FREQUENCY MODULATION

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CEMENT PRODUCTION

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GLASS PRODUCTION

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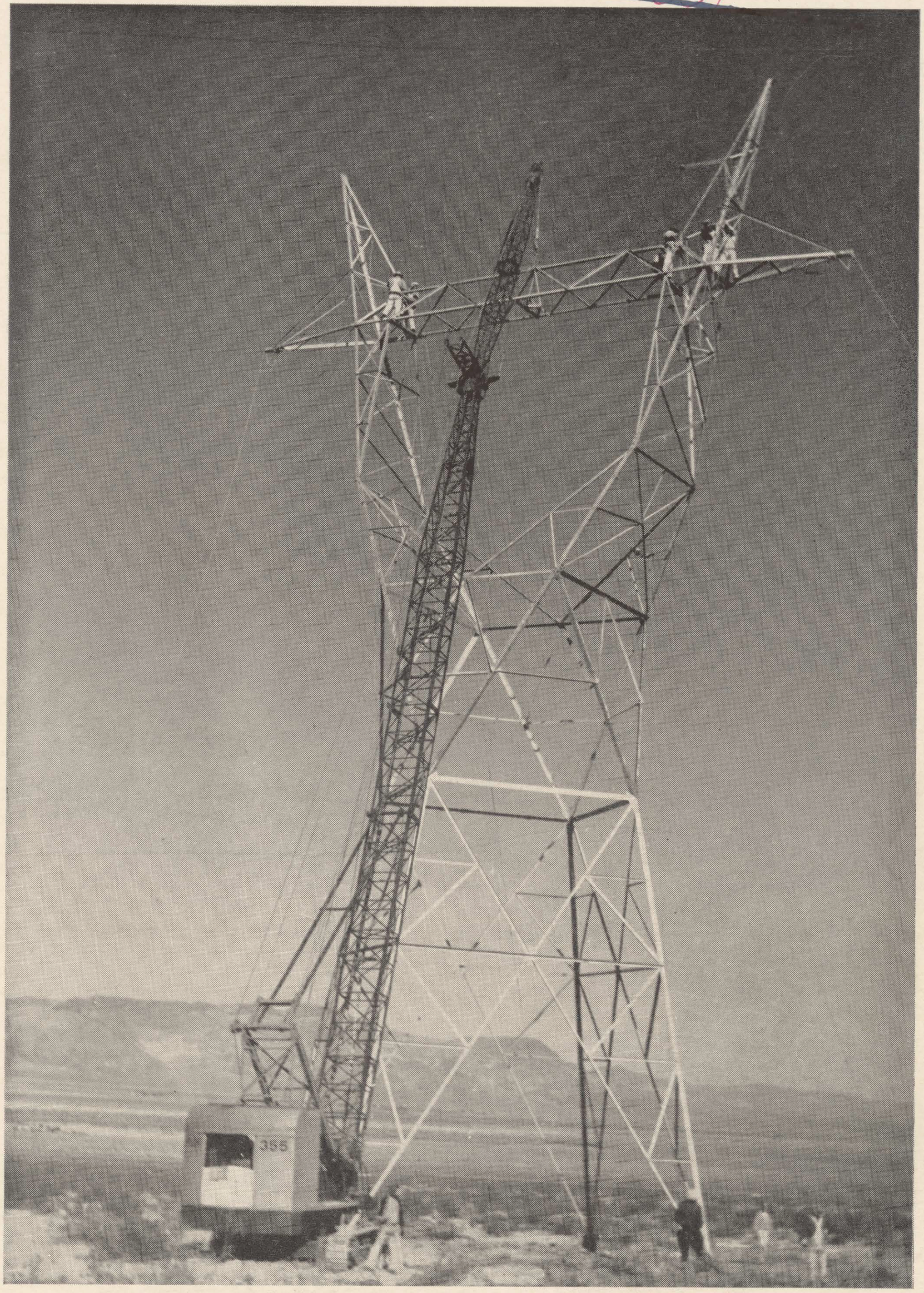
FEDERAL POWER



OREGON STATE TECHNICAL RECORD

NOVEMBER, 1940
VOL. XVIII. NO. 1

IN THIS ISSUE

Lee Coe, senior in electrical engineering, writes on frequency modulation and its adaptibility to present commercial broadcasting facilities.

Coe C. White, senior in electrical engineering, writes on the disposition of the federal power developed at both Bonneville and Grand Coulee dams.

IN THE NEXT ISSUE

Coe C. White again will write for us. This time it will be on the Aluminum Company of America plant at Vancouver.

William R. Cranford writes on the new U-235.

OREGON STATE TECHNICAL RECORD

VOLUME XVIII NUMBER 1

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[Courtesy Electric Light and Power]

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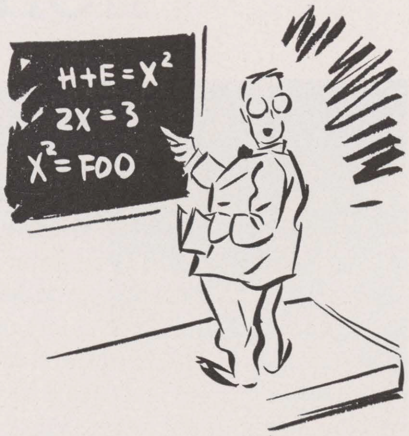


Frequency Modulation

LEE COE, E.E., '41

"The radio revolution"—that's what the Saturday Evening Post called frequency modulation. Let us see what kind of a revolution it is.

The basis of a radio signal is its carrier. This is an electrical wave of given amplitude and frequency; however, the carrier in itself does not convey any information to a listener. It is the variation in the carrier which makes it intelligible. Its presence may signify something, because even this is a variation from its absence. The length of time of its presences or absences may be made significant, as in radio telegraphy.

If the variation from presence to absence is accomplished by turning the signal on and off, amplitude modulation is being used. If the signal is merely removed to another frequency instead of turning it off during absences, the process is called frequency modulation.

In amplitude modulation as used by regular broadcasting stations, the amount of presence of the signal is made dependent upon the program sound being transmitted. The program wave form varies from positive values to negative ones. The radio signal must therefore have a basic power around which it may vary either positively or negatively. The amount of variation in the negative direction is limited, no one yet having found a way to get less than zero power. Thus the maximum degree of modulation is fixed.

For frequency modulation there is no such limit. To convey the program sounds, the frequency of the transmitted signal is made to vary above and below an assigned carrier frequency in accordance with the respective positive and negative values of the program wave form. By setting the carrier at a high enough frequency, any desired amount of variation may be had. This characteristic gives frequency modulation its prime advantage over amplitude modulation. This advantage discriminates directly against noise.

All noise and static which cause interference with ordinary radio signals may be considered as being by themselves radio signals, or a series of radio signals, occupying nearly the whole radio spectrum, and having characteristics of both amplitude and frequency modulation. Ordinary noise amplitude variations are comparable with the maximum degree of amplitude modulation of a desired signal, and therefore cause spurious output from amplitude modulation receivers. The frequency modulation component of noise, however, is, for ordinary amount of interference, rather small. Since the degree of modulation of the frequency modulation signal is not particularly limited, the transmitted signal modulation may be made so large that the noise modulation is insignificant by comparison. Because of this initial advantage, a weak frequency modulation signal may be heard above the noise where an amplitude modulation signal of equal strength would not be understandable. Also, a frequency modulation signal may be weaker than an amplitude modulation signal for completely noise-free reception. It has been experimentally shown that a frequency modulation signal only twice as strong as the noise signal will give practically completely noise-free reception, whereas an amplitude modulation signal must be fifty to one hundred times as strong as the noise for the same effect.

This advantage applies also to interference between two stations on the same frequency. Objectionable interference covers only a small area between the stations with frequency modulation. With amplitude modulation signal number one must be about twenty times as strong as signal number two if number one is to be satisfactorily received. With frequency modulation number one will be received interference-free if it is twice as strong as number two. It must be admitted that this is a decided improvement.

