing edge of the square wave.

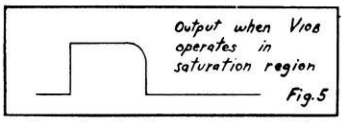


Fig. 5

On the other hand, if the grid of V_{10}^{b} is not positive enough when the tube conducts, instability results because the plate does not swing as negative as it should. The RC discharge curve of voltage across R_4 and R_5 is then nearly horizontal as it nears the cut off point of tube V_{11}^{a}. Under this condition transients and changes in B voltages will change the duration of the square wave, and the oscilloscope pattern will slowly drift as shown in Figure 6.

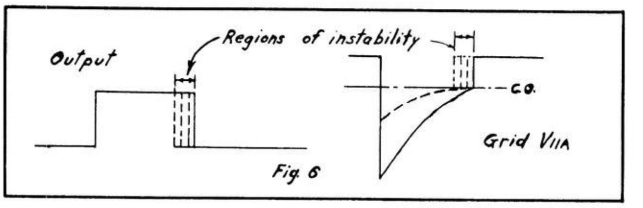


Fig. 6

The correct adjustment of R_1, R_2, and R_3 (especially R_1) will produce a sharp, stable square wave.

The Input Circuit

The ideal multivibrator described does not operate exactly as shown because of the effects of the input and output circuits. It is sometimes necessary to take special precautions, and the reasons, causes, and effects of these can best be understood by referring to the waveforms of the following circuit, Figure 7.

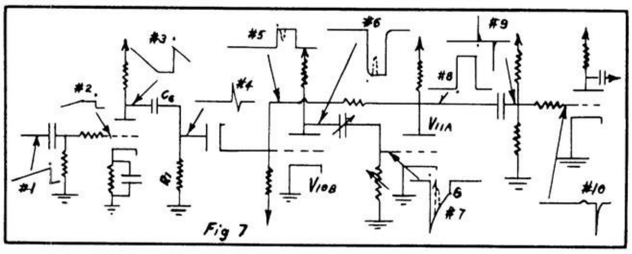


Fig 7

No. 1 is the output of a typical oscilloscope sweep circuit.

No. 2 is the wave form at the grid of V_{10}^{a}. It is clipped due to the drawing of grid current. The tube biases itself automatically for different amplitudes of input. Therefore a wide variety of imputs (as long as there is a steep trailing edge) will trigger the pulse generator.

No. 3 is the corresponding plate wave form.

The variation at the plate causes C_6 to charge and discharge across R_7. The small value of C_6 differentiates the wave form. Note the negative pip caused by the discharge of C_6 as the plate goes negative. If this were not clipped by the isolating diode, it would feed a positive pulse to the RC discharge voltage curve of the grid of V_{11}^{a}. This is illustrated by the dotted lines in Figures 5, 6, & 7.

This would cause the square wave to terminate at A instead of B for some settings of R and C. Since the amplitude and the rate of the trigger input varies over a wide range, its size cannot be controlled by the proper selection of circuit constants. It therefore must be eliminated.

The output of the first multivibrator is a square wave differentiated by an RC circuit to a positive and negative pulse (No. 9) which is forwarded to the next tube where the positive portion is clipped (No. 10) by drawing grid current. Note the positive bias of tube to aid this. The negative pip is inverted and amplified to trigger the second multivibrator. Isolation is another important function of this tube.

Because of the large, sharply differentiated, and constant signal applied to the second multivibrator, no isolating diode is necessary. The coupling condenser and load resistance of the isolating tube can be correctly set so that the undesirable feed through is negligible. That which does filter through lies so close to the leading edge of the square wave (and thus very much beyond cutoff) that it is not troublesome. This is due to the sharp differentiation of the square wave output of the first multivibrator, (No. 9) which makes the pulse extremely narrow. Figure 8 illustrates this effect.

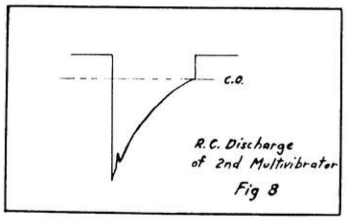


Fig 8

The operation of the second multivibrator is similar to that of the first, except that the output is fed to a cathode follower of infinite input impedance where it is mixed with the output of the other two channels across a common cathode load.

A high powered low impedance output is assured using a 6V6 as a cathode follower. It has a separate power supply to discourage interaction with the sensitive multivibrators through variations in DC supply voltages.

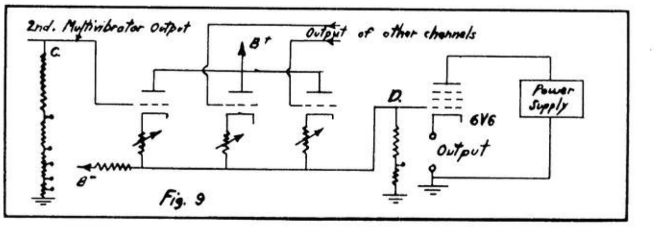


Fig. 9

Since a multivibrator produces a nearly constant amplitude output, the calibrated square waves are picked off the voltage divider at C. The artifact is of similar nature picked off at D.

The generator's output ranges from pulses of 250 microseconds' duration to 0.5 second and can be triggered from a range of less than 1 cps to 10,000 cps.

This completes the description of the units and indicates in part how closely electronics has become related to medicine, and especially to medical research. Geiger counters, brain wave recorders (electroencephalographs), electrocardiographs, and stimulators are just a few of the specialized applications. These are often combined with other straightforward electronic circuits to focus a little more light on the mysteries facing medical science.

Magnetic Flaw Detection

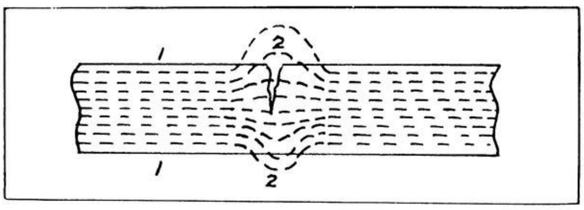
by bert k. erickson e'50

Tau Beta Pi awarded this essay first prize in its biannual paper competition among the fraternity's pledges. This one was selected from the field of 82 essays, and Mr. Erickson received the five dollar award from the fraternity.

The use of magnetism for testing iron and steel has been considered for many years; however, the first practical application of this method was developed and patented by William E. Hoke in 1922. Apparently the use of X-rays for similar tests was also developed for practical use at the Watertown Arsenal in 1922. The X-ray method of testing gained significance during the last war when a number of large structures had to be tested. The magnetic detector can not locate internal faults in large castings; however, it will work quite well with parts of a more conventional size. For example, in an article having a cross section area of about 8 x 5 in., a transverse fault having an area of about 0.75 sq. in. can be easily detected at the center of the metal. Although the magnetic detector can not locate deep internal faults, its original cost is much less than that of X-ray apparatus, and it can be adapted to assembly line production testing.

A fault in magnetic material is usually a small air gap, often of extremely small dimensions, in the solid metal. This air gap constitutes a path of relatively low magnetic susceptibility, and when placed under the influence of a magnetic field, the lines of force which are directed across the gap in a direction at right angles to its major dimension experience a considerable magnetic resistance.

Suppose an extremely large crack existed in a square bar as shown in the diagram below. When this bar is sub-



jected to an mmf directed along its axis, the flux is constant in all sections of the bar and is given by the relation, $\phi = BA$, where B is the flux density in lines per sq. cm., and A the area in sq. cm. Suppose the area of section 2 is one-half that of section 1. Now if section 1 of the bar is operated at a flux density slightly below the knee of the saturation curve, the flux density in section 2 of the bar will be twice as great as in 1; however, a B-H curve would show that the magnetic intensity in section 2 is many times greater than that in 1. If the saturated part of the B-H curve is relatively horizontal after the knee has been passed, the flux passing through the air surrounding the gap will be nearly as great as that passing through the iron in section 2. The detection of this flux extruding from the surface of a ferrous metal enables the fault to be located. The flux density within the bar must be great enough to produce a detectable magnetic potential gradient at the surface of the bar. Thus the principle of operation of the magnetic fault detector depends upon a change of magnetic potential gradient at the surface of the metal; this change being caused by a reduction of the area of homogenous ferrous metal.

The location of a fault in a magnetized body can be found with various devices. A compass or a search coil connected to a galvanometer give deflections when passed over a fault. A neon lamp is particuarly sensitive to the proximity of a magnetic field. However, devices depending upon these principles can hardly be used in sharp corners, and they must scan the entire test specimen. The old process of using iron filings, in spite of its antiquity, provides a very convenient means of examination. The field intensity across the fault will be higher than that along the good part of the specimen, and consequently the iron filings which have a permeability much greater than air will gather on the fault surface and can be easily observed. The action is really identical to that observed when a horseshoe magnet is dipped into a pile of nails. This principle was patented by W. E. Hoke in 1922.

The iron powder used must be prepared from a low carbon iron to keep the retentivity low. This powder must also have good mobility to be attracted to the fault area and to be completely removed from the test specimen at the conclusion of the test. Actually iron powder of this nature is used only for iron castings where the silvery appearance of the crack, bridged by the particles, is easily seen.

Faults in steel specimens are located with a detecting ink. This ink consists of spongy iron particles having a specific gravity nearly equal to that of the carrier liquid in which they are immersed. When this ink is passed over the surface of the test specimen, the iron particles adhere to the fault area. The ink can be obtained with a red or black color, and the fault can be easily observed as a red or black mark.

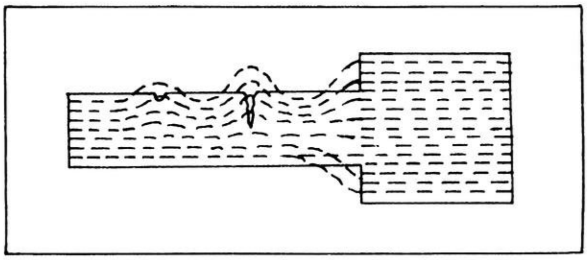
To avoid the undesirable task of pouring ink over the specimen, a convenient detector has been developed in which a small quantity of detecting ink is confined in a shallow receptacle having a transparent lid. This container is simply placed over the surface where the fault is expected. The outline of the crack appears on the bottom of the container. A special ink has been developed which has a luminous effect when viewed in a darkened room under a lamp giving ultra-violet radiation.

The principle of the magnetic fault detector is relatively simple and foolproof; however, an interpretation of the marks found on a test specimen requires some practical reasoning. The faults usually found are given in the following list:

1. Strain crack
2. Heat treatment crack
3. Grinding crack
4. Internal slag pockets
5. Non-metallic inclusions
6. Center roak

Strain cracks are probably the most common in parts that have been used and are generally surface cracks that are easy to detect. The heat treatment crack is the result of sudden changes of temperature involved during the application of the process concerned. These cracks generally take the form of a network or filigree pattern over the whole surface of the work. Cracking occurs when a steel billet is hammered after the forging temperature has died down. However, the rejection of a part having a heat treatment fault requires some consideration. A grinding crack is really a scratch produced by a grinding wheel improperly operated. Center roak is a series of cracks radiating from a point approximately in the center of the specimen.

