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S. B. WRIGHT

TANDEM OPERATED ECHO SUPPRESSOR

Filed July 2, 1924

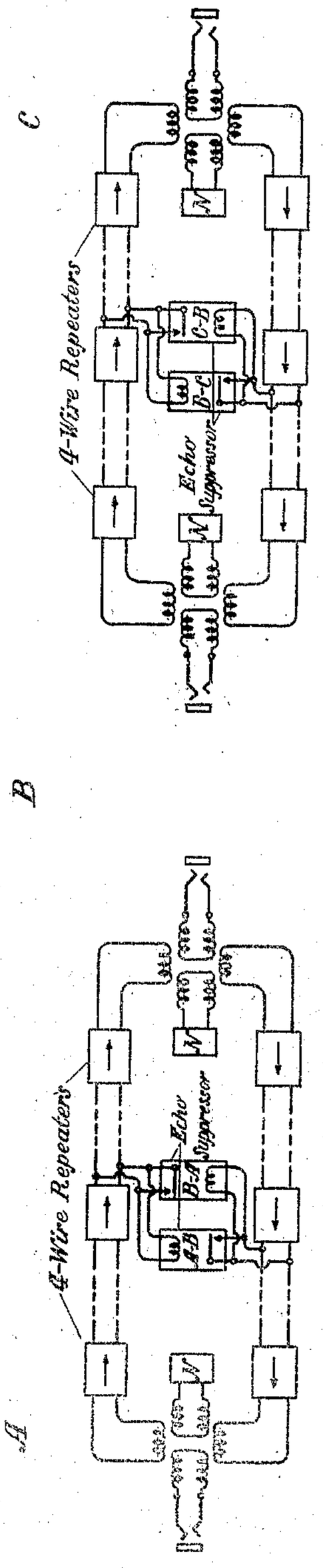

Fig. 1

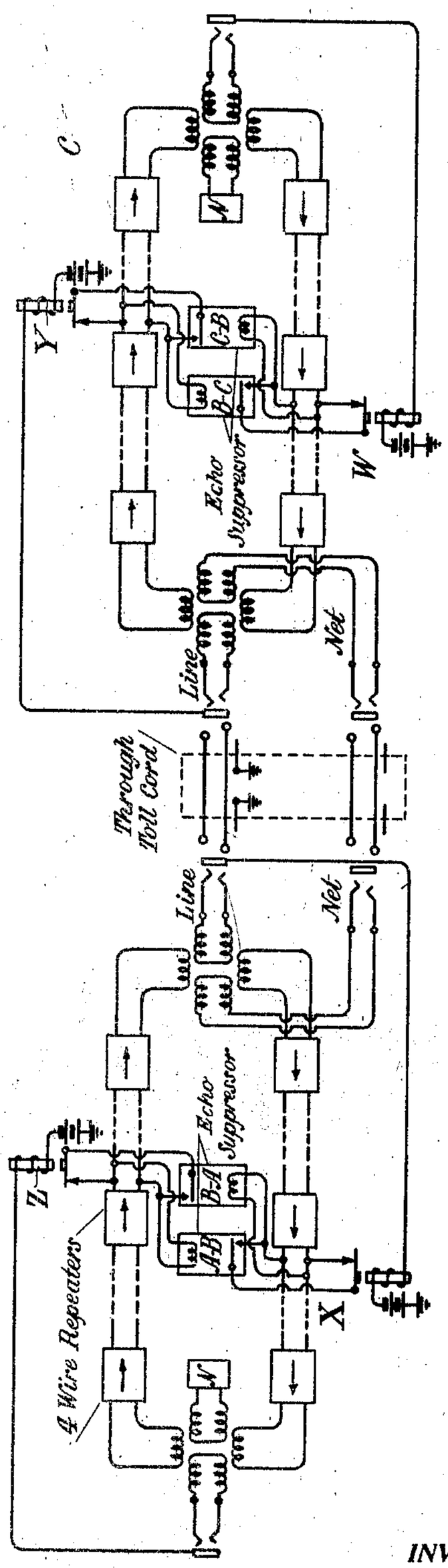

Fig. 2

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UNITED STATES PATENT OFFICE.

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TANDEM-OPERATED ECHO SUPPRESSOR.

Application filed July 2, 1924. Serial No. 723,802.

To all whom it may concern:

Be it known that I, SUMNER B. WRIGHT, residing at East Orange, in the county of Essex and State of New Jersey, 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 the 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 two transmission circuits adapted to be connected in tandem in such a manner that when a tandem connection is established, the echo suppressor unit for short-circuiting the path transmitting west will be disabled in the case of the one circuit, and the echo suppressor unit for short-circuiting the path transmitting east will be disabled in the case of the other transmission circuit. Under these conditions only one echo suppressor unit will be operative for transmission in a given direction so that it will not be possible to lock up the circuit.

The invention may 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 provided with echo suppressors of the ordinary type and arranged to be connected in tandem, while Fig. 2 illustrates a similar pair of four-wire repeater circuits provided with means for disabling certain of the echo suppressor units in accordance with the present invention.