The discrimination against interference and static afforded by frequency modulation leads to its claim to high fidelity reproduction. It is said by some observers that there is no noticeable difference in reproduction of sound by a good amplitude modulation system and a good frequency modulation system. These statements neglect the fact that high fidelity implies not only undistorted transmission of speech and music sounds, but also retention of the full volume range of programs. It is true that amplitude modulation systems can be made to transmit given tones fully as well as frequency modulation systems, but it is also true that because of the audible noise in amplitude modulation, the volume range must be compressed so that loud passages will not exceed the modulation capability of the transmitter and so that soft passages will not fall below the noise level in the receiver. With a frequency modulation system, the soft passages are not lost in the receiver noise, there being practically none; and loud passages are not lowered, because there is no fixed modulation limit. The improvement in naturalness and apparent realism is remarkable.

Other advantages of frequency modulation are that it allows the use of more efficient transmitter circuits, requires no high-powered voice frequency circuits, and permits broadcasting both facsimile and sound simultaneously. This means that one may listen to a program and have a radio newspaper printed before his eyes at the same time. Furthermore, because of non-interference between stations on the same channel, a large number of stations may be operated throughout the country; many more than can be at present, without jamming cross-talk and voices murmuring in the background common on the present broadcast band.

All the characteristics of frequency modulation are not on the advantage side of the ledger, however. Each frequency modulation station takes a band of frequencies so wide that only three transmitters could be picked out by a given receiver in the regular broadcast band. For this reason, frequency modulation stations have very high carrier frequencies, high in the shortwave spectrum. Waves at these frequencies do not behave like those at regular broadcast frequencies. Instead of traveling around the curve of the earth for hundreds of miles, they travel in approximately straight lines, and are therefore limited to line-of-sight ranges. For this reason, high places, the tops of skyscrapers, mountain peaks, are good locations for frequency modulation stations. Even with such locations, the coverage of a frequency modulation station is not nearly as great as that of an amplitude modulation station of equal power.

A second disadvantage of frequency modulation is its cost, both to the broadcaster and the public. The broadcaster, in order to be able to demonstrate the high-fidelity characteristics of frequency modulation to a prospective audience, must provide a system of very good quality, and provide programs suitable to such a system. "Soap operas" and daytime serials sound drearily the same with high fidelity and no fidelity. Scratchless recordings must be used, because even a slight scratch is glaringly apparent in a noiseless system. The public, in order to realize the reception advantages of frequency modulation, must purchase good receivers. High fidelity receivers cannot be built for ten dollars. Prices for the cheapest frequency modulation sets are now $60 for a table model and $160 for a console model.

Whether or not the advantages are outweighed by the disadvantages ,or vice versa, only time and experience will tell. It is apparent that for short-range communication, particularly in the military service, frequency modulation is ideal. It cannot be jammed by interference, may be made readily portable, is free of noise, and lends itself well to secrecy systems. Whether frequency modulation will supersede amplitude modulation for service to the general public is a much more complex problem. One point of view is that of Major Edwin H. Armstrong, professor at Columbia University, pioneer radio inventor, and discoverer of frequency modulation. He has put well over a million dollars of his own money into frequency modulation. The Yankee Network, serving the New England area, has nearly a quarter of a million dollars invested in stations now operating. On the other hand, a statement of RCA officials quoted in the Saturday Evening Post was ". . . we still feel the picture of frequency modulation future which its advocates paint is overly optimistic." This could scarcely be construed as rabid enthusiasm.

MACHINE SHOP NEWS

Four new South Bend lathes will be installed in the industrial arts machine shop sometime during the month of December, according to Professor G. B. Cox, head of industrial arts and engineering shops. These machines will replace four of the obsolete lathes now in use and will to some extent relieve the congestion experienced in machine shop sections.

A set of twenty new drafting tables was added to the department's equipment this summer and the tables are now in use. These tables were designed and built in the industrial arts shops, having been begun by the summer session class in production millwork and completed by departmental employees during the summer vacation. Each table is equipped with a tilting top and five individually locked drawers. Mortise and tennon joints are used throughout the units.

"A little boy and his mother were walking down Fifth Avenue in New York. The little boy was looking at the skyscrapers. Turning to his mother he said, 'Are there skyscrapers in heaven?'

"His mother replied, 'No dear, engineers build skyscrapers'."—Ohio State Engineer.

Flotation Production of Cement

WILLIAM R. CRANFORD, E.E. '42

The new Shasta Dam being built in northern California, one of the largest dams in the world, naturally requires large amounts of readily available cement. This then is the reason for the construction of a cement plant such as that built by the Permanente Corporation near San Jose, California.

The plant is unusual in that it employs the flotation method of processing material that would otherwise be too low in calcium carbonate to be used for making cement. This method, or a similar one, is used extensively for concentrating mineral ores, but was only recently pioneered by a plant in Pennsylvania for making cement. This plant is the second in the United States to employ the system.

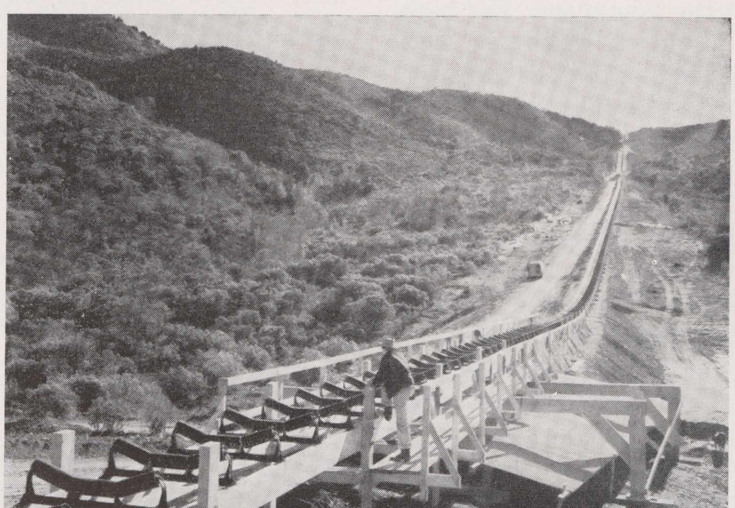
The method consists principally of agitating slurry to which has been added oily and frothing (or hydroxide) reagents. The oily substance coats the limestone, causing it to cling to the bubbles of the froth. The air brings the pure material to the surface where it is skimmed off, allowing the deleterious material to be drawn off at the bottom of the tanks. Several intermediate operations are, of course, necessary, but this is the principle of separation—the key to the operation of the plant.

The limestone deposit is about 15 miles west of San Jose in Santa Clara county, on the south slope of Bald mountain. The operation of producing limestone products begins at this point, in the quarry.

The material in the quarry is first located by exploring with diamond core drills, which bring up samples of material from beneath the surface. Several hundred feet of a 50-foot face of this material is then exposed by stripping off overburden, excavating, and wasting undesirable material. Selective quarrying is then carried out by means of a field belt conveyor along this face, and a movable lateral conveyor on which is mounted a pendulum or swinging conveyor. The end of this pendulum is equipped with a hopper, enabling ore to be loaded directly onto the belt by a large electric power shovel of 185 hp. This shovel has a five yard bucket.

The field conveyor deposits the limestone in a quarry storage pile, where uniformity is assisted by blending as the material is drawn off through a tunnel underneath and carried, by means of another belt conveyor, to a scalping screen and a large jaw crusher. This crusher reduces all oversized material to less than seven inches in diameter.

The limestone then travels down the hillside where it passes through a screening tower into storage piles. The drop of the conveyor belt feeds about 700 hp into the line by means of genera-



Courtesy, General Electric Co.
This 9.6 mile conveyor, the world's longest, will be used to transport concrete from the processing plant to the Shasta Dam site.

tors acting as brakes on the belt. The material between three and five inches in size is stored for later processing for sugar rock or lime. The material above five inches and below three inches in size is stored in another pile for manufacturing cement and commercial rock. Further uniformity of quality is obtained by the blending in these storage piles.

