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ECHO AND SINGING SUPPRESSOR SYSTEM

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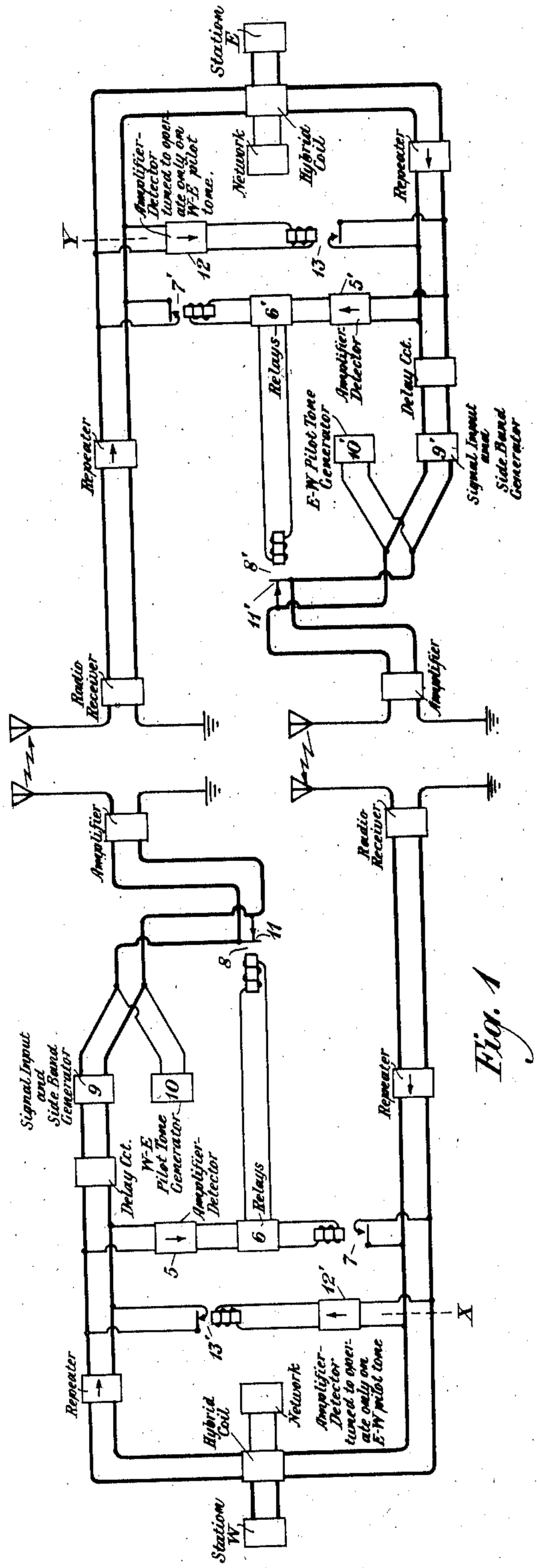

Fig. 1

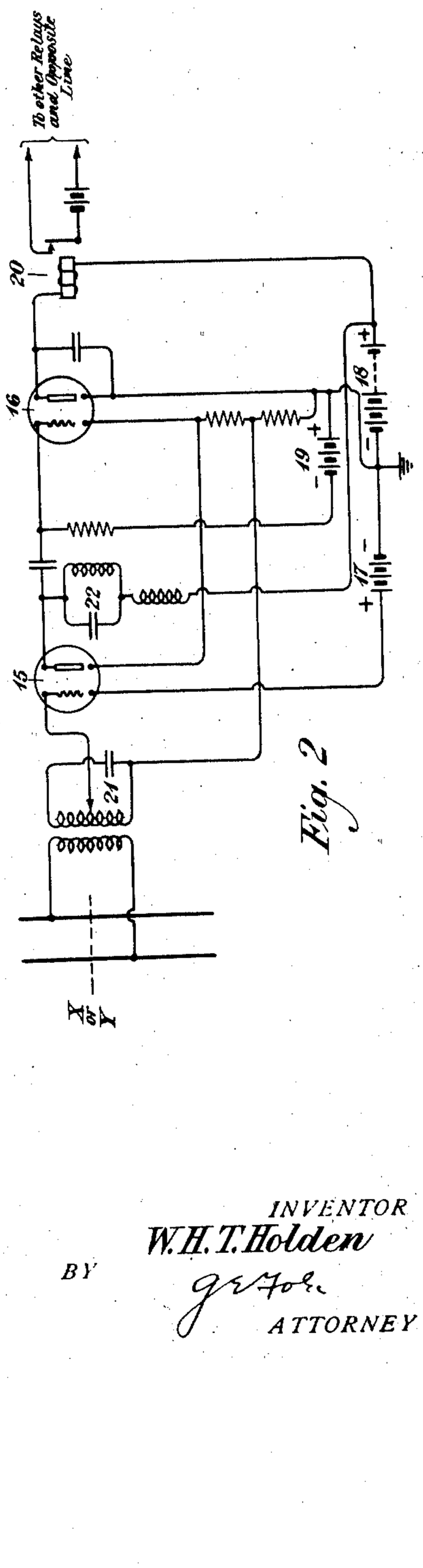

Fig. 2

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ECHO AND SINGING SUPPRESSOR SYSTEM.

