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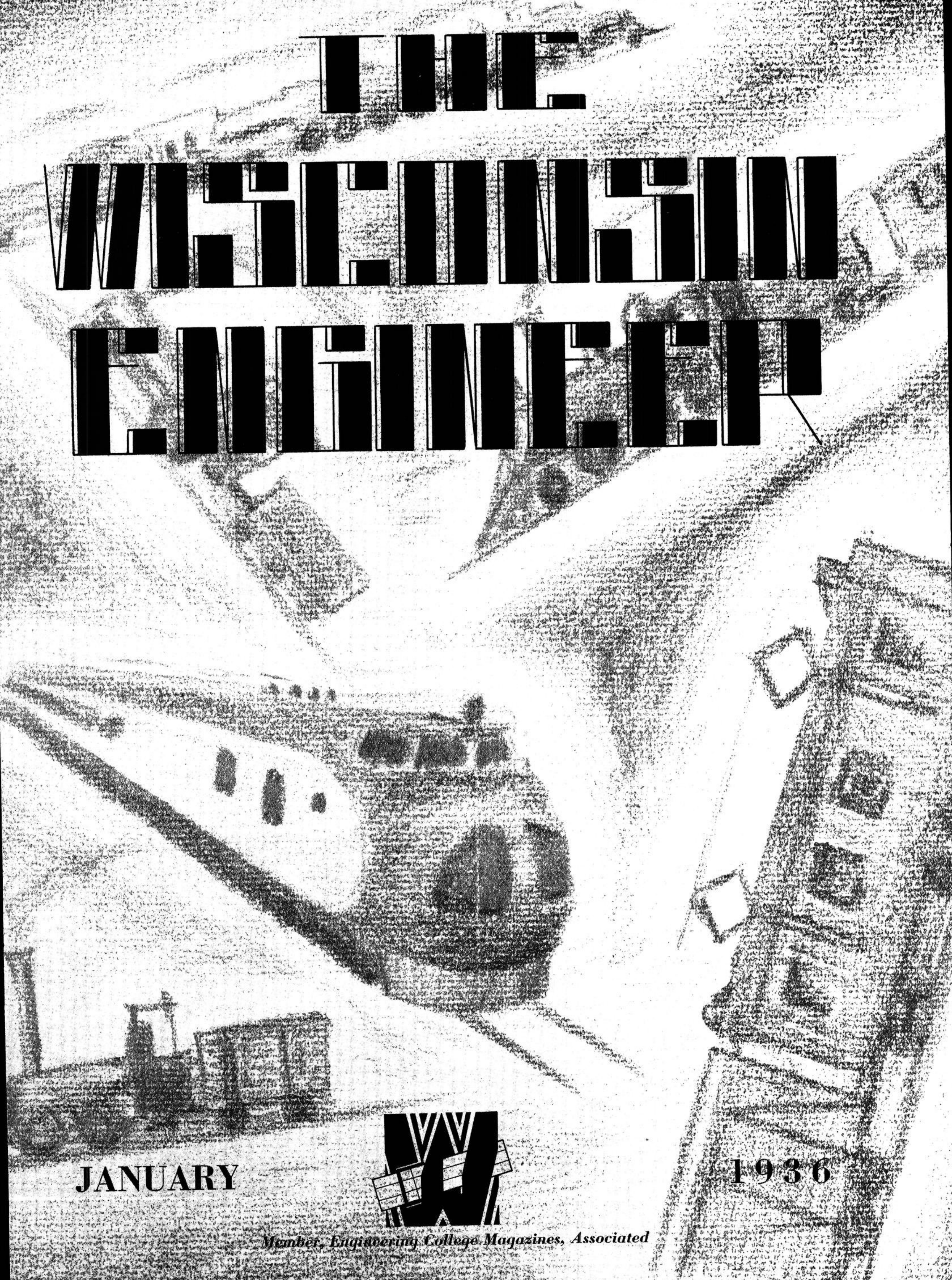
THE WISCONSIN ENGINEER



JANUARY 1936

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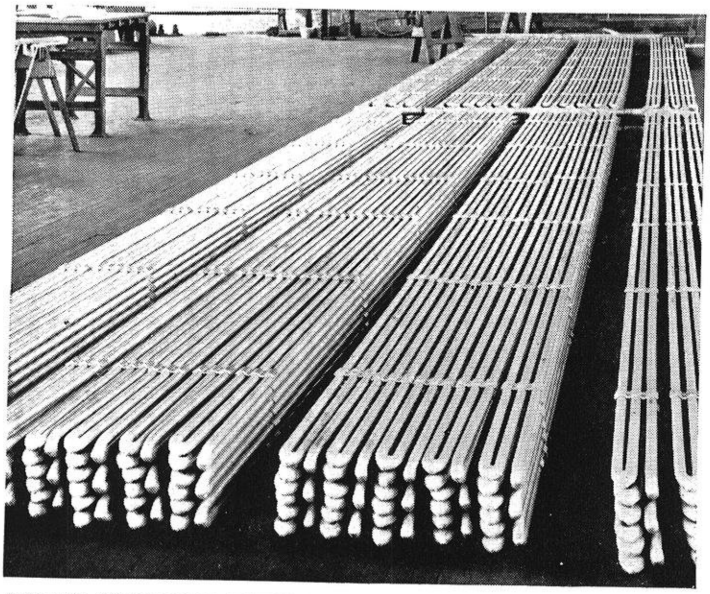


SEVEN HUNDRED WELDS—were needed to make this assembly of aluminum piping.

New Metals Emphasize Desirability of Jointless Design

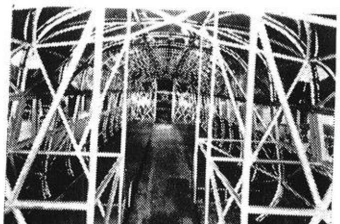
Welding Preferred Method for Fabricating Jointless Designs from New Materials

By H. E. ROCKEFELLER*

Welding is an important aid in securing the full benefit of the newer light weight alloys, corrosion- and stain-resistant steels and other ferrous and non-ferrous metals. Jointless welded designs in these new metals make the finished product attractive in appearance, efficient and economical to use and enable it to be priced salably.

In All Industries

Fabrication by welding can be undertaken without heavy capital expenditures and carried out at low cost. Welding is used in every industry for maintenance, for construction and for the fabrication of many products. The welding of mechanical refrigerators and gas ranges is typical of its production applications. Other typical applications include welding of chromium steel for resistance to sea water corrosion on seaplane pontoons, welding aluminum fuel tanks for airplanes, welding of the frame work of alloy steel on the new high speed railroad trains, welding of stainless steel beer barrels and innumerable other familiar products.



HERE'S HOW—the framework of the light weight, streamlined rail cars for high speed is Linde-welded from chrome-molybdenum steel tubing.

Welding is Simple Production Tool

Welding is the preferred method of fabricating almost every design in modern metals. Jointless welding can be done rapidly with a minimum of preparation of the pieces to be joined. Under procedure control providing jigs for positioning pieces, production can be as rapid and as free from rejections as any highly developed factory process. From the plant equipment standpoint it is easy to adopt welding. From the personnel standpoint the welding technique is quickly acquired through instruction by competent engineers.

For Jointless Strength and Safety

Products fabricated by welding are jointless, leakproof, permanent and safe. Improved methods of testing make it possible to tell exactly what stresses or loads a jointless welded assembly can take. Metals of different compositions, providing the most suitable material for the service it is to perform, can be welded into sound unified assemblies forever free from any of the losses which occur from joint failures.

Specialized Welding Assistance

To utilize the new alloys and metals fully, the advice of competent engineers in welded design is advisable. The Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, has for many years specialized in the development of new ways to use oxy-acetylene welding. Linde Engineers will gladly consult with you without obligation, and help you use welding and organize for welding production. This assistance can be secured by a telephone call to any Linde Sales Office. They are located at Atlanta — Baltimore, Birmingham, Boston, Buffalo, Butte—Chicago, Cleveland — Dallas, Denver, Detroit—El Paso—Houston—Indianapolis—Kansas City—Los Angeles—Memphis, Milwaukee, Minneapolis—New Orleans, New York—Philadelphia, Phoenix, Pittsburgh, Portland, Ore.—St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa.

IN JIG TIME—using jigs, welded joints can be made quickly in any commercial metal or alloy.

Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies—is available from Linde through producing plants and warehouse stocks in all industrial centers.

* Engineer, Development Section, The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

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△ The news that the university has purchased an electric organ probably raised many questions in your mind. Read here how the many effects are produced.

△ Leave it to an engineer to find an interesting life. Earl Hanson, m'22, finds that this depression has had many curious effects upon partially civilized natives in South America.

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The WISCONSIN ENGINEER

VOLUME 40, NUMBER 4 JANUARY, 1936

The Port Washington Power Plant

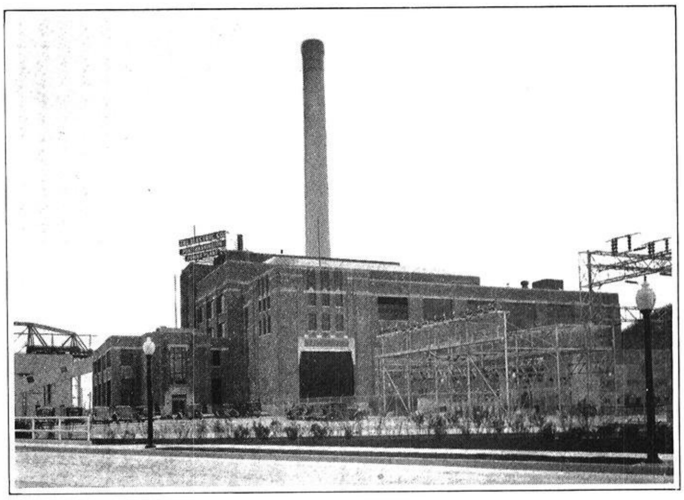
By G. G. POST, e'04

Introduction: The Port Washington station is located on the west shore of Lake Michigan at Port Washington, Wisconsin, 28 miles north of Milwaukee. In addition to its excellent condensing water and coal handling facilities, this site has the advantage of serving as an ideal location for the second source of electrical supply for the Milwaukee district. Port Washington is situated on the north end of a transmission loop around the metropolitan district, and Lakeside, the other large and modern station, on the south end.

