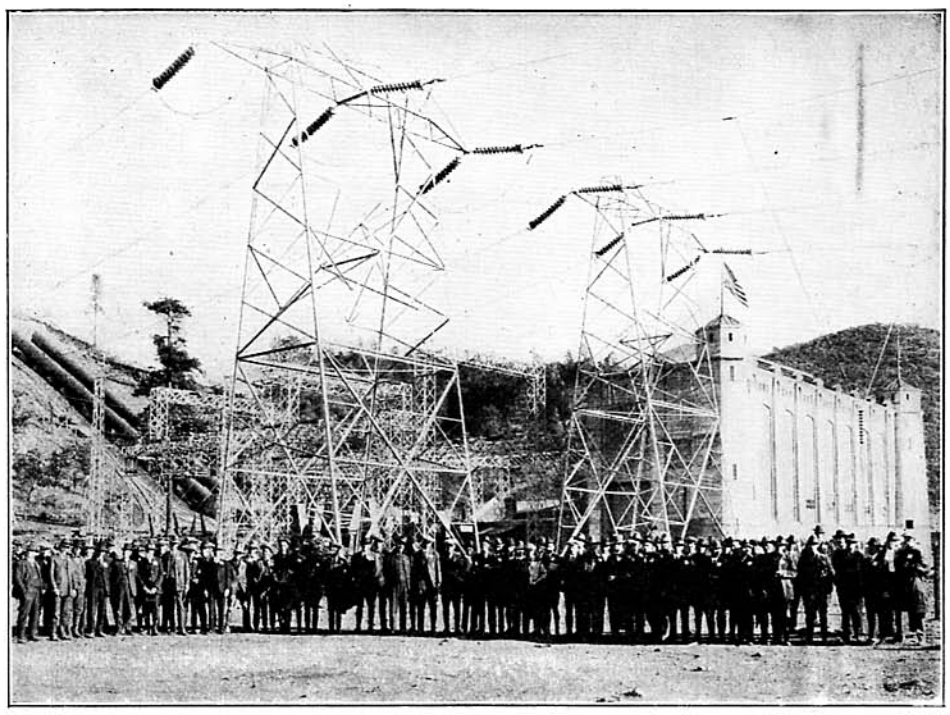
The World's Longest Line Radio System

By CHARLES W. GEIGER

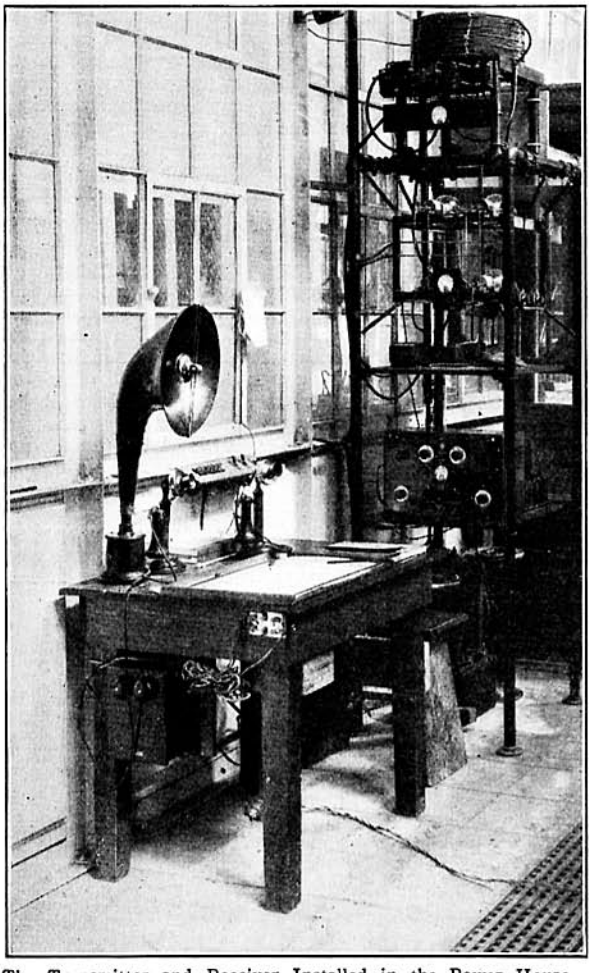
THE Pacific Gas & Electric Co. now has in successful operation the world's longest guided radio telephone and telegraph system between the Vaca-Dixon substation and the Pit River Power House No. 1. The system utilizes the twin circuit 220,000-volt transmission lines between the two points for a conducting medium, a total distance of 202 miles, and is for the sole purpose of directing the operation of the two stations both under normal and emergency conditions.

