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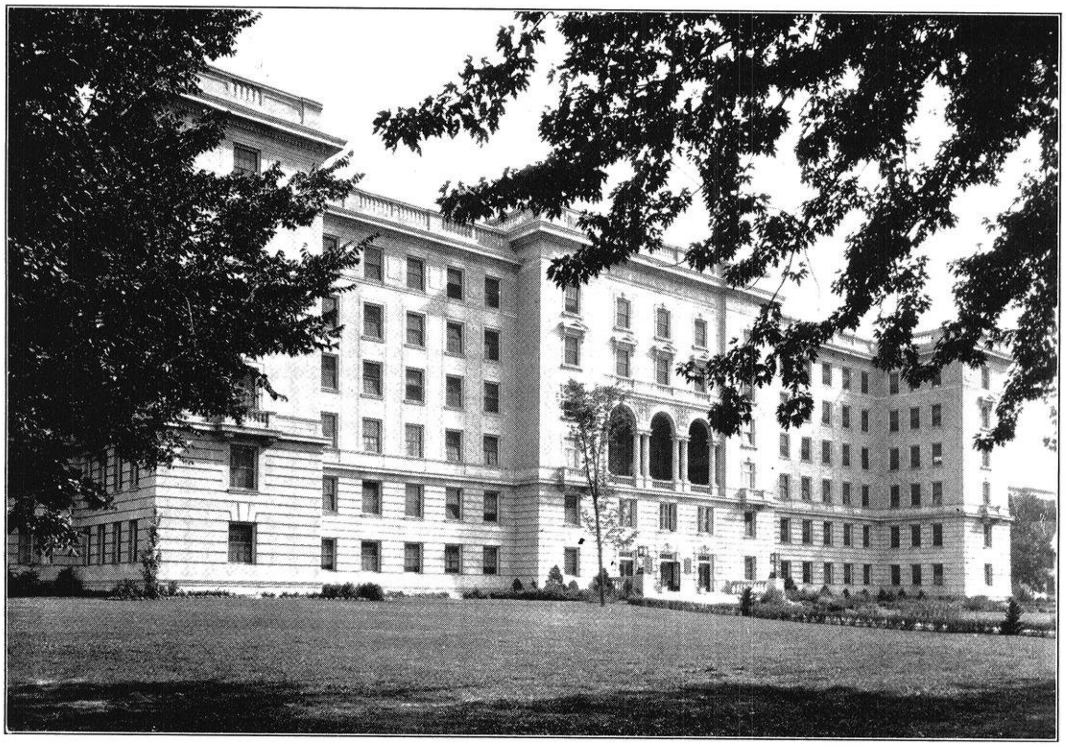
VOLUME XXXIII NUMBER II



THE WISCONSIN GENERAL HOSPITAL

PUBLISHED BY THE ENGINEERING STUDENTS
of the UNIVERSITY OF WISCONSIN

November, 1928

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Detroit Junior College, '22

A. N. CURTISS
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University of Pittsburgh, '27

O. B. GUNBY
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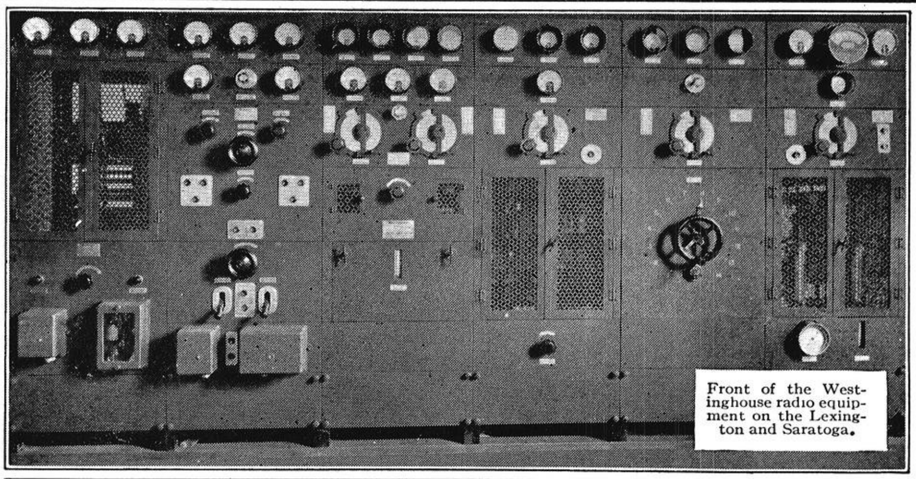
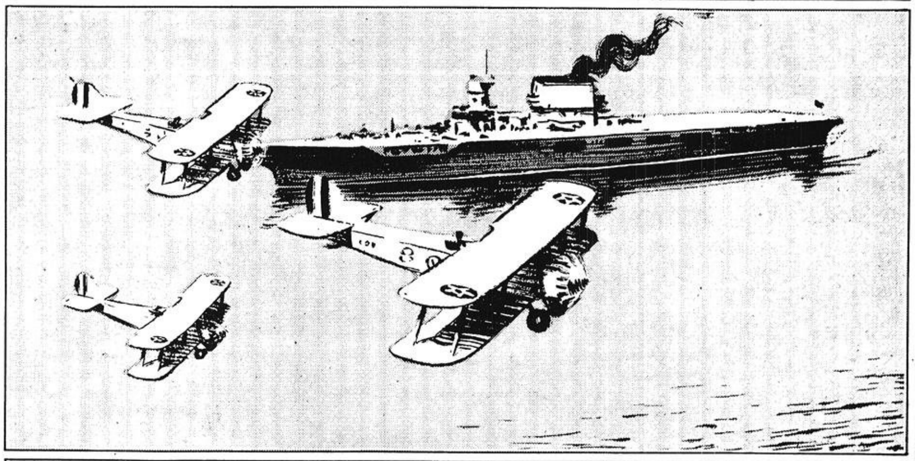
JOHN COLEMAN
Radio Engineer
Carnegie Institute of Technology, '23



Front of the Westinghouse radio equipment on the Lexington and Saratoga.



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The WISCONSIN ENGINEER

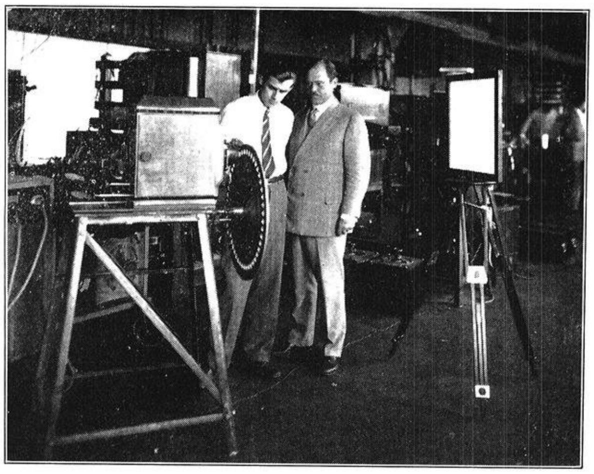
VOLUME 33, NO. 2 NOVEMBER, 1928

Extending Our Visual Horizons

A Description of the General Principles used in Television Broadcasting, giving some of the Problems to be Met before Successful Home Reception is Possible

By R. DEWITT JORDAN, e'27, *General Electric Company*

TELEVISION has as its goal the extension of man's visual horizons. In myth and in fable, television is as old as man, but in practice its realms scarcely extend beyond the four walls of a 20th century laboratory. The genii and magi of our youthful reading gave to favored ancients this occult power of peering into the inner lives of their fellow men. A bit of abracadabra accompanied by a puff of smoke, or a flash of fire, and the activities of ones neighbor became plainly visible even though he concealed himself behind walls of stone. Scientists of to-day have stripped the entire subject of its mysticism and have bottled up the "genii" within the sealed walls of the vacuum tube.



THE PROJECTION APPARATUS

Fig. 1: Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company and chief consulting engineer of the Radio Corporation of America, with his assistant, R. D. Kell, viewing the new television projection apparatus. The disk contains 48 lenses and the image reproduced on the ground glass screen is 12 inches square.

If we confine our attention to the meaning of the coined word "television" (tele meaning "at a distance" in the Greek, and vision meaning "seeing" in the Latin) we find that in a very broad sense "television", or "seeing at a distance" applies to the entire process of viewing distant objects through a telescope or pair of field glasses. Looking at the moon through the large telescope in the observatory on Mount Wilson would be a good example of this conception of television.

But television as we understand it to-day means to go beyond the range of vision even when normal sight be aided by powerful optical instruments. There are no limitations to its far-reaching sight, extending as it does to other lands and distant views. Nor does it matter if the intervening miles be shrouded in darkness or bathed in sunshine.

The needs of a television scheme are simply stated. First there must be focussed on the object that it is desired to represent pictorially at a distance, a machine, i. e., recorded, capable of differentiating between dark and light, and sufficiently sensitive to transform these differences into usable energy. To all intents and purposes such a device must be a "mechanical eye". Second, there must be a conducting medium between this "eye" and the third element which is the receiver of the visual impulses generated at the recording end. This conducting medium may be either the ordinary metallic circuit of the telegraph or telephone, or it may be the "ether" of the radio. The television receiver must be capable of transforming visually the varying stream of energy sent out by the recorder, into a reasonably accurate and entirely recognizable impression of the distant object. There is no "black magic" in such a scheme. Nothing can be included that is not based on engineering facts. Hence the television instrument of to-day must be a delicately balanced thing of metal, wood, and glass.

Of primary importance in the development of a television receiver is the consideration that it may be simplified to the point where it can readily be used in the home of the average man. The recorder-transmitter of television may be as elaborate and complicated as necessary, but the receiver must be as simple as the modern radio set that is so popular in the present-day home.

Television receivers may be worked out in a variety of ways according to well-known principles. Of primary importance is the initial choice of a light source. It is obvious that in order to distinguish between fine shadings of light and dark, such a light must be "inertialess", that

THE BROADCASTING STUDIO

Fig. 3: In broadcasting a play, it is necessary to use a camera for each character, and also one for "props" and other visual effects. The director cuts from one camera to another as each character speaks or whenever necessary to show objects or the hands of the players.

is, fluctuations of light radiations must be instantaneous. From full brilliancy to total darkness and back to maximum illumination again is a frequently repeated cycle in television work.

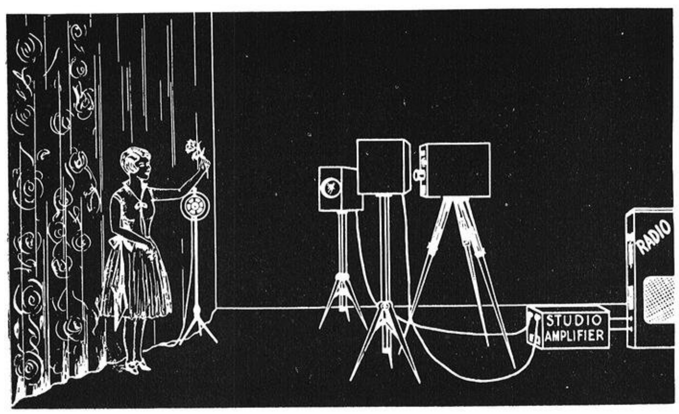
The choice of a light source has been narrowed down to two alternatives. They are the light control developed by Professor Karolus of Leipsig and the Neon lamp, and each has its separate field of usefulness. Where it is desired to obtain a large volume of light for projection on a screen, the system developed by Professor Karolus is preferable. The Neon lamp, a less brilliant, but more sensitive source of light, was developed several years ago and readily adapts itself to television work. While the Neon lamp does not compare with the Karolus light in brilliancy, it is more sensitive and easier to operate. It can thus be readily seen how the Karolus light adapts itself for use where projection upon a large screen is desirable, for example, in the laboratory or exhibition hall, while the Neon light is better adapted for use in the home.

In connection with the design of a practical television receiver for the average home, there is a distinct choice to be made between three well-known systems of reproduction, — the mirror drum which was the heart of Dr. Alexanderson's first television system, the disk with lenses, and the disk with holes. For television reproduction on a large scale, there may be certain advantages to be obtained by using the mirror drum and the lens disk, but to quote Dr. Alexanderson "from the point of view of television in the home, a hole is more economical than a lens and 48 holes are more so than 48 lenses."

The problem of synchronizing the receiver with the transmitter is fundamentally important in the design of a television receiver. Naturally, the first solution that comes to mind is that a synchronous motor shall be used on each machine, or that a special synchronizing wave be transmitted, or an attempt be made to synchronize at the picture frequency. However, where the goal of all effort is simplicity of design and of operation, and where first cost is an item of considerable importance, the introduction of special devices tends to lead the result away from the desired end. The adoption of a standard electric motor made for household use and of an electric hand control for manipulating its speed has been found after a little practice and coordination between eye and hand to give the desired results, and such a scheme admirably adapts itself to the simplified receiver. In special cases where the transmitting and receiving systems are on the same power network the machines may be operated by 60-cycle synchronous motors.

Speaking of television, Dr. E. F. W. Alexanderson says: "Such a system will consist of the television camera, the radio transmitter, and the television receiver in the home. Each of these elements is the subject for intensive study on the part of many investigators of to-day. More sensitive photoelectric cells for the camera and a more brilliant source of light for the projector are among the many things needed, but the principal difficulties that limit the use of television broadcasting at the present time are the unknown factors of radio transmission."

Feeling that the inauguration of television broadcasting would be the starting point of practical and popular television the sponsors of WGY began regular television broadcasts over this station early in the present year. The initial experiments were carried on from a laboratory transmitter on a wavelength of 37.8 meters with the accompanying voice transmission on the regular wavelength of 379.5 meters of WGY. A part of the latter equipment consisted of a new type of projector antenna used in tests between this country and Europe. This



DIAGRAMMITIC SKETCH

Fig. 2: The television camera consists of three units, a cabinet containing a 24-hole disk and a 1000 watt lamp as a light source, and two smaller cabinets each housing a photoelectric cell with amplifier.

type of antenna has the advantage that useful radiation which would ordinarily be wasted backward and sidewise is saved and projected in the general direction where it

(Continued on page 76)

What An Implement Engineer Thinks About

Excerpts from an address by O. B. ZIMMERMAN, m'96, *Experimental Department, International Harvester Company, before a meeting of the American Society of Mechanical Engineers at Kansas City*

IN the pioneer days of farm implement making, the fundamental inventions largely came from the farm from this and that mechanically minded farmer who, realizing a general and oppressive human need, had the genius to discover ways and means of meeting it. Now, however, the great majority of the significant advances that give agriculture new types of implements and more efficient and more durable models of developed machines come from the designing departments of the farm implement manufacturer. This busy world can't wait for the accident of genius; research has taken the place of inspiration.


O. B. ZIMMERMAN

Broadly and practically speaking the mechanization of agriculture is a new art. When we think of the fundamental dependence of agriculture on the farm implement industry for the means and agencies of production, and of the vital interest of all men and industries in that relation, it seems strange that there is hardly a text book available to the student of farm implement designing.

For one thing, engineering talent may have been scarce and slow to develop in our industry because of the presence of so many and so important variables in every problem of farm implement designing.

An automobile engine or transmission or device that will function efficiently in Texas will probably function just as well in Maine, and so with a bridge, a pump, a steam engine, a lathe or any article of shop equipment. It is vastly different with a mobile farm implement. Between Maine and Texas there may be a dozen or a score of variables in the contours, the soil, the climate, the crop or the deep rooted prejudices of the farmers that must be met in designing a farm implement for nation-wide use.

