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TELEPHONE SYSTEM

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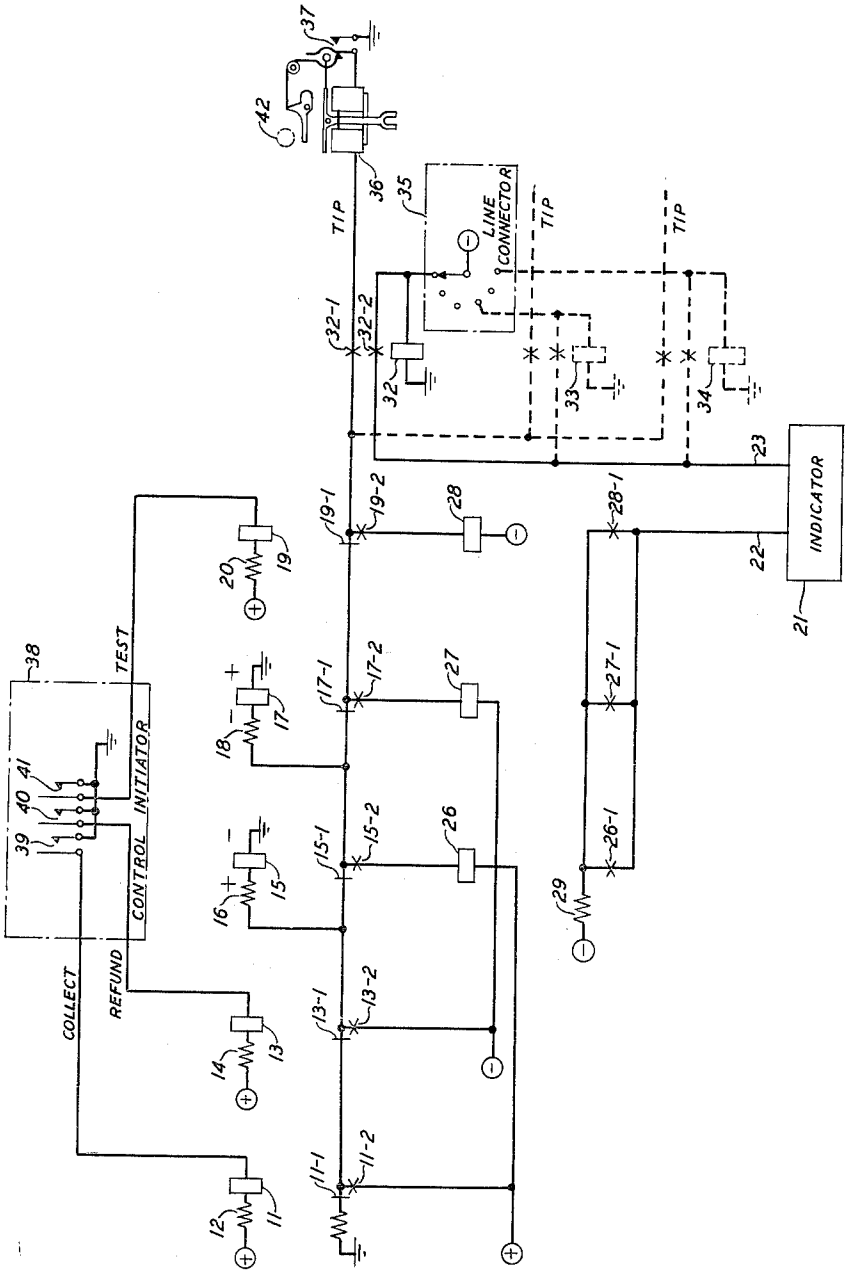

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to coin disposal control circuitry employed in conjunction with telephone pay stations.

The current expansion of telephone facilities brought about by the increasing number of customers and services required, has resulted in the greatly increased use of electronic equipment and hence posed many problems concomitant therewith. For example, along with the advantages of more economical operation and rapid handling of information, the problem arises of matching the impedance of equipment used in conjunction with electronic devices to those devices. Many times, existing equipment is not easily adaptable.

