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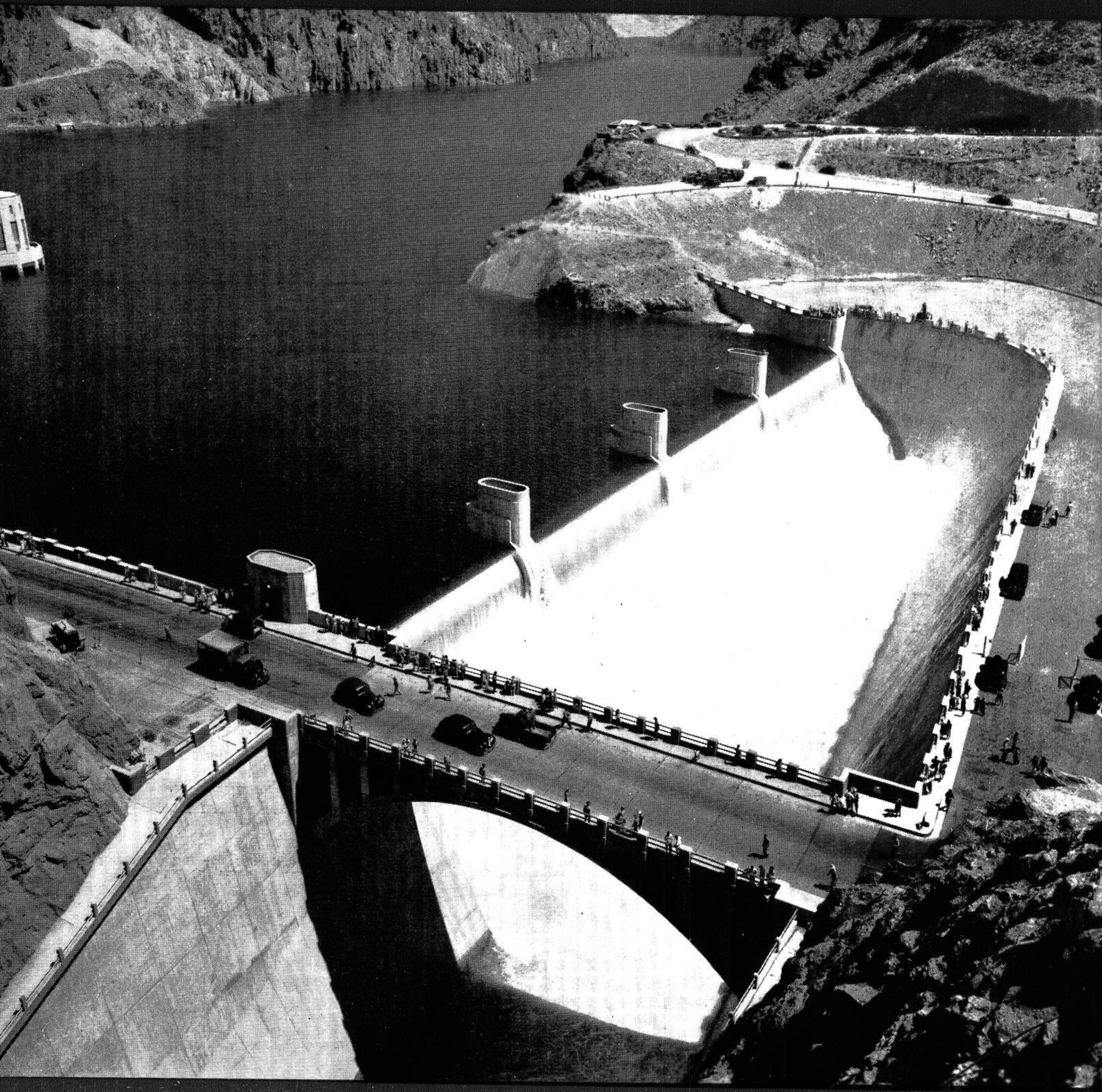
WISCONSIN ENGINEER

September, 1944



EMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

KEEPING UP WITH *Electricity*

BUMPLESS RIDES in trains and automobiles are forecast, because of a new-type stabilizer. Present job of the stabilizer is to make it possible for American tanks to fire with deadly accuracy, even when traveling at full speed over rough terrain. No details until after the war, but it is another of the many Westinghouse wartime developments with peacetime applications.

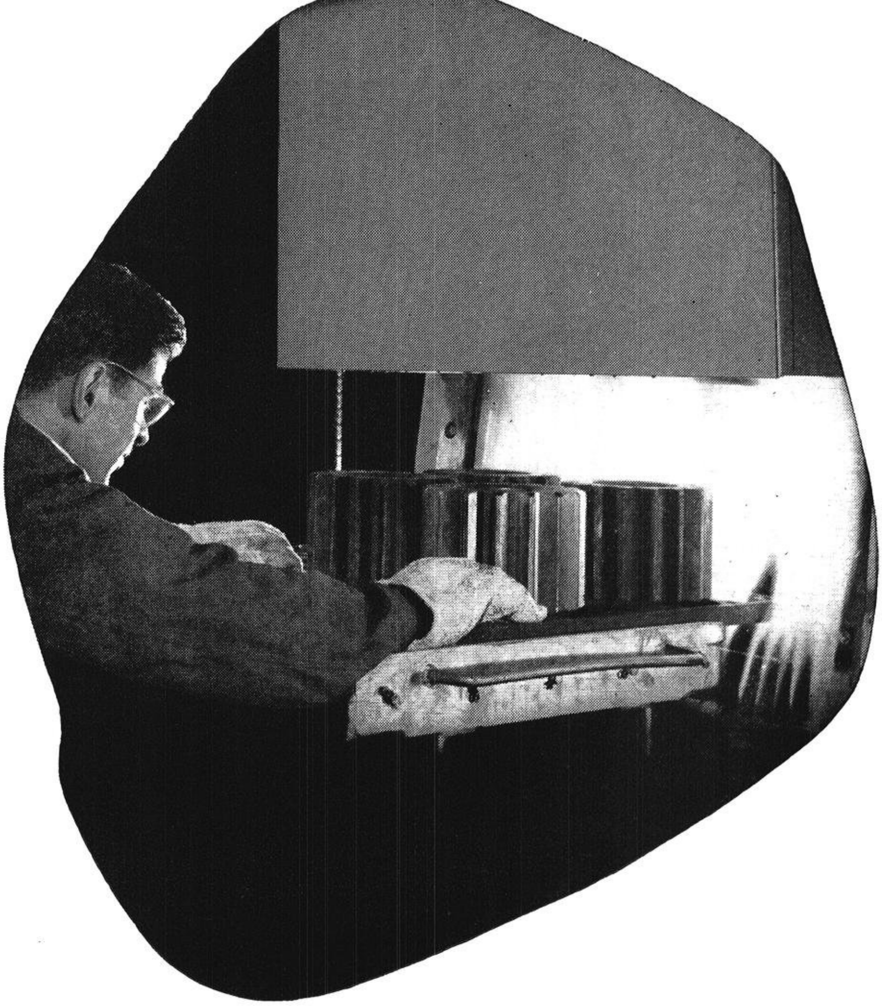
LIGHTNING UMBRELLA. A wire stretched over the top of a building, then grounded, forms a better protection against lightning than the old-time lightning rod, the Westinghouse High-Voltage Laboratory finds. Effect is like an umbrella, keeping the bolt entirely away from buildings where even the slightest spark might be dangerous.

THIMBLEFUL OF RECTIFICATION. Copper-oxide rectifiers are usually associated with high-current applications, but one type used in high-frequency instruments is rated at one milliampere—at one volt. It is 3/32 of an inch in diameter; a bank of four in their Micarta housing can be covered by a thimble.

OUTDOING THE LAC BUG—Shellac is produced by an Asiatic insect familiarly known as the lac bug. When the greater part of the world's population of lac bugs fell into enemy hands, this important plastic was cut off from us. Westinghouse research men then created synthetic molecules almost identical with the molecules of shellac. This new material is an even better shellac for many uses than shellac itself.

• • •

Let us send you a free copy of the new booklet, "Books by Westinghouse Authors." Titles listed are not only in the fields of Electricity and Electronics—many of them standard texts—but also cover a wide variety of other subjects, from Astronomy to Sales Engineering. Ask for booklet *UWE94*



Handcuffs for escaping carbon

Airplane propeller speed-reducing gears must be *tough and strong* to withstand the terrific punishment of long flights over enemy territory.

Westinghouse research engineers have found a way of toughening these gears so that *their former life expectancy is doubled.*

These engineers developed a process of heat-treating the gears in an *Endogas** atmosphere that prevents the escape of carbon from the steel parts.

Ordinarily, in a heat-treating furnace, the carbon-hungry oxygen actually *devours the carbon* on the outer skin of the steel, softening the surface and depositing a layer of scale.

In a furnace employing an Endogas atmosphere, any carbon which may escape from the steel is instantly replaced. The carbon content is undisturbed. Furthermore, no scale is formed—thus reducing, and in some instances, completely eliminating the cost of finish machining of Endogas-treated parts.

Another example of how Westinghouse research helps America outproduce all the Axis powers combined! Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.

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In This Issue . . .

COVER . . .

Lake Mead, the 115-mile reservoir behind Boulder Dam, is full to overflowing in this photograph. Recently, the world's largest man-made lake charged over the crest of the concrete spillway for the first time. The overflow furnished the initial test for the safety-troughs which carry the water through tunnels, around the dam, and back into the Colorado River below.
Courtesy General Electric

FRONTISPIECE . . .

Testing to assure that the porcelains will withstand the specified voltages before permitting arcs, and also that flash-overs as shown here leave no impairment of dielectric qualities.
Courtesy Westinghouse

THE QUARTZ CRYSTAL

by K. E. Palm

THE quartz crystal is the heart of communication. Due to the war it has become more important than ever. Without the crystal, it would be impossible to carry on dependable communication which would obviously cripple all large-scale troop movements. There is no question about it. The crystal ranks with the most important of war equipment.

But the crystal is also used in other applications besides in war-time communications. During World War I, it was used in oscillators producing supersonic waves for the detection of under-water craft. And as the art of radio developed, crystals were used more and more for keeping the frequency of transmitters and receivers constant. In the field of telephony, crystals are used in filter circuits which make it possible to transmit many telephone conversations simultaneously over a single conductor.

Other applications of the crystal are many. It is used in some electronic devices in the field of medicine. The diathermy machine is a well-known example. The crystal can be used for producing homogenized milk, acceleration of chemical reactions, underwater signaling, etc.

In industry, the crystal is used for precision timing (more accurate than measuring by the sun), pressure gauges, high frequency generators, and many other measuring devices.

It is in the last few years that the crystal has really proved its worth. The needs of the war with emphasis placed on electronics and radio has shown this to be true. With almost every piece of combat equipment requiring a number of crystals, the demand for this unimpressive looking little object has risen tremendously. With this increased demand for the crystal has come a great increase in the knowledge and use of the crystal. Consequently new methods of mass production had to be developed.

