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The

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UNIVERSITY OF WISCONSIN

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A SYNCHRONOUS COMMUTATOR FOR THE OSCILLOGRAPH

By GLENN KOEHLER

Instructor in Electrical Engineering

THE synchronous commutator which this article describes has been developed to extend the usefulness of the electromagnetic oscillograph. The oscillograph has long ranked as one of the most useful devices for carrying on experimental work in almost all phases of electrical engineering; it is especially useful in the study of electric circuits. It has been the only practical device for studying the wave forms of currents and voltages in electrical systems. However, oscillographs, as commercially developed, have had certain limitations as devices for carrying on studies of transient phenomena. These limitations are best pointed out by a brief description of the oscillograph mechanism.

The Operation of the Oscillograph

The oscillograph utilizes the principles in the behavior of a single loop of wire when carrying current in an external magnetic field. When the direction of the current and the direction of the field are at right angles to each other, a force is exerted on the loop which is at right angles to both of these. Since the current in the loop must flow down one side and up the other, the force will be directed backward on one side of the loop and forward on the other side. This constitutes a torque on the loop which is counterbalanced by the tension on the loop. If the current in the loop is varying in amplitude the torque will vary in phase and thereby cause a deflection of the loop which is always proportional to the strength of the current. The single loop of wire, as described, is called a vibrator when used in the oscillograph.

In order to interpret or record the deflection of a vibrator under the influence of a current, a small mirror is attached to the effective portion of the loop. The deflection of the vibrator is recorded by a beam of light in a manner similar to the ordinary galvanometer. Since the beam of light from the vibrator mirror is not reflected directly to a translucent screen but is first reflected to a viewing mirror which can be oscillated, or rocked back and forth, the spot of light can be made to trace on the screen the wave shape of the current which passes through the vibrator. The amplitude of this wave will at every instant of time be proportional to the current in the vibrator. The oscillating mirror merely introduces the element of time along a horizontal axis. Figure 1 illustrates the arrangement of the principal parts of the oscillograph.

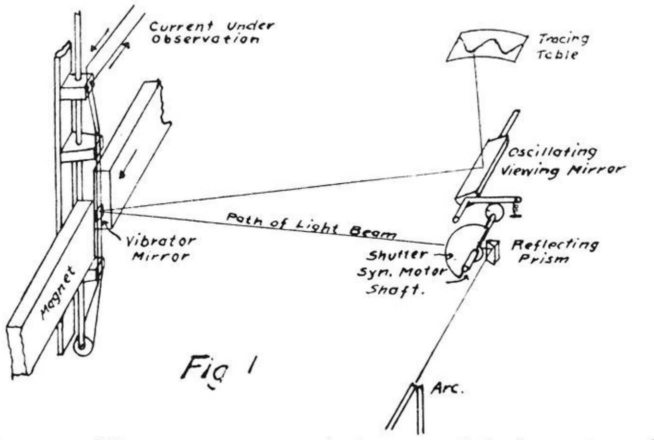

FIG. 1.—*The arrangement of the essential elements and optical system of the oscillograph.*

A single oscillation of the viewing mirror will produce a single sweep of light across the translucent screen. Periodic oscillations of the viewing mirror will produce a series of waves on the screen which will appear as a single wave snaking across the screen. If, however, the oscillations are periodic and in synchronism with the current in the vibrator the wave traced by the spot of light will appear to remain permanently on the tracing table. In order to produce waves which will remain permanently on the tracing table, the oscillating mirror must be driven by a synchronous motor energized from the same source as the circuit under study. This limits the device to the study of alternating current or recurrent phenomena of power frequencies, in so far as being able to observe and trace waves on the screen are concerned.

The oscillograph is also arranged so that electrical phenomena may be recorded on a photographic film. There is practically no limit, except to frequency, of the kind of phenomena which can be photographed. Without auxiliary devices, transient phenomena, or that class of phenomena which lasts only for a short time and is not recurrent, has to be studied through the picture taking process. The picture taking process of studying electrical circuits is not very desirable for organized laboratory classes in which a definite time is allotted for each task or exercise. In such a process the student is apt to feel that he is merely going through a routine performance to obtain a more or less predetermined result.

The synchronous commutator has been developed to remove the limitation pointed out and thereby make the oscillograph as useful for studying transient phenomena as for recurrent phenomena. The fundamental requirements which have been the guide for developing this auxiliary device are two in number. First, the transient must be repeated periodically and in synchronism with the oscillations of the viewing mirror of the oscillograph. Second, the transient must occur when the light is thrown on the tracing table, or during the forward movement of the viewing mirror. In the type of oscillograph with which the commutator is being used the mechanism of the viewing mirror is so arranged that the light is entirely cut off during the backward movement of the mirror.

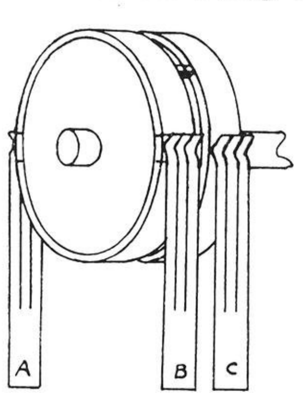

FIG. 2.

FIG. 2.—*The arrangement of the slip ring, the live and dead segments, and the brushes of the first commutator. Notice that the upper commutator segment is electrically connected to the slip ring.*

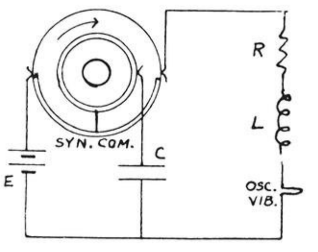

FIG. 3

FIG. 3.—*The commutator of figure 2 performs the operation of alternately charging and discharging the condenser C in synchronism with viewing mirror cam.*

Development of the Synchronous Commutator

The first scheme used by the writer to accomplish these purposes was a commutator mounted directly on the motor shaft of the oscillating viewing mirror. The power of the regular synchronous motor which drives the mirror was so inadequate that it was replaced by a direct current motor which was belted to the commutator and mirror shaft. The commutator itself was built up of a brass slip ring, a live segment and a dead segment. The live segment was electrically connected to the slip ring. Figure 2 shows the general scheme of both the commutator and the collecting brushes. Electrically, this arrangement was equivalent to Figure 3, which shows how the commutator was used in connection with condenser discharge phenomena. As the commutator rotated with the oscillating mirror cam of the oscillograph, condenser C was charged during the interval in which the light was cut off and then immediately connected to discharge through the coil L during the sweep of light across the tracing table. The transient current thus produced was recorded by a vibrator which was placed in series with the coil L.

The above scheme was soon abandoned, principally for two reasons. First, the space available on the mirror shaft was first limited; second and most important, it was not possible to show transients which result from alternating voltages. For these reasons a commutator exactly similar to the one just described was mounted on the shaft of a small synchronous motor of exactly the same speed as the motor which drives the viewing mirror. The brushes of this commutator were mounted on a circular disc so they could be shifted through 360 degrees but held in any position by a thumb screw. The necessity for doing this arose from the fact that the transient must occur while the light is on the tracing table, and that two synchronous motors will fall into step in twice as many different mechanical positions with respect to each other as there are poles. This method of mounting the brushes also permitted of closing the circuit on any point of the impressed voltage wave when alternating current transients were studied.

The synchronous commutator just described still lacked two refinements. First, it was possible to show only two cycles of any alternating current phenomena. This number is determined by the synchronous motor which drives the viewing mirror cam. It is not practical to obtain much of an idea of most transient currents and voltages in alternating current circuits in two cycles. Second, it was not possible to adjust the time of opening the circuit independently of the time it was closed. This is desirable for several reasons. Sparking at the brushes can be greatly reduced if the circuit is opened at a proper time. Residual magnetism in iron core coils can be regulated or eliminated. A principle in coupled circuit spark telegraphy can be illustrated, as explained later.

Improvement in Design

It was with these objects in view that the form of synchronous commutator shown in figure 5 was developed. This, being the latest development of synchronous commutators and overcoming all the difficulties heretofore enumerated, will be described in greater detail. Again the requirements which the commutator must fulfill are as follows: 1. It must run in exact synchronism with the motor of the oscillograph viewing mirror. 2. Its brushes must be so arranged that they can be so shifted about the commutator as to permit of adjusting the time of the transient with respect to the time the light is thrown on the viewing screen. This also permits of closing the circuit at any point of the voltage wave form when showing alternating current phenomena. 3. The brushes must be so arranged that the circuit can be opened at any time. 4. Means must be provided to produce enough cycles of an alternating current wave on the tracing table for the viewer to obtain a good idea of the phenomena. Usually eight cycles are enough.

In order to meet requirement number 1, the motor driving the commutator must be a synchronous motor with sufficient power to insure that the mechanism of the commutator will not constitute enough load to cause hunting. Figure 4 shows the general construction of the commutator mechanism and the quarter horse power synchronous motor. This is a self starting motor which

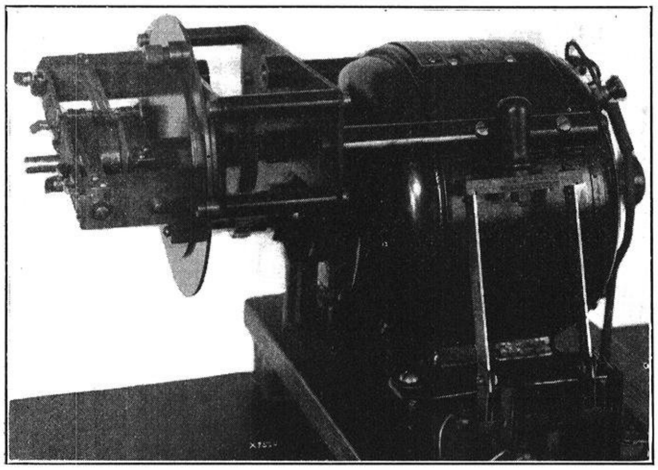

FIG. 4—*The Improved Synchronous Commutator. All three brushes may be shifted about the commutator by rotating the large disc. The inner brush may be shifted independently by rotating the small disc.*

runs at a speed of 1800 revolutions per minute on 60 cycles. In order to give the commutator the same speed as the shaft of the oscillograph viewing mirror which runs at 900 revolutions per minute on 60 cycles, the synchronous motor shaft is geared to the commutator by a two to one ratio. No difficulty has been experienced in getting gears which are accurate enough to

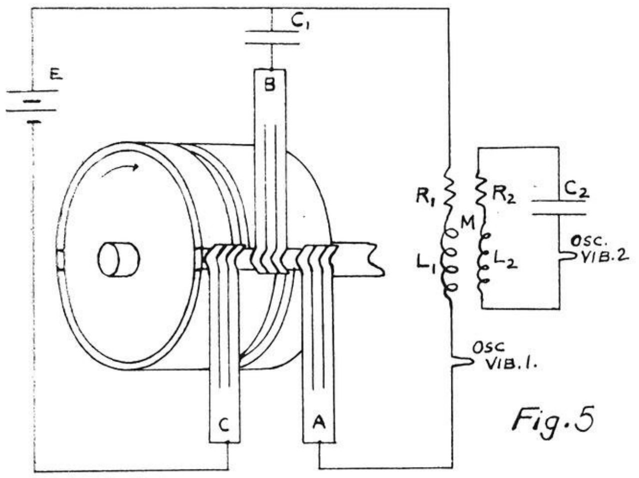

FIG. 5—*The arrangement of the live and dead segments and the three brushes of the commutator of figure 4.*

keep the waves exactly stationary on the tracing table of the oscillograph.

The commutator proper is built up of two wide brass segments called the live segments and two narrow brass segments called the dead segments. The four segments are mounted on an insulating material and are in turn insulated from each other. Figure 5 shows the arrangements of these segments and the manner in which contact is made to the segments through the three brushes A, B, and C. With this arrangement, as the commutator rotates in the direction of the arrow, brush B is alternately connected to brushes A and C. All three brushes are so mounted that they can be shifted together through 360 degrees in either direction about the commutator and held in any position by a thumb nut. Brush A can also be shifted against the rotation of the commutator through 180 degrees independently of brushes B and C. The position of all three brushes governs the time of closing a circuit and in turn governs the position of the transient wave on the tracing table of the oscillograph. The position of brush A governs the length of time a circuit may be held closed. Figure 4 shows the method of mounting the brushes.

Application of the Commutator

As a single application of the commutator, consider the electrical circuit of figure 5. This represents the diagram of connections for the apparatus shown in figure 6. When brushes B and C are connected by the

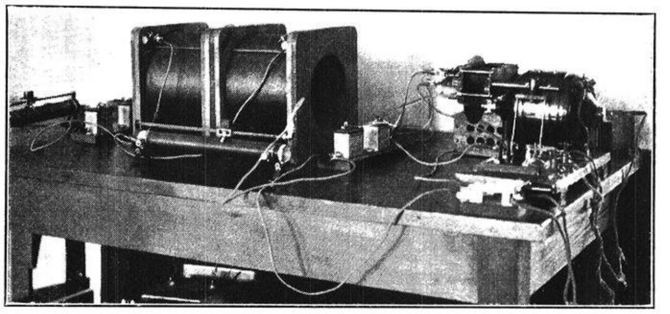

FIG. 6—*The laboratory set-up for the equivalent circuit of figure 5.*

wide live segment, the condenser C_1 is charged from battery source E_1. Then when the commutator rotates further so as to bring brushes A and B into electrical connection the charged condenser C_1 is placed in series with the coil L_1 and oscillograph vibrator No. 1. The discharge of the condenser C_1 through the coil L_1 produces an oscillatory current of character shown by the curve marked primary current in figure 7. Owing to the fact that a secondary circuit composed of a coil L_2, a condenser C_2, and an oscillograph vibrator No. 2 is coupled to the primary circuit through the mutual inductance M, all the energy initially stored in the condenser C_1, except that which has been lost in heat due to resistance, is gradually transferred to the secondary circuit. The lower curve shows the nature of the current in the secondary circuit. By a proper adjustment of the brush A, the primary circuit is opened at the instant the energy has all left this circuit. The secondary circuit is now free of the primary and therefore the remaining energy must all be dissipated in this circuit without transfer back into the primary. This illustrates a principle in spark telegraphy in which a quenched spark gap is employed to produce the same effect as that shown by the curves of figure 7.