Unfortunately all observed marks are not necessarily faults. A crack in any material usually takes a sinuous path, while a scratch or tool mark generally has a clean, straight path. The magnetic detector will indicate scratches as well as spurious readings due to changes of cross section. Consider the circular section shown below has a scratch, a crack, and a change of cross section. When a relatively large mmf is impressed upon this specimen, a deposit of iron particles will form over the scratch, the crack, and the joint where the cross section changes. If the scratch is small, the mmf should be reduced until the deposit over the scratch disappears. Now if a spurious marking occurs completely around the change of cross section, the mmf should be still further reduced until the crack, if any, in this area becomes apparent. Fine grinding cracks become noticeable in mild steel parts when the flux density is about 5,000 lines per sq. cm. or about half way up the saturation curve. The depth of a crack is indicated by the number of particles which pile up over it. Subsurface defects require substantially greater mmf's and are indicated by a clouding effect when ink is applied. A change in the type of steel, such as a cutting edge, will show up as a line.

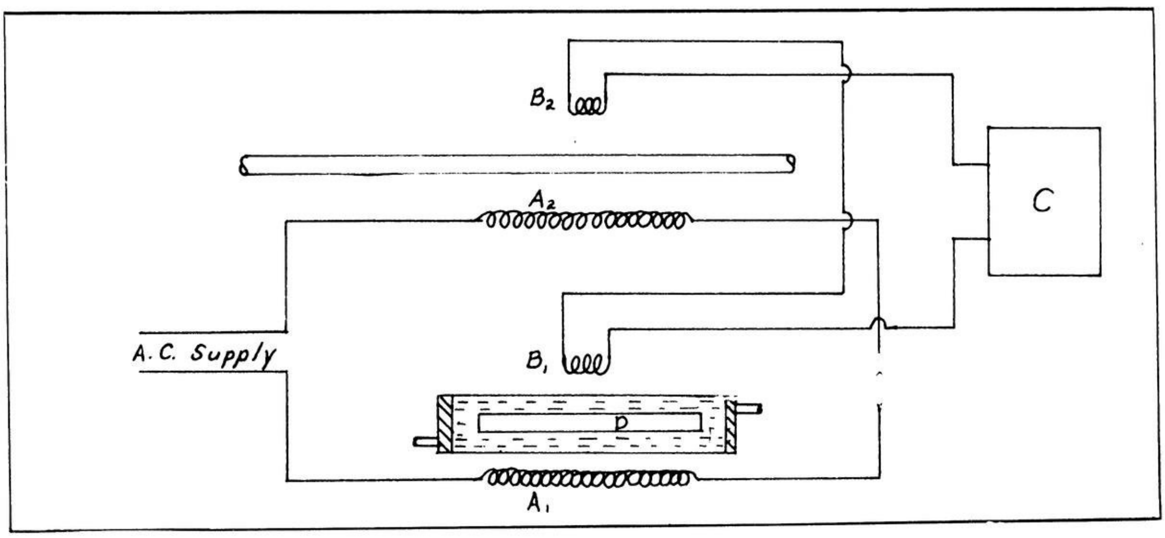


Test specimen which illustrates the effect of a scratch, a crack, and a change in cross section.

The flux produced by an alternating current has a tendency to flow in the outer surface of the iron specimen, and although it can be used for the magnetic detector test, the flux produced by direct current is more desirable. To test for cracks transverse to the axis of a bar, the flux is passed through the bar parallel to its axis. Thus a transverse crack will interrupt the flow of flux and its presence can be found with detecting ink. The flux for such transverse testing is essentially established by a coil surrounding an iron core which completes the magnetic circuit.

In the case of rolled bars or rods, where horizontal faults may be rolled into the section, the materials must be magnetized circumferentially in order that the lines of force shall be as nearly as possible at right angles to the major dimension of the fault. This flux can be produced by sending a heavy current through the rod itself, or in the case of a tube, by sending a current through a conductor stretched along the axis of the tube. This current may be continuous, but an impulse is generally used. If the test specimen has sufficient retentivity, it can be magnetized by forcibly removing it from the poles of the

(please turn to page 28)



Circuit diagram for magnetic comparison of the steel part with a standard sample.

REGISTER:

Professional Engineers

by john f. mcCoy e'50

The ethics of the engineering profession require that the engineer[1] produce not just a salable product, but one which has the attributes of utility and safety. The professional engineer, from this viewpoint, serves two masters, his employer, and the consumer of his product. If he is to consider himself morally responsible for his product, he will justifiably demand that others who use the title Professional Engineer be equipped with technical knowledge and practical training to such a degree that they can accept similar moral responsibility.

The prestige value of professional registration is readily apparent. Wisconsin courts of law accept the title Registered Professional Engineer as prima facie proof of ability to give professional evidence on technical questions. State law provides for the use of the injunction to prevent unlawful practice under the title. This factor protects not only the public, but also the profession in that it is a deterrent to bad publicity as a result of malpractice.

However, it is the aspect of the picture which concerns responsibility to the public which interests the Wisconsin Registration Board of Architects and Professional Engineers. In order to protect the public interests against loss of life or property, the board is empowered by law to grant two types of certificates of registration: the Engineer-in-Training certificate, and the Professional Engineer certificate. Persons who hold a degree in engineering or its equivalent, and who have passed an eight hour examination on general engineering subjects are registered as Engineers-in-Training. The Professional Engineer certificate is issued to those who have the qualifications for Engineer-in-Training status, and who, in addition, submit evidence of four or more years of engineering practice of a character satisfactory to the board and indicating that the applicant is competent to be placed in responsible charge of engineering work. A written or written and oral examination is again required, so that, to summarize, the Registered Professional Engineer will ordinarily have an engineering degree, have passed two state board examinations, and have had at least four years of practice.

Few professions can boast such high standards. Law graduates, for example, who maintain a certain academic average are exempt from taking the state bar examinations.

The Exam

The examination for February graduates applying for registration in the Engineer-in-Training category will be given on the Madison campus, and at Marquette, on Feb. 1. Applicants must remit a $10 fee during the period from Jan. 3 to Jan. 17. Application blanks and information material on the exam, is available in the Mechanical Engineering building.

The examination itself will be general problems, and all applicants will take the same exam. It will require a full day—four hours in the morning and four in the afternoon, and will be an "open book" type; handbooks, texts, and slide rules may be used. It is the intention of the board that the atmosphere in which the problems are solved shall simulate the conditions encountered in an engineering office, except that candidates will not be allowed to communicate with one another.

A general review of the basic sciences and fundamental courses in engineering is recommended for those applying for examination.

Why Register?

The prestige value of registration has already been mentioned. The professional engineering institutes, and the Engineers' Council for Professional Development have consistently supported registration as one of the best means of gaining recognition and respect for the profession. The act of registration itself is a positive proof to any prospective employer that the registrant is professionally minded and is thinking in terms of responsibility.

Legal Engineer-in-Training status provides an excellent reason for not joining sub-professional collective bargaining groups.

Reciprocity

At a recent convention of the National Council of State Boards of Engineering Examiners it was found that, in general, registration in Wisconsin will be recognized in all other states and territories which have similar requirements. The Wisconsin statutes[2] contain a reciprocity clause which provides for Wisconsin certification of Professional Engineers registered in other states under uniform laws.

A February graduate who expects to work in another state and who is in doubt about where to take the Engineer - in - Training examination would do well to write a letter of inquiry to the proper state board.[3] While the Wisconsin examinations will be recognized in most states, another fee may be required for a certificate of record. However, this disadvantage would probably be offset by the fact that, having taken the exam here, the registrant would not find it necessary to lose valuable working time in order to take the exam in the state in which the firm is located.

1The title *Professional* Engineer is used to designate those who by reason of their knowledge of mathematics, the physical sciences, and the principles of engineering, acquired by professional education and practical experience, are qualified to engage in engineering practice.

2Chapter 101.31 - Wisconsin Statutes as amended in 1949.

3The Engineering Library has on reserve a copy of U. S. Directory of Registered Professional Engineers for 1943. It is the biennial publication of the National Council of State Boards of Engineering Examiners, and contains the titles and addresses of member boards as well as a tabulation of reciprocity provisions in the 1943 state laws.

Editor's Note: This is the third in a series of four biographical sketches concerning the four engineering professors that retired from active teaching in the spring of 1949.

Emeritus Professor James W. Watson

(photo by Hone)

by douglas g. schinke e'50

James W. Watson, the oldest child of three, was born in La Crosse, Wis., on Jan. 16, 1879. Both his elementary and secondary school education were completed there; he graduated from high school in 1897.

The following fall he enrolled at the University of Wisconsin as a general science student. About three weeks before the end of the semester he decided to major in Electrical Engineering and entered the College of Engineering. The transfer forced him to do a semester's work in three weeks in such courses as descriptive geometry. Following his second year of college he postponed his formal education for a year in order to earn enough money to continue with schooling. During this year he managed his father's grocery store at La Crosse.

Mr. Watson returned to school as a junior, and graduated with a B.S. degree in June, 1902. During his senior year he served as editor of the "Wisconsin Engineer."

Wishing to continue his studies he returned to the University that fall to do graduate work. A small scholarship provided some financial aid, but he was forced to seek a part-time job in order to support himself. He found employment with D. C. Jackson, then chairman of the EE department. Mr. Jackson also did consulting work on power plant design, and it was in this field that Watson worked. Because of the time consumed by his job Mr. Watson was not able to complete his graduate study. He had hoped to find employment with a Chicago concern, but due to economic conditions they were not hiring new people.

Mr. Watson returned to the University in the fall of 1903 as an instructor in the Dynamo labs. In the latter part of December Professor

(please turn to page 30)

HAMBURG:

Ingenieur Schule

by hans j. thiede

Editor's Note: Technical education in postwar Germany cannot be compared directly with that in America. This article is written by a German engineering student in Hamburg, and he describes the methods and opportunities available to the technical student in Germany who is interested in obtaining an engineering education.

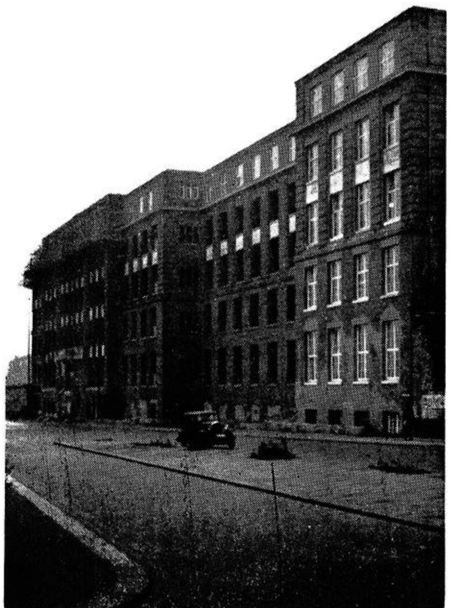
Hamburg being an industrial center as well as a seaport always required a great staff of engineers. The situation has changed after the war however, and about five per cent of all engineers and technicians living in Hamburg are unemployed now. Compared with figures from other parts of Western Germany, it does not seem too much as we have a considerably higher percentage in Bavaria for instance (ten per cent).

Since there is no technical department at Hamburg University, education in engineering is restricted to technical schools; i.e., the "Ingenieur-Schule", the "Bauschule", and the "Wagenbein-Schule".

