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S. B. WRIGHT

TESTING CIRCUITS FOR ECHO SUPPRESSORS

Filed Oct. 25, 1923

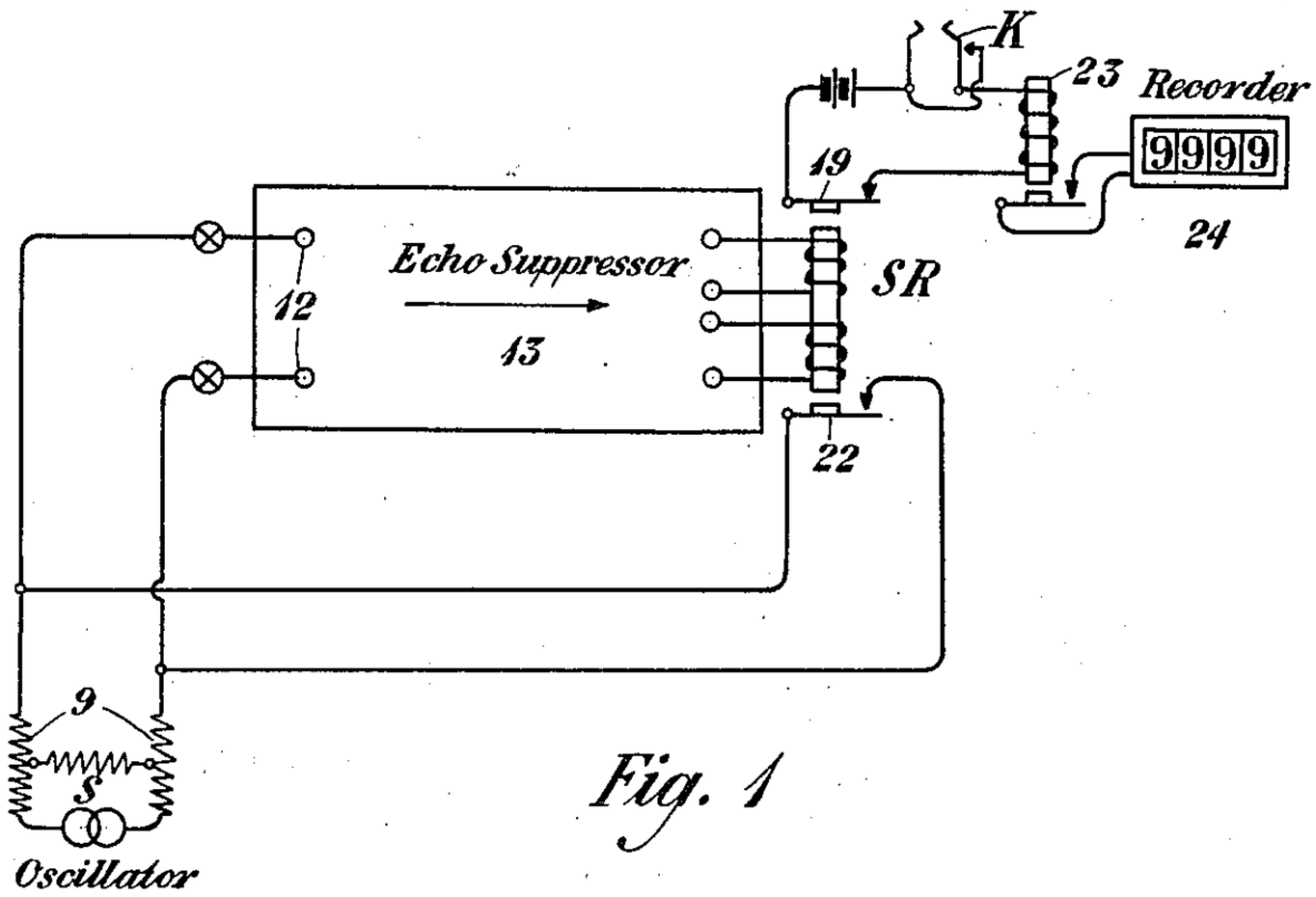

Fig. 1

