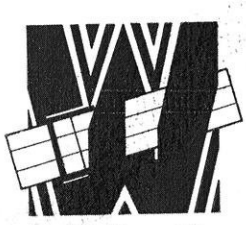
The Wisconsin engineer. Volume 40, Number 3 December, 1935

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

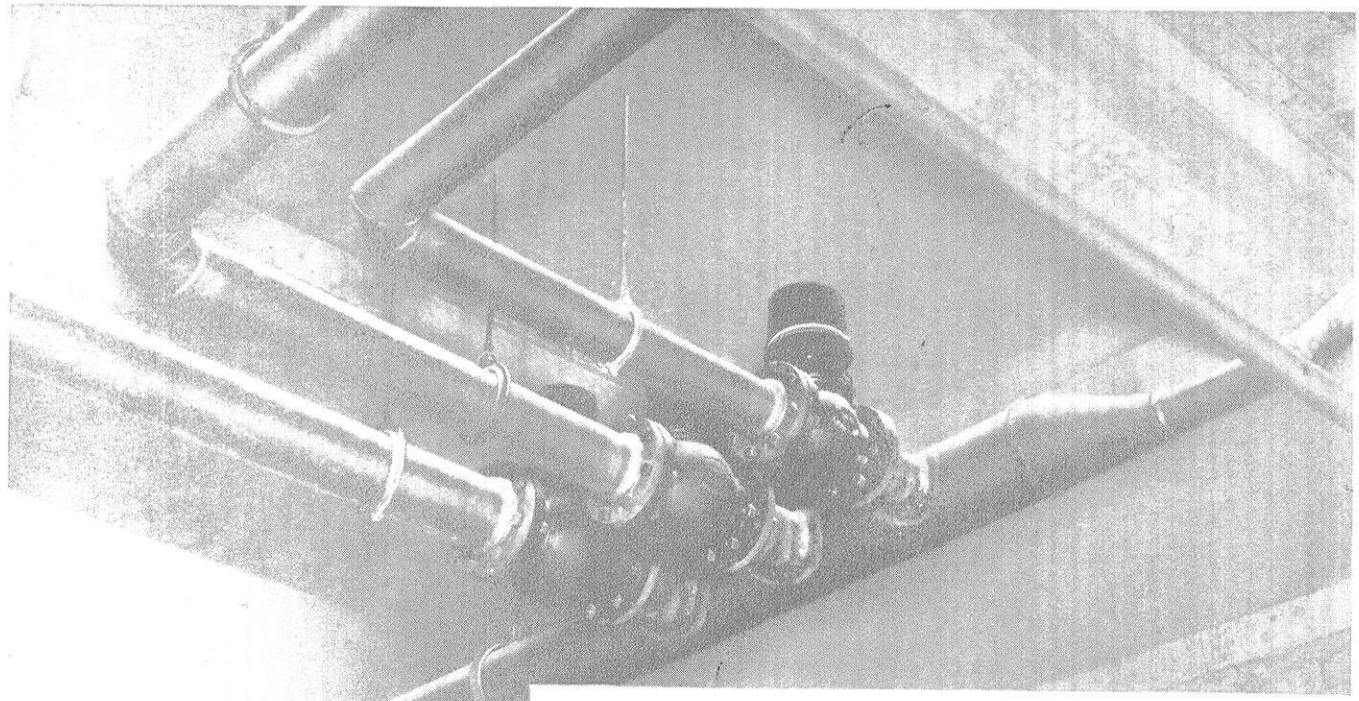
https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

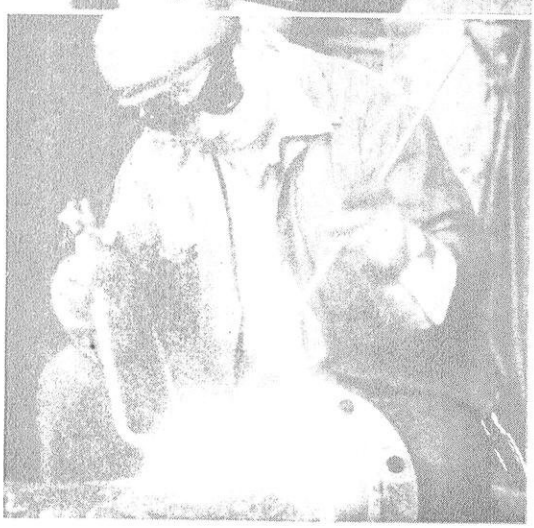
THE WISCONSIN ENGINEER



DECEMBER 1935

Member, Engineering College Magazines, Associated





On the installation shown above, the contractor fabricated by oxy-acetylene cutting and welding the bends, reducers, and other specials in his shop and installed them with tie-in welds on the job. The lines and bends were installed with a proximity which would have been impossible by other methods of joining. The insulation contractor estimated a 30 per cent saving on insulation labor because it was a welded installation.

OXWELDED PIPING SYSTEMS

. . . *are easier to install and cheaper to maintain*

● The economy of oxy-acetylene welded piping for power or domestic and industrial heating purposes extends all along the line. Oxwelded piping systems are cheaper and easier to install, and, once installed they are leakproof and lasting. There are no maintenance expenses on a system put in by this modern process.

Let Linde Help You

The Linde organization can help you with your welded piping projects from the first blue prints to the finish of the actual installation. Linde customers benefit from the closely coordinated research, development and field engineering facilities of the Linde organization. The Linde representative, who assists you as a part of Linde Process Service, makes the results of this research, development and field experience available to your organization.

You can arrange for this cooperation by communicating with the nearest Linde Sales Office or with 30 East 42nd Street, New York, N. Y. Address: The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES

FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

Editor
GEORGE H. COOK

Business Manager
TOM J. WILLIAMS

Editorial Staff
HOWARD HOLM, min'36
LEO NIKORA, m'36
ROBERT WHITESIDE, e'36
PAUL KETCHUM, e'38
F. BRAND WHITLOCK, e'38
ALDRO LINGARD, e'38
JOHN VAN VLEET, m'36
FRED ALEXANDER, e'38
ALLEN JORGENSEN, m'38
LEO HERNING, ch'38

Business Staff
HERBERT WILSON, m'37
VINCENT ESSER, e'38
MYRON ROSHAR, ch'38

The WISCONSIN ENGINEER

Published monthly from October to May, inclusive, by the Wisconsin Engineering Journal Association, 219 Engineering Bldg., Madison, Wis.

Member Madison Association of Commerce

△

Telephones University 177W - 277
Founded 1896

With the Contributors . . .

△ The midwest, especially Wisconsin and Illinois, has been the scene of fast train service inauguration. The timely article by Mr. Swanson presents some of the engineering difficulties encountered in high speed train development.

△ Messrs. V. M. Murray and L. C. Larson were recently called upon to investigate the problem of rural wiring. Read here how they attacked and solved a typical engineering investigation.

△ Do you remember when your city water supply used to be shut off upon the slightest provocation? Those days are gone forever, for your water works service is now kept at a high level by some of the devices explained in this issue.

△ What would you have done without those convenient fraction conversion tables in Shop 5? Ford Motors engineers have thrown theirs out of the window and are now using an inch that is divided in fiftieths. It's a step in the direction toward a more rational measuring system.

MERRY CHRISTMAS
—THE STAFF

VOLUME 40 DECEMBER, 1935 NUMBER 3

CONTENTS

FRONTISPIECE — Aerial View of Boulder Dam and Lake — *Courtesy Aero Digest*

HIGH SPEED STREAMLINE TRAINS — Maurice C. Swanson . . 43

AN IMPROVED NON-METALLIC SHEATHED WIRE — V. C. Murray and L. C. Larson 45

ON THE CAMPUS 48

ALUMNI NOTES 50

MODERN DEVICES FOR IMPROVING WATER WORKS SERVICE 52

THE CRITICAL ANGLE — Editorials 54

STATIC — By Engine Ears 56

SYNTHETIC COLLOIDS TO IMPROVE CONCRETE . . . 57

FORD MOTORS ADOPT NEW MEASURING SYSTEM . . . 58

CAMPUS ORGANIZATIONS 60

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

Subscription Prices:

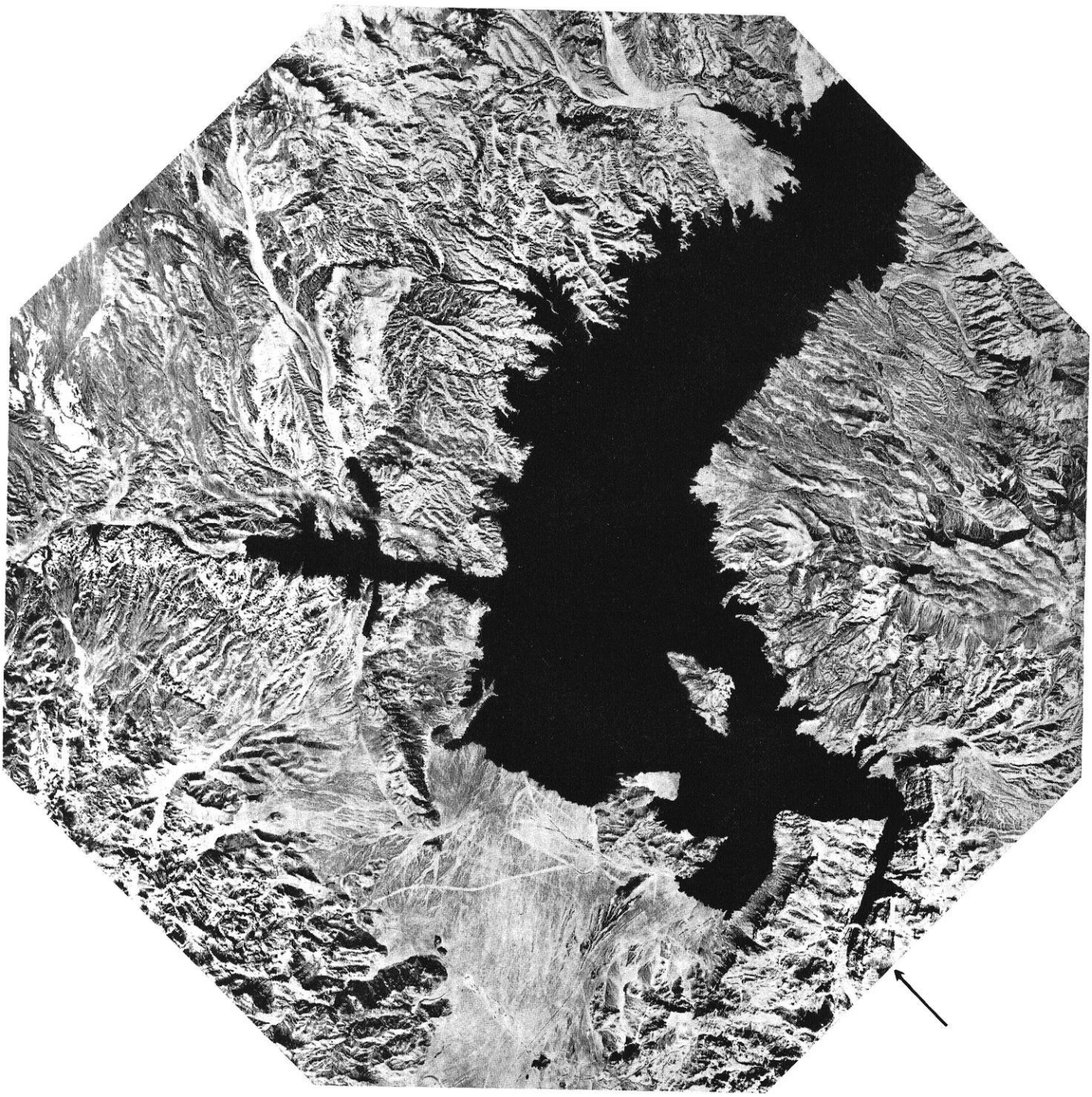
$1.00 per year **Single copy 15c**

Member of Engineering College Magazines, Associated

Leonard H. Church, *Chairman*, 501 Guardian Bldg., Cleveland, Ohio

Arkansas Engineer
Colorado Engineer
Cornell Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Nebraska Blue Print
North Dakota State Engineer
N. Y. U. Quadrangle
Ohio State Engineer
Oregon State Technical Record
Penn State Engineer
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Tech Engineering News
Villanova Engineer
Wisconsin Engineer
Washington State Engineer