To start with is the "Ingenieur-Schule," or Engineer School as you would say. There are four departments at this school:

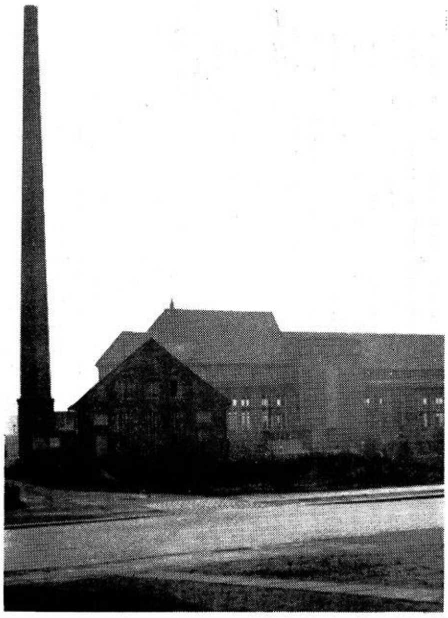
1) Machine-building
2) Ship-building
3) Electrical Engineering
4) Telegraphy and telephony

Each department includes five terms or half-years, and at the end of the fifth term there is an examination by a committee consisting of representatives of the government and concerned industries. All students having passed this exam get a certificate and are entitled to call themselves "engineer".



Main building which was bombed during the war. Reconstruction can be seen on the right wing and fifth floor.

(photos by Kurt von Deessen)



The engine shed of the Ingenieur Schule.

In order to pick out the most efficient of the applicants, all would-be-students have to submit themselves to an examination in mathematics, physics, chemistry, mechanical drawing, and have to write an essay on a given subject of general interest. The school has to do some sort of selection because applications are plenty, even though industry never absorbs as many engineers as the school turns out every half-year.

As to the method of learning, we do not have courses from which we are more or less at liberty to choose. We have to take all lessons which are offered to your class. That seems very much on high school lines, but you have to remember that there is a lot of knowledge to acquire in five terms. You take at least eight terms at your Universities. This might justify our method to a certain degree, but since we are in close touch with universities, progress is being made to introduce lecturing at Engineer Schools.

As to the subjects in machine building, there are lessons in mathematics, (including differential and integral calculus), mechanical drawing, statics, kinematics, hydrostatics, dynamics, electrical engineering, machine parts, physics, motors, steam engines, turbines, lifting engines and production. Here the various methods of technical production, particularly mass production, are talked over, different phases in the making of machine parts, calculations etc. During each term every student has to do some sort of construction job just to show that he has under-

(please turn to page 27)

Science Highlights

by donald miller m'50

BLEEDING IN CONCRETE

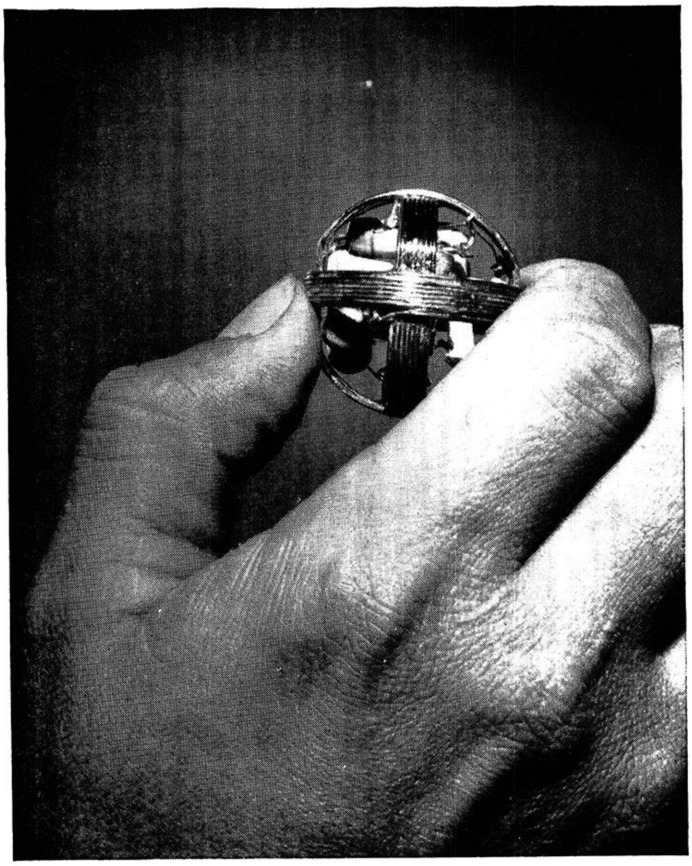
Bleeding of concrete is the settling out of the solid portions leaving water at the surface of the mix. By means of an apparatus recently developed at the National Bureau of Standards this very important property of cement pastes, mortars, and concretes may be measured directly and continuously.

Bleeding is most troublesome when the water moves to the surface of the mix with such force that appreciable quantities of very fine cement particles are carried along in suspension. When these particles are deposited on the surface of concrete, they hold sufficient water to form a paste of high water-cement ratio, which will constitute a plane of weakness when the material has hardened. High bleeding rates also account for water pockets and loss of bond at the underside of coarse aggregate mixtures. A moderate amount of bleeding, however, facilitates finishing operations such as troweling.

The present apparatus consists of a burette which is immersed in and partially filled with carbon tetrachloride. The carbon tetrachloride also covers the mix to be tested. The bleeding water rises from the selected area and because its specific gravity is less than that of carbon tetrachloride, it rises to the surface of the water in the burette, where it may be measured.

It was found that the effect of aggregate upon a neat paste was to arrest bleeding. The tests also illustrated the dependence of bleeding upon the settlement of the solid particles.

The principles involved in the method for measuring bleeding just described are the basis of a method proposed by the ASTM committee on cement as an ASTM Tentative method.



(cut courtesy GE)

Nerve Stimulus Receiver

SURGICAL RADIO RECEIVER

A tiny radio receiver which can be placed beneath a dog's skin surgically has been developed for use by medical scientists in nerve stimulation experiments.

Minute insulated wires run from the receiver, about the size of a ping pong ball, to whatever nerve is to be stimulated. The receiver picks up the radio impulses which are transmitted to the nerve.

The surgery involved is performed while the dog is anesthetized and the operation is painless. The incision soon heals, leaving the dog normal in every respect. Other stimulation experiments in the past have been performed with the dog under anesthetic, with the nerve laid bare, or with leads running through his skin. In these cases the dog has been in an abnormal state, having an adverse effect on the findings of the test.

The receiver is spherical, enclosed in a plastic case which is not irritating. The wire running to the nerve is also enclosed in plastic, being connected to the nerve by a small silver foil electrode, which fits in sleeve-fashion over the nerve.

For experiments the dog is placed in a cage which is a large coil ten feet in diameter. The coil is connected to the transmitter. The dog is then free to wander in the cage at will and can receive stimuli anywhere in it.

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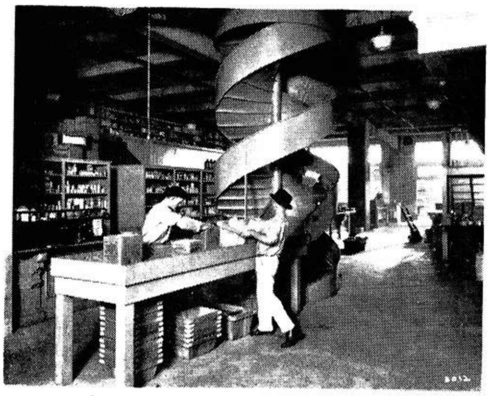
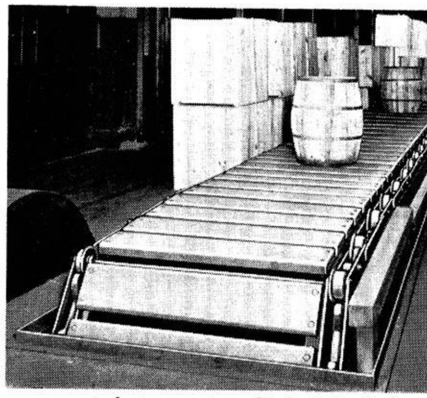
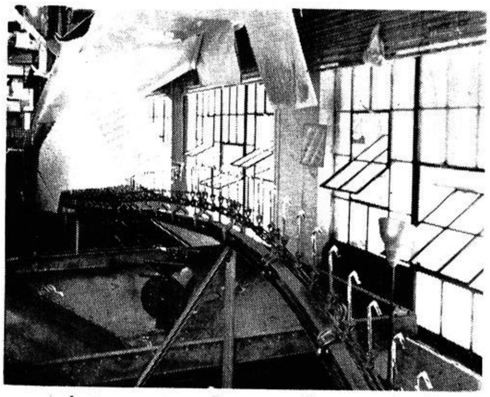


(photo courtesy Std. Conveyor Co.)
Figure 2

(photo courtesy E. W. Bushman Co.)
Figure 3



(photo courtesy Link Belt Co.)
Figure 4



(photo courtesy Conveyor Systems, Inc.)
Figure 8

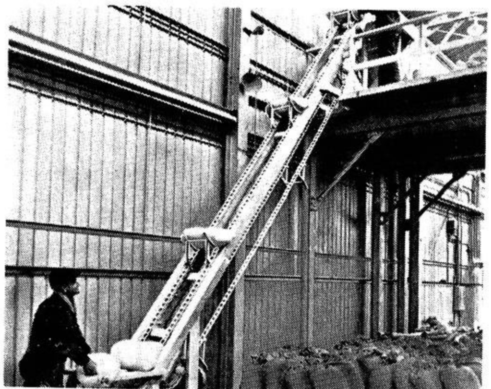


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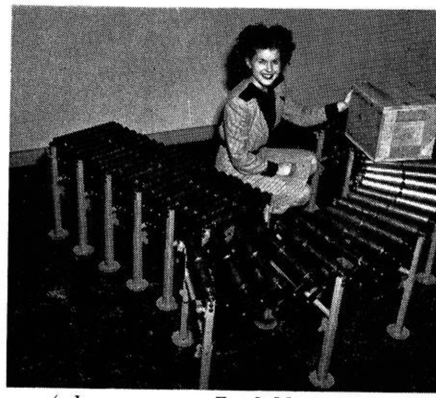
Figure 9



(photo courtesy Food Machinery Corp.)
Figure 10

CON-VEY-ORS

by robert h. lea m'50

If a person should look around, he would find many instances where a conveyor is or has been used to make his life more pleasant.

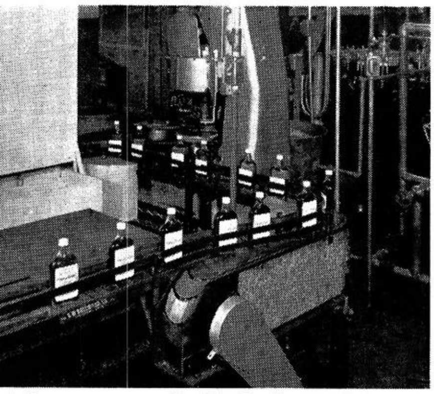
The people on the east coast have benefited considerably by one of the largest of conveyors, the Big Inch, a twenty four inch pipe which has carried tremendous quantities of oil and other liquids from Texas to Pennsylvania. In fact, every pipe is a conveyor, as is every electric wire. The slide of the logging industry which carries logs from the forest to the river is another conveyor, as is the card table which carries the cards from the dealer to the other players.

There was proposed an unprecedented 130 mile, iron and coal belt conveyor for Ohio. This conveyor would have saved many industries considerable sums for the transporation of these vital materials had other factions not intervened to prevent its construction.