The area of mobile operation may be irregular in contour and the ground may be soft, hard, stony, sandy, or sticky. There are hillsides to deal with, flat lands, and valleys. This machinery is subject at all times to weather conditions, to heat, cold, moisture, and dryness. It is therefore obvious that the designer's viewpoint is distinctly different from that of one who meets indoor conditions where there are far less jolting and shock-producing operations and where expansion, contraction, and resistance to rust seldom appear as important pactors.

Take for example a 14 inch plow, set to cut 6 inches deep and draw it at three miles per hour. In light sandy soil the dynamometer might read as low as 150 pounds, whereas in gumbo it might read 1,800 pounds, under hard conditions.

The binder may meet grain twelve inches high or six feet. The grain may be standing up straight or it may be lodged almost flat, so that the knife must barely skim the ground.

The wheat crop may be 3 bushels per acre or 40 bushels and special yields of 80 bushels per acre are met. The same machine must handle one extreme as well as it does the other.

The grain drill may be required to deposit evenly anywhere from a half bushel to four bushels of seed per acre, seed being of oats might mean the planting of 15 pounds per acre minimum and of barley may require as much as 340 pounds per acre.

What would be the effect on a farmer if his grain binder missed tying a few bundles per hour. The binder must tie with a permissible miss of only a fraction of one per cent, in spite of the difficult physical variations. When the knotter is in good order, when no fault can be found with the twine as to size or strength, one can count on not over one miss to 1,000 bundles. Whole days of operation are recorded without a miss.

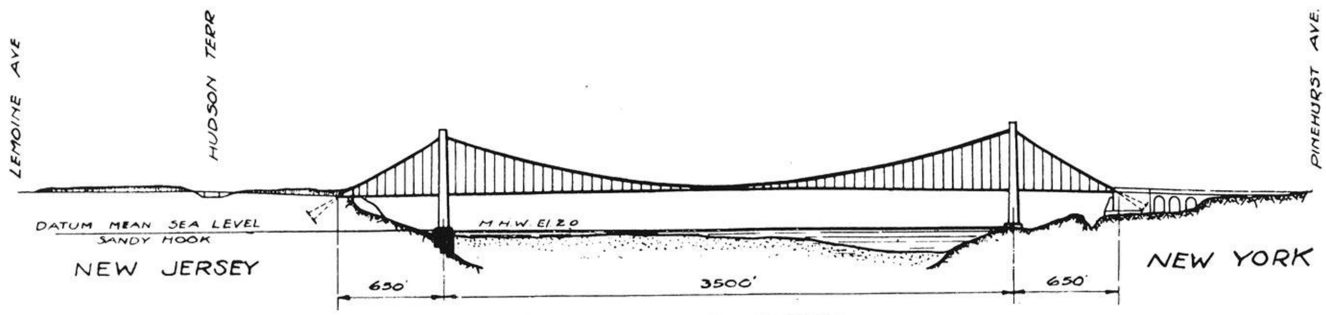
In addition to these variable field conditions it should be remembered that we are in most cases dealing with a peculiarly light weight product which is delicate to a considerable degree. The ripe grain in the field must not be too roughly handled or shattering results, with accompanying wastage. Such crops as peas or beans are particularly susceptible to injury in harvesting. If grain is handled by the thresher cylinder at too high speed, cracking results with loss in grading. If threshed too slowly, grain will not be removed and will be blown into the stack with noticeable loss. Similar delicacies must be considered when applying machinery to handling corn, beets, potatoes. Undesirable bruising, skinning, or other injury affects the keeping value as well as the saleability.

If the entire range of machinery as applied to agriculture be reviewed, one cannot fail to see the extremes in fine and coarse construction which must be met.

The delicate, high speed cream separator, which must not miss even a small fraction of one per cent of the cream present in the milk, is one type. The separator when brought up to speed of 7,000 R. P. M. and allowed

(Continued on page 74)

An Unusual Method *for* Levelling Across A Wide River



THE HUDSON RIVER BRIDGE

By H. A. Blau, c'20
Assistant Engineer, Bridge Department, Port of New York Authority

It is infrequent that the engineer is called upon to obtain the elevations of points upon opposite shores of a river such as the Hudson. It is infrequent because the Hudson has a width of thirty-six hundred feet and is not crossed by a bridge nearer its mouth than Bear Mountain which is 48 miles upstream. Crossing this river with levels at the site of the Fort Lee-Fort Washington bridge, now under construction, is more than infrequent. It is epochal because this crossing constitutes an important part of the ground-work required in the building of what will be a suspension bridge having the longest single span in the world.

When, in levelling, an occasion arises whereby the ordinary lengths of sights cannot be used, some scheme of reciprocal levelling must be adopted. Across such a water gap as the Hudson River, the difficulties of obtaining accuracy of results are almost appalling without the use of geodetic instruments and methods. To lessen these difficulties the New York Resident Engineer's office adopted an unusual scheme of observation for this reciprocal level work.

Several years ago the United States Coast and Geodetic Survey, in making a connection of their first-order level lines across the Mississippi River near New Orleans, used a special method of observation in their reciprocal levels. (See The Military Engineer, Vol. XIX, No. 105, May-June 1927, H. G. Avers.) This method, slightly adapted but fundamentally the same, was used successfully to cross the Hudson River at Fort Lee.

The method described below was evolved from a desire to eliminate the necessity and difficulty of using the movable target for the extremely long sights across water. The adopted scheme uses specially designed fixed targets the employment of which requires the simultaneous use of level instruments having a micrometer screw levelling device as an essential part of their equipment. Two eighteen-inch Wye levels equipped with a micrometer screw, a sensitive (5 second) bubble, and a very fine horizontal crosswire were used in the method described.

The specially designed target is shown in Fig. 1. It was cut from one piece of #20 gauge galvanized iron. The face was painted black with a horizontal white line one inch wide drawn through the center of each of the rectangles. The distance between the white lines was 1.25 feet. A steel scale, reading to hundredths of a foot, was riveted vertically between the rectangles. The distance from the center of the top rectangle to the zero of this scale was carefully determined and found to be 0.875 feet. This distance is known as the scale factor. Each target was identified by a number painted upon it of a size capable of being read through the distant instrument.

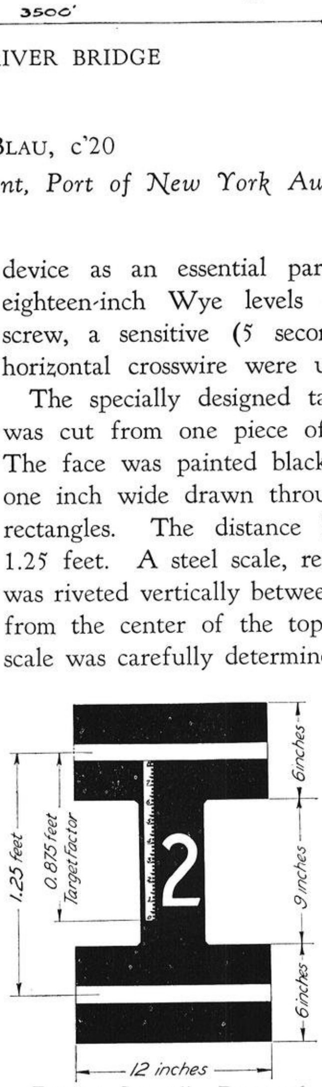


Fig. 1: Specially Designed Target

The sketch of Fig. 2 indicates the relative position of the required equipment. A and D are the micrometer levels, C and F are the special targets. They are screwed permanently in place. The height of these targets must be such that a level line of sight from either instrument will fall about midway between the rectangles. B and E are level rods held in the ordinary manner upon the respective bench-marks. It will be noted that the points A-C-D-F form a parallelogram and are thus laid out in order that true reciprocal distances may be obtained.

Observers stationed upon opposite banks of the river sight simultaneously on their distant targets. By means of the micrometer screw they set the horizontal crosswire of the instrument upon the center of the top rectangle and read the micrometer head. They then bring the bubble back to the center of its vial by means of the micrometer and, without sighting upon the distant target, again read the micrometer head. The center of the bottom rectangle of the target is then brought into the line of sight with the micrometer screw and a reading of the micrometer head once more taken.

These micrometer readings are means by which the distant rod readings may be calculated. This calculation is based upon a simple proportion the general form of which is as follows:

$$\frac{x}{n} = \frac{T-L}{T-B} \text{ or } x = n\frac{T-L}{T-B} \quad \text{----(A)}$$

Where T=Micrometer reading when sighting on top rectangle.
L=Micrometer reading when line of sight is level.
B=Micrometer reading when sighting on bottom rectangle.
n =Distance between centers of rectangles (1.25 Feet)
x =Distance in feet from the center of the top rectangle to the intersection of the level line of sight with the middle portion of the target.

The program of observations followed simultaneously from opposite sides of the river takes from thirty to thirty-five minutes to complete. Observers start their readings at a prearranged instant and carry-on as shown below.

1. Take a rod reading upon the nearby benchmark.
2. Sight upon the near target and read its scale.
3. Focus upon the distant target and make micrometer observations until ten observations of three readings each have been completed. The time required to make three micrometer readings is about 2 minutes.
4. Take check readings of rod on near benchmark and scale of near target.
5. Upon receipt of the "alright" signal from the opposite shore station, remove the instrument from its tripod and make the trip to that station. Upon arrival there repeat the program identically.

Observations were made each day for three days. One day's work consisted of two sets of ten observations each for each instrument.

There are several advantages in the use of this system of observation for reciprocal levels over long distances. As Mr. H. G. Avers states in his article in the Military Engineer, referred to previously, "With the movable target, the principle errors of observation arises from the difficulty of setting the target into the line of sight when the bubble is exactly in the center of the vial. The observer is under the necessity of bringing the bubble to the center, keeping it there, and signalling proper instructions to the operator at the distant target. With the fixed targets, the observer has only to manipulate his instrument and the entire set of observations on the distant target can be made without changing his position."

Using the fixed targets the poles supporting them may be made any desired height or may be done away with entirely. The target may be attached to a tree or side of a house, the only requirements being that the level line of sight from both instruments shall intersect the target about midway between the rectangles and that true reciprocal distances be adherred to as closely as possible. In case of the Palisades instrument station the target was

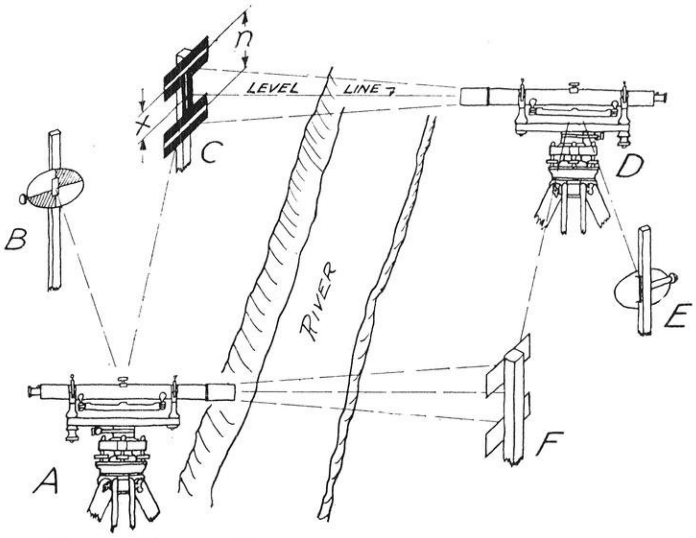


FIG. 2: Showing the relative positions of instruments and targets on either side of the river.

fastened to the columns supporting the pavilion roof, while the target on Fort Washington Point was fastened to a 4 x 4 post, sixteen feet high, guyed firmly with wire and turnbuckles.

Needless to say, the corrections due to the curvature of the earth and refraction, as well as instrumental error, are eliminated by the reciprocal level system.

A copy of two typical sets of reciprocal level notes are shown below. The data furnished by these two sets are used to develop the necessary steps in the computations required.

RECIPROCAL LEVEL NOTES

SET NO. 5

Target or Rod Sighted	Time A. M.	Backsight on B. M.	Scale of Near Target	Micrometer Readings Top	Level	Bottom
B. M. (N. Y.)	11:00	10.086				
#1	11:05		0.168			
#2	11:10			72.7	61.0	50.6
	11:12			72.0	60.7	50.2
	11:14			72.1	60.5	50.3
	11:16			71.8	60.2	49.8
	11:18			71.6	60.0	49.9
	11:20			71.4	59.8	49.9
	11:22			71.2	59.6	49.9
	11:24			71.0	59.5	49.7
	11:26			71.0	59.9	50.0
	11:28			71.1	59.9	49.8
#1	11:30		0.168			
B. M. (N. Y.)	11:33	10.086				
			SUM	715.9	601.1	500.1
			MEAN	71.59	60.11	50.01

Remarks:
B. M. (N. Y.) Elev. = 12.750 Instrument — Buff #16143.
Observer — D. G. Tippett. Date — January 6, 1928.
Recorder — N. A. Caggiano. Station Occupied — FWP, N. Y.
Weather — Mild, sunny, moderate Southerly breeze.

Target or Rod Sighted	Time A. M.	Backsight on B. M.	Scale of Near Target	Micrometer Readings Top	Level	Bottom
B. M. (N. J.)	11:00	3.945				
#2	11:04		0.246			
#1	11:10			57.0	51.6	35.4
	11:12			58.0	51.4	36.5
	11:14			58.2	51.1	36.5
	11:16			57.8	51.3	36.2
	11:18			57.5	51.3	36.1
	11:20			58.5	51.2	36.1
	11:22			57.0	50.9	35.5
	11:24			57.4	50.8	35.5
	11:26			57.4	50.6	36.2
	11:28			57.8	50.6	35.8
#2	11:31		0.246			
B.M. (N. J.)	11:35	3.945				
			SUM	576.6	510.8	359.8
			MEAN	57.66	51.08	35.98

Remarks:
B. M. (N. J.) Elev. = UNKNOWN. Date — January 6, 1928.
Observer — H. A. Blau. Instrument — Buff #16144.
Recorder — O. K. Murray. Station Occupied -- Pal. N. J.
Weather — Mild, fair, light S. W. breeze.

RECIPROCAL LEVEL NOTES

Set No. 6

Target or Rod Sighted	Time A. M.	Backsight on B. M.	Scale of Near Target	Micrometer Readings Top	Level	Bottom
B. M. (N. J.)	2:15	3.948				
#2	2:17		0.247			
#1	2:20			67.9	60.6	46.2
	2:22			67.4	60.6	46.2
	2:24			67.8	60.5	46.2
	2:26			67.7	60.7	46.3
	2:28			67.8	60.8	46.2
	2:30			67.5	60.6	46.4
	2:32			67.9	60.8	46.8
	2:34			68.0	60.9	46.9
	2:36			68.2	61.1	46.8
	2:38			68.3	61.0	46.8
#2	2:41		0.247			
B. M. (N. J.)	2:45	3.948				
			SUM	678.5	607.6	464.8
			MEAN	67.85	60.76	46.48

Remarks:
B. M. (N. J.) Elev. = UNKNOWN. Date — January 6, 1928.
Observer — D. G. Tippett. Instrument — Buff #16143.
Recorder — O. K. Murray. Station Occupied — Pal. N. J.
Weather — Clear, light S. W. breeze.