In seeking a solution to expansion requirements, it has been found that the most efficient manner of handling large numbers of customers who require service intermittently, is to employ common equipment which may be utilized in conjunction with any of a plurality of individual customers. Electronic switching systems of the nature contemplated employ a common trunk selecting means whose function is to associate common control equipment with the particular lines requiring service. In this invention, which concerns itself primarily with the control of coin disposal operations, it is shown to be advantageous to also employ this trunk selecting means to connect and control coin disposal operations. Further, as an aid to complete and automatic operation, it is advantageous to provide the common control equipment with an indication of the proper operation of the coin collection equipment.

Accordingly, an object of the present invention is the provision of a coin disposal control circuit operative in conjunction with electronic switching systems.

In connection with remote telephone pay stations, coin disposal control is of the utmost importance in order to insure collection for the services rendered. There are two essential elements in the proper collection of deposits; these are, a reliable mechanical collector and reliable control of that collector. With this invention, a common type of coin collector may be employed having a coin disposal relay operative in response to a D.C. voltage of one polarity to collect coins and in response to a D.C. voltage of an opposite polarity to refund coins. It will be apparent, however, that this specific type of coin disposal relay is not essential to the invention but is merely convenient as an element of the illustrative embodiment thereof. Reliable control of such a coin collector requires efficient and accurate positive action; in other words, efficient and accurate application of dependable control signals, in this case D.C. voltages. Yet another requirement is an effective testing technique for ascertaining the condition of the coin collection mechanism from a remote point.

Another object of the present invention is the provision of a coin disposal control circuit yielding more efficient coin control and more efficient testing of the coin collector to verify its proper functioning.

Wherever common equipment is employed, the operating time thereof is of the essence because the sooner such equipment is free to serve other lines, the fewer such units are required and the smaller the capital outlay. The total time for coin disposal control includes the operation of the coin disposal mechanism and the testing thereof to

make sure that the operation is completed. By using a coin disposal relay having an automatic disconnect feature, time may be saved, in that a disconnect signal need not be transmitted from the central office. In addition to this, however, the period of application of other control potentials and the time required for the testing operation must be minimized.

Still another object of the present invention is the provision of a coin disposal control circuit requiring a minimum amount of operating time; more specifically, the provision of a circuit capable of more rapidly and accurately determining the effect of the application of control signals upon a coin collection device.

When common equipment is to be used with a plurality of lines, the fact that such lines are not identical becomes important. The variation in length and electrical characteristics presents varying impedance conditions to such common equipment. When D.C. control potentials are employed as herein suggested, the problem of stray line capacitance arises. Generally, in order to test whether or not a coin disposal relay has operated, assuming that such coin disposal relay is of the self-disconnect variety in which case it opens its own operate circuit upon actuation, one would first detect the presence of current flow and assume this means the relay is being energized and then detect the cessation of such current flow and assume the coin disposal relay has interrupted its own circuit. Due to the presence of surges, however, such simple detection is inadequate by itself because the surge may appear to be the energizing current and its cessation the disconnect indication. A solution for this problem in the past has been to wait until the surge subsides; however, because the capacitance of each line varies, the period before such surge subsides also varies. The common equipment must therefore have a built-in waiting period equivalent to the longest time possible, or provide means for automatically varying the waiting time in accordance with the conditions experienced on each line.

Another object of the present invention is the provision of a coin disposal circuit which checks the response to its coin disposal orders within a minimum of time, which time is automatically determined by the capacitance encountered on each line.

As will be hereinafter illustrated, this invention involves the unique utilization of a plurality of relays operative to connect a control potential to the tip conductor of a pay station line over which the coin disposal relay may be operated, and to monitor the operation of the coin disposal relay. Marginal-operate relays, operative upon cessation of the initial surge due to line capacitance, are energized when the line has approximately reached the voltage level of the control potentials. The operation of such marginal relays causes the inclusion in series with the coin disposal relay of test means, the operation of which is designed to monitor the operation of the coin disposal relay and translate the conditions ascertained into D.C. voltage levels indicative of such operation.