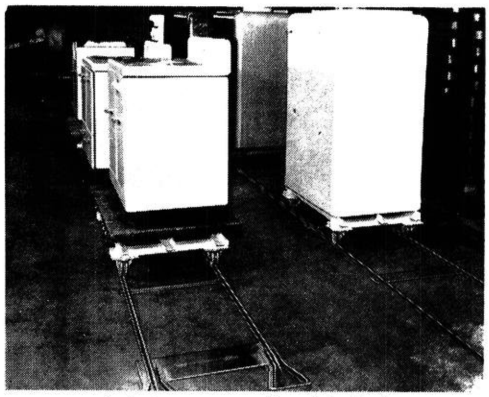
Today's industries are rapidly moving into the higher competitive consumers' market which has long been absent because of the war. For many years the only real concern of an organization was to get as many units out as quickly as possible. Cost was of little consequence in many industries because the market was at the mercy of the producer. However this situation no longer exists; the consumer now has his pick, and his choice is very largely determined by the price.

In any industry it is possible to break the total cost of an item into a few major classes. These may be the cost of the raw material; the cost of direct labor, the wages to the men who change the form of the materials; and the costs for the sundry indirect activities such as sales, advertising, research, management, materials handling, etc.

Of these product costs, materials handling is one of the largest elements, comprising about 30 percent of the total cost in this category. However, it is an expense problem that can be tackled directly in the fight to bring prices down. The human element in this problem is small, thus making possible a direct and scientific approach towards


(photo courtesy E. W. Bushman Co.)
Figure 5


(photo courtesy Link Belt Co.)
Figure 6


(photo courtesy Bassick Co.)
Figure 7

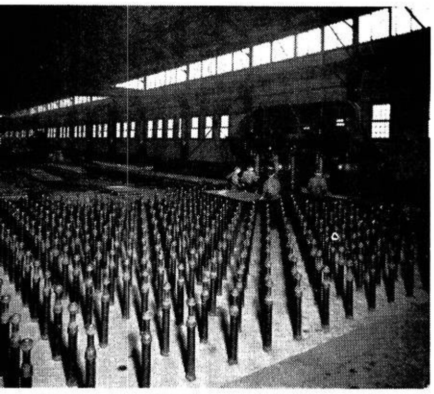
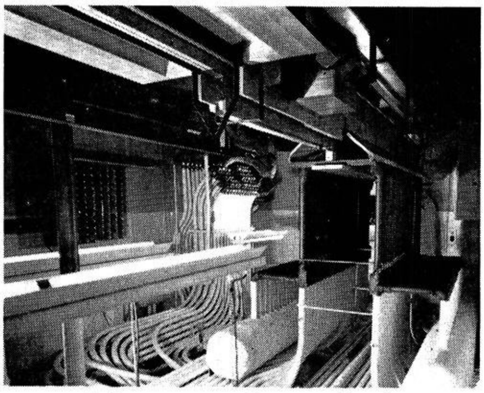


photo courtesy Mathews Conveyor Co.)
Figure 11


(photo courtesy Lamson Corp.)
Figure 12


(photo courtesy Metzgor Co.)
Figure 13

reductions—something quite difficult in labor problems. Also, there is no outside party that can control this expense as is the case in material costs.

Industry has found that the cost of materials handling can best be cut by reducing the required manpower. This can be accomplished by giving a worker a powered machine to do the lifting and transporting, or by removing the man entirely and transporting the materials easily and steadily on conveyors.

CHUTE OR SLIDE CONVEYORS

Of the many types of conveyors one of the simplest in form and function is the chute or slide. Free and ubiquitous gravity furnishes the push to the objects that they carry. The chute is usually made from sheet metal, and is either straight or spiral depending on the distance through which the product must be dropped. Figure 2 shows a double bladed spiral conveyor which is used to lower orders from storeroom to shipping room.

The spiral chute offers a very effective method of transmitting objects from one floor to another below. The pitch in the spiral can be so designed that the product will travel at uniform and undamaging speed from upper to lower levels. A wall or retainer is usually placed on the outside edge of the chute to prevent the object from being carried off the side by centrifugal force.

The spiral is actually one of the lesser uses of the roller conveyor. This conveyor is often laid out in a nearly horizontal plane with a slight slope in one direction so that an item will still roll along by gravity. The roller conveyor is usually used for the transporting of flat surfaced objects; but by redesigning the roller it is possible to transport other shapes such as shell casings.

Many times it is impossible to use gravity for moving the object because of a limitation in the drop in elevation of the conveyor over the distance on conveyance. Under such circumstances the objects may be pushed along; or more often, the rollers can be made "alive" by some ex-

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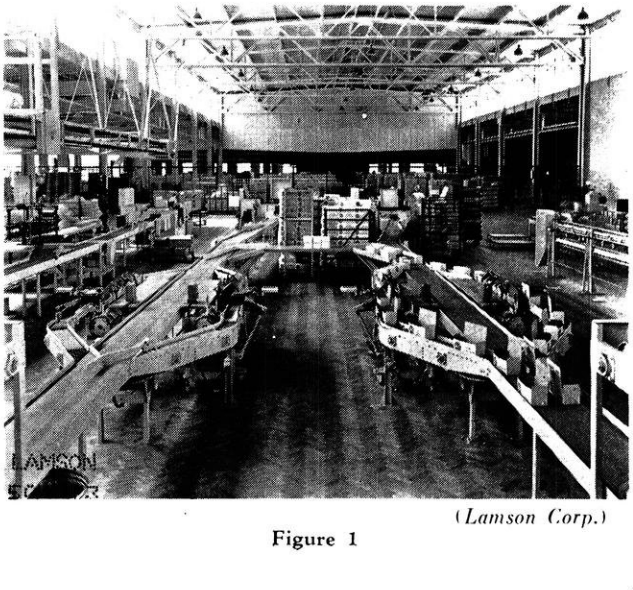

(Lamson Corp.)
Figure 1

ON *the Campus*

by fritz kohli e'50

Too Late to Start My Beard? No! It's Never to Late!

YOU have almost two months remaining to blossom out in grand style with a magnificant beard which would make any lawyer green with envy.

It should be not only your privilege, but your duty to join the ranks of the bearded engineers. The advantages of growing a beard are three-fold. First, you treat yourself to fifteen or twenty minutes extra sleep each morning during the time you normally spend shaving. Secondly, you aid your society's St. Pat contestant by the extra points awarded for each beard. Thirdly, your beard is one more instrument in showing up our smooth-cheeked friends, the lawyers.

Prizes will be awarded for the best, longest, curliest, thickest, and best colored beards. And for those who are not blessed by nature with a profuse plumage, a special prize is being offered for the puniest beard.

I.R.E.

The I.R.E. Student Branch held their monthly meeting on Wednesday, January 11. Plans for the coming semester were discussed, and a special election was held to replace those officers who are graduating in January.

The highlights of the evening were informative talks by three student members of the group. Jack McCoy and Richard Pier, both senior E.E.'s explained the projects to which they are currently devoting their spare moments, and John McMullens, a graduate student, spoke briefly on Magnetic Amplifiers.

Kappa Eta Kappa

Members of Kappa Eta Kappa entertained their wives and dates at an informal Christmas party at the Capitol Hotel on December 9, 1949. Presents were distributed to the members and their guests by "Santa" Rollie Chapple. The KHK Barber Shop Quartet, composed of Don Barber, Bob Feutz, Floyd Peronto and Glenn Petersen, entertained by singing several old favorites and Christmas carols.

Hangover Hop

An after New Year's party was held in the Park Hotel on January 7, 1950 by the members of Eta Kappa Nu, Pi Tau Sigma and Tau Beta Pi. The party was informal, providing a last chance to relax before final exams.

Triangle

Five new members were initiated into the Wisconsin Chapter of Triangle on December tenth. They are: Professor Patrick H. Hyland, Raymond H. Greisbach, John A. Middleton, Harry M. Bridwell and Ned W. Breuer.

The second rushing smoker of this semester was held December first for a group of engineers. The group was entertained by some slides of the old St. Pat's day parades. Professor Patrick Hyland, the main guest and speaker, gave a short talk about the slides.

The members of Triangle are happy to announce the names of three new pledges: Harland L. Bielefeldt, Robert C. Sommerfeld, and George Simonds.

A.S.M.E.-S.A.E.

Bill Brennand, two time Goodyear Trophy winner at the Cleveland Air Races, presented movies and a talk on his experiences at a joint meeting of ASME and SAE on January 5, 1950. Preliminary plans were made for the St. Pat contest and the candidate from the Mechanical engineering school was elected.

S.A.M.

On November 30, the Society for the Advancement of Management held a meeting with Mr. Stanley Stavrum, Personnel Director of Oscar Mayer Co. Mr. Stavrum talked on the popular subject of the day, "How To Get a Job." The group really got the inside dope on what the interviewers and personnel men are looking for, both good and bad.

On December 9 the group held its informal Cabaret Christmas Dance in Tripp Commons of the Union. The evening started with recorded music. Later a few physical education students were brought in to head group games and a simple form of barn dancing. The evening was ended with an impressive series of Christmas carols.

Latest Paris Style

—No less a person than Prof. D. W. Brogan, the author of a learned and witty book about America—says the stylish women of Paris are rushing to get their hair cut short, and Paris men are wearing beards again—full beards, Dundrearies, and above all chin whiskers.

There are two popular variants of the chin whisker at present: Brigham Young style, with a big square beard; and Horace Greely style, with a fringe around under the chin—in both cases with shaven upper lips—Des Moines Register via The Wisconsin State Journal.

Alumni Notes

by hank williams e'50

E. E.

Harvey W. Hanners ('31) was appointed Chief Engineer of the Superior Engine Division of the National Supply Company of Springfield, Ohio. Mr. Hanners, who has been associated with the Superior Engine Division since 1941, has been assistant to the chief engineer for the past two years. He has specialized in the manufacture and development of both diesel and gas engines.

Harvey Hanners

C.E.

Lebrecht J. Klug ('08), head of the Klug & Smith Co., Consulting and Contracting Engineers, was named "Engineer of the Month" in the December issue of "Milwaukee Engineering." Mr. Klug is a life member of ASCE. Important structures designed by him include viaducts and bascule bridges in a number of Wisconsin cities, and structures in the fields of manufacturing and the handling of coal and grain.

Oswald J. Muegge ('23) has been appointed State Sanitary Engineer of Wisconsin and Acting Director of the Committee on Water Pollution, replacing Mr. L. F. Warrick who is now with the U. S. Public Health Service in Washington.

V. L. Minear ('23) recently attended a conference at the Corps of Engineers Waterways Experiment Station's concrete research laboratory at Clinton, Mich. Minear is Foundation Specialist in the office of the Chief of Engineers, Washington, D. C. Since graduation he has had wide experience both in this country and abroad. He served as captain in the Corps of Engineers in the AEF. He is the author of numerous articles on foundation grouting.

C. P. Lindner ('25) was one of a group of engineers who recently inspected the Lake Okeechobee dykes in Florida which were constructed by the U. S. Engineers, and which suffered only minor damage in the recent hurricane. Lindner is Chief Engineer of the South Atlantic Division at Atlanta. Subsequent to graduation, he was on the staff of the Topographic Engineering Department and assisted Prof. Ray Owen at Summer Camp. He has been with the Corps of Engineers since 1929, chiefly on river development and flood control, and served for a time as director of the Waterways Experiment Station at Vicksburg.