College Publishers' Representatives, Inc., 40 East 34th St., New York



Two hundred square miles of territory surrounding Boulder Dam (arrow) and Lake are seen in this photograph

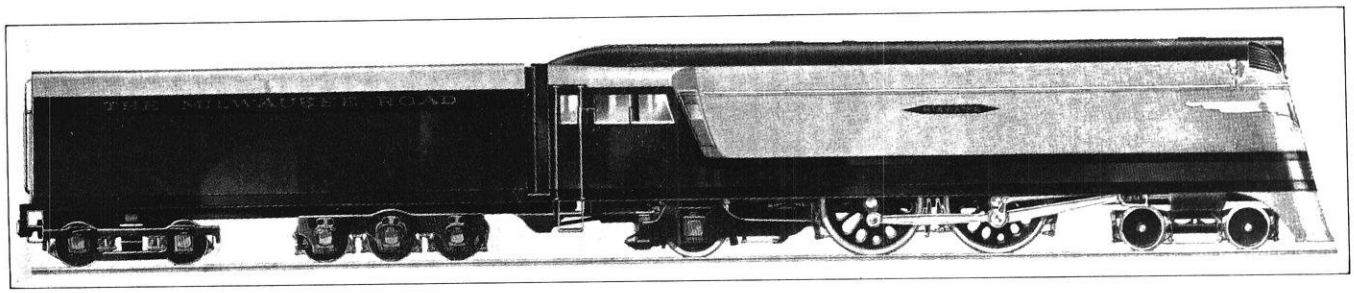
Courtesy—Aero Digest

The WISCONSIN ENGINEER

VOLUME 40, NUMBER 3 DECEMBER, 1935

High Speed Streamline Trains

by **MAURICE C. SWANSON**



The Hiawatha

RECENTLY, everyone has become streamline conscious. Within the last few months many of the railroads have inaugurated swift and picturesque streamline trains. There now operate from Chicago, three new streamliners to the Twin Cities, and one to the Coast. The near future will produce at least three more of these new trains, two to the Coast and one to St. Louis. This paper is a brief consideration of their mechanical and structural features.

Back in 1892, crudely streamlined, 400 h.p., 100-mile an hour electric cars were designed to operate over the proposed, but never completed, Chicago-St. Louis Air Line. Eight years later, the Baltimore and Ohio Railroad built at the Mt. Claire shops, a completely streamlined passenger train consisting of two locomotives, five coaches with hooded trucks, and an observation car, the rear-end of which had been built in the form of a vertical parabolic surface. This train, known as "The Windsplitter," made the 97-mile run from Philadelphia to Baltimore in 101 minutes.

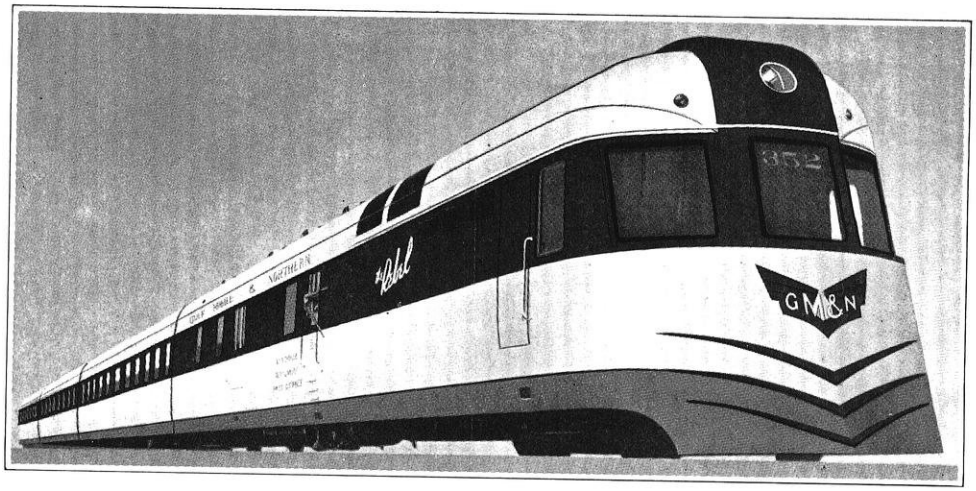
A few years ago the Budd Manufacturing Company built a light-weight, stainless-steel car, 22,000 lbs. in weight, and fifty feet in length, for branch line service on the Reading Railroad. The car body rode upon two, six-wheel trucks, the wheels being equipped with rubber tires. In the forward truck, there was mounted a 125 h.p. Cummings engine directly connected to a 250 volt, Westinghouse generator furnishing power to a traction motor in the rear truck. A short while later, the Texas and Pacific began operation of a streamline, stainless-steel, two-car coupled, Deisel-electric train in Texas.

The Union Pacific Railroad, which has contributed much to the development of the streamline Deisel-electric train, conducted its research in the Aerodynamic laboratory at the University of Michigan. In order to secure data under conditions corresponding to running speeds, much of the experimentation was carried out with 90-mile an hour air speeds. After final measurement of the drag in the wind tunnel, it was found that the train traveling at 90 miles an hour would have a total wind drag of 950 lbs., thus requiring 228 rail h.p. or 285 b.h.p. to take care of the wind factor alone. All of the mechanical resistances due to rolling journals, flanges, etc., were estimated by the best formula available to be approximately 850 lbs. at 90 miles per hour. Thus, the total calculated resistance was found to be approximately 1800 lbs., which necessitated 432 h.p. at the rail or 540 b.h.p. Inasmuch as the maximum output of the engine was 660 b.h.p. and that of the generator 600 b.h.p., the train acquired a balancing speed of 91 m.p.h. as compared to the specified speed of 90 miles per hour.

The starting and stopping of a train, such as this, brings up some interesting facts and figures. The acceleration is such that the train can attain a speed of 60 miles per hour in 1½ miles, 80 miles per hour in 5½ additional miles, and 90 miles per hour in from 14 to 15 additional miles. When the train has reached this speed, the problem of arresting the 54,000,000 ft. lbs. of energy in the case of

the three-car train or the 120,000,000 ft. lbs. in the case of the six-car train in 40 seconds or the standard distance of 3,000 feet, becomes a difficult one.

Heretofore, uniform retardation was found to be difficult because the coefficient of friction between the brake shoe and wheel varies widely with speed and pressure, being as high as 25 per cent at low speeds and fading out to 5 or 6 per cent at 100 miles an hour. While high percentages of braking power would be safe at high speeds in deceleration, a point of speed would be reached where the wheels would suddenly lock with disastrous results.



The Rebel

Thus, in cooperation with the air brake companies, an entirely new automatic releasing device called a "decelekron" was devised, which consists of nothing more than a 100-pound weight mounted on bearings and arranged to move in the line of motion of the train. The weight is suitably restrained from forward or backward motion by calibrated springs. By means of a lever arrangement, the weight actuates a pneumatic releasing valve, which operates to release air from the brake cylinder when the forward spring has become compressed to a certain predetermined amount. Thus, by means of this device, it has been made possible to take full advantage of high braking pressures and yet keep within the coefficient of friction between the wheel and rail. It is possible to safely stop the train from 90 miles an hour in a distance of 2,745 feet, as compared to the 3,000 feet minimum stopping distance of an ordinary steam train from 60 miles an hour.

The cars of the Union Pacific have not been connected by the conventional method of automatic-coupling, but rather by what is known as articulation. Inasmuch as the train is to be permanently coupled, one truck under each car could be eliminated by placing a truck under the connection between the cars. Protruding from below the floor of the car body on each end are two cast-steel discs each with a hole through its center; the discs drop over the king bolt on the truck and support the ends of the car bodies. Although a saving in the number of trucks has been accomplished, the point of suspension of the car body has been removed from the centers of percussion. Thus an added responsibility has been placed on the riding quality of the trucks.

In a high speed train, no part plays a more vital role than the trucks which carry the rolling load along the rails at high speeds. The function of the truck is to translate the sharp shocks and vibratory motion of the wheels and axles into a quiet, smooth motion of the body above. Thus a type of truck has been chosen which confines the unsprung weight to the wheels, axles, and roller bearings, and which would insulate vibration by the use of rubber acting in shear.

The Union Pacific now has completed two of these trains. The first, a three-car train, 204 feet in length, weighing 190,700 lbs. and powered by a two-cycle, six-cylinder, 600 h.p. Winton Deisel engine, has been placed in service between Kansas City, Missouri, and Saline, Kansas. The second, a 900 h.p. train of six cars, 376 feet in length, and weighing 420,000 lbs., has been placed in service between Chicago, Illinois, and Portland, Oregon. This train makes a 2,272-mile run in 39 hours, or an average speed of 58.2 m.p.h. At present, two more nine-car, Pullman trains are under construction for service from Chicago to the West coast.

Last spring, the Burlington Route placed in service between Chicago and the Twin Cities, two three-car, 197 feet Shotweld, stainless-steel trains, powered by an eight-cylinder, two-cycle, 660 h.p. Winton Deisel engine. The main generator, a differentially-wound General Electric machine, produces current for two 300 h.p. self-ventilated motors in the front truck. The motor control consists of an electro-pneumatically operated controller operated by a master controller in the cab. The motors are progressively-connected series, parallel, and parallel short field positions. All of the control has been mounted in convenient switch cabinets placed inside the car.

The remaining Deisel-electric articulated train installations are all very similar in appearance and construction to the Union Pacific and Burlington trains. On a 488-mile run between Jackson, Tennessee, and New Orleans, the Gulf, Mobile and Northern has placed a streamline, Cor-ten steel, four-car train, drawn by a three-car, 207-foot train equipped for two-end operation. In each end has been placed a Westinghouse, six-cylinder, 400 h.p. Deisel engine. Two neighboring roads, the Boston and Maine, and the Maine Central, have begun joint operation of a three-car Deisel-electric train, the "Flying Yankee," between Portland and Bangor, Maine, on a 136-mile run.

Because of a number of serious disadvantages of the long, articulated motor train, a number of roads have begun experimentation with Deisel-electric locomotives in drawing new, light-weight and ordinary heavy coach trains. Because the length of the articulated train remains fixed and is thus not adapted to variation in volume of

traffic; because it is inconvenient in switching and turning around, and is easily put out of service in its entirety by a minor breakdown, the Illinois Central, Baltimore and Ohio, Santa Fe, and Burlington roads have been led to consider the Deisel-electric locomotive as a replacement for the steam locomotive on some fast passenger runs.

Not only are railroad men divided in their choice of oil-electric or steam locomotion, but the steam advocates have disagreed among themselves. On the one hand, we have the Milwaukee Road who produced a new, beautifully streamlined, high pressure locomotive, for drawing light-weight streamlined coaches. On the other hand, we have the Northwestern Railroad with its rebuilt Pacific type engines drawing rebuilt coaches on just as fast a schedule as that upon which any streamliner operates.

The two locomotives, built by the American Locomotive Company for the Milwaukee Road have incorporated a number of new features besides the streamlining, namely, the use of a boiler pressure of 300 lbs., oil fuel, all welded, silicon manganese steel boiler, and rods of light nickel alloy. The all-welded coaches are 40 per cent lighter than the ordinary coach. The streamline effect is completed by a beaver-tail observation car.

The Baltimore and Ohio Railroad has just received two new high speed and high pressure, and somewhat streamlined, steam locomotives with 84 inch drivers to be operated with new Cor-ten steel coaches of 40 per cent less weight than those formerly used. The New York Central has completely streamlined a number of their Hudson type engines in service between Chicago and New York.