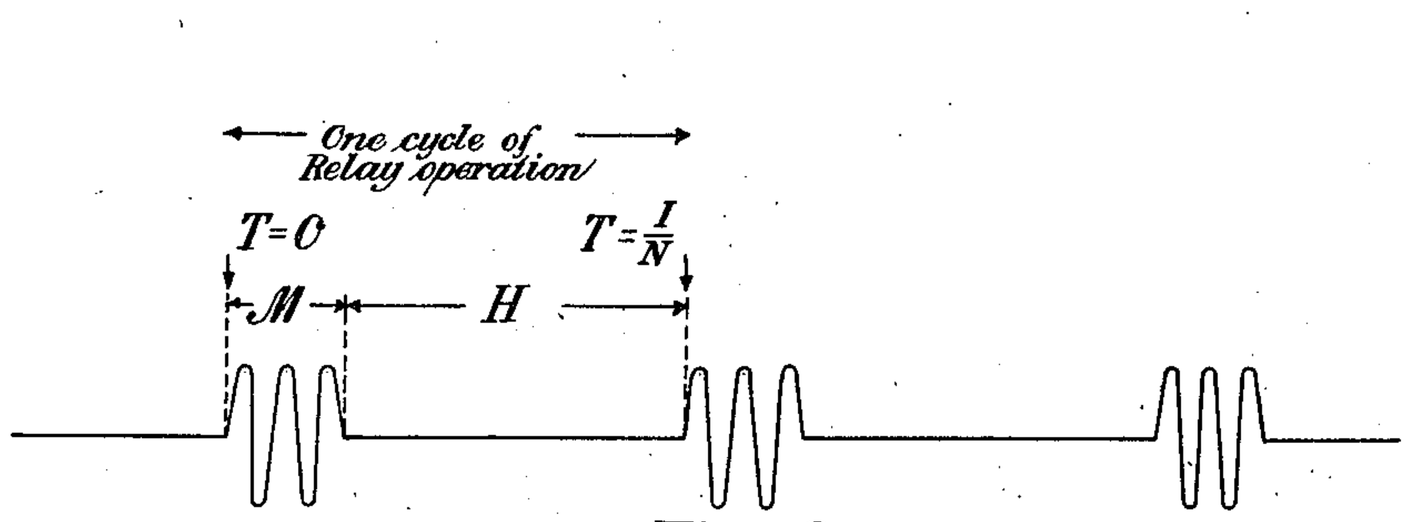

Fig. 2

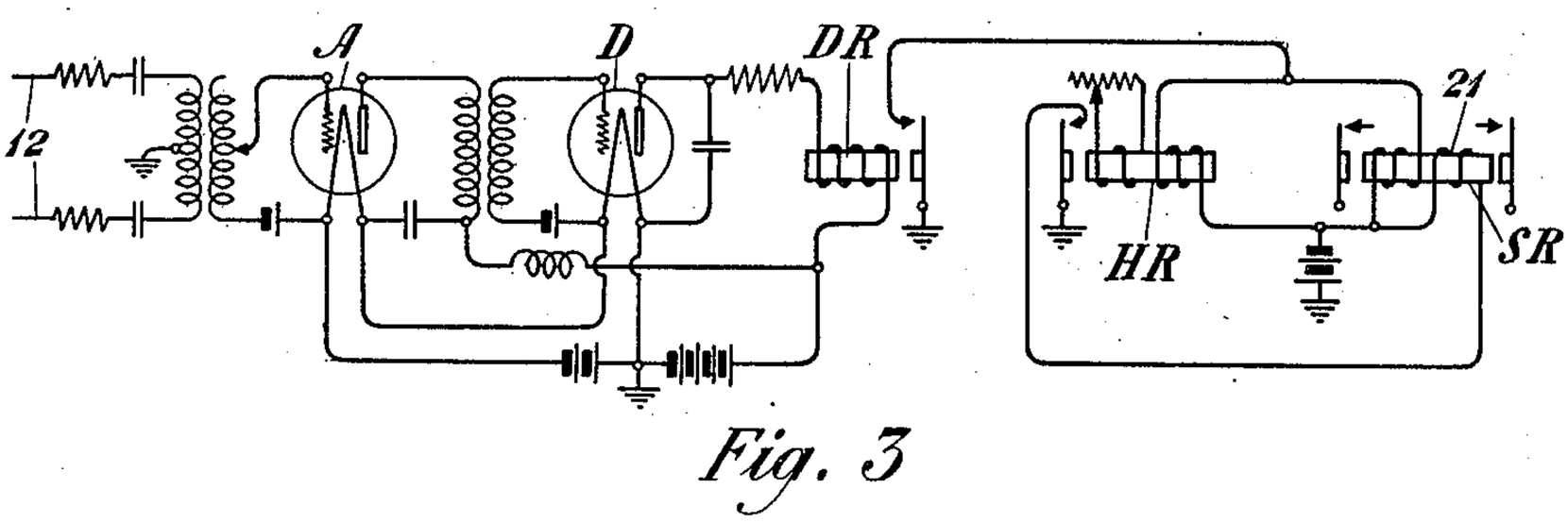

Fig. 3

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UNITED STATES PATENT OFFICE.