The system is coupled to the transmission line through a single wire antenna about 1800′ long. This wire is attached to the twin vertical circuit transmission towers at a point on the center line of the tower and at the elevation of the middle cross arm. Six standard 10″ suspension insulator units are used for dead ending and supporting the antenna. The main station ground system is also used as a ground for the radio equipment, sending on a wave-length of about 10,000 meters.

The transmitting equipment is a regular vacuum tube Radiophone similar to those used by the high power broadcasting stations. Four 250-watt and one 50-watt Radiotron tubes are employed, two of the tubes being used as oscillators and two as modulators with the 50-watt tube as a speech amplifier. The plates of the 250-watt tubes are supplied with a potential of 2,000 volts D.C. from a 2-kw. generator. This generator has two commutators, each supplying 1,000 volts D. C. and a tap is taken off to supply 1,000 volts D.C. potential to the plate of the 50-watt tube. Mounted on the same shaft with the 2000-volt generator is a 1⅜-kw., 125-volt exciter which also has sliprings for supplying 88 volts, 30-cycle alternating current. This 88-volt alternating current is stepped down to 11 volts through a special 800-watt transformer and is used for lighting the filaments of all the tubes. The generator and exciter are driven by a direct connected 6¾-hp., 115-volt D.C. shunt-wound motor. This motor derives its energy from the main station storage battery which is unusually large in order to handle the 220,000-volt oil circuit breakers. Normally the battery floats on the charging set and a contactor has been installed in connection with the automatic motor starter which short circuits a portion of the charging generator field rheostat and permits a rise in generator voltage to compensate for the extra load of the radio motor generator set. Thus under normal conditions of operation no drain is placed on the storage battery. An automatic motor starter is used for control of the motor-generator set, the starting and stopping of the set being accomplished by taking the telephone receiver off or putting it on the hook.



The High Tension Lines and the Aerial at the Pit River Power House. Note the Aerial Parallel to the Lines and the Lead in on the Right. A Wave-Length of 10,000 Meters is Employed in This Wired Radio System.



The Transmitter and Receiver Installed in the Power House. Note the Calling System Consisting of a Microphone Attached in the Horn of the Loud Speaker Which Howls When the Other Station Rings.

The receiving equipment consists of a Colin B. Kennedy type 110 Universal receiver, which has been modified to make it a non-regenerative receiver, and a Western Electric loud speaking outfit using two stages of audio-frequency amplification.

Calling is accomplished by mounting a calling microphone in the horn of the loud-speaker which, when the calling circuit is completed, will oscillate and howl in much the same manner that the ordinary telephone will howl when the receiver is placed against the transmitter. This gives a very loud note, the pitch of which will depend upon the natural period of oscillation of the diaphragms and which is clearly audible in all parts of the station. Ordinarily, it is not necessary to use the calling system, as the receivers are always in service and the operator is near the set so that the loud speaker simply talks to him and he starts up his set and talks back. The system is arranged for simplex operation and all that is necessary is to operate a small telephone switch which energizes a contactor to connect either the transmitting or receiving set to the antenna, thus permitting talking or listening.

All the experimenting and development work necessary to place the equipment in a satisfactory operating condition was done under the direction and supervision of Dr. L. F. Fuller.

