Is Short-wave Relaying a Step Toward National Broadcasting Stations?

Listeners-in in Cleveland, Ohio, Now Hear Pittsburgh as Distinctly as They Hear Local Stations, by a New Method of Broadcasting

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Re-broadcasting is a system of transmitting on a certain wavelength, picking up the signals at a remote point, and using the received energy—amplified locally—to actuate other broadcasting transmitters on one or more different wavelengths.

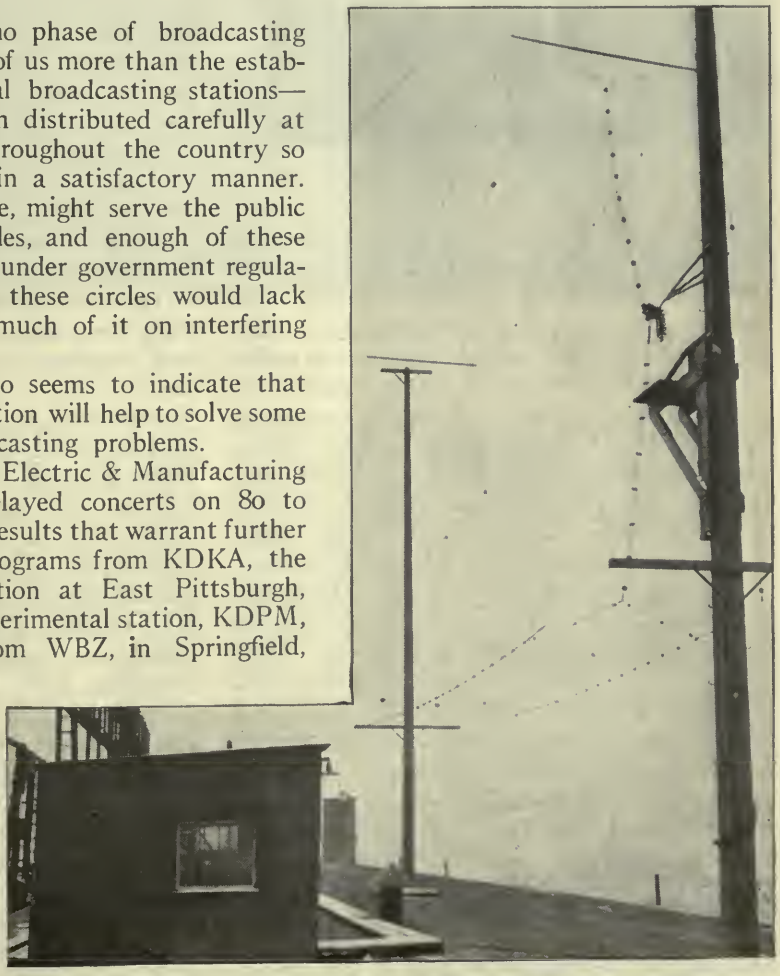
The possibilities of re-broadcasting are indeed staggering. A central station, located in Washington, for example, could carry the voice of the President to listeners in every section of our country if re-broadcasting, as described in this article, were properly fostered. That is a large order, but we shall undoubtedly see its realization by this or some similar system before long. This article by Mr. Rodgers is the first to appear on this very interesting development.—THE EDITOR.

PERHAPS there is no phase of broadcasting that appeals to all of us more than the establishment of national broadcasting stations—just a few of them distributed carefully at selected centres throughout the country so that they serve all sections in a satisfactory manner. One large station, for instance, might serve the public within a radius of 500 miles, and enough of these stations could be established, under government regulation, so that no one within these circles would lack entertainment—or get too much of it on interfering waves.

