

A History of Synchronization

By FRANK B. FALKNOR*

ACCORDING to recent newspaper releases, the public has just been informed of the fact that new wonders in broadcasting are about to take place in the form of the synchronized operation of two or more radio stations on the same channel. By this is meant that two or more radio stations will be operated on the same channel at the same time carrying the same program.

Information of this type is often misleading in facts regarding the history of development of a new art, as well as to whom the credit is due for having the vision to suggest such a venture and the perseverance to carry the vision to a practical solution.

Started in 1924

As early as 1924 Dr. Frank Conrad, Assistant Chief Engineer of the Westinghouse Electric & Mfg. Co., had suggested the synchronization of two or more radio stations as a means of securing greater coverage on a

*Doolittle & Falknor, Broadcast consultants, Chicago.

With the congested condition of the air, the scramble for channels, a harassed Federal Radio Commission, it appears that considerable virtue will be found by everyone in the suggestion of synchronization for chain programs in the interest of channel economy. Naturally much can not be expected immediately, but the groundwork has been laid for the simultaneous operation of two or more radio transmitters using the same program material. A history of this work is given in this article by Mr. Falknor who was closely identified with pioneering work on this line.—Editor.

single wave length. At that time the operation of such a scheme was all but impossible. This was due to the fact that stable frequency control appara-

tus and frequency multipliers were practically unknown. Some work along these lines had been done and it was evident that in a short time the necessary apparatus would be available.

By the end of 1925 considerable knowledge had been gained of methods of frequency multiplication by means of distortion multipliers and in January 1926 Dr. Conrad instructed the writer to proceed to Springfield and Boston and synchronize stations WBZ and WBZA. Up to this time both of these stations were carrying the same programs but operating on separate frequencies, thereby using up one radio channel needlessly.

First Synchronized Stations

Work on the problem was begun about the middle of January, 1926, and was completed in March, 1926. During this period many problems were encountered and overcome, there being no previous experience from which to draw. The final solution, however, was sufficiently satisfactory