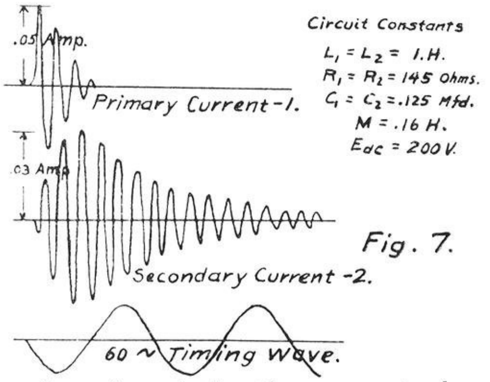

FIG. 7.—*A tracing of the phenomena produced by the set up of figure 6.*

So far all the requirements previously set forth have been fulfilled and illustrated except number four. As previously stated, in order to meet this requirement the commutator must be so associated with the oscillograph that at least eight cycles of an alternating current phenomena will be shown on the tracing table. This is accomplished by first placing the commutator shaft in the upper set of bearings of the gear mechanism and connecting it to the middle gear by a four to one gear ratio. This causes the commutator to run at one-eighth the speed of the motor. Then the commutator shaft is connected to the viewing mirror shaft of the oscillograph by a block chain through a one to one set of sprockets. This causes the viewing mirror to run at the same speed as the commutator and one-eighth the speed of the motor driving the commutator. The viewing mirror will now run at one-fourth the speed it had when the regular motor of the viewing mirror was used. Therefore, four times the number of cycles of an alternating current phenomena will appear on the tracing table. This gives eight cycles, a sufficient number for most purposes. However, in order to prevent excessive flickering, which would result from long intervals between successive waves due to the slow speed the mirror shaft would have on a frequency as low as 60 cycles, it becomes necessary to use a frequency of about 120 cycles on the motor and circuit under study. The synchronous motor illustrated herewith will not start on a frequency much in excess of 60 cycles but will run on 120 cycles after it is started at a lower frequency and both frequency and voltage are increased to 120 cycles and approximately 240 volts respectively.

The arrangement of the commutator just described is illustrated by figure 8. When using the commutator in this manner to show alternating current phenomena, only brushes A and B need be used. As a particular application of the arrangement consider the equivalent electrical connections, shown by figure 9, of an alternating e. m. f., the commutator, a coil L, a condenser C, and the oscillograph vibrator No. 2 in series. The revolving segment which performs the same function as the revolving wide brass segment on the actual commutator, alternately closes and opens the circuit on an e. m. f. which has the form shown in the upper curve of figure 10. During the time the circuit is closed a current builds up in the circuit in the manner shown by the lower curve of figure 10 when the circuit is tuned to the impressed frequency. It will be noted that the curve traced by vibrator No. 1, the upper curve of figure 10, not only shows the form of the voltage but also the value of the voltage when the circuit is closed. The closing time can be regulated by the position of all the brushes. This particular point is important because the form of the current

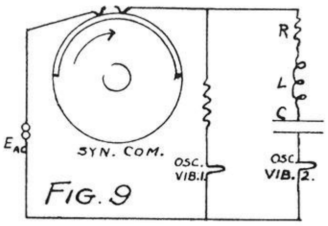

FIG. 9.—*The commutator, when used to show transients which result from alternating voltages, is equivalent to a single live segment which periodically closes a circuit through the two brushes shown.*

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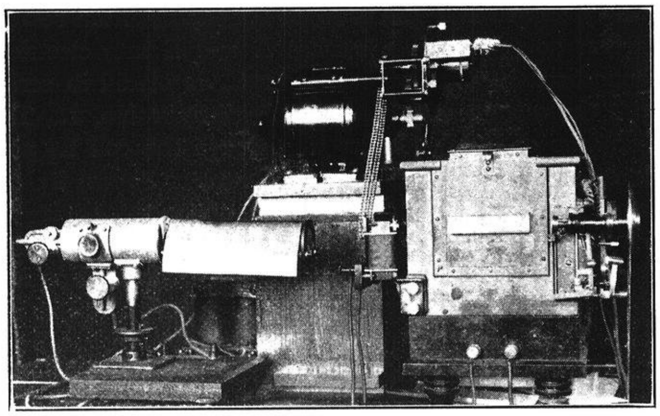


FIG. 8.—*The synchronous commutator is connected by a chain to the shaft of the oscillograph mirror for showing alternating current phenomena.*

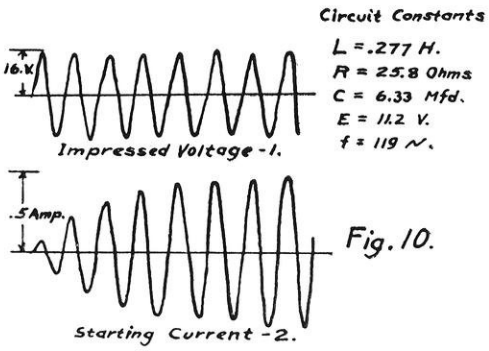
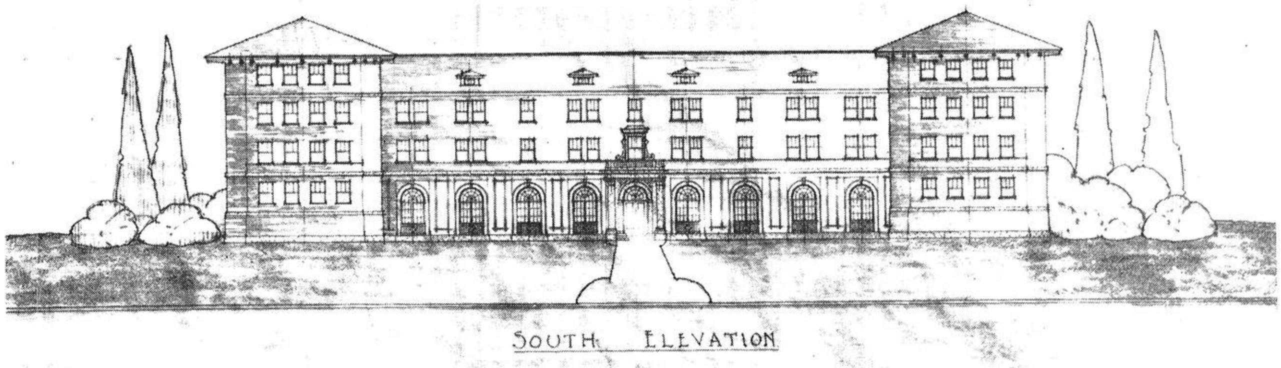


FIG. 10.—*The upper curve shows the form of the voltage impressed across the circuit of figure 9. The lower curve represents the current in the circuit immediately after the circuit is closed.*



Architect's drawing of the proposed dormitories.

RENTS IN THE PROPOSED DORMITORIES

By Leslie F. Van Hagan

Professor of Railway Engineering

THAT the landlady is a rapacious individual who tarries in our midst only for a brief period while she amasses affluence is the accepted tradition of the college student. It is a baby brother to the tradition among their elders that the landlord is a soulless extortioner. Among the advantages looked for from the dormitories, which are promised us here at Wisconsin in the near future, not the least is that room rents will be placed at the lowest possible level. It is interesting to speculate as to what that level may be.

A study of this question was recently made by the class in engineering economics. The results of the study, which of course were unofficial, seem to be of sufficient interest to our student body to warrant being presented herewith. The study itself was made before plans were available and under the limitations that usually surround a class exercise of this kind and does not represent painstaking research into all phases of the problem. The real justification for presenting it is that it may remove some misconceptions about the renting situation in general, and it illustrates the method of solving such economic problems.

Living Quarters Cost Money

The conclusions will be presented before we go into details. The estimates of the various members of the class range from $3.89 per man per week to $5.00. The mean was $4.08. The university authorities would like to keep the average rent between $2.50 and $3.00.

The first step was to determine what information would be needed. The items listed in Table A were analyzed. For example: Depreciation will depend upon the amount of the investment, the probable life of the physical plant, and the rate of interest that can be earned by a sinking fund. The amount of the investment can be estimated roughly by determining the number of cubic feet of building needed per man and the cost per cubic foot. Furnishings will have to be included in the amount of the investment, and they can be estimated either in detail or upon the basis of cost per man.

The following is a typical estimate of the annual cost of a dormitory that will house 200 students and be in use 42 weeks each year.

TABLE A

DETAIL OF ANNUAL COST OF ONE 200-STUDENT DORMITORY

Item	Amount
1. Depreciation	$ 2,608
2. Interest	15,400
3. Maintenance	4,800
4. Operation	16,480
5. Taxes	None
6. Insurance	407
TOTAL	$39,695

$$\text{Cost per man per week} = \frac{\$39{,}695}{200 \times 42} = \$4.73.$$

By such analysis, the class determined that the fundamental data needed were as follows: 1. Cubic feet per man; 2. cost per cubic foot; 3. cost of furnishings; 4. life of dormitories; 5. life of furnishings; 6. interest rate on sinking fund; 7. interest rate on investment; 8. cost of insurance; 10. number of student-weeks per year.

Scientific Guessing

It is obvious that the details which follow represent only a scientific guess. There is much uncertainty regarding plans at this time. The construction of the dormitories may be skimped or it may be elaborate; there is room for much variation in the cost of furnishings; and the cost of operation, which Table A shows is an important factor, will vary with the service policy of the university authorities. On the other hand, we have the group of women's buildings, already in use.

to serve as guides to the probable policy in regard to the proposed men's buildings.

Cubic Feet per Man. The state building code specifies that there shall be at least 400 cu. ft. of space per adult in each sleeping room. Obviously this is too little space for a person to live and work in. An estimate based upon personal opinion gave the following results:

Room 8′ x 11′ x 9′	=	792 cu. ft.
Hall 8′ x 4′ x 9′	=	288 cu. ft.
		1080
Other space 33 1/3%	=	360 cu. ft.
Total	=	1440 cu. ft. per man.

An investigation of actual buildings gave the following data: City Y. M. C. A., 2140 cu. ft. per man; fraternities, 3200; Chadbourne Hall, 6150; Barnard Hall, 4310; nurses' home, 3140. The figure adopted was 3000 cu. ft. per man.

Cost per Cubic Foot. The investigators brought in these actual building costs: Madison Y. M. C. A. (1917), 30 cts.,; Green Bay Y. M. C. A. (1924), 37 cts.; architect's opinion, 30 to 35 cts.; Madison Masonic Temple (1924), 40 cts.; nurses' home (1923), 35 cts.; state hospital (1924), 40 to 45 cts. The figure adopted was 40 cts. The investment in the building to house 200 men was, therefore,

200 x 3000 x $0.40 = $240,000.

Cost of Furnishings. The estimates for furnishings included beds and bedding, tables, chairs, book-cases, dressers, rugs and curtains, furnishings for a common living room, and cleaning equipment. One estimate placed the figure at $110 per man and the other at $120. These estimates impressed the class as being low, and the figure adopted was placed arbitrarily at $200 a man, or $40,000 for the building.

The total investment for building and furnishings was, therefore, $280,000, or $1400 per man. This was checked against the following recent figures: Cornell, $1,600; Harvard, $3,000; Yale, $10,000.

Life of Dormitories. Various authorities place the life of this type of construction at from 40 to 75 years. Gillette says 40 to 50 yrs.; Barnes, 40 yrs.; Merriman, 25 to 75 yrs.; Metcalf, 40 to 50 yrs.; Wisconsin Railroad Commission, 75 yrs.; Traction Valuation Commission for Chicago Consolidated Traction Co., 66.6 yrs.

Two of the oldest buildings on the campus — North and South halls — were built as dormitories and have served the university for 75 years. They are good for many more years of usefulness. The university builds well, and the proposed dormitories will undoubtedly stand as long as any building now on the campus. Furthermore, the dormitories are not apt to be rendered obsolete by more modern competing buildings. A life of 100 years seems a conservative estimate.

Life of Furnishings. Cooley says the average life of furnishings is 12.5 yrs.; Gillette, 20 yrs.; Starret, 20 yrs.; Wis. R. R. Com., 7 yrs.; the University of Wisconsin estimates 15 to 20 yrs.; fraternities allow from 8 to 15 years. The figure adopted was 12 years.

The Rate of Interest. The scheme of financing has not been made public. The alumni have offered to assist materially. It was assumed that the entire cost would be met by a bond issue. At this time money is plentiful and rates are low. Municipals range from 4.2 to 5.0 per cent; mortgages bring 6 per cent; industrial bonds at 6 to 7 per cent. Various of the state trust funds are being loaned at 5.5 per cent. The figure adopted was 5.5 per cent for interest on investment. This was shaded to 5 per cent for the sinking fund to allow for time lost in finding safe investments for it.

We now have sufficient data for the computation of items 1 and 2 of Table A. The depreciation was computed on the basis of a 5 per cent sinking fund, a life of 100 years for the building, and a life of 12 years for the furnishings. The factors used below are taken from a sinking fund table.

Building — $240,000 x 0.0004	=	$	96
Furnishings — $40,000 x 0.0628	=	$	2512
Total annual depreciation	=	$	2608

It will be noted that the depreciation on the building is practically nothing, but on the furnishings it is an appreciable item.

The annual interest charges on the total investment are:

$280,000 x 0.055 = $15,400.

This is a large item in Table A. and amounts to $1.83 per man per week.

Cost of Maintenance. There is practically no maintenance on the furnishings. The cost of maintenance on a large building in Milwaukee averaged 0.149 per cent of the cost of the building over a period of four years; for Chadbourne Hall it averaged 2.31 per cent over six years; for Barnard Hall it averaged 1.33 per cent for six years. Both of the latter buildings were badly mistreated during occupancy by S. A. T. C. men, so the maintenance costs are higher than normal. Barnard Hall is a well-built, modern structure, while Chadbourne is an old type. Two per cent on the cost of the building was chosen for this item.

$240,000 x 0.02 = $4800.

Cost of Operation. This item was estimated as follows:

1. Help — 5 people at $100 for 12 months	$6,000
2. Heat — 600 M cu. ft. at $7.00	4,200
3. Water — 200 men at $1.00	200
4. Light — 200 men at $1.00 for 9 months	1,800
5. Laundry — 200 men at $1.00 for 9 months	1,800
6. Telephone — 14 phones at $30.00	420
7. Supplies	300
8. Magazines	50
9. Management — 42 weeks at $5.00	210
	$14,980
Contingencies and omissions 10%	1,500
Total	$16,480

(Concluded on page 133)

STREET LIGHTING---A PROBLEM FOR ENGINEERS

By H. M. Sharp, e '22

Engineer, National Lamp Works

PROVIDING adequate street illumination at reasonable cost for city streets is one of the most urgent problems before municipal officials today. The tremendous growth in the number of automobiles in use and the development of large urban centers of population have given rise to an acute congestion of traffic on streets and highways. The importance of light in relieving this congestion cannot be overestimated.

The primary requirements which a system of street lighting must fulfill if it is to be judged adequate are:

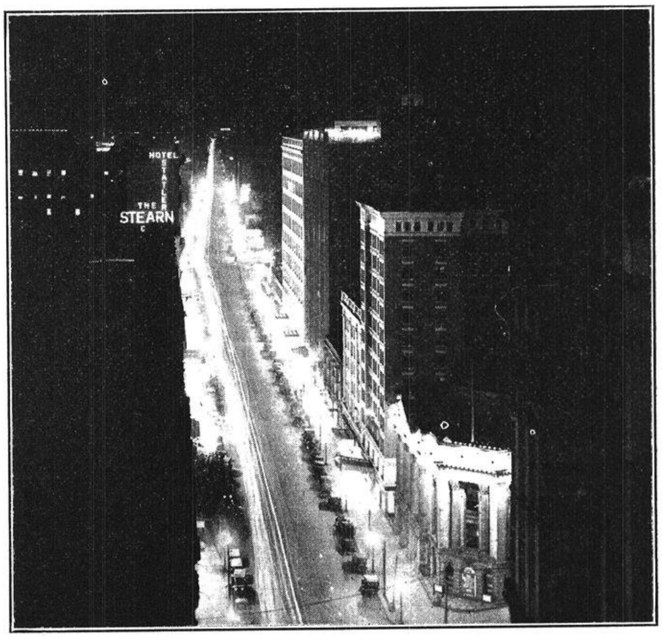
1. Reduction of traffic accidents.
2. Alleviation of crime.
3. Contribution to comfort and convenience of the community.