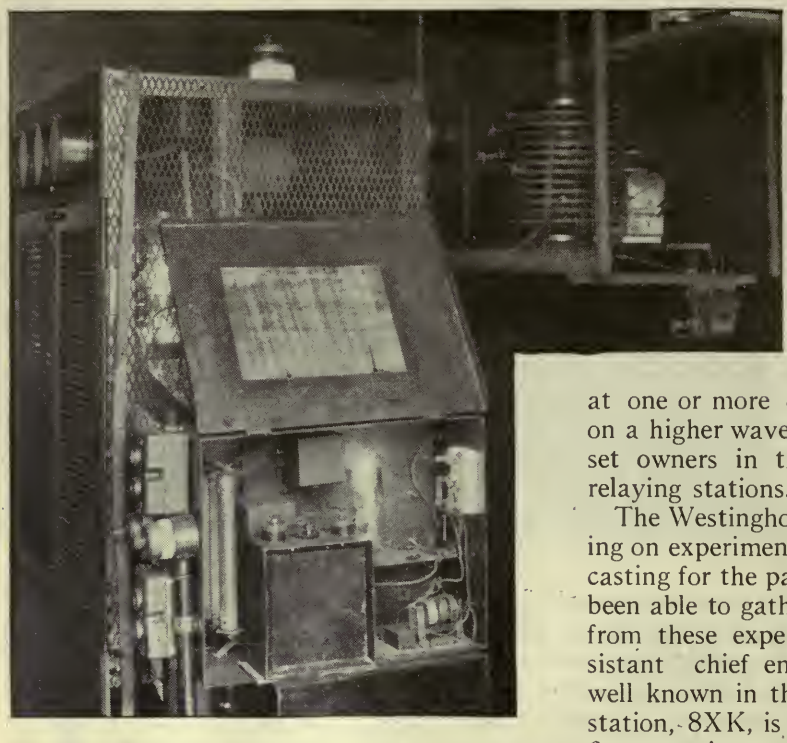
The present trend in radio seems to indicate that the national broadcasting station will help to solve some of the most important broadcasting problems.

Already, the Westinghouse Electric & Manufacturing Company has successfully relayed concerts on 80 to 100-meter wavelengths with results that warrant further research along this line. Programs from KDKA, the company's broadcasting station at East Pittsburgh, have been relayed from its experimental station, KDPM, in Cleveland, Ohio and from WBZ, in Springfield, Mass. In both these cities, KDKA's concerts have been received with great clarity, even though Cleveland is one of the so-called "dead" spots of the country.

Short-wave relaying and the establishment of national broadcasting stations are, therefore, pertinent subjects in which every radio fan, engineer, and manufacturer should be vitally



THE SHORT ANTENNA USED FOR 100-METER TRANSMISSION
Erected at KDKA, East Pittsburgh, Pa.



THE 100-METER VOICE AMPLIFIER AT KDKA

interested. Mr. H. P. Davis, vice-president of the Westinghouse Company, is said to be the first to suggest national broadcasting. His plan involves: "The establishment of radio broadcasting on the same basis as other public utilities, with an Interstate Radio Commission and, therefore, a Federal Commission created by presidential appointment. This commission would be vested with full power and authority to make regulations and enforce them to the full extent. A transmitting license would then take on the nature of a franchise because of the large expense necessary in establishing a high-class station. There would be established two classes of broadcasting stations. First, the stations national in scope, and second, local stations serving particular districts. The local stations could be made non-interfering by the allocation of different wave bands."

This plan, of course, must be worked out in all its various phases, a task requiring great attention to details and the solving of many engineering problems incidental to its perfection. One difficulty, which has possibly already occurred to you is the fact that the small receiving set, especially if it is of the crystal detector type, would be unable to pick out the long-distance stations, and would therefore be quite out of the radio world. Here is where short-wave relaying supplies the missing link between the large national station and the small receiver.

Just what is the plan of short-wave relaying? Briefly, it is the broadcasting of programs on a wavelength below 100 meters, to be picked up at one or more distant stations and relayed on a higher wavelength to serve the receiving-set owners in the districts surrounding the relaying stations.

The Westinghouse Company has been carrying on experiments with this method of broadcasting for the past year and has, in that time, been able to gather a great deal of useful data from these experiments. Frank Conrad, assistant chief engineer of the company, and well known in the radio world because of his station, 8XK, is believed to be the man who first experimented with broadcasting on these very short wavelengths. Before Mr. Conrad got into the work, radio engineers had proved by mathematics that transmission on short waves was impracticable, but he had an idea that their calculations might not be correct, and decided to investigate for himself the possibilities of broadcasting effectively on wavelengths of 100 meters or lower. First, he built a set to transmit on 100 meters and found by tests with an amateur operator in Boston that the 100-meter wavelength was more selective and more efficient than even 360 meters. Mr. Conrad next arranged for a private telephone connection between Station KDKA and his home, about four miles distant, and by a special circuit arranged to receive programs from the studio circuit over his telephone line. He then connected this telephone line to his 100-meter transmitting set and sent out KDKA's programs simultaneously with the broadcasting on 360 meters.

In Boston and other places it was reported that this transmission was stronger than the signals received directly from KDKA on 360 meters! This was true, even though his station was much less powerful than the one at East Pittsburgh.