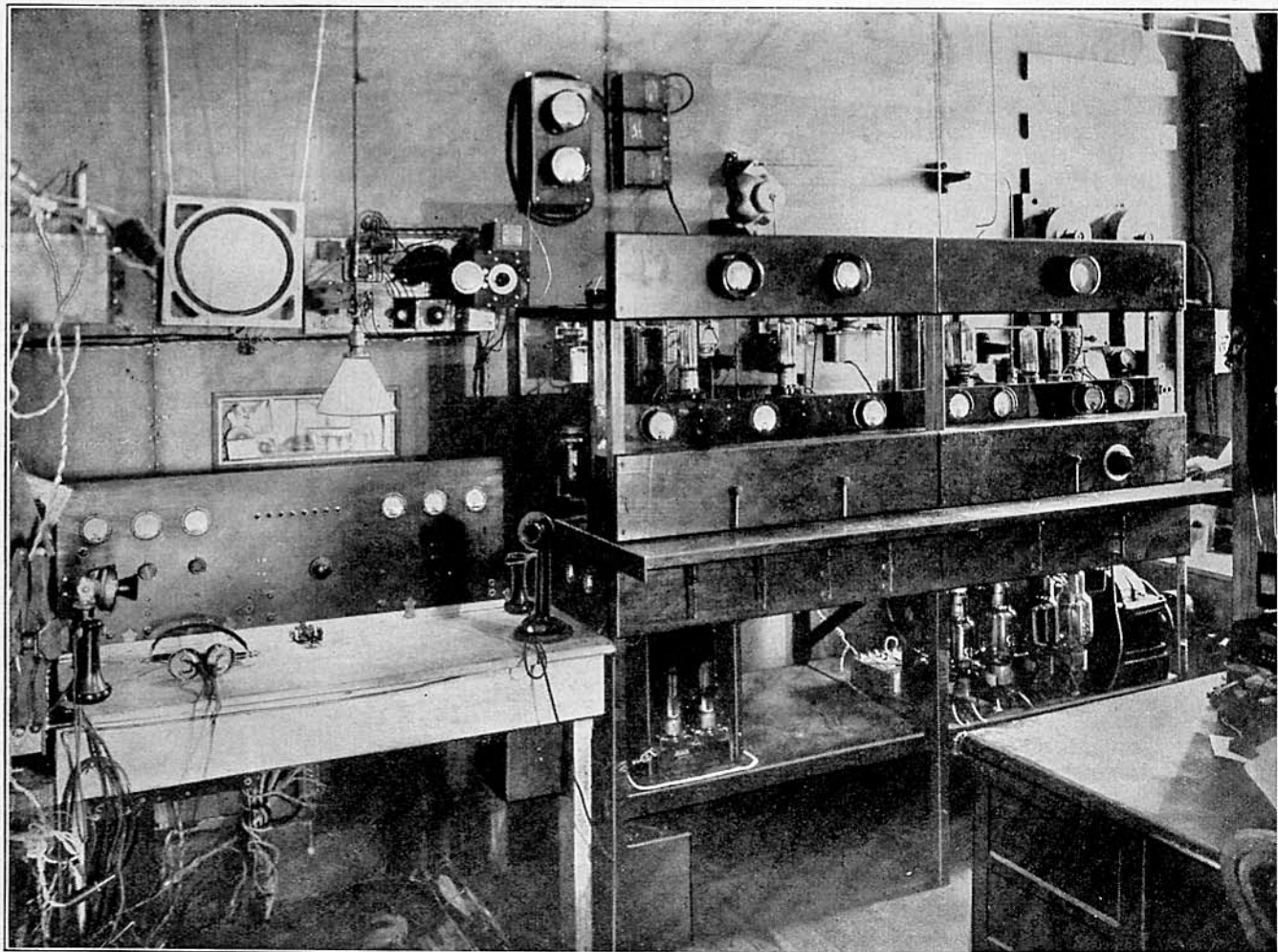


Figure 1. This photograph shows the complete synchronizing equipment and the 500 watt transmitter used at WBZA in Boston

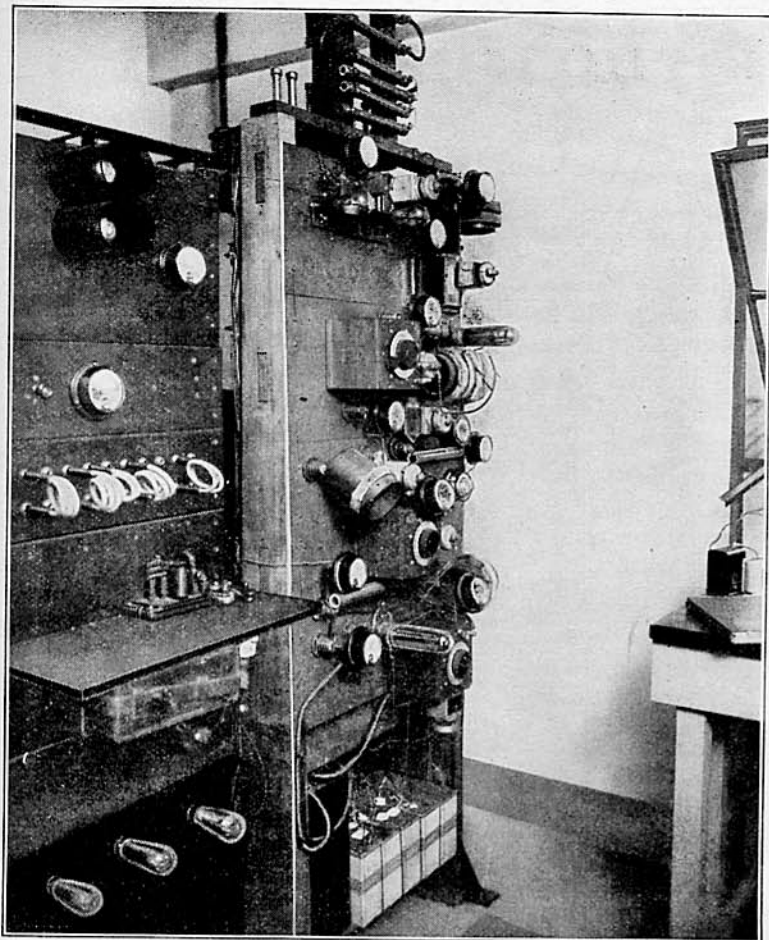


Figure 2. Here is shown a front view of the frequency multiplier in the KYW transmitter room on top of the Congress Hotel at Chicago during the July, 1926, experimental work

Synchronizing by Radio

The success of the synchronization of two radio stations by means of a wire circuit led to the experimental synchronization of KDKA, Pittsburgh and KYW, Chicago, using a 62 meter radio channel to carry the synchronizing frequency instead of a wire circuit. This work was begun in July 1926. It involved numerous problems not encountered in wire transmission, such as the operation of a radio receiver to receive the 62 meter carrier, control of level of the receiver output, a flywheel device to remove all traces of fading and greater frequency multiplication than previously used.