The fulfillment of these requirements also brings to the municipality closely allied benefits such as stimulation of civic interest on the part of the citizens, community advertising, and a beneficial effect upon real estate and retail business. However, the above listed prerequisites constitute a problem which is capable of solution by technical methods and it is in this connection that the engineer can be of real assistance in this vital municipal question. It is true that in the choice of lighting equipment and its location upon the street, there is a psychological factor to be considered in addition to technical details, but that is not beyond the ken of the modern engineer. The problem is clearly defined; on one hand the requirements which must be met, on the other a balance between cost, efficiency, and appearance which will adequately fulfill the conditions.

Good Street Illumination Prevents Accidents

The falling of darkness may be compared to the placing of partial blindfolds on drivers and pedestrians alike. Fifteen years ago, when the traffic was largely horsedrawn, the need for light, other than merely outlining the roadways, was not imperative. In this day, however, with 17,000,000 automobiles in use, more than 16,000 fatalities in 1924 due to motor accidents, and the annual death rate from automobile accidents mounting at the rate of 1,000 for every additional 1,000,000 automobiles, the traffic is serious. It is here that light plays its important part, for not only is light required for vision, but also experiment has proven that it actually takes less time to see an object under good illumination than under a dim light. Hence good street lighting by aiding in quick vision eliminates many of the accident hazards, and consequently prevents a very definite proportion of accidents. A survey of a number of American cities has shown that over 17% of all night traffic accidents can be prevented by adequate street lighting. This saving in money alone, would more than pay the total street lighting bill in the United States.

In analyzing common night traffic accidents it is found that they may be classified into five groups. A



A Splendid Example of Business District Lighting—Euclid Ave., Cleveland, Ohio. 15,000 lumen Mazda lamps are used, spaced opposite each other every 90 feet along the street.

proper system of street lighting will eliminate many of the conditions which give rise to such accidents and consequently be instrumental in their prevention. The common types of night accidents and the methods of their prevention are as follows:

A. *Driver Runs Into Obstruction Or Break In Pavement*

Street lighting, especially on the thoroughfares, should reveal all breaks in the pavement or obstructions in the street. These requirements necessitate a fairly uniform distribution of light on the street surface, against which the obstruction and dangerous faults are seen as shadows, or as breaks in the sheen of streets with a "polished" surface.

B. *Driver Strikes Pedestrian Stepping Into Street or Waiting In Street for Street Car*

The spacing of lamps should be close enough so that there will be no dark areas between units. On wide streets satisfactory results can be obtained only by locating lamps on both sides of the street.

C. *Driver Collides With Another Machine or Street Car on Entering Thoroughfare from Side Street*

On account of the additional traffic, the lighting requirements of thoroughfares are more rigid than those of the side streets leading into the thoroughfares. The thoroughfare system should be so designed that the crossings are especially well illuminated. This increased amount of illumination at once indicates to the driver that he is nearing an artery of travel and warns him to be cautious.

D. Driver Coming Into Thoroughfare From Side Street Strikes Pedestrian Crossing Side Street

The liklihood of this type of accident is avoided by the same treatment of the lighting system as outlined in C. A high-powered lamp at the head of the street not only warns the driver to proceed cautiously, but also furnishes a bright spot of light underneath the lamp against which a pedestrian is seen in silhouette.

E. Driver Overruns at Dead-End or Sudden Turn

A lamp of adequate power placed at the head of the dead-end street or on the outside of the turn illuminates the curb and surroundings. At particularly dangerous spots where the traffic is heavy, warning beacons may be used to advantage.

Crime is Lessened on Well Lighted Streets

All persons, their statements to the contrary, have an inherent dread of darkness, for darkness is all concealing. Adequate street lighting not only alleviates this dread, but also affords real protection, because the sneak thief or criminal is unable to come upon his victim unawares, and consequently the chance of detection and difficulty of escape are increased a hundred-fold. A survey conducted in the Cleveland downtown area by Mr. Ward Harrison showed that the installation of a "White Way" system reduced crime by more than 40%.

The third requirement which a system of street lighting must fulfill is not as definite nor as easily defined as the preceeding two. It is not only physical, but mental. Proper illumination will enable pedestrians and motorists to go about the city with ease and assurance after nightfall, and consequently will produce in them an agreeable mental state. But that is not all the story, because light, by means of its distribution, color, intensity, etc., can produce psychological effects, either pleasing or displeasing with a corresponding mental reaction. Glaring units must be avoided, because of the blinding effect of excessive brightness upon the eye and vision. On residential streets there should be sufficient light not only to illuminate the roadway, but to enable the passerby to discern house numbers, trees, shrubs, lawns, etc., so as to furnish a background or picture. In downtown areas, the lighting units should give sufficient upward light to illuminate the fronts of buildings and thereby eliminate the depressing "tunnel" effect which is produced only when the street surface

STREET LIGHTING SPECIFICATIONS

Street Class	Lamp Lumens per ft.	Mounting Height	Desirable Lamp Spacing, Ft.	Arrangement of Lamps	Lamp Lumens per ft. Length of St.
		100,000 Population or Larger			
Principal business	10000-50000	14-25	80-150	Parallel	200-1000
Secondary business	10000-25000	14-18	80-125	Parallel	100-500
Principal thorofares	6000-15000	20-25	125-250	Parallel or Staggered	30-100
Secondary thorofares, wholesale and mfg. district	4000-10000	20-25	125-250	Staggered	20-50
Boulevards and Parks	2500-10000	14-20	125-250	Parallel or one side	10-50
Residential	2500- 6000	14-20	125-250	Staggered	10-40
Alleys business section	2500- 6000	16-20	125-250	One side	20-50
Outlying streets and alleys	1000- 2500	16-20	200-400	One side	2½-10
		20,000 to 100,000 Population			
Business	10000-25000	14-18	80-125	Parallel	100-500
Thorofares	4000-10000	20-25	125-250	Staggered	20-50
Boulevards and Parks	2500-10000	14-20	125-250	Parallel or one side	10-50
Residential	2500- 6000	14-20	125-250	Staggered	10-30
Outlying streets and alleys	1000- 2500	15-20	200-400	One side	2½-10
		5000 to 20,000 Population			
Business	6000-15000	14-18	80-125	Parallel	50-300
Thorofares	4000-10000	20-25	125-250	Staggered or one side	20-50
Boulevards and Parks	2500- 6000	14-20	125-250	Parallel or one side	10-30
Residential	2500- 4000	14-20	125-250	Staggered or one side	10-30
Outlying streets and alleys	1000- 2500	16-20	200-400	One side	2½-10
		5000 Population or Smaller			
Business	2500- 6000	12-16	80-125	Parallel or staggered	20-100
Thorofares	2500- 6000	16-20	125-250	Staggered or one side	10-30
Residential	2500	14-20	125-250	Staggered or one side	10-20
Alleys	1000	16-20	200-400	One side	2½-5
Highways	2500- 4000	25-35	300-600	One side	5-10

is illuminated. A degree of ornamentation in the lighting equipment is also desirable, and is obtainable without undue cost or sacrifice of illuminating efficiency.

Modern Street Lighting Practice

In proceeding to provide adequate street illumination for any city, the first step is to divide the streets into several distinct classes, each class having definite lighting requirements. The table shown in Figure 1 gives the illuminating engineering specifications for the various classes of streets, according to the population of cities, while below is given a brief tabulation of street classifications, with their requirements.

1. *Principal Business Streets.*

It is customary to provide a high level of illumination to not only facilitate traffic but to advertise the locality and create an effect of prosperity. Ornamental equipment is used, consisting of a pleasing design of lighting fixture, architecturally correct post, and underground wiring.

2. *Primary Thorofares.*

These are streets which serve as arterial highways and thus carry a large amount of high speed traffic. A high level of illumination must be provided with precautions against glare. Ornamental or semi-ornamental lighting equipment may be used. Usually underground wiring is furnished although overhead wiring is used where ornamentation is not desired.

3. *Secondary Thorofares.*

These are considered to be streets which do not carry as much traffic as the primary thorofares. Usually they are the ones which pass through the manufacturing and wholesale business districts. Lighting equipment similar to that used on primary thorofares is usually provided, but the level of illumination may be lower.

4. *Boulevards and Parks.*

These drives usually carry heavy traffic and must be well lighted. On winding boulevards care must be taken in the location of units so as not to confuse drivers as to the direction of the drive. Ornamental equipment of pleasing design should be used with current supplied by means of underground cable.

5. *Residential Streets.*

A sufficient level of illumination should be provided to make visible obstruction or depressions in the pavement and sidewalks. Careful attention must be given to location of units in order to prevent interference of the light by tree foliage, and to avoid deep shadows caused by trunks of trees, shrubs, etc. Either ornamental or plain equipment may be used depending upon the location. If ornamental equipment is used, underground wiring should be supplied.

6. *Outlying Streets and Alleys.*

Sufficient light for protection or marking of dangerous points. Usually non-ornamental equipment is used with over head wires and small size lamps.

7. *Highways.*

Adequate lighting is imperative in order to eliminate the glaring headlight evil and to make possible a safe 24 hour use of our highways. Special lighting units for this type of illumination have been developed, so that by using moderate sized lamps spaced relatively far apart, adequate illumination may be obtained.

The importance of "zoning" city streets for purposes of illumination cannot be overestimated. By this means a complete and unified system may be designed, and where it is not possible or feasible to complete the installation at once the work may be mapped out and completed in a comprehensive manner in two or three years. Lighting equipment and other apparatus necessary for the supply and maintenance of the system should be standardized, making due allowance for the requirements of the various classes of streets. This plan results not only in a unified street lighting system, of which the city may be proud, but in lower costs, for the elimination of myriad types of equipment lowers not only first cost, but maintenance charges as well. Many cities are revising their street lighting systems along these lines, or have done so, notable among them being Milwaukee, Lansing, Washington, D. C., Chicago, Augusta, Schenectady, and Los Angeles.

In all his street lighting work the engineer should keep before him the fact that the goal of a street lighting plan is to insure to the citizens of any community the use of streets at night with the same degree of safety, comfort and convenience as in the daytime.

CENTRAL AMERICA AND WEST INDIES EXTENDING RAILWAYS

That a progressive and steady advancement in railway construction has taken place in Central America and the Caribbean Islands during the past decade, despite economic disturbances and political disorders, is brought out in a survey of the railroads of these regions released by the Department of Commerce.

A growth of 400 per cent in trackage, from 2,000 miles in 1914 to 10,000 miles in 1924, is disclosed by this publication.

This increase, however, it is pointed out, has been very largely due to American ingenuity and enterprise; the numerous fruit, sugar, and mining companies in these regions financed by United States capital taking the initiative in this movement. A large number of these American companies operate their own railway systems, and have a considerable amount of mileage in service. Very little has been done by individual governments themselves in extending their own systems, the report states.

The history of railway development in Central America is replete with all the thrills of fiction. From the time the first lines were laid down many of the states have been the scenes of bitter struggles between private organizations for the control of railway systems and of the industrial undertakings and natural resource developments that they serve.

THE ENGINEER'S PARADE

FOR the first time within the memory of most of the students now in the College, weather conditions for the annual St. Pat's Parade were perfect; Saturday, March 28, had in abundance all the qualities that long-haired, short-haired and entirely bald poets rave about. Welcoming the marked change from the rain, snow and sleet that greeted the last three parades, all true followers of old St. Pat pinned "a bit o' the green" to their flannel shirts and looked forward to a most enjoyable day.

Shortly after twelve o'clock, the parking areas behind the Engineering building, Science Hall and the Chemical Engineering building became scenes of great activity; a commotion reigned, in comparison with which the much advertised turmoil of Hollywood's motion-picture studios was as calm and peaceful as the reading room in a school for armless deaf-mutes. Floats began to take form; individuals and groups who were entering "stunts" assembled. For the small boys of Madison, who were out in force, it was a veritable circus day. The band arrived, thirty-five strong, with Steve Polaski, captain-elect of next season's football team, twirling a mean baton. Direct from a concert tour embracing New York, Boston, Philadelphia, Washington and Chicago, and acclaimed by John Phillip Sousa as "the best band I have ever heard", the musicians were at the peak of their powers. Many were attired in feminine apparel of a grotesque and bizarre nature, and large signs announced to an appreciative world: *All our men are women — not one a lady — and we blow about it too!* F. K. Lhotak, m '26, was in charge of the band organization.

Subpoenaed in a Dublin lawsuit, St. Pat was unable to appear in Madison in person this year, but a never-failing consideration for "His B'ys" prompted him to notify the parade committee well in advance of the date set, so that other arrangements could be made. In a radiogram to the chairman of the parade committee, St. Pat, in commenting upon the unfortunate circumstance that detained him in Dublin, said:

"The lawyers have utterly ruined Ireland. One time "a little bit of Heaven", it is now, by due process of law, rapidly going to the Devil. Now, when I call a man a scurvy rogue he sues me for libel instead of selecting his stoutest shillalah and coming over for a sociable evening."

A St. Pat Parade without St. Pat would be a more pitiful anomaly than ham without eggs (more of eggs, anon) or liver without the bacon. A contest promoted by the parade committee solved the problem. The student branches of the national engineering societies each selected a candidate to compete in a general election wherein votes were sold at the rate of ten for one cent. The funds raised in this manner went toward defraying the expenses of the parade.

Determined that their candidate should win, the civils hocked their winter overcoats and stuffed the ballot-box with money enough to bury every lawyer in Christendom. When the balloting was finished, Robert Morris, c '26, had piled up 130,000 votes, an overwhelming majority. He led Bruce Reinhart, m '25, by nearly 70,000 votes. Daniel Kelly, third in the race, polled 25,000 votes. The generously proportioned figure of the victorious civil was well adapted to the role of St. Pat. Clad in green and fine linen and armed with a shillalah that once reposed beside the harp in Tara's halls, Morris made an imposing figure. His carriage, in grace of line and luxury of its appointments, rivaled the coaches of the nobles of old France.

Shortly after two o'clock, the parade started down State Street to the stirring strains of the band. Near the middle of the column, a ten piece orchestra, organized by J. K. Kolb, m '26, played popular music for the crowds that lined the street. A replica of the famous Toonerville Trolley, entered by Triangle, attracted great attention; it was awarded first place among the fraternity floats. Second prize went to the Signal Club, Pi Tau Pi Sigma, for its unique float suggesting the recent aviation bombing tests that aroused so much controversy between the Navy and the Air Service. "Gold-diggers: 1849 and 1925", a float entered by the miners, took first place in the engineering society group. A. S. M. E. placed second with its float contrasting the Air Service with the Law School — "Hot Air, No Service". Among the unclassified floats, "Blockheads", the Wisconsin Engineer's take-off on the Student Senate placed first. "Richard's Inferno", entered by the A. I. Ch. E. depicted graphically the inevitable tortures of the law students.