Target or Rod Sighted	Time A. M.	Backsight on B. M.	Scale of Near Target	Micrometer Readings Top	Level	Bottom
B. M. (N. Y.)	2:15	10.082				
#1	2:17		0.163			
#2	2:20			65.5	53.3	43.8
	2:22			64.7	53.5	44.2
	2:24			65.5	53.5	43.3
	2:26			64.8	53.5	43.5
	2:28			65.1	53.5	43.3
	2:30			65.2	53.5	43.4
	2:32			65.3	53.6	43.5
	2:34			65.5	53.6	44.0
	2:36			66.1	54.1	44.6
	2:38			66.3	53.4	44.5
#1	2:40		0.163			
B. M. (N. Y.)	2:45	10.082				
			SUM	654.0	535.5	438.1
			MEAN	65.40	53.55	43.81

Remarks:
B. M. (N. Y.) Elev. = 12.750 Date — January 6, 1928.
Observer — H. A. Blau. Instrument — Buff #16144.
Recorder — N. A. Caggiano. Station Occupied — FWP, N. Y.
Weather — Clear, mild S. W. breeze.

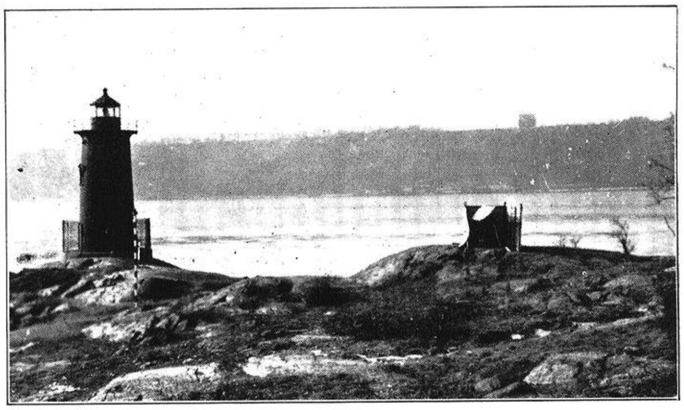


FIG. 3: Fort Washington Point, N. Y., Instrument Station. Target No. 1 is on black and white pole at left of picture.

This completes the outline of the fieldwork. The next step is the determination of the difference in elevation between the New York and New Jersey benchmarks by "reducing" the field notes.

It is first necessary to translate the scale readings on the targets into heights above the respective benchmarks in feet. To do this a mean value of the rod and scale readings is obtained for both the New York and New Jersey shores.

Thus, for the New York Target (#1):

Mean rod reading =	10.084
Mean scale reading =	—0.166
Difference equals	9.918
Adding the Target Factor	+0.876
	10.793

10.793 is the "*Rod Reading*" or height above the New York benchmark of the center of the top rectangle of target #1.

Likhewise, for the New Jersey Target (#2):

Mean rod reading =	3.947
Mean scale raeding =	—0.247
Difference equals	3.700
Adding the Target Factor	+0.875
	4.575

4.575 is the "*Rod Reading*" or height above the New Jersey benchmark of the center of the top rectangle of target #2.

Next must be computed the value of "x" from the micrometer readings by means of the proportion shown previously in the formula (A).

For Set #5

New York

$$x = 1.25 \frac{71.59—60.11}{71.59—50.01}$$

$x = 0.665$

New Jersey

$$x = 1.25 \frac{57.66—51.08}{57.66—35.98}$$

$x = 0.379$

For Set #6

New York

$$x = 125 \frac{65.40—53.55}{65.40—43.81}$$

$x = 0.686$

New Jersey

$$x = 1.25 \frac{67.85—60.76}{67.85—46.48}$$

$x = 0.415$

Using these values for "x" the distant rod readings are computed thusly:

(Continued on page 62)

Utility Demands *of* A Modern Hospital

By D. W. Nelson, m'20,
Instructor in Steam and Gas Engineering

THE Wisconsin Legislature in 1920 authorized the establishment of the Wisconsin General Hospital in connection with the Medical School of the University. The hospital was erected as a memorial to those who served in the World War. Its purpose is to supplement the existing resources of the state for care of patients, for education of physicians and nurses and for the advance of medical knowledge. It has a bed capacity of about three hundred.

The building, which was designed by Arthur Peabody, State Architect, has six stories and a basement and in addition has a number of rooms on the roof which are used for patients requiring open air treatment. It is built of brick, with stone facings and cornices, and is of fire proof construction. The building contains about 380 rooms, has a gross floor area of 132,000 sq. ft. and a gross cubical contents of 2,000,000 cu. ft.

Engineers who lay out and select mechanical equipment for such buildings have been handicapped because of the scarcity of reliable information on the service requirements of such an institution. Because this hospital was considered to be very well equipped for its intended medical purpose, it was decided to determine its service requirements for guidance of engineers working on the design of similar buildings. This study has been completed and has been published in the Transactions of the American Society of Heating and Ventilating Engineers, Vol. 34, 1928.* It is also available from the University of Wisconsin, Engineering Experiment Station Reprint No. 8. It is hoped that similar studies will be made on other types of buildings such as offices and apartments.

MONTH	CITY WATER GALLONS		HOT WATER GALLONS		LAKE WATER GALLONS		STEAM FOR H.W. POUNDS		STEAM FOR BLDG POUNDS		ICE MADE POUNDS		ELEC. FOR LIGHT KILOWATTS		ELEC. FOR POWER KILOWATTS		CITY GAS CUBIC FEET	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
JANUARY '26	—	—	—	—	—	—	121	137	321	431	—	—	2.62	3.07	2.16	2.51	16.0	20.4
FEBRUARY	252	318	60.5	80.0	26.6	37.6	119	141	281	356	5.10	6.32	2.54	3.09	2.12	2.34	15.7	20.1
MARCH	227	318'	71.0	101.0	28.5	39.7	113	158	280	396	5.22	6.27	2.26	2.54	2.05	3.16	15.4	20.2
APRIL	239	310	72.5	83.5	27.5	36.9	115	126	214	302	5.44	6.82	1.98	2.85	1.98	2.36	16.1	21.5
MAY	232	322	66.4	79.0	24.3	39.6	106	121	80	262	5.77	6.49	1.96	2.31	1.73	2.14	14.9	19.6
JUNE	203	280	64.1	70.0	16.5	26.8	103	119	32	126	7.10	9.18	2.01	2.63	1.89	2.36	16.3	24.4
JULY	233	345	66.0	75.0	—	—	102	112	2	51	6.44	7.54	1.87	2.41	1.96	2.11	14.4	19.4
AUGUST	246	305	63.9	71.0	31.2	62.3	102	108	1	29	6.44	7.31	1.98	2.50	2.04	2.66	15.8	20.4
SEPTEMBER	346	423	71.0	87.6	35.2	69.1	117	136	95	254	7.08	8.30	2.54	3.07	2.30	2.56	18.6	23.6
OCTOBER	387	474	75.4	88.2	33.1	45.4	112	132	152	256	5.94	6.54	2.54	2.89	2.24	2.64	17.1	23.8
NOVEMBER	340	438	78.6	95.4	32.4	41.4	126	141	265	401	5.14	6.27	2.80	3.39	2.27	2.61	17.9	27.6
DECEMBER	355	481	97.5	126.6	33.7	45.6	135	156	386	526	7.04	8.96	3.22	4.19	2.26	2.87	19.6	25.6
JANUARY '27	332	372	90.4	100.0	34.0	40.5	123	163	402	530	6.26	7.37	2.90	3.31	2.08	2.30	18.0	23.5
FEBRUARY	289	336	82.1	107.0	32.3	46.3	119	135	222	329	5.22	5.61	2.55	3.01	1.96	2.18	17.2	21.2
MARCH	305	364	80.7	88.6	33.4	38.5	134	150	202	269	5.39	5.83	2.60	3.97	1.94	2.24	18.2	22.2
APRIL	312	406	81.0	91.0	31.0	40.7	132	143	181	254	6.00	6.76	2.48	2.88	1.93	2.46	19.0	25.7
AVERAGE FOR 12 MONTHS ø	333.2•	411.8•	82.1•	98.1•	33.1•	45.9•	117.6	134.7	168.3	273.9	6.15	7.18	2.45	3.05	2.05	2.43	17.3	23.1

ø MAY 1926 TO APRIL 1927 INCL. • AVERAGE FOR EIGHT MONTHS — SEPTEMBER 1926 TO APRIL 1927 INCL.

FIG. 1 — Daily Quantities — Average and Maximum Amounts Used per Patient-Day.

In this hospital, ventilation of patients' rooms is by open window supply. A special type of window is used in which the air is admitted at the cross bar of the sash, or at the top, or at both places. The sash draws inward like a transom and the air flows upward without striking the patient. All toilet rooms, bath rooms, utility rooms, and certain special treatment rooms, have mechanical exhaust ventilation by means of four exhaust fans on the roof. Except for the air supplied by one fan to several lecture rooms on the sixth floor, there is no fresh air supplied to the building by mechanical means.

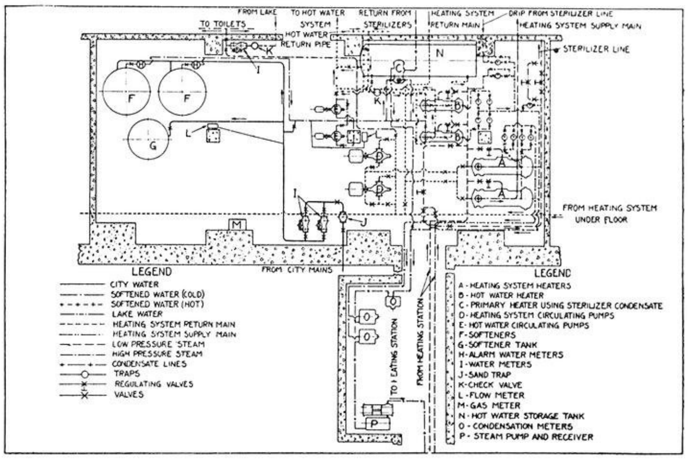


FIG. 2 — Layout of Mechanical Equipment and Position of Water Meters in Wisconsin General Hospital.

Of the 88 buildings connected to the central steam heating plant of the University, this hospital is one of three buildings that is heated by hot water. The system is a down feed type with forced circulation. The building contains 36,000 sq. ft. of hot water radiation which gives 55 cu. ft. of gross space for each square foot of radiation.

The circulating pumps for the heating system are in duplicate, each being capable of handling the entire load. Each pump which has a rating of 600 gallons per minute is driven by a 7½ h. p. motor. This gives a circulation of one gallon of water per hour for each square foot of hot water radiation installed.

The water is heated by low pressure steam from the central plant and the heaters are in duplicate, each being capable of heating 36,000 gallons per hour from 170 to 190 degrees when supplied with steam at 3 lb. pressure. These heaters are the usual shell and tube type with the water passing through the tubes.

The water for the hot water services of the building is heated by heaters of the same type. These are also in duplicate, each having a capacity of heating 2000 gallons

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*"Utility Demands of a Modern Hospital" by G. L. Larson, D. W. Nelson and R. A. Rose, University of Wisconsin, presented at the Annual Meeting of the A. S. H. V. E., New York, N. Y., January, 1928.

per hour from 50 to 180 degrees when supplied with steam at 5 lb. pressure. The storage tank has a capacity of 1200 gallons. For circulating the hot water to the various fixtures in the building, duplicate pumps are used. Each has a capacity of 90 gallons per minute and is driven by a 3 h. p. motor. Either pump may also be used as a booster pump if the city water pressure drops to a point where boosting is necessary.

Due to the fact that Madison city water has hardness of about 22 grains per gallon, all hot service water is softened. There are two Zeolite units installed, each having a softening capacity of 24,000 gallons in 24 hrs. with a maximum rate of softening of 4000 gallons per hr. Under the average condition of operation, it is necessary to regenerate each unit once per 24 hrs. A considerable amount of water is used in flushing these softeners and the total water per patient used in this building will, therefore, be greater than the amount to be expected in a building not having softeners. It should also be noted that there is no laundry in connection with this building and allowance will have to be made for additional water consumption when a hospital with a laundry is considered.

This building has two sources of water supply. The cold water to all toilets, utility closets, slop sinks, and hose bibs is termed "lake water" and is supplied from Lake Mendota by the University pumping station. All other water used is supplied from the city mains and is termed "city water". None of the "lake water" is heated, and only "hot water" is softened.

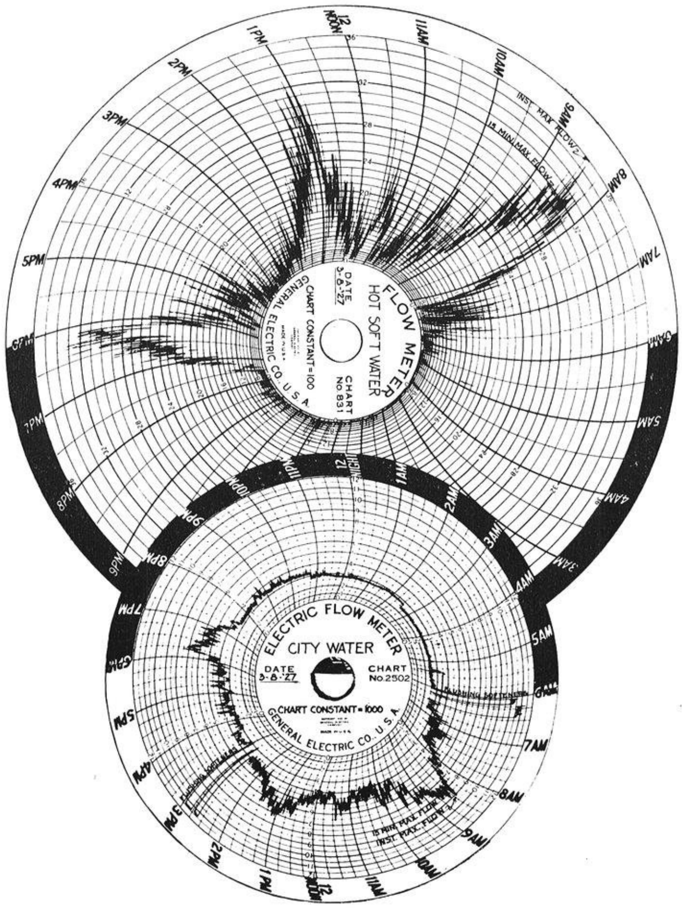


FIG. 3 — Typical Flow Chart for City and Hot Water.

Installed in the basement of the building is a 15-ton capacity motor-driven carbon dioxide refrigerating machine. This machine has an ice-making capacity of thirty 60-lb. cakes of ice per day in addition to the capacity necessary to cool the cold storage rooms adjacent to the main kitchen, and to cool the seventeen small boxes in the diet kitchens and other parts of the building.

There are two major electrical circuits. One circuit supplies the current for lights, physio-therapy apparatus, x-ray machines, and the small motors that are usually connected to lighting circuits. The other circuit supplies power to elevators, pumps, fan motors, refrigerators, etc. There are two passenger elevators and a service elevator.

In the central heating station of the University, there is installed a turbo-generator for the exclusive service of the hospital in case the usual source of power fails.