These difficulties were finally overcome and the system was placed in operation a sufficient number of times to demonstrate that a solution was available when an economic demand presented itself. In these experiments the 62 meter channel carried a master frequency from Pittsburgh to Chicago of about 5 ke. At the Pittsburgh end the 5 ke. frequency was multiplied to 570 ke. with distortion multipliers, and then was modulated and fed to the antenna. The 5 ke. was also fed to the modulators of the 62 meter transmitter.

Received in Chicago

At Chicago the 62 meter signal was received at a location several miles

that these two stations are still operating synchronously. To date they are the only stations in regular operation that are truly synchronized.

Since April, 1926, WBZ of Springfield, Mass., and WBZA of Boston, Mass., have been operating simultaneously on the same channel. In other words, they have been synchronized since April, 1926.

Method of Operation

The method of operation consists of having a master frequency generator at the Springfield transmitter whose frequency is of the order of 25 ke. This frequency is multiplied to the proper value assigned to the station and then modulated with the program material. The modulated carrier is then passed to a power amplifier and fed to the antenna system in the conventional manner. The master frequency is also amplified and fed to the telephone line connecting Springfield and Boston, which is about 105 miles in length. At the Boston end it is again amplified and multiplied to the same number of cycles per second that is radiated at the Springfield transmitter. It is then modulated with the same program material and fed to a power amplifier which excites the antenna system. Originally the synchronizing control frequency and the program material were carried between the two stations on the same

pair of wires but at the present time separate circuits are used.

