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H. S. HAMILTON ET AL
TANDEM OPERATED ECHO SUPPRESSOR

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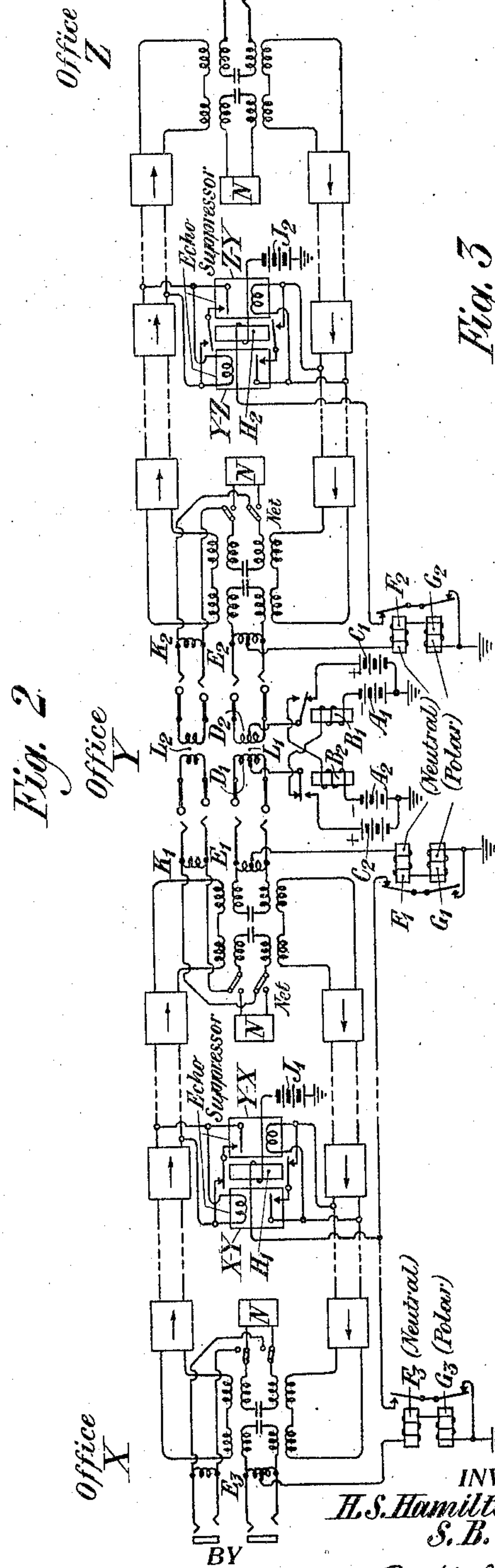
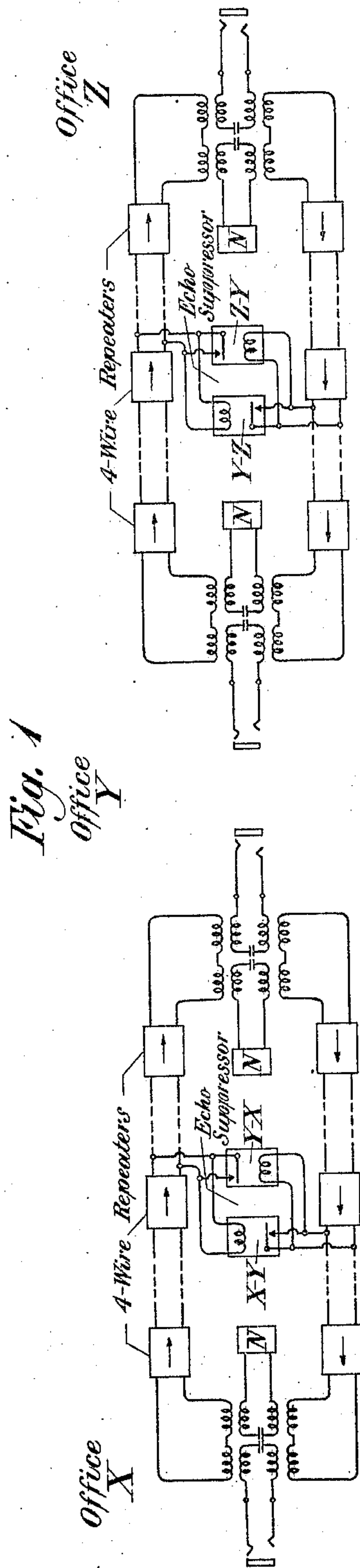
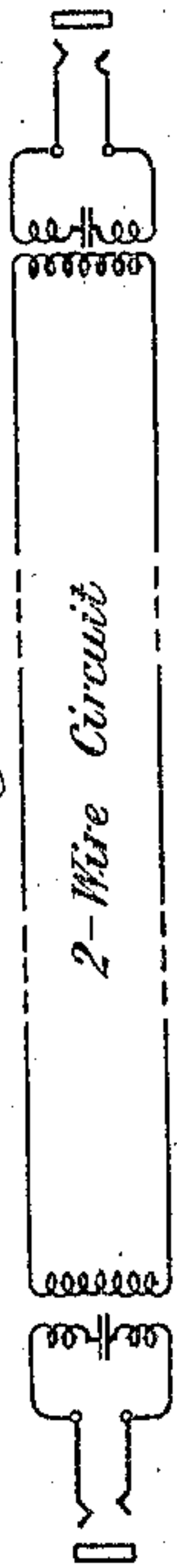