The station's initial installed capacity is 80,000 kw., with a possible ultimate capacity of 400,000 kw. The outstanding feature of the station is its unit design, that is, there will be a single boiler for each single turbo-generator, also one set of transformers, one transmission line, and one set of auxiliaries for each unit. Fundamentally, Port Washington's design is based on Lakeside's except that such advancements are incorporated as are dictated by operating experience and improvements in the power plant art. The principal advancements, besides the unit arrangement already mentioned, are the adoption of 825°F. steam temperature for both throttle and reheat, and the generation of electrical energy at 22,000 volts.

Flexibility: Because of the unit design, a flexibility has been obtained which will permit adopting changes in design for future extensions to the plant. Each section could be almost an entity in itself. For example, the mercury cycle or steam at 1,000°F. temperature could be adopted should future developments show them economically justified.

Coal System: The plant burns eastern bituminous screenings, which are transported from lower lake ports in lake freighters and received at a dock having a storage capacity of 330,000 tons located immediately adjacent to the power plant site. In constructing the dock, which was built especially for coal storage purposes, earth fill was obtained from excavations into a hill situated on the building site. A coal handling bridge unloads, stores, and reclaims the coal. Coal, when needed for plant use, is reclaimed from the stock pile, dumped into a bin in the pier leg of the coal bridge, from which it is spouted into hopper bottom cars for a short haul to a track scale and to a dumping pit.



General View of Plant

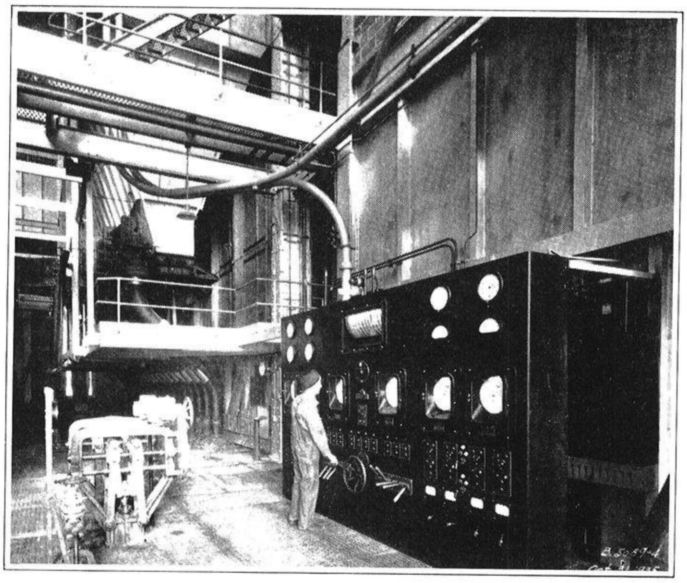
The coal is then placed on an inclined belt from the dumping pit by means of apron feeders and conveyed into the crusher house, where a magnetic pulley and a grizzly and crusher prepare it for delivery to the plant. An inclined belt is again used for this purpose.

The coal bridge is equipped with a 10-ton clam shell bucket and has an unloading capacity of 600 tons per hour. The span between the shear and pier legs is 422 feet, while a canti-lever, which can be raised, extends beyond the shear leg about 95 feet, thus making all the hatches of lake carriers with the widest beam accessible to the bucket.

The bin and feeder system of pulverized fuel firing is used. An economy study showed this system to be more desirable than the unit system, not only from a purely cost basis but also from a load carrying reliability standpoint. Two pulverizing mills of 15-tons per hour capacity each, are located in the boiler room where they are readily accessible to flue gas ducts from the airheater behind the boiler. Flue gas drying in the mills, similar to that at Lakeside, is used. Important advantages in economy and safety are obtained by using flue gas instead of air for drying the coal.

In an effort to conserve building costs as much as possible, the amount of green coal storage capacity in the boiler room has been held to a minimum. This is feasible because of the proximity of the large supply of coal in storage on the dock adjacent to the plant. The green coal bunker is at the side of the furnace and has a capacity of 1100 tons which is sufficient to carry the plant over a week-end.

Pulverized coal is fired vertically into the furnace through 20 burners of the forced draft type. These are supplied by 10 duplex feeders directly connected to variable speed D.C. motors. The pulverized coal bins are located directly in front of the boiler, and have a capacity of 290 tons which is sufficient to carry the plant over peak loads without operating the pulverizing equipment.



Boiler Control Panel and Burner Deck

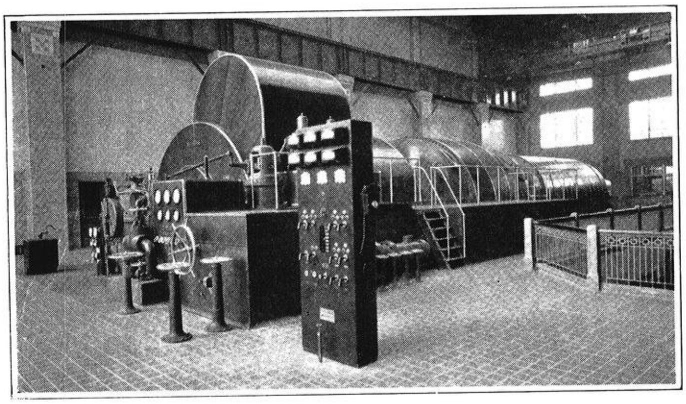
Boiler: The boiler is designed for a maximum pressure of 1390 lbs. per sq. in. and operates at 1325 lbs. The three-drum bent-tube design is used. The drums, made from solid steel forgings, are the largest ever built, and are the longest that it was possible to build with the equipment now installed in the manufacturer's shops. All are 40″ inside diameter with seamless walls 5¼″ thick. The upper drums are 62 feet long and the lower 59 feet, 8 inches, the former weighing approximately 70 tons each and the latter 63 tons.

The boiler banks are 110 tubes wide and 20 tubes deep, making a total of 2200 tubes, 3″ outside diameter and 5/16″ thick. All boiler tubes are made of low carbon steel. The boiler has a maximum evaporating capacity of 690,000 lbs. per hour and a total heating surface of 44,087 sq. ft. The superheater is a combination radiant and convection type with 1464 sq. ft. of projected tube area in the radiant section (located in the two side walls of the furnace) and 8700 sq. ft. of heating surface in the convection section located behind the first bank of tubes in the boiler. By passing the steam first through the radiant section and then through the convection section the actual metal temperature of the tubes in the former can be kept at a lower figure. The radiant section consists of 126 vertical elements of 2″ No. 1 B.W.G. special chrome molybdenum steel tubes spaced on 2¼″ centers. The convection section consists of 170 elements in three loops of 2″ bare tubes having ¼″ wall thickness. The two lower temperature loops are made of low carbon steel and the high temperature loop of chrome-vanadium steel. The reheater is of the radiant type and is located in the rear wall of the furnace. A total of 1508 sq. ft. of projected tube area composed of 116 vertical bare tube elements 2″ in diameter, No. 7 gauge on 2¼″ centers, form the reheater. The reheater tubes are composed of chrome-nickel alloy (KA2ST). Turbine characteristics played a large part in determining the type and combination of superheater and reheater surfaces. The above layout was selected because it automatically gives the most uniform steam temperature for both superheater and reheater outlets over a wide load range.

The furnace bottom is protected by a water screen having a heating surface of 2420 sq. ft. The lower and upper front walls are covered with finned water wall tubes having a total heating surface of 4830 sq. ft. The furnace volume is 54,700 cu. ft., giving a combustion rate at maximum boiler rating of somewhat below 15,000 b.t.u. per cu. ft. per hour.

The gases make four passes through the boiler and discharge directly into two plate-type air heaters. The two heaters have a total of 121,000 sq. ft. of plate area with spacing on the air side of ½″ and on the gas side of ⅜″. The gas from the air heater is discharged into a steel breeching to a 300 ft. concrete stack of 15′6″ inside top diameter, located on the ground immediately to the rear of the boiler room. The air discharged from the air heater is at a temperature of about 630°F. and is used for combustion purposes. There are no economizers. Two induced draft fans each have a capacity of 185,000 C.F.M. at 11.5″ static pressure, and two forced draft fans each having a capacity of 112,500 C.F.M.

Turbine Room: The turbine is an 80,000 kw. tandem compound unit operating at 1800 r.p.m. Steam conditions at the throttle are 1230 lbs. gauge and 825°F. total temperature. The turbine has three admission valves. All blading is of the reaction type. There is an inter-stage reheat connection in the high pressure cylinder. The steam is exhausted from the high pressure cylinder at about atmospheric pressure and is admitted to the center of the low pressure clyinder where it flows in opposite directions through the last rows of blading. The last row of blading can thus be kept to a moderate length and to a normal tip speed, 872′ per second. Steam is extracted from the turbine for feed water heating at five points, the highest being at the reheat point where it is bled before going to the reheater. The steam is finally exhausted into a 52,500 sq. ft. single pass surface condenser, which contains 8830 Muntz metal tubes, 7/8" diameter, No. 18 B.W.G., 26 ft. long between tube sheets. The tubes are rolled into the tube sheets at each end, and in order to provide for tube expansion with differences in temperature the tube sheet and the water box at the discharge end are of the floating type with a welded steel expansion joint between the tube sheet and the condenser shell. There is an external air cooler containing 1150 sq. ft. of surface as well as two twin ejector three-stage steam jet air pumps. A deaerating hot well assists in keeping oxygen out of the feed water. The two circulating water pumps have a total capacity of 110,000 g.p.m. when operating together and 73,000 g.p.m. each when operating singly.



Front View of 80,000 kw. Turbo Generator Unit

There is a total of eight extraction heaters for the five extraction points, two each for the three higher points and one each for the two longer points. The condenser condensate pump discharges through the two lower stage heaters into the suction of the boiler feed pumps. A condensate surge tank system is connected at this point. The high pressure boiler feed pumps, of which there are three, two motor driven for regular service and one steam driven for stand-by, take the feed water at this point and discharge it through six heaters at the three higher stages. By locating the high pressure pumps at this point rather than at the discharge of the higher pressure heaters, widely fluctuating water temperatures to the pumps are avoided, thus eliminating one of the most serious handicaps to successful high pressure plant operation. Lower pumping costs are also effected due to pumping the comparatively cool 200°F. water. Each feed pump has its inlet at a common header, but discharges through its own series of extraction heaters directly into the boiler. By thus equalizing the pressure at the boiler drum through the separate feed lines, hunting in the pumps at light loads is minimized. Loss of one of the feed pumps, or of any of the high pressure heaters, would not put the station out of service because the other set would permit operating at better than half load. The high pressure heaters have all welded shells and forged steel heads made integral with the tube sheets. The head covers for the heaters have the pressure applied from the inside, thus avoiding the necessity of having gaskets withstand bolt pressure in addition to the pressure exerted by the water.