Application filed June 1, 1926. Serial No. 113,021.

My invention relates to means for suppressing echoes and singing in communication systems, and more particularly to echo and singing suppressor arrangements which are applicable to two-way systems having a part of each path formed by a radio channel.

Echo and singing suppressor arrangements applicable to long wire telephone circuits are now well understood in the art. For a description and explanation of such systems, reference may be had to an article entitled "Echo suppressors for long telephone circuits" by A. B. Clark and R. C. Mathes, Journal of the American Institute of Electrical Engineers, June 1925, page 618 et seq.

The object of my invention is to provide means which will (1) permit duplex operation of a radio channel (forming part of a two-way communication system) without the necessity of perfect balance when a single frequency is used for transmitting in both directions, (2) permit the operation of the wire circuits of the system, which circuits employ repeaters, without the necessity of perfect balance and with the elimination of echoes in such circuits, and (3) accomplish (1) and (2) above without the liability of being operated by noise or static interference.

My system has many features in common with the system described in the above identified article and shown in Fig. 7 on page 622 thereof. In particular, I employ certain controlling means which operate only when speech is applied to the system.

I will now describe in detail the essential features of my invention in one desirable embodiment, it being understood that reference may be had to the above identified article for that part of the system which is old in the art and does not call for detailed consideration herein. The following description is to be read with reference to the accompanying drawing. Figure 1 of the drawing shows diagrammatically and in part schematically the two-way communication system embodying my invention, and Fig. 2 shows diagrammatically and in detail certain elements forming a part of the system.

The station W and the station E are interconnected by a two-way telephone system having over a part of its length paths adapted to transmit in opposite directions. A portion of each path is a radio channel, and associated with the wire paths are radio transmitting and receiving means designed for duplex operation on a single frequency. At each end of the double path circuit are the usual hybrid coil and balancing network. The repeaters and the delay circuits, included in the system as shown, are old and well understood in the art.

When speech is transmitted from station W to station E, the voice currents in the upper wire path associated with station W cause the operation of relay 7 associated with the amplifier-detector apparatus 5 through other relays 6. It is understood that this operation can occur only in response to voice currents. The operation of relay 7 places a short-circuit across the wires of the lower channel associated with the station W.

In the upper wire channel are signal input and side-band generating means 9, which may be of any suitable type. I associate with the means 9 a generator 10 which produces a pilot tone of a frequency outside the speech band. This generating means 10 is connected as indicated in the drawing, so that the pilot tone may be supplied to the system at a point not affected by noise or static. Connected to the relays 6 and operable therewith in response to voice currents is the relay 8. In order to prevent singing, the circuit between the signal input and generating apparatus, and the transmitting antenna is normally short-circuited. Now, when the relay 8 operates in response to the voice currents from station W in the upper wire path, this short-circuit is removed, and the outputs of the elements 9 and 10 are supplied to the transmitting antenna for simultaneous transmission over the radio channel. Considering the description so far given, it will be seen that means are provided for preventing echoes and singing in the left half of the system when speech is transmitted from station W, and, in addition, means are provided for transmitting simultaneously with the voice signals a distinctive pilot tone.

In the right half of the system in the upper channel there are provided a receiving antenna and suitable radio receiving apparatus. The speech from station W, accompanied by the pilot tone, passes over the upper wire channel, and there is produced

the operation of the amplifier-detector 12 and the associated relay 13. This amplifier-detector apparatus is shown in greater detail in Fig. 2 of the drawing and will be further discussed below. It is tuned to operate only in response to the pilot tone from station W to station E. Upon the operation of relay 13, a short-circuit is placed across the lower pair of wires associated with station E, disabling that section of the transmission path from station E to station W.

When speech is transmitted from station E to station W, the operation of the system is similar to that described above. Through the amplifier-detector apparatus 5′, voice currents operate relays 6′ and 7′, the operation of this latter relay short-circuiting the upper wire path. The signal input and side-band generator apparatus corresponds to the apparatus 9 described above. Likewise, there is a pilot tone generator 10′ which produces a distinctive tone of a frequency outside the voice band. A relay 8′ operates with relays 6′ in response to the voice currents and supplies the pilot tone along with the signal and high frequency currents to the lower radio channel. At the left end of the circuit the amplifier-detector apparatus 12′ is tuned to operate only on the pilot tone from station E to station W. Upon operation, the relay 13′ places a short-circuit across the upper pair of wires associated with station W, this action corresponding to the action of the relay 13 in the case of transmission from station W to station E. We thus have echoes and singing suppressed.