These forementioned installations of new and radically designed 100-mile an hour equipment usher in a new era of railway train design. Which of these many types of motive power and equipment will prove the more efficient in operation and maintenance and yet satisfy this new demand for speed remains to be seen.

An IMPROVED *Non-Metallic Sheathed* WIRE

by **V. M. MURRAY** *and* **L. C. LARSON**

IT WAS the original purpose of this study to attempt to evolve a method of wiring rural buildings which would meet the requirements peculiar to this type of structure and at the same time use only wiring materials and devices now on the market. The system developed, then, would be new only in the sense that it might be a new arrangement of existing materials and devices. This plan was adhered to as closely as possible but, as will be shown later, it was soon discovered that the solution lay in completely sheathing the entire installation in a non-metallic, insulating covering. Since outlet boxes of such material were not manufactured, it was necessary to design and have built boxes of the desired type. These boxes are **now** on the market so that it can now be said the original object has been attained.

It is proposed, first, to discuss the special requirements of a wiring installation for rural buildings; second, to point out how the present methods of wiring fulfill or fail to fulfill these requirements; and, finally, to describe in detail a method of wiring developed at the University of Wisconsin which fulfills these requirements to a greater extent than do the existing systems.

I. *Requirements of a Good Wiring Installation for Rural Buildings*

The one type of rural building which presents the most interesting and singular wiring problem is the barn used to house livestock. A study of other rural buildings shows that the wiring of them will present no important problems not encountered in the wiring of such a barn. Attention, then, should be focused on barn wiring.

For instance, the wiring in the vast majority of such barns is fully exposed. This involves not only the protection of the conductors from mechanical injury, but also the protection of persons and livestock from electric shock. Such shock is generally caused by the unexpected existence to ground of a potential not exceeding 110 volts. For human beings such a shock may be merely uncomfortable, but for the average farm livestock it is highly dangerous and very probably fatal.*

Again, barn wiring, if it is to have a reasonably long life, should be highly resistant to the corrosive actions of **moisture**—caused by condensation from the humid atmosphere of stables; **gases** — such as ammonia fumes; and **disinfectant compounds**—with which dairy barns are often sprayed.**

A third requirement is that the initial cost of the installation be low. This is of prime importance to the rural consumer because:

Finally, the fire hazard introduced by wiring the building for electricity should be very small. It is the opinion of the writers that this hazard **is** very small with the methods now in use. Indeed a study of approved methods and devices makes it extremely difficult to understand how the permanent wiring of a building **can** cause a fire. This opinion is further strengthened by a recent detailed study of the fires in Wisconsin for 1934 which shows that the

*See *Electrical Stunning of Cattle* by H. J. Koenig and *Electrical Stunning of Hogs* by R. W. Regensburger—papers presented at a meeting of the Operating and Engineering Section of the Institute of American Meat Packers, October 17, 1930. Also records, either published or available for inspection, of *Industrial Commission of Wisconsin, Hydro-Electric Power Commission of Ontario, Low Voltage Hazards Sub-Committee N. E. L. A.*

**As is required, for instance, in the Chicago milk-shed area.

permanent wiring could not have produced more than 1.2 per cent of the total number of fires for that year.

II. *Present Methods of Wiring Rural Buildings*

Rigid Conduit: Probably no greater protection can be given the conductors against mechanical injury than to surround them with a rigid steel wall as furnished by rigid conduit. The protection of the conductors is certainly adequate. There is, however, some question as to the adequacy of the protection given persons or livestock against electric shock. Ideally, the conduit forms a continuous low resistance electrical connection from the far end of any circuit to the grounded neutral bus in the cut-out box. In actual practise this is often not the case. High contact resistance at junctions—particularly outlet boxes—makes it quite possible for a section of conduit to become "alive" while not permitting the passage of sufficient current to clear the fault by "blowing" the fuses.

Regarding the life of this type of installation: Conduit, even galvanized, is not sufficiently resistant to the corrosive action of the moisture, fumes, etc., present in stables. In the experience of the writers, the average life of this type of installation **when installed in buildings housing livestock** is about six years. Indeed, condensation within metal raceways and boxes is so severe that it is now common practise to specify drain holes in the system.

As regards initial cost: Conduit is the most expensive of all three methods of wiring. This is caused not only by the high cost of the conduit itself (the pipe), but by the large labor costs incurred in installing it.

Rigid conduit, then, while offering excellent protection to the conductors, has considerable shock hazard, is short-lived, and very expensive.

Armored Cable (B.X.): In this type the protection afforded the conductors is probably not as great as conduit but it certainly is adequate. The shock hazard, however, is not only as great as when conduit is use, but it may be greater. Some types of B.X., after having been installed for some time, develop an insulating film on the spirally wrapped armor which is sufficient to insulate adjacent turns from one another. Any fault current in the sheath must then follow the spirals of the metal, thus introducing a higher impedance to the grounded bus in the cut-out box than is the case with conduit.

There seems to be no reason to regard a B.X. installation as more resistant to corrosion than conduit. It is, however, very much cheaper installed.

To summarize: The B.X. installation has well protected conductors and is very much cheaper than conduit. It does, however, offer considerable shock hazard, and it is short lived.

Knob and Tube: This method affords no protection to the insulated conductors except that which can be obtained by mounting in sheltered places and by using protective strips of wood. There is, though, very little possibility of obtaining a shock from the installation, largely because the amount of metal sheathing has been greatly reduced, —only the metal outlet boxes and their metal covers remain to constitute any hazard. For the same reason, the life of the knob and tube installation is much longer than either of the other two. As regards cost: Knob and tube is the least expensive of the three.

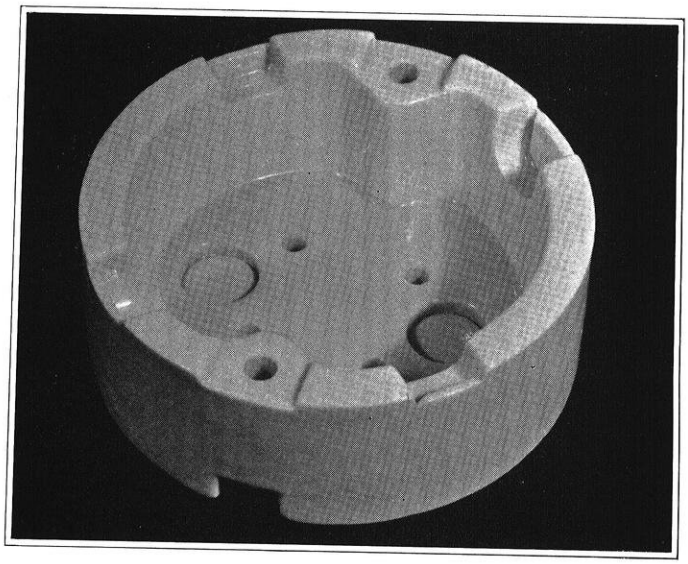


FIG. 1—*The porcelain outlet box, equipped with six thin-walled knockouts*

It is the studied opinion of the writers that, of all the **present** methods of wiring rural buildings, knob and tube (when carefully installed so as to obtain adequate protection for the conductors) is the best.*

III. *The Completely Non-Metallic Sheathed Installation*

In the last analysis, the problem of developing a wiring system suitable for rural buildings becomes little more than so improving the Knob and Tube method as (1) to

*Some very excellent work in knob and tube, fostered by the engineers of the Northern States Power Co., can be found in the northern portion of Wisconsin.

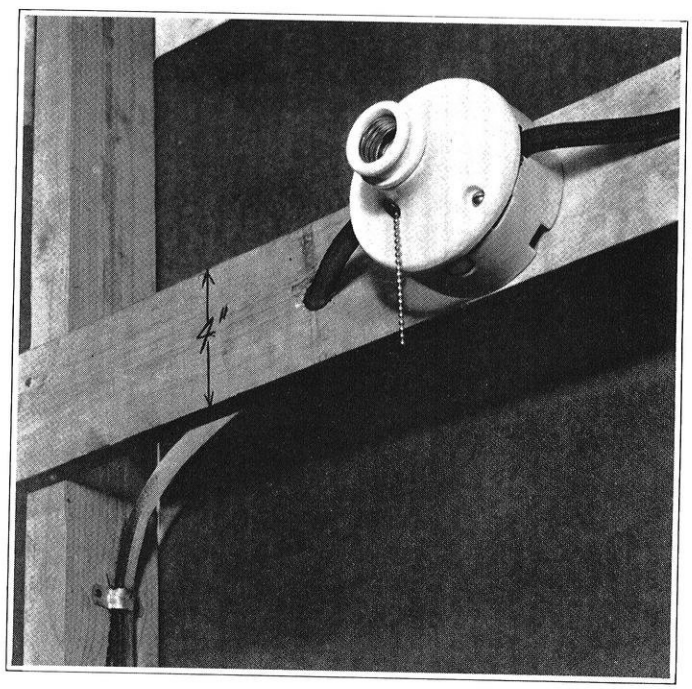


FIG. 2—*Looking up at a side wall porcelain receptacle, 7'2" above the floor level*

obtain more protection for the conductors and (2) to eliminate entirely the small shock hazard and the corrosion caused by the presence of the metal outlet boxes. In other words, to completely sheath the installation but to do it with non-metallic materials.

It is now proposed to describe in detail one method in which this was accomplished.

Outlets: The outlet boxes used were all of a new type developed as part of this study. The box, illustrated in Fig. 1, is made of porcelain and so dimensioned as to take any standard 4″ cover. It is, in effect, a 4″ box in porcelain. The only unusual feature is the use of U-shaped

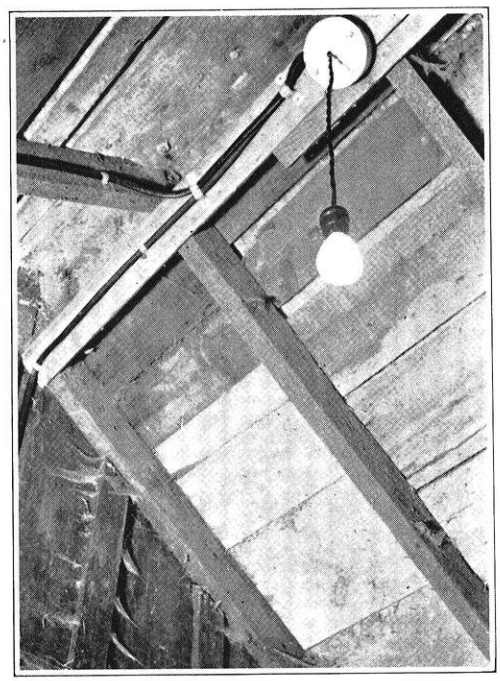


FIG. 3—*Looking up at a ceiling outlet. The procelain box carries a 4″ porcelain drop-cord cover plate, brewery drop-cord and bakelite socket*

cable openings instead of the usual holes. This not only gives stronger construction, but permits easier installation of the cable. No connectors were used.

Only the one type of outlet box was used throughout the entire installation,—for switches, convenience outlets, lamp receptacles, and junction boxes.* Since this box was built to take a standard 4″ cover, it was not possible to use the line of flush devices which fit in the standard sectional metal boxes. All switches, for instance, were exclusively of the surface type.

The box covers were 3/32″ thick and 4½″ in diameter and made of Grade XX, laminated Bakelite. This material, manufactured under many different trade names,** is an excellent insulator, fire resistant, absorbs very little moisture, and, while being sufficiently strong, is easily worked. It is, however, expensive. For this reason, covers made of asbestos-cement compounds have been employed experimentally.

The covers are held in place by 8-32 brass machine screws. These screws are completely surrounded by porcelain and therefore constitute no shock hazard.

Conductors: The type of conductor used was the approved non-metallic sheathed cable sold under various names, such as Romex, Braid-X, Cablex, Durax, etc. Such cable can be obtained in the following forms:

2—No. 14 conductors
2—No. 14 conductors with a bare ground wire
3—No. 14 conductors
3—No. 14 conductors with a bare ground wire

or the above combinations with other wire sizes.***

By using such cables, not only were the insulated conductors protected by the outside braid, but cables could be mounted snugly against a surface and not away from it as in knob and tube wiring.

