

THE SPECIAL INSTRUMENT HOUSE AND ANTENNA

Used at WGY for sending their programs out on 107 meters for rebroadcasting. A special heavy mast is used to prevent swinging and consequent changes in wavelength. The antenna itself is made of $\frac{3}{8}$ " hemp wound with many fine bare copper wires

The Rebroadcasting Set at WGY

Behind the Scenes of the High Power 107 Meter Transmitter at the Schenectady Station—The Novel Electrical Arrangements Which Have to Be Made Where the Powerful Short Waves Are Produced

By W. J. PURCELL

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ONE of the most interesting contributions to radio during the present year has been the development and successful operation of the short wave transmitter.

By its use distant places heretofore only occasionally reached on long wavelengths become readily accessible with a fair degree of reliability. Signals are transmitted so clearly and with such volume that it is possible to pick them up 3,000 miles away and successfully rebroadcast them.

For several months past, WGY, the Schenectady station of the General Electric Company, has been experimenting with a short wave transmitter, and on April 5, these experiments, carried on in cooperation with the British Broadcasting Company in England, reached a climax. On that day, every station in England

relayed or rebroadcast the WGY short wave signals. One radiogram received from London during the progress of the concert enthusiastically proclaimed it "all as clear as if played in London." The concert broadcast was held in the Wanamaker auditorium in New York, and consisted of organ, tenor solos, trumpet selections, and speech. The program was conveyed by line circuits to WJZ in New York, from which point, after amplification, it was conveyed over wire to the control room of WGY in Schenectady. There it was twice broadcast, once on a short wavelength of 107 meters, and on 380 meters from the regular transmitting equipment. The short wavelength signals, inaudible on most receiving sets, crossed the Atlantic and were picked up on a sensitive receiver by 2 LO and were then fed by wire to all the stations making up the British Broadcast-

ing Company group. Crystal set owners in London, Manchester, and other English cities, and near-by English transmitting stations, all reported excellent reception of the music played in New York.

WGY was informed recently on excellent authority that the Gilbert & Sullivan comic opera "The Mikado" produced in the Schenectady studio and broadcast on both 107 and 380 meters had been heard in Johannesburg, Africa, May 15. The short wave signals were received. This constitutes a new distance record for WGY as Johannesburg is 8,034 miles from Schenectady.

NEW RADIO WRINKLES AT WGY

WHILE the design of a short wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2,803 kilocycles—requires the use of some unusual and novel apparatus. As shown in the accompanying picture, the antenna used is of the fan type, but it differs in some respects from the conventional antenna. In order to decrease resistance losses, its conductors are made of three-eighths inch hemp, over which is braided many fine strands of bare copper wire. The two wooden poles supporting the antenna are much larger than necessary to support structure of this size, but they are essential to prevent the antenna from swinging. A swinging antenna would cause unfortunate frequency changes.

The building sheltering the transmitter proper is located slightly to one side, allowing the counterpoise to come directly underneath the center of the antenna, greatly increasing the radiating efficiency of the system. The antenna is eighty feet high and sixty feet in width at the top portion of the fan. Its fundamental wavelength is 160 meters. When the antenna is operated below the fundamental period, its current seems very low. Measurement, how-

The Importance of Rebroadcasting

Many of the prophets among those radio men who ought to know, say that broadcasting eventually will mainly be done by super-power broadcasting stations, located in leading cities of this country, where excellent speakers, excellent music, and the other bone and sinew of radio programs are easily had. The smaller local stations will not be disposed by this scheme of things, these forecasters say, for they will be able to pick up the super programs and rebroadcast them. KDKA and WGY have been doing some extensive and quite successful experimental work with transmitters for rebroadcasting. Before the finished commercial product must come the experiments. This story by Mr. Purcell of the special set at WGY should interest the host of amateur operators and broadcast listeners who have heard the surprisingly penetrating waves of WGY on 107 meters. "Broadcasting Complete American Programs to All England" in this magazine for March, told of KDKA's experiments in rebroadcasting.—THE EDITOR.

ever, shows a much higher field strength and radiating efficiency on the short wave adjustment than when a smaller antenna and a higher antenna current are employed.

