

UNITED STATES PATENT OFFICE

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OVERFLOW JACK CIRCUIT

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This invention relates to telephone systems and more particularly to improved signaling arrangements for such systems.

The primary object of the invention is to provide arrangements whereby an operator desiring to establish a connection with a group of toll lines or trunks, all of which are busy, may connect her cord circuit to a jack associated with the group of lines and referred to as an overflow jack and may receive signals on her cord circuit supervisory lamp which will at all times indicate whether or not all circuits in the group are busy. A further object of the invention consists in providing arrangements of the above type whereby a plurality of operators desiring to establish connections with the group of lines may connect their cord circuits to multiples of the overflow jack and all receive these same signals. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the figure of which is shown a circuit diagram embodying a preferred form of the invention.

In the drawing is shown a group of outgoing lines L_1, L_2, L_3 and L_4 , which might be trunk, toll or other types of lines. These lines would terminate respectively in the jacks J_1, J_2, J_3 and J_4 and there would be associated therewith the signal lamps L'_1, L'_2, L'_3 and L'_4 controlled by sleeve relays S_1, S_2, S_3 and S_4 . These signal lamps are for indicating the idle condition of their respective lines. Adapted to be associated with the group of trunk or toll lines is a cord circuit L_5 equipped with a marginal supervisory relay CS and a lamp CL. Obviously the cord might be another trunk or toll line if desired. Other cord circuits similar to L_5 , such for example as L'_5 , might also be provided. Associated with the group of toll lines would be a series of overflow jacks such as JO, JO', etc. With these overflow jacks would be associated signaling apparatus for accomplishing the objects of the invention.

The operation of the arrangements will now be described.

Assuming that all of the outgoing circuits represented by jacks J_1, J_2, J_3 and J_4 are busy, the associated relays S_1, S_2, S_3 and S_4 will all be operated and the lamps L'_1, L'_2, L'_3 and L'_4 will all be extinguished. Relay C will, however, be operated, its circuit being traced from battery 61 through the operated contacts of relays S_1, S_2, S_3 and S_4 and the winding of relay C to ground. Relay C operated, connects battery to lamp LO which is associated with overflow jack JO, causing the lamp to light, and also all other multiples of this lamp such as LO'. The circuit for lighting these lamps is from battery 62, normal contact of relay L, lead 107, contact 13 of relay C and through lamps LO, LO', to ground.

Any operator desiring a connection to this group of outgoing circuits will upon perceiving a lighted overflow lamp, realize that all circuits in the group are busy and will then connect her cord to the overflow jack. Assume that one such operator connects her cord to jack JO. Relay CS in her cord will operate, its circuit being from battery 63, winding of relay CS, sleeve of cord, sleeve of jack JO, lead 100, contacts 8 and 9 of relay F, lead 101, and through a parallel circuit consisting of winding 1 of relay A and winding 2 of relay B to ground. Relays A and B are polar relays and are so connected that each will operate only on current through its respective winding 1, and then only if a greater current is not flowing through its winding 2. Upon completion of the above mentioned circuit relay A operates. Since no current is as yet flowing through winding 1 of relay B, it will not operate. Relay A connects ground over lead 103 to the winding of the stepping magnet SM, thence over lead 105, contacts 12, 11 and 10 of relay F to battery 64, causing the magnet to advance the brushes B1 and B2 of switch SW to the terminals 21 and 31, and to close its off-normal contacts ON. As these contacts are part of the switch SW they will remain closed until the switch has returned to its normal position. The closure of contact 4 and the ad-

vance of the brushes to contacts 21 and 31 serve no useful purpose at this time. The closure of contact 5, however, connects ground to resistances RA and RB, thus completing circuits to allow current to flow in winding 2 of relay A and winding 1 of relay B. The value of resistance RA is such that the current flowing through winding 2 of relay A is larger than that through winding 1, causing relay A to release. The circuit through winding 1 of relay B is from battery 64, contacts 10 and 11 of relay F, lead 106, winding 1 of relay B, resistance RB, off-normal contact 5 to ground. The value of resistance RB is such that the current through winding 1 of relay B is less than the current through winding 2 and relay B therefore does not operate. With relay A released, the circuit previously traced for the stepping magnet SM is open and the switch remains at rest with its brushes upon terminals 21 and 31.

Should one of the outgoing circuits become idle, for example, the one connected to jack J2, relay S2 will release, causing lamp L/2 to light and opening the circuit of relay C which will release. Relay C released, connects battery through its contact 3 to relay F, thence through off-normal contact 4 and interrupter 6 to ground, causing relay F to operate and release intermittently. With relay F released, relay CS in the cord is connected as described previously to relays A and B. This circuit is of low enough resistance to operate relay CS. With relay F operated, relay CS is connected over lead 102 to resistance H1 which is of high enough resistance to cause relay CS to release. Relay CS therefore operates and releases in synchronism with interrupter 6, causing lamp CL to flash as an indication to the operator that a circuit is now available. Lamp L/2, now lighted, indicates the idle circuit. Relay F at its contacts 10, 11 and 12 removes battery, each time the relay operates from the stepping and release magnets SM and RM and from the operating winding of relay B in order to prevent the switch from either advancing or restoring falsely.