Fig. 3



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TANDEM-OPERATED ECHO SUPPRESSOR.

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To all whom it may concern:

Be it known that we, HAROLD S. HAMILTON and SUMNER B. WRIGHT, residing at New York and East Orange, in the counties of Bronx and Essex and States of New York and New Jersey; respectively, have invented certain Improvements in Tandem-Operated Echo Suppressors, of which the following is a specification.

This invention relates to transmission circuits and more particularly to transmission circuits employing echo suppressors.

One of the objects of the invention is to provide an arrangement whereby two or more circuits, each equipped with echo suppressors, may be operated in tandem. The problem presented when two or more circuits, each having an echo suppressor, are switched together, is to prevent the circuits getting into such a condition that, when two subscribers at the ends begin to talk at about the same time, neither subscriber will be able to hear the other.

The nature of the trouble will be evident if we imagine that two circuits, each containing an echo suppressor, are connected together. If the subscriber at end A begins to talk, the voice currents generated will cause the suppressor near his end to operate in such a way as to short-circuit the transmission path coming from the subscriber at the end B. If, before the voice currents from the subscriber at end A reach the second suppressor near the end B, the subscriber at end B has already started to talk and the voice currents generated at his station have caused the suppressor near his end to operate, it will be evident that the voice of the subscriber at A will be blocked by the suppressor near end B while the voice of the subscriber at B will be blocked by the suppressor near the A end. Talking under these conditions would be difficult because part of the time both subscribers might be talking with neither one hearing the other.

In accordance with the present invention it is proposed to overcome this difficulty by arranging the echo suppressors so that when two transmission circuits are connected in tandem the pair of echo suppressor units associated with one transmission circuit will be rendered ineffective while the pair of echo suppressor units associated with the other transmission circuit will remain in

such a condition that they may function normally. This control over the echo suppressor units may be exercised automatically in establishing the connection by means of a cord circuit or other connecting link. Preferably, the cord circuit will be arranged so that it will render ineffective one or the other of the pairs of echo suppressors, depending upon which transmission circuit it is connected to first.

The invention will now be more fully understood from the following detailed description when read in connection with the accompanying drawing, Figure 1 of which illustrates two four-wire repeater circuits adapted to be connected together in tandem and provided with echo suppressors of the ordinary type, Fig. 2 of which illustrates a similar arrangement provided with means for rendering certain of the echo suppressors ineffective in accordance with the present invention, and Fig. 3 of which illustrates a two-wire toll circuit which may be connected to one of the four-wire circuits without affecting the echo suppressors.

