

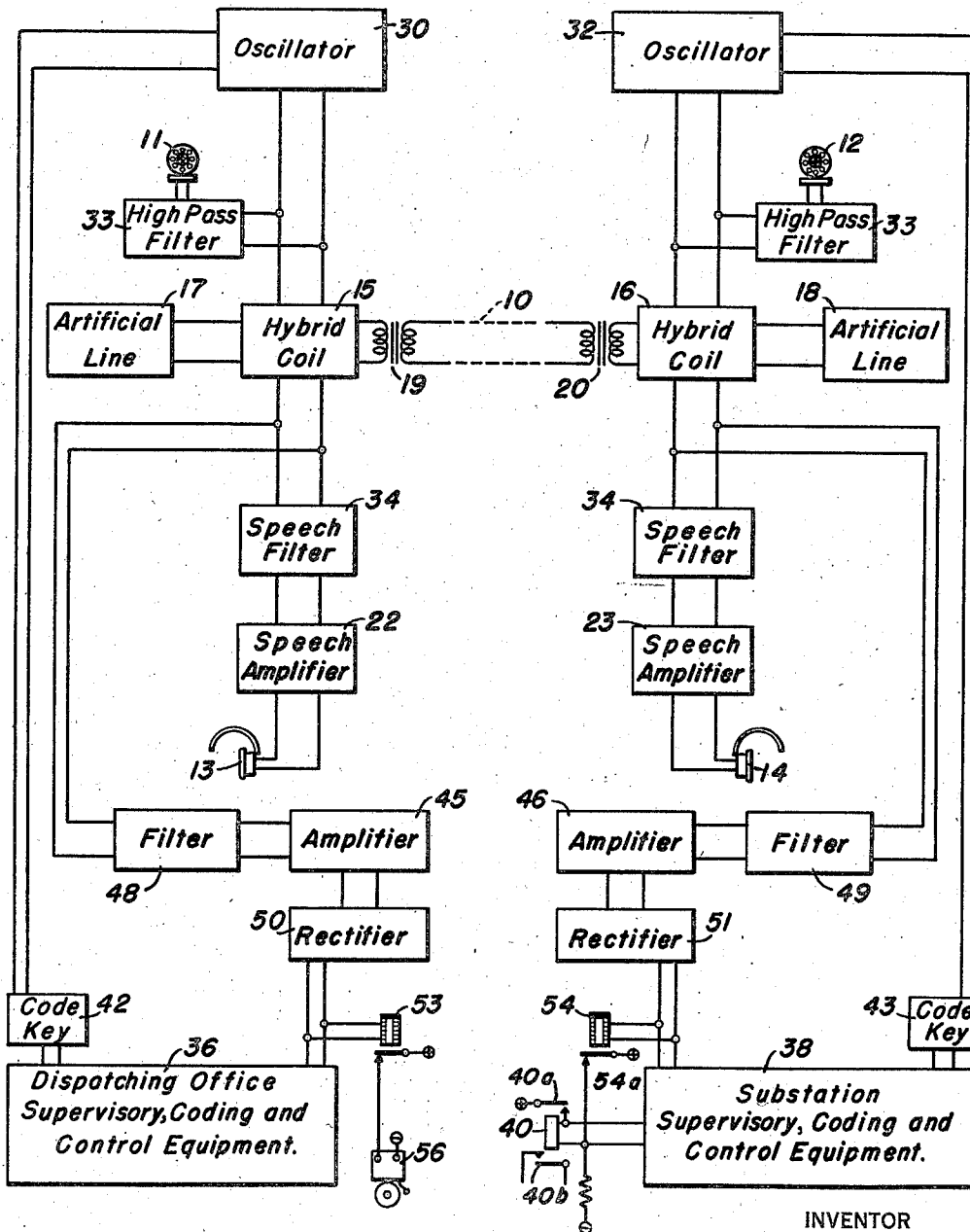
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CONTROL SYSTEM

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CONTROL SYSTEM

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My invention relates, generally, to control systems and has reference in particular to remote control and signalling systems.

Generally stated, it is an object of my invention to provide an improved control and signalling system which is simple and inexpensive to manufacture and is easy to operate.

More specifically, it is an object of my invention to provide for effecting two-way supervision of a signalling channel for controlling remote apparatus over a telephone line independently of telephone communication and signalling operations.

It is an important object of my invention to provide for supervising a signalling channel by using different audio-frequency tones at each end of the channel for signalling and effecting indications at the other end of a line fault condition.

Another object of my invention is to provide for using two different relatively low-frequency voltages on a repeated telephone circuit for continuously supervising the circuit from both ends.

Another object of my invention is to provide for normally maintaining predetermined different audio-frequency tones on a telephone line from different points in order to maintain supervision of the line from both points, and for using control means responsive to said tones for indicating a fault condition of the telephone line if the tones are removed or attenuated below a predetermined value for greater than a predetermined time.