As mentioned above, provision for the lapse of a set time precedent to the operation of the test means to ascertain the correct operation of the coin disposal unit is inadequate as a solution to the problem of faulty operation due to voltage surges. If the time is inflexibly set to accommodate the largest anticipated surge, when short lines relatively free of stray capacity are involved it is possible that the coin disposal relay will be operated and automatically disconnected before the test means is even applied to the line. In such a case, when the test means is applied the line will appear to be open and it will not be known whether this open is due to prior operation of the relay, or due to failure to operate the

relay, or due to no deposit having been initially made in the coin collection equipment.

A feature of the present invention is the elimination of fallacious tests by the insertion of means for testing the operation of the coin disposal relay into the coin disposal relay circuit only after the line surge has subsided and the line voltage has attained a stable state.

From another aspect, a feature of this invention is the insertion of operation testing means immediately after the initial surge has subsided, regardless of the duration of such stage. Specifically, this invention employs marginally operating relay means for the control of test apparatus insertion.

Another feature of the present invention is the provision in a coin disposal control circuit of means designed to take full advantage of the time saving attributes inherent in self disconnecting coin disposal relays.

Yet another feature of the present invention is the provision of means for indicating proper operation of the coin disposal relay in response to control signals in the form of particular D.C. voltages.

The foregoing, as well as additional objects and features, will be more clearly understood from the description hereinafter made in connection with the drawing, wherein a circuit schematic of an illustrative embodiment is depicted.

Referring to the drawing, it will be seen that the circuit is comprised of several basic elements. Coin disposal relay **36** has associated therewith hopper trigger contacts **37** which close upon deposit of a coin to ground one side of the relay windings, and which automatically open upon operation of the relay. The coin disposal relay is designed to operate on D.C. voltages, collecting coins in response to a positive potential and refunding coins in response to a negative potential. Only one such coin disposal relay is indicated; however, it is to be understood that others would be similarly operated over lines such as those controlled by "dashed" relays **33** and **34**. Control initiator **38** is a symbolic representation of means to be employed for initiating either collect, refund, or test-for-coin-presence operations. Hereinbefore, the possible utilization of this coin disposal control circuit in an electronic switching system has been referred to. In such event, the control initiator would advantageously be a part of the trunk selector switch. Indicator **21**, located at the bottom of the FIGURE, serves a dual purpose. In any well-known fashion, indicator **21** detects the voltage present on either leads **22** or **23** deriving specific information therefrom. As will be described hereinafter, the presence of a voltage on lead **23** indicates that one of the line relays **32**, **33**, or **34** is operated and the presence of a particular voltage on lead **22** indicates the functioning of a coin test relay **26**, **27**, or **28**. Line connector **35** is a symbolic representation of the means employed for connecting control circuitry to the particular lines requiring service. It is to be understood that in any completely integrated system there will be interconnection between elements such as control initiator **38**, indicator **21**, and line connector **35**, whereby the operations thereof and the results achieved in accordance with these operations may be automatically analyzed and a subsequent course of action developed therefrom.

The coin control circuit of this invention has as its major functions: testing for the presence of a coin in the coin collector, collecting coins present if service is to be rendered, and returning coins present should such be necessary. In order to test for the presence of a coin, a voltage is applied to the tip conductor of the line loop connecting the central office to the pay station in question. If a coin is present, hopper trigger contacts **37** will be closed and therefore a complete circuit will be available between the source of voltage and ground. By placing a current flow detection device in this circuit, the existence of such circuit is detectable and thus a coin's presence is detectable. Collection and refund of coins is performed in a similar fashion, applying the proper polarity potential to the tip conductor in order to operate the coin disposal relay. It should be noted that the voltage employed to test for the presence of coins must be of a relatively low magnitude in order to prevent operation of the coin disposal relay therewith.