In installing the cable two general rules were observed:

(1) Wherever possible, mount the cable directly onto wood stripping so as to give it a solid backing.

(2) Protect the cable when it is within seven (7) feet of the floor.

The application of both rules is shown in Fig. 2.

The cable was said to be sufficiently protected if:

(1) Mounted back against the siding of the building—the projecting studding furnishing sufficient protection.

(2) Mounted on the larger flat surface of the 2″x4″ or 2″x6″ studding.

(3) If a strip of wood is fastened alongside the cable in such a manner as to project above the cable.

(4) For horizontal runs, the cable is drawn through holes drilled in the studding at least 2″ from the inner edge and a piece of stripping at least ¾″x4″ is nailed in front of the cable.

Grounding: Because of the extremely small shock hazard of this type of installation, the minimum amount of grounding required by the Codes was regarded as sufficient. The farm installation made as part of this study has only one ground — that at the meter service.†

If it is desired to ground the frame of some metal-clad appliance which is wired into the system, this could be done in two ways: One method—the simplest—is to drive a ground at the machine itself. If, however, there are several units to be grounded, the type of cable containing a bare ground wire should be used. This wire can be connected from the frame of the machine to the neutral conductor in the cut-out box or service switch used as entrance to the building. Under these conditions, **the neutral must be grounded** at the entrance to every building in which such an arrangement is used.

Costs: The non-metallic sheathed cable system has been installed on the B. W. Qualley farm near Stoughton, Wisconsin. The electrical contractor (A. M. Quam) displayed extraordinary interest in the cable system. His records provided the following data:

(Continued on page 51)

*The writers have been lately informed by the Standard Electrical Porcelain Manufacturers of Chicago, Illinois, that the companies which are members of this group plan to market a *complete* line of non-conducting outlet and junction boxes.

**Such as Synthane, Dilecto, Formica, Spauldite, etc.

***A new type of non-metallic sheathed cable, tentatively called "protected neutral concentric cable," is now being manufactured by The General Cable Corporation, New York. It is even more compact and requires less protection than the types listed here.

†Permitted, in this case, by the Industrial Commission of Wisconsin.

ON THE CAMPUS

N. Y. A. JOBS

These days in the various departments of the College of Engineering you will find 99 energetic engineers doing a great variety of things as their duties under their N. Y. A. jobs. In addition to this number, there is another fairly large group of engineers employed on N. Y. A. jobs in other branches of the university.

All of us, at one time or another, have wondered whether these N. Y. A. positions were really doing some good or whether they were just "soft jobs" where lucky students could earn a portion of their expenses doing not much of anything. This idea, of course, is decidedly wrong. Besides having to work diligently at useful occupations for their money, undergraduates holding N. Y. A. jobs must earn at least a 1.0 grade-point average or they are immediately dropped. Graduate students have a higher standard to reach—they must earn 1.5 grade-points per credit to keep their positions.

Here are some typical occupations of some of the N. Y. A. workers in the College of Engineering:

In the Chemical Engineering department there is a senior working to determine more about the microstructure of nickel deposits. There are a number of civils in the Highway Engineering department helping develop tests to measure the quality of alphaltic products used by the highway commission.

Conducting experimental work on a new type of domestic water heater, collecting data on hot water consumption in homes, and doing experimentation on plumbing and water heating problems keeps a number of men busy in the department of Hydraulic and Sanitary Engineering.

The Electrical Engineering department has men tackling the problem of protecting distribution circuits from damage by lightning. In connection with this, laboratory tests to determine the effectiveness of lightning arresters are being carried out and some work is being done on the apparatus and methods of testing. They are also developing photometric and illumination demonstration apparatus. This apparatus is being designed and constructed so that it will be useful to demonstrate lighting and illumination principles for classroom and general use.

Mechanicals interested in domestic heating are helping the Mechanical Engineering department run a comprehensive test on oil burners. They are trying to determine the relation of the gravity of the oil to the efficiency of the burner, the value of a heat saver on an under capacity boiler, and the relation of the size of flame to the efficiency of the oil burner.

Figuring the effect of form and scale on strength of materials, testing a large number of specimens of various forms, sizes, and materials in tension, cross bending, impact, and fatigue, computing strength properties, and charting results occupies part of the time of a number of men in the Mechanics department.

The Topographical Engineering department has a considerable number of men working on surveys in various locations near the campus.

●

DYNAMIC BALANCING DEMONSTRATED

The engineers who are taking Steam and Gas 109 and Machine Design 5 were present at a demonstration of static and dynamic balancing of machine parts given by the Gisholt Machine Company at their plant Tuesday morning, December 3.

This company is one of the few who manufacture dynamic balancing machines. Shafts are balanced while rotating at their critical speeds by very specialized machines using calibrated scales and correcting gages. After the demonstration the group was shown through the plant and the newly installed boilers. Mr. Senger, m'23, was in charge of the demonstration.

ALL-UNIVERSITY XMAS FESTIVAL

Slide rules aren't the only things that occupy the attention of Wisconsin engineers. Proof: witness the fact that three engineers were appointed to positions on the committee in charge of the All-University Christmas Festival to be held in Music Hall on Tuesday, December 17, at 7:30 p. m.

Russell Baum, m'37, is general chairman of the fete, an event which, since its innovation nine years ago, has become a tradition in the life of the university.

Among Mr. Baum's assistants are Gay Upjohn, e'38, and Herbert Wilson, m'37.

Mr. Upjohn is in charge of the arrangements for the carolling tour which immediately follows the program in Music Hall. Five Greyhound buses have been chartered to carry the crowds of students to Madison hospitals and other institutions where they have been asked to sing. About 100 free tickets are on reserve at the Memorial Union desk for those who want to carol, the committee has announced.

Chairman of the committee on decorations and arrangements, Mr. Wilson, is planning a transformed Music Hall. With brightly lighted Christmas trees and fragrant evergreen boughs, the interior of the hall will set the mood for the approaching holidays and carry out the spirit of Yuletide.

The festival is sponsored every year by the local Y.M.C.A. and Y.W.C.A. organizations. The program will include Christmas songs by the Tudors, prominent music organization on the Hill, a short drama presented by Zeta Phi Eta, national honorary speech sorority, Christmas readings, organ music, and singing en masse by the students.

Additional committee chairmen (non-engineers) are: Elinore Ungerman, program; Betty Schlimgen, advertising; Mildred Marshall, contacts; Jean Heddemark, music; and Elinore Irish, publicity.

KOEHLER CONTRIBUTES TO RADIO ENGINEER'S HANDBOOK

The second edition of the Radio Engineer's Handbook, published about December 1, contains a section on "Audio Amplifiers" written by Prof. Glenn Koehler. Professor Koehler presented the subject of Amplifier Design in a new way and put forward a new theory on Class B Amplifiers.

The Radio Engineer's Handbook is published by the McGraw-Hill Co. The first edition came out in 1931.

●

PROF. OWEN BACK

After an absence of more than a month due to a gastric hemorrhage, Professor Ray S. Owen has returned to his classes. Although he is back, Professor Owen has not yet regained his strength and is on a liquid diet which calls for milk, cream, and orange juice every two hours.

●

AIR-CONDITIONED ROOM

In the basement of the Engineering building, in the Mechanics department, an air-conditioned room has recently been constructed under the direction of Mr. K. F. Wendt. The room is steam heated and has a constant circulation of air which can be controlled for heat, between 45° and 90°, for relative humidity, between 20 and 90 per cent, and for speed of air circulation by a large three-speed fan.

It is cooled by a standard refrigerating unit which cools the air going through the fan. Humidity is controlled by injecting a fine mist of water into the air stream when it is necessary to add water.

The last two or three weeks have been spent in calibrating and adjusting the instruments so they read accurately, but soon it will be used for testing purposes. The room is to be used to store mixes of mortars, or bricks, or the like under constant conditions of temperature and humidity. Probably on some of the tests even the mixing will be done in the room so that standard conditions will prevail during the whole run of the test.

●

OUR SYMPATHIES

The staff of the Wisconsin Engineer extends its sympathies to Prof. L. F. Van Hagan in his recent bereavement due to the death of his mother on December 4.

DAWSON MADE OFFICER OF C.S.S.W.A.

Frank M. Dawson, professor of hydraulic engineering, was elected vice president of the Central States Sewage Works Association at the meeting at Urbana, Illinois, on October 25 and 26. L. H. Kessler, assistant professor of hydraulic and sanitary engineering, described the use of a new device for the rapid determination of oxygen utilization in the control of the activated sludge plant at Monroe, Wisconsin. Donald E. Bloodgood, '26 and engineer in charge of the Indianapolis activated sludge plant, reported the results of experiments at that plant on the digestion of garbage with sewage sludge.

●

C. F. BURGESS SPEAKS TO SENIOR CHEMICAL ENGINEERS

The students in Dr. Watts' course in applied electochemistry were privileged to hear Mr. C. F. Burgess when he visited the chemical engineering department Friday, December 6. Mr. Burgess was chosen to head the chemical engineering department when it was originated here, and is now chairman of the board of directors of the Burgess Laboratories.

Long a staunch friend of Thomas Edison, Mr. Burgess related some of the incidents which occurred during their friendship. His long relationship with research men has led Mr. Burgess to some interesting conclusions concerning success in engineering. He stated that "Some people go through life without seeing many things. The ability to observe and understand what you see can be developed by practice. A research laboratory does not need elaborate equipment, but it does need men who can think."

●

CIVILS DOING RESURVEY

Eight students in the Civil Engiing school are at present employed on a resurvey of some United States Coastal Geodetic Survey monuments which were laid out two years ago. The funds for this work are provided by the National Youth Administration.

The monuments were set out as a C. W. A. project in the winter of 1933, but like many of these alphabetical projects, the work was hurried and funds ran out before the work could be suitably checked. Hence, the need for the present resurvey.

The purpose of these monuments is to have a system throughout the states, so that surveyors will not have to go a long distance before they can tie into a monument, the elevation and coordinates of which are known.

●

FLUID FLOW

Professor O. L. Kowalke and P. G. Ellis of the chemical engineering department have recently taken some interesting pictures of fluid flow through a square-edge orifice. The apparatus is made of glass with a brass orifice plate and contains glycerine with suspended aluminum powder to obtain effects that may be photographed.

●

CORRECTION

The November issue of the Wisconsin Engineer carried an incorrect account on this page of Prof. B. G. Elliott heading the committee arranging the "Solid Fuels and Domestic Stokers" conference. Prof. L. A. Wilson is chairman of this committee and deserves all due credit.

●

ENGINEERS OF THE DANCE

The new course in Social Engineering, recently inaugurated at Wisconsin, met for the first time this semester in the Memorial Union Friday night, December 6. To the music of two campus bands, 400 engineers (there were also some lawyers) and their escorts removed all thought of Steam and Gas reports from their minds and spent a very enjoyable evening. Some of the senior engineers topped off a perfect evening by going on duty after the dance for the test run at the university heating plant.

●

NICE GOING, EDDIE

Eddie Jankowski, junior mechanical from Milwaukee, has been voted most valuable player on the 1935 Wisconsin football team by his team mates and will be one of the 10 candidates for the Chicago Tribune most valuable Big Ten player trophy.

Jankowski was a high school sensation in Milwaukee and soon made a reputation as a Badger frosh star in 1933. Last year he was used at fullback, but he alternated at fullback and right half this season for Wisconsin, being used most of the time at right half.

ALUMNI NOTES

MECHANICALS

RUEDEBUSCH, RICHARD, '10, works in the research department of the Boston Blacking and Chemical Co., Cambridge, Massachusetts.

SPERRY, CARLTON D., '14, acts as an industrial engineer for the Charles E. Bedaux Co., Tribune Tower, Chicago.

MUELLER, EMMET, '19, is a sales engineer and district manager for the Vilter Manufacturing Co., with offices at 2457 Woodward Avenue, Detroit.

KAAP, LAWRENCE, '33, has a position with the International Harvester Co. as an engineer.