V. W. Palen and D. E. Gotham put eccentric wheels on a flivver, mounted a barrel over the rear end, placed a saddle on the barrel and entered the contraption as the "Black-and-blue-Hawk Riding Academy".

"St. Pat's Descendant" in a baby carriage fitted with all modern improvements, including pressure and temperature control on the milk supply, got many a laugh.

"The Lawyer's Handicap", a giant whisky flask, was another outstanding float.

About halfway down State Street the foul (the word is used advisedly) machinations of the "shysters" were disclosed. Smarting from the ridicule heaped upon them in past parades, a desperate though abortive attempt was made to break up the procession. Eggs, some 4,000 of them, that had been tried in the incubator and found wanting, were purchased by the ambulance-chasers and secretly conveyed to the roofs of several buildings on State Street. At the strategic moment, eggs rained upon the unsuspecting plumbers.

Taken by surprise, the engineers nevertheless handled the situation well. The parade was stopped while the roofs were cleared of the enemy's artillery. Altho the clothing of the paraders within range of the flying hen-fruit was liberally spattered with eggs of most potent aroma, no serious damage was done to the floats. The

ST. PAT'S PARADE—*Top row: St. Pat's descendent, St. Pat, himself, The Triangle Fraternity Float, Center: The Engineers' Idea of the Student Senate, The A. S. M. E. Float, Bottom Row: The Take-off on General Mitchel's Fight with the Navy, The Engineer's Flask, Wisconsin Engineer's Float.*

lawyers made a desperate attempt to hurl all their ammunition before being chased by the engineer police, who were thirsting for gore; eggs were tossed from the roofs by the hundred, to prevent their capture. Nevertheless, large stores of the ellipsoids came into the possession of the sons of St. Pat.

As a practical joke, it went considerably beyond the pale, for the clothing of participants and bystanders was all but ruined. The situation was aggravated by the fact that most of the eggs contained dead chicks. Many co-eds in new spring attire were struck by the missiles, for the aim of the shysters was no better than their judgment.

Two law students were captured and dragged through the mess on the street. That it was a mess is best indicated by the fact that it was found necessary to have the fire department flush the street. Even after this was done, that section of State Street had a most unsavory atmosphere for hours.

After the melee, the parade moved on again, around the square and back to the university by way of Langdon Street. The P. A. D. house, home of one of the law fraternities, is on Langdon Street, and the engineers had reason to believe that the P. A. D.'s were the ring-leaders in the afternoon's battle. Their mood for vengeance, as ripe as the lawyers' eggs, St. Pat's brigade tarried awhile before the P. A. D. house, to the great concern of its inhabitants, whose guilty consciences and fear

(Concluded on page 133)

IMPORTANCE OF INSULATION IN ELECTRICAL ENGINEERING

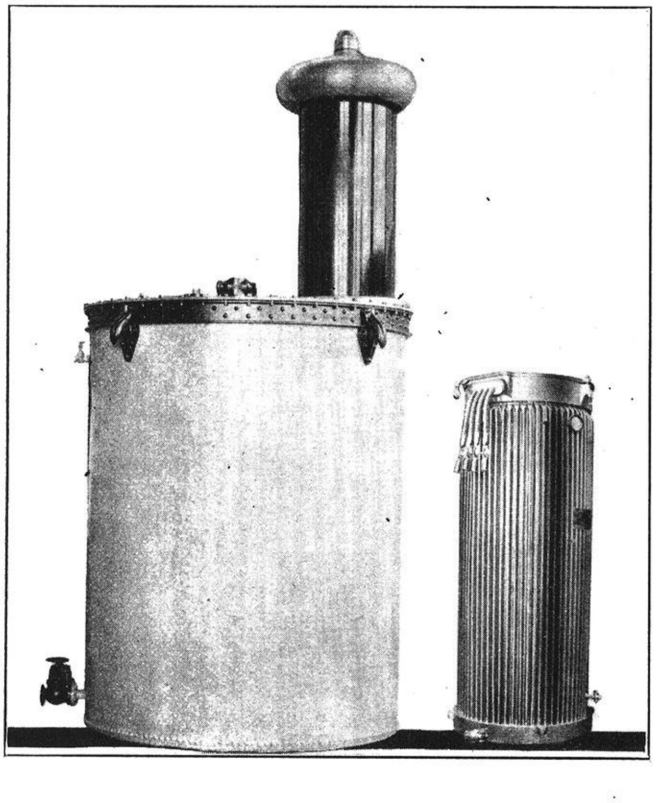
By Lawrence E. Barringer
Engineer of Insulations, General Electric Company

HAVE you ever been in the electrical repair shop of a large manufacturing concern? What one part of the machinery would you say was responsible for most of the failures? You would probably reply, "The insulation." When a machine is overloaded, the copper is heated, but the insulation usually breaks down long before the copper melts.

You have perhaps seen flywheels on large motor-driven reciprocating compressors. The effect of pulsating power drawn by such units may cause flickering of the electric lights unless the variations are smoothed out by a flywheel. But, it is an interesting fact that the manufacturer of the motor is much more interested in the size of the flywheel than in the lighting company. He is afraid that the continual vibration of the coils due to the variations in torque will sooner or later crack the insulation of the end connections. Thus, we see that the durability of electrical machinery is dependent, to a large extent, on the durability of the insulation.

A 13,200-volt generator is usually larger than a 2200-volt machine of the same capacity. The larger size is due to the extra space required by insulation.

The transformers used by Steinmetz to produce one million volt lightning are huge compared to a low voltage transformer of the same rating. The accompanying illustration shows a comparison between one of these transformers, rated 500 kv-a for one hour, and a 2300-volt unit rated 500 kv-a continuously. Other things being equal, the continuous rated unit would naturally be larger than one for intermittent rating. The large difference in size is due to the amount of insulation. Of course, the cost of a piece of apparatus depends somewhat on the size, and it is therefore evident that insulation is a large factor, both directly and indirectly, in the manufacturing cost of apparatus.



Space consumed by insulation usually means either a larger magnetic circuit with greater iron losses, or less space for the copper with higher resistance losses. It is thus seen that the limitations in durability, first cost, and efficiency of electrical apparatus, are due mostly to the insulating members of its construction. Insulation engineering is, therefore, of the greatest importance, and the problems to be solved are not at all simple. The American, French, and German technical papers are today full of discussions on the properties of di-electrics. Insulating materials come under this heading.

The electrical resistance of copper and the effect of temperature upon it are well known. The core loss of iron can be fairly well calculated. The changes in these materials are very gradual as temperature increases. But insulating materials are inherently much more unstable. Their properties change tremendously when influenced by heat, moisture, torsional strain, vibration, etc. The delicate insulating materials must therefore be protected from these deteriorating effects as far as possible in the design of the apparatus. However, it is impossible to design apparatus to eliminate these effects entirely, and in selecting insulating materials it is not only important to obtain an insulation value, but also the greatest possible resistance to these other effects — that is, heat, moisture, mechanical strains, etc.

You have probably seen people but tarpaulins over automobile spark coils in rainy weather. It is most important to keep insulation dry. Some electrical machinery has to be installed in mines and other places where water will drip on it. And even harder service is encountered in chemical works where acids or alkalis may be splashed on the winding. In coal breakers, the carbon dust has a tendency to ruin the insulation. The insulation engineer must, therefore, foresee these needs and develop special insulations for special purposes.

The following is an interesting problem which serves as a sample of those which the insulation engineer is again and again called upon to solve. A good many domestic refrigerating machines have been sold in the last few years. Most of these have stuffing boxes around the shaft which are quite liable to slow leakage. In order to avoid this difficulty, it has been proposed to eliminate the stuffing box by putting the motor inside the refrigerating machine where the insulation of the windings must not only provide effective electrical insulation, but must also protect the copper from sulphur dioxide which, in the presence of moisture may readily be converted into sulphurous acid. The insulation must prevent this, first by being itself quite resistant to either sulphur dioxide or sulphurous acid, and secondly by being so carefully applied that the metal of the conductors is completely covered and protected.

There are many uses of insulation with contradictory requirements. In some cases, insulation must fulfill certain mechanical requirements. It must be flexible in the case of armature coils, cables, magnet wire, etc., and rigid and inflexible in the case of bus bar supports, third rail insulators, transformer bushings, etc. The porcelain insulators carrying heavy high voltage transmission lines, in addition to insulating the wires, serve as a part of the mechanical construction.

Another instance is that definite wear with abrasion is desirable as in insulation between commutator segments, or distributor blocks of magnetos, while in other cases, such as in dead segments of rheostats, the less abrasion the better.

Furthermore, the high heat conductivity is advantageous in some cases and not in others. For instance, in armature coils high conductivity is desirable to draw off the heat from the windings. In the insulation of electric heating appliances, however, the electrical insulation must have heat insulating qualities as well.

With these many and varied requirements, it is not surprising that a multitude of types and forms of insulating materials is employed. We usually think of electrical apparatus as being constructed of two materials, copper and iron; in its insulation, however, porcelain, glass, mica, marble, slate, soapstone, rubber, varnishes, japans, enamels, pitches, molded compounds, papers, cloths, wood, and other materials are often used.

The theory of insulating materials is only imperfectly known. The dielectric strength, insulation resistance, power losses, and surface leakage, are not only different for the various insulating materials, but even the ordinary physical properties such as compressive strength, transverse strength, toughness, coefficient of expansion, etc., vary greatly with temperatures, humidity, thickness of insulation, form and pressure of electrodes or conductors, and other conditions. Since the theory is imperfectly known, a wide range of tests must be made in order to decide the true value of any insulating substance. The specific values claimed for insulations must always be accompanied by a statement covering the exact conditions of test, or otherwise such values cannot be safely compared with those secured by other investigators, nor safely used in the design and construction of electrical devices. Due to the lack of theoretical and test data, the application of insulating materials is largely a matter of judment. Poor judment in their selection, or carlessness in their application, will inevitably result in a machine of comparatively low efficiency and shortness of life.

Proper selection of insulating materials best adapted to the purpose does not dispose entirely of the problem. Very often, several different materials are used in the insulation of the same coil, and it is necessary that these be arranged logically. For instance, in using varnished cloth tape and mica tape for insulating high voltage generator coils, it would be a mistake to apply first the varnished cloth and then the mica tape, because the mica tape should be next to the copper where higher temperatures, which would soon destroy the varnished cloth insulation, are encountered.

The manufacturing processes are also of the greatest importance. It may be possible to obtain very satisfactory grades of both mica tape and varnished cloth tape, and yet not secure the desired results in insulating armature coils, simply because the taping ordinarily done by hand with mica tape has not been properly carried out, the winders leaving pockets and loose portions which will soon prove weak spots under high voltage stress.

Insulation should be built up as a solid homogeneous mass, free from air pockets and moisture. All cotton insulation and all porous organic insulation should be thoroughly dried at a temperature sufficient to remove the last traces of moisture, and then thoroughly filled with some highly insulating material such as varnishes, asphaltic filling compounds, etc. Insulation specifications should not only correctly stipulate the materials required, but should also specifically outline the arrangement and methods of application.

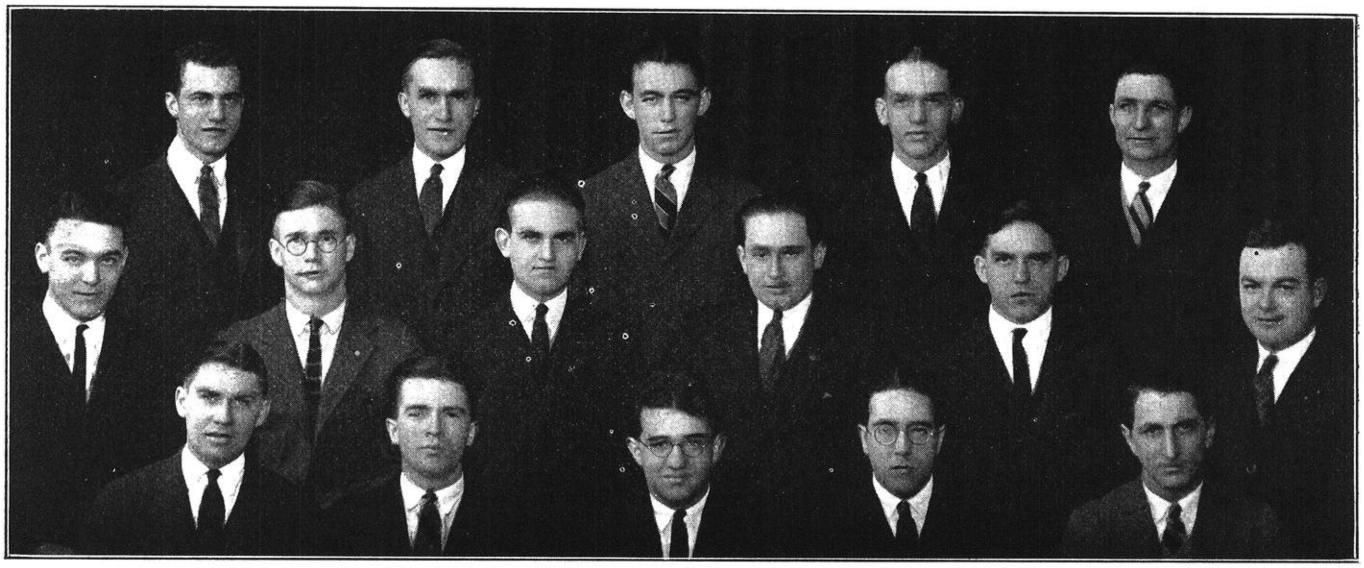
In the purchase of a small motor, you might be called on to decide between an expensive and an inexpensive machine. You will probably find that the difference between them is not one of efficiency or other obviously important characteristics, but chiefly the quality of the insulation.

From the foregoing, it seems obvious that the role of insulating materials in the efficiency, first cost, and durability of electrical apparatus, is very important. The great variety and complexity of the materials employed, the difficulty of reliable evaluation, and the chance of error in selection and arrangement, make it very important that electrical designing engineers give careful attention and study to this group of materials, with a view to always making the most intelligent and advantageous application of them in practice.

A highway signal to be surely noticed by the driver, particularly on a strange road, must come within the area of "vision of comprehension"; in other words, it must obtrude itself sufficiently on the driver's eye and mind so that he will realize that he is receiving a signal, says Lewis E. Moore, m '00, C. E. '06, writing upon "Railway Signaling Methods for Public Roads." The driver's eyes ordinarily focus on the road at a distance of one or two hundred feet ahead. The eyes move side to side, but there is a fairly definite elevation above which they do not usually look. Highway signals placed above this elevation fail in their purpose.

EDITORIALS

S. G. Sargis



The Staff — *Top row: Thiemann, Abendroth, Hockings, Richtmann, Liddle; Center row: Summers, Holmes, Teare, Lindner, Wolfe, Edwards; Bottom row: Taylor, Smith, Levin, Homewood, Sargis.*

CHANGE OF STAFF. Following the practice established last year, the board of directors of the Wisconsin Engineering Journal Association elected the business manager and the editor of the Engineer at mid-year instead of at the end of the year, as was formerly done. The new business manager is C. E. Johnson, e '26, and the new editor is H. C. Wolfe, e '26. These men and Mr. French, the advisory editor, appoint the other members of the staff. The Engineer extends its thanks to the men who are leaving the staff for the part they have taken in publishing the Engineer and for the work they have done in training the new members of the staff. The Engineer is especially grateful to H. G. Holmes, who was business manager for two years; to E. R. Summers, who served as editor during the past year; and to V. A. Thieman, C. P. Lindner, W. M. Richtmann, G. H. Abendroth, A. W. Edwards, and T. F. Ziegler, who have had charge of various departments.

