

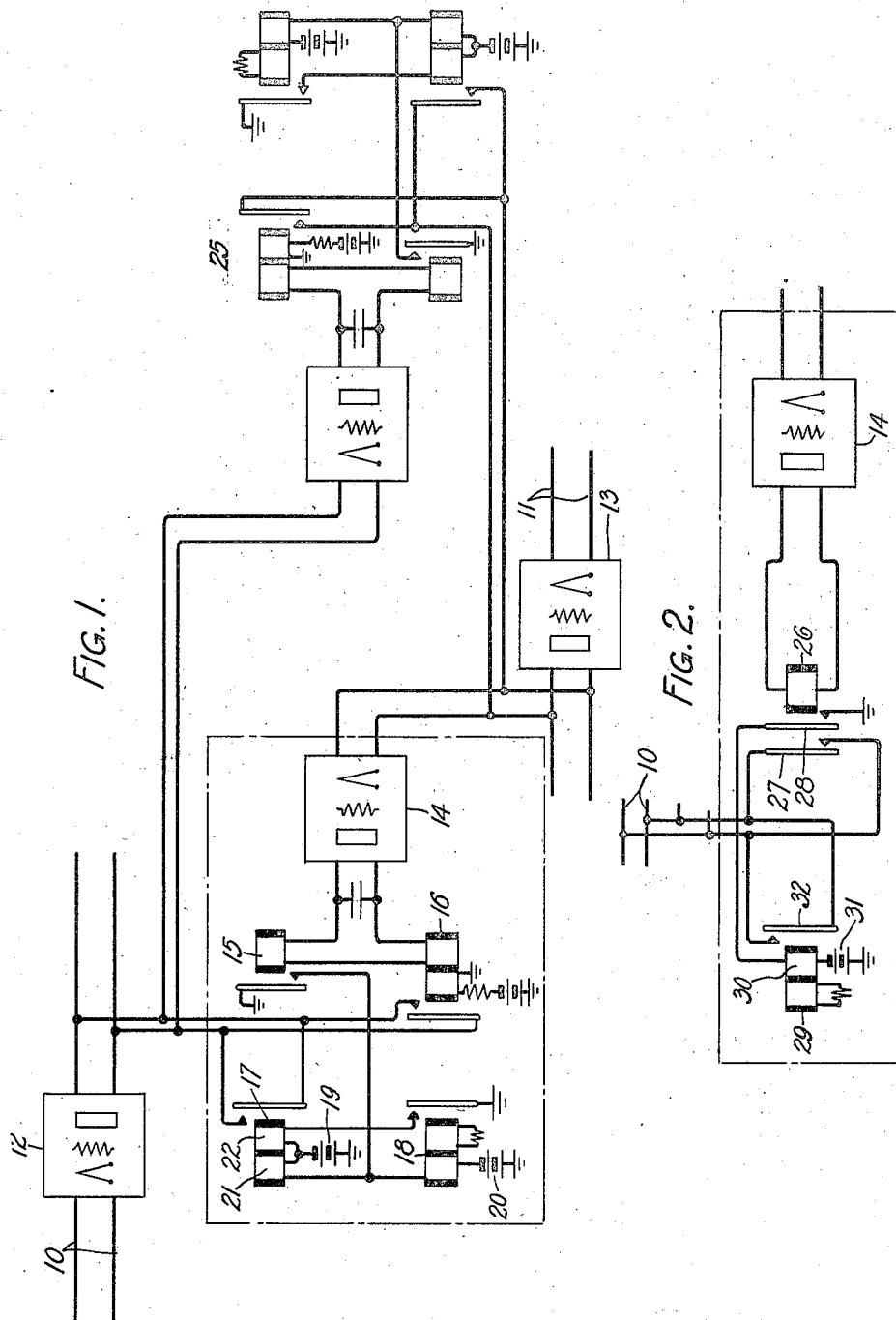
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ELECTRICAL WAVE TRANSMISSION SYSTEM

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ELECTRICAL WAVE TRANSMISSION SYSTEM

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This invention relates to electrical wave transmission systems and particularly to echo suppressing circuits therefor.

In designing signaling circuits which are electrically very long, an important problem is presented by the necessity of avoiding serious echo effects. Echo effects are caused by reflections of signaling waves which take place whenever electrical irregularities are encountered in the transmission circuits. Reflection of transmitted waves occur in all practical circuits. It is only in circuits of such length as to require a number of repeaters, however, that the echo effects become serious. The fact that the circuits are electrically very long makes the time lag of the echoes appreciable, and at the same time the repeaters overcome the high attenuation of the long circuits and consequently intensify the effect of the echoes. The seriousness of the effect is a function both of the time lag and the volume of the echoes relative to the direct transmission.

Various circuit arrangements known as "echo suppressors" are used to avoid these effects. These arrangements depend upon the fact that in all practical signaling circuits employing more than a single repeater there are points where the waves being transmitted in the two directions pass through separate paths. At these points the direct transmission takes place through one path, while only reflected waves or echoes are transmitted through the other. The echo suppressor is located at one of these points and usually consists of a relay arrangement for limiting the transmission through the echo path without disturbing the transmission through the main path. For satisfactory operation, it is often required that the echo suppressor have a short operating time and a longer releasing time.

