Feb. 16, 1932. O. BOEHM 1,844,941

SIGNALING

Filed Sept. 7, 1929

Fig. 1

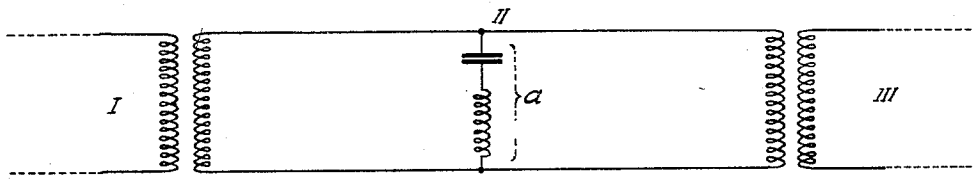
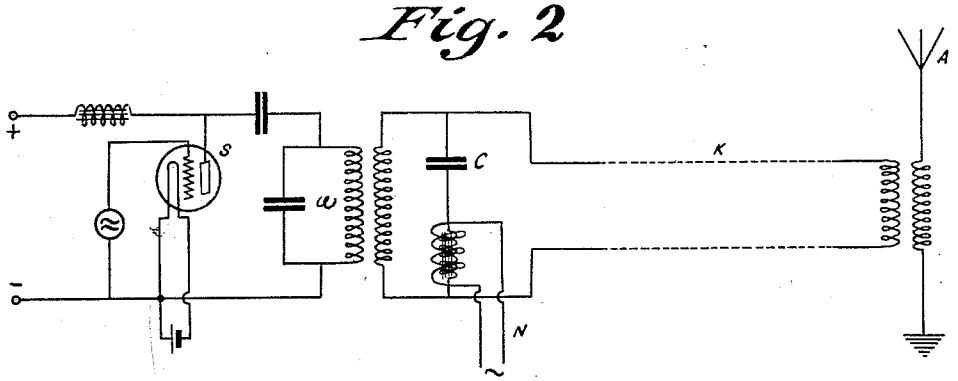



Fig. 2




INVENTOR
OTTO BOEHM
BY H. T. Grover
ATTORNEY

Patented Feb. 16, 1932 1,844,941

# UNITED STATES PATENT OFFICE

OTTO BOEHM, OF BERLIN, GERMANY, ASSIGNOR TO TELEFUNKEN GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE M. B. H., OF BERLIN, GERMANY, A CORPORATION OF GERMANY

## SIGNALING

Application filed September 7, 1929, Serial No. 390,931, and in Germany September 28, 1928.

The object of this invention is a sending method for wireless telegraphy which is of especially great value for the transmission of signals on very short waves. For the purpose of avoiding disturbances to service by fading, it has been suggested in the prior art to send the same signals simultaneously on several radio frequency waves inasmuch as fading usually does not affect simultaneously several different waves. In the methods heretofore customarily used for signal transmission on several ways, several such waves were generated either by several radio frequency generators simultaneously, or else a radio frequency wave was so modulated by several audio frequency waves that a larger frequency band is sent out.

Now, this latter method has proved more suitable, though it involved this drawback that the modulator means used in connection therewith produced a spectrum of several radio frequencies in which the intensity or amplitude of the various frequencies were widely different. Hence, the use of such a method in practical work had this drawback that, in spite of the reduction of the disturbances due to fading, marked intensity variations were found to arise since the radio frequency oscillations serving for the transmission of the signal were of widely different intensities even before being transmitted.

Fig. 1 illustrates a circuit arrangement embodying the principles of this invention.

Fig. 2 is a modification of the invention applied to a transmission system.

Now, according to the disclosure of the present invention a number of radio frequency oscillations of different frequencies, and equal intensity, can be produced by connecting between the radio frequency generator and the antenna a transfer means or transfer line containing the combination of a condenser and a coil, the tuning or detuning, as the case may be, of this branch containing capacity and inductance being effected by direct or indirect action of audio frequency oscillations. By providing this branch influenced in its tuning by audio frequency in the transfer circuit, radiation of a frequency band of equal intensity can be attained, as shall be shown by the aid of an embodiment illustrated by way of example in Fig. 1.

Suppose circuit I is a circuit associated with the radio frequency generator, circuit III the circuit feeding the antenna with the radio frequency oscillations to be sent out. Between these two circuits is the transfer or intermediate circuit II in which a shunt branch $a$ is provided comprising a series connection of a condenser and a coil. It is assumed in this connection that either the condenser or the coil, or both, can be so influenced by audio frequency oscillations that the value of the capacity or inductance is varied correspondingly.