So grasping is dishonesty, that it is no respecter of persons; it will cheat friends as well as foes; and were it possible, would cheat even God himself. —Bancroft.

FORCE OF HABIT Familiarity with any subject makes less and less demand upon our conscious attention, until we reach the point of doing things by habit. Habit is a repetition that has become mechanical. One operates a typewriter or a workman performs his task in a machine shop automatically. This form of habit is the most economical and efficient, but the danger lies in the fact that this habit forming tendency can invade our mental sphere also. The man who lives by force of habit has stopped growing and thinking. In order to escape from such a rut it is necessary, psychologists tell us, to form the habit of breaking through the crusts of unintelligent and habitualized thinking. This means that one must interest one's self in something different and continually keep before him some hobby or problem which will require consciousness and real hard thinking. Life for anyone is not mapped out but is an adventure requiring alertness at all times. By falling into the rut of habitualized thinking one loses the fascination and beauty of life. In other words variety is the spice of life.

Debt is to the man what the serpent is to the bird; its eye fascinates, its breath poisons, its coil crushes sinew and bone, its jaw is the pitiless grave. —Bulwer.

THE MAN SHOULD FIT THE JOB — ROBERTS. "When you young men graduate from school and begin to look for a position, you will find that the work is not as varied as it is in school; you will just be an engineer with no prefix such as Civil or Mechanical," said Dr. Roberts of the Westinghouse Education Department in a talk to senior engineers at 4:30 o'clock, on March 6, in the auditorium of the Engineering Building.

"The firm foundation of engineering rests upon the engineering schools," continued Dr. Roberts, "and may be represented by the base of a pyramid which is divided into squares. The squares resemble a sheet of coordinate paper and on the ordinates are listed the various classes of engineering work, while on the abscissas are listed the different operations that may be performed in each field. By entering the ordinate scale with the class of work that you intend to do, and the abscissa scale with the operation that you want to perform in that particular field, a point will be located on the base that will represent your chosen field. The altitude of the pyramid is divided into a number of sections parallel to the base, and represents the competition that is encountered. As you go up the scale the competition will decrease.

"Your success in getting a job depends upon your ability to analyze yourself in this dual respect. To make a proper analysis, consider every engineering graduate to have three sides to his nature, a social, a physical, and a mental. Represent these three characteristics by the sides of an equilateral triangle, and then extend a perpendicular from each side, of a length that is a measure of your ability in that particular nature. The intersection of the three lines determine a point that gives the relation of each of the three characteristics to one another. With this analysis it is possible for you to pick the type of work that you should follow. For instance, if your mental characteristics are high in comparison to the others as shown by the triangle, it indicates that the type of work that you should take requires mental energy, such as research or design.

"Be sure that the position that you first take is broad enough to give you a chance to study all of the fields of engineering," concluded Dr. Roberts, "so you can make a proper choice of the work that you are best fitted to follow."

THE SYNCHRONOUS COMMUTATOR

(Concluded from page 122)

depends in many cases upon the value of the e. m. f. when the circuit is closed. In this arrangement it is also important to have control over the opening time by the position of the independent brush A in order to reduce sparking at the commutator and the large voltage vibrator kicks which result if the energy in the circuit is high when the circuit is opened.

The two tracings shown represent the application of the commutator to only two types of a large number of electrical phenomena studies which might be carried out on the tracing table of the oscillograph. The distinct advantage of this method of studying transient phenomena over the old method of photographing is self evident. It is much more interesting to carry on an experimental study when the results of experimentation are immediately available. For example the student desires to know what takes place when he changes the resistance or any of the other circuit constants. By the use of the synchronous commutator he can see what changes the waves undergo while changes in the circuit are being made. Valuable time is also saved by this method. It requires about five minutes to make the average tracing, whereas in the old method of photographing it required, on the whole, about 30 minutes for the average tracing. The writer has found the use of this auxiliary device far superior to the old method of photographing in routine laboratory exercises, because the photographing process always seems somewhat of a mystery to the student.

DORMITORY RENTS

(Concluded from page 124)

This is a large item; it amounts to $1.96 a week per man. A check, based upon fraternity experience, shows a cost of $1.99 a week per man, and a check, based upon Y. M. C. A. experience, shows $2.05 a week per man.

Cost of Insurance. The buildings would be insured in the State Insurance Fund, at very low rates, against fire and tornado. The low rates presuppose insurance to the amount of 90 per cent of the value.

Fire insurance on building
$240,000 x 0.90 x 0.000833 = $180.
Fire insurance on contents
$40,000 x 0.90 x 0.00325 = $117.
Tornado insurance on building and contents
$280,000 x 0.90 x 0.000435 = $110.
Total = $407.

Number of Weeks per Year. The dormitories will probably be filled to capacity for 36 weeks during the regular session and for 6 weeks during the summer session, or a total of 42 weeks. The annual expense will have to be spread over these 42 weeks of usefulness. Probably there will be a rate for each semester based upon an 18-week semester and a rate for the summer session based upon a 6-week session. This will eliminate argument about payment during holidays.

THE ENGINEER'S PARADE

(Concluded from page 129)

of the results of their folly moved them to seek protection of the police.

Who was the first to use the lawyers' own weapon against them, we do not know, but the spatter of that first thrown egg on the more or less imposing facade of the P. A. D. house was the signal for a barrage of garbage that made the previous skirmish a tame and colorless affair. With the supply of refuse exhausted, the air cleared (though the aroma lingered) and the target stood out as the most artistic job of exterior decorating seen in Madison for years. A sally from the lawyers' castle was a failure; several P. A. D. paddles were taken from their owners and now hang in engineers' rooms as trophies of the battle.

Justice done, vengeance accomplished, the parade completed its course and disbanded.

An eventful day, — eggs-actly so!

ENGINEERING REVIEW

J. P. Smith

TRAFFIC ON THE PANAMA CANAL

The Panama canal is being used at an increasing rate every year. During the fiscal year ending June 30, 1924, 5,230 ships paying tolls passed through the locks. The net income from the transit revenue was $16,307,-948 and a net income from auxiliary business operations was $901,624. The income of the Panama Railroad Company was $1,044,887 making a grand total of $18,254,495 net profit to the United States. This is an increase of 38.7% over that of 1923.

From the time of the opening of the canal in 1914 to July 1, 1924, $97,802,818 tolls have been collected and 107,910,991 tons of cargo in 25,032 ships have transited the canal. The net gain above all operation and maintenance expenses was $33,241,425. Since the original cost of the canal was $352,205,669.39 up to the opening of the canal in 1914, it can be seen how the canal is beginning to pay for itself.

The size of the ships passing through the canal is increasing at a fair rate. In 1921, 1922, and 1923 the average registered net tonnage was 3,311, 3,440 and 3,957 tons, with tolls of $4,042, $4,195, and $4,559. The largest traffic comes from tankers coming from the California oil fields.

There is a generous margin of safety before the present canal is outgrown. The ultimate capacity of the locks and water supply is 40 ships a day. Where tandem and two—short ships—to a chamber-lockage are made the capacity may be increased to 60 ships a day. As but 14.33 ships passed through the canal per day in 1924 there is not a great deal to worry about.

—*Engineering News-Record*

SOMETHING NEW IN LOCOMOTIVES

The conventional type of steam locomotive is not going to be replaced in a hurry, but it is interesting to note that there are other types in the field which are not so well known. The demands for greater hauling power and greater economy in fuel consumption have produced a new type of locomotive which is being used in England. The Ramsay Locomotive company has built a turbo-electric condensing locomotive.

The efficiency of the steam turbine in stationary use has tempted designers to adapt it to railway uses. One of the greatest difficulties in the former applications of the turbine was that of transmitting the power to the axles. In the Ramsay locomotive this is done by electric motors operated by current from the turbo generators.

If a steam turbine is to be successfully operated it must be run with very high initial temperatures and pressures or by condensing the steam and thus reducing the back pressure due to the air. Condensers are not used on the ordinary locomotive. Efficiences may be further increased in the turbine type by using condensers. The condensor on the new type of locomotive must be very efficient and reliable or the advantage of the turbine is lost. The Ramsay locomotive uses a condensor in which the cooling is caused by both direct air cooling and evaporation. A special rotary condensing chamber is moistened with a thin film of water by partial immersion in water.

The appearance of the locomotive is so unusual that it might be well to describe it. The front portion of the Ramsay locomotive, which is connected to the rear portion by a special universal joint, incorporates the boiler, forced draft set, driver's cab, the main turbo-alternator set, and the auxiliary direct-current turbo generator under the boiler. The rear portion of the locomotive is occupied by the condensing plant with axial fan, condensate extracting pump, etc. Room, however, has been found for the main water tank and coal bunker. Communication between the turbines and condenser is by means of a 24 inch diameter exhaust pipe which is provided with a flexible rubber connection reinforced by internal rings of aluminum.

Each portion of the locomotive carries two driving motors, each pair of motors being bolted to a center cross-bearer which carries a transmitting shaft and spur wheels. Pinions are keyed to the motor shafts and these mesh with the spur wheels, the power being finally transmitted through coupling rods from the spur wheels to the drivers in the ordinary manner. The spur wheel and pinion shafts are enclosed in a gear case and run in an oil bath. The gear ratio is 2.8 to 1.

The main turbine is of the impulse type and contains nine stages. The mean blade diameter is 36 inches. It is designed for a steam pressure of 200 lbs. per sq. in., and the steam is superheated to a total temperature of 685 degrees F., exhausting to a vacuum of 27 inches.

(Concluded on page 136)

AN OPPORTUNITY FOR STUDENTS ONLY

"The Explosives Engineer" is a magazine for users of explosives. Its subscribers are the officials, engineers, superintendents, and assistants of the large mining, quarrying, and construction operations. Practical men find it of great value and thousands have told us how much they appreciate it.

Its contributors, in addition to its editorial staff, are men in charge of important projects, nationally known engineers, and prominent scientists. The magazine is devoted to the technology of drilling, blasting, loading, and transporting of ores, coal, and stone. Its scope is international. Experiments and advancements in blasting practice are described, usually for the first time, by writers well versed in their subjects.

The engineering student will find it valuable to read "The Explosives Engineer" during his college days. There is a special reduced rate of $2.00 a year for students. Mail the coupon today.

THE EXPLOSIVES ENGINEER

WILMINGTON DELAWARE

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Wilmington, Delaware

Enclosed is a money order (or check) for $2.00, for which send me "The Explosives Engineer" (regular subscription price $3.00) for one year, beginning with the current issue.

NAME..

COLLEGE..............................CLASS..............................

CITY..............................STATE..............................

ALUMNI NOTES

R. T. HOMEWOOD

CHEMICALS

Paul A. Nichol, ch '24, is with the Proctor & Gamble Co. He was transferred recently from Cincinnati, Ohio, to Kansas City, Mo.

Milton J. Shoemaker, ch '21, is with the Du Pont Fibersilk Co., Buffalo, N. Y. He has for the past two years been engaged in research work on artificial silk. His address is 40 Rosedale Ave., Buffalo, N. Y.

CIVILS

H. G. Affleck, ex '22, is now a second lieutenant of infantry in the United States army, stationed at Denver, Colo. He visited the university recently.

Eugene F. Bespalow, c '21, announces the arrival of a daughter, Hope Marilyn, born January 11. Bespalow is plant manager for the Shearman Concrete Pipe Co. at Jacksonville, Fla.

E. T. Ericksen, c. E. '90, has changed his address from Box 2, Orland, Calif., to 721 Taft Bldg., Los Angeles, Calif.

D. L. Fairchild, c '09, has moved from Douglas Ave., Minneapolis, to 302 N. Seventh St., Willmar, Minn.

R. N. Greenman, c '23, is with the American Telephone and Telegraph Company, 311 W. Washington St., Chicago.

Lieut. Wm. T. Hopkins, c '13, is supply officer of the U. S. S. Peary in the United States naval forces that have been on guard off the coast of China.

Clifford Older, c '00, is a consulting engineer with Monsoer, Older & Quinn, Marquette Bldg., Chicago.

J. H. Olson, c '24, is working for the Sewerage Commission of Milwaukee. He is making his home at the Y. M. C. A. on Fourth St.

James R. Price, c '22, is in the employ of the Milwaukee Sewage Commission. Price was married recently to Miss Hazel Horstmeyer, Madison. They will reside at 745 Bartlett Ave., Milwaukee.

Olaf N. Rove, c '22, visited the university on January 21 after spending a year and one-half in graduate study in Norway. He plans to complete the requirements for a master's degree at Wisconsin.

James A. Schad, C. E. '16, announces the birth, on February 25, of Marjorie Jane. Schad's address is 1641 Lunt Ave., Chicago, Illinois.

Lewis A. Schmidt, c '23, is on the Dix River Project at Bengin, Ky.

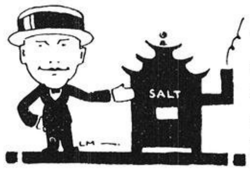
Philip K. Schuyler, c '21, who has been construction engineer on bridges for the North Carolina Highway Commission, has been granted leave of absence by that commission so that he may accept a position as associate professor of Highway Engineering in the University of North Carolina. While at the university he will have charge of considerable experimental work for the highway commission.

Robert E. Smith, c '20, is sewer tunnel engineer with Hammen Construction Company. His address is 422 Belgravia Ct., Louisville, Ky.

Walter C. Thiel, c '22, is in Long Beach, California.

Kenneth R. Wicker, c '23, is with the Metre Sewerage Commission, Milwaukee. He gives his address as 18-155 Knapp St., Milwaukee.

Harold P. Wood, c '13, died at his home in Cleveland on November 26, 1924, following a month's illness. Mr. Wood had, for the past nine years been connected with the New York Central Railroad Co., in Cleveland. His wife and two sons survive.



Pond Sherron Wu, M. S. C. E. '15, writes, "Since the beginning of the present year I have joined the Government Salt Administration as the chief of the newly created Works Department. My department has to do with construction works in all the the districts throughout China. I have made a number of inspection trips in connection with some proposed work and find that we will have a lot to do in the future because, ever since the reorganization of this service in 1915 no attention has ever been paid to the proper housing of the different works and staffs, nor the improvements of the various properties. We have now a program to spend a million dollars a year for the next five years for such improvements. I am starting a designing division also. Just now I am building a thousand feet of concrete bunding for one of our depots near Tientsin and up-to-date office buildings in Harbin, Tientsin, and Hankow."

Karl L. Zander, c '23, is assistant engineer in Kenosha. He was married on October 25 to Ruth McClelland, '21, Finaley, Ohio. They live at 606 Congress St., Kenosha, Wis.

Ben Zelonky, c '22, is Construction Engineer with Gustave E. Kahn, Milwaukee. His home is 847 14th St., Milwaukee.