Meters were installed where necessary and daily readings were taken over a period of sixteen months of the following: city water, hot water, lake water, steam for heating hot water, steam for heating building, ice produced, city gas and electricity used for lighting and for power. In addition to the regular type of water meters on which were read the daily items, indicating and recording flow meters were installed on the city water and hot water lines. Fig. 2 shows typical daily charts of these meters. The flow meters served as a check on the continued accuracy of the water meters and gave a means of studying the distribution of the water requirements through the day.

The meters installed to measure the quantities of water and steam used were removed and tested for accuracy of registration against weighed quantities of water frequently enough to insure their accuracy throughout the sixteen months' period of data taking. If any repairs were made to a meter, it was tested upon removal and again before replacing in service, so as to have a record of its accuracy at all times.

Table 1 shows a summary of the results of the daily readings on a patient-day basis. These figures were arrived at by dividing the daily quantity of an item by the number of patients in the hospital on that day. Two columns are given under each item, one for an average and one for the maximum day in each month.

A considerable increase in the quantity of water used was found in the last eight months of the period as compared to that in the first eight months. The only direct cause for this seems to have been an increase in water pressure in the main serving the University district when the west side reservoir was put in service by the city water department in September 1926. This increased pressure caused more water to be used through faucets, through drinking fountains, by the x-ray developing machines, by the water sterilizing equipment and by the refrigeration machine. There is a total of about seven hundred outlets of various sizes 1 inch and smaller, controlled for intermittent use either by faucets or valves.

(Continued on page 72)

Decimal Point Determination in Slide Rule Operation

By J. T. Rood, *Professor of Electrical Engineering*

THE location of the decimal point in slide rule manipulation is a problem which troubles many engineers. The following method supplies a simple, quick way for determining the location of the decimal point with absolute exactness in even the most complicated computations.

I. Multiplication. Fundamental Theory.

If the rule is set for the following two-figure multiplications:

√ √
2×80 = 160 (1)
√ —
2×40 = 80 (2)

the following points will be noted: First, that in example (1) the slide projects to the *left* of the rule, and the number of places or digits in the answer to left of the decimal point is equal to the *sum* of the number of digits to the *left* of the decimal point in the two numbers multiplied together. Second, the slide in example (2) projects to the *right*, and the number of places or digits in the answer is equal to one *less* than the sum of the number of digits to the *left* of the decimal point in the two numbers multiplied together.

Similarly with the multiplications

√ √
2×.0008 = .0016 (3)
√ —
2×.0004 = .0008 (4)

the following points will be noted: First, that the slide projects to the *left* in example (3), and that the number of places or digits in the answer is equal to the number of digits to the *left* of the decimal point *minus* the number of (negative) zeros to the *right* of the decimal point in the two numbers multiplied together. Second, that the slide in example (4), projects to the *right*, and that the number of places in the answer is one *less* than the number of digits to the left of the decimal point *minus* the number of negatives zeros in the two numbers multiplied together.

> *This article appeared in the November, 1921, issue of THE WISCONSIN ENGINEER and also in December, 1926. The article was enthusiastically received, and we had many requests for copies of the issues in which it appeared. In answer to a popular request, we have condensed the article somewhat from its original form, and are reprinting it here again.*
>
> *The method described by Professor Rood has been used in many of the classes in the engineering school.*
>
> —THE EDITOR.

In general, then, with any series of multiplication we can proceed as follows: (1) Place a positive check (√) over the first number. (2) Perform the successive operation, placing over each term a positive check (√) if the slide projects to the *left*, and a negative check (—) if it projects to the *right*. In case a term is raised to an integral power, (a) use this term as many times as a multiplier as its power, placing against it a proper check for each time it is so used, (b) count its positive digits or its negatvie zeros over as many times as the given power. To place the decimal point add up all the positive digits and subtract the negative checks and the negative zeros and point off the result as the number of decimal places.

Example:

√ —√— √√—√ √
$1.25\times(3.14)^3\times(.0\,0\,6\,2\,5)^4\times2{,}365=?$
Digit progression = 1390
Count 7 — 3 — 8 = —4
Answer .00001397

II. Division. Fundamental Theory.

(In division projection to the right or left of the rule is handled in the same manner as in multiplication.) If the following simple divisions are performed on the rule:

√
40
—— = 8. (5)
5
√

√
.04
—— = .08
.5
√

√
50
—— = 12.5 (6)
4
—

√
.05
—— = 12.5
.004
—

the accompanying rule for division is readily established. (1) Against the first term in the numerator place a positive check, (2) perform the division of the term or terms. (3) As a positive count, sum up (a) the positive digits in the numerator, (b) the negative checks in the denominator, and (c) the negative zeros in the denominator. (4) As a negative count sum up (a) the positive digits in the denominator, (b) the negative checks in the numerator, and (c) the negative zeros in the numerator. (5) The sum gives, (a) if positive, the number of digits to the left of the decimal point in the answer, (b) if negative the number of zeros to the right of the decimal point before the first significant figure.

Example:

$$\frac{447.2\times17.8\times1{,}8740\times.000945\times(0018)^2}{(3.14)^2\times33\times84.9\times(.0015)^2\times8.45}$$

—√ — √ —√ √

Digit progression = 8740

1. Positive; Sum of

   Positive digits in numerator 10

(Continued on page 70)

Campus Notes

CHI EPSILON HOLDS NATIONAL CONVENTION AT WISCONSIN

The national conclave of Chi Epsilon, honorary civil engineering fraternity, was held at the Memorial Union Building, November 3, the Wisconsin chapter acting as host. The program included a business session in the morning, attendance at the Wisconsin-Alabama game, and a banquet in the evening.

The Wisconsin chapter announces the election of the following senior civils: Leo Janicki, Otto Wehrle, H. S. Hahn, John Beran, A. A. Armstrong, and F. A. Fischer.

TAU BETA PI ELECTIONS

Tau Beta Pi announces the following elections to membership:

Seniors: A. J. Armstrong, L. W. Eastwood, H. S. Hahn, L. F. Hillis, H. G. Hyland, L. C. Janicke, O. J. Knechtges, C. A. Kuehl, D. H. Kuenzli, J. A. Kulp, L. B. Mangnus, J. N. McGovern, J. A. Oakey, H. E. Rex, T. T. Ricks, H. L. Stokes, A. H. Schoofs, O. W. Wehrle, and W. C. Ziehlsdorff.

Juniors: G. C. Roeming and T. A. Geissman.

A. S. C. E. INITIATES

The commotion which occurred on the campus last October 18th was merely the natural outcome which can be expected when thirty engineers serenade the Law School by way of initiation.

The men who had applied for membership met on the Law School steps and were met by a group of older members who blindfolded them and conducted them on a tour of the campus, serenading the Women's dormitories and the Law School's evening occupants. After the tour they were conducted back to the Engineering building where full membership in A. S. C. E. was conferred on them.

The men initiated are: J. Arnold, J. Armstrong, L. Berg, W. Bliffert, J. Dahlman, J. Davidson, R. Henkel, L. F. Hillis, M. B. Hunder, O. J. Knechtges, C. Lyneis, B. F. Ludowise, H. W. Mohr, J. Oakey, Leo Pratt, J. A. Ruedt, R. Slaby, E. Schlondrop, and C. K. Stevens.

IT HAPPENED AT SUMMER CAMP

Prof. Wesle: "Peterson, I bet you've been sleeping in your tent all morning."

Pete: "Excuse me sir. I never bet."

A. I. CH. E. REORGANIZES

On October 24th, twenty interested Chemical Engineers met in the Chemical Engineering building and succeeded in reorganizing the local chapter of A. I. Ch. E. This one of the several societies has been inactive for the past two years and the Chemicals felt that they must revive their chapter for their own mutual good.

The officers elected are: President, E. C. Ragatz; Vice-president, C. B. Zimmerman; Secretary, T. T. Rick; Treasurer, R. Casselman; and Sergeant-at-arms, R. Mc Farlane. Senior and Junior members to Polygon were also elected in the persons of H. Gustafson and J. Lacher, respectively.

NO SOUND IN A VACUUM

Prof. Kahlenberg: "Why don't you answer my question?"

Frosh Engineer: "Why I did, Professor; I shook my head."

Louie: "Well, you don't expect me to hear it rattle way up here, do you?"

THREE ENGINEERS MAKE PHI ETA SIGMA

Phi Eta Sigma, Honorary Freshman Fraternity included three engineers in its recent elections. The men are: Arnold F. Meyer, mechanical; Leo F. Losak, civil, and Jack Essock, chemical.

E. C. M. A. HOLDS CONVENTION AT NEBRASKA

The eighth annual convention of the Engineering College Magazines Associated was held at Lincoln, Nebraska, October 25 to 27, the *Nebraska Blue Print* being host. Prof. L. F. Van Hagan, national chairman of the association, E. A. Wegner, business manager, and Marvin Hersh, editor, of the *Wisconsin Engineer,* were the Wisconsin representatives.

The Wisconsin Engineer was awarded first place among twenty-one magazines for its Alumni Notes section and also an honorable mention for its editorials.

A PERFECT RECOMMENDATION

Personnel Scout from G. E.: "How about this man Jones, is he steady?"

Professor Hyland: "I'll say he is. If he was any steadier he'd be motionless."

AZIMUTH CITY IMPROVEMENTS

An announcement coming from Prof. Ray S. Owen's office tells us that Azimuth City, that metropolis of vacationing Civil Engineers, is due to have some improvements before next summer. There are deemed necessary so that this city may compete with other progressive cities. The Civils must have their little comforts.

It is planned to erect a flag pole on the grounds and to screen in the mess hall and office buildings. It is also planned to extend the triangulation net one quadrilateral towards Madison.

A SCOTCHMAN OUT-SCOTCHED

A Scotch traveling salesman, held up in the Orkney Islands by a bad storm, telegraphed to his firm in Aberdeen: "Marooned here by storm wire instructions."

The reply came: "Start summer vacation as from yesterday."

SOPHOMORES MAKE HIGH HONORS AND HONORS

Included in the recent announcement of men making Sophomore high honors and honors were a large number of Engineers. High honors are awarded to any student securing during his first two years 165 grade-points, plus 2 grade-points for each credit above 60 which he has taken; honors are awarded to any student securing during his first two years 135 grade-points, plus 1½ grade-points for each credit above 60 which he has taken.

The list appears herewith:

SOPHOMORE HIGH HONORS

	Credits	Points
Civil Engineering:		
Roeming, George Carl	70	205
Sanner, Edward Reed	70	196
Mechanical Engineering:		
Kraut, Ralph John	77	223
Electrical Engineering:		
Johnson, Everett Arthur	69	196

SOPHOMORE HONORS

	Credits	Points
Civil Engineering:		
Benesh, Alvin Henry	71	174
Heberlein, Edward Garrett	68	161
Hornig, Frederick Franklin	72	173
Matthias, Franklin Thompson	70	157
Plotz, Rezin Smith	68	156
Mechanical Engineering:		
Kubasta, Robert William	68	179
Electrical Engineering:		
Bolliger, Theodore Carl	80	196
Brown, George Harold	68	151
Fairweather, Robert William	69	180
Hove, Adolph Magnus	68	162
Howes, Edward William	69	176
Joos, Martin	75	188
Lester, John Aldrich	67	168
Van Vleet, James Goulden	70	154
Chemical Engineering:		
Catlin, John Blanchard	70	159
Lacher, Jack Hammitt	70	151

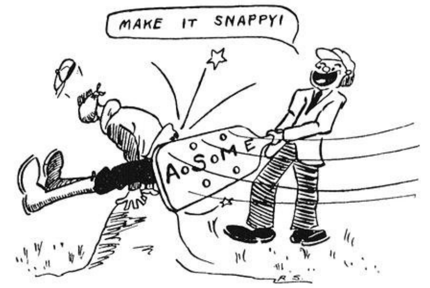
AFTER GRADUATION

The Big Boss (looking over drafting room): "That new fellow from Wisconsin seems to be tending to business. He isn't shooting off his face like most of these other draftsmen. I like a close-mouthed man."

Chief Draftsman: "Oh, he isn't close-mouthed boss; he's just waiting for Pete to bring back the spitoon."

HOST OF MECHANICALS JOIN A. S. M. E.

Thirty-four mechanical engineers were initiated into the local student chapter of the American Society of Mechanical Engineers on October 25th. They were first conducted on an interesting tour of the heating tunnels from the Hydraulics building to the Engineering building. Upon arriving there, they were allowed to cool off by driving the Steam and



Gas lab. "aeroplane" which was quite a thrilling experience. Then after being tested as to their ability as boiler-makers they were allowed to quaff a cup of water, that was somehow extremely difficult to drink.

The men initiated are: G. L. Stetson, M. R. Costello, R. Czerwonky, B. E. Taft, G. A. Rudolf, W. C. Hasslinger, G. Phillips, Gordon Jones, L. . Barron, Don Miller, B. W. Hogan, F. Hammer, G. G. Bayley, M. F. Mortensen, W. M. Barker, R. C. Bird, H. Cady, E. Freyburger, R. Schroeder, G. W. Gibson, J. E. Douglas, H. N. Henderson, P. M. Judson, J. H. DeLap, F. J. Geittman, R. L. Weiss, C. Steinke, A. H. Schoofs, W. T. Wilson, D. W. Hinkel, W. I. Nelson, C. J. Quinn, G. W. Carell, and E. G. Vidas.

After the initiation a short business session was held explaining the advantages of A. S. M. E. E. Freyburger was elected junior representative to Polygon. The meeting closed with the serving of the standard refreshments — cider and doughnuts.

GETTING PARTICULAR

St. Peter: "Who's there?"

Voice Without: "It is I."

Peter (peeved): "Get outa here; we don't want any more school teachers."

PI TAU SIGMA ELECTS SEVEN MECHANICALS

Six junior and two senior mechanical engineers were recently elected to Pi Tau Sigma, National Honorary Mechanical Engineering Fraternity. The men are: A. E. Kratsch, '29; A. H. Schoofs, '29; R. W. Kubasta, '30; J. C. Powers, '30; O. C. Cromer, '30; R. J. Kraut, '30; W. T. Wilson, '30; and F. K. Schefe, '30.

The annual national convention of Pi Tau Sigma was held at Armour Institute of Technology, Chicago, on November 1 to 3. Robert V. Brown and H. E. Rex of the local chapter attended as delegates.

ENGINEER'S BALLAD

Fools may sing of hearts and love
And eyes and cheeks and hair,
Write sonnets to a woman's glove,
And swear her wondrous fair,
Bah! She's an artificial thing,
All powder, paint, and lipstick,
But listen to the song I sing,
And Hail! My love, the slip-stick.

Women are babbling all the time
Of dates, and drinks, and dresses,
Which wouldn't help at all when I'm
Computing torques and stresses.
It conquers without fear or doubt
Whole hosts of sines and surds,
And helps me work in peace without
An avalanche of words.

Slide-rules are always accurate,
Women never so;
And tho they're not affectionate
They never answer "No!"
So hence with women's wanton ways,
With eyebrows, lips, and curls;
My little log-log polyphase
Is worth a dozen girls.

Cornell Widow.

TAU BETA PI SLIDE RULE AWARDED TO COWIE

Alexander Cowie, mechanical, who made an average of 94.96, was awarded the slide rule presented annually by Tau Beta Pi to the engineer making the highest average during his freshman year. The presentation was made in Freshman Lecture by Richard Jewell.

Some other men making exception-

(Continued on page 70)

Alumni Notes

CHEMICAL

Asplund, Arne, ch'27, was in the United States for about two months during the past summer, studying the "Masonite" process and has returned to Sweden to install the first plant of this kind to be build in that country. Masonite is an insulating board for building construction and is made from saw mill waste. Mr. Asplund gives his addres as Rundvik, Sweden.

