Oct. 4, 1960 A. H. FAULKNER 2,955,161

TONE DETECTOR FOR COIN CONTROL

Filed June 29, 1956 2 Sheets-Sheet 1

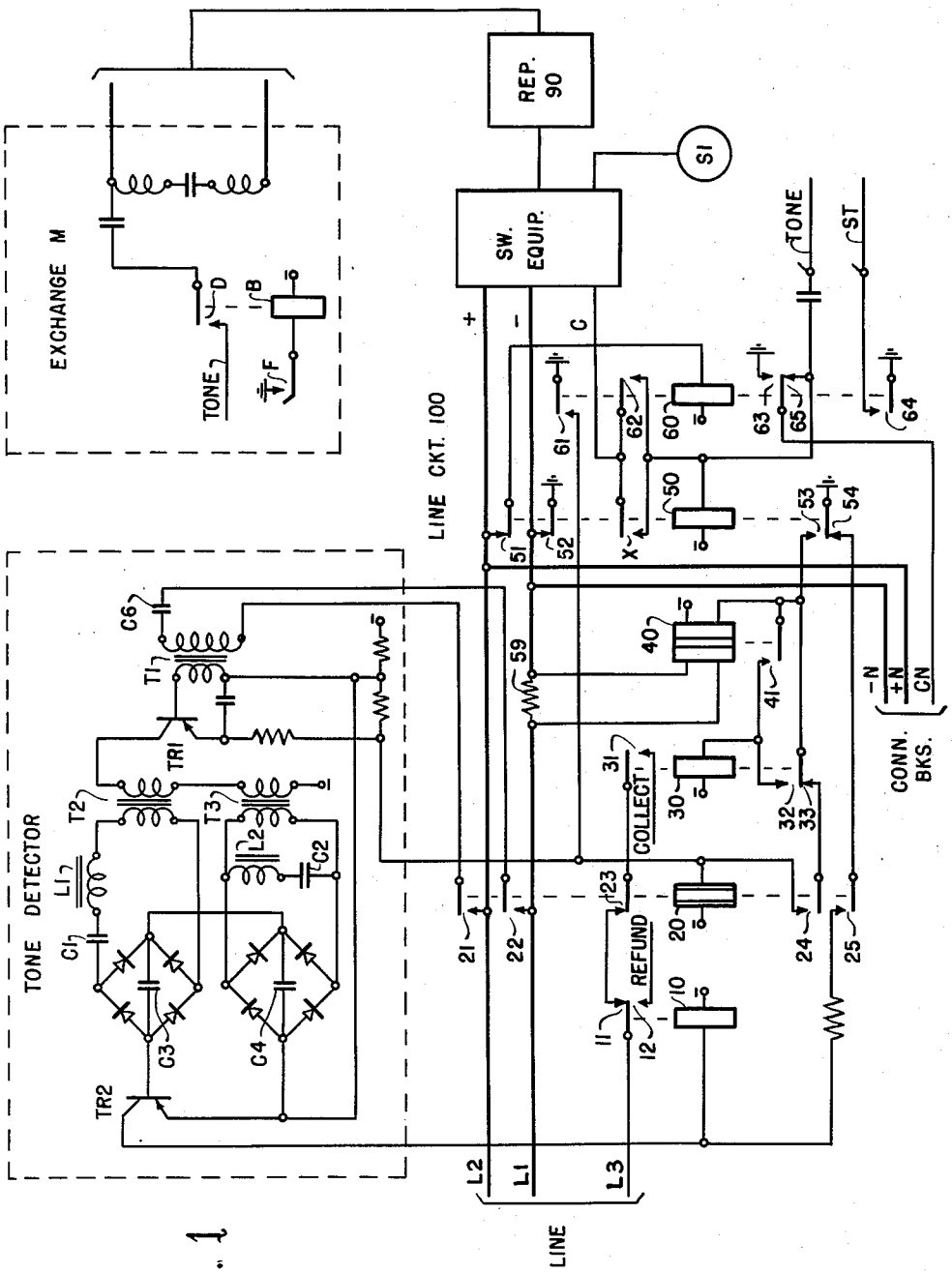

FIG. 1

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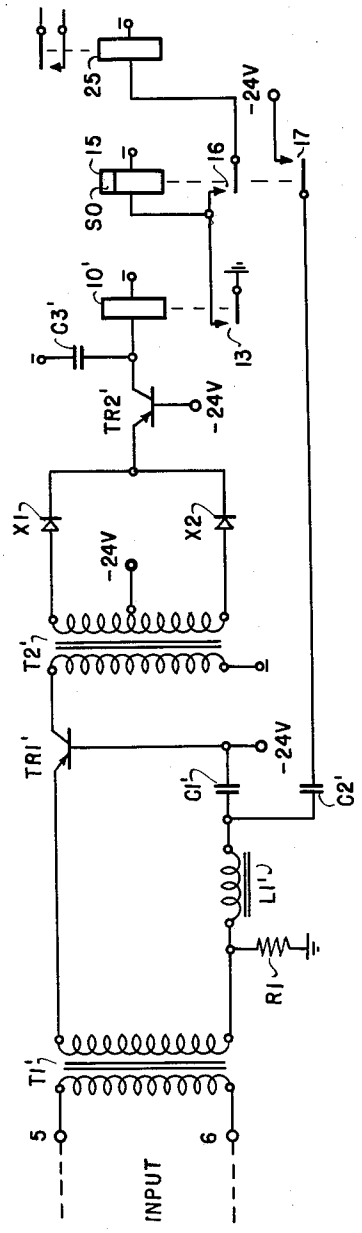
FIG. 2



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TONE DETECTOR FOR COIN CONTROL

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The present invention relates in general to a tone detector control arrangement and more specifically relates to a control arrangement including a tone detector responsive to a tone signal applied to the trunk or line conductors on a toll call from a paystation for controlling a coin refund at the paystation.

A previous application filed by A. H. Faulkner on February 7, 1956, Serial No. 563,925, disclosed a transistor tone detector. That detector was shown connected to the conventional C lead in a paystation line circuit and responded to a particular tone signal applied to the C lead on a toll call for controlling the coin refund operation at the paystation. However, in small exchanges wherein the toll service is provided from a nearby exchange, the conventional C lead is not extended thereto for economic reasons. The tone signal for operating the tone detector must therefore be applied over the trunk conductors and in this case the transistor tone detector is connected to these conductors. It must therefore be responsive not only to a particular tone frequency, but for optimum performance must discriminate between voice frequencies or other noises generated in the voice transmitter, which is connected to the line conductors, and any tone returned over the trunk conductors for controlling the refund operation.

The present invention accordingly discloses a tone detector arrangement responsive to a tone provided thereto over a trunk line on a toll call for controlling a coin refund at a paystation.

Fig. 1 shows a tone detector embodiment of the invention using one tone frequency returned from a toll operator's position, while Fig. 2 shows another embodiment of the invention utilizing two tone frequencies.