Ancillary, yet important functions also to be considered are, checking for the correct response of the coin disposal relay upon reception of the signal to either refund or collect coins, and checking pay station lines in order to indicate which ones are presently in use. The expeditious handling of these ancillary functions as well as the three major functions recited above is performed in a unique fashion by this invention as will be described.

Before performing any control function, the line connector **35** must connect the tip lead of the pay station line requiring service to the coin control circuit, and prior to this, a test must be made to insure that no line relay, e.g., **32**, **33**, or **34**, in any coin line is currently operated. This is done by examining lead **23**. If we assume that the line leading to coin disposal relay **36** is in use, line connector **35** will have applied battery to relay **32** and simultaneously via contacts **32–2**, closed by relay **32**, to lead **23**. Lead **23** is multiplied to make contact on all line relays and thus the operation of any one of them will produce a voltage on line **23** indicative thereof.

For discussion purposes it will be assumed that line connector **35** is connected as shown in the figure, thereby energizing relay **32** which closes its contacts **32–1** and **32–2**. This contact closure connects the tip of the line loop to the pay station containing coin disposal relay **36** to the coin control circuit and provides an indication on line **23** that the coin control circuit is engaged. It will also be assumed that coin **42** has been deposited causing closure of hopper trigger contacts **37** and grounding of coin disposal relay **36**. The central office wishing first to determine whether or not such a coin has been deposited initiates a coin test operation. Such initiation is symbolically indicated by the closure of switch **41** in control initiator **38**, thereby applying ground over a test lead through relay **19** and resistor **29** to a positive voltage. Operation of relay **19** closes contacts **19–2** and subsequently contacts **19–1** open. Closure of contacts **19–2** provides an operating path for relay **28** from a low negative voltage through the windings of relay **28**, contacts **19–2**, contacts **32–1**, the winding of coin disposal relay **36**, and hopper trigger contacts **37** to ground. Because a coin has been deposited, relay **28** operates closing its normally open contacts **28–1**, whereupon voltage is applied to conductor **22**. It will be noted that the voltage applied via relay **28** is of insufficient magnitude to operate coin disposal relay **36** and hence the coin test may be made without detrimental effect on actual coin disposition. After the check has been made and the results thereof ascertained by indicator **21**, switch **41** can be opened.

As hereinbefore discussed, due to the problems created by stray capacitance on the telephone line, it has been found necessary to delay the insertion of test relay means such as relay **28** until after the initial surge has subsided when higher potentials are employed. If this is not done, the initial surge will appear to be energizing the attached coin disposal relay and its subsidence thereafter would falsely indicate proper operation thereof. Such false indications are prevented by delaying insertion of the test relay until after the line has achieved a steady state voltage.

Considering first the operation of coin collection, switch **39** in control initiator **38** is closed providing a ground over the collect lead through relay **11** and resistor **12** to a positive voltage. Operation of relay **11** causes closure of contacts **11–2** and subsequent opening of contacts **11–1**. A circuit path is thereby established from a large positive potential through contacts **11–2**, normally closed contacts **13–1**, **15–1**, **17–1**, **19–1**, and **32–1**, winding of coin disposal relay **36**, and hopper trig-