ELECTRICALS

Conley, B. L., e'18, M. S. Physics '20, E. E.'26, has moved from 616 Locksly Place, Webster Groves, to 5936 Woodland, St. Louis, Mo.

Fuldner, Walter H., e'28, is recovering from a nervous breakdown which followed his graduation. He is living at Tyron, North Carolina. His address is that city, care of Dr. Fuldner.

Lueck, Irving B., e'28, is in the Machine Switching office of the Plant Department of the Illinois Bell Telephone Co. He is now engaged in the construction of the largest switching frame in the world, which will eliminate two offices in the loop district of Chicago. Mr. Lueck is living at 4119 Kenmore Ave., Chicago, Ill.

Motl, Lawrence F., e'28, is Facilities Engineer with the Wisconsin Telephone Company of Milwaukee. His address is 2114 Wisconsin Ave.

Paul G. Stewart, e'28, has decided that there is still a future in the Telegraph business. He is Engineering Apprentice in the Western Union Telegraph Company in their Milwaukee office. His address is 1007 Murray Ave., Milwaukee, Wisconsin.

Rubinstein, Harry W., e'27, formerly at 777—26th St., Milwaukee, Wis., is now living at 348 Newport Ave., Milwaukee, Wisconsin.

Rusch, Hugo L., e'23, has moved to 150 Cramaton Ave., Mount Vernon, New York. Mr. Rusch is with the A. C. Nielson Co. as Industrial Research Engineer.

Scheer, George H., e'28, is taking the training course offered by the Westinghouse Manufacturing Co. of Pittsburg. He is living at 815 Franklin Ave., Wilkinsburg, Pa.

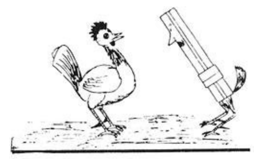
Schudardt, R. F., e'97, National President of the American Institute of Electrical Engineers, and Chief Engineer of the Commonwealth Edison Co., gave a talk at the opening meeting of the Madison Section of the Institute. The banquet was held in the new Memorial Union building Tuesday, October 23. Mr. Schudardt discussed the various things a student may expect after college in the various branches of college work

Thieman, Vincent A., e'25, has left the Wisconsin Public Service Corporation and has entered Harvard on a scholarship.

Wolfe, Harry C., e'2, has recently been promoted to the position of manager of a large electroplating concern in Cleveland. Mr. Wolfe, while here in school, was very active in student affairs, as he edited the Engineer for one year. His address is now 15998 Nela Crest, Cleveland, Ohio.

Zermuehlen, Herman W., e'28, is in the Training course of the Illinois Bell Telephone Co. preparatory to his work in the engineering department. His address is 5627 Winthrop Ave., Chicago, Ill.

MINERS



Beatty, George W., min'24, has given up engineering and is now studying poultry in the graduate school of the College of Agriculture in Madison. He intends to go into the poultry business in Alabama when he finishes the course.

Cameron, George H., min'28, is located at Niagara, Wisconsin. He is employed by the Kimberly-Clark Paper Co.

Crawford, Howard D., min'27, is metallurgist with the Sullivan Mining Co., Kellog, Idaho.

Ehrlinger, H. P., min ex'26, is in charge of the electrolysis in the new electrolytic zinc plant of the Sullivan Mining Co., Kellog, Idaho.

Fritsche, Oscar O., min'26, has returned to the mining department here. He was elected research fellow for the next two years, and is carrying on in the Blast Furnace Slag investigations.

Goff, Ira N., who secured a PhD in the Mining department last June, is assistant to the General Superintendent of the Indiana Harbor Plant of the Inland Steel Co.

Higgins, Arthur K., min'28, is located at Maurer, New Jersey. He is employed by the American Smelting and Refining Co. and at present is assisting in the construction of a new electrolytic lead plant. When the plant is completed, he will remain in the operating department. This plant of the American Smelting and Refining Co. is under the supervision of **Jones, T. D., min'22.**

Lorig, Clarence H., min'24, M. S.'25, PhD'28, who for two years has held a special fellowship in the department of Mining Engineering, and who took his doctor's degree last June is with the Ladisch Drop Forge Co., Milwaukee, Wis.

Walters, Edward C., min'23, is steam shovel superintendent for the Irwin Anglo Chilean Nitrate Corporation at Tocopilla, Chile, South America.

Zoellner, Alfred M., min'28, is research engineer for the A. O. Smith Corporation. His address is 240—27th St., Milwaukee, Wisconsin.

MECHANICALS

MacLean, J. D., m'11, M. E.'16, M. S.'27, research engineer in charge of research at the Forest Products Laboratory at Madison, Wis., presented a paper on the Relation of Treating Variables to the Penetration and Absorption of Preservatives into Wood, at the twenty-fourth annual meeting of the American Wood-Preservers' Association. His paper was a comprehensive summary of the large amount of work done at the Forest Products Laboratory during the past few years, in regard to the treating of wood fibers under different conditions, to determine the relations of temperature, viscosity, and pressure to the absorption and penetration of preservative oils and zinc chloride solutions into refractory wood.

B. K. Breed, m'24, who has been, for the past four years, divisional engineer for the Underwriters' Laboratories in Chicago, in charge of domestic and industrial oil-burner testing, has resigned to join the architectural department of the Preferred Utilities Co., 33 West 60th St., New York City. Mr. Breed will devote his entire time to aiding architects, engineers and builders in planning and laying out Ray or Hart oil-burning systems.

Feirn, W. H., m'24, has been with the United States Radiator Corporation for the last three years in the capacity of sales manager. He is now living at 1424½ Atkinson Ave., Milwaukee, Wisconsin.

Hanzel, J. W., m'26, has moved from 1818 Wesley, Berwyn, Ill., to 5353 Eddy St., Chicago, Ill.

Hoefer, Elmer G., m'05, M. E.'15, is now Professor of mechanical engineering at the University of North Carolina.

Ligh, David R., m'28, is with the Brown Instrument Company of Philadelphia. He is in the Industrial Engineering Department as a Time and Motion Study Engineer, spending most of his time in setting rates of production and trying to increase the general efficiency of the manufacturing. Mr. Ligh is living at 4606 Wayne Avenue, Philadelphia, Pennsylvania.

McArthur, Donald A., m'23, was married to Doris Maas of Gary, Indiana, on Sunday, June 24. Mr. and Mrs. McArthur are living at 545 Harrison St., Gary, Indiana.

Meili, Otto H., m'26, who left a position with the Link Belt Company of Milwaukee last year to go into business with his father at New Holstein, Wis., was married last summer and is now living at 2030 Jackson St., New Holstein, Wis.

Mollerus, F. J., m'24, is now with the International General Electric, foreign branch. He is living at 45 Washington Road, Scotia, New York.

Naujoks, Waldemar, m'26, construction engineer, designer, draftsman, and general utility man in the construction of a new forge plant in Cleveland, writes us enthusiastically about his job. He is very busy with the construction of the new plant at present. Mr. Naujoks will be Sales Engineer for his company after the plant is completed. His address is 1303 East 134 Street, East Cleveland, Ohio.

Perry, Russell, m'26, was married to Miss Helen Burtiss, on June 15. He is on the faculty of the Agricultural Engineering department of the Oregon Agricultural College at Cornvallis, Oregon.

Tews, Roland, m'25, is now living at 575 Johnson St., Gary, Ind.

Waterman, M. C., m'28, is in the research department of the Land Economics and Public Utility department of Northwestern University. His work consists of making a comparative study of conditions in private and municipal generating plants in Wisconsin, as to capacity, length of operation, organization of owners and labor, and the number of people served. Mr. Waterman is living at Barrington, Illinois.

CIVILS

Chae, Leon E., c'22, gives his new address as 1319 Maple Avenue, Evanston, Illinois.

Consoer, Arthur W., c'14, is vice-president and general manager of the consulting engineering firm of Consoer, Older & Quinlan. The Chicago office of the firm has been moved from 140 S. Dearborn St. to 205 Wacker Drive, Chicago, Ill.

Cottingham, Willard S., c'25, instructor in Structural Enginering at the University of Wisconsin, was married Sept. 1, to Miss Edith Bullock, of Madison. Mr. and Mrs. Cottingham will make their home in Madison.

Ellsworth, Charles W., c'14, is Superintendent of Construction for the McLennan Construction Company of Chicago. Mr. Ellsworth visited the campus last week and called on old friends here. His business address is 307 N. Michigan Ave., Chicago, Ill.

Fisher, Maxwell W., c'28, is now working with the Wisconsin Highway Commission, Green Bay division, as instrument man. His permanent address is Nicolet Bldg., Green Bay, Wis., care of Wisconsin Highway Commission.

Fowler, Wm. H., c'16, is secretary of the Dravo Contracting Co. of Pittsburgh. He is living at 715 Montour St., Cordopolis, Pa. A son was born to Mr. and Mrs. Fowler on August 5.

Gale, Grant, c'26, formerly with the Kewaunee Mfg. Co., is now teaching Physics, Mathematics, Mechanics, and Drawing at Grinnell College, Grinnell, Iowa.

Gillette, Paul C., c'18, has left Bellevue, Pa., and his address now is Box 76, Croton-on-Hudson, N. Y. He is a valuation engineer for the Public Works Engineering Co. of New York.

Gardner, Harold Ward, c'05, head of the department of civil engineering at the Colorado School of Mines, Golden, Colorado, has received the degree of bachelor of law at the Westminister Law School of Denver.

Gruetzmacher, C. S., c'14, is a research engineer with the Water Department of the City of Milwaukee. The annexation program fostered by Milwaukee together with the natural growth of the city has led to a study of the needs for and the best methods for securing an additional water supply. The Engineering News-Record for August 23rd contains an article by Mr. Gruetzmacher describing the methods used in this work.

The study is being made by him under the direction of **J. P. Schwada,** c'11, who is city engineer of Milwaukee. The tests consist of taking samples of water from Lake Michigan and putting it through a series of bacteriological and chemical tests. Samples have been taken as far out as three miles to determine whether the incrased purity of the water should warrant building an intake crib that far out.

Hambrecht, A. L., c'10, was appointed state construction engineer, and took office on Sept. 15. Mr. Hambrecht has had a wide experience in engineering practice. After his graduation from the university he went to Cinncinatti as a building construction engineer. He left there to become a designing engineer for such types of plants as sewage disposal and water systems. In 1915 he entered the employ of the highway commission and in 1917 went to Spooner as assistant division engineer. He has been division engineer in the Madison division for the past few years.

Hanson, Maurice M. (Moose), c'19, is plumbing instructor for the Wisconsin State Board of Vocational Education. He covers the Green Bay, Oshkosh, Appleton, and Fond du Lac district with headquarters at the vocational school at Appleton. He was registered in the 1928 summer session for courses in education and psychology.

Smith, Ralph A., c'25, has been with the consulting engineering firm of Consoer, (c'14), Older & Quinlan, and has recently been put in charge of their Niles Center office.

Sogard, L. T., c'24, married Ernestine Moore of Anna, Ill., where she was supervisor of music. Mr. and Mrs. Sogard are living at 245 N. Long Ave., Chicago, Ill.

Hastings, W. Harold, c'27, is building superintendent for Robert L. Reisinger & Company, 466 Oakland Ave., Milwaukee, Wis. He is living at the Y. M. C. A. of that city.

McMullen, Ralph E., c'27, left the Wisconsin Highway Commission on March 31 to become a detailer with the

(Continued on page 70)

Engineering Review

STERILIZATION OF TUNNEL SHAFTS

Chlorine is used by the city of Chicago for the sterilization of shafts of water tunnels which have become polluted by leakage from sewers.

The chlorization of shafts has been resorted to as an emergency measure on several occasions. Whenever "live sewers adjacent to water tunnel shafts are being repaired or replaced to correct leakage into the shafts chlorination has been advised because of the relative rapidity with which pollution at the surface of the shaft may be carried down and contaminate the water passing through the tunnel. Studies on the time of penetration and the circulation in the shafts of various depths have been made, using a salt solution and an electrical apparatus with a sensitive millivoltmeter to record the presence of this solution at various points in the shaft.

The method of chlorinating shafts is to connect a hose by a special fitting directly to a chlorine tank and lowering the hose to the bottom of the shaft. The gas is then turned on at a rate sufficient to prevent frosting of the tank and the hose raised gradually at the rate of about two feet per minute. This practice has proven effective and practical and has been very helpful in connection with tunnel pollution work.

—*Municipal News and Water Works*

CAST-IRON HOUSES FOR ENGLAND

Cast-iron houses are one of the most recent novelties devised in England in the effort, which has now been going on for a number of years, to meet the problem of modern housing for workers, at rentals which are low.

The cast-iron house has a concrete foundation, timber doors, steel frame, cast-iron outer plates, an inner shell of fibre board four and a half inches inside the cast-iron, an outside finish of cement and pebble dash, a tile roof, and brick chimney. After the foundation is constructed, it is said that the rest of the house can be 'turned out' in two weeks and that the only men needed for the job are two laborers, one 'fixer' and two tilers. A cast-iron house of six rooms and bath is reputed to cost about $2,600.

STEAM CORRODES IRON

Steam in the absence of oxygen attacks iron to a very slight extent at 650 dgerees F. The action increases rapidly with the temperature so that serious damage may result in time at temperatures around 1,200 degrees F. It has been shown that in steam boilers, with an oxygen concentration in the water of less than 0.1 c. c. per liter, a small amount of gaseous hydrogen is evolved at a temperature of 585 degrees F. The amount evolved increases with the temperature within certain limits not yet fully defined. The action of steam on iron at high temperatures produces magnetic oxide of iron according to the reaction:

$$3Fe + 4H_2O = Fe_3O_4 + 4H_2$$

This is becoming a more important practical consideration owing to the present tendency toward higher pressures and superheating in modern steam power plants. Already, signs of deterioration have been observed in steel superheater tubes. It has been found that steel, wrought iron, malleable iron, and white and gray cast iron are all subject to attack, but that the high-chromium and nickel-cromium iron alloys are much more resistant under these conditions.

—*Mechanical Engineering*

ECHO DEPTH SOUNDER

A device attracting general interest is the Behin echo-depth-sounder. This device, an invention of the German physicist Herr Behin, is designed to enable soundings to be made at sea by noting the time interval taken by a sound to travel from the surface to the bottom and thence to return as an echo. The true basis of the invention is an instrument capable of measuring time down to the thousandth part of a second. This instrument is at any point on the ship and is connected to a firing head and two microphones. When the firing head control on the instrument is operated a cartridge is ejected from the ship's side. This cartridge is fitted with a delay action fuse and explodes when it has descended through a few feet of water. The noise of the explosion is caught by one of the microphones which operates a relay that starts the action of the time interval recorder. The echo from the bottom is shortly afterwards received by the second microphone, which acts to stop the recorder. From the known velocity of sound in water, the scale of the recorder may be graduated to read directly the sounding in feet or fathoms. The two microphones are placed inside on opposite sides of the ship's hull to prevent the echo-receiving microphone from operating under the sound of the explosion which sets the starting microphone to work. In some instances where this shielding effect is not available, the echo-receiving phone is fitted with an arrangement which momentarily throws it out of action as the cartridge is fired. The device is applicable to sounding in air also. It was employed during the trials of the Zeppelin airship Z-R3 before she left Germany, and worked satisfactorily for all speeds up to 62 miles per hour.