Generator: The generator is rated 80,000 kw. at 85 per cent power factor and 22,000 volts. Excitation is normally supplied at 250 volts by a 300 kw. direct-connected exciter and a 5 kw. direct-connected pilot exciter. In an emergency, the excitation is automatically transferred from the exciter to a 250 volt excitation bus supplied by a battery and two 300 kw. motor generator sets. The generator voltage is regulated manually, but automatic regulation may be added if it is found advisable. The neutral is grounded through an 8-ohm resistor.

The generator air cooler is of the enclosed type and is adaptable for the use of either condensate or raw water as the cooling medium. It is so designed that raw water is needed only after the condensate temperature reaches 75°F., which, with Lake Michigan cooling water, is necessary for only a few months each year. The cooling air is circulated through the generator and cooler by two fans, each driven by a 200 h.p. motor.

Station Auxiliary System: The station auxiliary system is entirely electrical with the exception of one boiler feed water pump and one house service pump, which are steam-driven and are to be used only in extreme emergencies. Motors in sizes of 100 h.p. and above are supplied with 2300 volt, three-phase service, and smaller motors are supplied with 460 volt, three-phase service.

The auxiliary load is normally carried on a 7500 kva., three winding transformer, connected directly to the generator leads. A spare transformer is connected to the 22 kv. bus. These transformers are rated 7500 kva., 22,000/2300/460 volts, 8 per cent reactance at 2300 volts, 4 per cent at 460 volts. The 2300 volt winding is rated 6500 kva. and the 460 volt winding 2625 kva. An automatic changeover scheme has been incorporated, similar to the one used at Lakeside, so that in case of trouble on either transformer, the auxiliary load is quickly transferred to the other unit. It is planned that as additional turbo-generators are installed, the essential auxiliaries will always be supplied by a transformer connected to the leads of the generator with which they are associated, and the initial spare auxiliary transformer will become the spare for all such units.

Both the 2300 volt and the 460 volt buses are divided into two sections with one set of essential motors connected to one section and a duplicate set to the other section. Thus, continuity of service to essential auxiliaries is assured at all times.

The 2300 volt and the 460 volt buses and switchgear are of the metal-clad type. Oil circuit breakers are used on the 2300 volt system. They are of the vertical lift type. The 460 volt switches are all of the air-break type.

Automatic Oscillograph: A six-element automatic oscillograph is installed to record transient conditions during system disturbances.

General: In a paper presented before the American Institute of Electrical Engineers at its summer convention in 1933, certain design features of the plant were outlined in some detail and so no attempt has been made to cover them again in this paper. As a matter of interest, the results of the economic studies made in connection with the design of this plant are given in the following table:

SUMMARY OF ECONOMIC STUDIES
FOR
PORT WASHINGTON POWER PLANT

	Net Annual Saving
(a) 1200 lbs. Pressure over 300 lbs. — Actual at Lakeside	58,965
(b) 1200 lbs. Pressure over 600 lbs. — Estimated for Port Washington	36,754
(c) 1200 lbs. Pressure over Mercury Vapor-Steam Cycle	21,414
(d) 825 Degree Temperature over 750 Degree	15,070
(e) Bent Tube Boiler with Low Heat Release Furnace over Straight Tube Boiler with High Heat Release Furnace	9,763
(f) Storage System of Pulverized Coal Firing over Unit System	11,062
(g) Five Extraction Points with Air Heater Only over Four Extraction Points with Economizer and Air Heater Combination	7,429

NOTE: All comparisons, except (a), based on 60% annual load factor, fuel cost of $14.82 per hundred million B.t.u., and fixed charges at 13% per annum.

From this it will be observed that Port Washington embodies the best features known to the power plant art at this time. The records show that it was designed for both reliability and economy and should therefore produce results which will be beneficial both to the company and its customers.

Back Siphonage and Cross Connections in Plumbing Systems

By ANTON A. KALINSKE, c'33

EVEN though the water department may send absolutely the purest and finest possible drinking water into the water mains for its consumers, it does not necessarily mean that this water will reach them uncontaminated. Surely not a very pleasant thought to contemplate, considering the enormous sums of money spent by our cities in providing safe water. Offhand, it is hard to imagine how any pollution can get into the water pipes, since they are under pressure, and any leak in them would force water out, instead of pollution going in.

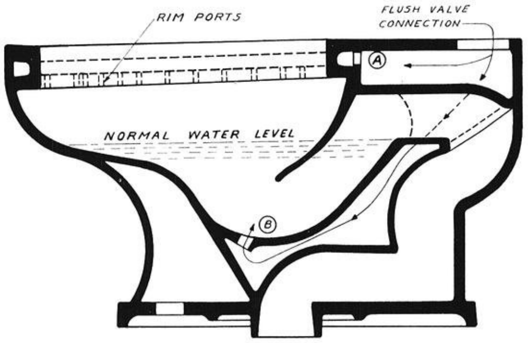
The answer to this is that water pipes are not always under a pressure sufficient to prevent pollution from going into them. In fact, certain phenomena may occur that can produce temporarily a negative pressure, a vacuum, in the water lines, thus causing pollution to be drawn in through any leak, or through a plumbing or industrial fixture that has its water inlet submerged in contaminated water. Places in the water-supply piping through which it is possible to contaminate the pure water are called cross-connections. There are direct and indirect cross-connections, which can be best defined by examples.

A common direct cross-connection to be found in many homes is that between the cold pure water piping and the cistern water, where cistern water is used for hot water because of its softness. The cistern has a pump connected to it which pumps the water, either to a closed pressure tank in the basement or an open tank in the attic, from which the water goes to the heater and thence to the hot water fixtures. The pump is set to maintain a pressure of say 40 lbs. per square inch. In order that the home may have hot water when the cistern goes dry, a cross-connection is made between the city water and the cistern water and a valve put in. Let us assume that the city pressure is 80 lbs. Obviously, with 80 lbs. on the pure water side of the cross-connecting valve and 40 lbs. on the cistern side, none of the contaminated cistern water can ever get into the pure water pipes. However, suppose a number of cold water fixtures are opened; due to friction loss in the pipes the city pressure in the house may easily drop to 10 or 20 lbs. When this happens and if the valve leaks, as all valves will do after a few years of use, some of the cistern water will cross over into the pure water lines.

This type of cross-connection, in which a safe water supply is separated only by a valve from an unsafe water supply, is extremely dangerous and should never be permitted. However, there have been and are numerous such connections in homes, hotels, factories, and other commercial and industrial buildings. Many disastrous dysentery and typhoid fever epidemics have been traced to such cross-connections, especially where the unsafe water is contaminated with sewage. As far as this type of cross-connection is concerned, the best corrective measure is its elimination.

Though the indirect cross-connection does not present as great a hazard as the direct type, they are so much more numerous in plumbing systems that they must be considered as important factors in endangering the purity of our water. The ordinary closet bowl with an automatic flush valve presents an indirect cross-connection, because the water-supply is connected directly into the bowl through the flush valve, thus causing the inlet to be submerged in foul water, especially if the bowl becomes clogged. If a vacuum occurs in the water line, and they do occur due to various causes to be mentioned later, the flush will open up, as it can hold pressure only in one direction, and the water in the bowl will rise up through the flush valve into the supply line. Any fixture having an inlet which can be submerged in foul water, therefore must be considered as an indirect cross-connection. A few common ones are: lavatory with below the rim spouts which can be submerged if the trap or overflow drain clogs, bath-tubs, laundry tubs, various hospital fixtures, industrial tanks, and many more. The best correction of an indirect cross-connection is to raise the inlet supplying the good water above the overflow line of the fixture; however, this is not always possible, as is the case with the flush valve closet bowl.

Figure 1 shows a cross-section of an ordinary closet bowl for use with flush valves. Water is supplied to flush the bowl through two points, (A) and (B). Water through (A) goes to the holes around the rim of the bowl. If the bowl is clogged and water stands up to the overflow level it is obvious that if a vacuum occurs in the supply line the water will be drawn up. With water at the normal trap level, if a vacuum occurs it will be relieved through port

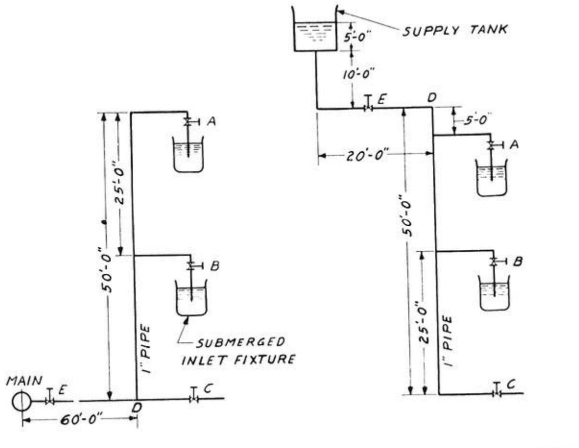


CROSS SECTION VIEW OF ORDINARY JET TYPE CLOSET

Fig. 1

A and the rim holes; however, if port A is small and the rim holes are "limed up" due to hard water, enough air will not be supplied to relieve the vacuum rapidly enough, and water in the trap will rise up through B, fill the back chamber, and go up into the supply line.

Mention has been made of the occurrence of vacuums in supply lines. What are the conditions that produce them? The hydraulic principles involved can best be explained by use of generalized piping layouts shown in Figure 2. The upfeed system is used where the city pressure is high enough to force water to the top floors; if it is not, the water from the city mains is pumped up to a tank on the roof of a building and the water fed down. In both these systems, when the pressure is shut off by means of valve (E) to make a repair on the system, if fixture B is opened, water will siphon from fixture A (submerged inlet fixture similar to clogged closet bowl) down into fixture B if valve A leaks or opens up under a reverse pressure. This is due to the formation of a siphon with the water pipes. Since the distance between the two fixtures is less than 33 feet (height that water will rise under atmospheric pressure) the water will not leave the upper parts of the piping if valve B is open and valve A closed. However, if fixture C is opened, then if fixture A is closed the water will drop down to a height of 33 feet, producing a practically perfect vacuum in the upper part of the riser. Then if valve A opens or is opened, foul water from the fixture will rush up and into the riser very rapidly.