Walter O. Zervas, c '22, is commercial engineer with the Wisconsin Telephone Co., Milwaukee, Wis.

ELECTRICALS

C. A. Andree, e '22, M. E. '23, gives his address as 209 W. Gilman St., Madison, Wis.

Russell G. Davis, m '21, is with the Chain Belt Company, Keystone Bldg., Houston Texas.

Elmer Ely, m '09, announces the arrival of a son, John Andreas, on October 25, 1924.

David Greiling, m '24, is with the Lyiman Refrigeration Co., Beloit, Wis. His address is 624 Whitman Hgts., Beloit, Wisconsin.

W. W. Greiling, m '22, is in the drafting department of the American Blower Company, Detroit.

Neal D. Herrick, e '23, has changed his address to 382 Charles St., Malden, Mass.

Clarence Johnson, e '09, is district engineer with Westinghouse Electric & Mfg. Co. His address is 144 Edgemont Ave., Ardmore, Pa.

V. E. McCallum, e '20, announces the birth of a son, Evan Arthur, on January 6, McCallum lives at 856 Webster Ave., Chicago.

Gordon Meyrick, e '22, is living at 418 S. Jackson St., Green Bay, Wis.

T. G. Nee, e '99. gives his address as : c/o Horne Co., Ltd., No. 36, Kawaguchicho, Nishiku, Osaka, Japan.

Rudolph Heins, e '22, is with the Menominee and Marinette Light and Traction Company, Menominee, Michigan. He has been on detached duty at Madison for the past three months.

Waldemar P. Schoenoff, e '24, was married on March 22 to Miss Leota Z. Bongey of Madison. Schoenoff is with the Commonwealth Edison Company. His address is 1401 Winnemac Ave., Chicago.

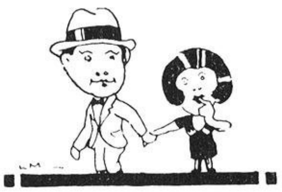
Reeve O. Strock, e '23, has been placed in charge of the construction of radio station WHT, Chicago. Strock has been very active in radio work; he is credited with the development of a condenser microphone transmitter now in use by the General Electric Company. He was on the Engineer staff in '22.

C. D. Willison, e '05, is secretary-treasurer of the American Chest Company. His address is 318 Hartwell Ave., Waukesha, Wis.

MECHANICALS

Carl Bars, m '25, is with the Central Station Institute of the Commonwealth Edison Company. He is in the electrical testing department. His address is 5907 S. Parnell Ave., Chicago.

George Carlson, m '24, is with the Bucyrus Company at Milwaukee.



Maurice Fitze, m '24, was marrie on March 28 to Miss Pearl A. Borchert, Madison.

Riemar Frank, m '20, is in the rail division of the Inland Steel Company; 1105 First National Bank Bldg., Chicago.

A. D. Fulton, m '16, announces the birth of a daughter, Hemingham Lyons, on February 7. Fulton's address is 605 Rowland Ave., Balto, Md.

Merritt A. Giles, m '22, is with the Doherty organization in Denver, Colorado. This organization trains engineers along public utility lines, and gives them a chance to learn where they fit best. Giles has recently been married. His address is 720 Logan St., Denver.

David Greiling, m '24, is with the Lyiman Refrigeration Company at Beloit, Wis. His address is 624 Whitman Hgts., Beloit. He is at present on detached duty at Cleveland, Ohio.

E. W. Jones, m '23, is with the John A. Manning Paper Company, Troy, N. Y.

Herbert E. Lindeman, m '20, writes that he has recently entered the blissful wedded state and is still very happy. He is with the A. P. Green Fire Brick Company, Mexico, Mo. His address is % Hoxsey Hotel, Mexico, Mo.

Donald A. McArthur, m '23, has the title of Chief Clerk with the Gary Street Railway, Gary, Ind.

Edward W. Meyer, m '95, has changed his address to 129 Michigan St., Milwaukee.

Jose Margarida, m '15, is a furniture manufacturer and dealer in San Juan, Porto Rico. His address is 61 Munoz Rivera St.

R. L. Meyer, m '20, has become a member of the firm of Geo. Weatherwax Company, piping contractors, and will become active in that connection in about a year. He is temporarily with the Standard Oil Company in charge of installation of mechanical equipment at Mishawaka, Ind. His permanent address is 1454 Bell Plaine Ave., Chicago.

Fred Mollerus, m '24, is with the General Electrical Company at Schenectady. His address is 117 Knott Terrace. He divides his time between the testing departments at Pittsfield, Mass., and Schenectady.

George T. Moore, m '18, is living at 1237 Oxford St., Berkeley, Calif.

Joe Rosecky, m '24, is with the Allis-Chalmers Company in Milwaukee. His address is 901 S. Beecher St. For the present he is on detached duty in Peoria, Ill., where he will be for about three months.

Emil F. Stern, m '19, was married on March 17 to Miss Rebecca Adland. They live at 5009 Sheridan Road, Chicago.

ENGINEERING REVIEW

(Concluded from page 134)

The turbine is flexibly coupled to a three-phase alternator and has a speed range of 1,800 r. p. m. at starting to 3,600 r. p. m. at 60 miles an hour. The three-phase alternator is designed to develope 890 kw. at a maximum pressure of 600 volts.

The auxiliary turbine is a single stage machine flexibly coupled to a direct-current generator which provides the energy for the excitation of the main alternator poles as well as for the auxiliary direct current motors driving the condenser fan, condenser rotor, condenser extracting pump, and the forced draft set for the boiler. It also supplies the necessary current for lighting the train. The auxiliary turbine operates under the same conditions as the main turbo set.

The boiler is of the ordinary locomotive type, and the combustion chamber is supplied with air by a high speed forced draft located in the cab. A simple locking device is provided on the fire door to prevent a blow-back, the door being prevented from opening by a safety catch when the forced draft fan is in operation.

The transmission of power from the main turbine to the driving motors is three-phase, current being supplied from the alternator to the four alternating current slip ring motors, each motor having a continuous output of 275 h. p. and one hour's rating of 360 h. p.

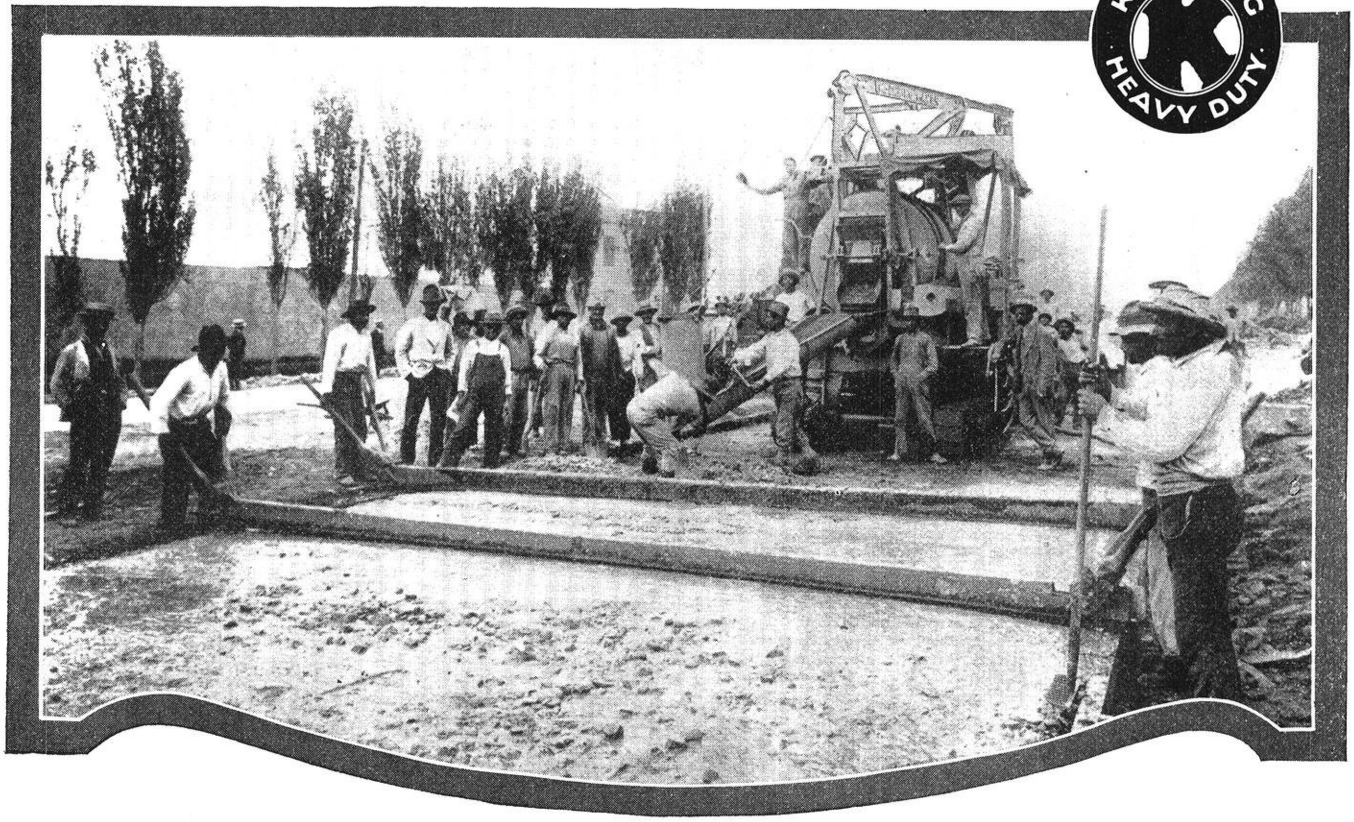
The following tractive force is developed at the rims of the driving wheels for the acceleration period from rest to 60 miles an hour:

Miles an hour	Tractive force.
At starting	22,000 lb.
15	22,000 lb.
30	11,050 lb.
60	8,600 lb.
60 (normal running)	6,000 lb.

Shop and track test have shown that the locomotive performs very satisfactorily and has advantages over steam and electric locomotives. It is controlled in the same manner as an electric locomotive by means of a controller wheel. The smoothness of motion usually found in an electric locomotive is found in this locomotive combined with the independence of the steam locomotive. Each engine is a self contained power plant.

—*From Railway Age.*

KOEHRING



Paving in Peru

IT is not only in this country that Koehring pioneers, but in sections all over the world the Koehring paver is blazing new concrete trails of progress, development and civilization.

In Peru, for instance—paving streets of Lima and thirty-two of its other principal cities, building the important motor highway between Lima and Callao and pushing paving work in Cuzco, Arequippa and Ayacucho. The Koehring paver is found taking its part in this major public improvement.

Koehring Pavers and Mixers are identified with noteworthy construction projects in all parts of the country and the world. "Koehring Heavy Duty" is a symbol signifying equipment of the highest grade, built to deliver maximum operating service over a period of years.

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ATHLETICS

B. R. Teare

RESUME OF THE SWIMMING SEASON

In an exceptionally fine swimming season, Wisconsin has shown herself to have one of the best teams in the conference. We took second place in the conference meet at Chicago, and won dual meets with Iowa, Indiana, and Chicago and lost only by close scores to Minnesota and Michigan. The relay team surprised us by taking the match from Northwestern and was undefeated throughout the entire season, and the water basketball team won the conference championship without a loss. In total points we lead our opponents by a score of 188 to 149. Herschberger is the high scorer with 50 points and Gilbreath is second with 29¼. Wheatly and the men on the relay team, Flueck, Gilbreath, Hipple and Herschberger, will receive their major W's, and Cook, Hall and Simpkins, the minor awards, for their consistantly good work in the plunge and diving. The members of the water basketball team who have played in games for at least thirty-two minutes will also receive major insignia. Herschberger, who has had to compete with men of Olympic calibre like Breyer and Howell, of Northwestern, has time after time won places in the forty and hundred yard swims. He is one of the outstanding swimmers in the conference, and fortunately for Wisconsin is but a sophomore. To conclude the season properly a banquet was held at which Coach Joe Steinauer was presented with a loving cup by the members of his squad.

TRACK

The Wisconsin tracksters, having done very well at home, are planning to try for greater honors. Winning easily from Notre Dame and Iowa, and breaking plenty of records in the process, they further showed their ability by taking second in the conference meet. With McAndrews starring in the dashes; Kennedy, Bergstresser, and Captain Vallely in the longer runs; McGinnis in the hurdles and Schwartze in the weight events, they should be able to make a good showing against our western opponents.

The tour as planned calls for the meet at the University of California, Berkeley, on April eleventh, and on the return journey meets with Utah and Colorado, and competition in the Kansas Relays. The meet with Arizona on the way out had to be cancelled because of the contract with California which specifies that we shall compete with no teams on the trip before their meet. It also provides, among other things, that each of the contestant's entries be limited to twenty men and these entries must be turned in three days before we leave — no changes can be made without mutual consent.

Reports from the Golden State indicate that California has a very strong all-around aggregation and we will be taxed to the utmost to make a creditable showing. Their greatest strength appears to be in the weight events with possible weaknesses, if any, in the distance runs and high jump. The Badgers are also strong in the weights, and in the dashes, but weaker in the hurdles and javelin throw. However, in a track meet anything is likely to happen.

The team was given a good rousing send-off as it left on April third for the coast. A thousand students gathered on the lower campus with a small band, and enthusiastically cheered and sang "Varsity" and "On Wisconsin." As the team was pulled to the station in the red wagon the crowd almost doubled, recruited, as it seemed, from everywhere. Before the train left speeches were given by Coach Jones and Captain Vallely, and then the team departed on the greatest enterprise of a Badger track squad, taking with it the hearts and hopes of the student body.

The Track Team Send-off.

CREW

Although at the time of writing the crew has not been picked, prospects for the season look pretty good. The weather was warm here earlier than usual this year, but even so the season lags behind that in other schools. We had a crew out on Lake Monona before the first of April, which is quite early; last year the men could not get out in the shells until the eleventh of April.

The men left from last season's successful Poughkeepsie crew are Capt. Teckmeyer, Sly, Grunetz, Bent-

(Concluded on page 139)

CAMPUS NOTES

J. Levin

Mr. Farley Osgood, president of the American Institute of Electrical Engineers, delivered a talk to the junior and senior engineers on the subject, *What a College Graduate Goes Up Against and How to Meet It,* at 11 o'clock, March 19, in the auditorium of the Engineering Building. In the course of his address, Mr. Osgood, who is a graduate of the Massachusetts Institute of Technology and is now vice-president and general manager of the Public Service Electric company of Newark, N. J., stressed the fact that one of the most serious shortcomings of many engineers today is their lack of thorough training in the expression of the English language, and advised his listeners to continue their study of English if they wished to make their mark in the world; for the men who employ engineers are usually non-technical men and require explanations and reports in every-day, clean-cut English.