If this circuit is tuned to the frequency of the radio frequency oscillations which are transferred by circuit I to circuit II, it represents a short-circuit for this frequency, as is well known, this short-circuit being not quite perfect solely for reasons of the ohmic resistance of the said branch. Hence, no radio frequency oscillations of the frequency impressed by the generator upon the circuit I will reach circuit III and therefore the aerial.

However, in the presence of detuning of branch $a$ at the rhythm of an audio frequency current, radio frequency oscillations having a frequency differing from the generator wave will be transferred to circuit III. If the frequency of the generator oscillations is $\omega$, and if the detuning of branch $a$ is in accordance with a frequency $n$, then a radio frequency oscillation of the shape $\sin \omega t \sin n t$ will be transferred to circuit III, and there, as will be understood, represents two radio frequency oscillations having frequencies $\omega+n$ and $\omega-n$.

In order that a greater number of frequencies may be radiated, the variation in detuning of branch $a$ must be effected not with only one audio frequency but by several, say, by frequencies $n$, $2n$, $3n$, etc. Then an oscillation or wave of this form will reach the antenna $\sin n t$ ($\sin nt+\sin 2 n t+\sin 3 n t \ldots$). However, this is a frequency spectrum or band comprising the frequencies $\omega+n$ and $\omega-n$, $\omega+2n$ and $\omega-2n$, $\omega+3n$ and $\omega-3n$, etc., the oscillations of all frequencies

have the same or at least practically equal intensity or amplitude.

In so far as the construction of this transfer or intermediate means is concerned, the short-circuit branch may be made of variable tuning by that the inductance coil consists of an iron-core choke coil whose magnetization in well-known manner is influenced by radio frequency oscillations so that corresponding detuning of this branch is produced.

One embodiment of a circuit arrangement according to this invention is shown in Fig. 2 where S is a radio frequency tube transmitter whose output circuit carries a wave of frequencies $\omega$. Between the tube transmitter S and the antenna A is a transmitter or intermediate circuit or line K and in parallel relation to the coupling between the transfer line or circuit and the transmitter circuit is the short-circuit branch consisting of condenser C and the inductance coil comprising the iron core L. N is the line through which audio frequency oscillations generated in one or more separate generators are fed to the iron-cored choke-coil. Instead of varying the inductance of coil L in a way as stated, as will be understood, the capacity of the condenser could be influenced by a vibratory diaphragm.

It must further be noted that the arrangement as described is suited also for telephony work. In this case one would proceed as follows: The tuning of the branch comprising condenser and coil is influenced by the audio frequency or tonal oscillations to be transmitted. Hence, in a scheme of the kind illustrated in Fig. 2, microphone vibrations rather than audio frequency oscillations produced by a separate generator are transferred over line N. What results, as can be seen from the above equations, are side bands of the telephonic oscillations without carrier wave. For the reception of such oscillations, it would be possible, as known in the prior art, to add the carrier wave at the receiving end. Hence, this scheme comprising a plurality of wave suggested for telegraphy work is readily useful also for telephony work.

I claim:

1. In a system for simultaneously transmitting a signal on a plurality of wave lengths, an oscillation generator, an antenna coupled thereto, a series tuned circuit tuned to the frequency of waves generated by the oscillation generator paralleling an output circuit of the generator, and means for altering the tuning of the series tuned circuit in predetermined fashion.

2. In a system for simultaneously transmitting a signal on a plurality of wave lengths, an oscillation generator, an antenna coupled thereto, a series tuned circuit tuned to the frequency of waves generated by the oscillation generator paralleling an output circuit of the generator, and means for altering the tuning of said series tuned circuit at a relatively low frequency.

3. In a system for simultaneously transmitting a signal on a plurality of wave lengths, an oscillation generator, an antenna coupled thereto, a series tuned circuit tuned to the frequency of waves generated by the generator paralleling an output circuit of the generator, said series tuned circuit comprising a series arrangement of reactances, and means for altering in predetermined fashion the effective value of one of said reactances.

4. In a system for simultaneously transmitting a signal on a plurality of wave lengths, an oscillation generator, an antenna coupled thereto, a series tuned circuit tuned to the frequency of waves generated by said generator paralleling an output circuit of said generator, said series tuned circuit comprising an inductance coil and a condenser, and means for effectively altering in predetermined fashion the effective value of said inductance.

DR. OTTO BÖHM.

## CERTIFICATE OF CORRECTION.

Patent No. 1,844,941. February 16, 1932.

OTTO BOEHM.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 86, for "there" read this; page 2, line 8, for "radio" read audio; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of Octoober, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)