UP FEED SYSTEM DOWN FEED SYSTEM

Fig. 2

It is not always necessary to shut off the pressure to produce a vacuum. For instance, supposing in the upfeed system illustrated in Figure 2 the pressure in the main was 500 lbs. per square inch, or $50 \times 2.31 = 116$ feet of water. If, due to a high rate of flow from fixture (C), the pressure loss due to friction between the main and point (D) is 75 feet of water, then the pressure at (D) is $116 - 75$ or 41 feet of water. Therefore, at a point 41 feet up the riser the pressure is 0 (atmospheric) and above that a negative pressure exists; however, the water does not leave the riser if valve (A) is closed, but if it is open, back-siphonage will take place from fixture (A). Of course, if the outlet at (A) is not submerged, but open to the atmosphere, then when (A) is opened the water in the riser will drop down to a height of 41 feet.

Consider the downfeed system when a high rate of flow exists at (C). Suppose this rate of flow for the piping shown is 30 gallons per minute with valve (C) wide open. What is the pressure at level of fixture (A)? Pressure at (C) is practically 0 if valve (C) is wide open, then pressure at $(A) = -45 +$ friction loss between (C) and (A) in riser. For a 1" pipe having 30 g.p.m. flow and of length shown, the loss is equal to 32 feet; therefore, the pressure at $(A) = -13$ feet, which is a vacuum. If air is not admitted at point (A) the riser will flow **full** under a vacuum. If valve (A) opens and the outlet is submerged, back-siphonage will take place.

Vacuums are produced in piping with water flowing due to undersize pipes for the rate of flow required by the various fixtures. This causes excessive friction losses and reduces the pressures below atmospheric on the top floors. Vacuums produced without shutting off the pressure are undoubtedly the most common, but are rarely noticed as they occur only momentarily. However, because of their common occurrence the chance of these vacuums producing back-siphonage and pollution of water is very great.

If a fixture cannot have its supply inlet raised above

(Continued on page 69)

ALUMNI NOTES

ELECTRICALS

JOHNSON, F. ELLIS, '09, for five years head of the department of engineering at Iowa State College, was appointed dean of the College of Engineering at the University of Missouri. Dean Johnson designed the new engineering building for Missouri which will be constructed as part of a million and a half dollar building program.

MOTL, LAWRENCE F., '28, has the position of telephone engineer for the forest protection division of the Wisconsin Conservation Department, E. C. W., located at Forestry Protection Headquarters, Tomahawk, Wisconsin. Following his graduation he trained for flying at Kelly Field, Texas, and served as 2nd lieutenant for 15 months.

FUSSELL, LEWIS, '07, died at his home in Swarthmore, Pennsylvania, sometime last summer. Dr. Fussell was the founder and the only chairman of Swarthmore College's department of electrical engineering.

HAMBUECHEN, CARL, '99, e'01, is vice-president and treasurer of the Benwood-Linze Electric Manufacturing Co. of St. Louis.

KEENE, ALVIN D., '12, who is with the Samson United Corporation of Rochester, New York, has the position of chief engineer.

THAYER, NEAL B., '27, has been appointed superintendent of the Elkhorn Light and Water Commission. He spent the last six years as an engineer for the Toledo Edison Co., at Toledo, Ohio.

STEHR, MELVIN W., '34, spent the weekend in Madison recently. He is employed by the T M E R & L of Milwaukee as a sales engineer, his work being mainly associated with power sales.

ROWE, RICHARD, '34, is with the Allis-Chalmers Co. of Milwaukee where he is doing test work.

MARTZ, GUY E., '28, is manager for the Southern Arizona Public Service Co. at Benson, Arizona.

KIRBY, MELVIN H., '32, is still with the Lake Superior District Power Co. with headquarters in Ashland. Since last spring he has been one of the district sales supervisors in charge of merchandising in four districts.

CURRAN, GEORGE W., '29, works in the technical department of radio stations KFI-KECA in Los Angeles.

ERIKSON, DON, '31, m'32, who formerly was with the Public Service Commission in Madison and also in Superior, has been employed by the Beloit Iron Works since early last summer.

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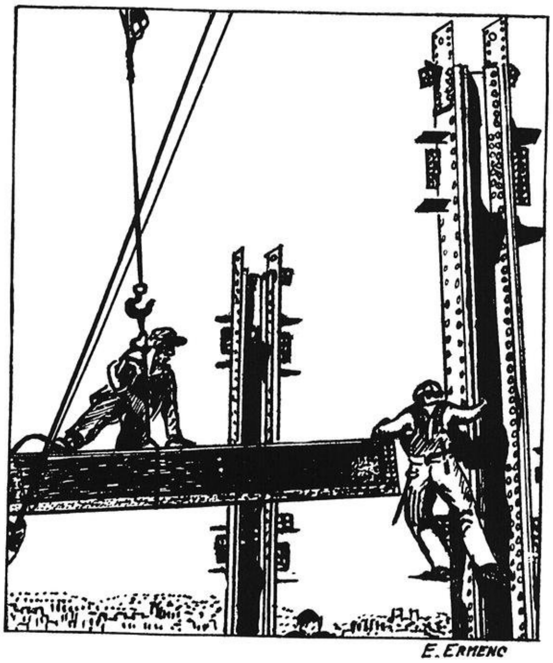
MINERS AND METALLURGISTS

FAY, C. A., '11, has the position of manager with the Clayton Silver Mines of Clayton, Idaho.

HOUGHTON, SAM L., '14, is actively engaged in the development of a group of high grade gold claims in Arizona.

MANGOLD, JOHN V., M.S.'25, formerly employed by the Cerro de Pasco Copper Corp. at Morococha, Peru, now has employment on the Fort Peck Dam project at Fork Peck, Montana.

CRAWFORD, HOWARD D., '27, has resigned from his position as chief chemist for the Peru Mining Co. at Deming, New Mexico, and accepted a position as chemist with the United Verde branch of the Phelps Dodge Corp., Clarkdale, Arizona.



TIEMANN, THEODORE D., '30, paid the department a visit recently. He informed us that for the past eight months he had been busily engaged in erecting a fluorspar concentrator in southern Illinois.

SMYTHE, WILLIAM O., '35, who until recently was employed as a metallurgist for Sivyer's of Milwaukee, has accepted a position as metallurgist with the Ladish Drop Forge Co.

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CIVILS

NETHERCUT, EDGAR S., '89, after serving the Western Society of Engineers for 18 years as secretary and director, was elected secretary emeritus, following his request to be relieved of active duties. He will devote his time to travel and historical research in the field of engineering.

STANEK, EDWARD R., '35, went to work in October for the Wisconsin Highway Commission at La Crosse.

HORDER, JOHN S., '34, announces the arrival of son, John

S. Jr., on October 20. Horder has been working with the Wisconsin Highway Commission at Milwaukee since last June.

STEINMETZ, GEORGE P., '23, became chief engineer of the Wisconsin Public Service Commission on December 1, being promoted from the position of chief engineering auditor which he had held for two years. After graduating from the university Mr. Steinmetz began his engineering career by joining the staff of the old Wisconsin Railroad Commission as assistant water power engineer.

JANICKI, LEO C., '29, teaches house wiring in the Boys' Technical High School of Milwaukee.

JANICKI, HARRY R., '27, is working for WPA at North Platte, Nebraska.

SOLLID, ERIK, '33, has resigned from the Wisconsin Highway Commission's staff to join the staff of the Reclamation Service at Denver.

ANDERSON, BERT E., '15, owns and acts as secretary of the Southern California Lime and Cement Co. in Los Angeles.

HALL, MELVILLE C., '15, is in the lumber business, serving as treasurer of the Walker-Hall Co. in Walden, New York.

BLOODGOOD, DONALD E., '26, has been promoted to first lieutenant in the U. S. Officers' Reserve Corps.

MARTIN, GEORGE, '26, works for the firm of W. C. Kirchoffer of Madison as a civil engineer.

SUMMERIL, FRANKLIN J., '28, **TUHUS, KENNETH**, '33, **HOLST, CHARLES J.**, '33, are all connected with the drainage control of the WPA, working in or out of Madison at present. Summeril is chief of party and has been on surveys to Hayworth, New Lisbon, Prentice and Phillips. Holst acts as a transit man, but at present is stationed in the Madison office where he is working on flowage maps, while Tuhus serves in the capacity of assistant hydrology engineer.

HAMEL, VERNE, '32, is in charge of the field survey for the drainage control of the WPA. He spends most of his time in Spooner where the drainage control has an office.

CHEMICALS

MILLINGTON, FRED M., '23, has the position of manager with the Iron Mountain Gas Co. of Iron Mountain, Michigan.

MACK, DAVID J., '31, is teaching in the department of chemical engineering at Purdue University. Besides his teaching, he is also doing graduate work.

MECHANICALS

SCHMIDT, CHESTER J., '23, who formerly worked in the J. O. Ross Engineering Corp. office in Chicago, moved to Detroit where he is now the district manager for the same corporation.

CAREY, JAMES L., '88, died at his summer home near Kenosha, Wisconsin, early last fall. He was a specialist in the design of paper mills, and was well known abroad having designed mills in Australia, England and China.

TECKEMEYER, OSCAR W., '26, acts as assistant construction engineer with the CCC at the Sand Lake camp at Aberdeen, South Dakota.

BENEDICT, WALLACE, '04, is engaged in developing mining properties in the West. His address is Como Mines, Dayton, Nevada.

GUNTHER, JR., GUSTAVE A., '23, acts as district manager and engineer for the Chain Belt Co. in Detroit. He and his family are living at 26800 Pembroke Road, Huntington Woods, Royal Oaks, Michigan.

JAHN, CARL W., '27, serves in the capacity of engineer for the Ladish Drop Forge Co. at Cudahy.

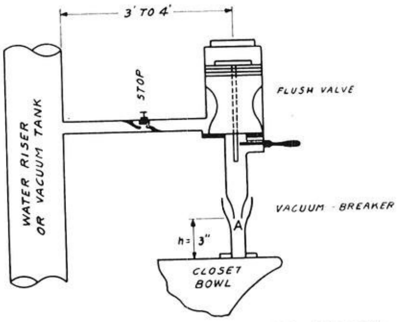
Back Siphonage and Cross Connections in Plumbing Systems

(Continued from page 67)

the overflow rim, then the only correction is the installation of a vacuum-breaker on the fixture, which will open up during the occurrence of a vacuum, and supply air to the riser, at the same time preventing water from being drawn up from the fixture. The flush valve closet bowl is such a fixture, together with numerous others. Vacuum-breakers can be of a check valve-air opening type, or those that have no check valve, only a direct opening into the atmosphere. Water does not spit out of the direct opening due to reduction of discharge pressure by reduction of size of opening. The reduction in size of opening increases the velocity of the water, thus reducing its pressure; this is called the Venturi principle in hydraulics. A general sketch of a vacuum-breaker of this type is shown in Figure 3. Care must be taken to install this type of vacuum-breaker on a bowl for which it has been designed, otherwise it will spill out water sidewise through the air ports.