STETSON, GEORGE L., '30, M.S.'33, who is with the Shell Petroleum Corp., acts in the capacity of a junior engineer.

THERN, ROYAL S., '34, acts as senior engineer in the Soil Conservation Service. His work is that of survey and design.

SCHMID, BEN J., '33, who is with the General Electric Co., is assistant head of the turbine test department. He is a supervisor in the manufacturing end of work relating to steam or electric power.

MARTINY, KEITH C., '33, is with the Kimberly-Clark Corp., where he does structural and mechanical design engineering.

WILSON, WILLIAM F., '34, works for the Allis-Chalmers Manufacturing Co. dismantling, repairing and rebuilding tractors.

LEU, HAROLD, '34, corresponds that he is employed as engineer in charge of a line manufacturing radio equipment at the Globe Union Co. of Milwaukee.

POLLACK, WILLFRED, '35, holds the position of assistant test engineer for the TMER & L Co. in Milwaukee.

WHELE, KURT, '35, acts as turbine auxiliary operator at the Lakeside plant of the TMER & L Co.

SCHUBERT, GILBERT W., '33, is engaged in tractor design and service in the experimental department of the Industrial Tractor Division at the Allis-Chalmers Mfg. Co. of Springfield, Illinois.

LEY, RALPH, '34, writes that he is an engineer at the Felker Bros. Mfg. Co. of Marshfield, Wisconsin.

FYFE, CLAYTON, in the capacity of assistant to shop superintendent of the Globe Union Company, is solving engineering problems.

ERMENC, JOSEPH J., '34, acting as a cadet engineer at the Milwaukee Gas & Light Co., is testing automobile engines run with coke-oven gas.

WOJTA, A. J., '32, formerly of the Soil Conservation Service, is now superintendent of field work in the CCC.

ANDERSON, DONALD A., '33, has the position of supervising agricultural technician in the Soil Conservation Service.

STRASSMAN, ROBERT C., '34, has been advanced to the postion of secretary-treasurer of the Badger Die Casting Co. He takes an active part in sales, design, and management.

AMUNDSON, ROALD HARRY, '35, is solving machine design problems on special electric motors for the Louis Allis Co.

ANDRONE, GEORGE W., '35, is now working for the Barber-Colman Co.

CHEMICALS

DOWNING, RAY C., '10, has the position of superintendent of manufacturing with the Lowell Gas Light Co., Lowell, Massachusetts.

COOPER, CLARENCE E., '17, acts as chemist for the Lehigh Navigation Coal Co. at Lansford, Pennsylvania. His address is 34 W. Bartsch Street.

GILL, TERENCE A., '17, who is with the Shawinigan Chemical Co. of Montreal, serves as their sales manager.

BOZARTH, ROGER, '22, works for the Public Service Co. of Hammond, Indiana, in the capacity of gas engineer.

RIDGEWAY, GORDON, '25, is connected with the Armstrong Cork Products Co. in Cleveland as a sales engineer. He and Beatrice Shroeder Ridgeway, '28, are living at 1293 Donald Avenue, Lakewood.

BONE, WINSTON, '34, acts as chief draftsman for the drainage control of the WPA with headquarters in Madison.

●

METALLURGISTS AND MINERS

ROBERTS, MORGAN E., '18, who is with the Pure Oil Co., has a position with them as a geologist and is stationed temporarily at Odessa, Texas.

WOSCHUTZ, JOSEPH F., '23, acts as a metallurgist for the Inland Steel Co. at East Chicago, Indiana.

GILLETTE, JOHN B., '33, who is with Libby, McNeill and Libby of Houston, Delaware, serves in the capacity of their plant engineer.

KIEWEG, BURTON R., '32, M.S.'33, acts as an engineer with the United States Forest Service at Park Falls, Wisconsin.

ZOELLNER, A. M., '28, has a position with the H. F. and John Barnes Co. of Rockford, Illinois, as metallurgist.

ROUP, ROLLAND R., M.S.'35, works for the Globe Union Manufacturing Co. of Milwaukee as a ceramic engineer.

EMANUEL, W. A., '20, paid the department a visit recently while on his vacation. Mr. Emanuel is a metallurgist with the Anaconda Copper Mining Co. of Anaconda, Montana. His work has mainly to do with the company's arsenic plant of which he is superintendent.

SCOFIELD, LOYD M., '21, serves in the capacity of mining engineer for the Pickands Mather Co. of Ironwood, Michigan.

●

CIVILS

ERIKSEN, ERIK T., '89, C.E.'90, has retired from his practice of civil engineering. He is now living at 249 N. 31st Street, Corvallis, Oregon.

KURTZ, CHARLES M., '97, who is with the Southern Pacific Co. of San Francisco, acts as their structural engineer. His present home address is 129 Nova Drive, Piedmont, California.

CHAMBERLIN, GEORGE W., '10, serves in the capacity of mining engineer for Pickands Mather and Co. of Ironton, Minnesota.

GEISSE, J. HARLIN, '17, who is in charge of the development section of the Department of Commerce Bureau of Aeronautics, recently completed the first transcontinental flight in a tail-less fliver plane. The plane took off from Santa Monica, California, on August 2 and by easy stages landed in Washington on August 12. The development of this plane is intended to put planes within the reach of modest incomes. Mr. Geisse was vice-president and chief engineer of the Comet Engine Co. of Madison until June, 1935, when he went to Washington as chief of the manufacturing inspection service of the bureau. He was promoted to his present position in 1934.

WOODSON, JAMES P., C.E.'16, acts as an engineer with the Alabama Power Co. of Selma, Alabama.

HEFFERNEN, RAYMOND, '20, holds the position of vice-president and treasurer of the Waterways Engineering Corp. of Green Bay.

RUFF, RICHARD J., '33, acts as an inspector on a government project which has been under way at Detroit for the last two years. The project consists of the deepening of the Livingstone Channel in Canada.

STEFFEN, ALFRED J., '33, has a position as chief of party with the drainage control of the WPA, making Madison his headquarters at present. He has been on surveys to Hayworth, Phillips, Crandon, New Lisbon and Tomah during the past few months.

ROBBINS, FRANCIS L., '33, acts as senior engineer at the erosion control camp at Coon Valley, Wisconsin.

●

ELECTRICALS

SEVERSON, STEPHEN B., '07, is vice-president and general manager of the Dominion Natural Gas Co. and its associated companies, with offices in the Jackson Building, Buffalo.

KEMP, WILLIAM B., '11, acts as trunk engineer for the Michigan Bell Telephone Co. in Detroit.

DAHM, PAUL, '13, has the position of a circuit designer in the Telephone and Signal Department of the Pennsylvania Railroad in New York.

WALTER, CHARLES W. P., '34, is now associated with the Metropolitan Life Insurance Co. in New York. He is in the actuarial department.

WALSH, WILLIAM, '34, is now connected with a brokerage firm in New York City.

THOMAS, EVERRETT, '24, is associated with the General Electric Co. of Fort Wayne, Indiana, as an electrical engineer.

NIMMER, F. W., '24, has been promoted to the general office of the Ohio Edison Co. at Akron, his position now being that of assistant general distribution engineer.

DAVIS, ROBERT, '27, is employed by the Hygrade-Sylvania Co. at Clifton, New Jersey, as an engineer.

WYSS, WALTER E., '33, M.S.'34, was married to Caroline N. Benedict, '34, on July 6 at Madison. They are at home in Washington, D. C., where Mr. Wyss is a student attorney with the General Electric Co.

KNAAK, LAWRENCE B., '31, has the position of branch manager with the Globe Union Manufacturing Co. at Kansas City, Missouri.

HEMMINGWAY, HUGH L., '31, who since January last has been employed by the Kendall Refining Co., Bradford, Pennsylvania, acts as their automotive engineer.

RAFFIL, A. W., '34, who formerly was with the engineering department of the Public Service Commission of Wisconsin, is now with a firm of consulting engineers in Chicago.

An Improved Non-Metallic Sheathed Wire

(Continued from page 47)

Wiring Costs, Excluding Overhead and Profit; Non-Metallic Sheathed Cable System

Building	*Dimensions*	*Outlets*	*Material Cost*	*Labor Cost*	*Total Cost*	*Cost per Outlet*
Barn and Milkhouse	34'x64'	13	$15.89	$20.30	$36.19	$2.78
Hog Barn	18'x42'	4	7.84	5.07	12.91	3.23
Chicken House	15'x24'	2	3.69	2.17	5.86	2.93
Granary	18'x26'	2	3.15	2.17	5.32	2.66
Garage	12'x26'	3	4.50	3.62	8.12	2.71
Pump House	10'x12'	2	3.30	2.17	5.47	2.74
TOTALS		26	38.37	35.50	73.87	av. 2.84

If the overhead costs and profit, at the rate of 25 per cent, are added to the above total of $73.87, the total cost of wiring the six buildings becomes $92.34 and the final cost per outlet (26 outlets in all) is $3.55. The cost per outlet in the barn and milkhouse alone is $3.48.

Those who are familiar with the cost per outlet in rural buildings for the armored cable (B.X.) and rigid conduit systems will note that the final cost per outlet in this **initial** installation employing the non-metallic cable system is approximately 18 per cent more than the cost of B.X. and from 30 to 50 per cent less than rigid conduit. These comparisons are based upon $3.00 per outlet for the B.X. method and $5.00 to $7.00 per outlet for the rigid conduit method—figures which were chosen by electrical engineers of the Wisconsin Public Service Commission as an average of estimates received from several practicing electrical contractors in and near Madison, Wisconsin.

SUMMARY

Five requirements of a good wiring installation for rural buildings have been laid down in Section I. These requirements are met by the completely non-metallic sheathed installation as follows:

1. The conductors are protected in a sheathed cable which in turn is adequately protected by wood stripping or by the studding of the building everywhere below the seven-foot level.

2. Non-conducting cable sheathing and porcelain outlet boxes, together with porcelain or bakelite lamp sockets and box covers afford little, if any, likelihood of electric shock to either man or animal.

3. The materials enumerated in 2 resist corrosion and should provide 15 to 20 years of good service.

4. Cost studies made of an actual installation have demonstrated that the non-metallic sheathed installation can be provided, at present, at a cost comparable to the cost of a B.X. system. The probable small increased cost over that for an open knob and tube installation can be justified by the extra protection afforded the conductors and the resultant compact, neat arrangment of cable and outlet boxes.

5. This system offers no more fire hazard than do existing systems, and, contrary to popular belief, permanent wiring of buildings is a minor cause of fires.

Finally—while it is the writers' opinion that all wiring installations should be made only by competent electricians, this non-metallic sheathed installation, employing the cable and porcelain box combination, discourages unapproved and dangerous extensions.

Modern Devices *for* Improving Water Works Service

*LEO HERNING, ch'38

MODERN devices developed during the past twenty years have played an important part in bringing the waterworks system to its present efficient status. Less than twenty years ago water would be shut off for hours at a time to repair minor difficulties, but today, due to modern electrical equipment and an efficient, organized force of men, the time and number of times that water is shut off is reduced to a minimum.

The first thing to be considered is the service offered by the water department today. A night man is maintained for emergency service which a single man could handle. A night crew is also operated from 10:00 p. m. to 6:00 a. m. to take care of valve, main and hydrant repair in which it is necessary to shut off the water. Both the emergency man and night crew are equipped with trucks to provide prompt service.

Another thing which is kept here in Madison is a so-called "Black Book." This black book contains a collection of photostatic copies of the original records showing the location of all mains, hydrants, valves, and services. They are drawn to scale and give accurate dimensions from the property lines. One of these books is provided for each of the service trucks, one is at the pumping station, one at the water works department, and one at the service building. This enables the employees to make prompt shut-offs and saves a considerable amount of time which otherwise would have to be spent in consulting the original records which are maintained in the City Engineer's office.

Another of the improvements is the adoption of the policy of building manholes around all of the gate valves so that no excavations are required in case a valve needs repairing. Every hydrant is now equipped with a gate valve so it is not necessary to shut off the main in case of a hydrant repair.