From the sugar rock storage pile material is drawn off and run through a processing plant where it is washed, and impurities removed by hand, as the limestone passes over vibrating tables. If the stone is to be used for processing beet juice, it is loaded directly into gondolas for shipment. If it is intended for lime, it is again stored in a raw pile from which it is drawn off into a cone crusher.

The product from this crusher is screened into four sizes. The three smallest of these sizes are stored for sale as aggregates, road rock, etc. The largest size passes into a silo and is fed to the lime kiln.

As this material passes through the kiln, it is carefully and completely burned to produce a lump quick-lime. From the cooler it is lifted in a covered skip and stored in two steel waterproof silos. As it is drawn from the silos and loaded into cars, the lime passes over another conveyor belt where it receives a final inspection and any possible impurities not removed in the picking plant are removed by hand. A thorough inspection is easy at this point as the burning creates a marked contrast between the colors of the impurities and the pure limestone.

As stated before, all limestone above five inches and below three inches in size is used in the manufacture of cement and commercial rock in sizes not obtained in screeening material behind the cone crusher at the lime plant. For both purposes the material is drawn from the raw cement rock storage pile and is passed through a secondary crushing and screening plant. If the entire draw-off is to be used for cement, the product maximum size is one-half inch. If commercial rock is being produced, the maximum size is increased to two inches, and material under one-half inch is diverted to the raw mill feed bins for the manufacture of cement. Commercial rock is available in washed and screened gradings, birdseye gravel, dust, limestone dust, and flue dust.

From the raw feed bins the cement rock is uniformly introduced into wet grinding ball mills by means of Feed-O-Weights, which also record the tonnage of material used. These mills operate in closed circuit with rake classifiers, which return to the mills all material not ground to the desired fineness. The plant is equipped with two each of such raw bins, Feed-O-Weights, mills, and classifiers. These mills contain about 25 tons each of forged steel grinding balls.

The product of these primary mills and classifiers is a mixture of ground limestone and water, called slurry. This slurry contains approximately 10 per cent solids and about 65 per cent of this material is sufficiently fine to pass a screen containing 200 holes to the linear inch.

Slurry from the primary classifier is piped to two Dorr bowl type classifiers which work in conjunction with two additional raw-grinding ball mills. These mills further increase the 200 mesh fineness of the solids in the slurry to approximately 95 per cent. One of these mills is similar to the primary grinding Traylor mill, and the other is an Allis-Chalmers mill.

From these bowl classifiers the product is piped to two 150 foot diameter thickening tanks, where the excess water is drawn off, leaving the slurry approximately 65 per cent solids. The underflow, or product material, from these thickeners is stored in eight large steel tanks where it is blended with clay.

Clay for this purpose is obtained from deposits near the plant, crushed in a pulverator, and ground with water in a Traylor tube mill. A fineness of approximately 95 per cent passing a 200 mesh screen is obtained in this clay slurry. If analysis indicates a deficiency of iron in the clay, the content is raised by addition of iron ore.

When satisfactory chemical properties are obtained, this finished slurry is then interground in a Smidth tube mill and piped to two large concrete storage tanks from which it is fed into the kilns.

If the raw slurry, at the point of leaving the Dorr bowl classifiers, is low in calcium carbonate, or pure limestone content, the plant is equipped with a flotation plant to remove sufficient of of the other materials in the slurry to raise the limestone content to the ideal relationship. After this treatment, the slurry is piped to the thickeners and treated as normal slurry.

The plant is equipped with three large kilns, approximately eleven feet in diameter by 460 feet in length. Natural gas is used for firing, and maximum temperatures of approximately 360 degrees Fahrenheit are generated. One of these kilns is the Traylor type, and the other two are Smidth's Unax. All are equipped with coolers which serve the double purpose of cooling clinker and preheating the air for burning.

The operation of removing clinker rings from the kilns is quite an interesting process. They are shot out with a gun firing a shell with a powder charge equal to that of a 12-gage shotgun

(Continued on page 17)

Developments in Glass

FRANK E. BIASCA. CH.E., '41

Recent developments in glass technology show a trend toward the use of glass of greater utility made from inorganic materials. There has also appeared a glass of entirely organic nature.

A new high in glass technology was reached when the Corning Glass Works completed the huge 200-inch, 20-ton, telescopic disk. The same company has recently announced the production of a heat resistant glass of thermal expansion so low that it approaches that of fused silica. The resistance of this glass has been demonstrated by pouring molten iron at 2600 F into a piece of the glass set on a cake of ice. Likewise, a dish may be heated on ice with an extremely hot oxygen flame. To demonstrate its complete resistance to breakage under temperature changes this glass has been submerged in a hot bath of salt at 950 C (1740 F) and then dipped in ice water. The new glass has a coefficient of thermal expansion only one-fourth as large as any previous glass, and only about 40 per cent greater than that of fused quartz.

A patent covering the manufacturing of this glass has been issued and assigned to the Corning Works within the past few months, but it is emphasized by the Corning management that the development is still in the pilot plant stage and that another two years will pass before commercial production can be started.

The essential steps in the manufacturing process may, however, be described somewhat as follows: The object to be manufactured, such as a dish, beaker, flask, or tube, is produced by ordinary means from certain original types of borosilicate glasses which are somewhat unstable. By means of a heat treatment, the glass is separated into two phases, one high in silica and highly stable, and the other low in silica and soluble in acids. The soluble part is extracted and leaves a skeleton-like glass which contains 96 per cent silica (SiO_2). This is subjected to a heat treatment to condense the porous structure to a clear, solid mass. During this part of the process a shrinkage of 13 per cent in linear dimension and 35 per cent in volume occurs.

This process promises success because mass production methods are applicable. An important feature of the process is that the ware is formed, not at the high vitrifying temperature, but rather at the comparatively low melting temperature of the original glass. For this reason it is claimed that the glass may be produced at relatively low cost, despite its similarity to fused silica. The Corning management is not stating uses for the product yet, but, if it can be produced cheaply, it will be capable of replacing quartz, and may also find a domestic market in the form of cooking utensils.

Another development in glass utility is the production of improved safety glass, which combines the rubbery strength of polyvinyl acetal plastic with plate glass to produce a safety glass of great strength over a wide temperature range. In 1939 the Ford Motor Company began the manufacture of safety glass using a vinyl type of plastic or binding layer. Other companies have also replaced the common cellulose acetate sheet with new vinyl plastic. This material is well recognized as superior for long life, but it has a tremendous advantage in that it requires no edge sealing, thus permitting savings in time and space. It is not unusual for vinyl plastic to resist exposure in test equipment equivalent to approximately 15 years of normal use as automobile glass without discoloration or fogginess.

Another recent development of the glass industry is the spinning of glass fibers, also known as fiberglass and glass wool. Over 560 groups of products now employ it. It serves in insulation, curtains, draperies, suspenders, watch bands, and many other cases. The printing of fiberglass with a surface dye has recently been made possible, and it is expected that more use will be made of curtains, drapes, spreads, etc., made of the material, because it insulates well against heat and is completely non-inflammable. Fiberglass has long been recognized as highly suitable in electrical insulation. Its fire resistant qualities are combined with light weight. Because of its resistance to acids and temperature changes, fiberglass is finding increasing uses in filtration.

The manufacture of glass wool is an interesting and precise operation that is somewhat analogous in certain respects to rayon manufacturing. The fibers may be produced either as staple or continuous.

Small glass marbles of 1/3 or 1/4 ounce of almost optical quality glass are automatically fed at 30 second intervals into a small electric furnace, where the glass is melted at an accurately controlled temperature. Marbles are used for a number of reasons, one of which is that they are more easily inspected. Inspection is essential since a single air bubble would stop production for several minutes at least. A variety of glasses is employed, including an alkali free glass used for electrical purposes.