Vacuum-breakers to relieve a vacuum must, if at all possible, be installed on the discharge side of valves, (Venturi type cannot be used anywhere else, of course), and not on the pressure side. This requirement is made so as to eliminate the possibility of the valve in the vacuum-breaker sticking and not opening when a vacuum occurs on the line. If the vacuum-breaker is on the discharge or fixture side of the flush valve, the valve in it will be actuated each time the fixture is used, thus preventing its "freezing" into place. Such a vacuum-breaker would have to be large enough to prevent the formation, or relieve a vacuum already formed, in such a manner that no water can be drawn up from a submerged inlet fixture into the supply line. The rate of air flow through the vacuum-breaker will determine what size it should be to prevent formation of any vacuum.

Plumbers, architects, inspectors, health officials, and building managers and owners should have definite information regarding the reliability and effectiveness of the various devices, such as vacuum-breakers, for preventing and eliminating back-siphonage and cross-connections which are now on the market. In order to aid this the Wisconsin State Board of Health are now having all such devices tested and reported on by the Hydraulic and Sanitary Engineering Laboratory of the University of Wisconsin, before they give their approval for the use of any special device in this state.



FLUSH VALVE AND AIR-BREAK INSTALLATION FOR TEST

FIG. 3

THE ELECTRIC ORGAN

By JOSEPH RICE, e'36

THE production of tones by wave synthesis is old. A musical instrument in which tones were produced by a combination of electrical currents was invented in 1906 by Thaddeus Cahill. Cahill intended to generate music by means of alternators and to distribute it over wires to listeners, in much the same manner as has been proposed to transmit radio programs over power distribution lines. The promoters were so enthusiastic over the new invention, that they installed a 200 ton instrument in New York, and laid 33 blocks of distributing cables along Broadway and Fifth Avenue. The scheme soon failed, however, because the whole instrument was costly and cumbersome.

Many other approaches have also been used, but it was only until recently that a method was developed far enough so that it was practical to produce a musical instrument commercially. This instrument produces sound by generating small electrical currents of desired frequencies. These frequencies may be combined in different ways and amplified to produce desired tones. The production and synthetic combination of these frequencies will be described in this article.

It is well known that any sustained musical sound can be analyzed into sine wave components; that is, the tone may be separated into a fundamental tone of certain amplitude and frequency and different harmonics. The quality of a musical tone is determined by the relative frequencies of the fundamental and the various harmonics. It has been found through experiment that in most musical tones of the predominant harmonics are those of the lower frequencies, and that harmonics above the eighth have little effect in characterizing the tone. This is especially true in the middle and upper registers where harmonics of the higher order would lie above the range of audibility.

When the composition of a musical tone of repeating regular wave form is known, it is very easy to reproduce it synthetically by combining proportions of the fundamental with definite ratios of its first eight harmonics. In combining the fundamental with the harmonics, the relative phase angles of the partials is immaterial insofar as the effect upon the ear is concerned. Apparently the ear itself analyzes sound waves into the fundamental and its harmonics, and the perception of the tone is determined solely by the relative amounts of energy of the different frequencies.

The electric organ produces current of the desired frequencies and by proper combination of the harmonics a tone of the desired quality or tone color is built up. The currents generated in the instrument are of low voltage and amperage and are fed through a transformer to an amplifier and translated into sound by a suitable loud speaker.

A number of small alternators are used to generate the electric currents. To produce tone of equal intensities the voltages of the generated currents must be equal. To accomplish this, the number of turns on the coil of each alternator is different.

The alternator consists of a metallic disc which rotates in close proximity to a permanent magnet, Figure 1. About this permanent magnet is wound a coil. This disc is not a true circle but has a number of convolutions, or high spots equally spaced around its periphery. As it rotates it does not touch the permanent magnet, but these high spots pass

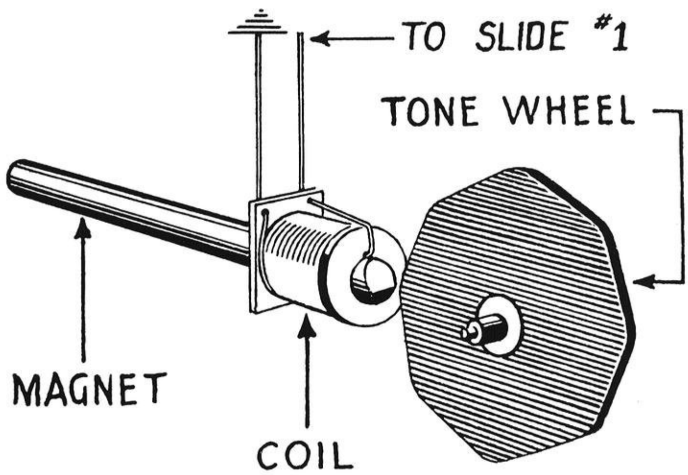


FIG. 1

close to the magnet and change the reluctance of the magnet circuit; thereby inducing a minute flow of current in the coil.

For example, if 440 high spots pass the magnet extremity in a second, 440 corresponding impulses are set up in the coil during this second. If head-phones were connected to the terminals of the coil, a musical sound would be heard. This sound would be Standard International pitch 'A'. If a similar disc were rotated at one half this speed, 220 impulses would be set up in the coil per second and the tone produced would be one octave lower.

The wave forms of the peripheries of the rotors or tone wheels are very carefully computed, and the rotors are cut with a very high degree of accuracy so as to obtain as nearly a sine wave of current as possible.

It is of great importance that the rotors be very accurately centered on their respective shafts, so that the minimum air gap between the point of the magnet and the rotor will be constant as the rotor is turned. A second very important requirement is that the tone wheel be rotated at as constant a speed as possible. In order to obtain this constant speed of rotation a synchronous motor is used. This synchronous motor must be supplied with alternating current or interrupted direct current from a source of constant frequency. The importance of uniform speed of rotation of the tone wheels cannot be overemphasized. The failure of many experiments with this type of instrument were due largely to the lack of means for driving the generators at constant speed.

The Hammond Electric Organ contains 91 of these tone wheels, which make it possible to super-impose currents having frequencies of n, 2n, 3n, 4n, 5n, 6n, and 8n cycles, or any combination of these, upon one another. Each current is made to produce one particular tone having one of eight different and distinct intensities by changing the voltage. Thus a musical tone of any desired quality (within reasonable limits) may be produced merely by the proper selection and proportioning of the energies of the harmonics which are super-imposed upon the fundamental.

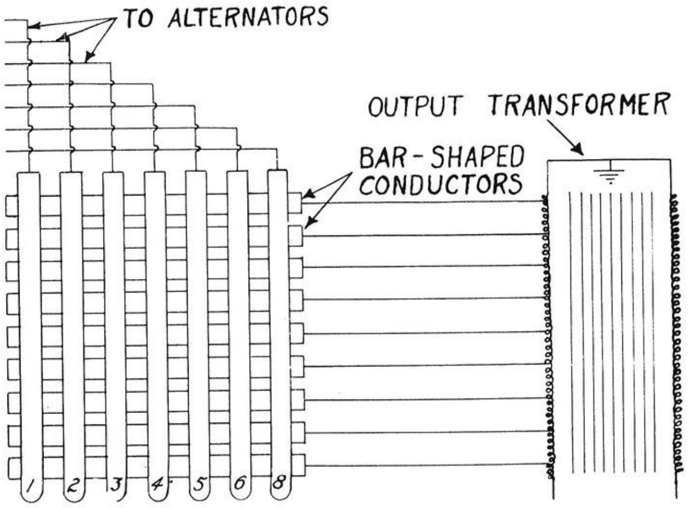


FIG. 2

Figure 2 shows how the outputs of the different alternators are combined and how the amplitude of each is determined. The slides as shown are marked 0 to 8 inclusive, except 7, which is omitted. The slides move longitudinally in a pair of guide plates. Each of the slides is provided with a resilient sliding contact which is adapted to make contact with any one of the number of bar-shaped conductors, which are in turn connected to various taps on the primary of the output transformer.

The fundamental tone current produced by the generator 'A', upon the depression of the proper key on the organ key board, for example, may be conducted through a greater or lesser number of turns of the primary of the transformer by shifting the slide bar '1'. Thus the relative proportions of the currents from the generator of the fundamental and the generators of the various harmonics may be readily adjusted to produce a musical tone of the desired quality.

NEW DEVELOPMENTS IN CERAMICS AND GLASS

SEVERAL developments in ceramics and glass mark the recent past. From Europe comes a process of tempering glass which has been developed by the Libby-Owens-Ford Glass Co. to the point where the glass so treated is enormously increased in strength. It is more elastic than steel and when broken shatters into particles of a harmless nature with no jagged cutting edges. The Corning Glass Works, called upon to cast an astronomical mirror much larger than any before made, succeeded in casting not only one but two satisfactory 200 inch mirrors of borosilicate glass. This marked a new era in glass manufacture in America. O. Hommel Co., working in its field between glass and ceramics, developed a simplified metal enameling process which is said to be the only successful one coat enameling process.

In the strictly ceramics field, the most far reaching development is that of light-weight refractories, brought out independently by several different companies. These materials are of primary importance for their heat insulating qualities, although similar materials are being perfected for structural purposes, lower temperature insulation, and sound insulation.

SYNTHETIC RUBBER CLIMAXES DYESTUFF DEVELOPMENT

ONE of the most heralded achievements of recent months was the production of DuPrene, which is a synthetic rubber made by the controlled polymerization of chloropene from acetylene. Although the chemists and engineers of the E. I. DuPont de Nemours & Co., Inc., first announced the results of their extensive investigation in November 1931, this development has only come about during the last year.

The award of the Nicholl's medal to Father J. A. Nieuwland by the New York section of the American Chemical Society not only indicated the chemical profession's high regard for this achievement, but also brought out clearly for the first time the cooperative group effort on the part of duPont's chemical engineers which was responsible for translating interesting and academic theory into large scale commercial production. DuPrene's unique points of superiority over the natural product quickly gave an increasing market, despite higher costs.