Many men in the field of electronics and communication predict that after the war, the demand for the crystal will not decrease but will still increase. This will be due to the desire of the people to have everything done for them easier and faster. Electronics will do this. Such things as communication by radio by a set which can be carried in the pocket, heating buildings by radio, instantaneous cooking of food with high frequency currents, etc., may seem a little far-fetched at the moment. But some such things as these were in actual production before the war. Devices like these call for high frequency generators. Today the only practical inexpensive way of keeping these generators at a constant frequency is by the use of the crystal.

Crystals have to be made to a specified size within millionths of an inch. As much care goes into the finishing of a crystal as the finishing of a precious stone. This of course makes the price high. But due to methods of mass production developed in the last few years, crystals can be produced at a fraction of their former cost. This lower cost will make the crystal applicable to such things as home receivers. The output of the receiver will be more constant and the tuning more accurate.

The raw supply of the quartz for the producing of crystals comes principally from Brazil. It is mined in large open-pit mines entirely by hand labor. Considerable care must be exercised in this mining process since the quartz can be easily damaged. Quartz is a compound of silicon and oxygen and is very hard. Much of this quartz is shipped to various plants in the U. S. by plane where it is sorted and finished.

A regular piece of quartz is hexagonal in shape with pyramidal tips at each end. Quartz has a definite atomic structure since it is a true crystal. In the natural state, the quartz piece has three axes—the X, Y, and Z which are respectively the electrical, mechanical, and optical. The Z axis goes through the quartz piece lengthwise; the Y axis is perpendicular to the Z axis and a face; and the X axis is perpendicular to the YZ plane. These axes can be determined within a few degrees in cases of quartz having natural faces. X-rays and polarized light are used in determining the exact axes. The methods by which this is done are too complex to go into at this time.

After the axes have been determined, the quartz is cut to the desired size and angle depending upon the frequency and the desired temperature coefficient. A blade charged with diamond dust has to be used for cutting since the quartz is so hard. After every few cuts, the

(Turn to page 22)

ELECTRIC SHOCK and

THE EFFECTS of electric shock upon the human being and upon animals is a subject upon which little investigative work has been done. With the advent of the electric fence, one of the few applications in which electric shock is used deliberately, the response of the human being to an applied electromotive force is gradually being determined. This article will describe first the general effects of electric shock upon the human being, and present secondly a more intensive treatment of the electric fence controller principles and functions.

In 1789 a stage carpenter at Lyon, France accidentally touched a 250 volt line and produced the first recorded death due to electricity. Since that time the death rate due to accidental electric shock has risen until at present it is 1 per 100,000 per year.

Death by electricity is due to three fundamental causes: a cessation of respiration due to a block in the part of the nervous system causing breathing; a serious reduction of the circulation of the blood due to ventricular fibrillation of the heart; or an overheating of the body. The second of these is the most dangerous for there is no practical way in which to bring a fibrillating heart into a normal beat. Of course, combinations of the three effects or complications may be present in causing death.

A popular misconception among engineers as well as laymen is the idea that the voltage of the circuit is the determining factor in causing death. It has been found that the amount of current passing through the body is in direct proportion to the severity of the shock. The great variation in effect of a shock from one voltage, which may range from a slight tingle to a lethal dose, is due to the variation in body resistance. The resistance of the body varies from 1000 ohms when wet to 500,000 ohms when dry.

The body resistance is made up of the skin resistance and the internal resistance. The former is usually very high when the skin is dry (70,000 to 100,000 ohms per sq. cm.) but falls to less than a hundredth of this when wet. The internal resistance is always low because the tendons, muscles, and blood are relatively good conductors. A high voltage shock usually produces serious burns because the outer skin is punctured and the body resistance falls from a high value to the low value of the internal resistance.

The effects produced in the body as a 60-cycle current is slowly increased have been fairly well determined. At one milliampere the threshold of perception is found, that is, the first effects of current are felt. From 1 to 8 ma are perceptible, but not especially painful. Currents of 8 to 15 ma are painful, and cause involuntary muscle contraction. When 15 to 20 ma are reached, pain with involuntary muscle contraction is produced, and loss of muscular control occurs. Currents of 20 to 50 ma will have the same effects, and, if the chest muscles are involved, will cause difficulty in breathing. From 100 to 200 ma will produce ventricular fibrillation of the heart, and 200 ma and up will cause burns, suspend heart action if the heart is involved, and produce respiratory block if the lungs are involved. Artificial respiration may produce resumption of breathing, even after as long as eight hours. If the damage to the respiratory system is severe, breathing may be suspended indefinitely.

Ventricular fibrillation is an uncoordinated contraction of the various heart muscles, making the heart useless as a pump. The heart beat, consisting of the contraction of the auricles, followed by the contraction of the ventricles, is entirely disrupted, and the distribution of blood throughout the body ceases. The possibility of producing fibrillation varies with the magnitude of current passing through the body, reaching a peak at about six amperes and dropping off as the current increases. It also varies with the duration of shock, being greatest when the length of shock is approximately equal to the length of heart beat, and with the part of the heart cycle in which shock occurs, (providing the shock is short in duration compared to the heart cycle) the heart being most sensitive to fibrillation when the muscles are relaxing after contraction.

In the case of a respiratory system block, the nerves are paralyzed by the currents and no longer control the lungs. The lack of oxygen which follows the cessation of breathing produces first unconsciousness, and, after 5 to 8 minutes, damages the brain so that the mental capacity is seriously impaired upon recovery. If damage to the nervous system is not too severe the block will pass

the ELECTRIC FENCE

by Otto Schreiber, ee grad

away and the person will resume breathing, provided oxygen has been furnished the vital cells of the body by artificial respiration.

The third effect of electric shock, heating of the body, produces internal changes in the body, results of which are still somewhat obscure. Visible evidences are destruction by heat of some vital organ, hemorrhages, or third-degree burns. The production of heat in the body is much more prominent at high frequencies. Above 100,000 cycles it is about the only effect produced by current.

In cases of electric shock it is well always to apply artificial respiration until either recovery or rigor mortis occurs. In the case of fibrillation the work will be in vain, but the body can often be tided over until a simple respiratory block is broken. Never handle electric circuits with wet hands or when the feet are wet. When freeing a victim from a live circuit, and no other method is available, use your foot instead of your hands. The old rule of keeping your left hand in your pocket when handling high voltage circuits is still the safest.

In 1934, E. J. Gengler of Brown Deer, Wisconsin was granted a patent on a fence charger consisting of a small light bulb and a flasher in series with the 115 volt a-c power line. This was the beginning of electric fencing; it is estimated that there are over 300,000 units now in use throughout the country. Because the controllers depend upon an electric shock, all the effects described above may be present if the fence is contacted by a human being. In the early days of electric fence controllers, no safety limitations were imposed on the manufacturers and the current output was adjusted by guess—usually by holding the output terminals to feel the shock. This haphazard policy led to human and animal fatalities, which in turn led to the formulation in 1939 of two safety codes, the National Electric Safety Code, and the Underwriters Laboratories Standard for Electric Fence Controllers. Wisconsin, Oregon, and Connecticut adopted legislation providing for enforcement of selected parts of these codes. For sale in Wisconsin, the controller must be approved by the Industrial Commission of Wisconsin, this approval being based upon suitable tests carried out in the Electrical Standards Laboratory at the University of Wisconsin and in other approved laboratories in the United States.

By the very nature of the electric fence, it is apparent that a fence controller cannot be designed which would be absolutely safe for all human beings because of the variations in physical condition of individuals and the widely differing conditions under which contact and shock occur. As examples: an individual with a weak or diseased heart may die from over-excitement, intense emotion, fear, or the shock of injury caused by electric shock, although the electric current involved may have been known to be safe for normal individuals; also, a seven year old boy was electrocuted when he slipped off a reservoir discharge pipe into the water at the same time clamping his arm over an electric fence. The fence controller had been approved and was installed normally, yet the unusual circumstances under which the contact took place were too favorable for electric shock to allow the boy to escape with little injury. The codes have been drawn up to prevent accidents under normal circumstances and to normal human beings and cannot provide for out-of-the-ordinary circumstances as described above. Information upon the amount of current deadly to man has been obtained from experiments upon animals such as rats, guinea pigs, and dogs, and upon human beings. The experiments upon human beings have not been carried to the extreme of danger to life, but consist in finding the "let-go" current, the current at which an individual can no longer release himself from contact with the fence.

In order to facilitate discussion of the types of fence controllers in common use we will classify them as follows:

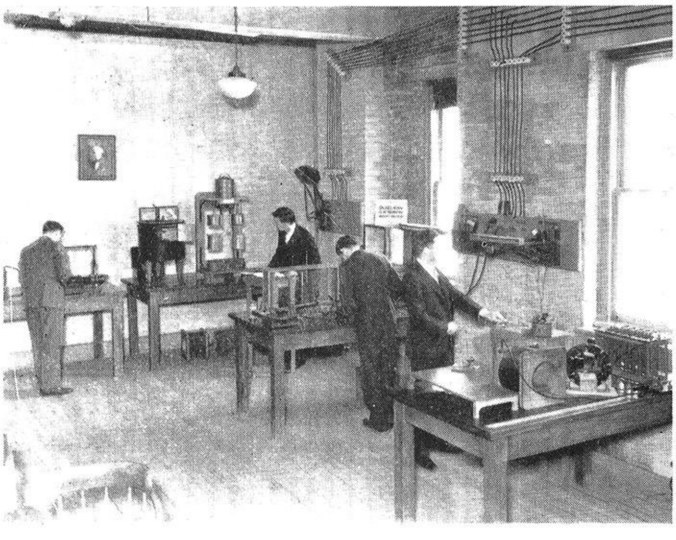
- I. Non-interrupted
  - a. Non-interrupted alternating current
  - b. Non-interrupted direct current
- II. Intermittent
  - a. Interrupted alternating current
  - b. Capacity discharge impulse
  - c. Inductive discharge impulse
- III. Single Impulse

The non-interrupted controllers have been outlawed

(continued on page 30)

SOPHOMORE

THE sophomore laboratory was founded in 1915 by Professors M. C. Beebe and E. Bennett. It began as a small and crowded course of instruction and experiment which was held in the hall on the second floor of the electrical laboratory in the section now occupied by the wire cages. It was built up from this small and insignificant beginning by Professors Bennett, Crothers and Kelso, who, working together, developed all of the early apparatus used in experiments at that time. Since the expansion of the laboratory in 1926, Professors Benedict, Kubiak and Larson have contributed greatly to building it up into the scientifically designed and modern laboratory it is now.



The lab several years ago.

When the idea of starting a sophomore laboratory was being considered, Professor Beebe favored a plan which would offer a semester of practical work in electrical engineering, since so many of the students at that time attended school for only a year or two, and then dropped out for various reasons. These students received no electrical engineering training because only basic courses were offered the first two years. When this work of organizing a sophomore laboratory was turned over to Professor Bennett, however, he developed the four year theoretical course. Because the immense future broadening of the field of electricity was evident, only a complete four year course could adequately cover the large amount of theory and the practical application required as a supplement. The original laboratory course embodied three main principles: to show the application of the fundamental electrostatic theory, to demonstrate the practical application of calculus in electrical problems, and to use no instruments until those same instruments had been calibrated by the student himself.