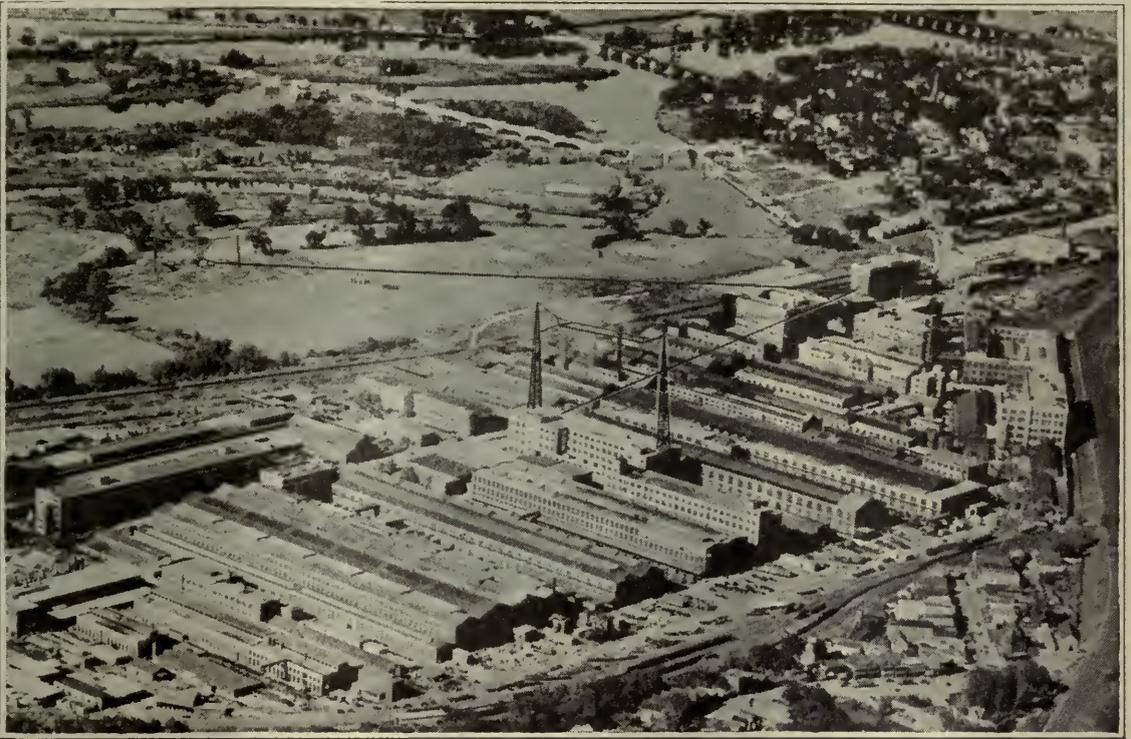
In order to secure maximum radiation, the transmitter is located on level ground, a mile from the nearest building. The instrument house is located near a bend in the river and the conductivity of the soil in that vicinity is therefore comparatively great.

The oscillating system is of the conventional coupled-type in which the frequency is

controlled by a tuned circuit rather than by the antenna circuit. This method greatly decreases the possibility of frequency change due to the swinging of the antenna in the wind. The primary coil consists of one and a half turns of copper ribbon two inches wide and this is tuned by an air condenser made of aluminum plates three feet square. In solving the problem of a spacer for these plates that would not break down it was decided to use very thin hard rubber strips. The power tubes are water cooled and are connected to a pump to a large radiator which insures an uninterrupted supply of water. Coupling to the antenna is secured through a single turn of copper ribbon clearly shown in the photographs.

Because the wavelength used is extremely low, we have had some odd electrical effects in the operating room. When a transmitter is built, the usual practice is to connect all metallic objects, such as iron frame work, transformer cases, and motor generator frames together with copper ribbon. This procedure, we discovered, could not be followed in our short wave transmitter because, while the inductance of a conductor only a few feet long is very small, it is great enough to allow a considerable voltage to be built up across it at this frequency.

Because of the intense field about the transmitter it is necessary to be very cau-



WGY AND WGY II.

Seen from an airplane. The retouched photograph shows the towers of the main station a-top one of the buildings at the Schenectady works of the General Electric Company. Both transmitters, the 107 meter one and the 380 meter one, are connected to the control room and studio which serves for both

tious while the set is in operation. Two men standing on insulated stools, each holding a metal rod in his hand, can draw an arc six inches long between the rods. No shock is felt because current of this nature travels through the skin rather than through the body. However, if the bare hands were used instead of the metal rods, a severe burn would be the result. Arcs will jump from the stove to the shovel when adding coal, and care is necessary to prevent the body from coming in contact with any metallic objects. It is possible to light an ordinary sixty watt electric lamp to full brilliancy by holding the glass bulb in the hand. Metal pencils, watches and like articles cannot be carried on the person because of the small sparks which jump to them. Shoes with metal nails cannot be worn because of the sting one feels when he steps on the nails in the wooden floor.

The modulator tube is water-cooled and it is connected to the same cooling system as the oscillator. The speech power amplifier is a 250 watt radiotron, and, because of the intense field from the oscillator and its associated

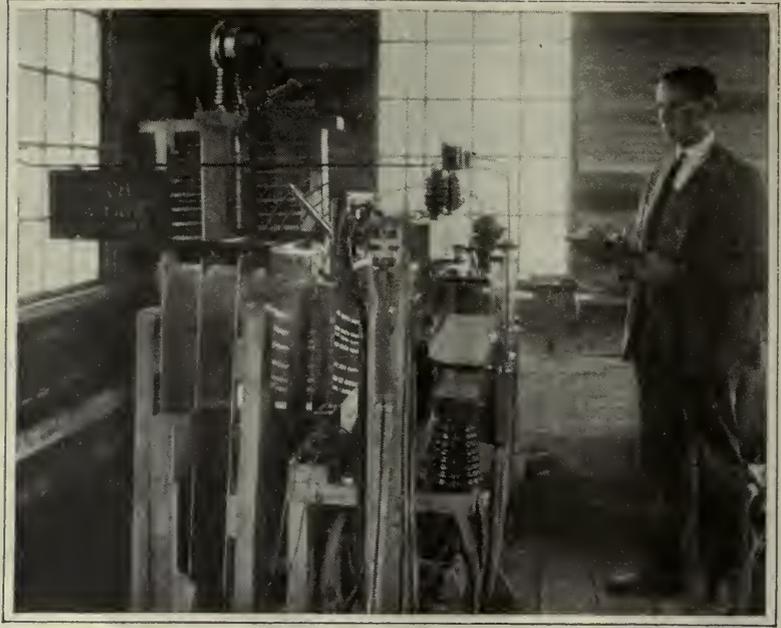
apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded, and the lines to the studio and control room are covered with lead and are buried to prevent the radio signal from getting back into the input circuit.