Due to this same cooperation have come, during recent years, such important developments as the commercial synthesis of camphor, the large-scale production of tetraethyl lead, the new refrigerants based on fluorine and others, as well as the wide variety of solvents, resins, and emulsifiers that are making over the paint and varnish industry.

We women do talk too much, but even then we don't tell half we know.

—Lady Astor

THE CRITICAL ANGLE . . .

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

FOR THIS NEW YEAR This is the first month of the New Year. It is the first part of a year in which world history of the most vital nature is being enacted throughout all parts of the globe. International policies, the success or failure of which will alike be remembered for ages to come, are approaching completion with 1936 forecast as a year of intense importance to the whole world. Can we not make it a year of utmost importance to ourselves individually as well?

Look back at last year and the years preceding it. Let us see if we can distinguish the direction in which our lives have been moving, then, "In the light of the past, let us interpret the future." Are we going in the direction which we wish? Are we moving steadily onward to whatever goal we have pledged ourselves to attain in life? Let us, I beg of you, not look at the petty pleasures and trivial friendships which obscure the view of life as a whole. Let us try to see life objectively, not subjectively.

If we are content with the results which our review has revealed to us, we are lucky people; but let's not be smugly satisfied with ourselves. Let us make it a point to continue on the path which has thus far led us in the desired direction. We must not neglect the precautions and safeguards which have enabled us to prosper as we have up to the present.

However, if we are dismayed by the policies and tendencies which have apparently directed us in the past, let us remember that it is never too late to change them and that no time is better than the present. If we were driving a car and it started to run off the road, we wouldn't hesitate to apply whatever measures were necessary to avert disaster. We would turn the wheel or apply the brakes to a car; we can do the same to ourselves. Let this be a New Year, not merely of happiness and pleasure, but of steady advancement to our ultimate goals, whatever they may be. Usually good times and fun automatically follow the attainment of whichever ends we set up as the most important of our lives. Let our wishes to each other be, not a happy New Year, but a successful New Year.

THE LAWYER AND THE ENGINEER In our comic zeal to ridicule the lawyers, we may have overlooked some of the fine and deep problems with which the law student wrestles. Perhaps it would do the engineer good to observe for a moment the sort of thoughts and life to which a lawyer looks forward.

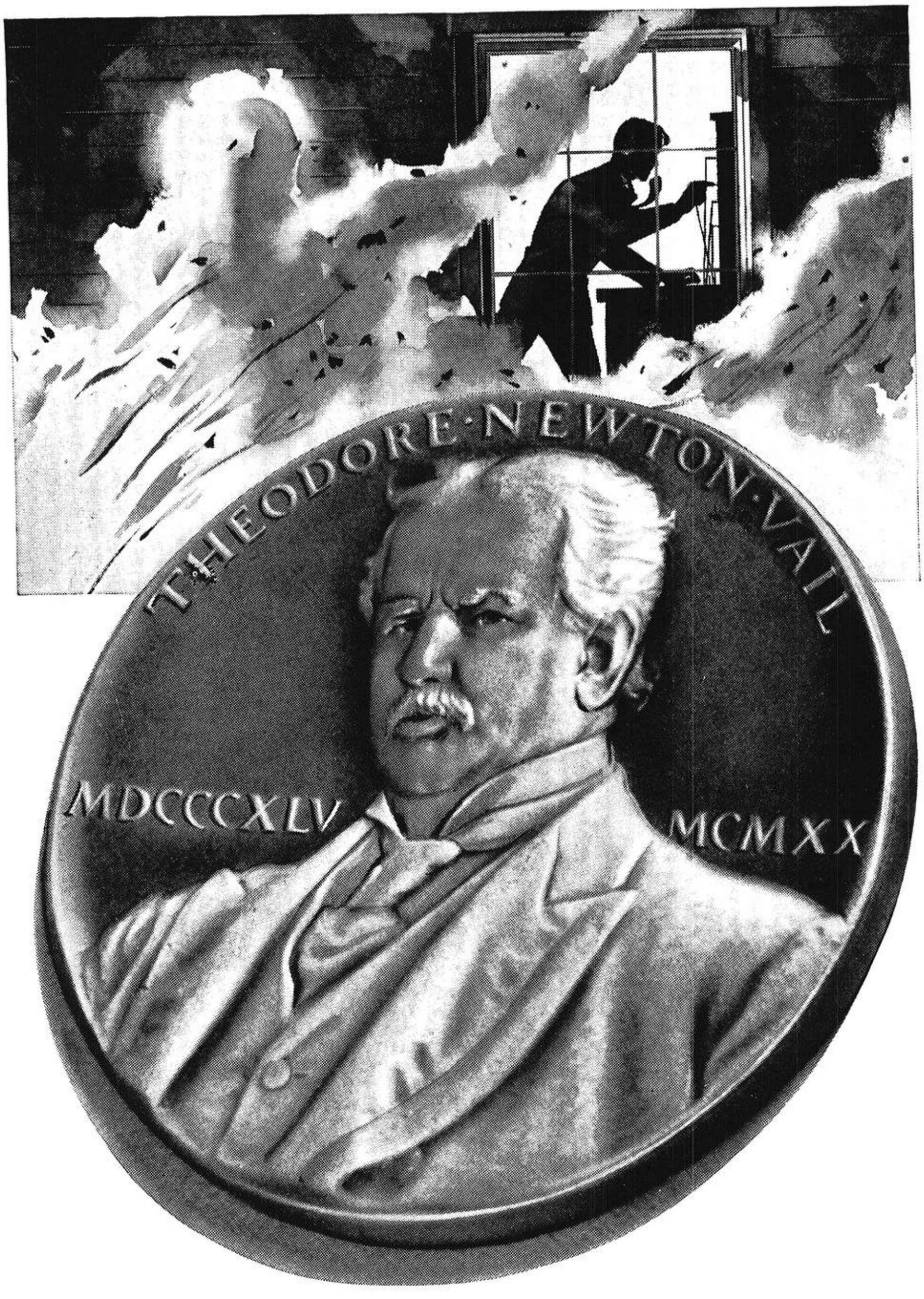
Our engineering courses may be likened to those in law, because the "case system" of teaching is employed in both. The student of law spends hour upon hour reviewing past court decisions, examining how the court acted in certain trials. From such examination, he gleans a rough idea of the path he will some day take in similar trials. In a like manner, the engineering student is presented problems typical of those he will be called upon to solve when he takes his place in the world.

There is a difference between the problems of the law student and those of the student engineer, however. Every problem in law is intimately bound up with the human being. People in trouble will come to the lawyer for help. Every act of his will be directly contingent upon the welfare of the individual; each of his thoughts will exalt or depress a human heart. Down through the ages have come the great forces of morals and ethics, forces which the lawyer must absorb and use in the moving and righting of human destiny. His is the task of making it easier for people to live together. He is a doctor of spiritual diseases; smiles and tears are the symptoms which concern him.

But see the engineer in his problems. Every perplexing situation in engineering is bound up with scores of human beings. People will come to him for help. Every act of his will some day concern the welfare of countless individuals, those living and those yet to come; each of his thoughts will be able to exalt or depress many a human heart. Down through the ages has come the knowledge of the great forces of nature, knowledge which he must absorb, forces which he must use in the moving of human destinies. The engineer, too, must make it easier for people to live together. No stethoscope does he have that will let him get beyond the intricate maze of machinery—beyond, to the uneducated worker running the machine. Where, in the clever logic of the engineer's design, is there a smile or a tear?

Thus, while the lawyer is painstakingly considerate of a

(Continued on page 79)



Back of a Medal

FIRE was raging through a Virginia village at midnight. A telephone workman sped there from his home . . . found the central office in danger.

Relieving the young woman operator, he handled all calls . . . summoned help from nearby towns . . . 'til buildings on both sides collapsed and the telephone building caught fire. Quickly he disconnected the small switchboard . . . moved it to safety . . . improvised a telephone station in a field.

In 20 minutes he re-established communication. Next morning, the rescued switchboard was installed in new quarters . . . telephone service was resumed as usual.

That telephone man received the Vail Medal . . . one of several awarded each year to Bell System employees for outstanding public service. Devotion to duty . . . day by day as well as in emergencies . . . has given America the world's finest telephone system.

BELL TELEPHONE SYSTEM

ON THE CAMPUS

ENGINEERS ELECTED TO PHI KAPPA PHI

At a banquet on January 9, fifty-three new members were initiated into Phi Kappa Phi, all-university senior honorary society. Among these were eight engineers: James J. Cadwell, Charles J. Halamka, Howard G. Holm, Luna Leopold, Leo S. Nikora, Tom J. Williams, Eldon C. Wagner, Robert Whiteside.

Williams, Holm, Nikora, and Whiteside are all members of the staff of the Wisconsin Engineer.

Phi Kappa Phi is an honorary society open to all seniors of the university. The primary object of Phi Kappa Phi is to emphasize scholarship in the minds of students and to stimulate mental achievement. Election is based on high scholarship and participation in campus activities.

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HYDRAULICS HIGHLIGHTS

Down in the hydraulics laboratory four men employed under the WPA are engaged on a project of testing various types of equipment used in plumbing work. One special item is a comprehensive series of tests so arranged as to give information for the standardization of grease and oil intercepters. This work is going on under the direction of Professor F. M. Dawson and Arthur McCloud, research assistant.

Mr. A. Kalinske, research fellow in hydraulics and sanitary engineering, has recently rewritten a bulletin dealing with cross connections in the plumbing system, copies of which are expected to be available this month.

With the assistance of students employed through the NYA, Professor Kessler is employed in making a series of tests designed to determine the effect of sudden dosages of strong trade wastes in the activated sludge method of sewage treatment.

Four members of the hydraulics department, Professor Dawson, Mr. Kalinske, Mr. McCloud, and Mr. Rolich, went down to Iowa City, Thursday, January 2, for the purpose of visiting and inspecting the work going on in the hydraulics laboratory of the University of Iowa. They were especially interested in experimentation concerning rivers, locks, and dams, for which the laboratory is especially adapted, being the best equipped in the United States for research in this line.

●

CONGRATULATIONS, SERVICE DEPARTMENT

After the fire December 11 in room 102 (no need to recall the details—everybody knows there was a fire), the service department did a fine, hurry-up job getting things going again.