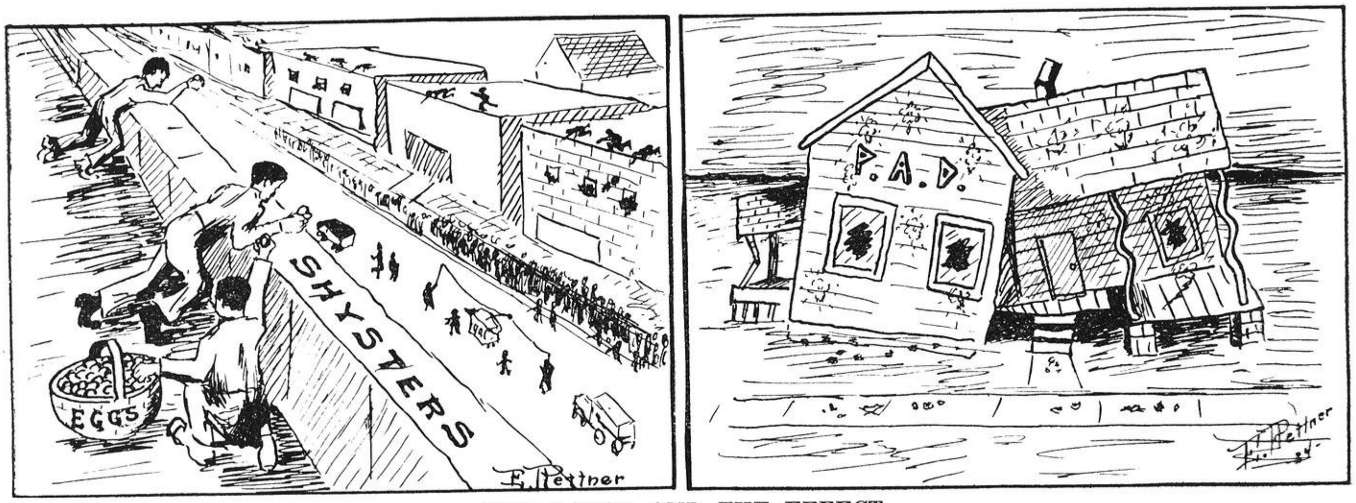
Tony Kyhos: "Mr. Owen, were those refraction tables made mathematically?"
Professor Owen: "Certainly."
Tony: "Well, I thought they were computed."

The Steam and Gas department has recently secured from the Nash Sales Company, Milwaukee, a six-cylinder Nash chassis which will be used for instructional and exhibition purposes. To the uninitiated, all chassis are alike; however, the Nash chassis which is located at present in the Steam and Gas Lab is quite unique in that it presents a cross-sectional view of the various parts of the automobile. Glass covered sides on the motor and gear case allow the observer to see how the individual units work in relation to each other. No longer need differential gears remain a matter of mystery or chance: side views of the gears and cylinders enable one to see the how and why of the progressive movements necessary to the operation of a car.

Beau: "Do you enjoy codfish balls?"
Brummel: "No, I never go to dances."

The senior engineers are on the verge of contributing a new tradition for future seniors — to wear Stetson hats as an integral part of the equipment for their successful entrance into the world. Although we have interviewed no less than a dozen seniors and half that number of profs, we have not had the satisfaction of learning any more about the contemplated head-gear than we knew before. By a series of laborious and complicated processes, however, we have arrived at the conclusion that the purpose of these proposed Stetsons is to enable the stately seniors to be distinguished from the common herd and the rest of the world.

Already a goodly number of seniors have signified their willingness to acquire such a crown, without which no engineer's wardrobe is complete. The only thing which remains to be done is to select from this varied array of Mexican sombreros, troopers, and western headgear, the kind of Stetson which will enhance the manly beauty of the greatest majority of its wearers. From an inspection of the variety of styles at the disposal of the Seniors we may safely predict that the appearance of these toppers on the campus will surely knock 'em cold.



THE CAUSE AND THE EFFECT

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Explosives Department
WILMINGTON, DELAWARE

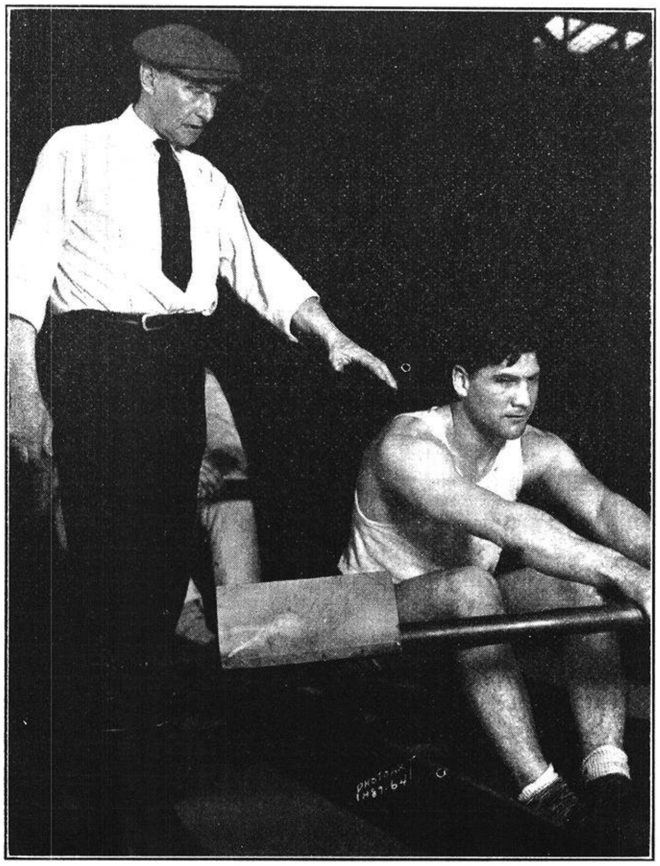
DU PONT

POWDER MAKERS SINCE 1802

ATHLETICS

(Concluded from page 137)

son, and Coxwain Coulter and about these fighters as a nucleus, Dad Veil is building a strong crew. Besides the second varsity and new men, among which are Holmes, Van Wagnen, Esser, and Treichel, there are the frosh crew men of last year, Olwin and White of the winning Engineers, McCarter and Decker from the L & S, and Burrus and Bratton of the Commerce oasmen. Coach Vail is satisfied that the fellows are



"Dad" Vail coaching Teckemeyer, m'25.

showing good form, and by steady gradual practice they will be in fine condition for the Poughkeepsie regatta. The course, however, has been changed from three to four miles, which handicaps us more than other crews because we cannot get into the shells as early in the spring as most of them and so lose some of the practice that is so essential for the endurance test that it is. The men must work gradually up to their speed — too stiff a practice in the beginning or too sudden a strain may disable a man for the entire season.

BASEBALL

Before the snow was off the ground Coach Lowman had his squad out stopping the swift ones and limbering up their arms, outdoors when the weather would permit and at other times in the annex. Fortunately for us the weather has been unusually warm and fair this spring for our locality. The long practice hours have done a lot for the fellows to put them into shape for the southern training trip.

Although many good men graduated last year, still there is promising material on hand. At first, fearing a lack of battery candidates, Coach Lowman worked hard on that phase of the game and developed some likely men. Shrenk, Stoll, Lustig, Edwards, Galle, and Clausen have done good work as hurlers, while Schmitt, Wold, Lamboley and Barnum have shown themselves able to take care of the receiving end. Infield material looks good with Larson, Steen, and Feuchtwanger at first; McAlpin at second; Captain Ellingson, Janssen, and Wieland at shortstop; and Tangen, Martell, and Donega handling third.

Leaving April third for the south the men expect to round themselves into good shape for the coming conference games which begin with Northwestern. The team goes to St. Louis first, and continues south through Mississippi and Tennessee playing eight games on its tour with St. Louis University at St. Louis, University of Mississippi at Oxford, Mississippi College at Clinton, Mississippi Agricultural College at Starkville, Union University at Jackson, Tenn., and finally Northwestern at Evanston. Scrimmage before the trip is good, but more batting and sliding practice is needed, as well as actual outdoor work, all of which will probably be secured on the trip.

THE FIELD HOUSE

At last the University is getting a field house! The Sauthoff bill, denoting two hundred fifty thousand dollars for that purpose, has passed both houses and received the governor's O. K. The plans for this much needed structure have not yet been drawn up, as the constructive details have still to be decided upon. However, the building will probably seat from ten to fifteen thousand people and provide all the facilities for track and gymnastic activities, and outside of it will be baseball diamonds and the long desired tennis courts. Like the big stadium at Randall, it will not cost the state anything, but will be financed by athletic receipts. The field house will probably be completed in time for the 1926-27 season.

EXTENSION NOTES

EDUCATION OF ELECTRIC METERMEN

The Meter Committee of the National Electric Light Association introduces its report in the Education of Metermen with the following words:

"Developments in recent years have shown a material change in the metering art. Many universities and colleges are awake to the fact that technical achievements are to be held and developed only by a broader and more thorough technical education. The man who has done things by rule of thumb is being pushed aside for the man who is technically trained."

The interesting fact disclosed in the above quotation is not the awareness of the universities and college of the superiority of technical education to rule of thumb methods, but the realization of this fact by industrial managers, and their whole hearted co-operation with the universities in providing this technical training. This is particularly true as it applies to the education of metermen through the agency of what are known as short courses or schools for electric meter men.

The first of these short courses was offered by the Iowa State College at Ames, Iowa, in 1919. In 1921, the University Extension Division and the college of Engineering of the University of Wisconsin in co-operation with the Railroad Commission and The Wisconsin Utilities association offered a similar course to the metermen of Wisconsin. At first the promoters of the school were uncertain as to the support the utilities would extend to the enterprise. They were unprepared for the enthusiastic and spontaneous response made in the nature of some ninety registrations. Last year 21 Universities conducted these short courses with a total attendance of 971 metermen. The fifth annual school for electric metermen was held at the University of Wisconsin April 7 to 11 inclusive with an attendance of about 70.

The benefits of these short courses to the metermen and to the utilities of the state are summarized by the Meter Committee mentioned above as follows:- "instruction in theory; practice in maintenance; appreciation of the importance of correct metering; interchange of ideas with others in the same field; better understanding between the university and the utility; technical students attracted to meter work; more intimate footing with manufacturers and their product; closer co-operation with state regulatory bodies; and the ultimate purpose of the courses, — more accurate metering."

The effectiveness of the work of these schools in this ultimate purpose is disclosed by the experience of one company whose records show that a greater percentage of the meters installed, tested, and maintained by metermen who had attended the meter school are more accurate at all loads than meters previously installed.

Robert P. Whitmer, manager of the furnace department of the American Foundry and Furnace Co., Bloomington, Illinois, who recently enrolled for the course in heating and ventilating, visited Madison on March 29.

The Department of Civil and Structural Engineering of the University Extension Division of the University of Wisconsin is revising its first course in Reinforced Concrete Construction (No. 418A) to conform in general with the new Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete. The course has been lengthened from twelve to sixteen assignments to care for the specification changes made and supplementary material and problems have been prepared.

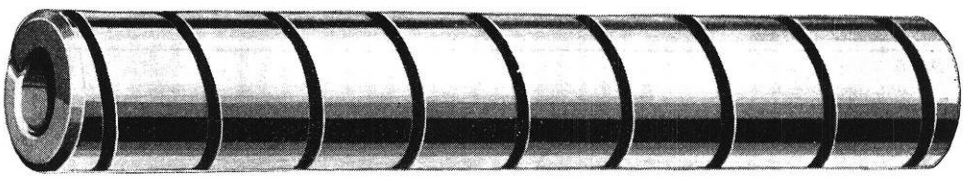
This new Report of the Joint Committee was published last December. Among the several changes in the specifications, perhaps the most important are in regard to allowable unit stresses in the concrete, unit shear, and unit bond in reinforced concrete beams, anchorage requirements for reinforcing steel in beams, flat slab design, column design, and concrete proportioning.

This revised course now has a fairly large enrollment which includes students from twenty-four states other than Wisconsin and from three foreign countries.

Mr. George A. Nuss, a student in Structural Engineering, has recently accepted an engineering position with the Stifico Steel Company of Michigan City, Indiana. Mr. Nuss was formerly located at De Pere, Wisconsin.

The recent articles in the Engineer on "The Mechanical Equipment of a Modern Newspaper Plant" by Prof. W. E. Wines of the University Extension Division have created wide interest. Prof. Wines' articles were written from first hand experience as Mechanical Superintendent for the Minneapolis Tribune, the Chicago Tribune, and the New York Times.

Julius Taeuber, a draftsman of the Allis-Chalmers Co., enrolled some months ago in the course in elements of mechanics. A letter recently received from him states that he is about to return to Switzerland to complete his university education but that he intends to complete the course in mechanics.



A Hyatt roller

Hyatt Rollers Are The Distinguishing Features Of Hyatt Roller Bearings

THE continued satisfactory service of Hyatt Roller bearings in machinery of all kinds through the past thirty years is due to their anti-friction elements—the Hyatt rollers.

These rollers are wound cold from long, flat strips of high grade alloy steel. They are carefully heat treated to make them tough and hard and are then carefully ground to close limits.

A group of these rollers held in a strong cage and rolling between hardened steel sleeves or races constitutes a Hyatt roller bearing.

Due to the design of Hyatt rollers and to their superior steel and careful manufacture, the following advantages result.

Friction reduction: Because of their true rolling motion Hyatt bearings eliminate at least 50% of the dragging friction of plain bearings. This results in worth while saving of power and in long life.

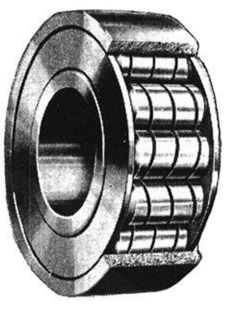
Durability: The alloy steel rollers are of the proper hardness to give years of service under the severest conditions of loads and shock loads without appreciable wear. Some Hyatt line shaft bearings at the Greenfield Tap and Die Corporation are still in use after thirty-three years of continuous service. These bearings usually outlast the useful life of a motor car. They have been in operation over fifteen years in coal mine cars without requiring replacement.

Lubrication: The spiral slots in the Hyatt rollers continually spread the oil over all the bearing surfaces and being hollow the rollers afford ample oil capacity for three or four months operation in most machinery. This results in at least an 80% saving in lubrication material and labor.

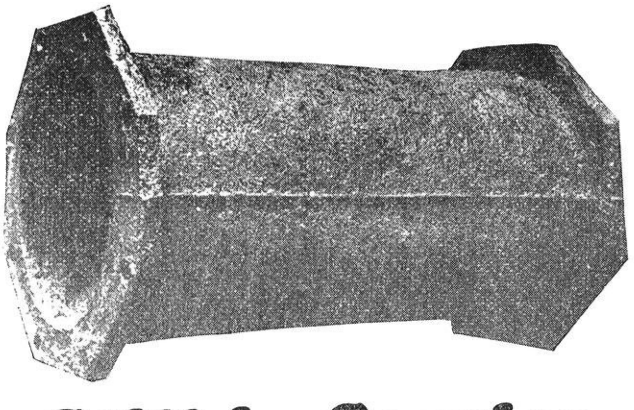
In any machinery you design now or when you get into practical work after graduation it will pay you to carefully consider the advantages of Hyatt roller bearings.

HYATT ROLLER BEARING COMPANY
NEWARK DETROIT CHICAGO SAN FRANCISCO
WORCESTER PITTSBURGH PHILADELPHIA CLEVELAND CHARLOTTE MILWAUKEE

HYATT



High duty type of Hyatt roller bearing



Still in Service After 250 Years

A HUNDRED years before Napoleon was born, before his wars scourged Europe, before the French Revolution raged, this Cast Iron Pipe was laid, in the reign of Louis XIV, to supply water to the fountains of Versailles.