Edmund Hirsch ('24) has been promoted to Chief Sewer Engineer in the Bureau of Sewers of Milwaukee.

Eugene A. Kraemer ('39) is now employed in the City Engineer's office at Oak Ridge, Tenn.

Harvey R. Wendorf ('39) is now Assistant Communication and Structures Engineer with the Civil Aeronautics Administration in Washington, D. C.

Thomas A. Holgate ('40) has left the Martin Company in Maryland to take a position as Aerodynamicist with the Boeing Corporation, Seattle.

Ted B. Prawdzik ('39) has been promoted to Civil Engineer III in the Bureau of Sewers of Milwaukee.

Frederick C. Engler ('46, MS '47) recently married Miss Edith Louise Meyn in Detroit where Mr. Engler is employed with the Trane Corporation.

William F. Faulkes ('41) was stricken with polio last June, in Charleston, W. V., where he was engaged in contracting. He was in a hospital until late in October when he was moved to the Georgia Warm Springs Foundation at Georgia Warm Springs, Ga., for further treatment.

Ralph G. Michael ('49) is engineer-inspector with the Chicago & Western Indiana Belt Railway of Chicago, with headquarters in the Dearborn Station in Chicago. He is engaged in the remodeling of an engine-house in Chicago for the purpose of converting it into a diesel-engine shop.

Gordon G. Robeck ('44) is on leave from the Public Health Service for the purpose of taking graduate work in sanitary engineering at M.I.T. He writes: "Tech has a wonderful and coming program in sanitary engineering, and most every phase of work here has been satisfactory."

Ch. E.

Norman H. Ceaglske ('28; MS'29; PhD'36) has been Professor of Chemical Engineering at the University of Minnesota since 1946. Norman had prior teaching experience at the University of Wisconsin, University of Iowa, and Washington University in St. Louis. He has done research and consulting work for private companies and is the author of numerous publications. He married Lucille Ostly of Madison, and they have four children.

Conveyors . . .

(continued from page 17)

ternal power source. One method is to run a power driven belt along the under side of the rollers so that the object is propeller by the friction of turning rollers. Another method is to turn the rollers by a chain and sprocket arrangement. These systems also have an advantage in that the speed of the object is controlled.

Unfortunately this conveyor is not adaptable to the moving of metal objects because of the possibiity of damaging the sliding surface. But this limitation can be obviated by replacing the sheet metal floor of the spiral with radial rollers.

ROLLER CONVEYOR

The roller spiral has an advantage in that it can transport such things as open tote boxes and barrels, and still do so smoothly and easily. Because of the reduced friction to travel, the spiral must have a smaller pitch, and allowances must be made to see that heavy products are not allowed to gain too much momentum. Because of the reduced friction there is also less chance for items to get stuck between terminals.

A variation of the live roller conveyor is the "roller flight." In this case the roller itself is carried along by moving chains connected to its axis. With this type of an arrangement it is possible to stop the moving object on the line without stopping the line or introducing a large load on the system, for the rollers will simply turn under the object as they pass beneath.

WHEEL CONVEYOR

In some instances a wheel conveyor is used in place of a gravity roller conveyor. It is essentially the same as the roller type except that the rollers have been replaced by staggered rows of wheels. The wheel conveyor is widely used for portable units, mainly in shipping and receiving, because of its reduced weight. It is also used as a feeder line to belt or roller conveyors. There is one major disadvantage in its use, and that is that the large space between the wheels limits its use to large flat objects such as boxes. By the same token however, some objects with irregular projections may be moved easily provided there is still sufficient surface to rest on the wheels. A wheel conveyor is shown in figure 3.

BELT CONVEYOR

It has been stated here that one of the main disadvantages of the roller and wheel conveyor is the inability to handle small or irregular objects easily. There are a number of methods for attacking this problem, with the power driven belt system being one of the most popular. Such a system is shown in figure 1, where boxes are carried to packing, automatically closed, and then carried on to storing. As can be seen, the belt conveyor is very adaptable to intermittent deflection of objects to other lines.

Belting is usually made of fabric or a composition rubber, and where high temperatures are encountered, of wire mesh. The endless belt is driven at the ends of the conveyor by pulleys, and it is supported in the middle by a roller conveyor or a smooth sliding surface. It is not necessary to have the supporting rollers very close together for this conveyor, but it is necessary to have idler rollers below to carry the belt in the returning travel. Sometimes the conveyor is designed so that some objects will be carried one way on the top surface of the belt, while others are carried in the opposite direction on the lower return.

The belt has its disadvantages in that it is limited to straight line motion, and that it has a higher cost and upkeep. The first of these points can be counteracted by employing roller conveyors for the curves, or another belt running at right angles.

SLAT APRON CONVEYOR

The slat conveyor is very often used where the product being conveyed is quite heavy, or where the deflection of the product to other lines might cause too much wear on a belt. The apron conveyor consists of a series of wood or metal bars supported at their ends by a moving chain. Such an arrangement is shown in figure 4.

DRAG CHAIN CONVEYOR

There is one type of conveyor which is used very extensively in the bottling industry in one form, and in heavy metal industries in another form. That type is the drag chain. In the bottling industry it consists of a series of plates attached together to form a continuous chain. These plates are so fitted together that they form a rather flat surface on which the bottles stand, and are so designed and connected that they may travel around curves. One of these conveyors is shown in figure 5. The advantage of such a drag chain lies in the firm support that it furnishes, and in the snake-like path which it can and must follow in automatic bottling machines.

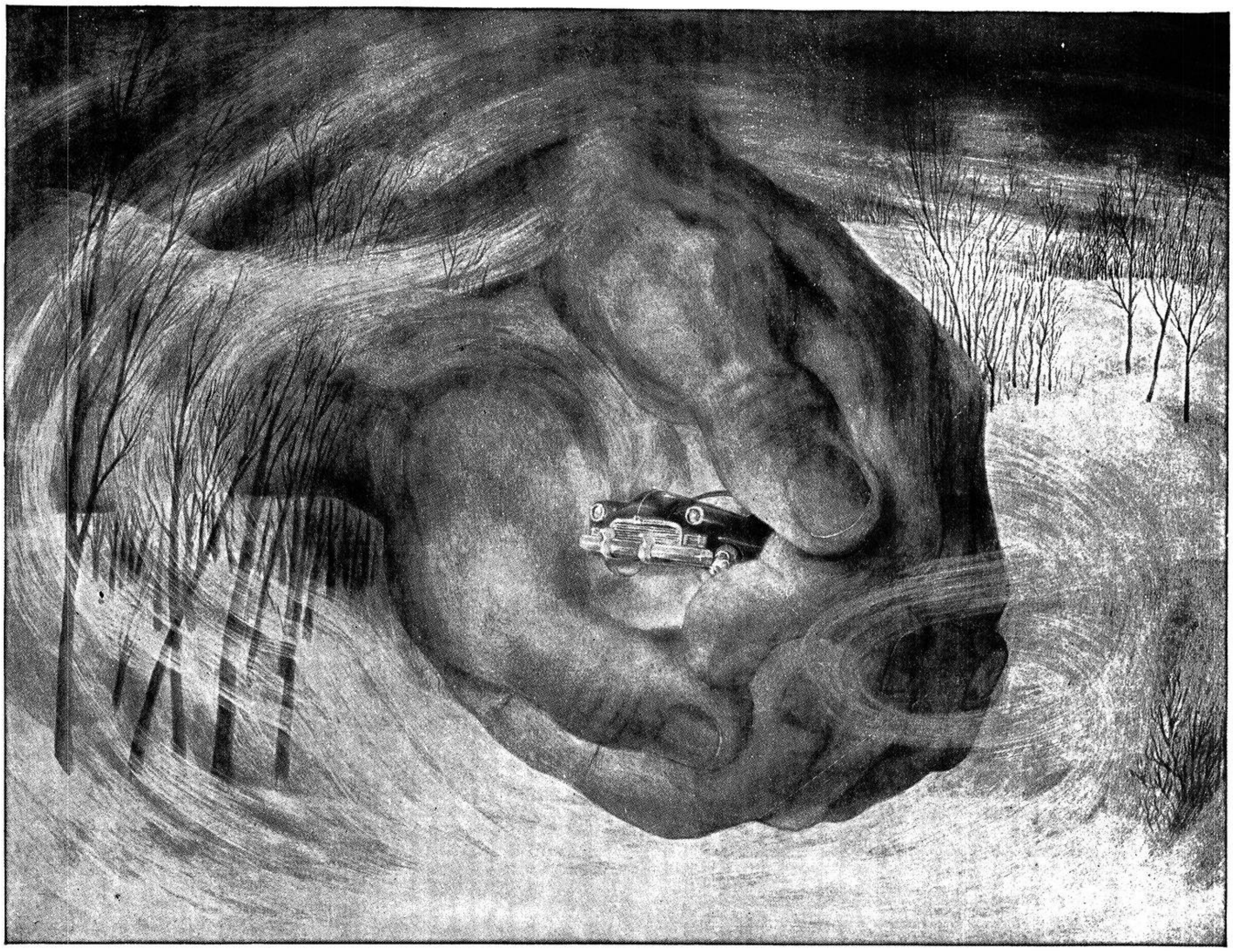
Heavy industries use the drag chain to move bars, sheet metal, and automobile frames through different operations of fabrication. For this use the chain is actually made of links with periodic insertions of "dogs." Figure 6 shows such a conveyor being used to move hot pipes from a furnace and holding them till they are cool.

PALLET CONVEYOR

The pallet type conveyor is a convenient method of carrying both small and large objects. It consists of a board like surface which is pushed or pulled along its route. The board may be supported on a roller conveyor, a drag chain system, or on a track as shown in figure 7.

The pallet dragged along a track by a power driven chain is useful in the handling of a variety of irregularly shaped or fragile articles. When handling assemblies, the pallet can be pushed along by hand to the different stages of work, as shown, or pulled continuously as is done in some aircraft work. When the pallet is not driven by a chain, the workman does not have to move with his work and can therefore do his job more easily. Another advantage of the free flow is that rejected pieces can be removed from the line more easily. Then too, the initial expense and the maintenance is very low.

(please turn to page 25)



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.

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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.