Referring to Fig. 1, a four-wire circuit is schematically shown, said circuit being equipped with the usual one-way repeaters and an echo suppressor between stations X and Y, while a similar circuit is shown between stations Y and Z for terminal connections over either circuit. Each individual echo suppressor functions in its normal manner, that is, when transmission takes place from X to Y the X—Y suppressor operates and short circuits the opposite branch of the four-wire circuit, suppressing echoes from Y, and vice versa.

If these two circuits were connected together in tandem and a person at X began talking to a person at Z, the X—Y suppressor would operate and cut off transmission from Z, while a short time later the Y—Z suppressor would also operate and cut off transmission from Z. If, however, during the interval between the operation of the X—Y and the Y—Z suppressors waves from the party at Z should arrive at the suppressor Z—Y, these waves would operate the Z—Y suppressor, thus cutting off transmission from X. Furthermore, since the X—Y suppressor would already be operated the transmission from the subscriber at Z could not get through to X and parties at both X

and Z might be talking for some time without either hearing the other.

Fig. 2 shows schematically an arrangement for obviating this difficulty by making both suppressor units associated with one of the four-wire circuits inoperative when the two circuits are connected together in tandem. In this figure, the operator's through toll cord circuit is shown at Y between the two four-wire circuits. This toll cord is arranged so that when all four of its plugs are inserted in the line and network jacks by which the four-wire circuits are terminated at station Y, the line terminals of the four-wire circuits as well as the network terminals will be directly connected together. By means of this connection it will be apparent that an almost perfect condition of balance will obtain at each hybrid coil by reason of the fact that the circuit connected to the line jack is identical electrically with the circuit connected with the network jack. In short, there is practically no unbalance at the Y terminals of either four-wire circuit so that the effect is practically the same as though the individual lines of the two four-wire circuits were directly connected together at station Y.

Further details of the apparatus will be clear from a description of the operation which is as follows: Assume that the left-hand line and net cords at office Y are first connected to the X—Y four-wire circuit, the right-hand cords not yet having been connected. Current flows from the negative battery A_1 through relay B_1 , through the normal contact of relay B_1 , through the simplex connection D_1 derived from the repeating coil L_1 , thence through the plug and jack terminals to simplex coil E_1 , through neutral relay F_1 and through polar relay G_1 to ground. Relays B_1 , F_1 and G_1 are operated as shown so that positive battery C_1 is applied to the right-hand core simplex D_2 . The relay F_1 , upon being energized, closes the control wire (which may be a simplex or composite circuit of any well known type if desired) at one point, but the energization of the polar relay G_1 opens the control wire at another point so that the circuit of the relay H_1 at the echo suppressor is not closed and consequently the two units of the echo suppressor remain in their normal condition.

The right-hand cords at office Y are then inserted in the Y—Z circuit. Current flows from positive battery C_1 , over the contact of relay B_1 , through simplex D_2 derived from repeating coil L_1 over the line plug and jack terminals to simplex E_2 and thence through neutral relay F_2 and polar relay G_2 to ground. This current is of opposite polarity from the current flowing through the left line cord and operates the neutral relay F_2 but does not operate the polar relay G_2 . Consequently, ground is connected to the

Y—Z control wire so that current from battery J_2 in the echo suppressor flows through and operates the relay H_2 , thereby opening the short-circuiting connections controlled by the two units of the echo suppressor. The two echo suppressor units associated with the Y—Z circuit are therefore disabled and the built-up circuit is then complete with only the X—Y suppressor functioning.