When staple fibers are to be made, the molten glass is discharged under a constant head in the furnace through a spinneret of 32 orifices in a plate of precious metal alloy. Directly below the spinneret is a special steam jet through which high pressure superheated steam is introduced in such a manner as to seize and pull the fibers at a high velocity, decreasing their diameters to 0.00025 inches each. It is possible to hold this diameter to plus or minus 2 per cent between approximately 0.0002 and 0.0004 inch in diameter. The fibers fall in lengths of from 12 to 15 inches, and are projected through the path of a gas flame to evaporate any moisture resulting from the steam. The fiber is collected and wound. It can be worked on standard cotton machinery.

Continuous fiber is produced by drawing 102 fibers from an orifice plate obtaining fibers of the same diameter as the staple fibers. The furnace set-up is similar, but no steam jet is needed. The fibers are led through an "eye" and wound on a bobbin, which rotates at a peripheral speed of 6000 feet per minute. From here it is possible to use standard cotton machines.

The process requires high standards of control. Molten glass at 2500 F with a viscosity of 2000 poises, similar to honey at ordinary temperature, is cooled 2000 F in 1/500 of a second during which time the viscosity has increased to 10^{13} poises.

Another product of the glass industry, which is being used more frequently at present, is the glass brick. This brick allows a certain amount of light to pass, is strong, corrosion resistant, a good insulator, fire proof, and exhibits a pleasing appearance. These bricks are poured in two sections, which are sealed together, leaving a vacuum in the center. In some cases fiberglass may be used to fill this vacancy.

In this age of plastics, it is not surprising that one having the appearance of glass should be developed. In 1937, Rohm and Haas of Germany announced the production of a glass of entirely organic base called Plexiglass. The esters of methacrylacid ($CH_2{:}C(CH_3)COOH$) are colorless liquids which can be made to polymerize and harden into bubble free transparent glass in thicknesses up to 2 inches. Plexiglass is impervious to air, rain, acids, gasoline, oils, fats, and waxes, but is dissolved by certain organic chemicals including acetic esters, benzene, chloroform, and alcohol. It is therefore useful in replacing wood in the filtration and conduction of certain liquids, where the use of metals is impossible. Further, the glass has been made into faucets, valves, connections, etc.

Plexiglass is less than half as heavy as silicate glass, but can stand from 8 to 10 times as much impact. When it does break, it does not shatter, but breaks into large pieces with no sharp edges, making it desirable for safety purposes.

An additional advantage is that the glass can be turned like metal or wood, cut, carved, etched, ground, engraved, and polished, and may be welded without leaving a seam.

An interesting, and perhaps novel, use of Plexiglass has been in the construction of models of blood vessels of human beings and animals by filling the vessels with a special solution of Plexiglass marketed under the trade name Plastoid, which polymerizes when heated to 50 or 60 C and retains the exact form of the original model, which is later dissolved and removed.

Recently furniture has been constructed of Plexiglass. It has an elegant but fragile appearance, but it is hard as wood, practically unbreakable, and impervious to dampness.

The old adage that people who live in glass houses shouldn't throw stones has evidently outlived its literal application in this day when not only window panes and water glasses are on the market, but also building blocks, clothing, and furniture are available in unbreakable glass.

BARNES TO EDIT CIVIL ENGINEERING

Donald P. Barnes, associate member of the American Society of Civil Engineers, and an Oregon State graduate, was recently named editor of Civil Engineering, official publication of the A.S.C.E.

After receiving his bachelor's degree at Oregon State, he continued his studies at the California Institute of Technology where he received his master's degree in structural engineering.

During the school year 1933-34 Barnes went to Germany where he audited courses in Berlin and Karlsruhe universities. Soon after his return he was employed by the United States Bureau of Reclamation and has been connected with that department until his present appointment.

Barnes is now a captain of Engineers in the organized Reserve, United States Army. He has done much writing and editing since his high school days.

Federal Power Goes to Market

COE. C. WHITE, E.E. '41

Our government power program for the Columbia river is now entering a crucial time in its development. The time has come to find consumers for all the power that can be generated and get that power transmitted to them. Two units of Bonneville are already running at nearly full load, but two more will be put into service early next year. Shortly after that the first unit of Grand Coulee will go into service, bringing the combined generating capacity of the two plants to over 300,000 kilowatts. Twenty-seven million dollars have been put into transmission lines to carry this power to market.

The backbone of the Columbia river power system is the 230 kilovolt transmission line from Grand Coulee to Bonneville. From Bonneville two such lines extend to the Vancouver substation at Ampere. To connect the Puget sound area with this network a 230 kilovolt line runs north to Chehalis and on to Renton where a large Seattle substation is located. Surveys for a similar line to cross the Cascades from Renton to Rock Island dam on the Columbia and thence to Coulee are now being made.

The central network formed by these lines will serve to move large blocks of power to minor transmission centers and to integrate the power facilities of the whole northwest. Seasonal variations in capacities of northwest hydro plants may then be mitigated by power exchanges throughout the system.

Transmission of power to individual load districts will be over 115 kilovolt transmission lines extending from major substations located at Bonneville, Vancouver, Chehalis, and Midway. The Vancouver-Eugene line crosses the Columbia river at Vancouver and connects with the St. Johns, Wilsonville, Salem, and Eugene substations. Another line is completed from Chehalis west to Raymond, Washington. Construction of two more lines from Bonneville to Oregon City and to The Dalles will proceed through this winter. The other federal transmission line on the system map are either in survey or construction stages.

The Vancouver-Eugene line is representative of the construction of the115 kilovolt transmission lines. H-frame pole structures with horizontal conductor spacing of twelve feet and a span of about 555 feet are built most of the way. Where the right-of-way is narrow, single-pole construction in 290 foot sections was used. Two hundred fifty thousand circular mil stranded copper conductor extends south to Salem on this line. From there to Eugene, the conductor is 397,500 circular mil aluminum cable steel reinforced.

The 230 kilovolt lines of the central net are all supported on standard steel towers with thirty foot horizontal separation and spans averaging from 800 to 1200 feet in length. The conductors are 1.1 inch diameter, 795,000 circular mil aluminum cable steel reinforced. These lines will carry about 100,000 kilovolt-amperes per circuit, the exact load depending upon the load character and line length.

All lines of the system are designed to withstand icing to a radial thickness of ½ inch. In the Columbia gorge the lines are built for ice one inch thick, while the exposed crossings at Bonneville dam are constructed to stand the simultaneous loads of a two inch ice sheath and a 60-mile-an-hour wind.

As many a private power concern has demonstrated, there is more to the power business than building the generation and transmission facilities. The power must be sold. To do this, the Bonneville Administration is striking out in two fields.

One field is in enlargement of small consumer demand by advertising, and by encouraging organization of Public Utility districts, municipal power districts and Rural Electrification administration lines.

The other field is more important from the standoint of sales volume. It lies in the encouragement of new industries located close to raw materials, transportation facilities, or markets by offering cheap power at the location. This brings a new idea to the power business. At any place on the system the wholesale rate for power is the same, regardless of the cost of transmission to that point. This is the so-called "postage stamp" rate. The customer near the dam pays the same transmission costs as the fellow at the end of the line.

Moreover, by allowing navigation and flood control considerations to remove from the capitalization two-thirds of the cost of the jointly used facilities of the dam—by using WPA labor for

(Continued on page 18)

Editorial Page

INITIATIVE AND THE ENGINEERING STUDENT

When most high school graduates enter the school of engineering, it is with the understanding that as soon as they have completed a four year course of study with reasonably high grades, industry will be waiting at the threshhold of graduation with open arms. They have been led to believe that because their course is probably more difficult and embraces more different fields of knowledge than most other courses, they are an elect group that industry in general can hardly wait to absorb.