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TESTING CIRCUITS FOR ECHO SUPPRESSORS.

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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 Testing Circuits for Echo Suppressors, of which the following is a specification.

This invention relates to echo suppressing arrangements for long telephone circuits and more particularly to a method and means for testing the operating time of echo suppressor circuits.

In long telephone circuits, particularly circuits of the four-wire type, it has been proposed to overcome the difficulty due to echoes which are reflected back from terminal points or points of impedance irregularities in the circuit by providing so-called echo suppressors which operate in response to talking currents transmitted in one direction to disable the circuit for transmission in the opposite direction. In the case of the four-wire circuit, for example, a voice operated relay may be arranged to operate in response to voice currents transmitted in one direction to short circuit the line transmitting in the opposite direction. The operating time of the echo suppressor in such a system is of importance for the reason that when the suppressor is actuated in response to voice currents it must not release until the last wave which has actuated the suppressor has had time to be transmitted to the terminal and back to the point at which the suppressor short circuits the return path.

In accordance with the present invention it is proposed to test the operation of the echo suppressor to determine its operating time by impressing an alternating voltage upon the suppressor of such frequency and amplitude as to be equivalent in effect to an ordinary voice current, the suppressor contacts being arranged in turn so that when operated the alternating current supplied to the input will be interrupted. This causes the suppressor to be actuated in response to the alternating current. As soon as it is actuated it interrupts the alternating current and the alternating current remains interrupted until the echo suppressor again releases, when it again actuates the suppressor and the cycle is repeated. By observing the number of repetitions of this cycle which occur within a given interval of time the total time required for the suppressor to operate and release may be determined.

The invention may now be more fully understood by referring to the following detailed description when read in connection with the accompanying drawing, Figure 1 of which illustrates the testing circuit for an echo suppressor, Fig. 2 of which shows the character of the waves actuating the suppressor and Fig. 3 of which shows in some detail the circuit arrangement of the suppressor itself.

In order to understand the invention the nature of the echo suppressor to which the invention is applied will first be described. Referring to Fig. 3, the echo suppressor arrangement comprises a vacuum tube amplifier A, working into a vacuum tube detector D in the output circuit of which is a detector relay DR. The input terminals 12 of the arrangement are in practice bridged across one line of a four-wire circuit so that voice currents transmitted over said circuit will be impressed upon the amplifier. These voice currents are amplified by the amplifier A and are rectified by the detector D, whose grid has such a potential that normally no current will flow through the detector relay, but when the voice currents are received a rectified current component is caused to flow through the detector relay to actuate the same. The detector relay DR controls the circuits of a hangover relay HR and a suppressor relay SR in such a manner as to energize both relays. The hangover relay closes a locking circuit through an additional winding of the suppressor relay SR so that the latter will remain locked up so long as the hangover relay HR remains energized. The latter relay is made slow releasing by means of an additional short circuiting winding and the time required for the hangover relay to release may be adjusted by means of a suitable resistance in circuit with the extra winding. Consequently, after the voice currents cease and the detector relay D becomes deenergized a definite interval of time must elapse before the suppressor relay SR releases its contacts, this interval of time being determined by the hangover relay, which in turn is regulated by means of the resistance, already referred to.

The result is that the arrangement as a

whole causes the suppressor relay SR to close its contacts very quickly when voice currents are applied to the terminals 12, but a definite interval of time must elapse after the voice currents cease before the suppressor relay SR will release its armature. The purpose of the present invention is to determine the time required for this operation. Accordingly, as is shown in Fig. 1, the echo suppressor arrangement schematically indicated at 13 has its input terminals 12 connected to a suitable source of alternating current, such as the oscillator S. The resistance arrangement 9 is included between the source and the echo suppressor to reduce the currents supplied by the echo suppressor to the desired amplitude. The suppressor relay SR, which in its normal operation, is used to short circuit the return path of a four-wire circuit, has its contact 22 arranged so that the input of the echo suppressor will be short circuited when the suppressor relay is actuated.

When the tone from the source S is applied to the terminals 12 of the echo suppressor, the suppressor relay SR operates and short circuits the input terminals 12 of the amplifier detector arrangement after an interval corresponding to the operating time of the relay system. This short circuit removes the alternating current from the amplifier detector, which causes the relay system to release after an interval, depending upon the adjustment of the hangover relay, already described.