With these facts in mind, the Westinghouse radio engineering department decided to try

THE LOOP AND RECEIVING SET AT THE CLEVELAND STATION, KDPM
This is where the broadcasts, sent from KDKA on 100 meters, were received

experiments with Cleveland, where the broadcasts from KDKA on 360 meters, had never been satisfactorily received. To that end a relaying station was established in the Cleveland Foundry, located on the Lake end of West 58th St., and the short-wave relaying tried out. It was not long before Cleveland fans were reported receiving signals from KDKA with the same volume as they were receiving local broadcasting.

The same thing is now going to be tried out in the Springfield station as an adjunct to the programs broadcasted from WBZ.

The mechanics of relaying presented a great many problems which had to be worked out gradually as they presented themselves.

In order to carry on this short-wave relaying, it was thought best to employ two transmitters controlled from the same microphone, one transmitter operating on 360 meters, the other on 100 meters. This was done and now there are also two antennas—KDKA's long antenna which is 105 feet high and 200 feet long, used for broadcasting on 360 meters, and the short-wave antenna which is 35 feet high and 40 feet long, used, of course, for sending the 100-meter signals.

In Cleveland, the 100-meter signals are received on a loop eight feet square, for the reason that the ordinary inverted L antenna might throw the receiving station out of tune if it swung in the wind. This antenna is located inside the building and is connected to a single-circuit detector unit, with two stages of amplification. The output of the receiver is delivered directly to a 250-watt transmitting set, containing one oscillating and one modulating tube. The transmitting antenna is duplicate of the one at East Pittsburgh used for sending on 360 meters (105 feet high and 200 feet long.)

Naturally there are difficulties encountered in relaying these short-wave signals. For instance, the small size inductances and capacities are difficult to construct. A slight

change, like the swinging of the antenna, will change the wavelength and throw the receiver out of tune. On the other hand, the efficiency on 100 meters or lower is comparatively high, on account of the lower electric losses which permit greater radiation from a given antenna at the same power input than is possible when sending on 360 meters.

Perhaps the principal reason why short-wave broadcasting will prove important in future radio telephone stations is that it will open up a great range of wavelength bands. This is, of course, irrespective of the possibilities of national broadcasting. For instance, there are only 25 wavelength bands, each 10,000 cycles wide, between 300 and 400 meters, whereas there are 300 such bands between the wavelengths of 50 to 100 meters. This fact may lead to the solution of the interference problem that confronts broadcasting as we know it to-day.

There are other things to be taken into consideration which show that the lower wavelengths have some very desirable characteristics. It has been observed that static is less noticeable than on 360 meters. This was found to be true when the same concert was heard simultaneously on 360 meters and 100 meters. A dash of static that would completely drown out the 360-meters broadcasting would scarcely be noticeable on the 100-meter wavelength.

Another advantage, indicated by these tests is that daylight does not reduce the range of the short-wave broadcasting as it does when the 360-meter wavelength is used. At direct variance with the system in use to-day, first tests have shown that daylight transmission is materially better than night transmission at a wavelength of 80 meters. It is believed, though still unproven, that there will not be the falling off in distance in the summer time which is one of the handicaps of broadcasting at present.

There are, to be sure, some drawbacks to broadcasting on extremely short waves. The most serious is that the receiver gets out of tune very easily. This is frequently due to the swinging of the antenna, but this sort of trouble could be easily reduced by using some sort of fixed antenna, or a loop such as is used at KDPM.

Mr. Davis has already suggested the relaying, by stations of limited power, of concerts broadcasted from a powerful central station, so that the whole country might listen to the same concert. That such a plan is feasible for a comparatively small area, the Westinghouse Company's experiments have proved; and since the theory itself is known to be sound, it seems that the development of a national broadcasting system can be a matter of only a few years.

ANOTHER "CAVE MAN"

Mr. N. M. McCoy, of Monmouth, Illinois, sends us this picture, and says: "Talk about cave-man stuff —how does this set look to you? Cigar boxes nailed on a board, for a panel. Have listened-in on most every station from Minneapolis to Atlanta and from Newark to Dallas! I enjoyed Mr. Tannehill's article [Radio Broadcast for February, 1923] very much and have had all his experiences and then some. He says: 'buy your parts, tie them together, part your hair in the middle, and go after Havana.' I can't part my hair in the middle; but I have seen the time when if the second hand on my watch had stopped I know I would have made the station."