It isn't very long after they have actually enrolled in their courses until they discover an amazing number of other "above average" individuals who are doing quite as well in the same course as they are. The greatest disillusionment, however, comes when they near graduation and find that, instead of besieging them with offers of positions in their chosen field, industrial concerns are sitting back at their leisure and considering for the few available positions only that small per cent of the class who managed to emerge at the top in the struggle for grades.

Much can be said for and against this system; undoubtedly the keen competition serves to weed out those who are totally unqualified. However, the significant point to note in this situation is that it is bringing more and more into prominence that important characteristic of a good engineer, initiative. As recently as fifteen or twenty years ago, the number of engineering students was so small and the opportunities offered by rapidly expanding industry were so plentiful, that mere acquisition of a bachelor's degree guaranteed an aspiring engineer a good position. Of course, even then the really successful and progressive men in engineering possessed initiative. But now, with the enrollment in engineering schools enormously greater than twenty years ago, and the increase in enrollment leading the expansion of the industries that employ the graduates, initiative is becoming an absolutely necessary attribute of an engineer.

The manner of application of this initiative toward placing ourselves as engineering students after graduation is varied. The usual method is, by continued and diligent effort and by participation in varied activities on the campus, to distinguish ourselves and attain high ranking in our class. This puts us in line for consideration for those few cherished positions that are offered by industrial concerns each year. However, even for the top students, this sometimes fails to produce the desired position.

A better procedure, which can be carried on in conjunction with the one mentioned above, is to develop some special interest in our chosen field and to study and work on this as a project. If the project is well chosen and the work well done, a new process might be developed or a modification suggested that would prove of actual benefit to a company interested in hiring us. Even if no outstanding results are obtained, the specialized knowledge we have acquired studying the problem, and the experience of working on our own initiative make us much more desirable in the eyes of any prospective employer.

The opportunities for development of this kind are numerous, and there is almost no limit to the places we can turn our initiative. On all sides in the technical literature we read of data that needs to be gathered on certain materials, or of problems that have never been investigated that might produce interesting and practical results.

In the last analysis, it all sums up to this: the industrial situation in this country has so changed that it is now necessary for an engineer to do more than acquire a degree to obtain a position in the field he desires to enter. He must exercise his initiative in building himself up and in making himself especially valuable to the industry he hopes to follow. This changed condition may result in greater difficulty in obtaining employment and may call for more careful application of time while in college, but those who succeed will be better engineers for it and will be more credit to their chosen profession.

R. G. FAIRFIELD, Ch. E., '41

Pilot Training at Oregon State College

B. F. RUFFNER
Professor of Aeronautical Engineering

During the academic year 1939-1940, 10,000 college students were given primary flight training in the colleges of this country. At Oregon State 30 completed the course. During the past summer 15,000 were given this training, of whom 60 were trained here. During the academic year 1940-1941, it is planned to train 30,000 more of whom about 100 will be at Oregon State.

The ground instruction in the primary course is given at the college. This gives a flyer the book knowledge necessary for him to qualify as a private pilot. Civil air regulations, navigation, meteorology, and theory of flight are all taught in this course. The course carries six term credits.

The flight instruction is given at Albany airport. In the primary course now in session two Piper Cubs, two Taylorcrafts, and a Rearwin are being used. Each student receives a minimum of 35 hours of flying, of which 17 are devoted to dual instruction and 18 are for solo practice.

The entire course, both ground and flight, is carefully planned so that no time is wasted. Except for a few hours of cross-country flying, all the time in the air is devoted to practice of maneuvers which develop coordination, judgment, and general flying technique. At the completion of the course each student takes a written examination prepared by the Civil Aeronautics Administration, and an examination on his flying ability given by a designated C. A. A. flight examiner. Those successfully completing these two examinations are given a private pilot certificate of competency, which permits them to operate an aircraft anywhere within the United States, with or without passengers, but not for hire.

This year two groups of primary students will be trained. The first group will complete their ground school during the fall term and their flying some time in January. The second group will take the ground school during the winter term, and their flying from February 1 to June 1.

The safety record established here has been justly praised by many. To date about 3600 hours of flying time have been completed by Oregon State students without a single accident. This speaks well for the flight instruction as given by the staff at Albany airport, and well for the students who have profited by this instruction. All through the course emphasis is placed upon safe habits of flying.

Beginning this fall an advanced flying course is being offered to a selected group of students who showed better than average ability during their primary flight training. This course consists of a ground course of sufficient scope to prepare the student for the written examination required of applicants for a commercial pilot's license. A theoretical and practical treatment of airplanes, aircraft engines, propellers, and instruments is given. Navigation problems of considerable difficulty are discussed. These include celestial navigation and navigation by radio aids, as well as by dead reckoning.

The flight instruction is given in heavier, open-cockpit airplanes of the same type as used in the Army for primary flight training. These airplanes are designed to withstand the stresses imposed in any type of acrobatic maneuvers. The student must, in this course, meet standards of precision in flying far greater than those required of the average private pilot. In addition to this greater precision, he must also be able to execute all basic acrobatic maneuvers including loops, precision spins, falling leafs, Chandelles, wing overs, snap rolls, and slow rolls. At the completion of the course, if he passes a successful flight examination, he will be granted a restricted commercial certificate of competency. This entitles him to the added privilege of flying for hire in a restricted area.

When the student completes the primary and

(Continued on page 19)

The Technical Societies

INDUSTRIAL ARTS CLUB

The annual Industrial Arts Club banquet was held on the evening of October 9 in the banquet room of the Corvallis hotel. Dan W. Poling, assistant to the Dean of men, spoke to the group of approximately 50 students and faculty members on the contribution of industrial arts training to American citizenship. Asa A. Robley, instructor in industrial arts, served as toastmaster.

John W. Turbyne, sophomore in industrial arts, was presented with the Epsilon Pi Tau freshman award for outstanding characteristics of scholarship and fellowship during his freshman year. Bruce J. Hahn represented the society in making the award.

This banquet is held every fall term as a reception for all new students in the department. Freshmen and transfers who are members of the club were guests at the affair.

SOCIETY OF AUTOMOTIVE ENGINEERS

The student branch of the Oregon State chapter of the Society of Automotive Engineers held no meeting in October, but concentrated its attention on the annual meeting of the national officers of the society, which was held in Portland this year.

The meeting was held in the ballroom of the Multnomah hotel on the evening of October 22. Arthur Nutt, national president of the S.A.E., and John A. C. Warner, general manager of the society, were guests of honor.

Both men spoke on the subject of national defense. Nutt, who is also vice-president in charge of engineering of the Wright Aeronautical corporation, chose for his talk, "Lessons Learned from the European Aircraft Industry." Nutt was in France at the outbreak of the recent siege on Paris and witnessed mass bombing of the city. Warner emphasized his speech on national defense with slide illustrations.

Five faculty members and 20 student members of S.A.E. and the Institute of Aeronautical Sciences from Oregon State attended the meeting. S. H. Graf, head of the department of mechanical engineering; W. H. Paul, associate professor of mechanical engineering; W. S. Gilmore, head of agricultural engineering; B. F. Ruffner, professor of aeronautical engineering; and Ralph N. Lunde, assistant professor of agricultural engineering, were the faculty members present.

The Oregon State chapter has 18 members in the student branch at present, and membership is increasing noticeably. Greater interest is being shown this year than in the past, and at the present rate of increase, the membership may increase to 25 by the end of the term.

CIVIL ENGINEERS

Captain H. J. Hoeffer, associate professor of military engineering, spoke on the national conscription bill and how it affects college students, at the first meeting of the American Society of Civil Engineers Wednesday night, October 9. Approximately 120 students and faculty members attended.

In addition to Captain Hoeffer's talk, a regular business meeting was held and it was decided that monthly meetings would be held with some guest speaker being invited. Lantern slides of various engineering projects in the United States are scheduled to be shown once a month with students interested in the subjects giving the lectures.