Consequently, when the subscriber at X talks to the subscriber at Z the voice currents will be transmitted through station Y over the upper lines of each four-wire circuit. Upon arriving at the point where the echo suppressor X—Y is applied, said suppressor will be operated to short-circuit the line of the four-wire circuit between X and Y, which transmits from Z to X. This prevents transmission from Z to X so that echo currents transmitted through the hybrid coil at Z cannot be propagated back to station X. The line transmitting from Z to Y between stations Y and Z is, of course, not disabled so that any echo currents which pass through the hybrid coil at station Z will be transmitted back to the hybrid coil of the four-wire circuit Y—Z at station Y. As already pointed out, however, the balance at this point will be almost perfect as it does not depend upon the simulation of a real line by a network. Therefore, the echo currents which will be returned to station Z through the hybrid coil at station Y will be so small in volume that they may be disregarded. Any components of the echo currents transmitted from station Z and which pass through the cord circuit to the line transmitting from Y to X will have considerable magnitude but will not be permitted to pass to station X by reason of the operation of the echo suppressor unit X—Y.

In case the plugs of the cord at office Y had been inserted in the jacks associated with the four-wire circuit extending from office Y to office Z before being inserted in the jacks associated with the four-wire circuit extending between office X and office Y, a circuit would have been established from negative battery A_2 , through the winding of relay B_2 , over the contact of relay B_1 , through the simplex circuit D_2 , over the terminals of the plug and jack, through the simplex coil E_2 , and through the windings of relays F_2 and G_2 , to ground. In this case, both relays F_2 and G_2 would be operated without affecting the control wire to the relay H_2 so that the echo suppressor units associated with the four-wire circuit between office Y and office Z would be permitted to function normally. Upon inserting the plugs of the cord into the jacks associated with the four-wire circuit extending from office X to office Y a circuit would be completed from positive battery C_2 , over the front contact of relay B_2 , over the simplex

circuit D_1 , and through the windings of relays F_1 and G_1 to ground. The direction of current would be such that the polar relay G_1 would not be operated so that upon the operation of the relay F_1 , a circuit would be completed from ground, over the control wire, and through the winding of the relay H_1 to battery J_1 . Relay H_1 would then operate to disable the echo suppressor units $X-Y$ and $Y-X$.

Fig. 3 shows a through toll line of the two-wire circuit type, which is not equipped with echo suppressors and which extends from office Y to some other office, as Z. If the through toll cord shown in Fig. 2 is used to connect a toll line of this type with a four-wire circuit of the type extending from office X to office Y, the echo suppressor associated with the four-wire circuit will remain in operative condition regardless of whether the connection to the four-wire circuit be made before or after the connection to the two-wire circuit. In establishing a connection from the two-wire circuit of Fig. 3 to the four-wire circuit extending between office X and office Y of Fig. 2 only the line portion of the cord circuit will be used, the connections not being established through the upper half of the cord circuit to the artificial line connections. Suitable networks, such as N, will be connected to the hybrid coils in place of the connections to the network jacks, as indicated by the switches shown. If the line plug of the cord circuit be inserted in the line jack of the four-wire circuit before the corresponding plug is inserted in the line jack of the two-wire circuit, the echo suppressor units $X-Y$ and $Y-X$ will not be affected for the reason that the circuit previously traced will be established through the relays B_1 , F_1 and G_1 , operating all three relays without producing any change in the control wire. If the other line plug is thereafter inserted in the jack of the two-wire circuit no control circuit will be completed as there is no simplex connection associated with the jack of the two-wire circuit. If, on the other hand, the line plug of the cord was inserted in the jack of the two-wire circuit before the connection was established to the four-wire circuit, the operation would not be any different, for the circuit of relay B_2 would not be completed over any simplex connection and hence the circuit already traced for relays B_1 , F_1 and G_1 would be established as before.