ARCTIC POWER

Thirty miles above the Arctic circle on the Glomfjord there is a $5,600,000 Norwegian state hydro-electric plant. This plant is equipped with unusually large generating sets and has several features which the ordinary plant does not have.

The power house is on the sea coast. At a height of 1,542 feet above it, a collecting bay delivers the water to two penstocks leading to the plant. Instead of the usual one or two valves, there are three at the upper end of each penstock, insuring the safety of the station in case of pipe failure. Room is provided within the power house for four turbines.

The power house contains three Pelton double runner type turbines, the largest of which is rated at 27,500 horsepower. In contrast with the usual high speed turbines operating at high heads these are built to operate at 330 r. p. m. The diameter of the runners on the largest turbine is 11 feet, and each runner carries 20 buckets of two feet width. The complete rotor weighs 35 tons. A ten inch jet issues from each of the nozzles. The highest efficiency that has been obtained with the turbine is 88.2 per cent.

The turbines are coupled direct to 15,000 volt, 25 cycle generators. The generators are rated at 20,000 K. W. at 80 per cent power factor. They are completely enclosed and are fan ventilated. The largest generator is 22 feet overall, and weighs 225 tons. The stator rests on rollers in the generator pit which makes it possible to revolve the machine and replace burned out coils.

The power is sent out over three-phase transmission lines at 15,000 volts. The lines are carried on steel towers to Naesne where it is used for municipal purposes.

COLOR MOTION PICTURE

A black and white film that produces color movies is one of the latest developments in photography. This is accomplished by using instead of the usual smooth surface film, a film embossed with minute cylindrical lenses which break up the light entering the camera into its various components which are suitably recorded on the light sensitive emulsion according to their intensities in black and white.

Based upon this radically new and simple principle, a film is being offered to the amateur photographer. It has been developed in the Eastman Kodak Research Laboratories and is embossed with 559 cylindrical lenses to the inch running length-wise of the film. When used in conjunction with a three color light filter — each section of which lets into the camera only light of its own color — the film may be used with any of the usual amateur movie cameras.

When used in the projector, the film acts upon the white light passing through it in such a manner as to separate it into three components of proper intensity and direction which, after passing through the lens and color filter, recombine on the screen to produce a naturally colored picture.

The simplicity of the underlying principle is the most significant fact about this new answer to the problem of color movies.

—*The Scientific American*

NOVEL METHOD OF CHIMNEY CONSTRUCTION

A novel method of chimney construction used in securing the additional sectional area required to take off large volumes of gases has recently been put to practical tests in Great Britain. There being no space available for building an entirely new and separate chimney, it was decided to construct the larger chimney round the smaller on and then remove the latter, as the loss consequent on stopping work while a new chimney was built was too great to be considered.

It was found that the foundations were large enough and strong enough to take the new structure, which was therefore built upon it, due care being taken to obtain a proper connection between the foundation and the new shell. This was done by concreting the newer and larger diameter on to the bottom and tapering portion of the old, and thus through this portion of the old chimney stresses were communicated to the foundation.

The new chimney is 1 ft. 10 in. larger in diameter than the old one. No scaffolding was used, the necessary platforms being fixed on the exterior of the old and narrower chimney. It was also essential that the inner forms should not touch the old chimney, as wind movements would have caused improper hardening of the concrete.

—*Concrete*

LARGEST EARTH FILL ON RAILROAD SYSTEMS

An earth fill which is probably the largest on any railroad was recently completed. It is located at Ringtown, on the Catawissa Branch of the Reading Company, and takes the place of a steel viaduct. This fill was needed because of the heavy improvement of the system to meet this demand.

The steel viaduct, built in 1897 to replace a wooden trestle, gave a good service until 1928, when it was decided to re-locate the line straight across the valley a short distance from the old line. Work on the fill was started on April 4, 1922, and was completed November 19, 1927, being first used for traffic on September 11, 1927. The fill is 3340 feet in length, has 116 feet maximum height, and 369 maximum width at the base. It is made of 1,352,613 cubic yards of material, the total cost being $1,200,000.

A huge culvert was necessary to carry the waters of a creek flowing through the valley. This culvert is 45 feet wide and 25 feet high above the bed of the stream, and measures 430 feet from end to end.

The material from which the fill was built was hauled out in standard cars to the fill and transferred to small work cars, then carried out to the fill and dumped on a curve at the end. The work-car track was built on out as work on the fill went forward.

ICE FOR BENDING TUBING

The United Bureau of Standards has recently found that, in making coils or spirals of small diameter brass or copper tubing, ice assists satisfactorily. The tube to be bent is first filled with water, which is then frozen by being packed in salt and ice. After freezing, the tube, filled with ice, is bent into the desired shape. The ice is then allowed to melt and run out, leaving the tube clean, shapely, and empty.

(Continued on page 62)

Editorials

FOR THESE ARE ENGINEERING TIMES The people have said that our next president shall be an engineer. It is a fitting choice, for these are engineering times. In times of international difficulties, it is natural for a republic to choose as president a diplomat; war times have usually thrust a soldier into the presidency; if financial trouble threatened, we might well expect a financier to step to the front. So, in this era of industrial development and great engineering activity, it is most appropriate than an engineer should be selected to direct the affairs of the nation.

Mr. Hoover's success as president is of vital importance to the engineering profession. He should, and undoubtedly will, receive the support and co-operation of every professional engineer in the country, regardless of party. In his exalted position, he will be the subject of scurrilous attack, as were his great predecessors, Washington, Lincoln, Roosevelt, and Wilson. The army of his defenders should include all who have a pride in engineers and engineering.

CHANGES ARE IN THE AIR Can you feel them? Changes always were in the air, but very few people took any notice of them as they occurred. Most of us are lacking in foresight although we are pretty well equipped with hindsight.

'Observation after the fact' is what most of us content ourselves with. It is easier than thinking.

OUR PONTIFICAL ANCESTORS Saint Patrick was an Engineer. He was! He was! But not the only ecclesiastical ancestor of whom we can boast, was old Saint Pat. Far from it, for history broadcasts that much bridge building was accomplished under the direction of monks, during the Mediaeval and Renaissance periods.

The fall of Rome left the famous bridges and roads to thieves and cutthroats. An order of Benedictene monks called the Brothers of the Bridges or Pontifices was established for the aid and safety of travelers. The repair and even the construction of bridges soon became their sacred duty.

Among the famous structures which were thus built, are those at Avignon, Ceret, Nions, Saint Esprit, and even the famous old London bridge which was started by Philip of Colechurch. These historical monuments were for the most part of gothic architecture. The Saint Esprit bridge over the Rhone was a stone structure more than half a mile in length and was composed of twenty-six stone arches.

Later highway and bridge departments were established by the several nations and little remains of the work of these Pontifices except a few scattered arches in France and England.

THE AMBASSADOR BRIDGE Among recent engineering achievements we may well consider the longest suspension bridge in the world, the Ambassador international bridge which is being completed at Detroit. It exceeds in length all structures of its type by one-hundred feet and will hold this superlative honor until the Hudson bridge is finished. Private interests which are financing the project are confident that the toll receipts will more than pay the interest of the twenty-two million dollar investment.

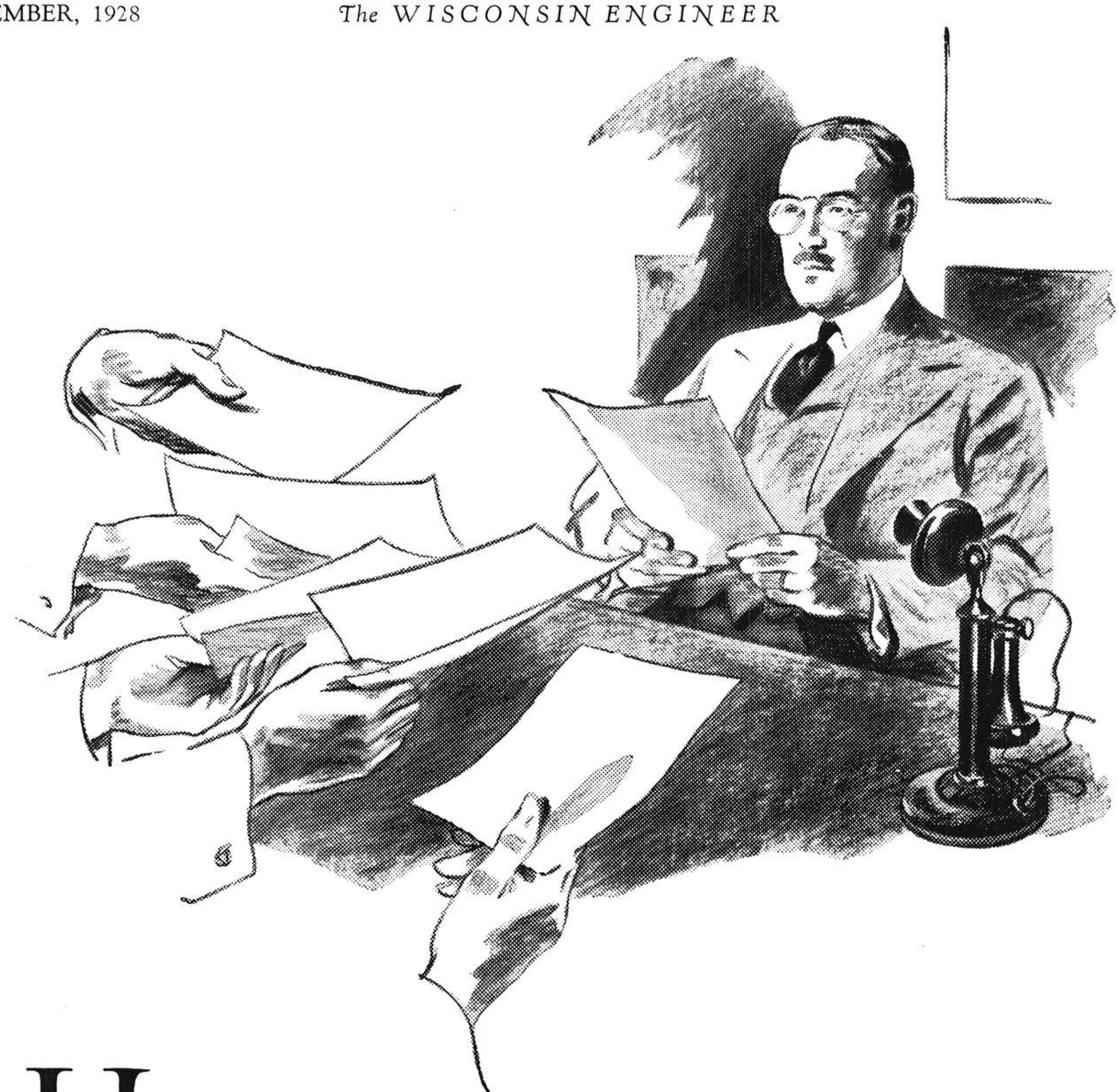
The main features of design are the 362-foot towers, the 1850 foot span which clears the river by 152 feet. The supporting cables are made up of 7,622 strands of No. 6 wire, one of the first uses of heat treated wire in this type of structure.

Besides being the longest suspension bridge in the world, this forms another international link with Canada connecting the business districts of Detroit and Windsor. It provides a shortcut for tourists between Chicago and New York, taking the place of river ferries, and will undoubtedly promote local trucking interests. Furthermore, disregarding its economic value and its financial investment, it stands as a monument of human accomplishment in this age of steel.

A COURSE IN AVIATION The importance of aviation is increasing at such a rate that it cannot be disregarded by any school at which engineering is taught. At the present time even though it is yet in its infancy, aviation is growing by leaps and bounds and is taking hold in the desires and ambitions of the younger generation.

Many students are entering the university now wishing to take a course in the theory and principles of areonautics, but they have to be satisfied with a course in mechanical engineering because none is given in the course they wish to pursue. This situation is quite unfortunate and should be remedied. These students have the same desire to learn areonautical engineering that students of not so long ago and even of the present time had and have relative to automotive engineering. And why shouldn't they? They are young and so is aviation and their ambition is to grow up with it and endeavor to make it better, safer, and more practical for the entire human race.

Wisconsin is known for her progressiveness and is proud of this distinction. She should be; but can she continue to remain on this pinnacle of progressiveness if she does not satisfy the desires of her students in this future field of engineering development? Other schools have already passed her in this field.



AN UNUSUAL METHOD OF LEVELLING ACROSS A WIDE RIVER

(Continued from page 50)

For Set #5

New York		New Jersey
10.793 =	Rod Reading of top rectangle =	4.575
— 0.379 =	Value of "x" =	—0.665
10.414 =	Distant Rod Reading =	3.910

For Set #7

New York		New Jersey
10.793 =	Rod Reading of top rectangle =	4.575
— 0.415 =	Value of "x" =	—0.686
10.378 =	Distant Rod Reading =	3.889

Tabulating the near and distant rod readings, and obtaining their differences, the difference in elevation of the two benches is obtained.

	Near Rod	Distant Rod	Difference in Elevation
New York			
Set #5	10.082	3.889	6.193
Set #6	3.948	10.378	6.430
New Jersey			
Set #5	3.945	10.414	6.469
Set #6	10.086	3.910	6.176
		SUM	25.268
		MEAN	6.317

The value of 6.317 is the difference in elevation between the New York and New Jersey benchmarks, the latter being the higher. Adding this difference to the elevation of the New York benchmark, the elevation of the New Jersey benchmark becomes

12.570 plus 6.317 = 19.067 feet.

Sets #5 and #6 are the results of one day's field work. The above difference in elevation between the two benchmarks is computed from thsee two sets only. A mean of three days reciprocal levels gave the result slightly different, but sufficiently close to a single day's difference in elevation, to make it evident that the accuracy required had been obtained.

As a check on the system a second pair of targets, having an interval of 2.00 feet between the rectangles, was sighted on immediately after the completion of each set on the smaller targets. This work was carried on entirely independent of that of smaller targets and the value of its result incorporated in the mean of the final value for the difference in elevation.

ENGINEERING REVIEW

(Continued from page 59)

A DIESEL AIRPLANE ENGINE BUILT

A Diesel Airplane Engine has recently been built for the first time by the Packard Motor Car Company. It is the product of several years of experimentation and its performance during the initial tests recently conducted was entirely satisfactory.

The engine is a radial air-cooled type developing two hundred horse power.

The application of the Diesel principle to aircraft purposes has long been considered by engineers, but the idea was usually rejected because of the great weight believed necessary for successful operation. This made the engine impracticable for airplane use. The Packard engineers have succeeded, however, in reducing the weight from one hundred pounds to three pounds per horse power, where it can be satisfactorly utilized. At the present time no details can be obtained concerning the construction of the engine or its operation. Further and more exhaustive tests are to be conducted before it will be introduced on the market.

The new power plant embraces many advantages over the present type of internal combustion motor. Probably the most important of these is the elimination of the fire hazard, for the type of fuel it uses is not combustible in its ordinary state. Having no electrical ignition, the radio interference now experienced during the inter-plane communication will be eliminated. The engine is said to have fewer parts than the simplest gasoline engine. The fact that it will carry an airplane twenty-five pre cent farther per pound of fuel is also to be considered from the viewpoint of economy of operation and increased radius of flight.