Other business of the meeting included the appointment of Wesley H. Butler, junior in civil engineering, as secretary to replace Sigvard O. Tysko, who did not return to school; the appointment of James A. Gallagher, senior in C.E., as chairman of the refreshment committee; and the appointment of Robert L. Stockman, senior in civil engineering, as alumni contact man to work with Dr. C. A. Mockmore, head of the department of civil engineering.

The next meeting of the group will be the regular term breakfast at which assistant state engineer C. B. McCollough will speak. The date has not as yet been set.

ELECTRICAL ENGINEERS

The Oregon State college chapter of the American Institute of Electrical Engineers held its first regular meeting of the year in Apperson hall 212 on Wednesday evening, October 9. Featured in the evening's discussion were speeches by several members about their summer experiences.

F. O. McMillan, head of the department of electrical engineering, and A. L. Albert, professor of communication engineering, told the members of the advantages which present themselves to students who are members of the institute.

Allen D. Snyder, Douglas J. Marsden, Charles W. Watson, and Jack E. Phillips were the student speakers who entertained the group with their talks. Phillips described the new air conditioning system of the Memorial Union ballroom, while the others gave information pertaining to the field of electrical engineering which they had picked up during the summer months.

President William H. Huggins introduced the speakers of the evening and made a few suggestions regarding the policy of the group for the coming year.

After the speeches were over, Lee Coe, senior in electrical engineering, was unanimously elected secretary of the society for the rest of the year. Following this, refreshments were served.

CHEMICAL ENGINEERS

The Oregon State chapter of the American Institute of Chemical Engineers had its first meeting Thursday, October 17, when plans for the coming year were made. The usual field trips to manufacturing plants throughout the state were scheduled, and tentative plans are being made for a trip to the San Francisco Bay area.

Officers for the year are: James A. MacLean, president; Carl Hering, vice president; Robert E. Vincent, treasurer; Robert W. Lundeen, secretary; and Robert A. Morrison, sergeant-at-arms.

MECHANICAL ENGINEERS

The student chapter of the American Society of Mechanical Engineers, held its first meeting of the fall term October 9. A. D. Hughes, instructor in mechanical engineering, told new members of a few advantages of belonging to the A.S.M.E. Donald L. Drake, senior in mechanical engineering, presided over the more or less informal meeting, during which several members of the group told of their summertime jobs on various engineering projects.

Although the club has not yet lined out a definite schedule for the coming year, the program promises to be well filled. A mechanical engineer's breakfast is planned for an early date, and Robert A. Plannansky, chairman of the engineer's bust, indicates that this year's occasion promises to be one of the best.

COMMUNICATIONS CLUB

The first meeting for the year of the Oregon State college Communications club was held in Physics 320 on October 8. A. L. Albert, professor of communications engineering, was the principle speaker of the evening. He addressed the group on some interesting aspects of frequency modulation which he learned during his travels over the United States throughout the past summer.

Professor Albert's talk had to do with the progress made in selling frequency modulation to the public and adapting it to commercial conditions rather than the technical problems of this type of radio design. He said that the transmitters and the receivers were ready for use, but that the public was not ready because they did not know frequency modulation at its best.

At a short business meeting preceding the introduction of the speaker, it was decided that the club would schedule only one regular meeting per month in the future. Some mention was made of resuming the code practice classes that met with so much favor last year, but nothing was decided on the subject.

At the close of the meeting cider and doughnuts were served.

THE HONOR SOCIETIES

TAU BETA PI

The first meeting of Tau Beta Pi, national honor engineering fraternity, was held Tuesday, October 22. Election of new members and the program for the coming year were discussed, and a new vice-president and recording secretary were elected to fill vacancies. The organization plans to have dinner meetings this year with outside speakers if possible.

Carl Hering, president, has just returned from the convention of the national fraternity, which which was held at Lexington, Kentucky, October 3, 4 and 5.

The officers for the Oregon State chapter this year are Carl Hering, president; William B. Wooton, vice-president; Karl Steinbrugge, corresponding secretary; Frank E. Biasca, recording secretary; James A. MacLean, treasurer; Robert S. Hampton, cataloguer.

ETA KAPPA NU

Guilford L. Hollingsworth, graduate in electrical engineering, presided at a short meeting of Eta Kappa Nu, national honor society in electrical engineering, on October 11. The main purpose of the meeting was to fill two vacant offices in the organization. Douglas J. Marsden, senior in electrical engineering, was elected recording secretary, and Lee Coe, also a senior, was elected to the office of correspondent to The Bridge.

It was decided to hold regular luncheon meetings for the group on the second Wednesday of each month in the Memorial Union tea room.

A survey of the activities of past E.E. graduates in the various positions which they hold or have held since their graduation was planned. This survey would correlate the benefits that these graduates have derived from their courses of study here at Oregon State college with the advice and suggestions that these men can give the students now in school.

PHI LAMBDA UPSILON

The first meeting of Phi Lambda Upsilon, national honor fraternity in chemistry, was held Wednesday, October 23. New pledges were elected and plans for the year discussed. A committee was appointed to make plans for the society's contributions to the chemistry departmental library.

The officers for the year are Alva V. Snider, president; Robert W. McGilvery, vice-president; James S. Smyth, secretary; and Dr. Charles S. Pease, adviser.

EPSILON PI TAU

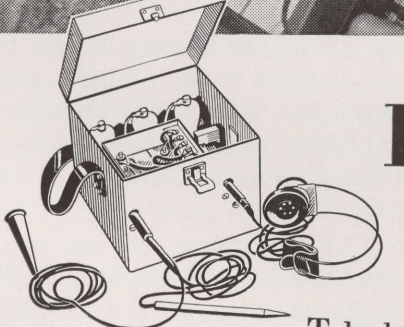
A meeting of Epsilon Pi Tau, national honor society in industrial arts, was held October 18 to elect new officers. Those elected were Arthur Palmer, instructor of industrial arts at Albany high school in Albany, Oregon, president; Oran J. Wright, senior in industrial administration at Oregon State, vice-president; George E. Weniger, junior in industrial arts education, secretary-treasurer.

The first project of the local chapter is a complete directory of the members of Delta chapter. The directory is to include each member's position, address, and college degree.

SIGMA TAU

James A. MacLean, president of the Oregon State chapter of Sigma Tau, national professional honor fraternity in engineering, was a delegate to the national Sigma Tau convention at Kansas State college in Manhattan, Kansas, last summer.

(Continued on page 20)



MEMORIAL UNION VENTILATION

In sharp contrast to the hot, stifling conditions that have prevailed in past years in the Memorial Union ballroom was the new atmosphere into which stepped a good many Oregon Staters on the night of November 2. This year a ventilating system, the only one of its kind west of Chicago, has been installed.

The system is designed to provide for cooling and dehumidifying the air and for reheating it when necessary. Normally, the plant is to operate as a cooling and ventilating system. In this capacity, it draws air from the ballroom into the air tunnel starting under the east end of the ballroom floor, through a filtering system, into a precooling device, through a dehumidifier, into a fan, where it is again sent out into the ballroom. This cycle is not accomplished as simply as it might seem from a cursory inspection of the air circuit. The air entering the system, after passing through the filters, is drawn into a precooling unit made up of a large number of coils containing chilled water.

Of special interest to the engineer should be this auxiliary system for chilling water. A chemical, Freon, is confined under pressure of a turbo-vacuum compressor. The Freon gas is sent through coils surrounded by water in an auxiliary tank. Heat is given up by the water to the gas, vaporizing it and returning it to the storage tank, thus cooling the water. From the precooler, the air passes into the dehumidifier, where it is sprayed with water from a storage tank, under pressure from a water pump. The amount of water supplied to the dehumidifier is controlled by a humidistat in the return duct leading back to the storage tank. As the humidity rises, the valve opens to a position allowing more water to go through the dehumidifying coil. On falling humidity the valve reduces the amount of water through the dehumidifier coil to prevent further dehumidification. From here the air is passed into a steam reheater coil, which may or may not be put into operation, depending upon the air temperature required in the ballroom. The air, now ready to enter the ballroom via the air tunnel, is picked up from the reheater by a fan operated by a 15 horsepower electric motor.