The sophomore laboratory had been a going concern for only two years when the first World War began, and as a result the work was interfered with to a considerable extent This was due to both the preoccupation of many instructors with army trainees and the reduced student body of 1918 because of enlistments and the draft. Immediately after the war, however, full laboratory work was resumed and improvements continued, although at that time expansion was necessarily limited because the entire portion of the second floor now comprising the sophomore laboratories was occupied by the Mechanical Practice shops. In 1926 this space was made available for the sophomore laboratories, which have undergone considerable expansion and constant improvements since then.

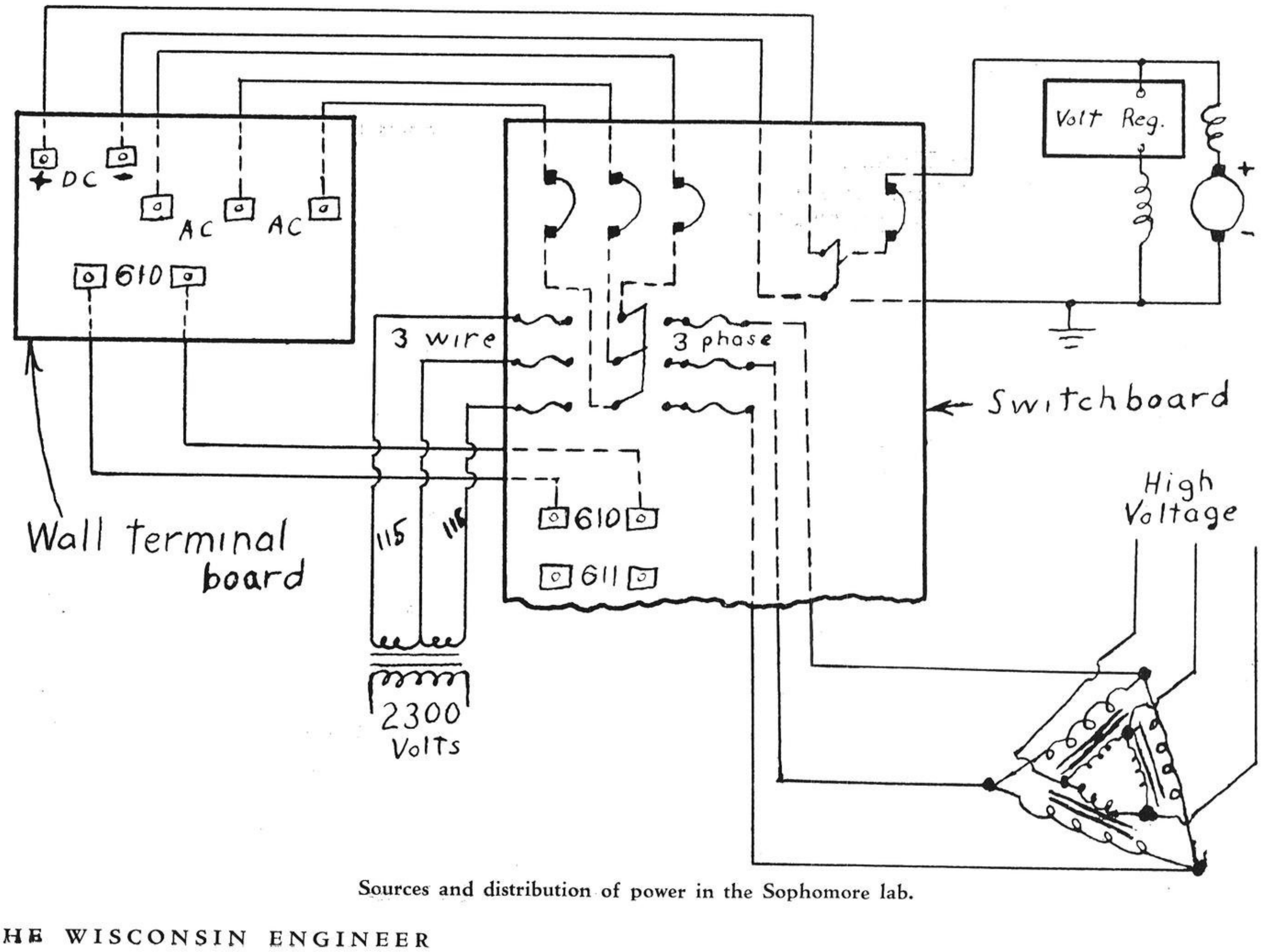
The basic purposes of the sophomore laboratory as formulated by Professor Bennett in 1916 have remained unchanged throughout all of this expansion, although new and improved equipment and apparatus have made possible more complete experiments and general laboratory work. The three main objects of the laboratory, as outlined by Professor Benedict, are to provide practice in electrical measurement methods, thereby giving firsthand knowledge of the apparatus through experience, to illustrate the theory taught in the classroom, and to provide a numerical check between theory and experiment in order to build confidence in the theory presented. The course is designed to present basic groundwork for later extensive application of specialized electrical work. In order to present this fundamental theory most effectively, the laboratory work is divided into four groups: Electrostatics, properties of conductors, D. C. circuits, and magnetism. Typical experiments in each group might include

EE IN LAB

by Harry Hanson, ee'46

these common procedures, and it is to be stressed that in each case the results are first calculated and then measured to observe how closely the results check with the calculations. In the electrostatic group, the experiment commonly used is to first calculate and then measure the interference between parallel pairs of power and telephone lines when the difference of potential between the power lines is known. To demonstrate the properties of conductors, the resistivity of water is first calculated by means of a parallel plate electrode immersed in water, and this calculated resistivity is then used to determine the resistance between co-axial cylinders and between concentric spheres. A typical experiment in D. C. circuits is to measure the currents and potential differences present in two wire and three wire lighting circuits for various types of loading, and to compare the measured voltage drops along the lines with the values calculated on the basis of known lengths and characteristics of the line wire and the measured line currents. In the magnetism group, a familiar experiment is to map the magnetic field near a solenoid using a flip coil and ballistic galvanometer and then using this field mapping data to verify the magnetomotive force of circuitation. In addition to these experiments, others are performed to demonstrate such applications as Faraday's laws of electrolysis, measure-

(Turn to page 31)



Sources and distribution of power in the Sophomore lab.

CAMPUS NOTES - -

by Mae E. Zimmerman '46

Have you noticed?????

Gleams in their eyes? Paces quickening? Hearts beating faster? Could be the V-12s anticipating the arrival of the 4,000 new fems on campus. Let's not get anxious, boys—there will be plenty to go around.

What's Harlow got that gets 'em?????

Psych is an interesting course on any campus and Wisconsin is no exception to the rule. However when a cat takes in a class . . . . we begin to wonder?? Or perhaps we should ask Don Hyzer, me '46 for further information regarding this matter.

One, two, three, kick!!

It seems that at a certain Sigma Nu party weird sounds and weird shapes were seen on a pier. Maybe Al Robbins and Jim Rice (V-12 engineers) and their dates could be of some help in clarifying this matter. I believe "conga" is the word for it—you learn something new every day.

It gets around.

Frank and June . . . .

Have you noticed that June Hartnell ee 2 is wearing sweaters a lot lately? Maybe it has some connection with a Theta Chi pin she received August 31. The lucky man? Frank Hyland, senior ee.

And then there's the time yours truly burned herself in physics lab—but we won't go into that

Word has been received from George Whitney that the V-12's have been seen running around campus with black eyes recently . . . (George included). His explanation (this time it's not the proverbial door) centers around boxing which has been given in P. T. Come now, George, even you can think of a better excuse than that.

The ROTC boys were given a little training in chemical warfare at Truax Field the "morning after" Prom. Certain gases were used to give the fellows an idea of what it's like. Included with the gases were instructions to sniff lightly as the gases were the real thing. Ed Fischer, ChE 2 suffering from too much prom, decided a sniff wasn't enough and in the next minute or two had all he could do to keep from meeting mother earth face to face—and without an introduction, too.

And then there was the time when censorship was for the Static only.

This is the issue we put anonymous after the heading, "Campus Notes".

That man Harlow again . . . .

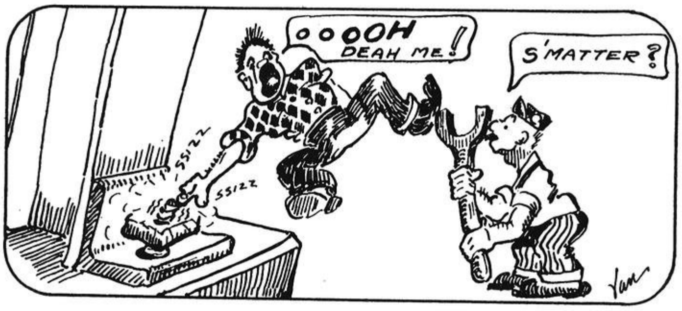
is heard aiming some of his remarks at the one fairer member of his class between the hours of eleven and twelve on Tuesdays and Thursdays . . . we're doing this without a commission, too . . . much to the general discomfort of the lady. Life is full of many such idiosynchrosies. (That word coming from an engineer?)

A question that should never be asked of an engineer is how much he lost at poker the night before an exam.

Any contributions to this column will be gladly accepted—at the Engineer office in the Mechanical Engineering Building—you know, the one with the red roof. Elevators will be installed in 1960.

To use up space we could tell a joke, but we'll leave that up to the static in this issue. We're still howling over the parrot and his "damn clever trick."

Harry Hanson, brain child of the E.E. 1 lab, inserted an ammeter across the d.c. circuit in lab. **#?!?#!!!**. White and trembling, Harry decided he would try mechanical engineering. (He's still an ee.)



"It can happen to you."

SOCIETIES

Tau Beta Pi

On Thursday, September 14, a banquet was held at the Park Hotel for the purpose of initiating new members into Tau Beta Pi. Robert Reynolds, professor of history, was the guest speaker for the evening and G. L. Larson, professor of mechanical engineering, officiated as toastmaster. The following members were formally initiated:

Charles Yaker
Morris Rowlands
Ted Nowak
Gail Russell Sutherland
Warren Smith
John Koetting
Vernon Holmes
Toru Iura
Paul J. Ruse
Stanley Mrazek

At the Tau Beta Pi banquet — Theodore Nowak received the $5.00 prize for the winning essay and Toru Iura received the plaque award.

Election of officers was held on September 28.

The retiring officers:

President	Edward Daub
Vice President	Bill De Long
Recording Secretary	Dick Derks
Corresponding Secretary	Warren Young
Cataloguer	Roland Wetzel

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HAM SLANG . . .

With the development of amateur radio, there has come the side-by-side development of certain expressions and slang used almost exclusively by these "hams". To the ordinary public, such expressions would sound like some code or untranslatable language. In a way, it is a code, abbreviated forms for some of the common American expressions, known to all the amateurs operating.