Fig. 2 of the drawing illustrates the action of the arrangement. If the tone is applied at the instant T=O the current flows into the input terminals of the amplifier detector during the interval M, required to cause the suppressor relay SR to close. This time may be described as the "make" time of the relay system. The short circuit will remain closed and the current entering the amplifier detector will be zero for the interval H, required for the system to release. The time H may be called the hangover time of the system. The removal of the short circuit permits the current to flow once more and the cycle is repeated. The time T required for each cycle of operation is equal to M+H so that by noting the number of operations of the relay in a given interval of time, as, for example, one minute, the total time required for both make and break can be obtained.

Since the settings of the relay system that are ordinarily used in practice will cause this cycle to be repeated about 10 times per second, it is desirable to have some auxiliary device capable of counting the operations at this speed. For this purpose, an auxiliary timing contact 19 is arranged to be operated by the armature of the suppressor relay SR. This contact is connected in series with a key or push button K, a battery and a relay 23. The relay 23 controls the circuit of the magnet (not shown) of a counting device 24, of any well known type. This counting device may consist of a ratchet wheel having some convenient number of teeth, for example, 100, and controlling a pointer moving over a dial having a corresponding number of divisions. Each operation of the suppressor relay will cause the magnet to move the wheel forward one step. To make an observation, the tone would be applied from the source S and the system set into vibration. The key K would then be closed for a suitable interval by an observer using an ordinary clock or watch with a second hand. The total number of revolutions of the ratchet wheel could easily be counted by means of an ordinary counting hand and the exact number of operations in the interval determined from the final position of the wheel. The device could readily be set back to zero at the beginning of each observation.

This arrangement and method of measurement are very simple and easy to carry out but would probably not give exactly the same time for the sum of the make and hangover intervals as would be given by an oscillograph, since the operations of the relays are repeated so rapidly that the fluxes of their cores do not have time to settle down to a steady state after one operation before the impulse for the succeeding operation arrives. The system may, however, be carefully calibrated with reference to oscillograph measurements of a typical echo suppressor system and will then give a reliable check of the suppressor, for any cause which would lengthen or shorten the hangover or operating time would also have an effect slowing down or speeding up the vibration of the relays.

It will be obvious that the general principles herein disclosed may be embodied in 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. The method of timing the operation of a voice operated echo suppressor system in which a suppressor relay is actuated in response to voice currents, which consists in impressing upon the system an alternating current, having a frequency and amplitude substantially equivalent in its effect to voice currents, to actuate the suppressor relay, and preventing the transmission of the alternating current to the echo suppressor system during the actuation of the suppressor relay so that the relay will again be released.

2. The method of timing the operation of a voice operated echo suppressor system in which a suppressor relay is actuated in re-

sponse to voice currents, which consists in impressing upon the system an alternating current, having a frequency and amplitude substantially equivalent in its effect to voice currents, to actuate the suppressor relay, preventing the transmission of the alternating current to the echo suppressor system during the actuation of the suppressor relay so that the relay will again be released, and measuring the interval of time required for the suppressor relay to pull up and release.

3. The method of timing the operation of a voice operated echo suppressor system in which a suppressor relay is actuated in response to voice currents, which consists in impressing upon the system an alternating current, having a frequency and amplitude substantially equivalent in its effect to voice currents, to actuate the suppressor relay, preventing the transmission of the alternating current to the echo suppressor system during the actuation of the suppressor relay so that the relay will again be released, and measuring the interval of time required for a complete cycle of the operation of the suppressor relay.

4. A testing circuit for timing the operation of an echo suppressor comprising a suppressor relay and voice operated means for actuating the same, said circuit comprising means to apply a source of current to the input terminals of the echo suppressor, and means controlled by the suppressor relay for preventing the transmission of oscillations from said source to the echo suppressor during the interval that the suppressor relay is actuated.

5. A testing circuit for timing the operation of an echo suppressor comprising a suppressor relay and voice operated means for actuating the same, said circuit comprising means to apply a source of current to the input terminals of the echo suppressor, and means for short circuiting the input terminals of the echo suppressor to prevent the transmission of current from said source to the input of the echo suppressor while the suppressor relay is actuated.

6. A testing circuit for timing the operation of an echo suppressor comprising a suppressor relay and voice operated means for actuating the same, said circuit comprising means to apply a source of current to the input terminals of the echo suppressor, means controlled by the suppressor relay for preventing the transmission of oscillations from said source to the echo suppressor during the interval that the suppressor relay is actuated, and a counting device controlled by a suppressor relay.

In testimony whereof, I have signed my name to this specification this twenty-fourth day of October, 1923.

SUMNER B. WRIGHT.