The invention is described herein in conjunction with the prepay postpay paystation arrangement disclosed in application No. 587,293, filed May 25, 1956, by C. E. Lomax. In that application the coin magnet has an individual connection to the central office and it is controlled by normal exchange battery to place the paystation in a prepay or postpay position as required. The essentials of the arrangement shown by Lomax, with the exception that the line circuit is shown in detail in Fig. 1, are illustrated schematically by the Repeater 90 having a connection to a nearby exchange M. In addition, a modification of the Lomax application is introduced for returning a tone signal from the operator's position. This is done by providing an additional key controlled relay which is operated momentarily to supply the desired tone.

A call initiated from the paystation connected to Line Circuit **100** results in a loop circuit being completed from ground at contacts **52**, the left winding of shunt field polar relay **40** in shunt with resistor **59**, conductor L1, the station circuit, back over conductor L2, contacts **51** to battery through line relay **60**. Line relay **60** closes contacts **61** to complete a circuit to slow-to-release relay **20**. This also grounds the emitter circuit of transistor amplifier TR1 to render it conductive. At contacts **62**

it prepares a circuit to line cut-off relay **50**. At contacts **63** it grounds the CN lead to busy the circuit to incoming calls, and at contact **64** closes ground to the start lead ST to initiate the allotter operation for causing the appropriate switches to be associated with the calling line all in any well known manner.

The switches indicated by the block marked Switching Equipment on being associated with the calling line cause ground to be returned over the C lead and contacts **62** for operating relay **50**. Relay **50** first closes contacts X to ensure the completion of its holding circuit from ground on the C lead before relay **60** restores to open contacts **62**. It then opens contacts **51** and **52** to restore relay **60**. At contacts **53** it closes a point in a holding circuit to be described for relay **20** while completing a circuit to the right winding of polar relay **40**. The line loop is now extended to the line relay of a switch in the block marked Switching Equipment and the calling party, if he has made his deposit and received dial tone, proceeds to dial the desired number.

