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VOICE OPERATED CIRCUIT

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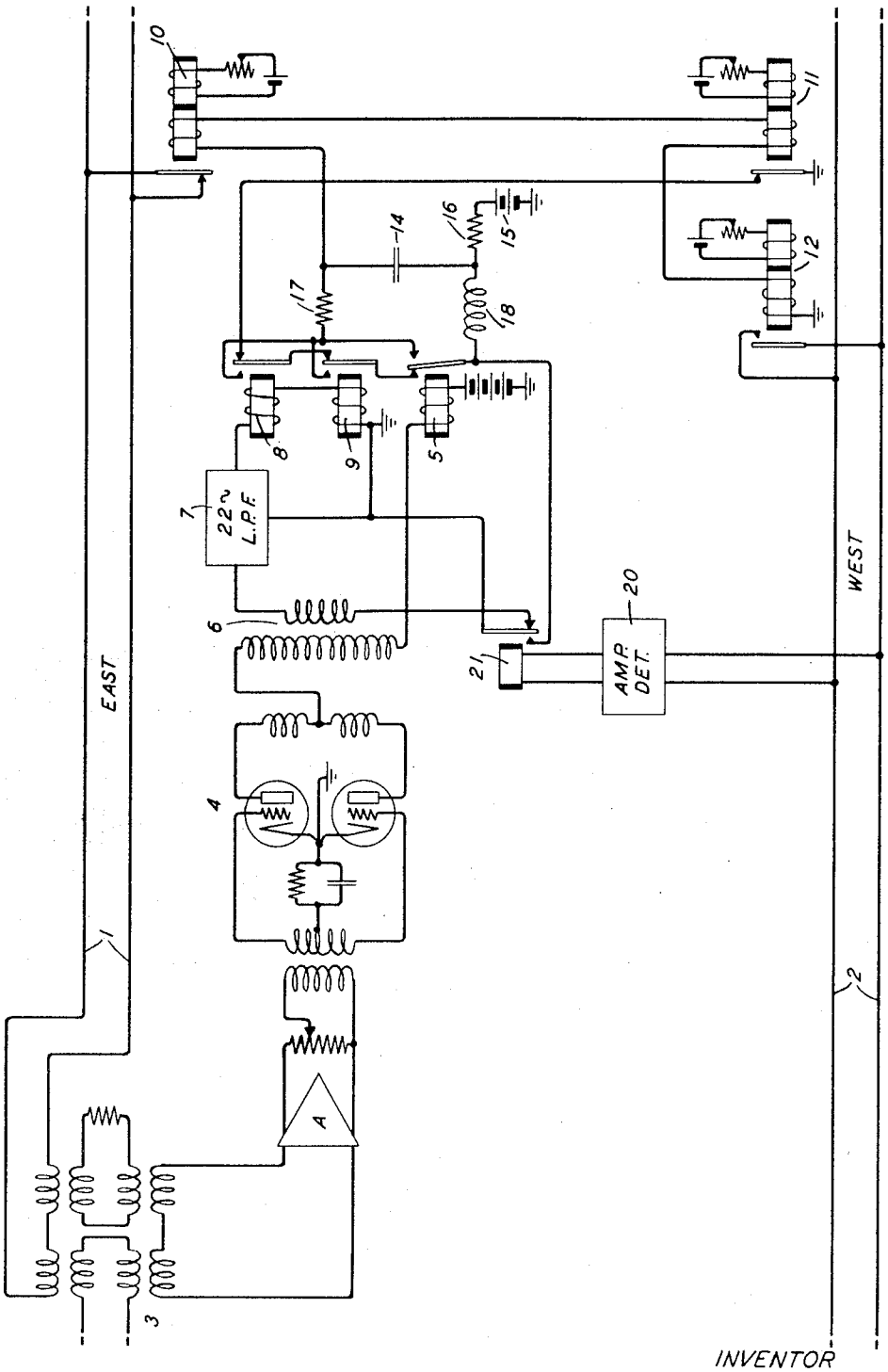

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VOICE OPERATED CIRCUIT

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This invention relates to voice operated relay circuits of the type used in echo suppressing equipment, voice operated repeater circuits and the like.

An object of the invention is to enable speech currents to exercise immediate and positive control over the circuit which they are intended to control while at the same time preventing false operation of that circuit by noise currents which may be present.

Voice operated circuits have heretofore been proposed for discriminating between speech and noise by taking advantage of the rising and falling vocal intervals of speech and utilizing this characteristic to discriminate from more or less continuous noise energy. The present invention is in the nature of an improvement upon voice operated circuits of this type.

