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L. G. ABRAHAM

SELECTIVE ECHO SUPPRESSOR

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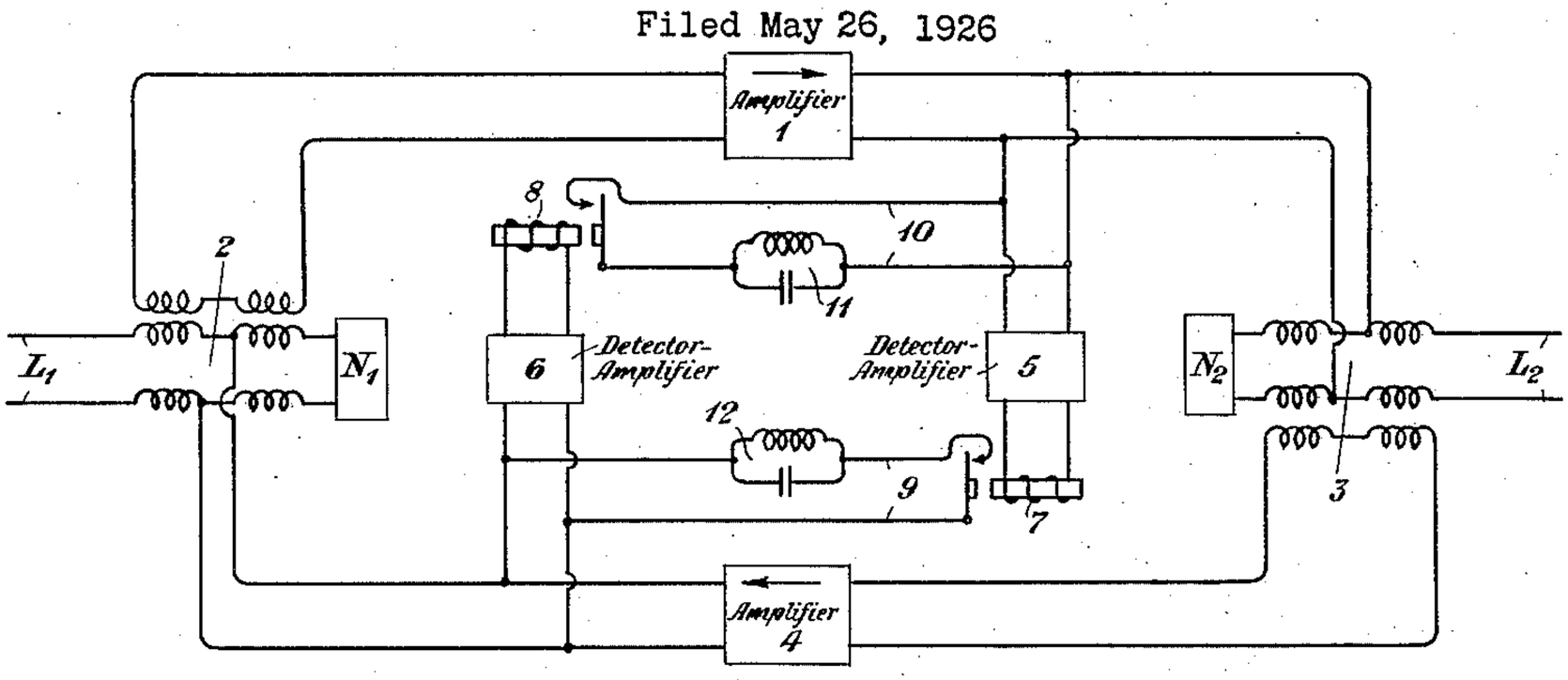