The accompanying photos show the temporary equipment during the experimental stage at Pit River Power Plant No. 1.

USE OF KILOCYCLES IN RADIO

The Second National Radio Conference, which met with Secretary Hoover in March, introduced a method of designating radio waves which is somewhat new to the radio public. This is the use of frequency in kilocycles (abbreviated kc) instead of wave-length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave-length in meters. As a matter of fact, wave-length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio

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sugar manufacturing company in Cuba, writes: "Here we are away from good medical service and any constant education like you are giving is sure valuable to us United States citizens down here in a foreign country." An industrial enterprise in Canton, North Carolina, employing 1,000 laborers, is receiving health information for the benefit of its employees. A citizen of Brentwood, Maryland, writes: "I always have some of my friends and neighbors in to hear the lectures. They have benefited a good deal by your lectures. There have been three or four children vaccinated since your lecture on that subject."

In Covington, Kentucky, "Health Education by Radio" is helpful to Boy Scouts that are subjected to health tests. A person writing from Nashua, New Hampshire, says, "A week or so ago I had three of our noted doctors at my house at the time that you were talking on tonsils and adenoids." A citizen of Dubuque, Iowa, says that health lectures are of particular interest to his mother who is connected with a children's clinic. In McGregor, Iowa, hints on how to keep fit physically are heard in a hall accommodating 100 persons, a loud-speaking horn being employed. "What better way could the Government educate the people in the way to better health and to help prevent the spread of disease in the United States?" inquires one individual. A teacher in Kalamazoo, Michigan, states that these lectures help her in properly instructing the pupils of the school in which she teaches. A person residing in Cherrydale, Virginia, was impressed with the advice that bottles of medicine prescribed for a patient should be destroyed after the recovery of the subject. A man in Brockton, Massachusetts, was so much impressed with the discourse, "How Do You Sleep?" that he has asked for a repetition of it by radio telephony. A woman of Brookfield, Massachusetts, who is a constant sufferer from headache, received valuable hints from a talk by radio telephone on this subject. A chief train dispatcher, living in Providence, Rhode Island, writes: "I had my eyes tested this morning and found my glasses needed changing and got a new prescription." A meteorologist of Binghamton, N. Y., states: "All public health work is valuable and the broadcasts cover a wide territory at little expense. Their inauguration has encouraged others to broadcast health information, notably, the New York State Department of Health, the Detroit Board of Education, and others. The Government needs to establish a radio audience. This cannot be done with phonograph records or political speeches."

Use of Kilocycles in Radio

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wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave-length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the fre-

quency may be. This necessary separation is variable and quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave-lengths from 150 to 200 meters, but this is a frequency band from 2000 to 1500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than, for example, the band having the same width in meters from 1000 to 1050 meters, which is 300 to 286 kilocycles. While it is possible to carry on fifty simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters.

In accordance with the recommendation of the Second National Radio Conference, the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The Conference recommended the practice of expressing wave frequency in kilocycles per second with wave-length in meters in parentheses thereafter. The relation between the two is very simple. To obtain kilocycles, divide 300,000 by the number of meters; to obtain meters, divide 300,000 by the number of kilocycles. For example, 100 meters = approximately 3000 kilocycles, 300 meters = 1000 kilocycles, 1000 meters = 300 kilocycles, 3000 meters = 100 kilocycles.

For highly accurate conversion the factor 299,820 should be used instead of 300,000.

WANTED, A NAME

Someone has suggested the name of "Radiowners" for those of us who have sets and listen in. Certainly it is better than most of the awkward terms in use today. "Listeners-in" is too long, "Radiophans" or "Radiofans" sounds like the name of an instrument, and we could hardly designate them as "receivers."