Some of the most common expressions and slang follow:

Bug	Speed Key
C. W.	Continuous Wave
D. X.	Long Distance
Hi	Laughter
Mil	Milliampere
Mill	Typewriter
N. G.	No good
O. M.	Old man
O. W.	Old woman
R. I.	Radio Inspector
Sked	Schedule
Y. L.	Young Lady
X. Y. L.	Wife
Op.	Operator
Jr. Op.	Son of operator
73	Regards
88	Love and kisses
Rock	Crystal
R. F.	Radio frequency current
Sky Wire	Antenna
Shack	Small house or shelter for amateur station.
Ham	Amateur operator
Bottle	Vacuum tube

These are only a few of the many such expressions floating over the airways. One such conversation with a fellow "ham" in some other part of the United States might sound something like this:

"O. K. there Bill. The Jr. op and Y. L. are here now. Imagine the X. Y. L. will be in the shack in a minute. She has to see that the O. M. keeps on sked. Hi. The last part of your broadcast was n. g., especially that part on the new sky wire. Maybe you can put that through again. Here's the X. Y. L. now. She says we have company so I will have to sign off. 73's. The Y. L. says to send her 88's. W9XXX signing off and clear with W6YYY."

The History of Amateur Radio

by June Hartnell '46

ALTHOUGH postponed temporarily by the war, amateur radio has developed into one of the most exciting and widespread hobbies ever known. When radio was first introduced to the people of the world, their imaginations were caught at once in the web that was to tie together all parts of the world. To hear a program or actual happening from some distant point in the world had been unthought of—now it brought people closer to each other. The thrill reached even a higher point, when distant reception was superseded by the actual talking to the people in far countries. Amateur radio grew by leaps and bounds. In the homes of "DX" enthusiasts or in their shacks, ham sets were set up—most of the transmitters being home made. With time and experience in using the right frequency for a certain time of day and finding the right band for distant or near communication there came the satisfaction of accomplishing something by yourself. Radio and amateur brought with themselves new engineering fields, calling forth all the abilities an engineer might possess. There was also a greater demand for operators, technicians, executives.

Soon after Marconi sent his first wireless message in 1899 between France and England, his first signals between England and America in 1901 were sent and received, a distance of more than two thousand miles. Men soon began to duplicate his achievements. Before 1917 however, five hundred miles was considered an accomplishment. Transmitting over one thousand miles was yet virtually unheard of. But already men were wondering if there were not amateurs much like themselves, in foreign countries, with the same hopes as they themselves, of sending and receiving across the oceans. All messages sent across the United States had to be sent in relays and amateurs were operating on 200 meters—all wave lengths below 200 were silent.

All the early transmitting sets used an induction coil and a spark gap to produce oscillatory currents, those of course being damped. The vacuum tubes were as yet unheard of.

1914 saw the establishment of the American Radio Relay League by Hiram Percy Maxim. This league, to become known as the A. R. R. L., governed amateur activities. During this period, various laws specifying wave-lengths for various services and licensing were set up. (Amateurs were set on 200 meters; here they could supposedly fool around and wouldn't harm anybody).

With the United States' entrance into the war, all activities were abolished for the next two and a half years. However, about three-fourths of the approximately five thousand operators were serving the armed forces as badly needed operators and instructors. It was during this period, however, that amateur radio was nearly abolished for all time. Soon after the Armistice, Congress began considering measures which would guarantee a non-return to the pre-war amateur activities. Although this bill was defeated, another year passed before licenses were again issued to amateurs and the war bans raised.

Before the bans were raised, however, the old A. R. R. L. again began functioning, eleven of their members financed the issuing of a publication calling together all amateurs again, bought QST as their official publication, and reorganized. With the ban raised and licensing again permitted, men rushed back to their sets, eager to renew their friendships across the air.

The 1st World War had introduced several new techniques in radio and design and transmission. One of the greatest of these was the use of the vacuum tube, which made possible the production of continuous alternating currents of any frequency desired. Distances of transmission were increased to two thousand miles. Again dreams began to shape in the minds of operators, dreams of bridging the ocean. In 1921, they began to be realized when, in a test run of some of the operators with the best equipment, thirty American calls were picked up in Europe. Again in 1922, a similar test was run and three hundred fifteen of our calls were heard in Europe and we picked up a couple British and a French call. All that remained now for the full realization of the dream was a two-way communication. Nearly maximum power was being used at that time, but there were the wave-lengths below 200 meters as yet untried. Engineers had said they were worthless, but they weren't and from tests it was proving as the wave-lengths dropped, results were

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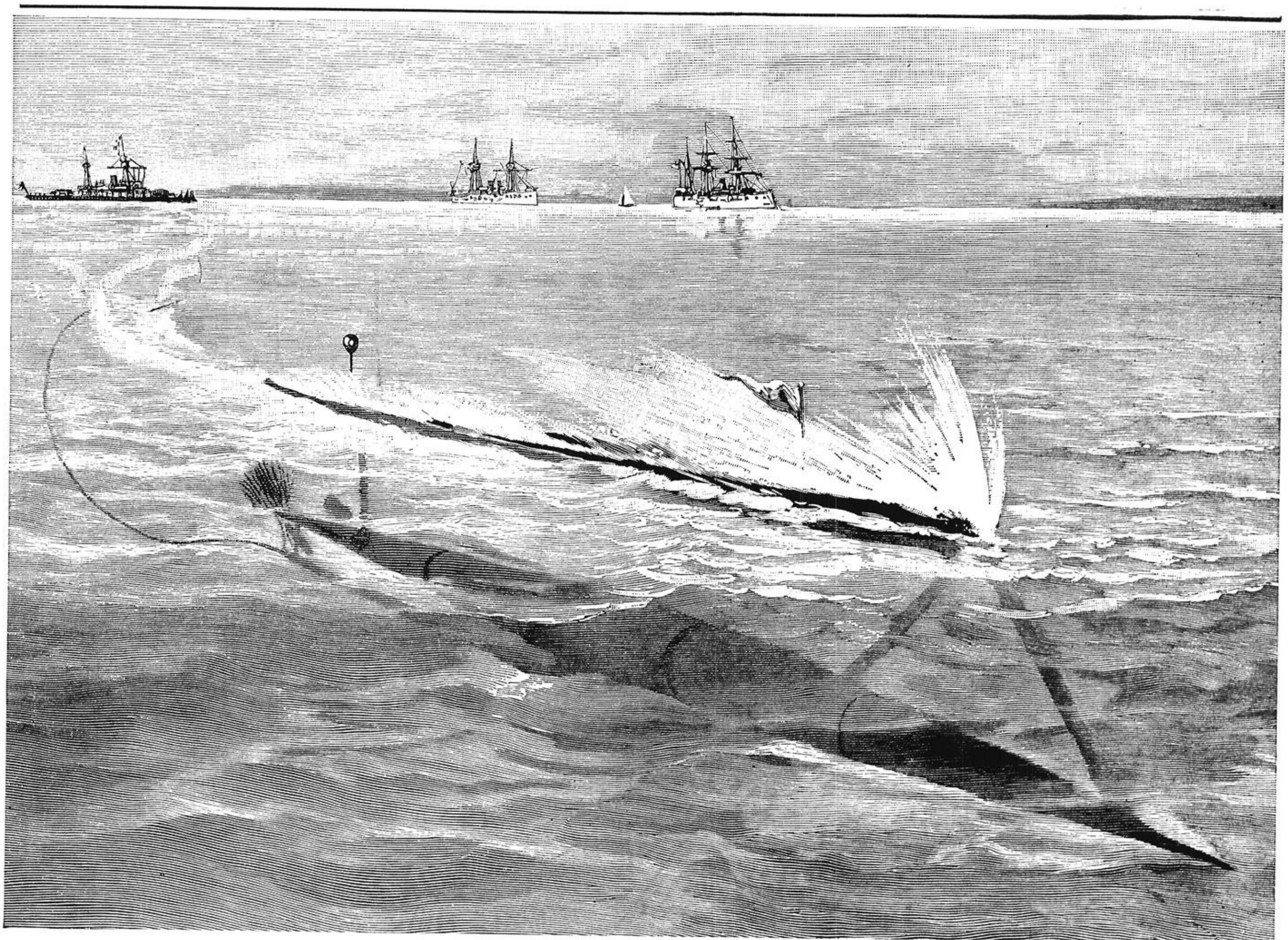
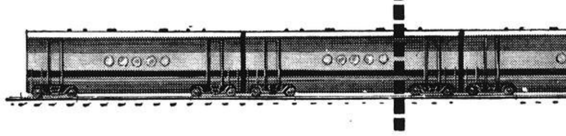
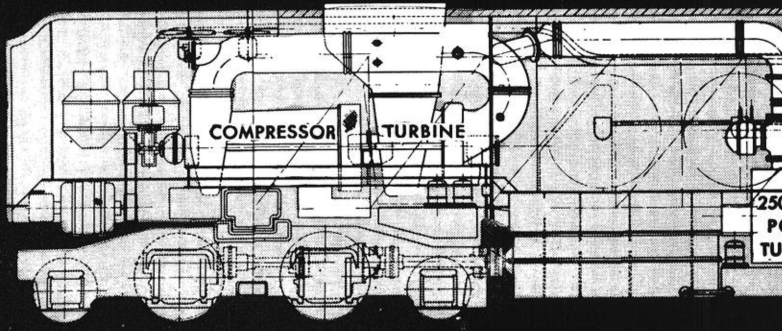


How to Cut a Locom

YET MAINTAIN ITS 

PLAN TO USE ALLIS-CHALMERS GAS TURBINES!



Actual Blueprint of a 5000 horsepower A-C Gas Turb

Today, A-C built Gas Turbines help boost output of U. S. super aviation fuel—promise to revolutionize power production in many fields after the war!

"ENGINEERING THAT AIDS ALL INDUSTRY FURTHERS AMERICAN GOOD LIVING"

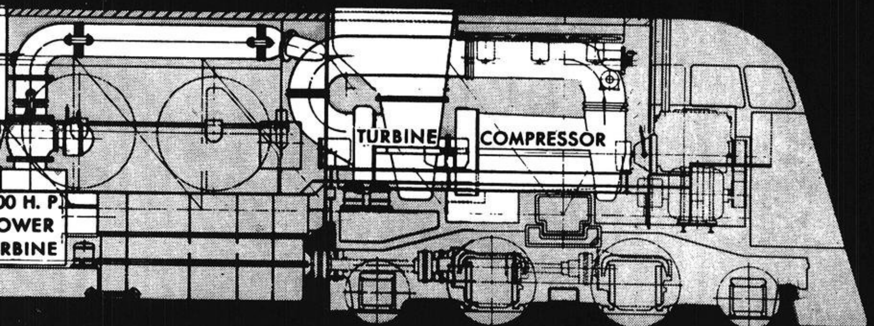
OVER 1600 PRODUCTS

Supplying the World's Industria

ALLIS-CH

otive in Half—

TOTAL HORSEPOWER!



en locomotive. Half conventional size—same power!

"TORNADO IN A BOX!"..."Simplest, most compact engine ever invented!" ... Biggest power story in 50 years!" ...