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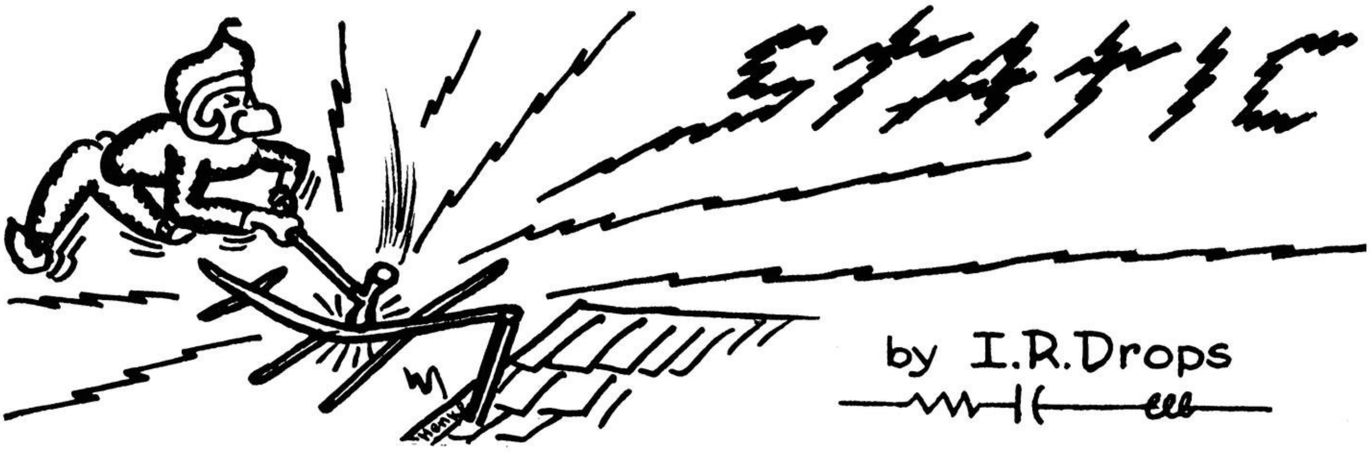


A frosh approached the cigar counter and said, "I usually smoke that brand in the can."

"And that's the best place to smoke them," replied the sweet young thing behind the counter.

* * *

I.L.S. Student: "I'm not feeling myself tonight."

One and Only: "You're telling me."

* * *

A group of Engineers was coming home from a party one night plastered to the gills. They came to the house of one of the fellows and called for the father. "Will you please do us a favor?" asked one. "What do you want?" replied the father. "Will you please come out here and pick out Johnny so the rest of us can go home?"

* * *

Pop Robin returned to the nest and proudly announced that he had made a deposit on a new Buick.

* * *

D.U.: Hey, don't spit on the floor.

Pledge: 'Smatter, does it leak?

* * *

Sergeant: "Where is the balance of your rifle?"

Frosh: "This is all they gave me."

* * *

A shoulder strap is a thin ribbon of material having both stress and strain, and is used to prevent an attraction from creating a riot.

* * *

An enemy, I know, to all
Is wicked, wicked alcohol.
The Good Book, though, commanded me
To learn to love my enemy.

Then there was the Chemical Engineer who died from drinking shellac. The boys all agreed that he had a fine finish.

* * *

"We'll have to rehearse that," said the undertaker as the coffin fell out of the car.

* * *

"This pen leaks," said the convict as the rain came through the roof.

* * *

A burlesque show is where the actresses assume everyone is from Missouri.

* * *

A spiritualist had a message from her husband to send him a package of cigarettes.

"Where shall I send them?" she asked a friend. "He didn't give an address." "Well," said the friend, "you notice he didn't ask for matches."

* * *

"Is that girl's dress torn, or am I seeing things?"

"Both, chum, both."

* * *

A drunk walked into an elevator shaft, fell four floors to the bottom, stood up, brushed himself off, and muttered: "I shaid UP!"

* * *

Confucius say—Aviatrix who fly upside down have bust up.

* * *

Then there was the young bride who casually commented that her husband never snored before they were married, and couldn't understand the roar of laughter that followed.

Lipstick is something which merely adds color and flavor to an old pastime.

* * *

A pink elephant is a beast of bourbon.

* * *

When they kiss and make up, the girl gets the kiss and the boy gets the make-up.

* * *

Early to bed and early to rise
And your gal goes out
With six other guys.

* * *

Then there was the girl who named her baby "Encore" because it wasn't on the program.

* * *

A married couple was sleeping peacefully when the wife suddenly shouted out in her sleep: "Good Lord! My husband!"

She was awakened by the crash of glass as her husband awakened with a start and jumped out the window.

* * *

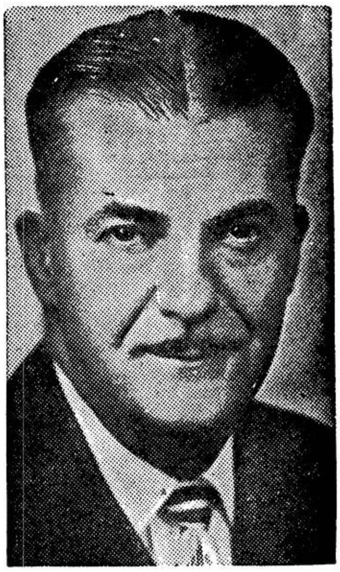
A quartet is where all four think the other three can't sing.

* * *

There once was a girl from Australia
Who went to the dance in a dahlia
But the petals revealed
What they should have concealed
So the dance as a dance was a failiah.

* * *

After a brief visit at a fellow engineer's home, Pat was amazed at how often his friend's grandmother read the Bible. Before leaving, he asked why the elderly woman took such a deep interest in the book. "Cramming for exams," was the reply.



Three slightly deaf men were motoring from the North to London in a noisy old car. Hearing was slightly difficult.

As they neared the city, one asked: "Is this Wembly?"

"No," replied the second, "this is Thursday".

"So am I," put in the third, "let's stop and have one".

* * *

Bell boy, knocking on door, in Southern hotel: "I've got a telegram for you, mistah."

Salesman: "Just slip it under the door."

Bell Boy: "I can't, mistah, 'cause it's on a plate."

* * *

A college boy after a good many years in the business world retired with a comfortable fortune of $60,000. He amassed this large sum through courage, enterprise, initiative, faithfulness, the careful investment of his savings, and the death of an uncle who left him $59,999.50.

* * *

Golf is like a love affair: if you don't take it seriously, it's no fun; if you do take it seriously, it breaks your heart.

Science . . .

(continued from page 15)

X-RAY MICROSCOPE

An X-ray microscope, which makes visible the internal details of materials, has been developed by scientists of the General Electric Company.

Clear, sharp X-ray images, magnified ten times have been produced in the laboratory, and these images have been further magnified by photographic enlargement. Higher magnifications are anticipated in the future.

The principle of operation is that X-rays can be reflected from polished surfaces, as can visible light, provided rays strike the surfaces at very small angles, almost parallel to the surfaces. The microscope consists of an X-ray tube and a pair of curved mirrors, which the X-rays strike at less than one-half a degree, after having passed through the sample. The mirrors bend the beams in such a way as to cast a magnified X-ray image of the sample on a photographic film. The mirrors are platinum coated slabs of fused quartz which are curved by mechanical pressure. The arrangement makes it possible to change the mirrors' curvatures in order to improve focusing.

The optical system is placed a few inches away from the X-ray tube, with the beam passing through the sample and its holder, then to the mirrors and finally to the photographic film which is located a foot or more from the unit.

CERAMIC DIELECTRICS

Rapid developments in the field of electronics have introduced operating conditions too severe for electrical insulating materials commonly used as dielectrics; therefore a systematic study of the variation in composition of ceramic dielectrics to their properties is being undertaken at the National Bureau of Standards.

Paper is a satisfactory dielectric for some types of capacitors, but at elevated temperatures it chars and fails. Ceramic dielectrics, however, not only withstand high temperatures, but have superior properties making possible smaller size capacitors.

One step in the development of miniature capacitors is the fabrication of ceramics in the form of thin plates of comparable thickness to that of paper and mica. The technique that has been evolved involves special treatment of the mixtures of calcines and bonding agent. The lumps in the mixture are broken by passing it through a fine sieve. The resulting powder is spread in a thin layer in a steel mold. The powder is then converted to a plate by a pressure of 20,000 psi. After the plates are ejected from the mold they are transferred to a sheet of glass for drying.

In order to preserve the flatness of the plates during the firing procedure, the plates are stacked and weighted while being fired. Firing for one hour at 1,445° C. results in finished plates.

Ceramic dielectrics are applicable to radio, radar, television, and hearing aids. Other investigators are examining the uses of ceramic dielectrics in problems that involve very high voltage, X-rays, and instantaneous photography.

ELECTRONIC TORCH

Hot enough to cut holes in firebrick and to melt tungsten, the hardest of all metals to melt, an "electronic torch" has been developed at General Electric Company. High-frequency radio signals and certain gases are combined to produce temperatures considerably higher than the melting point of tungsten, which is 3,370° Centigrade.

The heart of the torch is a tube known as a magnetron, which produces radio waves of a frequency of 1,000 megacycles per second. Leading from the tube is an antenna made of two short metal cylinders, one within the other. A high frequency arc can be made to form on the end of the antenna. If certain gases, among them nitrogen and carbon dioxide, are fed past the arc, the electronic torch results.

The high temperature produced on any surface placed in the jet is caused by the heat generated by the atoms joining together to form molecules. The molecules of gases composed of two atoms are broken into atoms by the high-frequency arc. These atoms join together again on any materials placed in the torch.

The electronic torch is still at the laboratory stage and its commercial possibilities have yet to be explored. The future does seem promising, however, for the electronic torch.

Conveyors . . .

(*continued from page* 20)

OVERHEAD TROLLEY CONVEYOR

Up to this time all of the conveyors mentioned have had designs which ordinarily employ support from the floor. All such systems must therefore take up a considerable amount of working floor space, and may occasionally develop into obstructions to cross travel. For this reason the overhead type of conveyor is used very extensively in industry.

The major parts of the overhead trolley are a track supported from the ceiling, and a series of ball bearing trolleys which carry an endless power driven chain. The object carried is supported by hooks or pans suspended from the trolley.

The overhead system is a very flexible arrangement since one unit can be constructed to wind back and forth around a plant for thousands of feet. The trolley can be made to travel close to the ceiling and then drop quickly down to the working level and then up to the ceiling again to give maximum clearance for other work. The conveyor often acts as a temporary storage between operations, and sometimes it is almost a part of the operation itself as in paint spraying (figure 8) and pickling.

This type of conveyor is one of the most expensive to install and maintain, but this expense is more than offset by the steady noninterfering flow of materials which it supplies. The daily power cost is surprisingly low, as it also is for other systems, and in one instance amounted to only 10 cents an hour to operate a 3 horse power motor which was driving a 1600 foot chain (Lamson Corporation).

PUSH BAR CONVEYOR

Very often it is necessary to move materials up to a higher level. In some instances this handling can be done by a belt conveyor, but often the slope is so great that the objects lifted would tend to slip back or tip over. One method of getting a package up quickly is to arrange power driven push bars over a conveyor. One such conveyor is shown in figure 3. Rather steep ascents can be made with such a system, and sometimes products can be lowered as well as raised.

ARM CONVEYOR

A variation of the push bar conveyor is the arm conveyor. This type consists of a power driven arm which completely carries the weight of the object being raised. Figure 9 shows such a conveyor being used to raise heavy bags. In this instance the rise is not perpendicular as is often the case. It can be seen that this type of conveyor is very easy to load and unload, and in some instances these operations are handled automatically from one conveyor to the next.

PORTABLE CONVEYORS

There are many occasions that arise where it is advantageous to have a portable conveyor; e.g., for shipping and receiving, for stacking, and for temporary or short term lines. The simplest form is probably a lightly constructed roller or wheel conveyor. This form can be moved about quite easily on the back of a delivery truck. A more complex type is that of a belt conveyor built on wheels. Such a conveyor can be used to carry boxes to the top of stock piles, load and unload trucks, etc. Still a third and most unique form is that of the accordian roller conveyor as shown in figure 10. This coveyor can be very useful to the payout department for it can be compressed short or extended to two and a half times the short length, or it can be laid down straight or curved.