Calls Heard

(*Continued from page* 41)

3II, 3BVY, 3BNU, 3BIF, 3FB, 3OH, 3BOF, 3ADB, 3CTY, 3ZP, 3BHL, 3KM, 3GZ, 3CC, 3AFW, 3AMW, 3AOD, 3AUW, 3SU, 3ARO, 3APR, 3CBZ, 3BJY, 3VW, 4BW, 4BI, 4BK, 4BY, 4EB, 4EP, 4EL, 4NV, 4FT, 4BX, 4OI, 4XO, 4FS, 4AAE, 4AG, 4MB, 5XB, 5XAJ, 5EK, 5BA, 5KC, 5XT, 5MB, 5ZB, 5JB, 5NZ, 5AAG, 5ZH, 5XAD, 5BH, 7ZO, 7ZV, 8CLV, 8EEC, 8XI, 8RJ, 8VN, 8AMM, 8VQ, 8BFX, 8IY, 8BNG, 8CIM, 8CUV, 8ZD, 8ABX, 8CFN, 8BV, 8UC, 8EL, 8CEA, 8CF, 8LO, 8ARD, 8WX, 8ALF, 8BDA, 8CDI, 8KJ, 8LC, 8EO, 8ZO, 8BDU, 8CXF, 8XY, 8ADQ, 8AIK, 8QK, 8BEO, 8FV, 8AWZ, 8CDD, 8CRL, 8CKO, 8ANB, 8AIW, 8CIY, 8BVY, 8ON, 8CLD, 8AVD, 8BJO, 8DBS, 8TE, 8ALT, 8BEN, 8AJX, 8UF, 8CBC, 8KP, 8GZ, 8ZW, 8CPV, 8FU, 8AXA, 8JY, 8ZK, 8BXA, 8II, 8BBE, 8JJ, 9ATO, 9ANO, 9CDU, 9CTE, 9AWF, 9DCB, 9ZN, 9AJ, 9BCH, 9DRR, 9APW, 9APS, 9DKK, 9CP, 9ACE, 9ZAA, 9BHD, 9CYM, 9OK, 9AWK, 9DRI, 9ZAE, 9DGO, 9BBD, 9CBA, 9EI, 9BVY, 9DGV, 9AAP, 9BGI, 9HK, 9QF, 9CMV, 9RY, 9BDB, 9DKL, 9FP, 9VZ, 9CY, 9BRE, 9ZY, 9BAR, 9DBL, 9AEN, 9BZI, 9YB, 9AEC, 9DXE, 9IL, 9CN, 9EJT, 9BRK, 9DOM, 9DAX, 9DWO, 9AMI, 9CPG, 9AVG, 9UU, 9ZT, 9PO, 9CUI, 9OR, 9DWF, 9AZX, 9BHW, 9BXK, 9OX, 9ARG, 9AZE, 9CXP, 9BGB, 9AL, 9CTV, 9AIX, 9AJS, 9APD, 9LZ, 9DYW, 9AEY, 9DSD, 9BDS, 9BUC, 9DC, 9DFB.

3WU, WASHINGTON, D. C. (ONE TUBE)

C. W.—1AP, 1AW, 1BM, 1FD, 1GV, 1II, 1IV, 1MY, 1ON, 1OW, 1PM, 1QP, 1RD, 1RU, 1UN, 1XM, 1XX, 1XZ, 1ZE, 1ABF, 1AGH, 1AGP, 1AIJ, 1AKL, 1AOK, 1AOL, 1ARY, 1ASF, 1AUN, 1AWB, 1AYO, 1AYZ, 1BAS, 1BDI, 1BDO, 1BEP, 1BGF, 1BKA, 1BKO, 1BMR, 1BOO, 1BYN, 2EL, 2FZ, 2OM, 2RM, 2AFP, 2AWF, 2BBB, 2BJP, 2BMR, 2BRB, 2BRC, 2BUR, 2BYW, 2CCD, 2CPD, 2CSL, 2CVU, 2CXD, 3's too numerous, 4BX, 4BY, 4EA, 4EL, 4FT, 4JK, 4KC, 4NV, 4OI, 5FT, 5FV, 5KC,