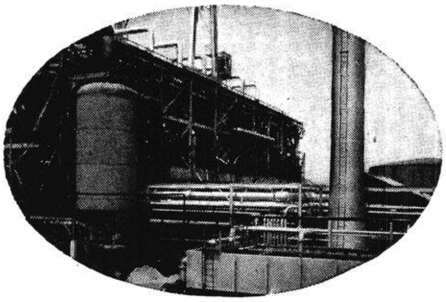
That's how engineers describe the sen- tional, new gas turbine . . . now in pro- ction at Allis-Chalmers!

It's already helping to win the war!

Today, A-C built gas turbines help save ecious power, in U. S. oil refineries. esult: 100-octane gasoline flows faster to S. fighting planes!

In the future, designers see: Power ants for locomotives that take up half e space yet deliver the same power as nventional engines! Gas turbine-pro- lled ships that carry 1000 tons more rgo without increasing length or dis- acement! Cheaper postwar production things American buyers need and want!

Today, Allis-Chalmers has more gas-turbine units in use than all other companies combined—and with 1600 different products in the battle of production, is building the greatest wealth of experience in the capital goods field.



A-C Gas Turbines have already been installed in modern oil refineries like this.

VICTORY NEWS

24-Hour-A-Day Welder: A new A-C welder—the Ampac "400" with sufficient capacity to use ¼" rods 24 hours a day—has recently been announced by Allis-Chalmers.

The Ampac "400" is simple in design—rugged in construction and covers a welding range of 50 to 500 amps in 8 easy turns of control wheel. Cuts welding time—speeds output! For further information, write for bulletin B6302, Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.

Front Line Action With The Seabees: In the South Pacific, big Allis-Chalmers crawler-type tractors have seen plenty of service clearing invasion roads—hacking airstrips out of jungles—filling shell craters.

At times, these 14-ton Diesel-powered giants have operated in temperatures as high as 175° in the sun . . . and in Alaska, at 65° below zero!

What Are Your Marine Needs? Allis-Chalmers has immediate capacity available for all sizes of Surface Condensers—built to either Navy or A.B.S. requirements—with or without Steam Jet Pumps.

Also capacity in varied amounts for hollow-bored and solid shafting, special forgings, large iron castings, engine frames, beds, etc. Check with us today.

ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

FOR VICTORY
Buy United States War Bonds

argest Line of Major
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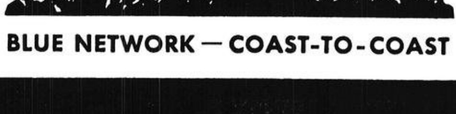
ALMERS

BACK ON THE AIR, OCT. 7
THE BOSTON SYMPHONY
8:30 P.M. E.W.T.—SATURDAYS



BLUE NETWORK—COAST-TO-COAST

ALUMNI NOTES . . .

by Melvin Sater, ch.e'44

Chemicals

ANDRUS, ORRIN E. ChE '26, a former member of the teaching staff of the Department of Chemical Engineering, is located at Los Angeles, Cal., and is the Director of Research for the West Coast activities of the A. O. Smith Corp. of Milwaukee. He recently spent several weeks at the Milwaukee plant during which time he visited Madison.

BROWN, ROBERT T. S1/C, ex '45, completed boot training at Great Lakes and was in Madison for a short visit.

PESCH, ANTHONY W. ChE '22, recently stopped at Madison to consult with the staff of the Forest Products Laboratory. He is superintendent of the Mobile, Alabama plant of the Southern Kraft Corp.

Electricals

BENNETT, B. F. ee '41, was on the test floor and in the Industrial Control Engineering department at General Electric until inductance into the U. S. Navy. He took his boot training at Great Lakes and received his commission in June and is now going to Princeton for radar training.

HELGESON, CAPT. EUGENE, is in the 6th Air Force stationed in the Panama Canal Zone.

LIND, CAPT. ANTHONY, is also stationed with the 6th Air Force in the Panama Canal Zone.

MURDINK, CLYDE L., went to boot camp at Great Lakes in June of this year and was home on boot leave Sept. 2, 1944. He expects to be assigned to a radio school. At boot camp he saw the following electricals: Bob Collins, Harold Boettcher, Bill Behrend, John Tanghe, and Bob Lawrence.

NESVIG, 1ST LT. ELLIOTT, is stationed with Lind and Helgeson with the 6th Air Force.

NETTESHEIM, 1ST LT. HENRY P., is in the U. S. Army Signal Corps, 3rd Air Force Division. He left school in June, 1942 and was at Camp Murphy Radar School in Florida for 3 months. He was then stationed in Panama to do communications work, air and ground equipment installation. He visited Madison August 25th. His present address is Drew Field, Fla.

Mechanicals

ANDERSON, 2ND LT. CHARLES E., was in Madison a short while ago after completing an engineering course at Ft. Belvoir. He is now assigned to Ft. Lewis.

BRIGHTLY, FRED C. me '26, who is the Vice-President of the Standard Galvanizing Co. of Chicago, Ill., is looking for a new site for his plant, possibly Madison, as the city of Chicago is condemning the plant for a new superhighway.

CAREY, THAIN H., has accepted a position with Bell Aircraft Co. of Buffalo, N. Y. in the Development Department.

HITCHCOCK, GEORGE, former instructor in mechanical engineering and university wrestling coach for many years, passed away at a local hospital. Mr. Hitchcock served in the navy during World War I at New London, Conn., as a chief machinist's mate. He came to Madison in 1920.

NILLES, JAMES E., completed boot training at Great Lakes, Ill., recently and visited Madison, his home, on boot leave.

O'LEARY, JOHN A/S, is at Great Lakes in boot training.

RATHER, NORVAL ELMER A/S, recently reported for his boot training at Great Lakes Naval Training Station.

SOMMER, MAJOR WARREN L. me '42, is at present the executive officer of an engineering combat battalion at Camp Van Dorn, Miss. He was stationed at Ft. Belvoir as an instructor in the Officer Candidate School, before his transfer.

Mining and Metallurgicals

BAIRD, JEROME met '43, formerly metallurgist with the Aluminum Company of America at Massena, N. Y., is now with the U. S. Navy.

DuMONT, CHARLES met, is metallurgist with the Electro Metallurgical Corporation at Niagara Falls, N. Y.

HAHN, (MISS) EMILIE min '26, who was on the faculty of the Customs College in Shanghai, China, is back in New York after a year's internment by the Japanese in China. Miss Hahn is one of the Japanese internees who was recently exchanged on the Gripsholm.

SWENSON, WILLIAM O. min, is now Chief Engineer of the Mountain City Copper Co., in Mountain City, Nev.

SCHULTZ, HOWARD met, is with the American Zinc Lead Smelting Co. at Langlath, Pa.

WOLLERING, WALTER O. met, has completed his training at the U. S. Naval Academy at Annapolis and has now been assigned to submarine duty.

ZAHALKA, HAROLD J. met, is Research Metallurgist with Haudaille-Hershey Corporation at Decatur, Ill. His work is under D. J. Girardi, Instructor in Metallurgical Engineering from the University, on leave.

STATIC . . .

—Bob Clayton and Fran Tennis,
m.e'46

Her lips quivered as they approached mine. My whole frame trembled as I looked into her eyes. Her body shook with intensity as our lips met, and my chin vibrated and my body shuddered as I held her to me.

The moral of course is: "Never kiss in a flivver with the engine running."

•

We can't find for love or money,
A joke that's clean and also funny.

•

Dear Voice of Experience:

The other night I was sitting on a sofa with my girl and she reached up and turned out the light. What shall I do?

(signed) Worried

Dear Worried:

I'd do the same thing you did and be just as worried.

V. of E.

•

Dean: "Know you? Why I knew you when your mother got kicked out of college."

•

Collector: "Is your husband home?"

Blonde: "Why?"

Collector: "I want to collect the installment on that sofa."

Blonde: "Shh!! He'll be gone in a minute."

•

Boy: "Sir, I have just resuscitated your daughter."

Guv'nor: "Then, by gad, you'll marry her!"

•

Freshman: "A woman's greatest attraction is her hair."

Soph: "I say it's her eyes."

Junior: "It's unquestionably her lips."

Senior: "What's the use of sitting here lying to each other?"

•

"Madam, may I see your daughter?"

"No; get out and stay!"

"But madam, see this badge? I'm respectable. I'm a detective."

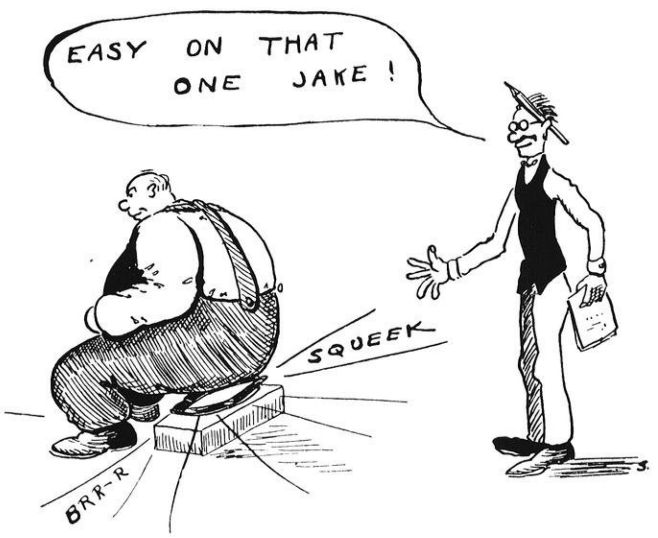
"Oh, I'm sorry; come right in. I thought it was a fraternity pin."

Her dress was tight—
She scarce could breathe;
She sneezed aloud,
And there stood Eve!

•

"Where did you get that cute blonde, Joe?"

"I dunno! I just opened my wallet and there she was."



Strength of materials.

"Poor Sarah; she landed in jail for having her dress on backwards."

"Why, they can't put her in jail for that."

"Ah yes, but they did; it was her evening dress."

•

"Is that your face?"

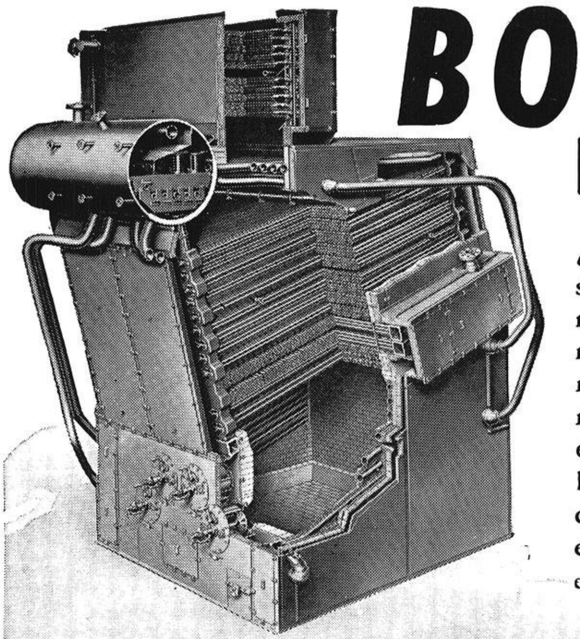
"It isn't anybody else's but."