The tandem connection between the two four-wire circuits shown in Fig. 2 may be extended from office X to another office at the left of X by using another through toll cord circuit at X, equipped similarly to that shown at Y. In this case the network N will be disconnected from the hybrid coil at office X and the hybrid coil connected to a network jack in a manner similar to that

shown at office Y. Assuming that the connection is built up beginning at office Z, the two echo suppressor units $Y-Z$ and $Z-Y$ will remain connected to the four-wire circuit between office Y and office Z for the reason that there is no simplex connection associated with the line jack at office Z (it being assumed that office Z is only equipped to make connections to a terminal two-wire line). When the two four-wire circuits shown are interconnected by the cord circuit at office Y, the connection will be established between the cord and the four-wire circuit between office Y and office Z first so that the echo suppressor units $Y-Z$ and $Z-Y$ will still remain in their operative condition. Upon establishing the connection to the four-wire circuit extending from office Y to office X the echo suppressor units $X-Y$ and $Y-X$ will be disabled. Upon establishing the connection at office X between the four-wire circuit shown and the four-wire circuit extending to the left (not shown) the former connection will be established first. The answering cord at X will then establish a circuit which operates both relays F_3 and G_3 . While the effect of this is to attempt to leave the echo suppressor units $X-Y$ and $Y-X$ in operative condition these units had already been disabled by the connection established at office Y so no change in condition takes place. Upon plugging into the jacks of the four-wire circuit extending to the left of office X the echo suppressor involved at the left of X is disabled in a manner similar to that described in connection with the four-wire circuit extending from office Y to office X. Consequently, when the complete connection is established only one pair of echo suppressor units will be operative, viz, the units $Y-Z$ and $Z-Y$ associated with the four-wire circuit extending from office Z to office Y.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a transmission system, a plurality of transmission circuits adapted to be connected in tandem, a pair of echo suppressor units associated with each circuit, one unit being responsive to currents transmitted in one direction to disable the circuit for transmission in the opposite direction and the other unit being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in said first direction, and means operating when said transmission circuits are connected in tandem to render all of the echo suppressor units ineffective except the pair associated with one transmission circuit.

2. In a transmission system, a plurality of transmission circuits adapted to be connected in tandem, a pair of echo suppressor units associated with each circuit, one unit being responsive to currents transmitted in one direction to disable the circuit for transmission in the opposite direction and the other unit being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in said first direction, means for connecting said transmission circuits in tandem, and circuits controlled by said means for rendering all of the echo suppressor units ineffective except the pair associated with one of said transmission circuits.

3. In a transmission system, a plurality of transmission circuits adapted to be connected in tandem, a pair of echo suppressor units associated with each circuit, one unit being responsive to currents transmitted in one direction to disable the circuit for transmission in the opposite direction and the other unit being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in said first direction, and a cord circuit for interconnecting a pair of said transmission circuits in tandem, and means associated with said cord circuit for rendering the pair of echo suppressor units associated with one of said transmission circuits ineffective.

4. In a transmission system, a plurality of transmission circuits adapted to be connected in tandem, a pair of echo suppressor units associated with each circuit, one unit being responsive to currents transmitted in one direction to disable the circuit for transmission in the opposite direction and the other unit being responsive to currents transmitted

in the opposite direction for disabling the circuit for transmission in said first direction, a cord circuit for connecting a pair of said transmission circuits in tandem, and means associated with said cord circuit whereby the pair of echo suppressor units associated with either of the connected transmission circuits may be rendered ineffective while leaving the other pair in operative condition.

5. In a transmission system, a plurality of transmission circuits adapted to be connected in tandem, a pair of echo suppressor units associated with each circuit, one unit being responsive to currents transmitted in one direction to disable the circuit for transmission in the opposite direction and the other unit being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in said first direction, a cord circuit for connecting a pair of said transmission circuits in tandem, and controlling circuits associated with said cord circuit for rendering the pair of echo suppressor units associated with either of said transmission circuits inoperative, said controlling circuits being so arranged that when the cord circuit is connected to one of said transmission circuits it will not affect the echo suppressor units associated therewith but when connected to the other transmission circuit the pair of echo suppressor units associated therewith will be rendered ineffective.

In testimony whereof, we have signed our names to this specification this 1st day of July, 1924.

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