The plate power supply to the water-cooled tubes is a three phase full wave rectifier capable of supplying thirty kilowatts at fifteen thousand volts. Filaments are lighted by special direct current machines to eliminate the ripple which results from the use of alternating current on tubes employing a high filament current.

The results obtained from a series of tests conducted with the coöperation of the British Broadcasting Company from January to April 5 have been extremely gratifying. The signals have been heard consistently in Los Angeles with loud speaker strength using only two tubes, and this at times when daylight covered the western half of the country. Tests have shown that the signals are remarkably free from fading which is very common on the longer waves.

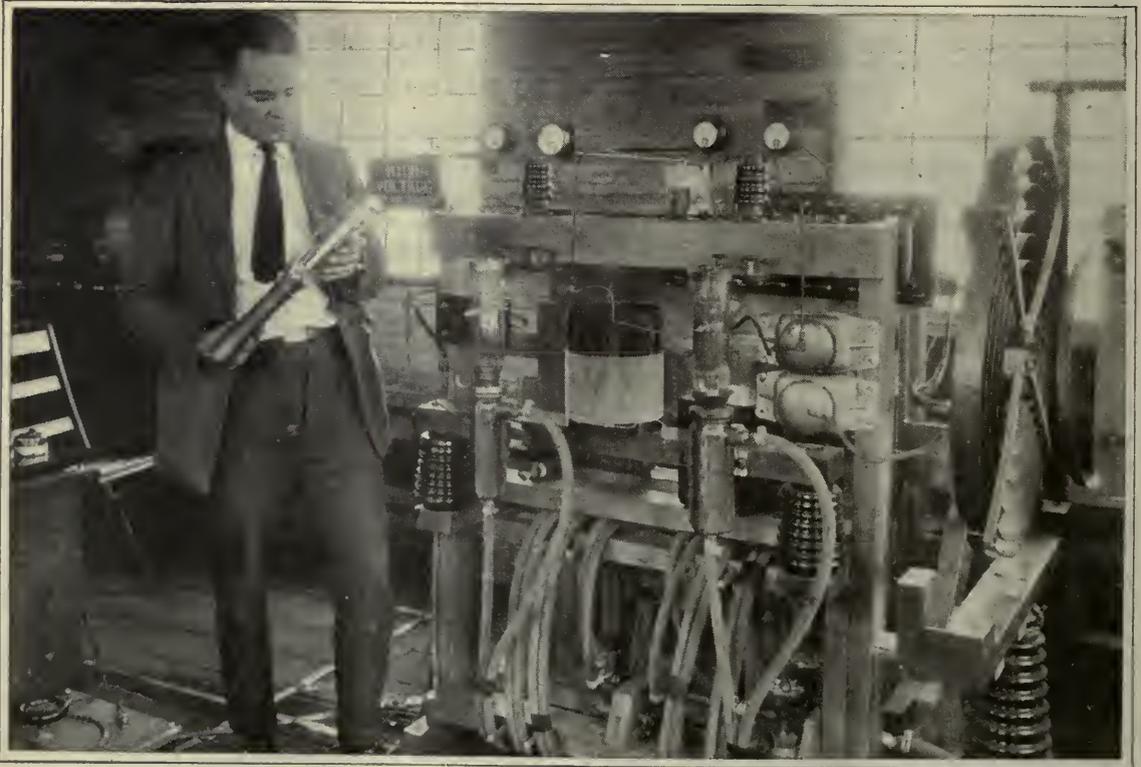
At the annual dinner of the Massachusetts

Institute of Technology alumni, in New York, WGY, connected to New York by a special circuit, broadcast the music and speeches on 380 meters wavelength and on 107 meters. The signals on 107 meters were so strong and clear that Pittsburgh picked them up and sent them to Hastings, Nebraska, which again re-broadcast. Finally KGO, the General Electric Company at Oakland, caught the three-times-relayed signals on delicate receiving apparatus and again put the dinner program into the air. The only wire used was that between WGY and WJZ in New York.



THE SHORT WAVE OSCILLATOR UNIT

Showing the special aluminum plate air condenser, at the left. Many difficult radio engineering problems were involved in getting this transmitter to work perfectly



THE 107 METER TRANSMITTER

With the short wave oscillator and modulator unit. The two water cooled tubes are in the foreground. One tube is used as an oscillator and the other as modulator