According to the embodiment of the invention to be described more fully hereinafter, a pair of polarized relays are connected in reverse order to the output of a low pass filter which in turn is in the output of the detector circuit to which the speech, and incidentally also the noise currents, are applied. One of these two relays operates immediately upon the initial application of speech current to the circuit and the other one of these relays likewise operates immediately upon the cessation of the speech waves. Noise currents which do not have a syllabic characteristic resembling speech are ineffective to operate either of these two relays. A third relay is preferably provided in the detector output circuit independent of the low pass filter and this relay is arranged to be operated by steady currents of greater amplitude than the noise that is incident upon the system. This relay, for example, would be operated by prolonged speech wave trains and bridge over the time interval between the operations of the other two relays. The circuits to be controlled by the speech are operated when any one of these three relays operates to shift its armature.

The nature and objects of the invention will be more clearly understood from the following detailed description in connection with the accompanying drawing, the single figure of which discloses the invention as embodied in a singing suppressor circuit.

The singing suppressor circuit is illustrated as incorporated in a four-wire circuit comprising the east branch 1 and the west branch 2. These branches are oppositely directed one-way circuits, assumed to extend toward the left eventually to a subscriber's set through the medium of any suitable transmission system and toward the right to a two-way radio or wire transmission channel. For example, the east line may extend to the radio transmitter and the west line to the radio receiver, or both lines may extend to a long distance telephone terminal such as an ocean cable telephone terminal.

Line 1 is normally disabled due to a short circuit being placed across it by the armature of relay 10. Line 2 is adapted to be disabled upon energization of relay 12 the armature of which places a short circuit across this line, but relay 12 is normally deenergized so that line 2 is in condition to transmit speech. It will be understood that the use of a short-circuit connection for disabling the line is merely typical of any form of disabling that may be desirable or expedient.

It is the function of the singing suppressor to clear the east line in response to speech coming over this line from the distant subscriber's station at the left and also to disable line 2. The speech is thus permitted to be transmitted over the east circuit, but currents such as speech, noise, echoes or other disturbances are prevented from being transmitted over the west circuit. It will be understood that both circuits 1 and 2 contain one-way amplifiers to provide the necessary amplification.

The singing suppressor is connected to derive some of the speech waves from line 1 through the hybrid coil shown at 3, this type of connection being used to prevent reflection into line 1 of any impedances utilized in the singing suppressor branch.

The voice waves derived from the line 1, after suitable amplification are detected by the duplex detector shown at 4. The space path of this detector includes a polar relay 5 between the detector anode and the plate battery as shown. In this same connection there is the primary of a transformer 6 the secondary of which is connected to the low pass filter 7, the cut-off frequency of which is about 22 cycles. The output circuit of the filter 7 includes in series the two polar relays 8 and 9 connected in respectively reverse order.

The armatures of relays 5, 8 and 9 are interconnected so that the operation of any one of them results in the operation of the relays 10, 11 and 12. Relay 11 is a hold-over relay the operation of which will be made clear presently. Condenser 14 is connected in a normal series circuit from battery 15 through resistance 16, condenser 14 and the operate windings of relays 10, 11 and

12. Upon the operation of any one of the three relays 5, 8 or 9, this condenser 14 is arranged to be shunted through resistance 17 and inductance 18 and when so shunted it is discharged at a rate determined by the proportioning of the resistance 17 with respect to the capacity of condenser 14.

The operation will now be described. Speech waves incoming over the line 1 find this line blocked due to the normal short circuit at the back contact of relay 10. A portion of the waves passes into the branch containing detector 4 by which they are rectified.

These speech waves are not a long continuous wave train, but occur as short trains of waves of syllable duration. The syllables or vocal intervals occur at the rate of about 2 to 20 cycles per second. It is found when speech waves are rectified, as by the rectifier 4, and are passed on through a transformer such as 6 and a low pass filter such as 7, that they produce in the output of the filter a current impulse of one sign at the beginning of a syllable and another current impulse of opposite polarity at the end of a syllable.

Polar relay 8 is arranged to attract its armature upon the initial impulse of a syllable while polar relay 9 attracts its armature on the final impulse of a syllable. A succession of short syllables therefore, has the effect of keeping the armatures of relays 8 and 9 in a state of vibration.

In the case of a long sustained speech sound or of a tone which may be applied to the system for testing or other purposes, relays 8 and 9 would not be caused to vibrate continuously. Relay 8 would operate upon the beginning of such a long wave train, but would then release its armature and relay 9 would not operate until the end of such wave train. The function of relay 5 is to operate in case of a long wave train of sufficient amplitude and thus to bridge over the interval between the operation of relays 8 and 9. For this purpose relay 5 can be made sluggish in its action and is also marginal in order not to be operated by the relatively weak continuous noise which may be present on the system.