Among the new devices developed, the aquaphone is perhaps the simplest and most effective. This is nothing but an old fashioned telephone receiver with a pointed pin inserted at the place where the wire ordinarily enters the receiver. This device amplifies the sound so that leaks that ordinarily could not be heard can be located. The aquaphone is used in three ways: first, by meter inspectors to find out whether there are any main or service leaks in the vicinity. If the characteristic hissing sound is heard the meter reader reports the location and a work order is issued; second, the aquaphone is used by the hydrant inspector to detect leaks in hydrants or mains and services in the vicinity of the hydrants. When it has been determined that a leak does exist in a given locality effective results are often obtained by driving a pointed rod down to the main and listening, which is the third use of the aquaphone. New York City uses this device almost entirely with very effective results.

Another device is the electric leak locator, which consists of a flat plate with four pointed lugs which can be inserted into the ground and electrically connected to an amplifier with storage batteries and earphones. This device provides a much larger amplification of sound and is of value in detecting very small leaks which could not be heard with an aquaphone. Its use is limited, though, to regions where traffic is light. It can only be used in a business district at night. This device is used to locate leaks under pavements where a rod can not be driven down to a main. By its careful use a leak can be located so accurately that only one pavement cut is necessary.

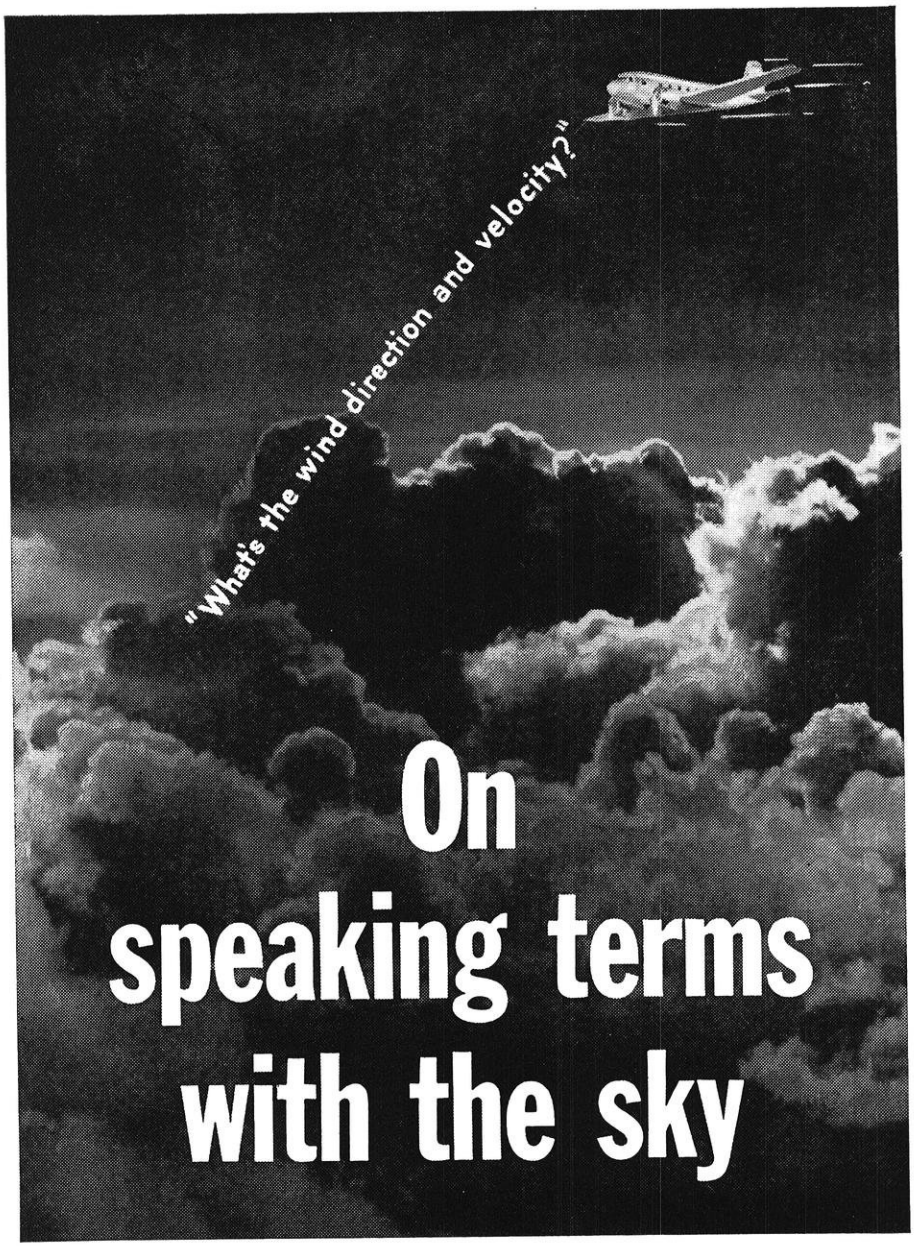
The electric pipe locator has saved large sums of money in the past by enabling the department to accurately locate service and distribution lines. This device consists of a buzzer, coil, dry cells, and earphones with approximately 100 feet of copper wire. If a service of which there is no record enters a house an electrical connection is established by connecting one side of the battery to a sill cock of the house and the other side of the battery to another sill cock or hydrant in the vicinity. When the buzzer is turned on an electrical contact is established, and by using the coil and earphones a person can tell definitely when he has passed over the pipe line in question. Many services which were installed many years ago and in peculiar locations have been located in this manner.

Another device which has been used many years and with which every service truck is equipped is a dip needle. The dip needle enables one to locate valve boxes or service boxes which are buried. They can be located when buried with as much as eighteen inches of dirt. This device proves very valuable in locating service and valve boxes when snow and ice are on the ground.

The ordinary physician's stethoscope is used to a great advantage, particularly in locating leaks under basement walls and floors. The stethoscope provides slightly greater amplification than the aquaphone and is equipped with two earphones so it excludes extraneous noises.

The city of Madison has about $500 invested in these devices which no doubt pay for themselves many times over every year in saving of labor, better service and elimination of unnecessary pavement cuts.

*Rewritten by Leo Herning from a presentation by L. A. Smith (Superintendent of Waterworks in Madison) before the Wisconsin Section Meeting, September 26, 1934.



FAR above the clouds, on all the leading airlines, your pilot is always within hearing and speaking distance of airports—via Western Electric radio telephone. ¶ This equipment, made by the manufacturing unit of the Bell System, is helping the airlines to set a notable record for fast, safe transportation. Teletype—another Bell System service—speeds printed weather information to airports. Long Distance and local telephone facilities, too, play important parts in airline operations. ¶ Bell System services reach out in many directions to the benefit of industry and commerce.

You can "fly" home by telephone, in a couple of minutes. Why not do it tonight? Station-to-Station rates are lowest after 7 P. M.

BELL TELEPHONE SYSTEM

THE CRITICAL ANGLE . . .

> *I disagree with every word you say, but I will defend to the death your right to say it.*
> —VOLTAIRE.

ETHICS IN YOUR ENGINEERING WORLD During the four years you spend learning engineering here, you receive little of that phase known as "social engineering." There is one mighty important thing in social engineering that should be brought home to each and every one of you . . . ethics.

When you leave the university, you may be an authority on processes or machinery. You might be a model of the social graces. We hope you are making it your business and duty to be both. But, over and above all, we want you to be moral, to have character, to act ethically some day. For that reason, you ought to have some moral problems given you, some to which there are no answer books, problems which a professor cannot make you see and feel, perplexities which can neither be seen nor solved except in the light of your own intelligence. There will come a time when problems of that nature will be uppermost in your thoughts. Your knowledge and beliefs will tremble at their roots, and your brows will be nettled in irksome perplexities. You will wonder what a fair wage for yourself will be . . . or what a fair wage will be for your employees. You will wonder how to go about hiring some other man's employee. Perhaps your employer will ask you to do things that will cause your conscience to tingle. You might be furtively glancing at some billboards which carry your firm's advertising, inwardly justifying yourself for the words which may be misleading millions of people. Or you might restlessly lie awake nights, trying to figure out how to treat your competitors, or what to charge for your goods and services. And many other problems of a similar nature may some day be adding gray hairs to your head.

You can quickly see that all these problems are very important, and that eventually they will be impressing themselves upon you with considerable force and gravity. You shall not escape them.

In a few weeks you will again be making out programs for a new semester. You should see to it that a course in business ethics is in your curriculum. It is the one course that will vividly bring before your eyes a picture of your true character and moral standing. Take it and see.

TOLERANCE Tolerance is like a sense of humor. Everybody thinks he has it, but it never works when he is personally involved. We haven't it at all, unless we have it when our own views and interests are involved.

During the past year, various people who seem to be misinformed and misguided have criticized this university as well as many others. Their actions have been motivated by the belief that some professors hold opinions which are dangerous to present society. Although the provocation has been great, the universities cannot follow the example of their critics. They must insist upon free speech for them.

One of the things that a university should seek to teach is open-mindedness. This does not mean vacant-mindedness or indifference. It does not offer an excuse for stupidity. Open-mindedness means a willingness to listen to all sides before forming a judgment, and a willingness to regard that judgment as tentative and subject to a revision in the light of further knowledge. The more practical and immediate the problem, the greater the need for open-mindedness. Discussion and deliberation are required to find the most satisfactory course of action.

The time when we **must** hear all sides is the time the decision is most important. If the universities can train their students in true tolerance, they will perform the service America needs most from them today.

●

THIS PROBLEM OF SAFE DRIVING For the past several months, much has been done to bring to the minds of our public the idea of driving safely. People in this country are being killed off at the rate of 36,000 a year . . . 100 people die every day! Thousands are painfully injured or maimed. And countless numbers are beartbroken over the misfortunes and death of dear ones.

Some months ago, Mr. Furnas' article, "—And Sudden Death," appeared. Now we have appeals in the newspapers, magazines, radio, and the courts . . . appeals to drive safely. People are being directed to consider the automobile casualties less objectively, to consider them with more feeling and emotion.

But maybe some appeal should be made to the engineers. They are making the automobiles too perfect for the people. Years ago, passengers felt the car strain under

high speeds . . . the physical discomfort reminded them to slow down. But the automobiles of today do not have the slightest tremor when going sixty miles per hour, and the drivers can use a little finger in guiding them at that speed. One can now sit in his car and enjoy the luxurious smoothness of both it and the road. He presses hard on the accelerator, having all the ease of mind and confidence in the world; he is lulled into a feeling of false security.

Therein lies the trouble. Automobile buyers are shown that cars of today are dependable, economical to run, speedy, easy to control, and so on; but how many drivers know what inertia forces and momentum are? How many realize the distance a car going sixty miles per hour will cover from the instant the driver finds that he has to stop to the moment it is at a standstill? The buying public is not being educated properly!

Soon some of you will be engaged in the automotive industry. Then you, too, will be putting into the hands of the unknowing public a wonderfully perfect vehicle. You will be proud of it, as are the engineers of the automobiles now. But, alas, for many you will be the creator of an accursed thing. Through teeth gritted in pain, bitter words will be gasped out . . . words that will curse this menace you shall have perfected. Loud and long will be the laments of saddened ones, and perhaps even you may some time rue the day you presented your Frankenstein to the world.

Now is the time to think of what you will do when the day you shall be in power comes.

MINING CLUB HAS PARTY

Mr. A. E. Blum, director of the State of Wisconsin securities division, was the guest speaker at the successful Mining Club dinner held Wednesday, November 20.

Club members escorted their dates to a typical mine setting at the dance held Friday evening, December 13, in the Mining and Metallurgy building. Preparations for the party were formulated under the direction of Wayne Hunzicker, Hershel Kaufman, Phillip McCaffery, Norwood Melcher, and Malcom Sanders.

●

JUNIOR and SENIOR ENGINEERS . . . See your POLYGON REPRESENTATIVE for ENGINEER RECOGNITION PINS.