ger contacts 37 to ground. As is well known, the initial surge of voltage caused by stray line capacitance will charge such capacitance to the potential of the line. Because the capacitance effectively parallels coin disposal relay 36, relay 36 does not become energized during such a surge. Relay 15, polarized as shown in the figure to operate when a positive potential is applied on the left side, is connected via resistor 16 to the extension of the tip conductor. This relay is a marginal operate type and does not operate until the line has attained steady state at a voltage approximately equal to the supply. When such steady state is attained, relay 15 operates closing contacts 15–2. Relay 26 is thus inserted in the energization circuit of coin disposal relay 36, and the line having attained steady state, no further voltage surge will falsely operate relay 26. Subsequent to the operation of contacts 15–2, contacts 15–1 open, severing the original power connection to the tip lead, and leaving only that connection which includes relay 26 in series. The characteristics of relay 26 are such that it operates in the same electrical fashion in which coin disposal relay 36 operates. Thus, when the current flow is sufficient to operate coin disposal relay 36, relay 26 also operates, and upon disconnection of ground at hopper trigger contacts 37, indicative of proper operation of coin relay 36, relay 26 is deenergized. In a fashion identical to that described in connection with test-for-coin-presence relay 28, relay 26 causes closure of contacts 26–1 and application of voltage to test lead 22. Presence of this voltage followed by its cessation indicates fulfillment of the coin disposal operation and further steps may then be taken to provide telephone service.

The coin refund operation is performed in a fashion identical to that employed for coin collection. In this case, however, switch 40 in control initiator 38 initiates the refund, operation of relay 13 connects a negative potential to the tip conductor, marginal relay 17 operates when the tip conductor achieves a steady state, and relay 27 provides the indication of correct or incorrect coin disposal relay operation.

The adaptability of this circuit is worthy of consideration. Relays 11, 13, and 19, directly controlled by coin control initiator 38, may be matched impedance-wise to electronic substitutes for switches 39, 40, and 41 thereby offering efficient operation in conjunction with electronic switching systems. Further, the results of various operations as indicated by voltages on leads 22 and 23 may be directly employed to control gating devices of well-known types to initiate subsequent operations.

The above description serves to illustrate the principles involved in the present invention. It is understood that numerous changes may be made by those skilled in the art without departing from the spirit and teaching of this invention and for that reason there is no intention of limiting it to the embodiment illustrated herein.

What is claimed is:

1. In a telephone system a line having a pay station thereon, means at said pay station responsive to the deposit of coins to establish a ground on said line, coin disposal means at said pay station responsive to voltage of a particular magnitude on said line to dispose of said coins and disestablish said ground, a source of voltage, voltage responsive switching means, means for applying said voltage to said line and for concurrently connecting said switching means to said line, means for automatically operating said switching means in response to said voltage achieving steady state at said particular magnitude, and test means connectable to said line by said switching means when operated for detecting the disestablishment of said ground.

2. In a telephone system, a line having a pay station thereon, said line exhibiting reactive impedance caused by stray capacitance, means at said pay station responsive to the deposit of coins to connect a ground to said line, coin disposal means at said pay station responsive to a

voltage of a particular magnitude on said line to dispose of said coins and disconnect said ground, a source of voltage, voltage responsive switching means, means for applying said voltage to said line and for concurrently connecting said switching means to said lines, means for automatically operating said switching means in response to the subsidence of the voltage surge caused by charging said stray capacitance, and test means connectable to said line by said switching means when operated for detecting the disconnection of said ground.

3. In a telephone system, a line having a pay station thereon, means at said pay station responsive to the deposit of coins to establish a ground on said line, coin disposal means at said pay station responsive to voltage of a predetermined magnitude on said line to dispose of said coins and disconnect said ground, a source of voltage, voltage responsive switching means, means for applying said voltage to said line and for concurrently connecting said switching means to said line, test means connectable to said line for detecting the presence of said ground connected to said source of voltage, said switching means operative in response to the voltage on said line achieving a steady state value to insert said test means between said source of voltage and said line, and indicating means controlled by said test means and operative to indicate the condition of said line as a voltage.

4. In a telephone system, a plurality of lines individually connected to pay stations, coin disposal means at said pay stations responsive to a potential condition of a predetermined magnitude, means for grounding the line connected thereto when coins are deposited at said pay stations, said ground being removed upon operation of said coin disposal means, a coin disposal control circuit selectively connectable to said lines, said circuit comprising a source of voltage, a voltage responsive switching means, means for selectively applying said voltage to one of said lines and for concurrently connecting said switching means to said one line, means for operating said switching means in response to said voltage reaching steady state at said predetermined magnitude, and test means connectable to said one line by said switching means to detect the presence of said ground and its subsequent removal.