Within two hours the repair men were at work putting the ventilating equipment (which is just below the burned room) in working order again. Then, early the next morning, men and materials were on hand to repair the burned portions of the room. This was done as fast as possible and within a week after the fire the room was ready for classes again.

The **Engineer** wants to congratulate the service department on the quick piece of work.

●

PROF. JANDA ILL

Professor Janda's absence from his classes since vacation has been necessitated by illness. He is recovering from a heart attack received Christmas day while shoveling snow in front of his house. He is expected to return in time to resume his duties for next semester, but in the meantime his adviser work is being taken care of by Mr. Arno T. Lenz.

●

WATER WORKS OPERATORS GO TO SCHOOL

The Third Wisconsin Short Course for Water Works Operators is to be held at the Hydraulics Lab February 10 to 13. This conference, like its two predecessors, is sponsored jointly by the State Board of Health, the State Laboratory of Hygiene, and the Department of Hydraulic and Sanitary Engineering. An enrollment of 40-50 water plant operators from Wisconsin and two or three from Illinois is expected. All sessions will be held in the Hydraulics Lab.

The program has been arranged so that lectures are scheduled in the morning and related laboratory work in the afternoon. Each morning, running with the university bells, there will be four lectures dealing with the various problems of the waterworks operator. Among the speakers are A. E. Gorman and C. H. Spaulding of Chicago, experts on the subject of water treatment and each speaking on one phase of the subject; Dr. M. S. Nichols, chemist, State Laboratory of Hygiene, on Water Bacteriology; Prof. R. E. Johnson, of the electrical engineering department, on Electric Motor Selection; and J. Zapata, research chemist of the Wisconsin Highway Commission, on Paints and Their Uses. In all, fifteen lectures are listed.

The laboratory work consists of a series of bacteriology experiments, a practical course in pump testing, and a number of hydraulic experiments. Most of one afternoon will be spent on a visit to the Columbus Softening Plant.

Students interested in any of the lectures are invited to sit in and listen.

METALLURGY AND MINING

The department shop has just completed making a dilatometer to measure the thermal expansions of metals. It makes r e a d i n g s of changes in length to 1/25000 of an inch. The shop has also made two precision furnaces for the exact determination of melting points exactly similar to those supplied by the U. S. Bureau of Standards.

Also a horizontal converter for blowing steel heats, lined with an acid lining, and a second one for copper or nickel heats, lined with a basic lining, have been recently completed.

•

The results of a series of experiments by Prof. Raymond J. Roark, professor of mechanics, and Richard S. Hartenberg, instructor in mechanics, have been published in a bulletin that was released recently. The work was done on the use of small plaster models to test the strength of everything from small machine parts to parts of giant skyscrapers.

•

NO SMOKING

Several recent small fires in waste baskets and the larger fire in room 102 last month have been traced to carelessly thrown cigarette butts. If these fires had been discovered a few hours later, it probably would have been too late to avoid a really disastrous fire.

The engineers ought to set an example for the rest of the university students — especially the lawyers — and act in accordance with the **No Smoking** signs.

Wait until you get outside to "light up." It means waiting just a minute and may prevent a serious fire.

•

MEAD HEADS A.S.C.E.

Prof. Daniel W. Mead has recently been elected president of the American Society of Civil Engineers. He will be installed at the organization's 83rd annual meeting in New York, January 15 to 18.

We extend our congratulations to Professor Mead.

•

Professor Ray S. Owen looked over some transits for the civil engineering department in Chicago during the vacation. Three new instruments will probably be bought at favorable prices, since the various companies are eager to have their instruments installed in schools in order that students may become familiar with them and later buy them when they are working for themselves. While in Chicago, Professor Owen also attended a meeting of the board of directors of the Associated State Engineering Societies, composed of the association of Wisconsin, Illinois, and Iowa.

•

If Mr. Arthur McCloud, hydraulics research assistant, seems to be wearing a proud air since Christmas vacation, it is because he is the father of a seven pound baby boy, born January 8.

"STATIC"

by ENGIN EARS

● Well, the baggage-loading-and-train-riding—some people call it Christmas vacation—is over, and all the New Year's resolution are well broken. About all that you can remember about the vacation is that Severson, one of those adult Miners, was seen in the company of two charming young ladies on the observation platform of a Chicago-to-Madison bound train. And, on the same train, deeply buried in the "Vogue," or something or other, sat the Hon. Mr. William H. H. H. Hofert, Ch.E.3. Yessir, it's wonderful what engineering will do for a man.

»» ««

● There are rumors going around that there will be written final examinations for the engineers again. Seems sort of foolish to come around with those things again—examinations never were a success.

»» ««

● By the way, the first name to be engraved on the brass-plated gaboon this year is that of Mr. L. V. Whitney of the Physics department—he carries the lead position for the crummiest puns-of-the-month club. He was heard mumbling something or other about shearing hydraulics rams for their steel wool.

»» ««

● If anyone has sufficiently recovered from the exams by the 7th of February, he can get a good start to another coma by going to this affair commonly called Prom. The only trouble with going to that political millennium is that you can't very well go to your first classes of the semester half-canned. Oh well.

»» ««

● A fellow wandered in to the **Wisconsin Engineer** office the other day. Said he had a word for the wise. This department, having a special weakness for the high intellectual, welcomed the contribution. We offer it to you for what it is worth—well, we offer it to you anyway.

VOICE OF EXPERIENCE

● Exams are upon us once more—that semi-annual epidemic of red-pencilitis which afflicts our instructors and plays havoc with undergraduate nerves. For the benefit of our freshman readers, all both of them, we wish to reveal a few of the methods of attack in favor among the campus elite (meaning, of course, the Engineering school). Through research, interview, and personal experience, we have determined that the engineers may be divided into four general groups:

Group 1: Those who cram all semester, get reports in on time, and even ask for extra blue books during the final. It is a cherished university tradition that there was once one such iconoclast enrolled, but painstaking investigation has not been able to establish the authenticity of this legend.

Group 2: Those who use files of old reports all semester, sleep, or scratch names on their lecture seats, then wake up the last two weeks and study like . . . well, stay up and cram all through the night before, in order to write a 40 on the fatal day. This is by far the largest and most representative group.

Group 3: The "wise guys" who spend days carefully printing neat little "crib cards," full of pretty figures and cute formulae, to be carried in the waist band of a sweater or in a coat pocket. These gentlemen usually can't find the particular data needed anyhow in the maze of figures on the cards, or find that the proctor is one of those impolite fellows who insists on reading over one's shoulder. The only real success in this line that we have heard of was in the case of a mechanical who made out a card index or reference sheet to go with the rest (trust a mechanical to be always efficient). It has been found that instructors, for some strange reason, frown on this form of aid and are likely to become unreasonable when it is used; accordingly, this method is not recommended for the beginner.

Group 4: Those who loaf all semester, their physical manifestations sprawled in the engineering lecture halls while their imagination roves about in the Home Ec school, and who go out the night before the finals to hang one on (let it be noted here that engineers get inebriated; only lawyers get drunk), then have a quick one in the morning on the way to school, sit down half "boiled," and bat out a 94 (to hear them tell it). This is by far the most painless method and just as good as any other insofar as results are concerned. In fact, some students are known to keep in training all semester for this crucial period.

Having thus scientifically expanded the field, we leave it to the reader to pick his own method. There is no known fool-proof method; so, step up, gents, and "name yer pizen."

Depression Comes to the Jungle

By CARL WALTER, e'38

THE insatiable jungle is nibbling once more at the fringes of civilization in South America, strangling the single-track railroads that serve to link jungle villages with the outer civilization that spawned them, swallowing lonely outposts, driving natives back to savagery. "For the depression has hit the jungle," says Earl Hanson, m'22, who has been doing research work for the National Geographic Society in the Orinoco basin and whose interesting article appeared in the May issue of Harper's, which is the third article written by Hanson for Harper's. Just by way of contrast, he has also conducted scientific investigations in Greenland under the direction of the Carnegie Institute, and has in general been leading the sort of life of which we all dream.

"Strange as it may seem, soap is becoming worth its weight in gold in the jungle," Hanson says. From the remotest outposts comes a cry, a pleading for soap—soap in any form, in any amount—plain brown laundry soap. And those familiar with the country look upon this with alarm, for this shortage, due to the general decline of trade with the interior, has a far deeper significance. What is true of soap is true of all the other refinements in the native standard of living, the commodities upon which civilization has made them dependent: matches, salt, fishhooks, cartridges, needles, buttons—the list is almost infinite. What overshadows all else is the fact that, without soap, the Europeanized native of the interior must shed his clothes once more, the human hide being easier to keep clean when modestly arrayed in a palm-fiber G-string than when enveloped in shirt and trousers. With this discard of the white man's garments there will be a subtle but none the less positive discard of the caste and culture that three centuries of contact with the whites have built up in the native settlement. Economic stability will return to the jungle, a stability that has been unknown since white adventurers first pushed into the interior in search of gold, rubber, and glory—and found them all, along with malaria and yellow fever thrown in for good measure. They were greedy, brutal rabble, typical of the vanguard that is always used by foreign business interests in savage regions. They raided the bush villages for slaves for their rubber plantations, and gave us examples of bloody tyranny that make Emperor Jones look like a Boy Scout. Even in the matter of native dart-poison, the natives have been forced to buy their supply at exorbitant prices from the white "patrons" who have muscled into the trade, who know neither how to make nor how to use it, but who buy up the supply cheaply from the producing Piaroas. Engineers, too, came onto the scene, hard-bitten men with stomachs full of quinine and heads full of dreams, dreams of the railroads that were to cut through a thousand miles of tangled jungle and avoid the river rapids that had always been a barrier to inland transportation. They hacked their right-of-way out of the matted forests, spiked down the rails, did build their railroads, and ran their trains in and out—but that is another tale.

The British plantation monopoly in the Far East stifled the rubber trade; civilization went into high gear and the jungle couldn't keep pace. So now the railroads rust, vines grow up between the ties, whole villages are now but rotting mounds of palm thatch and names on the map. The engineers and the adventurers are gone; they've found new, fresh, and richer fields for exploitation. The few remaining whites must follow, return to homes that are no longer theirs, or rot in the steaming lowlands amid the wreckage of their new civilization. Some elect the latter course. Their railroads still operate (at a steady loss), running from one sleepy jungle town to another, going nowhere in between, carrying no pay load. There are many dying towns like Abuna', whose great object of pride is her electric light plant which, for reasons of economy, is operated only on Thursday nights, when the weekly train stops overnight.