Fig. 1

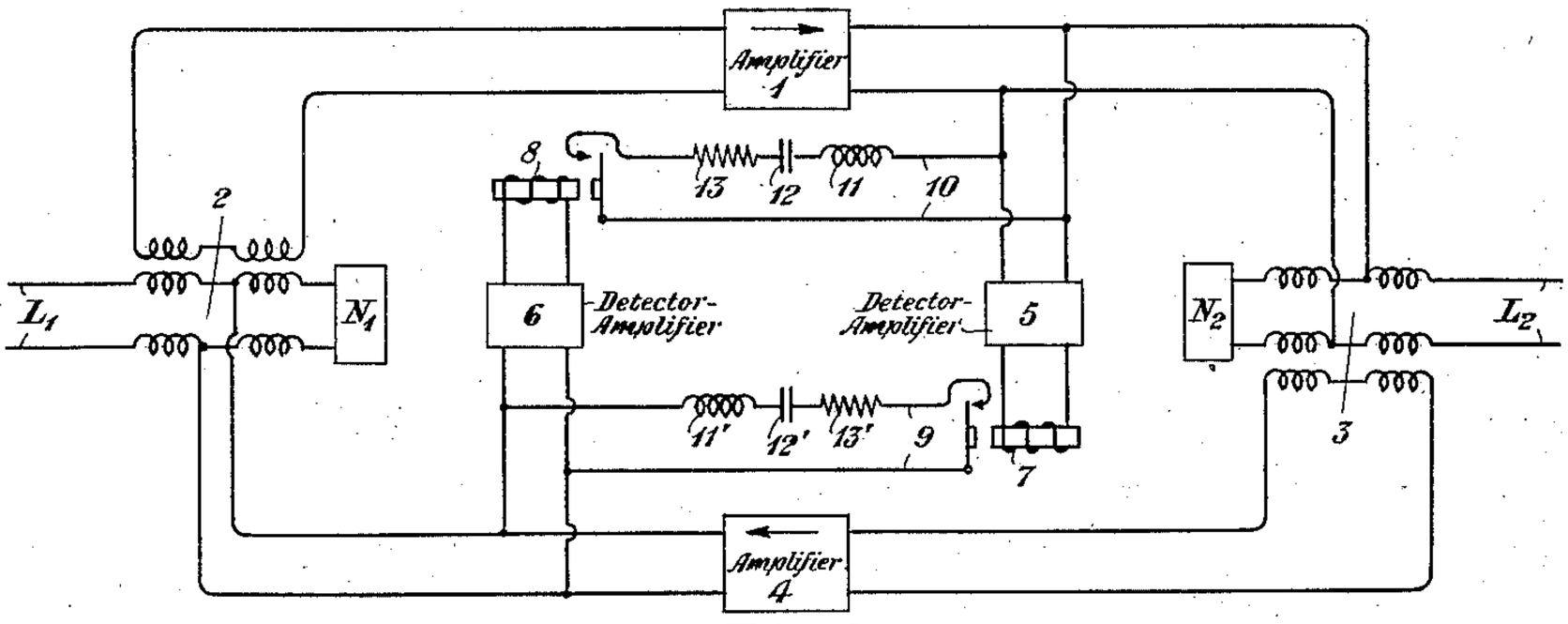

Fig. 2

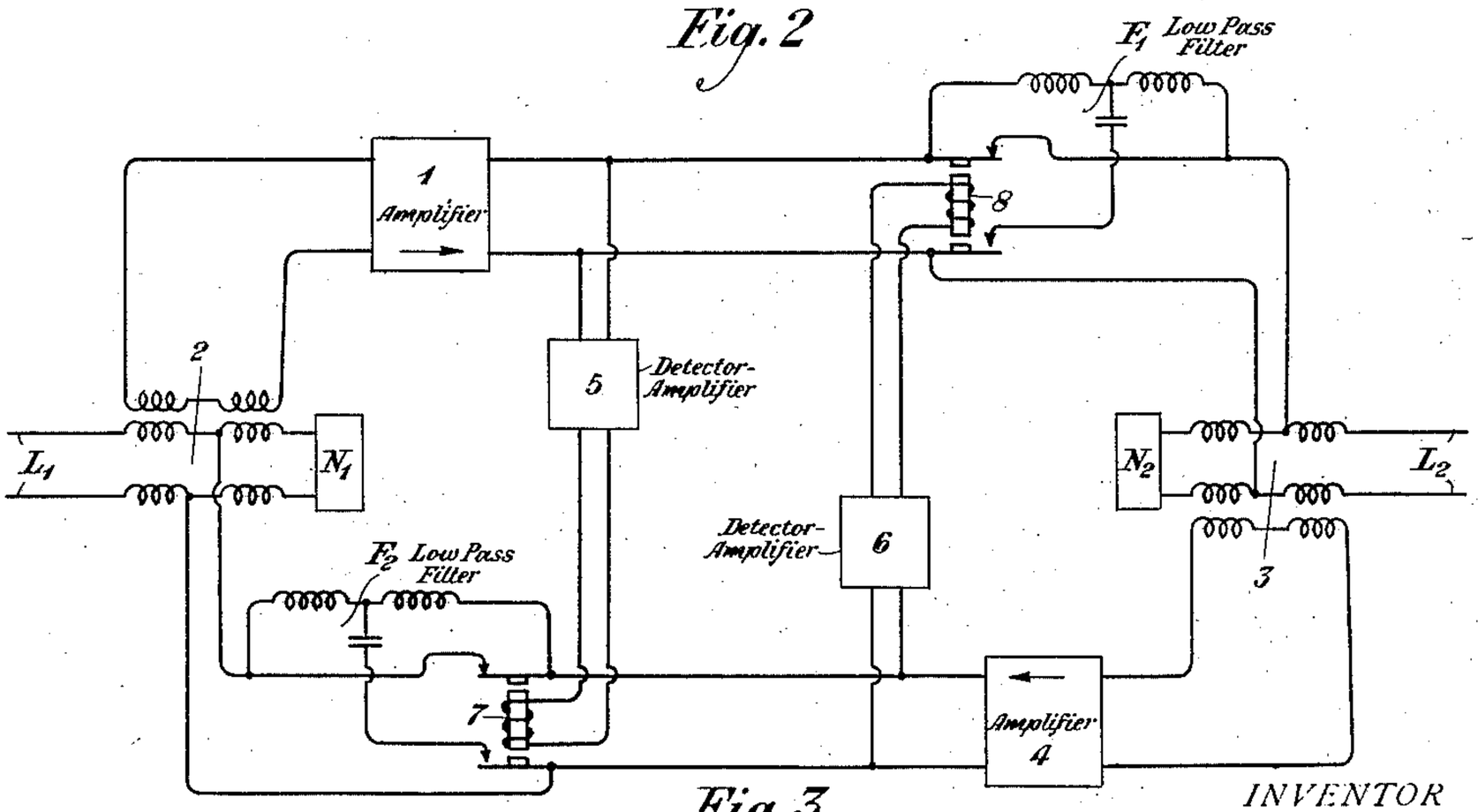

Fig. 3

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UNITED STATES PATENT OFFICE.

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SELECTIVE ECHO SUPPRESSOR.

Application filed May 26, 1926. Serial No. 111,847.

This invention relates to transmission systems, and particularly to improvements in devices for suppressing "echo" effects thereon. Primarily the object of the invention consists in providing a type of "echo" suppressor which will enable the receiving station to transmit in the opposite direction with certain frequencies at the same time that reception is going on with other frequencies.

As is well known in the art in designing telephone circuits which are electrically long, an important problem is presented by the necessity of avoiding serious "echo" effects. Echo effects are caused by reflections of electrical waves which take place whenever electrical irregularities are encountered in telephone circuits. The effects produced are very similar to echoes of sound waves. Some of the reflected waves return to the receiver of the talker's telephone so that if the effects are severe, he may hear an echo of his own words. Other reflected waves enter the receiver of the listener's telephone and, if severe, cause the listener to hear an echo following the directly received transmission.

While reflections of voice waves may occur in all practical telephone circuits, it is only in telephone circuits of such length as to require a number of repeaters, however, that echo effects become serious. The fact that the circuits are electrically very long makes the time lag of the echoes appreciable. At the same time the telephone repeaters overcome the high attenuation of these long circuits, and, consequently, make the echoes louder. In all practical telephone circuits involving more than a single repeater, there are points where the transmission in the two directions passes through two separate paths. At these points the direct transmission passes through one path while only reflected currents or echoes pass through the other. It