"STATIC"

By **ENGIN EARS**

● Well, the semester rose to its greatest heights these past several weeks, and everyone has had his chance to shine. Even the faculty outdid itself. What with the Polygon Dance and running the heating plant, lots of things could easily happen. Even our beloved lawyers squirted themselves into the public eye with a dance (it might be well to state that, due to their peculiar properties of viscosity and cohesion, only wet things squirt).

The Polygon Dance was a charm. Did you notice that not one of the civils wore hi-cut shoes? And that Polygon's ex-prexy, G. O. Nieman, Min.4, left his pipe home? Pat Hyland reported no drunks . . . maybe the lawyers ought to get him for their chaperon.

»» ««

● Heating plant? Test? Huh? Oh, that! Well, don't bother me . . . I'm tired. (Did you think that was John Van Vleet, M.E.4? Then you're wrong. He slept through it all. He and Sanderson, same vintage, believe in preserving their healths by sleeping . . . of course, when they're not sleeping, there are other preservatives.) The whole test was quite a success, and it was so warm all over that even the lake didn't freeze. But that heating plant test has Polygon nettled. For the last three years now, the Steam & Gas Department generously gives you a choice between the dance and the heating plant test. The Polygon boys are now trying to find out if the dance can be run in the heating plant.

»» ««

● Have you been wondering about the cover of this issue? Well, if you haven't had a course in Machine Design, you might just as well appreciate the color and forget the rest, because the contrivance thereon drawn uses a spring. This cover was put on with the hope that you would take it home for Christmas (just in case your profs hadn't given you enough already) and try to work out the force with which the Jumping Jack would leave the box. You might also try to figure out just what would happen if you had the box close to your face when you opened it. Those of you who get one from Santa Claus, try to get it away from your father long enough to get us some data on it. (It may not be such a good cover, but then look at the Octy.)

»» ««

● We hope you will have a very nice Christmas and a hilarious New Year.

● The faculty? Oh yes, they're still with us. From all reports, Major Larson is still successfully conducting his Armature Hour, and he will soon have the chemicals in his E.E.8 course well enmeshed in deduction motors.

Professor Ingersoll, of the physics department, is either studying to be a Boy Scout or else he must feel that he needs the exercise, because he spent one-half of one lecture demonstrating fire-by-friction to his sophomore physicists, most of whom had performed that experiment at the tender age of thirteen.

Dr. Watts put in his lament the other day when he mumbled something about the Tau Beta Pi initiates being "a little slow on the up-take," since they ruined some of his polishing wheels preparing their plaques. By the way, Prof. Watts had a substitute during a brief absence some time ago. This is the treatment the poor sub got in one of the electrochem classes.

Instructor: " . . . . the impurities in iron, which . . . . "

R. Stubbings: "What do you mean, 'the impurities in iron'?"

Inst.: "Well, just the ordinary impurities always found in commercial iron."

R. S.: "Well, what are they?"

Inst.: "Well, I might ask **you** that—what are they?"

R. S.: "Well, I asked you first."

Inst.: "Well, you've had metallography more recently than I."

Stubbings finally won . . . the instructor named the impurities.

»» ««

● When asked if he had a certain E.A. problem done, Charlie Halamka replied, "No, but I've got a fellow working on it." This suggests something. Why not have Dad buy you a few stooges for Christmas, so that you could have someone to carry the heavy part of your program. You could have, say, one in your Freshman year, two in your Soph., etc. You could carry a few credits yourself, just to keep your hand in. Look at the work it would save you, and imagine the field it would open up for unemployed stooges! Do your shopping early.

»» ««

● Incidentally, did you know that Jack Meyer, Ch.E.4, is getting together a staff to take in all his fan mail? He is playing the part of a priest in "Seventh Heaven" at the University Theatre. Gus Lehrkind, E.E.4, is chief electrician of the theatre, and he will keep his fellow engineer well in the lights. Luna Leopold, C.E.4, has quite a part in "The Green Goddess." Looks as if the boys are deserting the stages of turbines for other kinds of stages.

Synthetic Colloid to Improve Concrete

INCREASED permanence and resistance to all destructive forces will characterize concrete structures of the immediate future, according to Dr. Edward W. Scripture, Jr., director of the Master Builders Research Laboratories at Cleveland, where recent research with concrete and brick mortars foretells the coming of an "alloy age" in the cement industries.

The advancement of the construction industries may be facilitated by the use of certain synthetic colloids, possessing lubricating and lime hardening qualities. The permanence of concrete cannot be taken for granted. The forces of destruction are minimized by providing a concrete of increased strength and density resulting in reduced volume changes.

Since volume changes are the result of excess water, concrete approaches its potential strength and durability as this water is decreased. It has been established that the excess water, over and above that required for hydration of the cement but necessary to "place" the concrete, can be reduced by as much as 20 per cent through the introduction of a gelatinous colloid which paradoxically provides increased plasticity with less water.

This lubricating ingredient, by reason of its high puzzolanic properties, further reduces volume changes by the increase of its volume on combining with lime, serving at the same time to convert the soluble free lime persisting in simple concrete into insoluble form. The concrete is thus rendered more water-tight, less porous and therefore less subject to cracking, checking or crumbling under alternate freezing and thawing. With high resistance to all corrosive forces, it resists the disintegrating effect which sea-water has on ordinary concrete.

The synthetic ingredients which have been investigated possess properties first discovered by the builders in ancient Rome. They used volcanic ash, the first puzzolana, to strengthen the lime mortars cementing massive blocks of stone and marble in their temples, aqueducts and baths. Neglected for many centuries, the value of these lime-hardening substances has been the subject for increasing research in recent years.

A synthetic puzzolana possessing a triple factor for permanence has been developed. This not only reduces the sources of corrosion, but lubricates any given concrete mix so that the proportion of water can be cut and the consequent volume changes which cause checking and cracking largely reduced. With the increased density and lowered porosity resulting, there is less opportunity for destructive forces to operate on buildings subject to alternate freezing and thawing.

Ford Motors Adopt New Measuring System

ALLEN JORGENSEN, m'38

OF ALL the evils bequeathed to humanity by Usage and Tradition, few are as time consuming and clumsy as the English "system" of weights and measures.

The hue and cry for a simpler system has been heard, and answered, by one of the world's foremost industrialists — Henry Ford. While congressmen and scientists wrangled with practical men on the advisability of making a costly change to the metric system, Henry Ford's men were busy adapting the old system of measuring to efficient means. The result was the decimal system.

It is considered the first departure from conventional dimensioning practice. For countless ages man has resorted to the use of fractional measurements. Engineers and production men have been so firmly entrenched in the use of "halves," "quarters," "eighths," etc. that improvement was considered impossible without the complete change to the metric system.

Why then was not the metric system adopted? Scientists advocated the change while producers stood adamant to their resolution that no such revolutionary step be taken.

The builders of machinery that has made this the foremost industrial country can hardly be called ignoramuses, and it seems likely that if the metric system had the advantages claimed by its advocates a good percentage of progressive machine builders would have adopted it long ago. If they had wanted it, compulsory legislation would be necessary.

Many there have been who argue that we lose foreign trade because of our refusal to adopt and use the metric system which is now in use in so many foreign countries. Yet, 75 per cent of all manufactured articles are today made under the English system of measuring. Even Japan, although on the metric system by government decree, still has railroad distances given in miles instead of kilometers. It is obvious that producers in this country would also defy governmental legislation and resort to the use of the English system on the sly in preference to making the expensive change-over.

Americans have been accused of being too lazy to make the conversions necessitated by a change in scale. A bit of study would reveal that on the more intricate machines such translation would be exceedingly difficult, and consequently money consuming. Then, too, it must be borne in mind that all maps, deeds, lands, and countless documents are now expressed in terms of feet and inches. A change would be economically out of the question. It is true that it would be a fine heritage to leave to our children a system of measuring not based upon the size of "three barley corns to an inch" — drought or no drought — but the cost is prohibitive.

To obviate such a revolutionary change and still to gain efficiency, an adaptation of the old system seems to be the only answer. It is an adaptation similar to the adoption of decimal currency by the Hamiltonians as an escape from the pestiferous arithmetic of pounds, shillings, and pence.

Common fractions are out, and with them go the uselessly long decimal conversions. With the new system of decimal fractions, it is no longer necessary to carry the divisions of a fraction out to the sixth or seventh place in order to gain a true number. For instance, 1/64 of an inch when converted to decimal becomes 0.015625 of an inch; whereas, 1/50 of an inch under the new system becomes 0.02 of an inch. This is illustrative of the simplicity of conversion of the new system as compared to the old. It reduces the possible error when adding long decimals in shop and drafting room. Conversion tables need no longer be the master of the mechanic and draftsman.

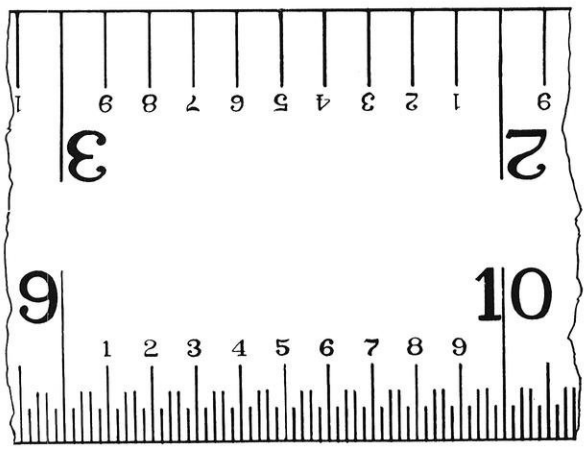
Under the Ford system no cumbersome dimensions are necessary. Every dimension is simply expressed and easily read, and the chances for error are practically eliminated. Where old parts must be replaced, it is a simple matter to convert the old system to the new. For those who have not become entirely proficient in thinking in "tenths," but only in such cases, it was decided to simplify the decimals resulting from converting the common fraction in the manner indicated.

Common Fraction Decimal of Existing	*Common Fraction*	*Ford Decimal*
0.015625	1/64	0.02
0.046875	3/64	0.05
0.46875	15/32	0.46

The new system is complimentary to the micrometer readings in that when a closer reading is required from that gotten with the naked eye and scale, it is merely necessary to affix the two final digit readings from the micrometer to the size gotten with the scale. This is a good deal simpler than adding it to an incongruous decimal converted fraction.

A primary requisite in the adoption of the Ford system is the accompanying change of "thinking grooves." The man on the job must be taught to think in terms of tenths rather than sixteenths. Inasmuch as mechanics are familiar to the use of the micrometer and resulting readings, in thousandths, this is a simple matter.

Whereas the old scale was calibrated in 1/64ths of an inch, the new one is calibrated in 1/50ths of an inch. The scale can thus be read in hundredths of an inch by merely



New Type of Scale Division

gauging with the eye an equal distance between marks. Having its smallest graduation at 1/50th of an inch facilitates quicker and more accurate reading. Although calibrated in fiftieths of an inch, all figures are read in hundredths, such as 20, 40, 60, 100. Another simplicity feature of the system lies in the fact that all dimensions where accuracy of a tenth is needed are expressed with one digit. As the accuracy increases to 1/100 or 1/1000 another digit, or two, is the only addition needed. With such small number-of-digit figures it is possible to keep a drawing from getting cluttered up with lengthy figures.

The Ford company finds the advantages from using the decimal system to be even more pronounced when determining dimensions through the use of trigonometrical functions, where the sines, cosines, tangents, etc., of angles must be multiplied or divided by the three or six place decimal equivalents of common fractions to obtain the desired result. In this system it is usual to have but one or two digits which must be multiplied by the trigonometrical function, thus materially reducing the time required and the chance of errors in calculations of this type."*

So long as standard tools, dies, etc., are made according to the old system it shall be necessary to conform on some parts to the old system. However, the transition is slowly taking place, and it is today the confident dream of Ford engineers that the Ford plant will soon be completely free from the tentacles of a time consuming measuring system.

*Abrasive Industry, June 1935.