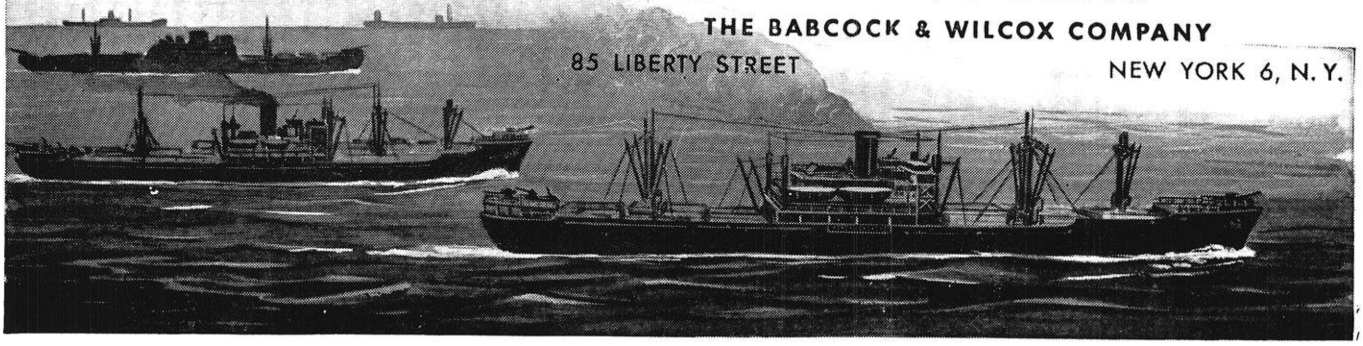
•

One pretty Scotch girl left high school because she received no interest from her principal.

•

The minister read the text: "The light of the wicked shall be put out." Instantly the church was in darkness. With scarcely a pause the minister continued: "In view of the startling fulfillment of this prophecy, we will spend a few minutes in silent prayer for the electric company."





MORE STATIC . . .

We point with pride to the purity of the white spaces between jokes.

The Last Mile

The most pathetic figure we have seen in a long time was the lisping lad who was trying to tell his date that he liked her size.

A bather whose clothing was strewed
By winds that left her quite nude
Saw a man come along—
And unless I am wrong,
You expected this line to be lewd!

•

I wish I were a kangaroo
Despite his funny stances,
I'd have a place to put the junk
My girl friend brings to dances.

•

If you should be the victim of a direct bomb hit, don't go to pieces. Lie still and you won't be noticed.

•

Doc: "Hey, stop! Don't you know that kissing is a good way to transact germs?"

V-12: "Good hell, it's perfect"

•

"Hi babe, don't you wish you'd met me sooner?"

"I certainly do—If I'd met you sooner, I'd have been rid of you long before now."

One Siamese twin: "You must have had a swell time last night; I look like a wreck today."

(More on page 24)

QUARTZ CRYSTAL . . .

(continued from page 7)

angle is checked. Steadiness of the angle has to be maintained.

The frequency of a crystal is determined either by its thickness or by its contour i. e., length and width. Thus there are two types of oscillators, the contour and the thickness. The quartz can be cut in many different ways. The two most common types being the AT and the BT. For AT cut crystals, which are used between 500 and 5000 kc., a cut of 35° with the optical axis is made. This angle is 49° for the BT cut which is used above 5000 kc. Since the thickness decreases with frequency, a limit is soon reached due to the loss in mechanical strength. A different type of crystal is usually used above 14 mc.

The temperature of a crystal in the majority of applications is not held constant to any degree. Therefore it is necessary to have a crystal with a low temperature coefficient. It can be shown that cutting these crystals at an angle with the optical axis makes for low frequency drift with varying temperatures. These angles must be correct within three minutes if the frequency drift due to the changing temperature is to be kept at a minimum.

The frequency of the crystal to be finished determines the thickness of the blank. But it is always made slightly oversized to allow for finishing. Some quartz has to be removed to change the frequency.

Before the crystal can be finished, it is etched. This process reveals the existence of any flaws in the quartz. Some of the most common are twinning, cracks, inclusions, and bubbles. All of these are mechanical except the twinning which is a crystallographic flaw. Optical twinning is an unsymmetrical arrangement of the atoms in part of the quartz. Electrical twinning is a reversal of polarity in the structure. Since quartz containing either type is not usable, the flaw must be tested for immediately. The crystal is etched in some fluorine compound and a beam of light focused on it. The projected light from the etched crystal accentuates the twinning so these areas can be marked off and discarded.

The quartz wafers are then cut into blanks by a diamond saw. The blanks are made slightly over-sized to allow for the grinding. They are then ground by machine to a closer dimension. Great care must be used in this grinding process so the edges won't be chipped or fractured. This would cause considerable lowering of the crystal activity. Again the crystal is given a thorough examination.

The crystals are then given another grinding treatment which flattens the two faces and squares the blank. The thickness is brought down to .001 of an inch of the desired thickness. Again the crystal is examined.

They are then polished by hand to between .00002 and .00005 of an inch of the required size. These measurements were all made mechanically. The crystals are then checked for activity. If low, the activity can be increased by rounding the edges. Measurements are now made electrically for frequency. A standard crystal in an oscillator (vacuum tube type) is used for the final adjustment. The crystal is polished to within a few kilocycles and it is then etched to the frequency desired.

The crystal is then placed in its holder, consisting of two electrodes and an insulated case. Temperature tests are then made on the crystal such as activity and temperature coefficient at below freezing and boiling temperatures. After passing this final test the crystal is ready to be used.

It may seem at first that the cutting and finishing of a crystal is a lengthy and expensive procedure. But this is not the case. A single finisher may finish as many as 75 crystals in an eight hour day. It has been shown beyond a doubt that the crystal is the most practical inexpensive and most accurate method of keeping the frequency of a vacuum tube oscillator at a constant frequency. Keeping the crystal in a constant temperature oven will keep the frequency of oscillations constant to within one part in 10,000,000 cps.

The secret of the crystal's efficiency is in its piezoelectric effect. "Piezo" is from a Greek word meaning "to press". When the crystal is compressed or placed under a mechanical strain, electric charges appear on the opposite faces. And conversely, electric charges applied to opposite faces causes the crystal to be mechanically strained.

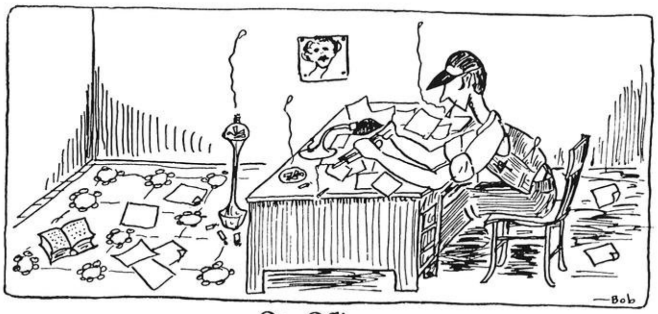
The piezoelectric effect may be used to fix a frequency to within one part in one million. The crystal is so made that when set in vibration by an alternating potential of the right frequency applied to the two faces, the crystal will resonate mechanically.

The vibration system of any crystal is complex. Each crystal has at least two vibrating frequencies as mentioned above. Coupling exists in the crystal between these different types of vibrations and between their harmonics. The degree of coupling depends on the two frequencies and on the physical size of the crystal. Sometimes multiple resonant frequencies are produced at closely spaced intervals. In the special zero-temperature-coefficient crystal, one of the two types of vibration has a positive temperature coefficient while the other has a negative coefficient. Each acts to cancel the other's effect.

Quartz is not the only crystalline material that is capable of producing piezoelectric effects. Other materials are rochelle salts and tourmaline. But these two are used very little. Rochelle salts produce a better response than quartz but is far weaker mechanically. Tourmaline is the best of the three mechanically but is weak electrically. But, it does find application at very high frequencies where the crystals must be ground so thin that quartz is impractical.

CAMPUS NOTES . . .

(continued from page 13)



Our Office

Tau Beta Pi—

New Officers:

President	Dick Derks
Vice President	Jim Tiedemann
Recording Secretary	Warren Smith
Corresponding Secretary	Paul Kaesberg
Cataloguer	John Koetting

Plans for a party to be held October 21 were discussed.

This . . . Happens

Pi Tau Sigma

held its initiation banquet at the Capital Hotel September 21, 1944. C. L. Coons of the Wisconsin State Conservation Department was the speaker of the evening. Movies were shown on Wisconsin's Vacation lands.

The following were initiated:

Herbert Pearson

Gail Sutherland

Toru Iura

Paul Rose

William Wendt

STATIC . . .

(continued from page 21)

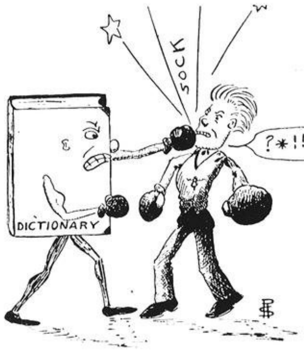
She was climbing out of Santa's sleigh, looking very much disheveled and groggy. Hair hanging over her eyes, her dress torn, and minus one shoe, she gave a vivid impression of the "Survival of the Fittest," or "After the Battle". And there sat the old boy himself, with his cherry-red nose and his hands folded over his bowl-of-jelly belly, a smile beaming from his round face.

A group of astonished onlookers were gaping at this odd spectacle.

"Santa Claus!" shouted one in exclamation.

"He certainly does," swore the fleeing damsel.

We hope the preceding bit o' wit did not disillusion any of you children.



Getting Even

"You're a cheat!" the first lawyer accused his opponent.

"You're a liar!" the other retorted.

Then from the judge: "Now that these attorneys have identified each other, we shall proceed with the case."

•

A parrot was sitting on the salon of a luxurious steamer watching a magician do tricks. The magician served notice that he was now going to do a trick never before accomplished. He pulled up his sleeves and made a few fancy motions. At that moment the ship's boilers exploded and sunk the ship. About ten minutes later as the parrot came to, floating about on a piece of drift, he was heard to mutter, "Damn clever, damn clever."

•

While visiting the Hawaiian Islands we had a very thrilling experience. We met two hula hula girls who loved the same man, so they pulled straws for him.

•

Soph: "How did you happen to come to Wisconsin? I thought your father was a Marquette man."

Frosh: "He is. He wanted me to go to Marquette, and I wanted to go to Northwestern. We had an argument and he finally told me to go to hell."

Mother (examining daughter's wardrobe): "Did you go to that dance last night, dear?"

Daughter: "No, Mother, I ripped that shoulder strap playing tennis."

•

Soph: "Have you ever been pinched for going too fast?"

Frosh: "No, but I've been slapped."

•

Football games are the only places where a man has his girl on one arm, a blanket on the other and nothing is thought of it.