Relay **20**, operated from ground at contacts **61**, connects the primary of transformer T1 to the line conductors at contacts **21** and **22**, opens contacts **23** to open a point in the circuit for returning collect potential to the paystation coin magnet, and at contacts **24** completes a previously mentioned holding circuit for itself over contacts **33** and **53**. At contacts **25** a circuit is prepared for relay **10**.

After receiving dial tone and making the customary deposit to remove the shunt around the dial springs, the calling party may proceed to dial the desired number. If the call is a local call, the switching equipment is operated by the impulses corresponding to the dialled number to extend a connection to a subscriber such as S1 and signal the called line. Battery is reversed on the trunk conductors in any well-known manner, when the called party answers, to operate shunt field polar relay **40**. It closes a circuit from ground at contacts **53** through contacts **41** to relay **30**. Relay **30** operates to close contacts **31** to prepare a circuit for returning collect potential to the paystation coin magnet and at contacts **32** it completes its own holding circuit from ground at contacts **53**. This is done to prevent relay **30** from releasing in the event the switchhook at the calling station is flashed to release relay **40**. At contacts **33**, the holding circuit for slow-to-release relay **20** is opened and it restores. Relay **20**, on restoring, closes contacts **23** to return the collect potential over contacts **11** to operate the coin magnet at the calling station for collecting the coin deposit. The collect potential is continually applied to the coin magnet at the calling station maintaining it in a postpay position wherein any coins then deposited are collected. It does not interfere with conversation as the coin magnet control is exercised over lead L3 which has no connection to the talking circuit. Conversation may therefore proceed in the conventional manner.

On release of the call, ground is removed from the C lead by the restoration of the switching equipment to restore relay **50**, which in turn restores relay **30** by opening contacts **53**. Relay **40** is restored when the line loop is opened as already mentioned.

On an uncompleted call relays **30** and **40** remain unoperated. Release of the connection restores relays **50** or **60** depending on the stage of the call. The circuit to relay **20** is opened at either contacts **61** or **53** and it starts to restore. A circuit is completed, however, over contacts **54** and **25** to relay **10**, before relay **20** is restored. Relay **10** operates to close contacts **12** and apply refund potential over lead L3 to the coin magnet at the calling station for refunding the coin deposit.

When relay 20 is restored it opens the circuit to relay 10 at contacts 25 and relay 10 releases.

As mentioned previously, a toll service is provided at a nearbly exchange and therefore the subscriber after making his deposit must dial such number as will associate his line conductors with a toll operator's circuit at the nearby exchange. This connection is extended through a repeater such as 90 to a toll operator's position in a manner similar to that explained in the aforementioned application. Only the trunk conductors extend between the exchanges. The operator is signalled and on plugging in she receives a paystation tone identification, if a paystation is calling, and cuts off the ring back tone all as explained in the Lomax application. After receiving the paystation identification the operator momentarily operates the key F to energize relay B. It closes a set of make contacts D for returning a 2000 c.p.s. tone signal over the trunk conductors as indicated in Fig. 1. The tone signal returned over the conductors is applied over contacts 21 and 22 to transformer T1 to vary the current passing through the emitter collector circuit of transistor amplifier TR1 accordingly. An amplified reproduction of the tone voltage is therefore induced in the secondaries of T2 and T3 and is applied to the series resonant circuits C1 and L1 and C2 and L2, respectively. Each is tuned to the 2000 c.p.s. tone signal. Since C1 and L1 are in series with the rectifier bridges feeding C3, and C2 and L2 are shunting the bridge feeding C4 the voltage developed across C3 greatly exceeds that developed across C4. The D.C. voltage difference is impressed on the base circuit of transistor TR2 resulting in comparatively high current flow through relay 10 in the collector circuit of TR2. Relay 10 operates to close contacts 12 to apply refund potential to the coin magnet at the calling station for refunding the deposit.

When the operator at the nearby exchange opens the key F to deenergize relay B, the contacts D shown in Fig. 1 open to cut off the tone signal applied over the line conductors. This substantially cuts off the current flow in TR2. Relay 10 is therefore deenergized and cuts off the refund potential by opening contacts 12.