CAMPUS ORGANIZATIONS

A. I. Ch. E.

At the first meeting of A. I. Ch. E. October 14 the following officers were elected: president, Neal Olson; vice-president, Clarence Eckman; secretary, Frank Watters; treasurer, Donald Gordon; Polygon representative, Earl Sargent. It was decided that a Chemical Engineer's Handbook should be presented to Myron Roshar, high chemical engineer of last year's freshman class.

At the second meeting held November 14 at the Union a film on the manufacture of "Bakelite," and musical entertainment by Gerald Risser and Earl Sargent were presented, followed by beer in the Round Table Room.

The next meeting will be announced in the near future.

●

PI TAU SIGMA

On November 15, the 18th National Convention of Pi Tau Sigma was officially opened at Purdue University. Representatives were present from the following sixteen chapters: Illinois, Wisconsin, Purdue, Minnesota, Armour, Missouri, Penn State, Cincinnati, Lehigh, Carnegie, Texas, Oklahoma, Colorado, Georgia, Drexel and Iowa. The installation of the Iowa Omicron Chapter, the only new chapter this year, took place on Friday evening along with the initiation of honorary members and undergraduates from the Purdue and Iowa Chapters. Following the initiation ceremony a formal banquet was held in the Purdue University Memorial Union. Slides were shown of Texas University campus and buildings, the site of the 1936 convention.

On Saturday morning the delegates were taken through the University Engineering Laboratories and in the afternoon were entertained at the Purdue-Iowa football game. From all reports, Saturday evening did not find the delegates resting up for the return trip or worrying about the E.E. 7 Problems due on Monday.

●

CHI EPSILON

Gerard A. Rohlich and Bernard H. Ter Maath, seniors, and John F. Eppler, Arthur R. Luecker, and Edwin J. Voss, juniors, were initiated into Chi Epsilon, honorary civil engineering fraternity, on November 13. President Luna Leopold welcomed the new men at a banquet that evening, and Rohlich responded for the initiates. Professor Louis Kahlenberg, who made the address of the evening, emphasized the need for imagination in the activities of life. "The university," he said, "can teach you what is known, but cannot supply the imagination."

ETA KAPPA NU

On November 19, Eta Kappa Nu had the pleasure of entertaining the national secretary, Mr. Alton B. Zerby, at a dinner in the University Club. Mr. Zerby told of the activities of other chapters and gave helpful advice on the projects of the local chapter.

The traditional placque night was held December 5 at the M. E. building and after a number of hours of good hard work and the expenditure of many joules of energy, the placques looked very presentable. The initiation dinner was held December 12 at the Memorial Union with Mr. L. C. Larson of the faculty as toastmaster. The speaker was Mr. B. E. Miller of Madison. The initiates are: Edmond F. Heinrichsmeyer, Everett C. Wallace, J. Robert Hafstrom, Joseph B. Rice, Willis F. Kraemer, Marvin C. Riggert, Carl E. Schultheiss, and Herbert Luoma.

●

TAU BETA PI

Dr. Ivan S. Sokolnikoff was initiated into Tau Beta Pi as an alumnus member at the banquet Tuesday, November 26, at the Memorial Union. After the dinner, Prof. J. B. Kommers, the toastmaster, introduced Earl Senkbeil who, as president of the organization, welcomed the initiates. Response was made by J. A. Liska, c'36. Dr. Sokolnikoff gave the address of the evening. The other initiates were:

Junior—Frank W. Parrott; seniors—Hershel E. Kaufman, Robert E. Whiteside, Gerard A. Rohlich, Gilbert O. Nieman, Howard G. Holm, Russell H. Stubbings, Joseph A. Liska, Wilmer P. Scheer, Chris T. Kopenitsi, Howard Perschbacker.

On Tuesday, December 11, Tau Beta Pi was privileged to hear Professor Bennett of the electrical engineering department talk on "Liberalizing the Engineering Course." The next issue of the Wisconsin Engineer will have details of the program.

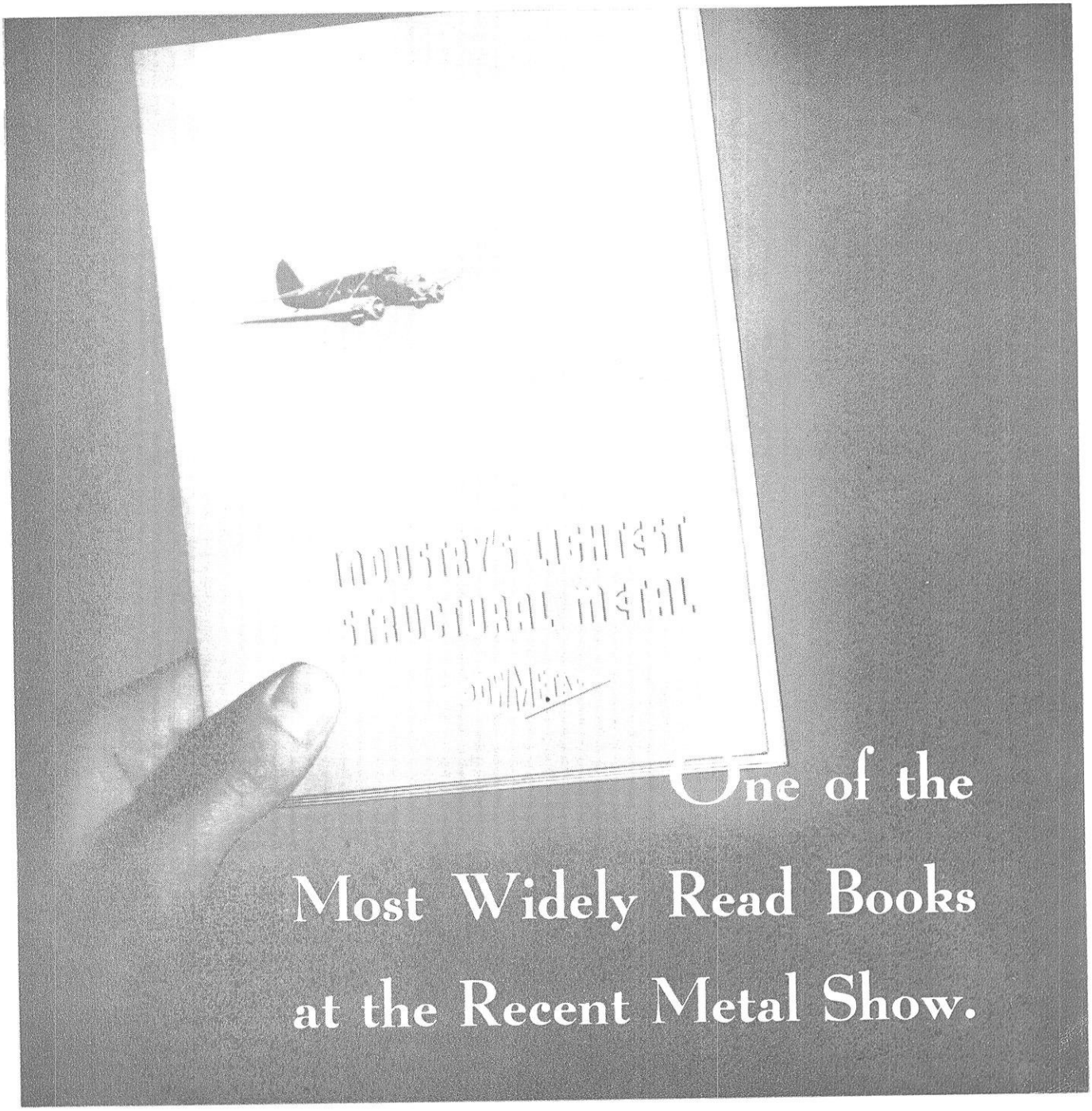
●

A.S.M.E.

The last meeting of the A.S.M.E. was held Thursday, December 12. The meeting was a joint affair with the A.S.A.E. Mr. C. E. White of the Standard Oil Company gave a volatility demonstration on various types of gasoline and showed movietone pictures on gasoline and on the new Jack Hilton radio program.

A paper on "Fermentation" was presented by Harland Pfanku.

The talk presented at a previous meeting by President Flanders was very much enjoyed by all present. His discussion of the economic problems of the day were considered by many as the best they had ever heard.



One of the Most Widely Read Books at the Recent Metal Show.

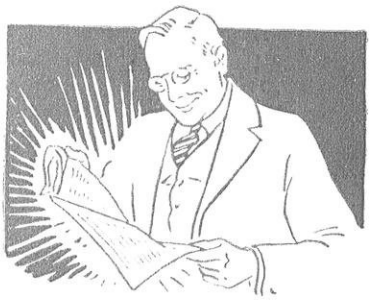
THOUSANDS of copies of this new Dowmetal book, "Industry's Lightest Structural Metal" were distributed at the National Metal Exposition held in Chicago. If you have not seen it, write for your copy. It suggests uses, discusses methods of working and finishing, and lists available forms.

New uses are being discovered for Dowmetal almost daily. When the question is "Still too heavy?" Dowmetal invariably supplies the answer to weight reduction. Much interesting and valuable information is contained in this new Dowmetal book. Most of it is non-technical.

SEND FOR YOUR COPY

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN

G-E *Campus News*

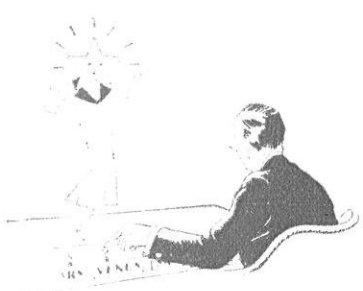


EDITORIAL BOUQUET

IT IS very pleasant to have people say nice things about one. The pleasure is curiously heightened, however, when the nice things are said in a roundabout way—never intended directly to reach one's ears. General Electric recently was honored in such a manner on the editorial page of the Spokane, Washington, *Chronicle*, and the Company is still basking in the warmth of the glow generated. The editorial, in part, read as follows:

"An exposition at which inventors of the Pacific Northwest will display their work will be held next month in Portland.

"It will probably be a revelation to those who see it. Most persons find it hard to think of great men coming from 'near at home.' When one speaks of inventors or scientists, the Northwest citizen thinks of the General Electric laboratories, or of observatories in California, or clinics in Vienna. . . ."



CELESTIAL PUSH-BUTTON CONTROL

HEAVENLY bodies a million times fainter than the faintest star the eye can see unaided will be brought to the earth for inspection and photography at the touch of an electric push button when the McDonald Observatory on Mt. Locke in western Texas is placed in operation. The observatory building itself is almost completed, but the technicians of the Warner and Swasey Company at Cleveland are "making haste slowly" with the polishing of the 82-inch reflecting mirror. They estimate that another 12 or 18 months will be needed before the mirror is ready for installation. The 45 tons of moving parts of the telescope will be at the command of a single individual, who will be able to take his stand upon an observing bridge and virtually order the stars to parade before him. The motors and complete electrical control to make this possible have been manufactured for the builders of the telescope by General Electric.

VOICES FROM THE SKY

WHEN the Whiteface Memorial Highway—a road leading to the summit of the 5000-foot Whiteface mountain in the heart of the Adirondacks—was dedicated this autumn, voices came down from the sky on a beam of light. There was nothing mystical about this performance, however. The beam of light came from a 24-inch G-E searchlight on the summit of the mountain. The voices were those of President Franklin Roosevelt and New York's Governor Herbert Lehman.

President Roosevelt's words, dedicating the highway, were carried on the light beam seven miles from the mountain to the crowd at the Lake Placid airport. Governor Lehman had spoken over the light beam the night before. He was so interested that, after the dedication ceremonies were finished, he spoke again to demonstrate the equipment to the members of his family. Both night and day demonstrations were successful, although once or twice during the day the words faded to faintness when small clouds floated by the mountain top and partially obscured the light beam.

Two-way communication was carried on by means of short-wave radio equipment located at the airport. G-E engineers, who made this special installation, had to transport a gas-driven power plant and a dozen or more storage batteries to the mountain top to operate the talking light beam.

96-205DH

GENERAL ELECTRIC