The air tunnel opening is rectangular in shape, dimensions being 32 inches by 62 inches. It tapers gradually down along the tunnel length to keep the air pressure constant. At given distances along the tunnel length are twelve separate air ducts leading to points along the south side of the ballroom. The air passes through these ducts up a channel located in a false section of each of the vertical posts along the wall into the space above a hanging, acoustical ceiling, which has been constructed about two feet below the old ceiling. This provides a constant pressure air space for the air which is admitted to the ballroom through a series of grills in the ceiling. A header is provided in the constant pressure section between ceilings to keep the air from circulating about in this area. Air dampers are located throughout the system to regulate the flow of air and also to keep pressures constant in all lines of the system. If at any time there should be an immediate demand for cold air, it may be provided by the turning of a damper to allow outside air to enter the system at the filtering unit.

The system should be elastic enough in operation, and the benefits to be derived from it should be as great as from any similar project of recent years.

CIVIL PILOTS

The Civil Pilot Training program at Oregon State college is in full swing again this year, and is speeded up to meet the increased demands of the military air forces of the United States for potential pilots. A total of 80 men will be trained in the two courses, primary and advanced. Their flight training is scheduled to be completed by January 15, 1941, whereupon another similar group will start training.

In the primary course are 50 men taking basic flight training in various types of light planes. The training ships for this group include two Taylorcraft, two "Cubs," and a heavier Rearwin. Flight training for this group started on October 14.

Three Waco YPF-14's were chosen as the training planes for the advanced course. The Waco is an open two-place biplane with a 220 horsepower Continental motor. The flight training in this section began the last week in October.

When everything connected with the course is under way, the airport at Albany is a scene of intense activity. The instructors are accenting the rules of aerial courtesy and other more specific air regulations which are necessary for the safety of the pilots and airplanes.

Prof: "What is the outstanding contribution that chemistry has given the world?"

Soph: "Blondes."—The Cal. Engr.

CEMENT PRODUCTION

(Continued from page 6)

and propelling a 12-gage lead pellet about 2 inches long.

From the coolers the burned slurry, or clinker, is transported over Skipulter type conveyors to large cone crushers, which reduce the material to about a pea-gravel size. This crushed clinker can then be stored in a large dry building for future use or conveyed directly to the finish mill feed bins.

As the clinker is fed to the finish grinding mills, a small percentage of gypsum is added to control the setting time of cement when used in a concrete mixture. Permanente's plant is equipped with four large finish grinding ball mills. Two of these are Smidth mills, one is a Traylor mill and one is an Allis-Chalmers. The two Smidth mills are single units, the Traylor and Allis-Chalmers mills are each composed of two units. The first units are preliminator mills carrying grinding ball charges of about 25 tons. The second units of both are 8 by 40 feet in size and use charges of about 75 tons each of forged steel grinding balls. These grinding mills are rotated with 1000 horsepower, three phase motor.

All these finish mills operate in closed circuit grinding with air separators permitting passage to storage of only the cement that has reached the required grading of fineness.

During finish grinding operation, samples of cement are taken hourly for testing by the National Bureau of Standards. If these samples pass all other requirements, test specimens are made of fine aggregates and cement, subjected to normal curing conditions and broken in strength-testing machines at intervals of from one to twenty-eight days. During this testing period, the storage bins containing the material sampled, are sealed by the Bureau of Standards and released for shipment only after these tests have proved the quality of the product.

While awaiting these qualifying tests, cement is stored in the 43 reinforced concrete silos, having a storage capacity of approximately 568,000 barrels. These silos are 90 feet high and occupy a space of about 90 by 270 feet. Bulk cement is drawn by gravity from these silos directly into freight box cars for shipment and cement to be packed is transported by Fuller-Kinyon air pumps and piping to the packing plant. From the packing machines the sacked cement is transported by means of shuttle conveyors directly into cars or trucks.

As to capacities, the quarrying and rock conveyor system can handle about 1200 tons per hour. The actual cement plant is rated at about 10,500 barrels of cement per day.

NEW KOAC TRANSMITTER

On the Oregon State college experimental farm at Granger, about half way between Albany and Corvallis on highway 26, construction of a new transmitter for radio station KOAC is getting under way. The construction permit has been received and specifies that work on the project start on or before October 14, 1940, and be finished by April 14, 1941.

The permit calls for a daytime power of 5000 watts and a night time power rating of 1000 watts.

The transmitter has been contracted for by the Graybar Electric company and will be the most recent product of Western Electric's laboratories. It will be equipped with voltage regulator, limiting speed amplifier, and a new high-efficiency Dougherty power amplifier.

The project will entail construction of a directional antenna system consisting of two 325 foot, uniform taper, self supporting, steel towers which will be equipped with 1000 watt flashing red beacons on their tips and standard one-third and two-thirds airway warning lights, controlled by a photo-electric switch.

Approximately 240 radials, each 720 feet long, and 240 radials 360 feet long will make up the ground system. No. 12 copper wire will be used and will be buried about two feet below the ground.

The building planned to house the new equipment will be of fireproof construction and will be heated by the exhaust from the transmitter's air cooling system, supplemented by other sources of heat as may be necessary.

Each tower will be connected by individual coaxial cables to the transmitter, and the phasing and current-dividing network of this connection will be part of the work contracted for by Western Electric. The phase angle between the towers will be continuously monitored through coaxial cables from a phase monitor in the transmitter house.

He (putting his hands over her eyes): "Guess who it is in three guesses or I'll kiss you."

She (quickly): "Charlie McCarthy, Robert Taylor, Eddie Cantor."

FEDERAL POWER

(Continued from page 9)

clearing the right of way, and by setting up liquidation of the cost on the basis of 3½ per cent for interest with amortization over a 40 year period, the rate for Bonneville power has been made low. The basic power rate is $17.50 per kilowatt year of contract demand. This is in many cases lower than the station bus-bar costs of smaller hydro plants. An even lower rate of $14.50 per kilowatt year applies at the dam site, but ready access to ocean transportation, labor supply, or raw materials in other locations will limit the local consumption of power.

For small users another rate is designed on the kilowatthour basis at 2½ mils per kilowatthour plus a yearly charge of 75 cents per kilowatt demand. Surplus power is sold at a flat rate of 2½ mils per kilowatthour to power customers to replace fuel stand-by power, but the stand-by plants must be ready to take the load when no surplus is for sale.

Bonneville power customers are of four classes: the Public Utility districts, Municipal electric systems, private power companies, and industrial power users. The much-heralded Public Utility districts are as yet situated mostly in Washington and have a total contract demand of but 5600 kilowatts. Municipal systems, numbering among them Cascade Locks, Forest Grove, Canby, and McMinnville, account for another 7400 kilowatts demand. Sixteen more municipalities have indicated their desire for Bonneville power when transmission lines are brought within reach.

Private power companies are already purchasing large blocks of power. The Portland General Electric company is purchasing under temporary contract 20,000 kilowatts of firm power and almost equal amounts of surplus power to care for peak conditions. Other private company purchases are smaller. Connection of the Bonneville system with the Puget Sound systems is to be principally for the purpose of power exchange.

It will be noticed, however, that these sales are mostly a matter of taking up the slack in the present power situation by substitution of one power source for another in markets already established. This type of consumption can be counted on for some expansion due to lower rates, but not on the large scale for which the Bonneville system is built.