Yet another object of my invention is to provide for normally using 170 and 245 cycle tones at different points on a telephone line for supervising the operating condition of the telephone line and signalling the operator in the event of a line fault, as well as controlling remotely located apparatus.

It is also an object of my invention to provide for obtaining two-way indications of a fault on a supervisory control channel in a telephone system by normally maintaining different audio frequencies on the telephone line and providing for a fault indication when either of the audio frequencies is removed or appreciably attenuated for a predetermined interval of time.

Other objects will in part be obvious and will in part be explained hereinafter.

In practicing my invention, two-way supervision of a supervisory control channel for a remote transmitter is provided over a telephone line independently of the telephone equipment by using audio-frequency oscillators of different audio frequencies which are filtered from the

telephone circuit, at the control station and remote-station, respectively. The audio tones are interrupted under the control of the supervisory control equipment to produce coded impulses for effecting operation of the transmitter from the control station. Control means at the control station responsive to the removal or attenuation of the tone frequency at the remote station indicates a fault condition after a predetermined time interval greater than that occurring in impulse signalling, and control means at the remote station responsive to removal or attenuation of the tone frequency at the control station for a predetermined time deenergizes the transmitter.

Two-way supervision of the control channel is thus provided.

For a more complete understanding of the nature and scope of my invention, reference may be made to the following detailed description, which may be studied in connection with the accompanying drawing, in which the single figure is a diagrammatic view of a signalling system embodying the invention in one of its forms.

Referring to the single figure of the drawing, the reference numeral 10 may denote a signalling channel comprising a telephone line connecting telephone equipment at a dispatching office or control station with telephone equipment at a substation or remote station adjacent apparatus to be controlled. For example microphones 11 and 12 and telephone receivers 13 and 14 at the control and remote stations may be connected to the telephone line through hybrid coils 15 and 16 having artificial lines 17 and 18, respectively, for balancing local speech out of the local receiver, and coupling transformers 19 and 20. The telephone receivers 13 and 14 may be provided with amplifiers 22 and 23 of any suitable type.

In order to provide for supervising the signalling channel between the remote and control stations, means may be provided at the control and remote stations for normally applying to the telephone line 10 potentials of different frequencies for controlling fault indicating means at the other ends of the line. At the control station, an oscillator 30 may be provided for applying to the line through the hybrid coil 15 a potential of a frequency in the lower portion of the audio range, for example, 245 cycles per second. At the remote station, an oscillator 32 may be provided for normally applying to the telephone line 10 through the hybrid coil 16 a potential of a different frequency in the audio range, for example 170 cycles per second. For the purpose of preventing interference between the voice frequen-

cies in the telephone circuits and the line supervision frequencies, high-pass filters 33 may be connected between the microphones 11 and 14 and their associated hybrid coils, and speech filters 34 may be connected between the telephone receivers and the hybrid coils for blocking from the voice frequencies all frequencies in the lower portion of the audio range which are not necessary for intelligible transmission of speech. The filters may, for example, block all frequencies below 300 cycles per second.

In order to reduce the amount of equipment required, the oscillators 30 and 32 may be used in connection with supervisory control equipment designated generally by the numerals 36 at the control station and 38 at the remote station for sending coded impulses for effecting operation of a transmitter or other apparatus at the remote station through the medium of a control relay 40 which may be used to turn a transmitter or the like, on or off in response to predetermined coded impulse signals from the control station. The oscillators may be controlled in any suitable manner, such as by code key relays 42 and 43 of the control station and remote station supervisory control equipment, respectively.

In order to provide for receiving the coded impulse signals, receiving means, such as the amplifiers 45 and 46, may be utilized at the control and remote stations and connected to the telephone line 10 through the hybrid coils 15 and 16, respectively. The amplifiers 45 and 46 may each be made selectively responsive only to the frequency of the voltage transmitted from the other station by means of suitable filters 48 and 49 which, for example, pass only frequencies of 170 and 245 cycles per second, respectively. With a view to operating the supervisory control equipment in response to coded impulse signals received by the amplifiers, means, such as the rectifiers 50 and 51, may be provided for converting the alternating-current impulses into direct current.

Two-way supervision of the telephone line 10 may be provided by utilizing control means such as the time-delay relays 53 and 54 at the control and remote stations, which may be either controlled by the supervisory receiving equipment or may be operated directly from the amplifiers as shown. These relays may be normally energized in response to the voltages applied to the telephone line by the oscillators at the remote and control stations, respectively. The relays 53 and 54 may be disposed to remain in the energized position during the relatively short periods of deenergization of the oscillators which occur in impulse signalling.