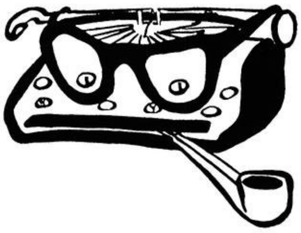
BALL TRANSFERS

Sometimes it is necessary to handle large sheets of metal as in the working or metal on punch presses. The handling of this metal can be made very easy by employing a field of ball transfers in the working area as shown in figure 11. Such a system of ball bearings allows the work to be fed to the machines from almost any angle and on a noninterfering support. This type of support can also be employed in lines where an object is fed at an angle from one conveyor to another since there is no resistance to motion in any one particular direction.

PNEUMATIC TUBES

There is a phase of manufacturing, other than the handling of the product itself, which can profitably use

(*please turn to page* 32)



A Guest Editorial

by Fritz Kohli

The Way We See It

Wilson Burned in Lab Mishap

Robert B. Wilson, a junior mechanical engineering student, received second and third degree burns on his scalp, arm and hand in an accident which occurred in the foundary laboratory on Dec. 14, 1949.

Wilson and another student were removing a sixty-five pound metal ladle, containing molten iron, from a furnace while their instructor was tapping the cupola· The accident occurred when another student dipped a sampling ladle, containing traces of moisture, into the large ladle. The moisture flashed into steam, causing a violent eruption of the molten iron which splashed Wilson on the head, arm and hand. The student with the sampling ladle was also hit in the eye by the metal but was protected from injury by the goggles he was wearing.

Resisting the natural impulse to drop his end of the ladle upon being burned, Wilson held on until the ladle could be set down without spilling its contents. By this time his hair and shirt were ablaze and the molten iron had caused deep burns. By his action, Wilson probably saved himself and those around him from much more serious injury if not death. Had the molten iron spilled on the concrete floor, the violent reaction between the two would have caused the entire contents of the ladle to be splattered with considerable force.

This accident brings to attention a rather serious need for financial protection for the students and instructors engaged in laboratory operations involving some degree of danger.

In this case the student was bedridden for three days, suffered partial immobility of one arm for at least a month, and partial immobility of his other hand for about two weeks.

Under the present laws, the state and university have no provision for insurance or financial compensation for injuries incurred in laboratories except by special legislative action on each individual case. The injured student's only recourse to this would be to take court action against the person directly responsible in the laboratory at the time of the accident. This would in most cases prove highly unsatisfactory· If the case was decided against the plaintif, he would merely incur additional expense, and if decided for plaintif, the financial burden would merely be shifted to someone to whom it would be equally hard to bear.

In many cases, students are injured due to their own inexperience, which could legally be defined as negligence. This would leave them entirely without a chance for compensation for serious and costly injuries.

Legislative action providing for a university wide compensation program for injuries incurred in laboratories and similar hazardous places of instruction would be one answer to this situation. If the state would not accept the responsibility for injuries incurred under these conditions, perhaps a group insurance plan provided for by laboratory fees would be possible.

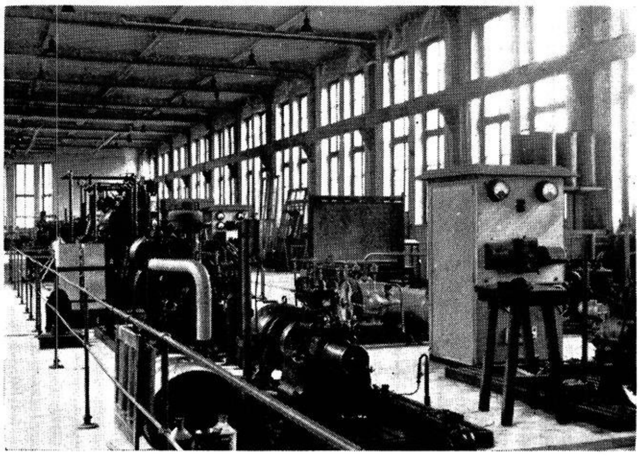
By what ever means it is accomplished, the important thing is to provide adequate protection for those persons working under the hazardous conditions which are inherant in most all laboratories.

(*Foton photo*)

Bob Wilson after accident.

Ingenieuren Schule . . .

(*continued from page* 14)



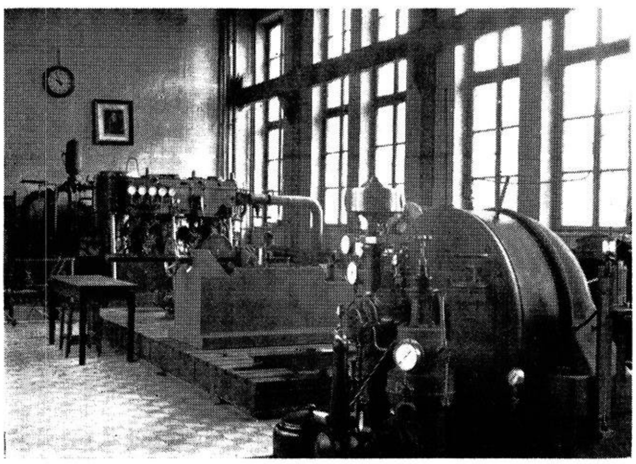
View of the electrical engineering lab.

stood what he's been told and that he is able to apply his knowledge.

That much about the Engineer School, and now a few words on the "Bauschule", a school which trains the steel and concrete construction people. The curriculum covers five terms, and there are different classes in construction engineering, architecture, and surveying. At the end of each course, there is a state examination similar to th Engineer School. Those fellows do all sorts of steel construction; such as, homes, bridges, and industrial buildings, as well as concrete construction like roads and bridges.

The "Wagenbein-Schule" is devoted to the education of technicians in automobile building, as well as train cars and the rolling stock of railroads.

This I hope may give an idea of the technical education in Hamburg. It is certainly not a complete list of all technical schools; there might be some more private training schools around here, but those three institutions mentioned above are the most important ones.



Machine testing laboratory of the Ingenieur Schule.

Judge: "You admit you drove over this man with a loaded truck?"

Engineer: "Yes, your honor."

Judge: "And what have you to say in your defense?"

Engineer: "I didn't know it was loaded."

* * *

"I wish we'd get a few shipwrecked sailors washed ashore," mused the cannibal chief. "What I need is a good dose of salts."

* * *

"I suttinly hopes I'se sick," groaned Rastus. "I'd sho' hate to feel lak dis when I'se well."

* * *

Little boy: "May I kiss you, Mary?"

Mary: "Not yet, I have scruples."

Little boy, throwing out his chest: " 'S'all right, Mary, I've been vaccinated."

* * *

"What's a Grecian urn, Daddy?"

"I dunno; I guess it depends on what he does."

* * *

His wife lay on her death bed. She pleaded: "John, I want you to promise me that you'll ride in the same car with my mother at the funeral."

He sighed: "O.K., but it's going to ruin my whole day."

* * *

A good listener is not only popular everywhere, but after a while he knows something.

Flaw Detection . . .

(*continued from page 11*)

magnet while the energizing current is on. The test is then completed by applying the ink and depending upon the residual magnetism to locate the defects.

Another method of magnetic fault detection was patented by C. Kinsley and later by T. Zuschlag. This magnetic analysis apparatus is a comparison system in which a steel part is compared magnetically with another standard sample. The circuit diagram of this system is shown below. A_1 and A_2 are two coils forming the primary winding of two transformers. These two coils are identical and contain the same number of turns. They are connected in series so that the same alternating current flows through them. B_1 and B_2 are two small secondary coils which are placed within the primary windings. The secondary coils are also exactly alike and are connected in series. However, these coils are connected in opposition, and when a current flows in the primary winding, the emf's induced in the secondary windings oppose each other. If the magnetic cores in each of the transformers are identical no current will flow in the secondary circuit. Thus with a perfect core in one transformer, the other one can be assumed to be perfect if no current flows in the secondary windings when the test is made.

The output from the secondaries is connected to an indicating device which may be an oscillograph or delicate relays for operating with very low voltage.

When testing steel bars, a short length of the bar is placed in the center of coil A_2. The bar is shown at D, and as it remains within the coil, it is enclosed in a tubular casing through which water is passed slowly to keep the metal cool. This bar can be regarded as a standard and it is supposed to be free from flaws. With the standard bar in coil A_1 and nothing in coil A_2, a current will flow in the secondary circuit due to the greater permeability and resulting greater amount of flux present in the standard bar. The indicator will register this current. If a similar bar is now placed in coil A_2, the indicator will return to its zero current position. The bar being tested is usually passed through coil A_2 and the indicating device carefully watched.

If the indicating device is an oscillograph, a curve can be made which will show the position and growth of secondary current as a fault passes through coil A_2. Different classes of steel will produce different shapes of curves, and the various grades can be classified or sorted by passing them through this apparatus. Even a change of composition in a given bar will show up on the oscillograph curve. A crack will produce such an impulse of current that the curve will go right off the scale.

When an oscillograph is used to measure the current in the secondary circuit, it is usually too sensitive for commercial use. This difficulty has been overcome by using sensitive relays to replace the oscillograph. Other circuits have regulating potentiometers to regulate the sensitivity and cut out undesirable impulses.

After the ink has been applied and observations made, the residual magnetism must be removed from the part tested. Unless this magnetism is removed, the part probably can not be taken from the magnetizer. Magnetized parts also collect iron dust which may get into the bearings of a machine. Aircraft parts which affect navigating instruments must be completely demagnetized. Most of the residual magnetism can be removed by reducing the current to zero and then reversing it slightly. This can be done with a potentiometer or a bank of condensers in the circuit. To demagnetize the part completely, it is gradually drawn through a coil in which alternating current is flowing.