At frequencies other than that intended to operate the tone detector, the voltage across C4 is greater than that developed across C3 and therefore TR2 is biased in the non-conductive direction by such signals. Although noises and speech signals generated in the voice transmitter may contain a 2000 c.p.s. tone which will be transmitted to the tone detector, other tones or frequencies will also be transmitted to the tone detector and thus render it incapable of reacting to noises or speech generated in the voice transmitter. In addition, by making capacitors C3 and C4 large enough to provide a time lag of about 1 second, false operation is further guarded against.

Battery is reversed under control of the operator as explained in the Lomax application to operate relay 40. It operates relay 30 as previously described. Relay 30 in turn restores relay 20 and is held operated over its holding circuit even if polar relay 40 is restored. Relay 20 on restoring closes contacts 23 to enable collect potential to be returned over contacts 11 to the coin magnet for operating the same. Relay 30 being operated maintains the coin magnet at the paystation operated so that any coins deposited pursuant to the call are collected immediately on deposit.

On release of the call, relay 50 is restored as previously described to restore relay 30 and the collect potential is removed from lead L3 to restore the coin magnet.

On incoming calls to the paystation connected to Line Circuit 100, relay 50 is first operated to ground on lead CN forwarded over contacts 65 from the switch having access to the connector normals all in any well-known manner. Relay 50 operates to prevent the operation of relay 60 when the called party answers by opening contacts 51 and 52. The switch sends ringing current over leads —N and +N to signal the called party while the ground provided to lead CN busies the circuit to other switches. The called party, on answering the call, now completes a talking circuit to the calling party in any well-known manner. A D.C. loop to the connector switch back bridge relay is also completed on answer by the called party. If desired the battery on this circuit is reversed from normal to operate polar relay 40 to in turn operate relay 30 as described. This causes collect potential to be returned to the called station for operating the coin magnet thereat as explained. The paystation is then in the postpay position so that if the call is a reverse charge call completed through an operator, deposited coins are automatically collected on deposit in a postpay manner. On release of the call ground is removed from lead CN and relay 50 restores to reconnect relay 60 to the line conductors. Relays 30 and 40 are also restored as described if they have been operated for the purpose just described.

In the tone detector embodiment shown in Fig. 2 two frequencies are utilized to guard against false operation. That is instead of only a 2000 c.p.s. tone being returned from the toll operator's position, two frequencies are returned, the occurrence of both of which is unlikely to occur in speech or noise generated in the voice transmitter.

Terminals 5 and 6 of transformer T1' are connected to the line conductors by relay 20 and on a toll call the aforementioned two frequencies are returned from the operator's position. Inductance L1' and capacitor C1' form a tuned circuit responsive to one of the two frequencies, which is amplified by transistor TR1'. The amplified current is transmitted across transformer T2' and rectified by diodes X1 and X2. The D.C. amplifier transistor TR2' develops current in its collector circuit at a high impedance level to operate relay 10' which corresponds to relay 10 in Fig. 1. Capacitor C3' serves to smooth out the voltage ripple and increase the circuit efficiency.

Relay 10' on operating completes a circuit for slow-to-operate relay 15 at contacts 13. After a slight delay it operates to complete a circuit for slow-to-operate relay 25 at contacts 16. At contacts 17 it connects capacitor C2' in shunt with capacitor C1' so that the circuit is now tuned to the other returned frequency. If the other frequency is present, relay 10' is held operated long enough to permit slow-to-operate relay 25 to operate and it then completes any control function desired such as the previously described coin control. If the second frequency is not present relay 10' restores before relay 25 can operate.

Thus having described the preferred embodiments of the invention, but not wishing to limit myself to the specific uses or embodiments shown, I am appending hereto a series of claims encompassing what I believe to be the scope of the invention.

What is claimed is:

1. A tone detector comprising two connected circuits each having a number of different current frequencies applied thereto, a tuned circuit associated with each of said first circuits, each tuned circuit tuned to one frequency, the tuned circuit associated with one of said first circuits arranged in series therewith, the tuned circuit associated with the other circuit arranged in shunt therewith whereby the ratio of the voltage developed across said one circuit to the voltage developed across said other circuit is higher when said one frequency is applied to both said circuits than when another frequency is applied to both said circuits, and a semi-conductor device connected to both said circuits and conditioned in a conductive direction when said higher voltage ratio is developed and conditioned in a non-conductive direction when another voltage ratio is developed.