has been the practice to locate the echo suppressor at one of these points. In this device, which is well known in the art, the electrical currents, with the help of vacuum tubes, are caused to actuate relays which cut off the echoes in the return path without disturbing the other path through which passes the main transmission. For a full and complete discussion and illustration of echo suppressors, reference is made to a paper by A. B. Clark and R. C. Mathes, entitled Echo suppressors for long telephone circuits, published June, 1925, in the Journal of the American Institute of Electrical Engineers, Vol. XLIV, pp. 618–626.

It is pointed out that it has been the practice heretofore for the echo suppressor devices in cutting off the echoes in the return path to close a short circuit across said return path. Obviously this would prevent the receiving station from any type of sending during reception. Instances might arise, however, in which it would be desirable to make it possible for the receiving station to signal during reception at some other frequency range. An illustration of such an instance might be found in cases where pictures were being transmitted over a line. The transmission band utilized for picture work might be approximately from 900 to 1700 cycles. While the picture was being received it might be very desirable for the receiving station to transmit in the opposite direction signals relating to the reception at some other frequency, such, for example, as 765 cycles. Accordingly, the echo suppresser of this invention is so arranged that it will not place a complete short circuit across the return path, but will merely short circuit or close the return path to certain frequency bands while still allowing other bands to be transmitted. Accordingly, echo effects from the original frequency band will be obviated without completely closing transmission in the return path. In other words, the invention provides an echo suppressor with selective properties with respect to different frequencies. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1, 2 and 3 of which are shown circuit diagrams illustrating a preferred form