If the telephone line is open circuited or short circuited, for an interval longer than the periods of deenergization normally required for impulse signals, both of the time delay relays will be deenergized, indicating the fault condition at both ends of the line. If the voltage from either oscillator is attenuated below a predetermined value at the other station for greater than said periods, one or the other of the relays 53 and 54 will return to the deenergized position. At the control station, an obvious circuit is provided for indicating means such as the alarm bell 56 to warn the operator of a fault condition on the telephone line. At the remote station, a shunting circuit is provided across the control relay 40 by contact members 54a when the time-delay relay 54 returns to the deenergized position, since the control relay is locked in through contact

members 40a, accordingly, indication of a fault condition on the telephone line may be provided, either by operating suitable indicating means from the control relay or by effecting disconnection of the apparatus being controlled from its source of power through separation of contact members 40b.

From the above description and the accompanying drawing, it will be apparent that I have provided in a simple and effective manner for obtaining positive supervision of a signal channel which may comprise a telephone line having transformers, repeaters, etc. connected therein. Two-way supervision is effectively provided without interference with either the telephone equipment or the supervisory control equipment, using the same channel. A signal system embodying my invention requires a minimum of equipment and is reliable in operation, regardless of at which end of the line a fault may occur.

Since certain changes may be made in the above-described construction, and different embodiments of the invention may be made without departing from the spirit or scope thereof, it is intended that all the matter contained in the above description and shown in the accompanying drawing shall be considered as illustrative and not in a limiting sense.

I claim as my invention:

1. The combination with a signalling channel, of means for applying potential of one frequency to the channel at one point, means for applying a potential of another frequency to the channel at another point, normally operable control means at the first point operable only in response to said another frequency, additional normally operable control means at the other point operable only in response to said one frequency, and means at each of the stations responsive a predetermined time after deenergization of said control means for indicating a channel fault condition.

2. The combination with a signalling channel in a telephone system, of filter means between telephone equipment and the channel for blocking audio frequencies in the lower range of voice frequencies, means for applying a potential of one frequency in the lower range to the signal channel at one point, means for applying a potential of another frequency in the lower range to the channel at another point, means at said one point normally responsive to said potential of another frequency and operable upon predetermined reduction of said potential at said one point for a predetermined time to indicate a fault condition on the channel, and means at the other point normally responsive to the potential of said one frequency operable upon predetermined reduction of said potential to effect indication of a fault condition on the channel.

3. The combination with supervisory control equipment operating over a telephone line between two stations for controlling apparatus at one station from the other station, of high-pass filter means connected for blocking audio frequencies below a predetermined level from telephone equipment, means at the one station for applying to the telephone line a potential of one frequency below the predetermined level, means at the other station for applying to the line a potential of a different frequency below the predetermined level, means at the one station selectively responsive to the potential of a different frequency for effecting deenergization of said apparatus when said potential of a different frequency falls below a predetermined value for a

predetermined time, and means at the other station selectively responsive to the potential of said one frequency and operable when said potential of one frequency falls below a predetermined value at said other station for a predetermined time to indicate a line fault condition.

4. In a two-way supervision system for a signalling channel for controlling apparatus at a remote station from a control station over a telephone system between the stations, means connected between telephone equipment and the channel for blocking frequencies in the lower audio range, an oscillator at the control station for applying to the channel a supervision potential of one frequency in the lower audio range, an oscillator at the remote station for applying to the channel a supervision potential of another frequency in the lower audio range, a receiver at the control station responsive only to the potential from the remote station, time delay means at the control station normally energized under the control of the receiver for sounding an alarm to indicate a fault condition on the channel when the potential from the remote station is reduced below a predetermined operating value at said control station, time-delay means at said remote station for effecting deenergization of the apparatus at the remote station upon the occurrence of a channel fault condition, and means at the remote station including a receiver responsive only to the potential of said another frequency for energizing the

time-delay means at the remote station so long as the potential of said another frequency remains above a predetermined value at the control station.

5. The combination with a supervisory control channel for controlling apparatus at a remote station from a control station over a signalling channel connected to telephone equipment at both stations through a hybrid coil, of high-pass filters connected between the telephone equipment and the hybrid coil for blocking audio frequencies below 300 cycles, an oscillator at the control station for applying to the channel through the hybrid coil a potential of a frequency below 300 cycles, means at the remote station including an amplifier responsive only to said frequency and time-delay means for effecting deenergization of the apparatus when the said potential remains below a predetermined value at the remote station for a predetermined time, an oscillator at the remote station connected to the channel through the hybrid coil at that station for applying to the channel a potential of a different frequency below 300 cycles, and means at the control station including an amplifier responsive only to the frequency of the potential from the remote station and time delay means for operating an alarm when the potential of said different frequency remains below a predetermined value for a predetermined time

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