2. A tone detector comprising two circuits connected in series and each having a number of current frequencies applied thereto, a tuned circuit associated with each of said first circuits, each tuned circuit tuned to one frequency, the tuned circuit associated with one of said first circuits arranged in series therewith, the tuned circuit associated with the other circuit arranged in shunt therewith whereby one voltage ratio is developed across said circuits when one frequency is applied to both said circuits and another voltage ratio is developed across said circuits when two different frequencies are applied to both said circuits, and an electronic valve connected to both said circuits and biased in a conductive direction when said one voltage ratio is developed and in a non-conductive direction when said other voltage ratio is developed.

3. For use with a paystation having a connection to a central office over a pair of line conductors, the improvement comprising two connected circuits each having a number of different current frequencies applied thereto from said line conductors, a tuned circuit associated with each of said first circuits, each tuned circuit tuned to one frequency, the tuned circuit associated with one of said first circuits arranged in series therewith, the tuned circuit associated with the other circuit arranged in shunt therewith, whereby the ratio of the voltage developed across said one circuit to the voltage developed across said other circuit is higher when said one frequency is applied to both said circuits than when another frequency is applied to both said circuits from said line conductors, and a semi-conducting device connected to both said circuits and conditioned in a conductive direction when said higher voltage ratio is developed and conditioned in a non-conductive direction when another voltage ratio is developed to permit a deposited coin at said paystation to be controlled in accordance with the voltage ratio developed.

4. In a telephone system, a line circuit individual to a paystation, an operator's position, means for extending a connection comprising a pair of line conductors from said paystation via a central office to another station in one instance and in another instance to said operator's position, a source of current of a predetermined frequency at said operator's position, frequency responding means in the said line circuit arranged to operate only in response to receipt of said current of said predetermined frequency for controlling a coin disposal operation at said paystation, means operated in response to the initiation of a call from said paystation for connecting said frequency responding means to said pair of line conductors, means at said operator's position for returning said current of said predetermined frequency over said pair of line conductors in case said initiated call is extended thereto, said frequency responding means operated in response to receipt of said current of said predetermined frequency over said pair of line conductors, a source of coin control potential at said line circuit, means operated by said operation of said frequency responding means for completing a connection to extend said coin control potential to said paystation for controlling the refund of a coin thereat, and means operated in response to the answer of a connection, in case said connection is extended to said other station, for disconnecting said frequency responding means from said pair of line conductors.

5. An arrangement such as described in claim 4, in which said frequency responding means includes a transistor amplifier, a circuit tuned to said predetermined frequency and connected to said transistor for supplying one voltage thereto in response to the return of said predetermined frequency, another circuit tuned to said frequency and connected to said transistor for supplying another voltage thereto in response to the return of said predetermined frequency, whereby said transistor is rendered effective for controlling a coin disposal operation in response to the supply thereto of said one and said other voltage.

6. An arrangement such as described in claim 4, in which said frequency responding means includes a tuned circuit, means controlled by said tuned circuit in response to the return of said predetermined frequency over said pair of line conductors for tuning said circuit to another frequency, means for applying a current of said other frequency to said line conductors, and means controlled by said circuit in response to the receipt of said other frequency for controlling a coin disposal operation at said paystation.

7. A tone detector comprising a pair of rectifying circuits, a transistor having a base circuit connected to one of said rectifying circuits and an emitter circuit connected to the other one of said rectifying circuits, a pair of series-tuned circuits, each tuned to the same frequency, one of said tuned circuits connected in series with said base circuit connected rectifying circuit and the other of said tuned circuits connected in shunt with said emitter connected rectifying circuit, and means for applying said frequency to said tuned circuits whereby said transistor is rendered conductive.

8. A tone detector comprising an electronic valve having a plurality of electrodes, a series-tuned circuit connected to one of said electrodes, another series-tuned circuit connected to another one of said electrodes, means for rectifying the voltage supplied by each tuned circuit, each tuned circuit tuned to the same frequency, and means for supplying any frequency to each tuned circuit whereby a voltage relationship is developed across the connected electrodes for controlling said valve in one manner in response to said same frequency being supplied to the tuned circuits and for controlling said valve in another manner in response to another frequency being supplied to the tuned circuits.

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