5. A telephone system as defined in claim 4 wherein said test means includes, relay means adapted to be serially connected between said source of voltage and said line under control of said switching means, and an indicator circuit controlled by said relay means to establish potential conditions on a test lead indicative of the state of operation of said relay means.

6. In a telephone system, a plurality of lines connected to pay stations and each exhibiting reactive impedance caused by stray capacitance, coin disposal means at said pay stations responsive to a potential condition of a predetermined magnitude, means for grounding one of said lines upon deposit of a coin at said pay station connected to said one line, said ground being removed upon operation of said coin disposal means, a coin disposal control circuit selectively connectable to said lines, said circuit comprising a source of voltage, voltage responsive switching means, means for selectively applying said voltage to said line and for concurrently connecting said switching means to said one line, means for automatically operating said switching means in response to the subsidence of the voltage surge caused by charging said stray capacitance exhibited by said one line, relay means caused by said switching means when operated to be serially connected between said source of voltage and said line, and an indicator circuit controlled by said relay means to establish a potential condition on a test lead indicative of the state of operation of said relay means.

7. A coin disposal control circuit connected to a line comprising in combination, a first source of voltage, a first voltage responsive switching means, means for connecting said first source of voltage to said line and for

concurrently connecting said first switching means to said line, first test means connectable to said line for detecting the presence of ground connected to said first source of voltage, said first switching means operative in response to the voltage on said line due to said first source achieving a steady state value to insert said first test means between said first source of voltage and said line, a second source of voltage, a second voltage responsive switching means, means for connecting said second source of voltage to said line and for concurrently connecting said second switching means to said line, second test means connectable to said line for detecting the presence of ground connected to said second source of voltage, said second switching means operative in response to the voltage on said line due to said second source achieving a steady state value to insert said second test means between said second source of voltage and said line, a third source of voltage, third test means connectable to said line for detecting the presence of ground connected to said third source of voltage, means for serially connecting said third source of voltage and said third test means to said line, and indicating means controlled by each said test means and operative to indicate the condition of said line as a voltage.

8. In a telephone system, a plurality of telephone lines individually connected to pay stations, coin disposal means at said pay stations responsive to a potential condition of a predetermined magnitude, means for grounding one of said lines upon deposit of a coin at the pay station individual thereto, said ground being removed upon operation of said coin disposal means, coin disposal control circuitry comprising a connecting point, a source of voltage, voltage responsive switching means, means for applying said voltage and said switching means to said connecting point, test means connectable to said point for detecting current flow through said connecting point, means for operating said switching means in response to the voltage at said point achieving a steady state value to insert said test means between said source of voltage and

said point, connecting means for selectively connecting said point to one of said lines when service thereover is required, first indicating means controlled by said connecting means for indicating the establishment of said connection, and second indicating means controlled by said test means for indicating said current flow.

9. In a telephone system: (1) a plurality of lines exhibiting reactive impedance caused by stray capacitance, a pay station connected individually to each of said lines, coin disposal means in each of said pay stations responsive to a potential condition of a predetermined magnitude, means for grounding any line connected to any one of said pay stations when a coin is deposited at said one pay station, means for removing said ground upon operation of said coin disposal means in said pay station connected to said grounded line; (2) a coin disposal control circuit having an output point and comprising a source of voltage, voltage responsive switching means, means for selectively connecting said source of voltage and said switching means to said output point, means for automatically operating said switching means in response to the voltage applied to said point achieving a steady-state value of substantially said predetermined magnitude, relay means controlled by said switching means when operated to be serially connected between said source of voltage and said output point; (3) connecting means for selectively connecting said output point to one of said lines when service thereover is required; (4) first indicating means controlled by said connecting means for indicating the establishment of a connection; and (5) second indicating means controlled by said relay means for indicating current flow through said point.

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