Much more serious is the plight of the "civilized" Indian, who has been living more in a white man's land than in his own, who has given up his civilization for that of the intruder, and who, strangely enough, looks upon the "savages" with far greater disdain than does the white man. Culturally he is a stranded white; biologically he is of diluted Indian blood. His dark skin makes it impossible for him to follow the whites back to the outer civilization, while his caste or pride tend to prevent him from shedding his clothing—trousers being universally identified with civilization in the South American hinterland—and rejoining his more savage brethren. Long deserted by the priests who first converted him, now deserted by the traders who served to keep his hybrid civilization alive, he seems to have no alternative but to return to this trouserless state. Once he "sinks" to discarding his clothes, the rest of his readjustment will come rapidly and more painlessly. The demand of mirrors, combs, and all the geegaws of civilization will vanish; the native will relearn the lost art of fire-making, he will renew trade relationships with the "uncivilized" tribes, plant larger gardens, spend more time in hunting. A few generations will see the total re-Indianization of the interior, self-sufficiency being the order of the day. The white man's trade route, north and south along the rivers, will give way once more to the native trade channels, which operate east and west. Even now white men on the Orinoco can buy the finest firearms from painted savages upstream who haven't the slightest use for them except as a medium of exchange, the guns having traveled from tribe to tribe in this casual manner all the way from the borders of Guiana through unexplored jungle. The Indian will learn once more to depend on his garden and his blowgun for food; internal trade will become increasingly important. There are forest tribes which have always been specialists, some in weaving palm fiber hammocks, many in carving dugout canoes, others in preparing dart poisons, and still others who do nothing but act as traders. Tribal big shots, Mr. Hanson reveals, hold power solely by their trading shrewdness, often changing tribes if attractive propositions are made to them.

This Indianization can but mean that all vestiges of the white man's occupation will vanish. When he returns, as he undoubtedly will, he will be starting from scratch, even as did his predecessors, to trade, to teach, to cut out, and build. Engineers will be needed, tough ones, with ambition and imagination. Business men, too, men with practicability and vision rather than brawn and a thirst. We can't prophesy as to whether or not the latter will be on hand, but we can guarantee that when they cry, "Bring on the engineers!," the engineers will be there.

And should any reader be among those to "go in," may he be advised not to attempt to show the Indians how to shoot craps—Mr. Hanson tried that dangerous experiment and discovered to his financial sorrow that the science of the galloping domino has already been brought to a fine point by these supposedly primitive children of the jungle.

The Critical Angle

(Continued from page 72)

handful of people, the engineer, with ignorance and indifference, hurriedly sketches out a design for some machine that will jostle the lives of thousands.

In the sight of those millions of pairs of eyes that are forced to constantly look at family wretchedness and agony, all because a brilliant but inconsiderate man has invented mechanical eyes to replace the human—in the sight of another set of millions of pairs of eyes, eyes hollowed and haunted with the rabbit-like look that bespeaks the fear of losing a job—in the sight of all those, must not the engineer be a cruel and self-centered master mind? Must he not be a criminal?

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SLEEP VERSUS ACTIVITY There are many students in this university, especially in the professional schools, who are here with but one purpose in mind. They go to class every day, prepare every assignment and read industriously in their libraries. Their entire time is devoted to preparation for their careers. Upon the work of these students is the greatness of this university founded.

However, this university offers more than merely the facilities for academic endeavor. The many extra-curricular activities give one sensations and experiences that are somewhat removed from our original reason for being here. Perhaps many have wondered whether these outside activities were worth the time students spend on them—are they of any value after college? Here is the opinion expressed by one of our national advertisers a few years ago:

"To suppose that a baseball nine will all cover just one position is as far from the truth as to think that everyone in the electrical industry is an electrical engineer.

"This field will always need trained engineers. But with its great manufacturing, construction and commercial activities, the industry must have non-technical men, too.

"Since the industry is manned by many types, the result of your work will depend a good deal on the success with which you team up. The qualities that win are not only efficiency attained by the light of a study lamp, but that all-pull-together spirit of the athletic field.

"This point of view may be useful to the man who has wondered whether campus activities, with all their striving and stern testing, their setbacks and their triumphs, have any counterpart in after life."

There is an activity on this campus that is sure to interest you and tax your ability. Do not have cause for self reproach at the end of your college career.

CAMPUS ORGANIZATIONS

POLYGON PLAN

The accompanying report shows what has been done by Polygon the past semester. Polygon has been very much pleased with the support it has received—certainly the results of your paying your activity fee should have pleased you. The Ag and Home Ec schools started using a plan patterned after the Polygon Plan this last semester, and Dean I. Baldwin of the College of Agriculture happily reports that both students and faculty have found the plan a successful solution to their problem of finance.

Thus far this school year, Polygon has provided you with a smoker, the **Wisconsin Engineer** each month, and a dance. The coming semester holds even more for you. Not only will you be getting the benefits of last semester, but Polygon hopes to have the biggest St. Pat's Parade in the history of the school this semester.

So, with the various societies going the limit to give you a fine program during the new semester, with Polygon trying to out-do itself to give you a worthwhile piece of entertainment, and with the **Wisconsin Engineer** striving to present you with the finest magazine it has ever published, with all those things to which you can be looking forward, we hope you will bear in mind that the idea of support should ever be with you.

We urge you, then, to pay your Polygon Fee promptly, in order that you will not only be able to attend the smoker which comes the second Wednesday of the new semester, but that you will also be doing your bit to help your Polygon representatives by not inconveniencing them with late fees.

Get on the bandwagon and ride through the most successful semester Polygon has ever had.

POLYGON FINANCIAL STATEMENT
as of January 9, 1936

	Registered	*Paid*	*% Paid*
Ch.E.	228	168	73.6
C.	195	159	81.5
M.E.	291	175	60.1
E.E.	256	136	53.1
Min.	48	44	91.7
Student Total	1,018	682	67.1
Faculty	86	54	62.8
Grand Total	1,104	736	66.66

Distribution of Fees

A.I.Ch.E.	$ 50.40
A.I.E.E.	40.80
A.S.C.E.	47.70
A.S.M.E.	52.50
Mining Club	13.20
Research Fund	32.40
Wisconsin Engineer	395.00
Polygon	158.00
	$790.00

Polygon Receipts

Receipts from fees:

682 Students @ $1.00		$682.00
54 Faculty @ $2.00		108.00
		790.00
Receipts from dance		51.70
Total receipts		841.70
Carried over		143.81
		$985.51
Fees	$158.00	
Dance	51.70	
	209.70	
Carried over	143.81	
	353.51	
Expenditure	213.55	
To carry over	$139.96	

PRESIDENT'S SCIENCE ADVISORY BOARD MAKES RECOMMENDATIONS

The second report of the Science Advisory Board, established by executive order of President Roosevelt in July, 1933, under the National Research Council, created by congress at the request of President Wilson in 1918, has just been published. Like the National Resources Committee, the Science Advisory Board addresses itself to certain problems of national development in which the engineer and scientist have a part. The report of the National Resources Committee which has been transmitted to our members in sections as a part of the semi-monthly "Embassy Service" relates itself to the broader problems of the planned technical, social and economic development of our national resources as seen by this board. Like the National Resources Committee, the Science Advisory Board has no authority for action. It may only recommend. Both reports attempt to give broad direction to national policies—the one emphasizing the values of a planned approach to national development, the second concerning itself with the relating of government to effective research and what may be called the "tools" of planning.

The general report of the Science Advisory Board covers such subjects as the national dependence on science, the need for a science advisory service to government and the future development of a science advisory service. It recommends, first, that a body be set up under the National Academy of Sciences to succeed the present reporting board, and second, that the responsible government officers and this new board continue to seek the solution of the problems which have been reported upon.

The second part of the report deals with the reorganization and reconsideration of certain of the scientific branches of the government, including the Weather Bureau, the Bureau of Chemistry and Soils, the Surveying and Mapping Services of the Federal Government. It also deals with the Relation of Patents to New Industries and a dozen other reports of inquiries into the purposes and the efficiency of present government undertakings.

G-E *Campus News*

LIGHT READING

It has won a prize, but you will not find it in the bookstore. The movie rights will not be sold; it will, alas, never be a best seller.

The title is: Non-Riemannian Dynamics of Rotating Electrical Machinery; the author: Gabriel Kron, University of Michigan, '24, G-E engineer. The award is the first prize of the George Montefiore Foundation of the University of Liege, Belgium—10,000 Belgian francs.

Tastes in literature differ; Gabriel Kron's preferences run to higher mathematics. Some years ago, he went on a walking tour around the world, and he took with him for light reading a book full of integral signs, tensors, matrix transformations, and elliptic functions. Instead of the usual souvenirs, he brought back the material for the paper that won him the Belgian prize. He also reports that the total cost of the trip was only $200! It suggests a tip for those who have trouble with padded hotel bills. Try carrying a calculus book on your travels!

SECOND SIGHT

The complete electric man is being built piecemeal. Electric eyes and ears came first, and loud-speakers with electric vocal cords. Now comes the machine with a memory and the gift of second sight. It has been developed by G-E research scientists to study the causes of failure of electronic tubes.

Something unusual happens in a tube. It is all over in a few hundredths of a second. Then, when peace has settled down, a camera shutter clicks and records on the film the story, not only of the disturbance and its aftermath, but of the events that led up to the disturbance.

Two modern devices make this possible: the cathode-ray oscillograph and the thyratron. The oscillograph is on the job, day and night, tracing on its fluorescent screen the history of the faithful operation of the tube. Then, unexpectedly, after months have elapsed, perhaps in the wee hours of the morning, the tube goes haywire. The disturbance sets off the thyratron tube which, in turn, trips the camera shutter, The disturbance has been over for a fiftieth of a second, but the trace still lingers on the oscillograph screen, and is photographed. No longer need the scientist hover anxiously over his apparatus. He can lie comfortably in his bed, knowing that the prerecording oscillograph will remember all that happened during the night and tell him about it in the morning.

CHINA CLIPPER

The Pan-American *China Clipper* which recently inaugurated trans-Pacific mail and passenger service in its epoch-making flight from California to the Philippines and back, carries several aids to flight which have been developed by General Electric especially for aviation service.

Each of the giant ship's four 830-hp Pratt & Whitney Twin Wasp engines is equipped with built-in G-E superchargers. Complete sets of G-E electric tachometers and electric oil-temperature gauges help the engineering officer at his post in the first compartment to check on the performance of the engines.

96-218DH

GENERAL ELECTRIC