The sharpness of tuning of the selective circuits associated with the apparatus 12 and 12′ is so chosen that the energy of static contained in this band is relatively small, whereby there is an increase of the ratio of the signals controlling the echo and singing suppressor to the noise and static. This sharpness of tuning should not be increased to such an extent that the time required for the operation of the device is seriously increased, as such an increase might require the use of additional delay circuits.

For the structural details of the amplifier-detector circuits 5 and 5′, reference may be had to the article identified above, and particularly to Fig. 3 on page 620.

Fig. 2 of the drawing shows in detail my arrangement of the elements 12 and 12′, the letters X and Y serving to establish a clear connection between the showing of Fig. 1 and that of Fig. 2. The vacuum tube 15 is the amplifier of this circuit, and the vacuum tube 16 is the detector. Batteries 17, 18 and 19 are the sources of filament current, plate voltage, and grid voltage, respectively. Included in this detail of the system are the tuned circuits 21 and 22. In the case of the amplifier-detector 12, these circuits are so tuned that the apparatus operates only in response to the pilot tone from station W to station E. In the case of the apparatus 12′ these circuits are so tuned that operation occurs only in response to the pilot tone from station E to station W. A relay 20 is included in the plate circuit of the detector tube 16, and the operation of this relay causes the operation of relay 13 or relay 13′, as the case may be, which relay functions to short-circuit the opposite line.

While the invention has been described in one specific embodiment which is deemed desirable and as applied to one type of two-way communication system, it is to be understood that this description is merely for the purpose of illustration and in no way limits the scope of the invention, which is defined in the appended claims.

I claim:

1. In a two-way system for the transmission of speech, including combined wire and radio paths adapted to transmit in opposite directions, means associated with the outgoing wire section of one of said paths for generating a pilot tone, means operable by voice currents in said section for disabling the incoming wire section of the opposite path and for supplying said pilot tone to the first path for transmission simultaneously with the voice, and means operable substantially only in response to said pilot tone for disabling the distant outgoing wire section of said opposite path.

2. In a two-way communication system in which speech is transmitted between distant points by modulated alternating currents of frequencies above the voice range, said system including combined wire and radio paths adapted to transmit in opposite directions; echo and singing suppressor arrangements, including in association with the outgoing wire section of one of said paths means for generating a pilot tone of a distinctive frequency outside the voice range, means operable by voice currents in said section for disabling the incoming wire section of the opposite path and for supplying said pilot tone to the first path for transmission simultaneously with the voice, and means operable substantially only in response to said pilot tone for disabling the distant outgoing wire section of said opposite path.

3. In a two-way system for the transmission of speech, paths adapted to transmit in opposite directions, each of said paths comprising outgoing and incoming two-wire sections and an intervening radio channel; radio transmitting means associated with the outgoing wire section of each path; radio receiving means associated with the incoming wire section of each path; means associated with said transmitting means in

each path for generating a pilot tone; means associated with the outgoing wire section of each path and operable by voice currents therein for disabling the incoming section of the opposite path and for supplying said pilot tone to the path carrying the voice currents for transmission simultaneously therewith; and means associated with the incoming wire section of each path and operable substantially only in response to said pilot tone for disabling the outgoing wire section of the opposite path.

4. In a two-way system for the transmission of speech, wire paths adapted to transmit in opposite directions, an intervening radio channel and radio transmitting and receiving apparatus for duplex operation thereover on a single frequency, means associated with the outgoing section of each wire path for generating a pilot tone of a distinctive frequency outside the voice range, means operable by voice currents in the outgoing section of each wire path for disabling the incoming section of the opposite wire path and for supplying said pilot tone to the path carrying the voice currents for transmission over the radio channel simultaneously therewith, and means operable substantially only in response to said pilot tone for disabling the outgoing section of the opposite wire path.

5. In a two-way system for the transmission of speech, a first station, a second station, a four-wire circuit connected at each end thereof with one of said stations and including a radio link, means associated with the first station for generating a pilot tone, means operable by voice currents in the four-wire circuit outgoing path connected with the first station for disabling the incoming path connected with said station and for supplying said pilot tone to said outgoing path for transmission over the radio link simultaneously with the voice, and means associated with the four-wire circuit incoming path connected with the second station for disabling the outgoing path connected with said station, said means being operable substantially only in response to said pilot tone.

In testimony whereof, I have signed my name to this specification this 27th day of May, 1926.

WILLIAM H. T. HOLDEN.