•

We now have proof that women are the most illogical of God's creatures. They wear skirts that only go down to here; they wear perfume that is named anything from Purple Passion to Aphrodesia; they wear lipstick guaranteed to attract men at forty paces; they gargle all sorts of things that are guaranteed to keep attracting them at 1/40 of a pace; they eat yeast so that they will have enough energy to stand up under the shock when they do attract one of us; they practice melting looks in front of the mirror; and yet when a man succumbs to all this plotting and tries to kiss the girl, what does she say? I quote: "But you won't respect me."

•

One of our freshman friends ordered an egg in one of the Madison restaurants. On her way to the table the waitress dropped the egg and in alarm cried out:

"Oh, what shall I do?"

"Cackle like hell," advised our friend, rising up from his semi-stupor, "You'll have a helluva time doing it again."

•

With all due apologies to Abbott and Costello, we present the following telephone conversation.

"Hello"

"Hello"

"Who's speaking, please?"

"Watt"

"What's your name?"

"Watt's my name."

"Yeah, what's your name?"

"My name is John Watt."

"John what?"

"Yes."

"I'll be around to see you this afternoon."

"Is this Jones?"

"No. I'm Knott."

"Will you tell me your name then?"

"Will Knott."

"Why not?"

"My name is Knott."

"Not what?"

Operator butting in: "Oh hang up."

New Staff

by Mae E. Zimmerman '46

Toru Iura greeted the world on August 2, 1923, in the city, famous for its Golden Gate, of San Francisco. He grew up like anyone else, I guess, (that's his story).

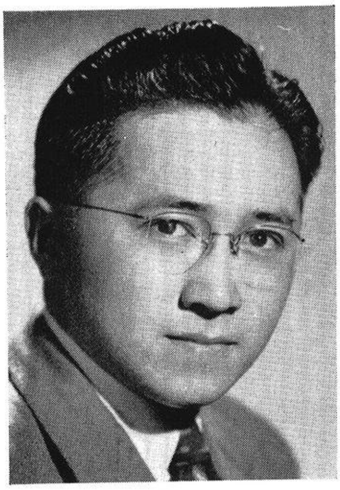
He attended high school at Los Angeles where he graduated in 1942. His course during school was of the general academic nature which would prepare him for college. His activities at high school accentuate his versatility. Toru's interest in sports led him to go out for football and also encouraged him to do his bit as cheerleader for the school. He took his place as vice president of the Senior Board of Control.

While at the University of Wisconsin, Toru has made a name for himself, in his studies and outside activities. He is one of the few students to have a straight three point for all his semesters here. Tau Beta Pi, MESW, and Pi Tau Sigma all have his name in their membership rolls. He worked on the business staff of the WISCONSIN ENGINEER and is now the business manager. Besides his studies and activities, Toru is also working for the University Material Testing lab as a student research assistant.

Toru, a Junior in mechanical engineering, when asked what he would like to do when he graduates, stated that he would like to take grad work if the army didn't catch up with him. Classification of 1-A does not leave too much hope for that at present.

Toru's home is now in Fort Lupton, Colorado.

Uncle Sam may not catch you, Toru, but if he does, we hope to see you back on the Wisconsin campus after the war is over, to carry on your good work.



On July 7, 1926, in the small town of Salem, Wisconsin screams of a bouncing baby girl made known to the world the entry of another member of the feminine sex. Little did her parents realize that eighteen years later their daughter would be toting a slide rule to classes and instead of wondering whether Columbus crossed the ocean in 1492 or 1942, she would be calculating the resistance of A and B in an electrical circuit.

The girl referred to in the above paragraph is Viola June Hartnell, —June to her friends—sophomore in electrical engineering. When asked why she chose engineering as her profession she exclaimed "Please don't ask me that" and stalked out of the room. Maybe the reason for her choice lies in the fact that when other girls were playing with dolls, she played football or baseball with the "gang". Or when Mary and Sally were taking Home Economics and typing in high school, June added to these subjects physics and trig. In any event June is an engineer and her grade point makes known the fact that she is a good one.

High school found June participating in all the outside activities she could fit into her program. This included everything from G. A. A. to dramatics, clubs, the editorship of her high school paper, membership in the girls' chorus and band and the writing of articles for her high school annual. While in college, June has been playing in the band with her licorice stick and is now editor of the WISCONSIN ENGINEER.

June is very definite about her likes and dislikes. Her pet peeve this semester is chemistry 2a—"it's something that shouldn't happen to an ee." In foods, chocolate cake rates first with butter icing as a must. Parties, dances, and picnics are fun, according to June, but her main interest now centers around a frat pin which she received this summer from a fellow ee.

When you see a girl setting up circuits in ee lab or hear this same girl complain about the disadvantages of not being able to add or subtract on a slide rule, don't be alarmed. It's just June Hartnell, '46.

AMATEUR RADIO . . .

(continued from page 14)

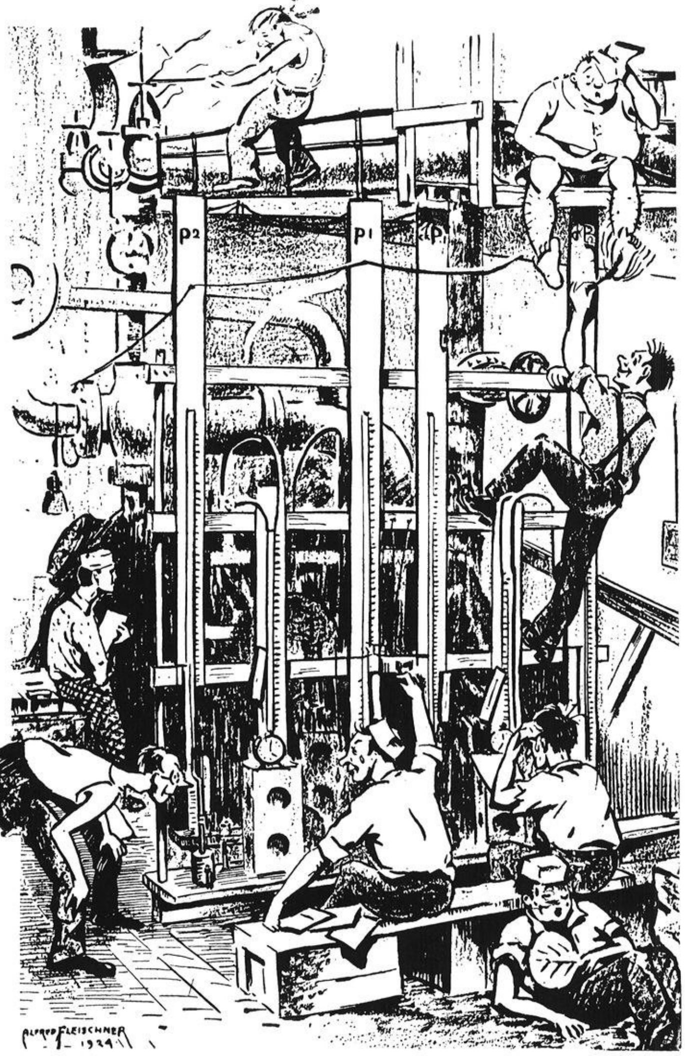
better (you can't always be right). Stations operating on 110 and 100 meters were soon working two-way across the Atlantic. Wave-lengths dropped some more, to 40, 20, 10, and 5 meters. Twenty meters showed great possibilities with the cross-continental communication now possible at noon.

The 56 mc. band, amateurs found, was ideal for working shorter distances—new equipment was introduced and perfected for this shorter working distance. Under good conditions the continent could even be spanned.

Between wars several advances were also made along amateur lines, the amateur became better known to the American people. Among these were: (1) the Radio Naval Reserve and Army Amateur Net, set up in 1925. From these two organizations have come thousands of men who are now on active duty with the army and navy. (2) An emergency program was put into effect in 1938 by the A. R. R. L. which has closely bound amateurs together and led to cooperation between them and public needs—Western Union, the Red Cross, and gave contact with exploring expeditions.

Amateurs are bound together today by the A. R. R. L. already mentioned which helps to stimulate interest in amateur radio and to represent the amateurs in legislative matters. Through the A. R. R. L., QST is published, a magazine with articles of interest to operators and men just getting started. Many of the articles are written by amateurs themselves.

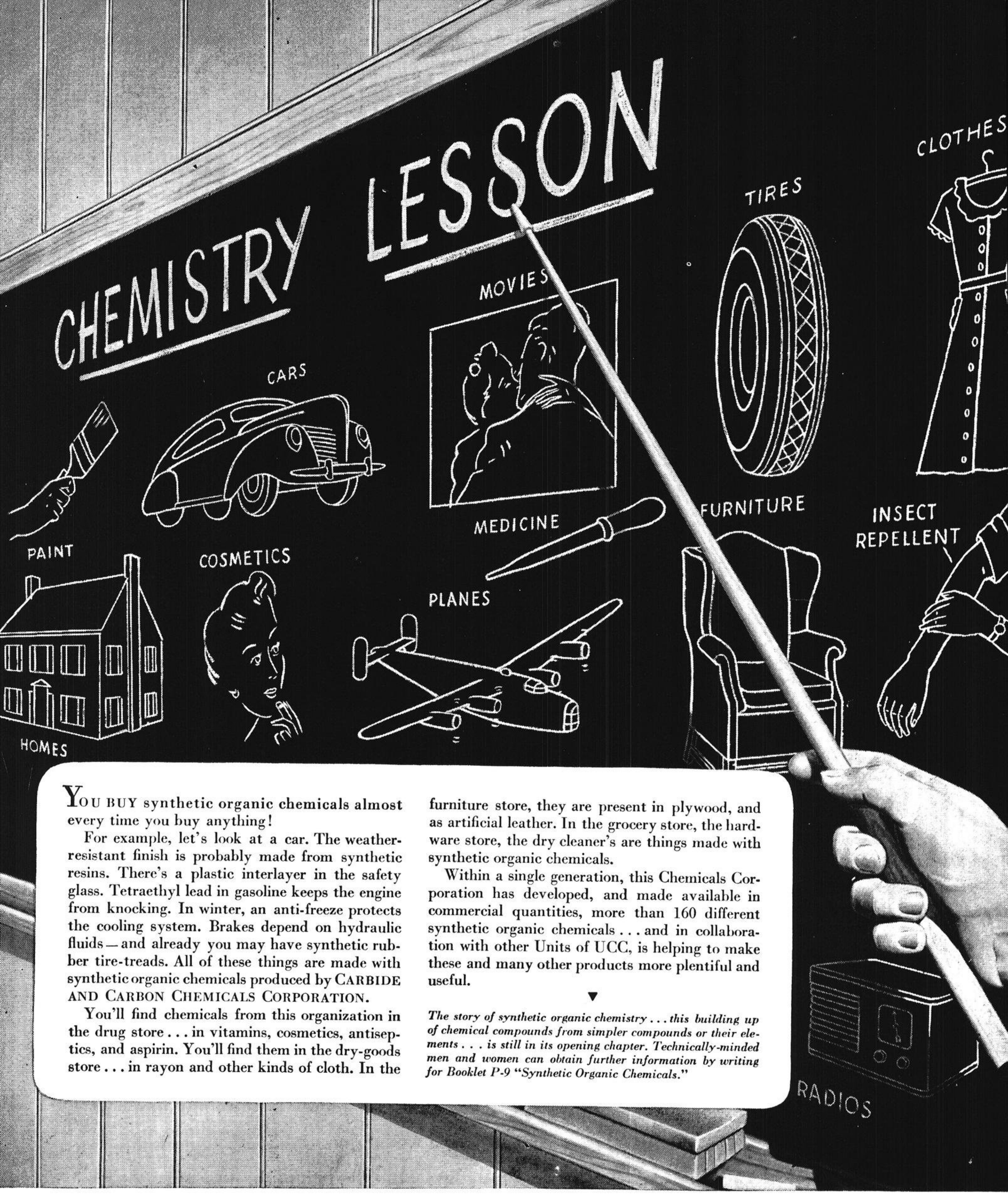
An international organization that leads to closer international cooperation in making contacts abroad in matters of common interest to amateurs of all countries is the IARU, the International Amateur Radio Union. W. A. C. certificates are issued by them—"Worked All Continents" —to such amateurs who have done so.