Detector 4 is of the type in which the space current is decreased below normal value when waves are incident upon its input circuit. Relay 5 is shown with its armature normally attracted. When sufficiently strong waves are impressed on the detector 4 and persist for a sufficiently long time, relay 5 releases due to the decrease in the space current.

When relay 8 operates to shift its armature from the normal position shown in the drawing to the opposite contact, all three relays 10, 11 and 12 are immediately energized. This takes place in the following manner: As soon as the armature of relay 8 leaves its normal contact, a rush of current is allowed to flow through the condenser 14 from battery 15 and through the windings of relays 10, 11 and 12 in series. This charging impulse of the condenser 14 causes these relays to operate quickly. When the armature of relay 8 reaches its opposite contact, condenser 14 is discharged through such armature contact armatures and normal contacts of relays 9 and 5, and resistance 17 and inductance 18 in series. Relays 10, 11 and 12 continue to be energized through the series direct current circuit including resistance 17, armature and contact of relay 8, armatures and normal contacts of relays 9 and 5, inductance 18, resistance 16 and battery 15.

When at the end of a syllable relay 9 attracts its armature, the discharge circuit of condenser 14 is broken and a rush of charging current flows into the condenser and through the windings of relays 10, 11 and 12 maintaining these relays operated. When the armature of relay 9 completes its stroke, a direct current circuit is closed similar to that previously traced for relays 10, 11 and 12 but this time including front contacts of relays 9 and 5.

By the operation of relays 8 and 9 as described, relays 10, 11 and 12 are maintained operated as long as speech currents are coming in over line 1. Condenser 14 in the manner that has been described bridges over the intermittent action of these relays to maintain a practically steady energizing current in the windings of relays 10, 11 and 12.

In the case of sustained tones or extra long syllables relay 5 releases its armature, as previously described, and maintains the circuits for relays 10, 11 and 12 through its armature and back contact.

At the end of a conversation or during a sufficiently long pause, relays 5, 8 and 9 remain in the condition shown in the drawing and relays 10, 11 and 12 release after a sufficient hang-over.

The release of all three relays 5, 8 and 9 breaks the discharge circuit of condenser 14 (prior to the release of relay 11) and this condenser is allowed to charge in series with the windings of relays 10, 11 and 12 preventing them from releasing immediately. The bias currents of these three relays are such that relay 11 releases first. When relay 11 releases it closes at its back contact a ground connection to the lower terminal of condenser 14 by way of the normal contacts of relays 5, 8 and 9 and inductance 18. This causes condenser 14 to discharge through the windings of relays 10, 11 and 12 in a direction to release relays 10 and 12 simultaneously. Relay 11 in this way controls the hang-over time of relays 10 and 12. The individual biasing currents for these relays are controlled by the associated batteries and variable resistances shown. Preferably relays 10 and 12 are biased alike from the same source so as to release simultaneously or so that relay 10 releases slightly ahead of relay 12 to insure that no singing circuit is established. For simplicity of illustration the drawings shows separate bias batteries.

As a result of the chain of operations described, as soon as speech comes in over the branch 1 relay 10 operates to clear this branch and allow the speech to proceed while relay 12 closes the shunt across the opposite branch. Both of these conditions are maintained as long as speech persists. At the cessation of the speech these relays are released after a suitable hang-over time to allow for all of the speech to pass on to circuit 1 and to prevent in circuit 2 echoes or other disturbances immediately following the cessation of speech in line 1.

When speech comes in on circuit 2 a portion of the speech passes through the amplifier-detector 20 and operates relay 21 shifting its armature from its back to its front contact. The breaking of the circuit at the back contact opens the input circuit of low pass filter 7 thus preventing the operation of relays 8 and 9. The closing of the front contact connects ground to the armature of relay 5 thus preventing condenser 14 from receiving a charge and preventing relays 10, 11

and 12 from operating even though relay 5 should operate.

What is claimed is:

1. In a voice operated circuit a detector on which voice waves are impressed, a low-pass filter in the output of said detector, a pair of polarized relays having their operating windings connected to the output of said filter in respectively reverse direction whereby one or the other of said relays operates at the beginning and at the end of speech impulses of syllabic frequency, and a switching circuit controlled jointly from said relays.

2. A voice operated circuit comprising a detector on which said voice waves are impressed, a transformer in the output of said detector, a low-pass filter connected to the secondary of said transformer, said filter having a cut-off frequency of the order of the syllabic frequency of normal speech, and a pair of polarized relays having their operating windings connected to the output of said filter in respectively reverse direction, one of said relays being poled to operate upon the initial application of speech to said circuit and the other upon the cessation of speech waves in said circuit, and switching means controlled from said relays.

3. A voice operated circuit according to claim 2 including also a third relay directly in the detector output circuit and operated on sustained speech wave trains or continuous tone waves, said relay also controlling switching means.

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