There is left industrial expansion as the mainstay of the Bonneville Power market. Bonneville's present capacity is 86,000 kilowatts. By January it will be 194,000 kilowatts and by midsummer the addition of Grand Coulee unit number one will bring the capacity of the whole system to over 300,000 kilowatts. A comparable expansion of industry is needed. .

The $4,500,000 plant of the Aluminum Company of America located at Vancouver is using power now under a twenty-year contract for 32,500 kilowatts of firm power. A like additional amount will be required upon completion of the second plant unit. Further expansion of the plant to supply urgent war needs is expected.

Another industrial contract has been signed with the Sierra Iron company for 6000 kilowatts of firm power. Start of plant construction has been delayed considerably by financing troubles. A smaller contract calling for an ultimate consumption of 2000 kilowatts has been signed with the Pacific Carbide and Alloy company, which intends to build an acetylene plant in the Portland-Vancouver area.

The total of all these contracts, however, does

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PILOT TRAINING

(Continued from page 11)

advanced courses, he has had the ground and flight instruction equivalent to the first portion of the Army and Navy flight training courses. If he enters either of the military services after completing the advanced C.A.A. course, he may go immediately into the secondary phases of the Army and Navy courses. It has been said by one of the C.A.A. officials that "the C.A.A. courses make flyers out of the boys, and the Army and Navy have only to worry about making them military pilots."

This is an air-minded generation. Thousands of men in colleges wanted to fly but were prevented from doing so because of the expense involved. Today any college man, who can meet the physical requirements, may learn to fly by enrolling in the C.A.A. courses now offered at many educational institutions.

At first some educators believed that it was not the function of colleges and universities to teach flying. They claimed that this was not the type of work that would fit into the general academic life of the college, and had little or no academic significance. In answer to this argument I have two remarks to make:

First, the ground courses as given involve subjects which contain scientific information, and which are sufficiently difficult to meet the most exacting educational standards.

Secondly, it seems to me that one of the primary functions of education is to develop initiative and self-reliance. There does not exist a situation that I know of that puts a man as much on his own as when the ground drops away from him on his first solo flight. One of our flight instructors, Howard Burleson, got out of an airplane and sent a student up on his first solo flight. Many spectators stood watching to see how it would turn out. Howard said, "Guess I'll get a cup of coffee, I can't do him any good; he's on his own now."

SIGMA TAU

(Continued from page 14)

He reports an excellent convention with an interesting, varied program. At the convention J. H. Belknap, formerly of Oregon State college, was elected counselor and will probably be elected president. Other counselors are Claryl B. Mapes and C. H. Sjogren.

Officers for the year at the local chapter are: James A. MacLean, president; Robert S. Hampton, vice president; Frank L. Wells, treasurer; William B. Wooton, recording secretary; Karl Steinbrugge, corresponding secretary; Eugene F. Grant, historian; and J. C. Othus, adviser.

FEDERAL POWER

(Continued from page 18)

not come near the capacity the system will have next year. The Bonneville Administration Marketing Division sees a job ahead. Certainly some power-hungry war industries will come to the Columbia river region, but to create for us a healthy regional development will require starting of many new local industries.

The rise of a greater variety of industry will be a great stabilization agent in our local economy, removing some of our regional dependence on the lumber and agricultural markets.

To inform industries on the possibilities of the Northwest and to aid local promotion, the Marketing Division, with the cooperation of state agencies, and chambers of commerce, is making complete summaries of industrial sites, transportation, labor, taxes, and resources for the whole Columbia area. The information will be for any interested party.

The Bonneville Administration is so confident that industrial expansion for the Northwest is coming soon that they have set in motion plans for early installation of the next units of both Bonneville and Grand Coulee, to be completed in 1942. Some thirty millions more will then be required for construction of lines to market the additional power.

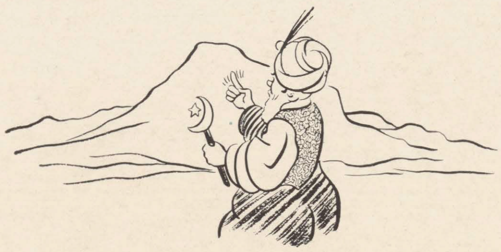
Such optimism is heartening, for the success of the Northwest in making profitable use of the power of the Columbia river would mean success of our government in management of a modern-day pioneering job and success of the people of the Northwest in lifting themselves out of a harshly dependent economic position.

The power is there. It is developed. To utilize it is our challenge and our opportunity.

Math Professor: "Now watch the blackboard while I run through it once."

—Pennsylvania Triangle

G-E Campus News

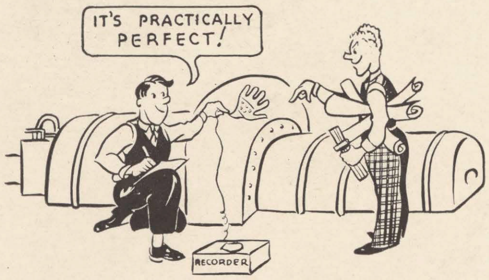


"HITHER, MOUNTAIN!"

IT'S been centuries since Mahomet resigned himself to go to the mountain because the mountain wouldn't come to him. If Mahomet were living today, he wouldn't have to go to the mountain, that is, if he were at Shasta Dam—the second largest concrete dam in the world—now under construction in California.

There the world's longest conveyor belt is moving mountains—5,700,000 cubic yards of concrete and 10,400,000 tons of sand and gravel—from the processing plant to storage piles near the dam site, a distance of 9.6 miles.

Driving the conveyor belt are General Electric motors and control, thoroughly checked and tested before going on the job by young student engineers taking the G-E Test Course. J. A. Jackson, Va. Poly. Inst., '00, and R. F. Emerson, Yale, '06, had charge of the engineering at Schenectady, and A. W. Moody, U. of Calif., '36, followed engineering on the job. All three are ex-Testmen.

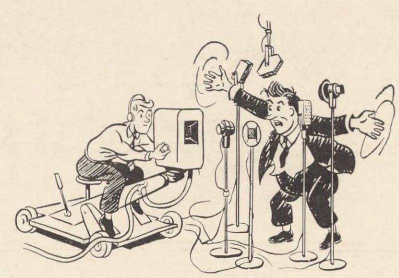


SUPER STREAMLINING

IN this modern age practically every means of transportation is streamlined—automobiles, airplanes, trains, and even baby carriages. The closest approach to perfect streamlining, however, is probably not found in any one of the foregoing but in a General Electric steam turbine, where nozzles must be designed to direct steam at the buckets at just the right angle.

G-E engineers have streamlined turbine nozzles to a point where they absorb less than two per cent of the velocity energy of steam traveling through turbines. Working with models, engineers about 20 years ago found they could feel low-pressure spots in an air stream blown through nozzle sections. Literally and figuratively they were "putting the finger" on streamlining deficiencies. Now, in a special laboratory, air is forced through model nozzles at a terrific speed (more than 700 miles an hour) while mechanical "fingers" feel for points of eddy or friction loss, and an automatic machine records the results.

These "streamline" tests, conducted by young student engineers "on Test" under the direction of experienced engineers, give records of inestimable value in the constant search for new ways to build more efficient turbines.



SIX VOICES

PEOPLE who have qualms about broadcasting probably would have passed right out if they had been in the shoes of George A. Mead, N. Y. State Commander of the American Legion, when he broadcasted recently from General Electric's television studios at Schenectady, N. Y.

For the first time in history a voice was carried over every practical means of voice communication. Mead's talk, in addition to going out on the ultra-short-wave band accompanying the picture on television, was simultaneously carried by WGY on long-wave radio, WGEO on short-wave, W2XOY on frequency modulation, and by light beam and ordinary telephone. In all, six distinct frequency bands carried his words to the four corners of the earth.

Directors of this unusual broadcast were John Sheehan, Union, '25, manager of G-E short-wave broadcasting, and J. G. T. Gilmour, Union, '27, program manager of G.E.'s television station, W2XB.

GENERAL ELECTRIC

953-7