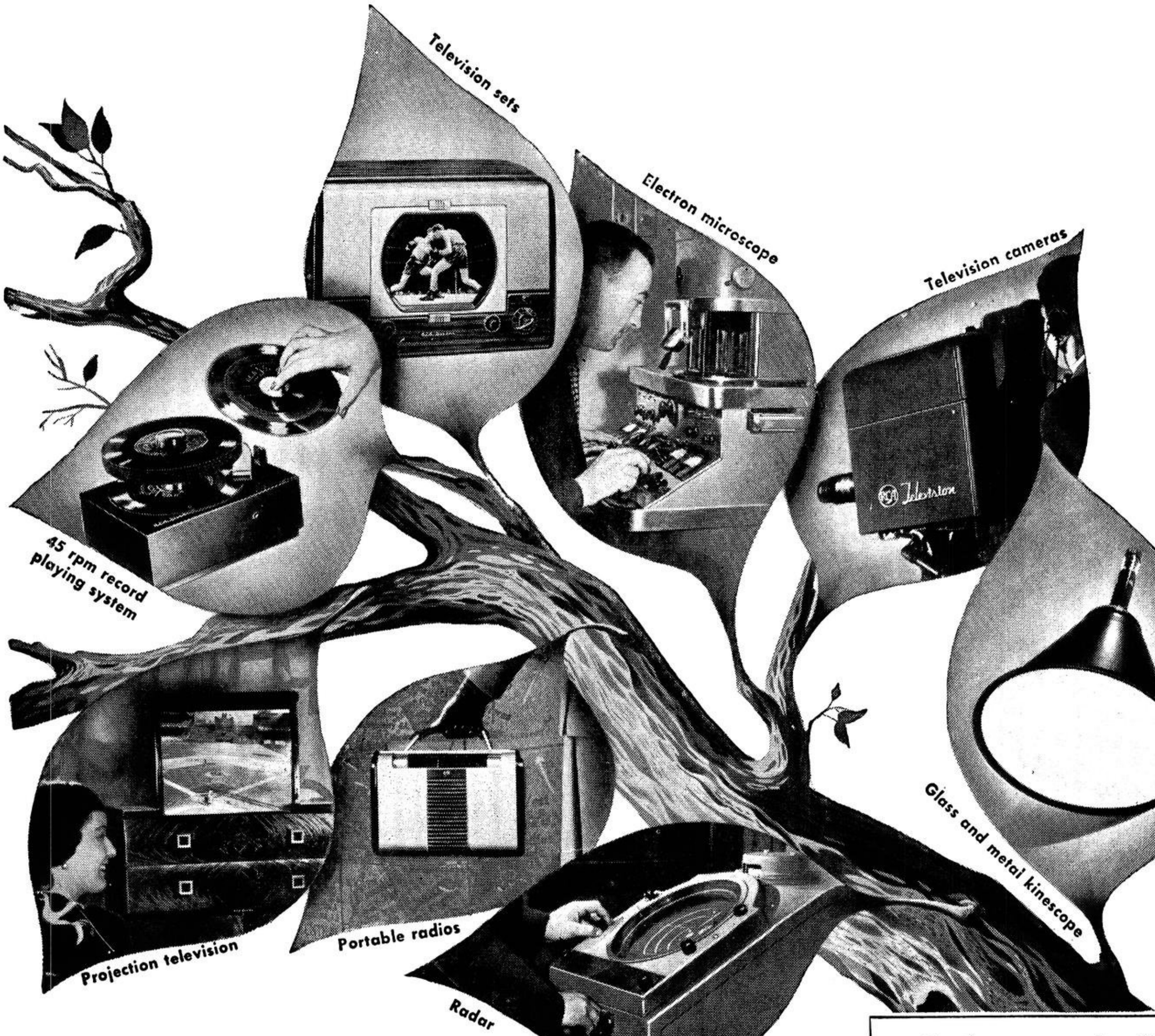
References:
Magnetic Crack Detection, Swift
Magnetic Tools and Applications, Molloy

* * *

A little man came into the office of a psychiatrist. "I was wondering," he said timidly, "if you couldn't split my personality for me."

The doctor looked puzzled. "Split your personality? Why would you want that done?"

Tears tumbling down the little man's face, he wailed, "Oh doctor, I'm so lonesome!"



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J. W. Watson . . .

(*continued from page* 13)

Swenson of the EE department was injured in the famous "Iroquois Theater" fire in Chicago, and Watson was called upon to assume his entire teaching schedule. This was, of course, a huge task for someone with only a few months' teaching experience and without adequate time for preparation. In fact, Watson had not yet taken himself some of the courses he was to teach, and consequently spent many long evenings mastering these subjects.

He continued teaching until about mid-way in the second semester, when Swenson had recovered sufficiently to resume his teaching duties. Mr. Watson went back to the dynamo lab, but took over Swenson's classes whenever he was absent to work on the forth-coming St. Louis Exposition.

Due to the repeated requests of Mr. Jackson, and Swenson's request for a leave of absence, Watson continued teaching. Swenson resigned after his leave of absence and Mr. Watson, who had now decided to continue in the teaching profession, remained on the engineering staff. In 1908 he became an assistant professor.

On Sept. 12, 1910, James Watson was married to Edith Churchill (class of '08—U. of W.). They have four sons, all of whom have done well in their respective fields. Charles C. Watson, Ph.D., is an associate professor in Chemical Engineering at the University of Wisconsin. Dr. Robert W. Watson is a pediatrician in Pasadena, Calif. James Watson, Jr., a mining engineer, is Area Production Geologist for the Mississippi district of the Shell Oil Company. Richard Watson is in the traffic department of the Wisconsin Telephone Company at Milwaukee.

James Watson became an associate professor in 1920 and a full professor in 1928. He is a member of Tau Beta Pi, Eta Kappa Nu, Kappa Eta Kappa, AIEE, and various other engineering and fraternal societies.

For many years, before the placement bureau was organized, he was in charge of placement for graduating Electrical Engineering students. He was called to head the Electrical Engineering department during the last war and served commendably.

June, 1949, saw the end of one of the longest teaching careers in the history of the University of Wisconsin, a period of service to the University and its engineering students that will long be remembered.

Conveyors . . .

(*continued from page 25*)

a conveyor system. That phase is the distribution of the many papers, blueprints, samples, specimens, and other small items that go directly or indirectly into the making of the final product. Many evasive hours are lost to this factor in an organization.

Many progressive companies have come to see that there is much to be saved by transporting these comparatively small items through pneumatic tubes. Such a system is composed of a number of evacuated tubes which lead between the different divisions of a company to a central dispatching office. When a message is to be sent, it is enclosed in a container and shoved into the nearest tube. The container is quickly sucked along the tube to the dispatching office, and there it is placed into a second tube which will carry it to its final destination. A central office is shown in figure 12.

One of the first advantages of this system is that there is a very definite saving in man hours and expenses for transporting an article. A second advantage is that there is a shortening of the time lapse from one stage to another so that a job may be finished in an overall shorter period of time. And thirdly, the time of the second or third workman involved in the operation is not wasted in waiting.

Briefly, the major types of conveyors have been introduced. It should be remembered, however, that all of these systems require some maintenance and power, and have an initial expense, all varying to a greater or lesser degree. All factors must be considered when making a choice of conveyor, and when that choice is made, it must be seen that proper care is given to the system if it is to last its expected life without production tieups.

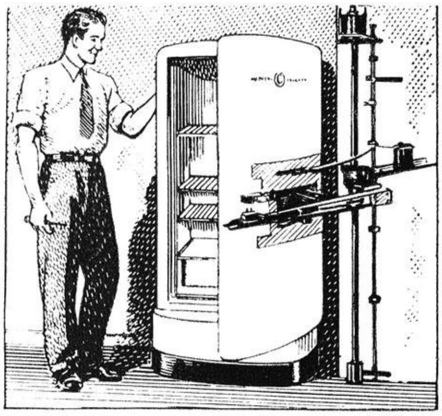
Costs can be cut with conveyors. The Metzgar Co. has this to say about a system they devised for the American News Company, for the handling and filling of book orders (figure 13):

"This small part of their business runs into about four million dollars' worth of books going to libraries, book stores, stands, etc. The books through their whole system are arranged alphabetically according to titles, grouped according to author and also according to publisher. It is a very interesting layout because orders must be filled out of a stock of around 50,000 items of books.

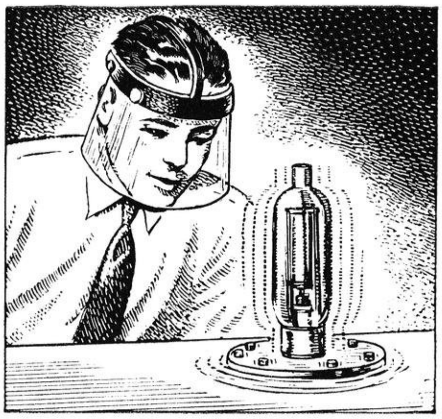
"The fibre boxes shown in the photograph carry the order along the inside to certain 'stations,' at which place a man is required to put in books from his group of shelving. He has perhaps a thousand different items which might be called for on this order. He puts in what is required and passes the fibre box on to the next station, where the man in charge goes through the same process just completed, etc., until the order is filled.

"This installation cost over $12,000.00, but in comparison to the old method of running around with each order through a myriad of shelving, it is figured then new conveyor will pay for itself in less than a year.

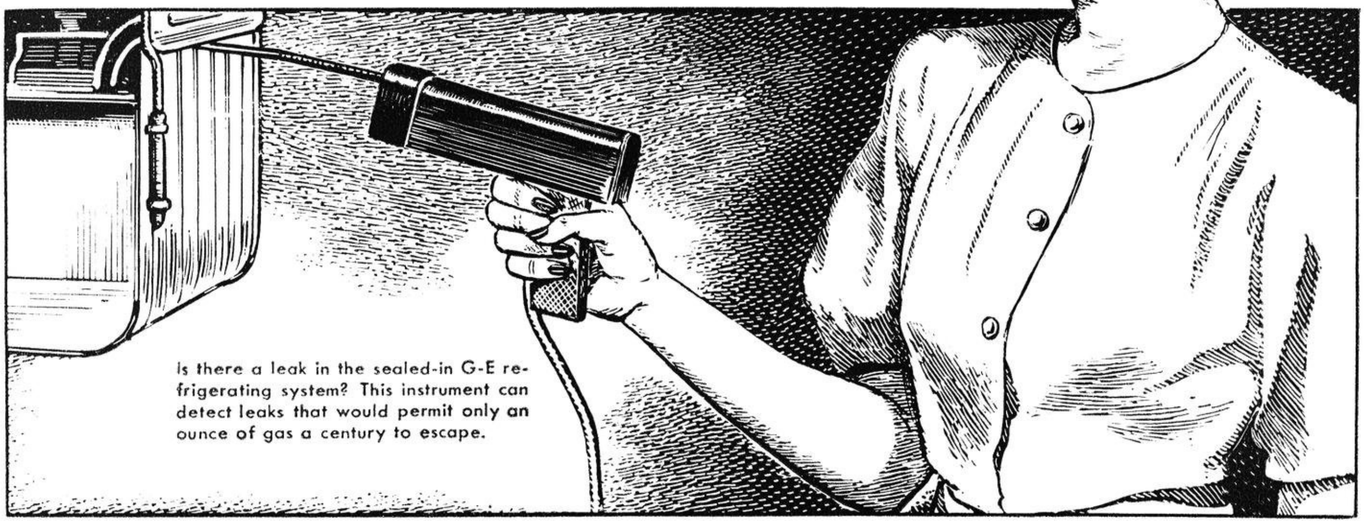
"Maintenance on the installation will be practically nil. Similar installations have been in service twelve years or more without any cost of repair."



Will refrigerator doors stand up to years of slamming? This device slams them 350,000 times, equivalent to 25 years' average use.



Will vibration harm tubes for aircraft radio? G-E engineers developed equipment to shake them 25 times a second for 100 hrs.



Is there a leak in the sealed-in G-E refrigerating system? This instrument can detect leaks that would permit only an ounce of gas a century to escape.

These were also tough tests for G-E engineers . . .

A LEAK that would take years to deflate a tire is big enough to cause trouble in the cooling system of a refrigerator. How to devise test equipment sensitive enough to catch such microscopic flaws and eliminate them from General Electric units was also a tough test for engineering skill and ingenuity.

But the G-E engineer in search of solutions makes use of the stream of new ideas flowing from industry's largest technical staff—the more than 9000 scientists, engineers, chemists, physicists, and mathematicians employed by General Electric.

The principle for the new electronic leak-detector now being used to check refrigerators came out of the G-E Research Laboratory. Further development of it was carried on by the General Engineering and Consulting Laboratory. It was applied to refrigerator testing by engineers in the Company's Erie, Pennsylvania, plant.

To the consumer, this sort of teamwork means better, more dependable, longer-lasting General Electric products. To the engineer it means more varied opportunities, quicker development, the advantages of belonging to an organization where emphasis on research and incentives for creative thinking are the tradition.

You can put your confidence in—

GENERAL ELECTRIC