of the invention and modifications thereof. Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 are shown two line sections L_1 and L_2 interconnected by two one-way circuits including the repeater, or amplifier, elements 1 and 4. Lines L_1 and L_2 are connected to the three-winding transformers 2 and 3 and the balancing networks N_1 and N_2, respectively, in a manner well known in the art. Bridged across the output circuit of amplifier 1 is a circuit including an amplifier-detector 5 and a relay 7. This relay 7 will respond to the currents transmitted through the amplifier 1 and upon operating, will close the circuit 9. In former types of echo suppressors the closing of the circuit 9 would close a dead short circuit across the output of amplifier 4 and hence stop all transmission from line L_2 to line L_1. However, in the arrangements of this invention a combination 12 of inductance and capacity is placed in circuit 9 so that it will be anti-resonant at some desirable signaling frequency such as 765 cycles. Accordingly, when circuit 9 is closed, it will place a shunt across the output of repeater 4 which will prevent the transmission of echo currents of the frequency band transmitted through amplifier 1, but will allow some other signaling frequency or frequencies, such as 765 cycles, to be transmitted without appreciable attenuation from line L_2 to line L_1. To prevent echoes when transmission is taking place from line L_2 to line L_1, a circuit is bridged across the output of amplifier 4 which includes an amplifier-detector 6 and a relay 8. The relay 8 controls a circuit 10, which is similar to circuit 9. Circuit 10 includes a combination 11 of inductance and capacity, whereby the circuit 10 will be anti-resonant at some desirable signaling frequency, such as 765 cycles. Accordingly, it will prevent echoes from being transmitted through amplifier 1 but will at the same time allow signaling at a frequency of 765 cycles to take place from line L_1 to line L_2. The amplifier-detectors are assumed to be adjusted by means well-known in the art so that they will have their greatest sensitivity to currents of frequencies between 900 and 1700 cycles, this being, for example, the transmission band utilized for picture work, and are so insensitive to currents of 765 cycles that they will not cause operation of the echo-suppressor relays.

In Fig. 2 is shown a modification of the arrangements of Fig. 1. Similar reference characters have been utilized to denote like parts in both arrangements. The only way in which the arrangements differ is in the construction of the shunt circuits 9 and 10. Instead of making these circuits anti-resonant at the signaling frequency of 765 cycles transmitted from line L_2 to line L_1, these shunt circuits are made resonant at the central frequency of a band transmitted from line L_1 to line L_2, such as 900 to 1700. This is accomplished by the adjustment of the inductances 11, 11′, the condensers 12, 12′, and the resistances 13 and 13′ in a manner well known in the art. Accordingly, these shunts when closed will prevent echoes from the frequency band, such as of 900 to 1700 cycles, but will not interfere with signaling frequencies some distance outside of this range transmitted in the opposite direction. As the arrangements are in other respects similar to those of Fig. 1, no further description thereof will be given.

In Fig. 3 is shown another modification of the echo suppressor of the invention in which like reference characters have been utilized to denote like parts with respect to Figs. 1 and 2. The arrangements of Fig. 3 differ from those heretofore described in that the shunt circuits 9 and 10 are omitted and the relays 7 and 8 are utilized to insert in the output of the repeaters low pass, high pass, or other filters, such as F_1 and F_2, which will cut off the echo currents but will allow the transmission of signaling currents of certain frequencies. In other words, the original signaling band transmitted through amplifier 1 will operate relay 7 which will insert in the output of amplifier 4 the low pass filter F_2. This will prevent echoes of the original signal band from being repeated back to line L_2 but will allow lower frequency signals to be transmitted from line L_2 to line L_1. Relay 8 and filter F_1 operate in a similar manner.

It is pointed out that the frequency values of a band from 900 to 1700 and 765 cycles are utilized for purposes of illustration only and that the invention extends outside of any such specific limits. Accordingly, while the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A circuit including an echo suppressor, and means in said echo suppressor providing for selective operation thereof with respect to different frequencies transmitted over said circuit.

2. A transmission line including two one-way line sections for transmission in opposite directions, means associated with one of said line sections and responsive to all currents transmitted thereover, and means controlled by said responsive means and associated with the other of said line sections for preventing currents of certain arbitrarily chosen frequencies from being transmitted over said last mentioned line section.

3. A transmission line comprising two one-

way line sections for transmission in opposite directions, amplifiers in each of said line sections, a circuit bridged across one of said line sections on the output side of the amplifier therein, said circuit including an amplifier detector and relay means, a circuit bridged across the other of said line sections on the output side of the amplifier therein, said last mentioned circuit comprising means whereby it will be anti-resonant at a certain frequency, and means controlled by said relay means for opening and closing said last mentioned circuit.

In testimony whereof, I have signed my name to this specification this 24th day of May, 1926.

LEONARD G. ABRAHAM.