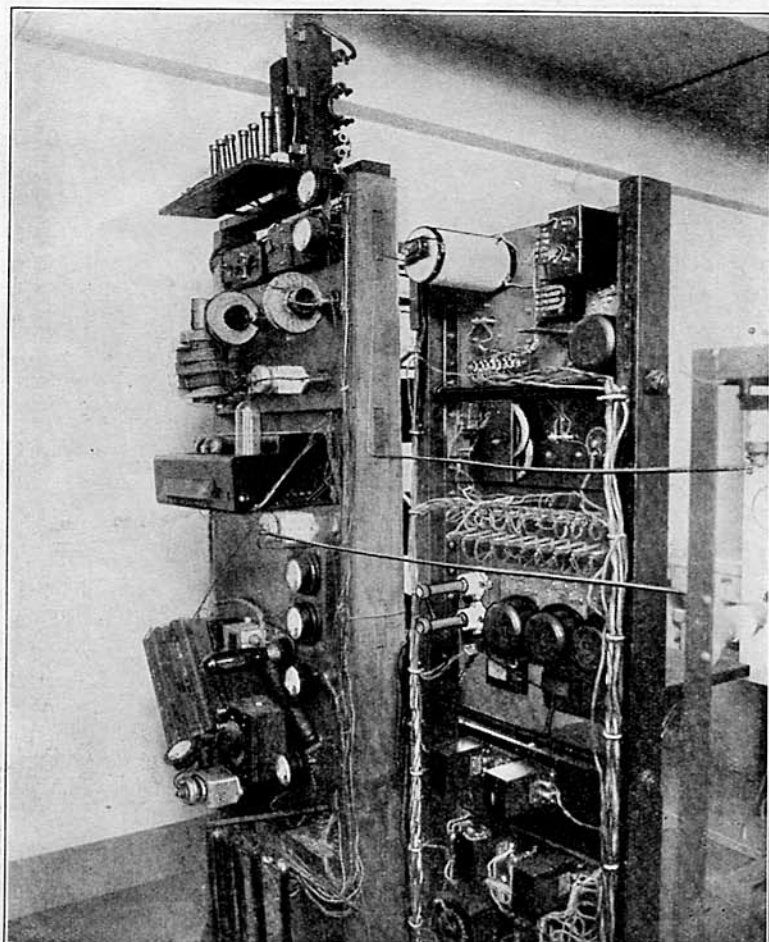


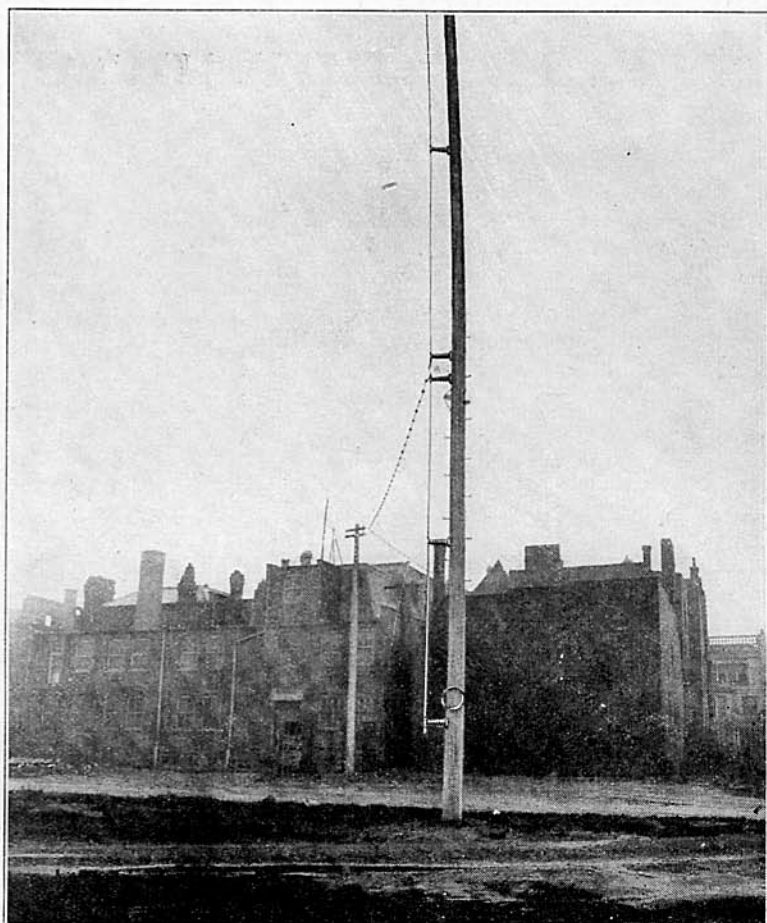
Figure 3. This photograph shows the circuits and equipment at the rear of the apparatus shown in Figure 2 during the July, 1926, experimental work for KYW

from the transmitter and the 5 ke. tone fed through a telephone line to the transmitter room of KYW. The receivers were automatically controlled from the transmitter room and required no attention during operation so that they presented little difficulty. After receiving the tone at the transmitter room, it was fed to a specially arranged mechanical oscillator which was substantially in tune with the received 5 ke. tone. This device added inertia to the system so that with a radio signal that faded over a range of 10,000 to 1, the output of the mechanical oscillator was substantially constant. This mechanical oscillator was actually driven by the received tone, so that the waves radiated at KYW and KDKA were of the same frequency, although the damping of the device was so low that it would continue to function for a period of three seconds with no exciting voltage present. This greatly reduced the radio transmission problem since constant transmission was not necessary for satisfactory operation. If the complete fading periods were not over one second in length the radio transmission was entirely satisfactory.

Radio Transmission Feasible

With a solution of this type it is evident that synchronization by this method offers an entirely satisfactory

Figure 4. Here is the receiving antenna for radio synchronization at Chicago. The site was at 1811 Prairie Avenue. The top section of the vertical aerial was the half-wave antenna, and the lower section was the counterpoise



solution where distances are involved that require prohibitive line costs,

provided that some choice is possible in selecting the frequency of the transmitter delegated to carry the "tie-in" frequency.

All of the above development was carried out by the writer during his employ by the Westinghouse Electric & Mfg. Co., as assistant to Dr. Frank Conrad, Assistant Chief Engineer.

Where Credit Due

Much credit for the success of either one or both of the above mentioned systems is also due to Walter C. Evans, Manager of Radio Operations, D. A. Myer, formerly engineer in charge of WBZ and WBZA, L. C. Wolf, formerly the writer's assistant and V. E. Trout, now manager of radio engineering for Westinghouse. To Mr. Trout is due the credit for the development of distortion frequency multipliers, upon which hinged much of the success of the entire problem.

While the writer feels that some credit is due him in this development as well as to those mentioned above, in all fairness (which is seldom exercised in giving credit for development of an art), the development and application of synchronization of two or more radio stations is primarily due to the vision of H. P. Davis, Vice President of Westinghouse and to Dr. Frank Conrad, whose engineering judgment and perseverance reduced synchronization to practice.

Figure 5. This view shows the receiving apparatus used at the 1811 Prairie Avenue receiving station for the KYW-KDKA radio synchronization during July, 1926