In a specific preferred embodiment, this invention comprises two relays simultaneously controlled by waves being transmitted through one of the one-way paths of a two-way transmission system. One of the relays operates directly to short-circuit the second one-way transmission path. The other relay operates a third relay to put a parallel short

circuit on the second one-way transmission path and simultaneously operates a retarded or slow release relay to close a holding circuit for the third relay. When the transmission of waves over the first one-way path ceases the first two relays are released, removing the first short circuit from the second one-way path, while the second short circuit is maintained for the period of time required for the slow release relay to operate. With this arrangement the second one-way path is short-circuited to limit the transmission thereover almost immediately upon the initiation of transmission over the first one-way circuit, and the short circuit is maintained for an appreciable time after transmission over the first circuit ceases.

In a modification of the invention, a single relay with a double set of contacts is employed in place of the two simultaneously operated relays. One set of contacts operates to directly short-circuit the second transmission path, while the other set of contacts operates to directly actuate a slow release or retarded relay to put a second short circuit on the transmission path.

While the arrangements of this invention are particularly adapted for use as echo suppressors they may be useful in other circuits, for example, in voice operated repeater circuits.

The invention is illustrated in the accompanying drawing, in which Fig. 1 shows one are particularly adapted for use as echo suppressor and Fig. 2 shows a modification of the invention.

Fig. 1 shows a portion of a four wire transmission system in which two-way transmission is effected by the use of two oppositely directed one-way transmission lines 10 and 11. The circuit arrangement would, in general, be the same for a two-way two-element repeater circuit except that in that case it has been found advantageous to connect the suppressor circuits to the input of the amplifiers.

Two one-way amplifiers 12 and 13 are associated with the lines 10 and 11, respectively. The input of an amplifier-rectifier 14 is connected to the output terminals of the amplifier 13. The operating windings of two relays

15 and 16 are connected in series to the output of the amplifier-rectifier 14. Relay 16 is of the biased type since, in general, faster operation is obtained with such relays. The armature and contact of relay 16 are connected to the output of the amplifier 12 to short-circuit it when the relay is operated. The armature and contact of relay 15 are connected in circuit with one winding 21 of a relay 17 and a battery 19. The armature and contact of relay 15 are also connected in circuit with the operating winding of a retarded or slow release relay 18 and a battery 20. The operation of relay 18 supplies current to a holding winding 22 of relay 17 from the battery 19.

The operation of the circuit is as follows: When transmission is initiated over the circuit 11, the waves in the output of the amplifier 13 energize the amplifier-rectifier 14, operating the relays 15 and 16. The operation of relay 16 immediately puts a short circuit on the output of the amplifier 12, thus preventing transmission over the line 10. The operation of relay 15 closes a circuit from ground through the armature and contact of relay 15, winding 21 of relay 17, and battery 19 to ground, operating relay 17 to put a second short circuit on the output of the amplifier 12. The operation of relay 15 also closes a circuit from ground through the armature and contact of relay 15, operating winding of relay 18, battery 20 to ground, causing the operation of the retarded relay 18 which closes a circuit from ground through the armature and contact of relay 18, holding winding 22 of relay 17, and battery 19 to ground.

When transmission over the line 11 ceases, relays 15 and 16 are released. The release of relays 15 and 16 removes the first short circuit from the output of the amplifier 12, and the release of relay 15 opens the circuit of the winding 21 of relay 17 and that of the operating winding of relay 18, respectively. However, relay 18, being of the retarded type, does not immediately release but holds for a short interval the contacts of relay 17 closed due to the circuit maintained through the winding 22 by the contact of relay 18. A short time after transmission over the line 11 has ceased, relay 18 releases, thus releasing relay 17 and removing the second short-circuit from the output of the amplifier 12.

A second echo suppressing circuit 25, similar to the circuit above described, is employed for making similar short-circuiting connections across the output of amplifier 13 while transmission is taking place over line 10. The connections are such that the operation of one echo suppressor short circuits the input of the other so that one suppressor cannot be operated by directly transmitted waves and the other by reflected waves to prevent transmission in either direction.

Fig. 2 shows a modification of the circuit of Fig. 1 in which fewer relays are utilized. The winding of a single relay 26 is connected to the output of the amplifier-rectifier 14. Relay 26 is provided with two sets of contacts. One set of contacts 27 operates directly to put a short circuit on the line 10 and the other set of contacts 28 operates to make a connection from ground through the operating winding 30 of a slow release relay 29 and battery 31 to ground. The operation of this relay closes a contact 32 to place a second short circuit on the line 10. Relay 29 is designed to be slow releasing so as to remain operated for a definite period after relay 26 releases, thus maintaining the short circuit on line 10 for an interval after transmission to amplifier 14 has ceased. A similar modified echo suppressor circuit may be utilized in place of the circuit 25 for controlling the short circuit on line 11.

What is claimed is:

1. In a wave transmission system, two one-way transmission circuits, means responsive to waves in one of said circuits for making a connection of low impedance across the other of said circuits, and means simultaneously responsive to waves in said one circuit for making a second connection of low impedance across said other circuit, the last mentioned means being arranged to remain operated for a definite period of time after transmission over said one circuit has ceased.
2. In a wave transmission system, two one-way transmission circuits, means responsive to waves in one of said circuits for making a connection of low impedance across the other of said circuits, and a slow release relay also responsive to waves in said one of said circuits, for making a second connection of low impedance across said other circuit.
3. In a wave transmission system, two one-way transmission circuits, a relay responsive to waves in one of said circuits for making a connection of low impedance across the other of said circuits, a second relay simultaneously responsive to waves in said one circuit and a slow-release relay responsive to the operation of said second relay for making a second connection of low impedance across said other circuit.

4. A combination according to the next preceding claim in which the first mentioned relay and said second relay are connected in series.

In witness whereof, I hereunto subscribe my name this 24 day of May, A. D., 1927.

HAROLD J. FISHER.