Takes a Lot
of
Help

Many regulations and orders now govern the amateur operations of stations. For example there are regulations concerning the getting of an amateur license—form, modifications, renewal, revocation, suspension, expiration. There are also others enumerating the classification of operating privileges, eligibility for licenses, call signals, use of stations, the bands to be used, violations. The FCC also issued orders relating to the present situation and to circumstances leading up to it.

Amateur radio has progressed far. These developments on other bands and under similar circumstances as have been mentioned have been made possible through the efforts of the amateur radio operator. Not only that, but the amateur has proved himself invaluable in many circumstances. It has been he who stuck by his post in flood areas, sent and directed aid to distress calls heard, rendered valuable service to his country during time of war and is again doing so today. Not only in this country, but in others as well, he has proved his worth. He was there helping during the earthquakes in New Zealand and in Nicaragua in 1931. When other communication failed, the amateur sent out the message. Today amateurs are working on frequency modulation and television equipment. Again the sets have been packed away for the duration, but after this war, they will be set up again, new techniques will be introduced—amateur radio will be bigger than ever before.



You buy synthetic organic chemicals almost every time you buy anything!

For example, let's look at a car. The weather-resistant finish is probably made from synthetic resins. There's a plastic interlayer in the safety glass. Tetraethyl lead in gasoline keeps the engine from knocking. In winter, an anti-freeze protects the cooling system. Brakes depend on hydraulic fluids—and already you may have synthetic rubber tire-treads. All of these things are made with synthetic organic chemicals produced by Carbide and Carbon Chemicals Corporation.

You'll find chemicals from this organization in the drug store . . . in vitamins, cosmetics, antiseptics, and aspirin. You'll find them in the dry-goods store . . . in rayon and other kinds of cloth. In the furniture store, they are present in plywood, and as artificial leather. In the grocery store, the hardware store, the dry cleaner's are things made with synthetic organic chemicals.

Within a single generation, this Chemicals Corporation has developed, and made available in commercial quantities, more than 160 different synthetic organic chemicals . . . and in collaboration with other Units of UCC, is helping to make these and many other products more plentiful and useful.

▼

The story of synthetic organic chemistry . . . this building up of chemical compounds from simpler compounds or their elements . . . is still in its opening chapter. Technically-minded men and women can obtain further information by writing for Booklet P-9 "Synthetic Organic Chemicals."

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ELECTRIC SHOCK . . .

(continued from page 9)

by the codes for various reasons. The chief objection to this type is the fact that the electric shock is continuous and provides no interval during which the victim can release himself from the fence. It has been concluded that 8 ma would be a reasonably safe output current for normal men. However, safe currents for children are much smaller, usually taken as half of the safe value for men. For controlling livestock the minimum effective current is believed to be 7½ ma, and thus a controller, to be effective would have to be dangerous to women and children. The d-c controller presents a different aspect. The maximum safe direct current for men is at least 80 ma, and for children is about 15 to 20 ma. The current believed to be effective in controlling cattle is about 15 ma, and so the controller might be built which would be effective and safe. However, with reasonable voltages on the fence, varying ground resistance would make it difficult to maintain the current at a safe value without occasional increases into the danger zone. For this reason this type is not approved by the code.

The intermittent type of fence controller was designed to utilize higher output in order to increase effectiveness and to permit the use of both a-c and d-c sources of energy. The controller impresses a short shock on the fence which is followed by an off period of about one second during which it is assumed that the victim will release himself. The interrupted a-c type transforms power from an ordinary lighting circuit and applies a shock to the fence at intervals of about one second. The capacity discharge type utilizes the discharge of a condenser to furnish the shock impulse. The inductive discharge fence controller operates on the induction coil principle, and is usually energized from batteries. The regulations provide for a maximum impulse current limitation of 300 to 500 ma, a quantity limitation of 3 milliamperes, and an off-period of at least 0.75 second.

The current output of these types must be limited in order to prevent fibrillation of the heart, or respiratory block. Judging from the thousands of these units in use, the regulations are sufficiently stringent to prevent fatalities under normal circumstances. The safety of the unit depends upon the victim being able to release himself during the off-period. Under normal circumstances this may be assumed possible, however, if the animal or human were to get caught or to become paralyzed by fear or muscular contractions the repeated shocks would be torture. The types are considered safe from an electrical viewpoint, and are generally so in the field.

The third type of electric fence controller is the single impulse. A high d-c potential is maintained on the conductor, and a single impulse shock is delivered instantly upon firm contact. Repeated contact will cause repeated shock. However, if a person grasps the fence, the impulse rapidly decreases to a small sustained current which may be easily released by the individual. From the results of field and laboratory tests, this type is considered to be reasonably safe to animals and humans. With the advent of the electronic tube into the fencer field this type is becoming more common. Rectifier tubes are used to provide the high d-c potential necessary, while gas-filled glow tubes are used to control breakdown and the discharge impulse.

Summarizing then, the types of controllers, it is seen that the non-interrupted controller is dangerous and not approved by the codes; that the interrupted type, when manufactured according to code, may be dangerous under unusual circumstances but is reasonably safe; and that the single-impulse controller is believed to be effective and the safest type.

References:

Poehler, H. A., Effects of Electric Shock, **Electronics,** 17, No. 7, p. 140.

Dalziel, C. F. and Lagen, J. B., Effects of Electric Current on Man, **Elec. Eng.,** 60, No. 2, p. 63.

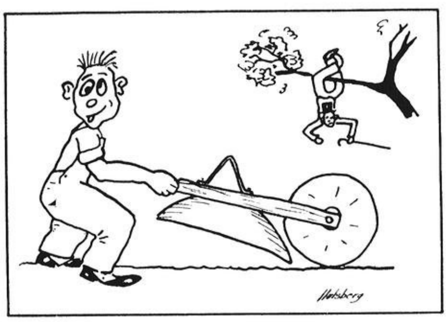
Ferris, L., King, B., Spence, P., and Williams, H., Effects of Electric Shock on the Heart, **Elec. Eng.,** 55. p. 498, 1936.

Langworthy, O. R., Nerve Cell Injury in Cases of Human Electrocution, **Journal American Medical Assoc.,** 95, p. 1107, July 12, 1930.

Kennelly, A. E., and Alexanderson, E. F., The Physiological Tolerance of A. C. to 100,000 Cycles, **Electrical World,** 56, p. 154, 1910.

Conrad, A. G., and Haggard, H. W., Experiments in Fatal Electric Shock, **Elec. Eng.,** 53, p. 399, March, 1934.

Kouwenhoven, W., Hooker, D., and Lotz, F., Electric Shock, Effects of Frequency, **Elec. Eng.,** 55, p. 384.



Ever feel this way?

SOPHOMORE LAB . . .

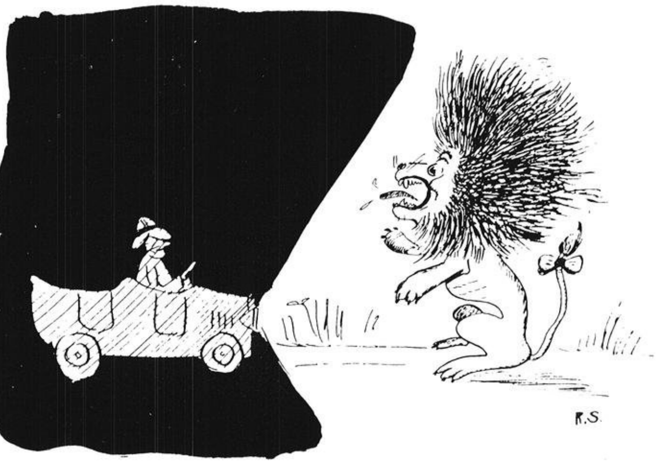
(continued from page 11)

ment of resistances, including the Wheatstone bridge and the voltmeter-ohmmeter methods, temperature rise in the windings of a coil, electromagnetic induction between power and telephone lines, magnetic leakages, and a determination of the B-H characteristic of a sample of sheet steel.

While most of the experiments are performed with direct current, both direct and alternating current power are available in the laboratory. A typical terminal board at the test position, the wiring to the distribution board, and the available power sources are shown in the above diagram. The direct current power of 115 volts and 50 kilowatts is generated in the dynamo laboratory on the first floor of the building. This power is controlled by a voltage regulator in order to keep it constant and is then grounded and carried to the distribution switchboard, where a 115 volt circuitbreaker is placed to prevent damage in case of an accidental short-circuit. All wiring is heavy enough to carry one hundred amperes continuously. From the distribution switchboard the power is carried to the various wall terminal switchboards for use in experimental work. The three phase alternating current comes from the 115 volt, 60 cycle three phase transformer secondary windings, and the line is protected by fuses between the source and the double-throw switch. The three wire alternating current comes from the 115/230 volt three wire source, providing either 115 or 230 volts. This line is also protected by fuses between the source and the double-throw switch. Circuit-breakers are placed in all three A. C. wires which carry the power to the wall terminal switchboards.

Safety rules in the laboratory have two purposes, both of which are inseparably related. Of primary importance is prevention of accidental injury to the experimenter. Definite rules covering the wiring of circuits and safe procedures are stressed, and each experiment has with it specific precautions to be taken. Artificial respiration is demonstrated to and practiced by the students at the beginning of the course so that they will be prepared to administer to anyone receiving an electric shock which results in cessation of breathing. Of secondary importance regarding safety is prevention of damage to delicate apparatus. The instruments used are easily damaged by rough handling and must be protected against voltages and currents beyond their full scale readings. Only through proper use of the equipment can accidents to the experimenters be avoided, and upon this fact all emphasis on safety precautions is placed.

The importance of a sophomore electrical laboratory in preparing a groundwork for later specialization is recognized by faculty and students alike. Thanks to the important work and untiring efforts of Professors Bennett, Kelso, Crothers, Larson, Benedict and Kubiak, the present modern, scientific laboratory leaves little to be desired.



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