To the patient researches of M. Blanc, Chief Inspector of the Water Service of Versailles and Marly, into dust-covered volumes in the garrets of the Palace of Versailles, we owe the proof of its antiquity.

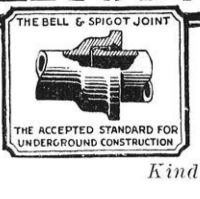
A report from the Director of the Water Service, M. Blanc's chief, says: "From their actual state of preservation, which is excellent, excepting the assembly iron bolts, these conduits seem to be able to furnish service for a very considerable time longer."

The high resistance of this Cast Iron Pipe to corrosion may be judged from the clearness of the fine "parting line" produced by the old horizontal method of casting.

THE CAST IRON PIPE PUBLICITY BUREAU
Peoples Gas Building, Chicago

CAST IRON PIPE

Our new booklet, "Planning a Waterworks System," which covers the problem of water for the small town, will be sent on request



Send for booklet, "Cast Iron Pipe for Industrial Service," showing interesting installations to meet special problems

How To Know a Good Bronze Bushing When You See It

There are certain things which are judged by the test of time, rather than by an individual investigation. They are accepted because of the good reputation which time and trial have given them.

You can identify a good bronze bushing bearing by a metallurgical analysis —or by merely specifying a Bunting Bushing Bearing. We will gladly tell students anything we have learned in this industry.

THE BUNTING BRASS & BRONZE CO.
TOLEDO, OHIO

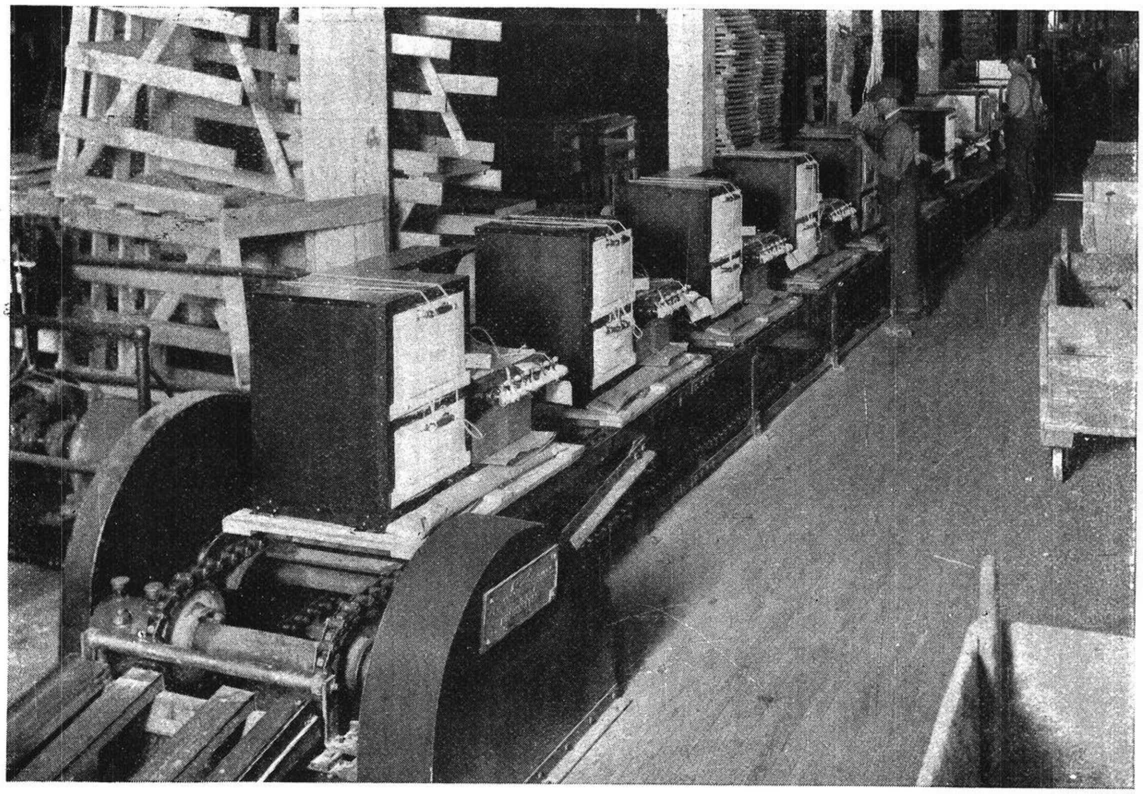
Branches and Warehouses at

NEW YORK
CLEVELAND
CHICAGO

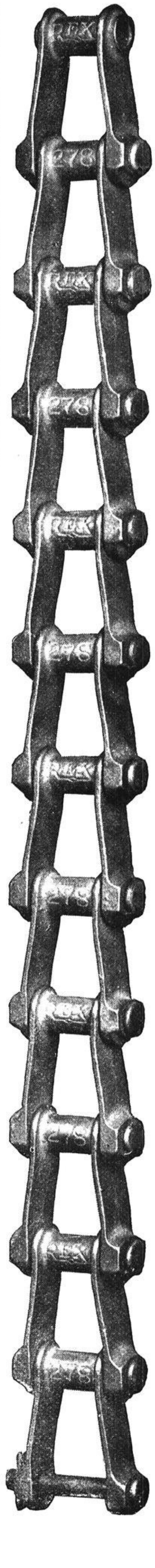
PHILADELPHIA
SAN FRANCISCO
BOSTON

"Many a man has failed because he couldn't 'figure it out.'"
—Baby Bunting

BUNTING
PHOSPHOR BRONZE
BUSHING BEARINGS
PATENTED



Progressive Assembly Conveyor, Cribben & Sexton Company, Chicago



Pioneers of Industry

Material handling, in itself a great industry, serves practically all other industries in the mechanical handling of raw, semi-finished and finished products such as: Coal, coke, ashes, sand, gravel, warehouse freight, cement, gypsum, glass, pottery, canning and packing produce, lumber, fertilizer, foundry sand, boxes, barrels and progressive assemblies. Its use is almost as limitless as the use of power.

Coincident with the expansion of the use of conveying machinery and power operations, the chain industry is also expanding. Indeed, improvements in chain have made possible many of the developments in conveying and power transmission.

Chain is also serving another great industry, that of concrete construction and road building, as the drive on Rex Mixers and Pavers.

Rex Conveyors, Rex Chain, Rex Pavers, and Mixers, built by the Chain Belt Company, have played a large part in the development of these three industries, conveying, chain, and concrete construction. This company also believes that they are still only in their infancy.

Whether you are a student, a graduate engineer or a manufacturer it might be well to inquire what they may hold for you.

Affiliated with the Chain Belt Company and associated companies at the present time are the following Wisconsin men:

Roy Phipps - '11-Mech.	Russ Davis - - - '18-M.E.
Arnold Wagner '11-M.E.	Fred Syberg - '18-Com.
Lloyd Bleyer - - '12-M.E.	Carl Richter - - '19-M.E.
Dick Corbett '13-Mech.	M. Fladoes - - '20-Com.
Brinton Welser '13-M.E.	Arthur Glasser '20-Com.
J. Millspaugh - - '14-E.E.	Harold Holtz - '20-Com.

David Zuege - - - - - - - '20-Chem.
Al. Kessler - - - - - - - - - - '23-Com.
Eugene Silver - - - - - - '23-Mech.
Hugo Czerwonkey - - - - '24-M.E.
August Gunther - - - - - - '24-M.E.
Paul Thessin - - - - - - - - '24-Mech.

REX

CHAIN BELT COMPANY

736 Park Street *Milwaukee, Wisconsin*

INDUSTRIAL LIGHTING CODES.

In order to protect workers from accidents and eye sight damage, no less than five states, New York, New Jersey, Pennsylvania, Wisconsin and Oregon have now in force lighting codes for industrial establishments. Other states are now considering the adoption of an industrial lighting code, and it seems only a question of time when all the states will adopt such a code.

Proper lighting of work places is not only of great importance to the operators working therein, directly affecting their safety and eyesight, but it is a factor of equal importance to the employer, as quality and quantity of output are deciding factors of profit or loss in the operation of the plant.

The introduction to the Wisconsin code reads as follows: "Insufficient and improperly applied illumination is a prolific cause of industrial accidents. In the past few years numerous investigators, studying the cause of accidents, have found that the accident rate in plants with poor lighting is higher than similar plants which are well illuminated. Factories which have installed approved lighting have experienced reductions in their accidents which are very gratifying.

"Of even greater importance, poor lighting impairs vision. Because diminution of eyesight from this cause is gradual, it may take the individual years to become aware of it.

"This makes it all the more important to guard against the insidious effects of dim illumination, of glaring light sources shining in the eyes, of flickering light, of sharp shadows, of glare reflected from polished parts of work. To conserve the eyesight of the working class is a distinct economic gain to the state, but regardless of that, humanitarian considerations demand it.

"Finally, inadequate illumination decreases the production of the industries of the state, and to that extent, the wealth of its people. Factory managers who have installed improved illumination, are unanimous in the conviction that better lighting increases production and decreases spoilage."

The Wisconsin Commission has adopted a rule to the effect that, "diffusive or refractive window glass shall be used for the purpose of improving day light conditions or for the avoidance of eye strain, wherever the location of the work is such that the worker must face large window areas, through which excessively bright light may at times enter the building."

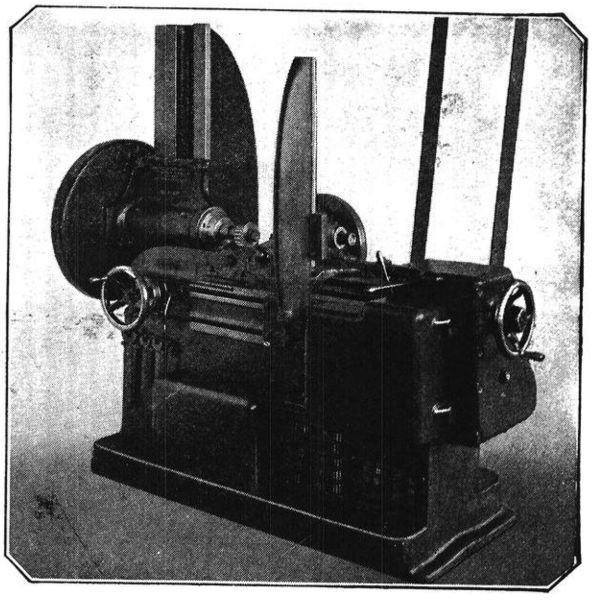
A glass is now available which meets the above requirements. It properly diffuses the light and prevents sun glare passing into the building and is known as Factrolite.

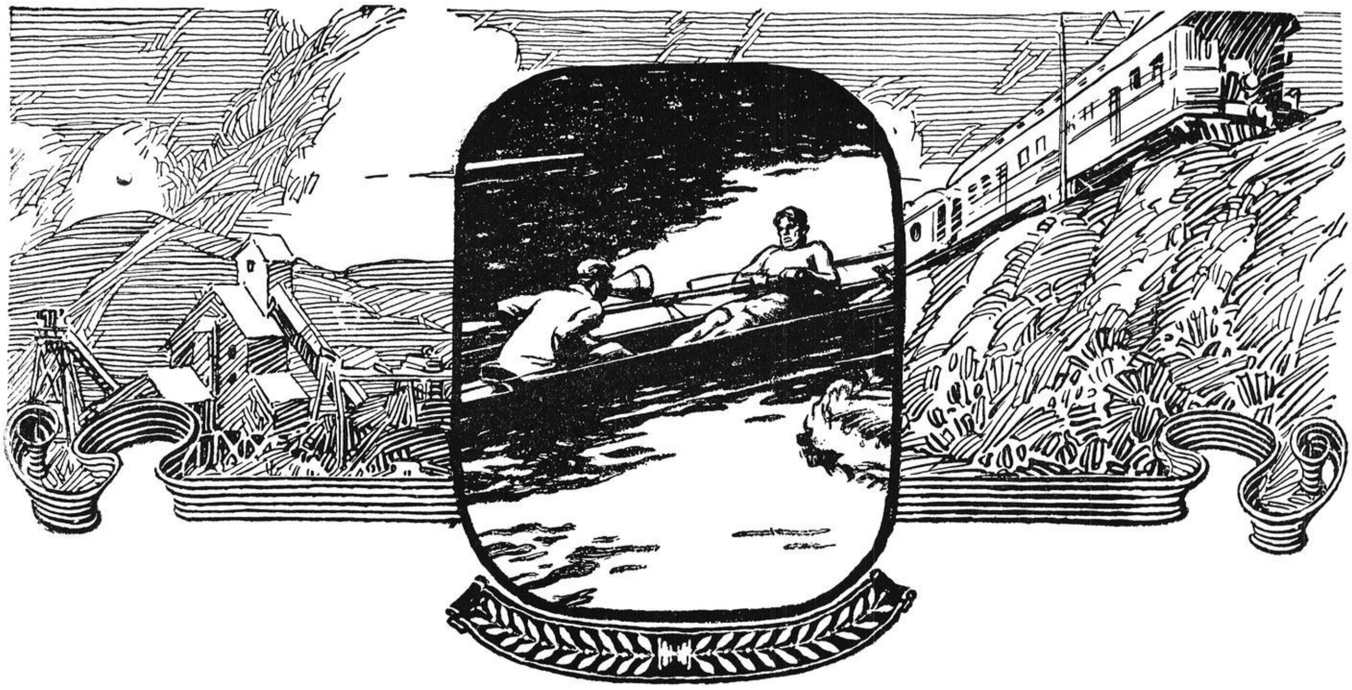
Engineers of to-day are making a thorough study of illumination, so that they may be able to plan and lay out industrial plants, to scientifically increase their efficiency to as near the maximum as possible. This accomplished the engineer is not only doing something worth while for his employer, but is doing quite as much for himself by coming into prominence with modern ideas.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago

No. 8.





THE FLAME THAT FIRES

COLLEGE athletic teams illustrate forcibly one truth—men achieve by inspiration. The bleachers' cry of "Hold 'em; Hold 'em!" has kept many a goal line uncrossed. "Touchdown! Touchdown!" has scored countless victories.

In an engineering organization like Westinghouse, this inspiration comes from engineering executives—men who correlate, organize, administrate, and inspire. They are engineers first, but engineers with the power to enlist the best of other men.

Many derived their own first inspiration from the Founder, George Westinghouse himself. He took a contract for electrifying the New Haven Railroad, for example, before the apparatus had even been designed.

"Now I've dropped you into the middle of the pond", he told his engineers. "It's up to you to swim out".

There was plenty of swimming—but Westinghouse knew his swimmers.

As has been true since organization began, the demand for men who can develop into leaders is far, far short of the supply. Westinghouse welcomes them. All industry welcomes them. Organizations lead because men, in turn, lead them.

This advertisement is seventh in a vocational series, outlining the fields for engineering achievement in the Westinghouse organization. A copy of the entire series will be sent to anyone requesting it.

Westinghouse

WESTINGHOUSE ELECTRIC

ACHIEVEMENT & OPPORTUNITY