BIRTH OF POWER ENGINEERING

The earliest print or drawing of any kind showing the construction of an engine has recently been found in a library of one of the old Oxford Colleges. The print is dated 1717 and the drawing was by Henry Beighton, a man of scientific attainments who could appreciate the several points of the engine. Newcomen's first engine was probably put into action in 1712, and there is a print

of this, but it is dated 1719, two years after the Beighton drawing. Newcomen did not invent the boiler, the cylinder, the piston or the idea of condensation, but he was the first to combine all of these in a practical manner, thus giving us what remained the standard form of engine for about a century and a half. Even after Watt had made his improvements in the eighteenth century Newcomen engines continued to be used.

In 1716 the first advertisement regarding Newcomen's engine was printed. It ran: "Whereas the invention of raising water by the impelling force of fire, authorized by Parliament, is lately brought to the greatest perfection, and all sorts of mines, etc., may be thereby drained and water raised to any height with more ease and less charge than with other methods hitherto used, as is sufficiently proved by divers engines of this invention now at work in the several counties of Stafford, Warwick, Cornwall and Flint . . . " This wording may well raise a smile when it is recalled that the engine which had been brought to "the greatest perfection," used about twenty to twenty-five pounds of coal per horsepower per hour. But Newcomen's engine marks the first step on the road which led to the industrial revolution and he it was who blazed the trail which leads directly to the wonderful super-power stations which are springing up in every part of the world.

—*Power Plant Engineering*

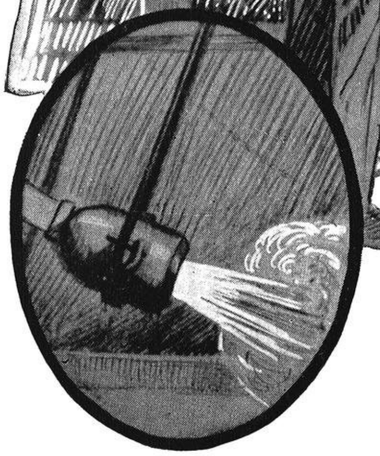
CONCRETE RAILROAD BED

A rigid railroad roadbed made of concrete has been proved superior to a ballasted track using wooden cross-ties. The Pere Marquette has carried out an expeiment on a quarter-mile stretch, which has been in use for over a year. The new bed is located on a 0.% grade between Detroit and Plymouth, at a point convenient for observation.

The quarter-mile section is made up of 34 slabs, each 39 feet long, 10 feet wide, and 21 inches thick. A light fabricated steel truss, in addition to reinforcing rods, was embedded under each rail, brace frames and adjustable tie rods being connected between the trusses at intervals. Steel stirrups were attached at 27-inch intervals to the upper longitudinal chords of 1/4-inch by 4-inch steel with which the trusses were fabricated. To these stirrups the rails were fastened with clips and bolts, the rails resting directly on the concrete except for the insulation necessary for the use of the block-signal system.

In the construction, ballast was removed to the bottom of the old ties, so the concrete slab is 15 inches higher than the adjacent roadbed. The fabricated steel was put in place and alignment was assured by the use of transit and level. Concrete was then prepared and poured. After flotation of the surface, rail bearings were troweled and, later, minor irregularities were removed by rubbing with carborundum bricks. Keeping the bed covered with moist sand for seven days was the curing process. The first train ran over it three weeks after construction.

The concrete roadbed is in excellent shape after a year's service and shows no disintegration, while the rails are not usually battered. Only four slabs have small



Testing the Strength of Hercules Dynamite in Ballistic Mortar House cracks, and the levels have settled slightly but uniformly. Trains ride smoothly over the next section and the noise made is no greater than on ordinary track, although different from the usual noise. There is no click as the wheels pass over the joints in the track and there is no dust.

ENGLISH AIRPORT EQUIPPED WITH RADIO COMMUNICATION

The huge English airport at Croydon is equipped with complete radio installations, so that communication is possible with all planes over the regular air-transport routes and their routes accurately followed. All regular passenger planes are equipped with radio transmitting and receiving apparatus, enabling them to keep in constant touch with the Croydon station.

HORIZONTAL REFRACTION IN GEODETIC SURVEY WORK

Some interesting instances of horizontal refraction have been encoountered by the Geodetic Survey of Canada in its survey work in that country. One outstanding instance of th elateral bending of light rays, was met when locating points along the lower t. Lawrence River. Here it was found that the lines across the river were apparently straight but those along the short were bowed toward the river. After many tests it was decided that this was caused by the fact that under certain conditions, the air over the water was warmer and therefore of a different density, at night when the observations were made, than that over the land. This difference in density caused the beam to be bowed toward th eriver and then back to the instrument.

The deviation from the straight line in every case was very slight — from 3 to 20 seconds of arc, — but still sufficient to render useless the calculations based upon the observation. The difficulty was overcome by taking repeated observations on days, or at times of the day, when the layers of air over land and water were as near as possible of the same temperature, and hence more nearly of the same density.

—*Engineering and Contracting*

BOILER GENERATES STEAM AT 1500 POUNDS PRESSURE

A novel system of high-pressure steam generation has been worked out at the Vienna locomotive-works. An auxiliary low-pressure boiler gets up a moderate pressure in the system to start it. From the evaporator or steam generator proper, which is entirely separated from the furnace, this saturated steam is pumped into superheated coils in the furnace. The steam then passes to the steam generator, where it bubbles up through the water, generating more steam. The superheated steam serves as the medium by which the furnace heat is transmitted to the water to be evaporated. At a pressure of 1500 lbs. per sq. in. and a total steam temperature of 825 degrees, it is necessary to pump 3½ times as much steam through the evaporator as is delivered for outside consumption. The system is tapped just beyond the superheater coils to supply the steam for consumption. The make-up feed water is forced through an economizer or preheater into the generator drum. Construction has been started on a 18,000 kw. plant operating at 1500 - 1700 lbs. pressure and 750 - 900 degrees steam temperatures. It will take up one-third the room of a plant the asme size operating on 250 pounds.

STORAGE BATTERY TRUCKS AND TRACTORS

The new Chicago Union Station has a very efficient system of handling mail and baggage. Between every set of two tracks there is a concrete platform which is on a level with the doors of the baggage cars; this platform runs to the basement where the mail terminal is located, and thus eliminates the us eof elevators and saves much time. Passengers use a larger platform on the other side of the train; that is, the baggage and passenger platforms are placed between the tracks alternately.

Electric tractors and trailers are used to convey the mail and baggage from the basement to the cars. The fleet consists of twenty tractors and eight trucks. There are four hundred and fifty mail trailers and one hundred and fifty highway trailers for baggage. The trucks operate continuously except when the drivers change every eight hours, when the batteries are removed for charging and the motor commutator and controls are inspected. It takes but a few minutes to complete this change, however. The batteries are charged from an enormous unit of the most advanced type consisting of the equipment necessary to charge twenty truck batteries, and at the same time, batteries in railroad passenger cars which are standing in the station.

The entire fleet is fitted with Alemite lubrication. One truck is taken out of srevice each day and all moving parts are inspected befroe greasing; it takes a month to service all of the equipment. The men in charge firmly believe that if they wait too long they will have considerably more to repair.

SOME TECHNICAL USES OF X-RAYS

The use of X-Ray treatments in the solution of technical problems is comparitively an old process, but few people realize the great importance of them when used in this capacity.

The principle and most important field in which X-Rays are being used is in the testing of materials. Huge castings and other iro nand steel equipment are being tested before being assembled, and in that way defective parts are detected before the machinery or building is completely assembled. The X-Ray is able to penetrate the object and detect the slightest flaw in the texture of the material. In addition to disclosing this, the X-Rays can disclose the way in which the atoms are arranged in the ultimate particles of the material, the size of these particles, whether they are arranged in a particular or a random manner, what changes take place in these arrangements when the

material is submitted to thermal, mechanical, or chemical treatment, whether two materials which have the same chemical composition, the same appearance under the microscope, or the same reaction to customary tests are really the same in atomic structure.

—*Industrial and Engineering Chemistry*

REFRACTORY CEMENT USES CHROMITE

A new high temperature cement has been recently placed on the market by the General Refractories Company. The basic component of this cement is chromite. It contains no sodium silicate or other quick-setting elements. The natural atmospheric quick-set has been intentionally retarded sufficiently to permit easy troweling without frequent addition of water. It sets hard and uniformly, and is said to maintain a constant bond through all temperatures. The fusion point is over 3,500 degrees Fahr. an dthe tensile strength is over 300 pounds.

—*Engineering and Mining Journal*

FLEXIBLE GLASS

Flexible glass is to be produced on a commercial scale in England by Dr. Pollack and Dr. Ripper, the inventors. The glass is a condensation product of carbamide and formaldehyde, and can be produced in the liquid form, a thick sirupy substance, or as a solid. Although not quite as hard as plate glass, it has the same appearance and a greater tensile strength while only half as dense. This glass is so flexible that a rod of it can be bent into a half-circle without breaking. When it does break the fracture is blunt, and there is no splintering. It can easily be turned on a lathe, drilled, filed, or polished. What is perhaps more important, this glass transmits ultra-violet rays, which adapts it for use in hospital and greenhouses. Other uses for it are in the manufacturing of enamels, vranishes, an das a basis for artificial silk and lapidary work.

ABRASIVES FINISH LARGE PROPELLERS

In the mkaing of ship propellers, which are generally manganese bronze castings, considerable labor is involved in finishing the driving sides of the blades. If they are rough, unnecessary power is expanded to overcome the resistance set up by friction. For the large transatlantic liners, the propellers are first machine planed accurately to pitch on the driving surfaces, at which time the over-all finish is also completed. Part of this finish is brought about by the use of pneumatic chipping hammers, followed by hand filing. The final finish is then obtained with abrasive cloth of various grades.

While these operations involve a considerable expense of labor and abrasive material, they are economical in the long run, as propellers finished in this manner can be depended upon to deliver as near maximum power as possible.

—*Iron Trade Review*

ALUMNI NOTES

(Continued from page 57)

American Bridge Co. at Philadelphia. He held that position only until July 15, when he resigned to become field engineer for John P. Pettyjohn and Co. He is now engaged on the erection of a new plant at Meadville, Pa., for the Viscose Corporation, makers of rayon. He will be located at Meadville for at least a year. His street address at that place is 541 Ellicott Court.

The project he is now directing requires the grading of a site nearly one-half a square miles in area. This necessitates the excavation of some 30,000 yards of earth. After that there will be one structure 300 by 665, one story high, one structure 100 by 300, six stories high, one structure 100 by 300, four stories high, a power house, employment office, reservoir, and a storage house. He is very busy keeping ahead of the builders with his grade stakes, building corners, wall lines, and batter boards.

Perlman, Charles, c'26, has left the Wisconsin Highway Commission and has gone to Gary, Indiana, to work as design and detailing engineer in the steel plant.

Russell, Cecil R., c'23, returned to his home country, New Zealand, after graduation, writes that business conditions are not good in that country, and work in civil engineering is scarce. His address is Box 606, Christ Church, New Zealand.

Smith, Leon A., c'12, Superintendent of the Water Department of Madison, Wis., is the author of an article entitled "Plan of Waterworks Management at Madison, Wisconsin," which was published in the Engineering News-Record for September 13th. Mr. Smith's right to speak with authority on this subject is evidenced by the fact that the average annual water bill in Madison is approximately half that in other cities of the same size in Wisconsin.

Martin, George, c'26, is with the Jerry Donahue Engineering Corporation of Sheboygan, Wisconsin.

Hanson, Paul E., c'22, engineer with the United States Coast and Geodetic Survey, was killed Wednesday, October 24, when he fell from a bridge at Columbia, Alabama. Mr. Hanson was installing a water gage when the accident occurred.

Whitson, Edward W., c'27, engineer with the Milwaukee Railway & Light Co., Milwaukee, Wisconsin, died October 26th, 1928.

CAMPUS NOTES

(Continued from page 55)

ally commendable grades are: Frank C. Ladwig, civil, 93.67; Raymond A. McCreary, mechanical, 93.33; Wm. A. Kuehlthau, electrical, 93.28; C. L. Fredenhall, electrical, 93.06; Walter F. Karsten, mechanical, 92.88; A. F. Langlykke, chemical, 92.61; Arnold F. Meyer, mechanical, 92.35; O. C. Cromer, mechanical, 92.08; Norbert Steckler, mechanical, 91.85; Howard Canfield, electrical, 91.68; Leo F. Kosak, chemical, 91.32; G. O. Williams, chemical, 90.76.

DECIMAL POINT DETERMINATION

(Cotninued from page 53)

Negative checks in denominator	3
Negative zeros in denominator	4
	17

2. Negative; Sum of
   Positive digits in denominator ---------- 7
   Negative checks in numerator --------- 3
   Negative zeros in numerator ---------- 7

   17

$17 - 17 = 0$ Answer: $= .8740$

If there is any question about remembering which projection of the slide gives the positive check and which one the negative, it is a simple matter to scratch a positive check (√) on the *left* hand end, and a negative check (—) on the *right* hand end. An alternate method would be to determine the rule for yourself by performing a few simple multiplications as 2×4, and 2×8.

UTILITY DEMANDS OF A MODERN HOSPITAL

(Continued from page 52)

The increase in pressure would naturally increase the leakage from these outlets.

Table 1 gives the steam used for heating on a twelve months' basis. Leaving out June, July and August, the average use of steam per patient-day was 220 lbs. At the University, the heating season is figured as 260 days from September 15 to June 1, inclusive. For the hospital building, in the year 1926-27, the steam used was 421 lbs. per square foot of hot water radiation per heating season. For the entire University, the steam used per square foot of steam radiation per heating season was 810 lbs.

The total water used per patient-day was 366 gallons. This is the sum of the city water and lake water averages during the last eight months of the period of observation. During this time the condenser on the refrigerating machine used 11,220 gallons on an average day, or 44 gallons per patient-day. The flushing of softeners accounted for 3,610 gallons on an average day, or 14 gallons per patient-day. Without the mechanical refrigeration plant and water softeners, the total water consumption would have been 308 gallons per patient-day.

The hot water used per patient-day was 82 gallons. This is 22.4 per cent of the total water used, or 26.6 per cent of the total water used exclusive of water for softener flushing and for cooling in the refrigeration plant. It should be noted that the above figures do not include laundry use of water.

The per-capita water consumption per day of the city of Madison is about 102 gallons. A comparable unit for the hospital would be the per-occupant-day consumption. During the entire period of observation, the number of occupants other than patients remained practically constant. There were about fifty-five full-time and part-time doctors and internes, one hundred and twenty nurses and two hundred and sixty employees. The total estimated to be on duty during the day time was three hundred and sixty. The use of this number was considered to give the fairest basis of calculating the consumption per occupant-day. Exclusive of the water used for softener flushing, and cooling in the refrigeration plant, this gives a per-occupant-day consumption of 127 gallons.

The daily charts taken from the flow meters on the city water and hot water lines gave a means of studying the variations in the use of these items throughout the day. Figure 3 shows typical charts and it will be noticed that there are three periods of maximum demand. Also, the study of these charts shows that on the per patient-day basis for city water, there was a peak period of consumption 2.33 times the average rate of consumption lasting for at least 15 minutes on the average day. For hot water, this ratio was found to be 3.92. This indicates that the hot water demand is more fluctuating than the total water demand.