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 A and B, while a similar circuit is shown between stations B and C. For terminal connections over either circuit, each individual echo suppressor functions in its normal manner, that is, when transmission takes place from A to B the A—B suppressor operates and short-circuits the opposite branch of the four-wire circuit, suppressing echoes from B, and vice versa.

If these two circuits were connected together in tandem and a person at A began talking to a person at C, the A—B suppressor would operate and cut off transmission from C, while a short time later the B—C suppressor would also operate and cut off transmission from C. If, however, during the interval between the operation of the A—B and B—C suppressors, waves from the party at C should arrive at the suppressor C—B, these waves would operate the C—B suppressor, thus cutting off transmission from A. Furthermore, since the A—B suppressor would already be operated, the transmission from the subscriber at C could not get through to A and parties at both A and C might talk for some time without either hearing the other.

Fig. 2 shows, schematically, an arrangement for obviating this difficulty by making one-half of each suppressor inoperative when the two circuits are connected together in tandem. In this figure, an operator's through toll cord circuit is shown at B 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 B, 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 to the network jack. In short, there is practically no unbalance at the B 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 B.

When the toll cord establishes the connection between the two four-wire circuits in tandem, a ground is connected to the sleeve conductor of the line jack of the four-wire circuit extending from station A to station B, thereby causing current to flow through a control wire (which may be a simplex or composite circuit of any well-known type, if desired) to operate a relay X at the four-wire repeater station at which the echo suppressor A—B is applied. This relay renders the A—B half of the echo suppressor inoperative by opening the short circuit controlled by the A—B half of the suppressor, the B—A half of the suppressor, however, remaining in its normal condition.

Similarly, the C—B half of the echo suppressor on the circuit between B and C is rendered inoperative when the other end of the toll cord is inserted in the line jack at B by means of a ground applied to another similar control wire to operate the relay Y. The B—C half of the suppressor is not disabled, however, as the relay W remains normal because the sleeve at C is not grounded.

The resulting effect is, therefore, that of a four-wire circuit equipped with a single echo suppressor arrangement, the two halves of which are located not near the center of the circuit but one near the receiving end for each direction. Consequently, when the subscriber at A talks to the subscriber at C, the voice currents will be transmitted through station B over the upper lines of each four-wire circuit, and upon arriving at the point where the echo suppressor B—C is applied, the latter suppressor will be operated to short-circuit the line of the four-wire circuit between B and C which transmits west. This prevents transmission from C to A so that echo currents transmitted through the hybrid coil at C cannot be propagated back to station A. The line transmitting west between stations A and B is, of course, not disabled so that any echo currents which pass through the hybrid coil of the four-wire circuit between A and B at station B will be transmitted back to the subscriber at A. 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 A from this point will be so small in volume that they may be disregarded. The echo currents transmitted through the hybrid coil at station C, however, may have considerable magnitude because the balance at that point depends upon the simulation of a real line by a compromise network so that the unbalance may be considerable. Echoes transmitted to A from this point are prevented, however, by means of the echo suppressor unit B—C.

The method above described is applicable to circuits built up of more than two four-wire repeater circuits equipped with individual echo suppressors. For example, it will be apparent that if a connection be established at C to a third four-wire circuit by means of a toll cord connection similar to that shown at B, the relay W would be operated to disable the suppressor unit B—C and its place would be taken by half of another suppressor located at a point beyond C. Similarly, if a connection is established at A to another four-wire circuit, the relay Z will be operated to disable the suppressor unit B—A, its place in turn being taken by one-half of a suppressor unit located beyond A. It will be understood, of course, that where connections are to be established at either A or C to other four-wire circuits, the network N will be disconnected and connections established to network jacks, as shown at station B.

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 being responsive to currents transmitted in one direction for disabling the circuit for transmission in the opposite direction, the other being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in the first direction, and means operating upon the connection of said circuits in tandem to render all of said echo suppressor units ineffective except one pair, of which one will be responsive to currents transmitted in one direction and the other responsive to currents transmitted in the opposite direction.

2. In a transmission system, a plurality of transmission circuits adapted to be connect-

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

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 being responsive to currents transmitted in one direction for disabling the circuit for transmission in the opposite direction, the other being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in the first direction, and means operative when said circuits are connected in tandem to render all of said echo suppressor units ineffective except one unit associated with one of said circuits and responsive to transmission in one direction and another unit associated with another of said circuits and responsive to currents transmitted in the opposite direction.

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 being responsive to currents transmitted in one direction for disabling the circuit for transmission in the opposite direction, the other being responsive to currents transmitted in the opposite direction for disabling the circuit for transmission in the first direction, means to connect said transmission circuits in tandem, and circuits controlled by said means to render all of said echo suppressor units ineffective except one unit associated with one of said transmission circuits and responsive to currents transmitted in one direction and another unit associated with another of said transmission circuits and responsive to currents transmitted in the opposite direction.

In testimony whereof, I have signed my name to this specification this 1st day of July, 1924.

SUMNER B. WRIGHT.