In determining the sizes of heaters, softeners, pipe lines and other pieces of equipment, it is important to know the maximum demands as well as the average demands that must be met. For instance, a softener installed on the hot water system should not only be able to handle the daily load of 82 gallons per patient-day, but must be able to handle a load 3.9 times this amount for a period of at least 15 minutes. If it is not designed or chosen to meet the load during times of maximum demand, the water will not be entirely softened, and in some cases damage to the filter bed my occur. Likewise, the heater and the storage tank for the hot water system must be chosen with respect to the maximum demands for hot water. With a given ratio of maximum demand to average demand, either the heater must have sufficient capacity to handle this entire maximum load, or a storage tank must be provided of such a size that the maximum demands above the amount that can be handled by the heater will be drawn from the storage tank, with not more than the allowable drop in temperature.

WHAT AN IMPLEMENT ENGINEER THINKS ABOUT

(Continued from page 47)

to die under its inertia will run for 22 minutes. That surely is an indication of refined design and workmanship.

The simple rugged plow is quite another. In operation the plow is a rigid unit. It must enter the ground to a predetermined depth, cut, raise, turn, reverse and place a strip of soil while at the same time it must cleanly and accurately cover trash, fertilizer, weeds, or other litter. In its highest form the plow today is but a play tool for the farmer, who seated comfortably on the tractor, simply jerks a string to set his plows in the ground automatically, or likewise lift them.

As we review past developments, comparing the spade and ancient crooked stick plow with the modern tractor gang plow, the brush drag with the modern harrow and pulverizer, the hand hoe with the high-speed tractor cultivator of today, the sickle with the harvester-thresher, it is evident that much progress has been made in the application of machinery to agriculture, but it must be apparent to the student who views our industry from the outside as it is to us on the inside that only a beginning has been made. The field is wide and it is full of invitation and of challenge.


1930
1930

EXTENDING OUR VISUAL HORIZONS

(Continued from page 46)

is desired. It is built in a checkerboard pattern; the sides of each square being a wire half a wave length long. All of these half-wave antennas are connected in such a way that they oscillate in phase and require no tuning or adjustment.

The problems of television broadcasting by radio are many and varied. In many cases where encouraging reports have been received from experimenters in Los Angeles and San Francisco on transmissions originating in Schenectady, New York, observers within a radius of fifty miles have reported very poor reception. Peculiar among the problems met with is that presented by a "mirage" effect similar to that phenomenon which may be observed over a lake in the morning and evening, and which results in the distortion of images and sometimes in the appearance of several interwoven images. A possible explanation of this phenomenon may be found by assuming that if the reflecting Kennelly-Heaviside layer which is supposed to be located about one hundred miles over the earth were broken up at times into several layers at different heights, each layer would reflect a separate image causing an irregular and distorted view to be received.

Another problem that also must be solved before television broadcasting may be perfected is closely wrapped up with the velocity of light. Radio waves travel at the speed of light, and even though such velocities have always been treated as being almost too high for comparison with anything that occurs on the earth, it has been found that these rays are too slow for television according to Dr. Alexanderson, whose explanation is "Light travels at the rate of 186,000 miles per second and yet it has been found by experiment that light will travel only about 200 miles in the time required for tracing one line of a television picture and only 50 miles in the time required to trace ¼th of a line in a picture. Thus if two rays have traveled from the transmitting to the receiving station through different paths and the length of these paths differs by only 50 miles they will register separate images differing as much as ¼th of the picture. Each of these rays will then trace its own picture and the result will be that there will be two pictures displaced by that amount. On the other hand, a multiplicity of rays may arrive having traversed different paths, each tracing its own picture with the result that the details of the picture will be blurred."

The problem of static and its elimination is also of some importance in television broadcasting and has been the subject for much study. However, the difficulties of both static as well as fading on short wave are rapidly being overcome, and consistent operation is just around the corner.

What infinite possibilities as a source of entertainment, and of educational value television broadcasting offers in the future can hardly be more than guessed at. The original broadcasts were made using some extremely simple subjects, for example, a cardboard sign bearing the heavy

black letters "WGY", or another sign of a checkerboard figure. During later experiments the faces of the experimenters in the laboratory were broadcast.

At 1:30 P. M. on the afternoon of September 11th, 1928, and again at 11:30 P. M. on the same date, the first television play ever broadcast was sent out through WGY. This marked another important milestone of science, and with the inception of visual as well as audible dramatic broadcasts, a vast new field of entertainment has been opened up. The television version was the same in every respect as the stage offering, but many new problems in dramatic technique were presented in putting on the air a performance intended for reproduction instantaneously in homes distant from the scene of the action.

The television camera used during the broadcasting of the first television play by radio, consisted of three units, a cabinet containing a 24-hole disk and a 1000-watt lamp as a light source, and two smaller cabinets each housing a photoelectric tube with amplifier. These cabinets were all mounted on tripods in order that they might be raised, lowered, or tilted to suit the height or position of the performer.

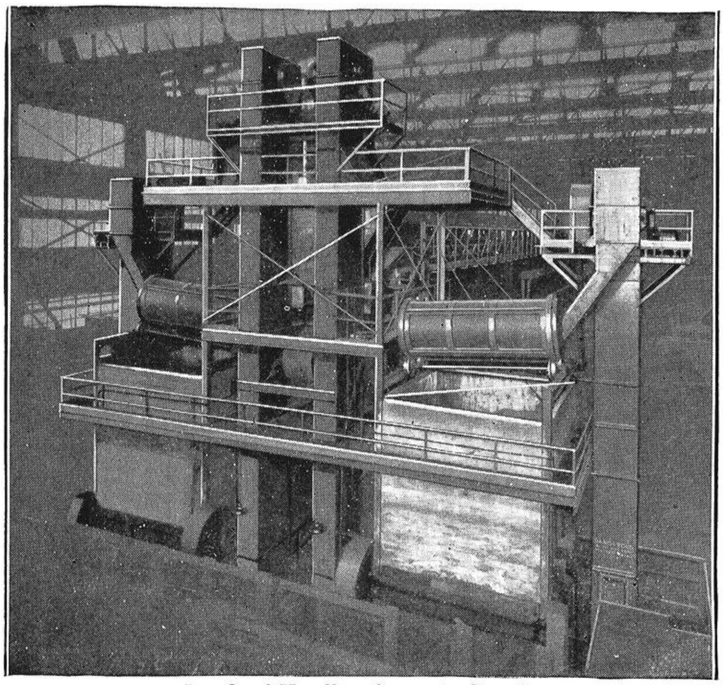
In the presentation of the first television play, "The Queen's Messenger", it was necessary to use three cameras, one for each of the two characters, and a third for the introduction of "props" and other visual effects. This made it necessary for the director to "cut" from one camera to another as each character spoke his, or her, lines, and to "cut in" the third camera when it was necessary to show the hands of the players, a gun, cigarettes, keys, etc., as needed for the action of the play. The director governed the radio output by means of a small control box with two knobs. One of these knobs was arranged for cutting in the various cameras on the set, and the other knob enabled the director to fade the images in or out, very much the same as a fade-out in motion picture work. Further to aid the director, a television receiver was located near at hand. In addition to the cameras there was a microphone for each actor to pick up the spoken lines. Because of the red image produced by the characteristic glow of the neon lamps used, it was necessary to accentuate the make-up of the actors to a point of exaggeration, and to define the mouth and nostrils sharply with strong color. Diamonds or other bright stones could not be used on the hands because they introduce a disturbing glare into the image. Each actor worked in front of a white screen, such a background being necessary to give definiteness to the features.

From the admittedly crude and inadequate television apparatus of to-day to the perfected commercial broadcasting of complete dramas of to-morrow is a step of gigantic proportions, but there is no doubt but that it will come, and much of the credit must be given to the patient experimenters in the laboratories of the present.

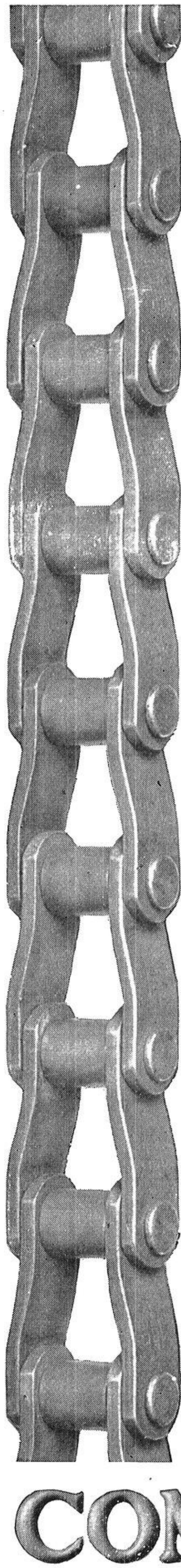
NEW AUTOMOTIVE KINK

He: "You see, we've gone into truck farming."

Visitor: "You can't fool me. You don't raise trucks; they come from a factory."



Rex Sand Handling System in Foundry
Showing (right to left) Rex Elevators (buckets on belt) for knockout sand, screens and bins (center) Rex Elevators for tempered sand discharging to disintegrators and belt conveyor to foundry floor. Paddle mixers are below.



At left: strand of Rex genuine Chabelco 1030

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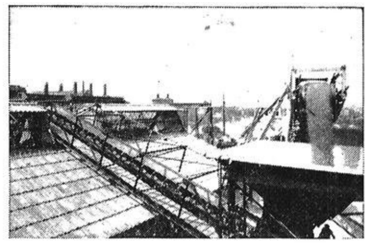
Sand Handling and Reconditioning was once one of the Major Problems in transforming metal into castings. It need no longer be so—

In foundries, large and small, Rex Sand Handling Equipment has eliminated hand labor, saved valuable floor space, and, in keeping with the modern trend, has speeded up production generally throughout the plant.

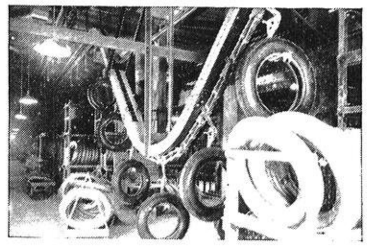
The plant view shown above is a unit of one of the largest American corporations, where the use of Rex Sand Handling Equipment, coupled with a change in the character of the work, resulted in an increase of 300% in production.

Many similar industrial problems of handling have yielded to Chain Belt engineering skill plus Rex equipment.

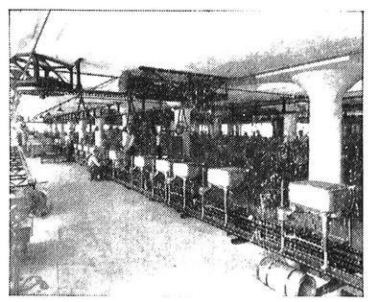
Whether you are a Student, a Manufacturer or a Graduate Engineer, it may be well to investigate the possibilities that Rex Handling Equipment holds for you. We will gladly furnish information to anyone interested.



Rex Installation in Cement Mill
The Chain Belt Company and The Stearns Conveyor Company (owned by the Chain Belt Company) provide practically all equipment for mechanical handling of cement from the raw state through the kilns and mills to the finished product. The installation shown is at the plant of the Peerless Portland Cement Company.



Rex Overhead Conveying
At the Firestone Plant, tires ride high on the ceiling, come down to the floor at desired intervals, move to many destinations, and go from floor to floor on this Rex Overhead Conveyor.



Progressive Assembly
Since the Maytag Company of Newton, Iowa, manufacturers of washing machines, installed Rex Conveying Equipment, production has greatly increased, inspection made easier and fewer hands needed in the assembly operations.

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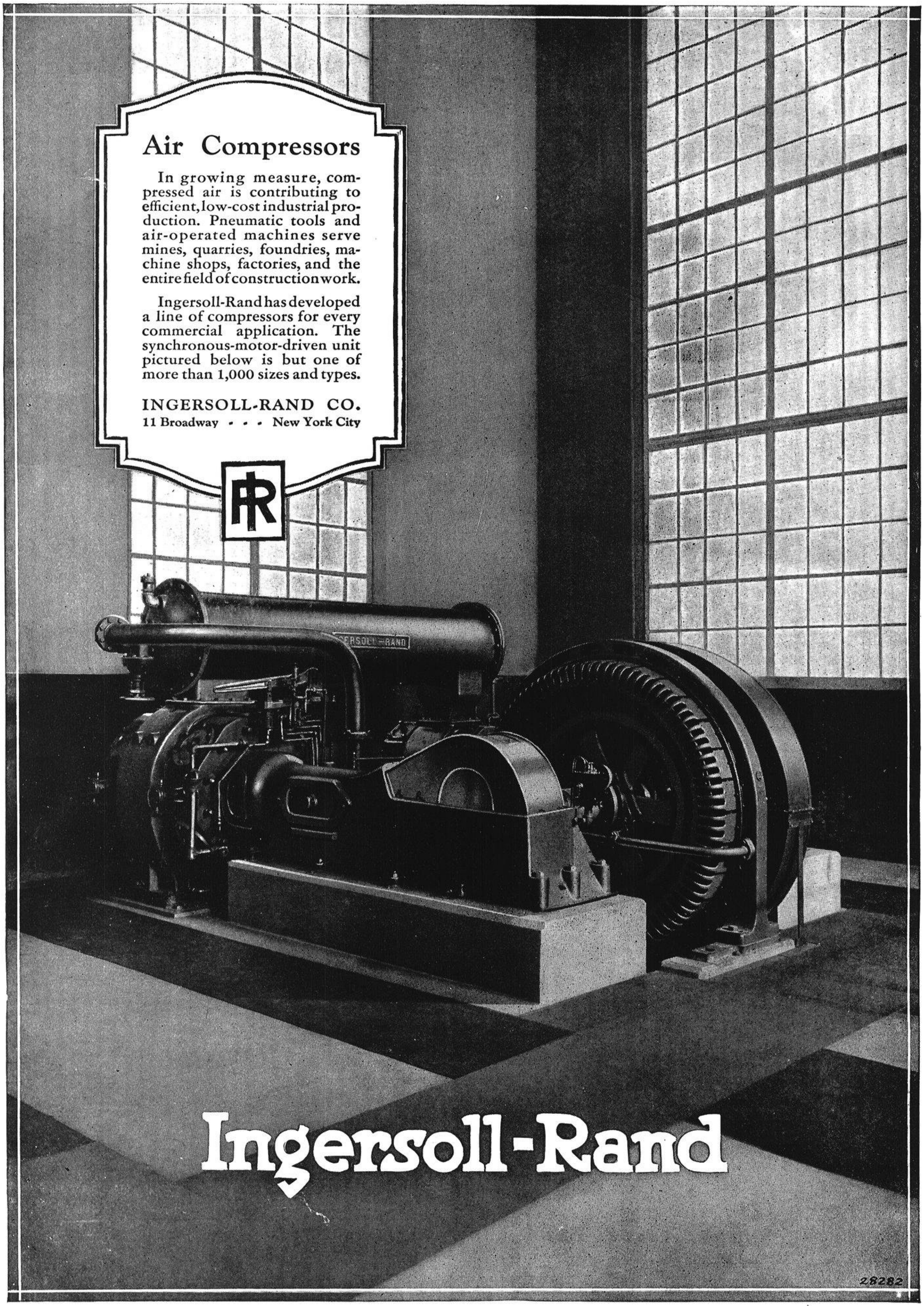
THE STEARNS CONVEYOR COMPANY, E. 200th St. and St. Clair Ave., Cleveland, Ohio (*Owned by* Chain Belt Company)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