Assume, however, that before a circuit became idle another operator desired connection to one of the circuits in this same group. Observing that lamp LO' is lighted, she would connect her cord, such for example as cord L'5, to jack JO'. Two relays similar to CS will now be connected in parallel over leads 100 and 101 to the windings of relays A and B, resulting in an increase in the current flowing through these relays. This increase in current through winding 1 of relay A is sufficient to more than offset the biasing current through winding 2 of relay A, and relay A will, in consequence, operate.

The increase in current through winding 2 of relay B will not affect this relay since

winding 2 is the biasing winding which is preventing relay B from operating.

With relay A operated again, the stepping magnet SM will again be energized, causing the switch to advance its brushes to terminals 22 and 32. Brush B1 now completes a circuit to connect resistance L''2 in parallel with the relays A and B. The value of resistance L''2 is equal to the parallel resistance of relays A and B. The circuit from the sleeves of the jacks JO and JO' to ground is, therefore, reduced to half its original value so that normal current flows through the two relays CS causing both to operate and light the cord circuit supervisory lamps CL. The connection of resistance L''2 in parallel with relays A and B reduces the current through winding 1 of relay A so that the biasing winding 2 will again cause the relay to release. The current through biasing winding 2 of relay B is also reduced but not enough to permit relay B to operate. If a circuit should become idle at this time, relay F will again be caused to operate and release intermittently and the sleeve lead 100 will be transferred alternately from lead 101 to 102. The resistance to ground over lead 102 has also been reduced to one-half its former value by the connection of resistance H2 in parallel with H1. This is accomplished through brush B2 and switch terminal 32.

The insertion of a third cord in another multiple of jacks JO JO' will in like manner increase the current through winding 1 of relay A causing it to operate and energize the stepping magnet of the switch. The switch will advance its brushes to terminals 23 and 33, reducing the resistance of the two paths over leads 101 and 102 to one-third of the original value, and shunting relay A so as to cause its release. As shown in the drawing, provision is made for the connection of four cords in parallel and the advance of the switch over four corresponding terminals. Since each additional cord connected in parallel increases the current through relay A by a smaller amount, the number of parallel connections which can be permitted is limited only by the sensitivity of relay A. For convenience the circuit as shown is limited to four such connections. It will be understood, however, that this is not a limitation in the invention, but merely a matter of convenience.

Assuming that a fourth cord is connected in parallel with the three already described, relay L''4 will be energized after the switch has advanced its brushes in the usual manner, and will remove battery from lead 107, thereby extinguishing the lamps LO, LO', etc., as a signal to the operators that no further connections are to be made to these overflow jacks.

The release of the switch will now be described. Whether one, two, three or four

such parallel connections have been established, the position of the switch will connect the proper L resistance in parallel with relays A and B so that both relays will be released.

When a circuit becomes idle and the operators are signaled by flashing of their cord circuit supervisory lamps, one or more such operators who may not be busy at the time will withdraw their plugs from the overflow jacks in order to establish connection to the idle circuit.

The withdrawal of a plug from the jack will cause a decrease in the current over lead 100, and in winding 1 of relay A and winding 2 of relay B. Relay A, already released, will not be affected by a reduction in current through its operating winding. Relay B, however, having the current reduced in its biasing winding 2, will now operate because of the greater current through its operating winding 1. Relay B, operated, will connect ground over lead 104 to release magnet RM, which will operate to restore the switch to normal. Should relay F be operated at the moment when the cord is withdrawn, the operation of relay B and release magnet RM will not occur until relay F has released since the battery circuit for relay B over lead 106 is open at contact 11 of relay F, and that for the release magnet is open at contact 12.

With the release magnet operated, the switch will restore its brushes to normal, and will open its off-normal contacts 4 and 5. Contact 5 open, interrupts the operating circuit of relay B which will release. If any cords remain connected to the jacks JO, JO', etc., relay A will immediately be energized since its biasing winding 2 has been opened at off-normal contact 5. Relay A, operated, will again close the circuit for stepping magnet SM, causing it to be energized and to advance the switch brushes to a point at which the shunt provided by the L resistance (L''2, L''3 or L''4) reduces the current through winding 1 of relay A sufficiently to cause relay A to release, and prevent the further advance of the switch.

Although no use is made of the tip and ring conductors in the foregoing description, it will be understood that the signals can be as easily transmitted over these conductors as the sleeve, the supervisory relay in the cord being suitably connected to receive them.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely different forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link cir-

cuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having an operating winding connected to said common sleeve circuit and operated when a link circuit is connected to one of said overflow jacks, and means controlled by said polar relay for operating the marginal signaling means of the link circuit connected to the overflow jack.

2. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having an operating winding connected to said common sleeve circuit and operated whenever said link circuits are connected to said overflow jacks, and means controlled by said polar relay for operating the marginal signaling means of the link circuits connected to the overflow jacks.

3. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having its operating winding connected to said common sleeve circuit and operated when a link circuit is connected to one of said overflow jacks, and means controlled by said polar relay and said relay common to said overflow jacks for intermittently operating the marginal relay means of the link circuit connected to the overflow jack.

4. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having its operating winding connected to said common sleeve circuit and operated whenever said link circuits are connected to said overflow jacks, and means controlled by said polar relay and said relay common to said overflow jacks for intermittently operating the marginal signaling

means of the link circuits connected to the overflow jacks.

5. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having its operating winding connected to said common sleeve circuit and operated whenever a link circuit is connected to one of said overflow jacks, and means controlled by said polar relay and the relay common to said overflow jacks for intermittently varying the resistance of said common sleeve circuit whereby the marginal signaling means in said connected link circuit may be operated intermittently.

6. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having its operating winding connected to said common sleeve circuit and operated when ever a link circuit is connected to one of said overflow jacks, a stepping magnet operated by said polar relay and means controlled by the operation of said stepping magnet for releasing said polar relay and for intermittently applying ground to a circuit for varying the resistance of said common sleeve circuit whereby the marginal signaling means in said connected link circuit may be operated intermittently, said circuit to which ground is intermittently applied being controlled by said relay common to said overflow jacks.

7. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said lines and each including in its sleeve circuit marginal signaling means, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to all of said overflow jacks, a polar relay having its operating winding connected in parallel with said common sleeve circuit and operated when a link circuit is connected to one of said overflow jacks, a stepping magnet operated by said polar relay, switching means controlled by said stepping magnet for releasing said polar relay and for controlling jointly with said relay common to said overflow jacks the intermittent variation of the resistance of said

common sleeve circuit whereby the marginal signaling means in said connected sleeve circuit may be intermittently operated, and additional switching means controlled by said stepping magnet for varying the resistance connected to said sleeve circuit in parallel with the operating winding of said polar relay whereby said polar relay may again be operated and released when another link circuit is connected to one of said overflow jacks.

8. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said jacks and each including in its sleeve circuit a marginal signaling means and a source of current, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to said overflow jacks, a polar relay having its operating winding connected in parallel with said common sleeve circuit and operated when a link circuit is connected to one of said overflow jacks, switching means controlled by the operation of said polar relay for decreasing the resistance connected to said common sleeve circuit in parallel with the operating winding of said polar relay, and additional switching means controlled by said polar relay for operating said marginal signaling means in said link circuit.

9. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of link circuits adapted to be connected to said jacks and each including in its sleeve circuit a marginal signaling means and a source of current, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to said overflow jacks, a polar relay having an operating circuit connected in parallel with said common sleeve circuit and effective when a link circuit is connected to one of said overflow jacks and a releasing circuit effective when said relay is operated, switching means controlled by the operation of said polar relay for decreasing the resistance connected to said common sleeve circuit in parallel with the operating circuit of said polar relay whereby when a second link circuit is connected to one of said overflow jacks the current through the operating circuit of said polar relay will be restored to normal value and the releasing circuit will remain effective, and additional switching means controlled by said polar relay for operating said marginal signaling means in said connected link circuits.

10. A telephone system comprising a plurality of telephone lines terminating in jacks and signaling means, a plurality of

link circuits adapted to be connected to said jacks and each including in its sleeve circuit a marginal signaling means and a source of current, a plurality of overflow jacks having a relay common thereto and operated when all of said telephone lines are busy, a sleeve circuit common to said overflow jacks, a polar relay having an operating circuit connected in parallel with said common sleeve circuit and effective when a link circuit is connected to one of said overflow jacks and a releasing circuit effective when said relay is first operated, switching means controlled by the operation of said polar relay for decreasing the resistance connected to said common sleeve circuit in parallel with the operating circuit of said polar relay whereby when an additional link circuit is connected to one of said overflow jacks the current through the operating circuit of said polar relay will be restored to a normal value such as when only a single link circuit is connected to the overflow jacks and whereby the releasing circuit will remain effective, a second polar relay having a releasing circuit connected in parallel with said common sleeve circuit and an operating circuit completed by the operation of said first polar relay but not effective when the current flow over said common sleeve circuit and through the releasing winding of said second polar relay is equal to or greater than said normal value, additional switching means controlled by said first polar relay for operating said marginal signaling means in said connected link circuits, and means controlled by said second polar relay for restoring said switching apparatus to normal.

11. In a telephone system, a group of outgoing lines and a plurality of associated overflow jacks, signals for said overflow jacks, means for automatically actuating the signals of said overflow jacks in response to seizure of all of the lines of the group, operators' link circuits adapted to be connected to said overflow jacks when all of said lines are busy, signal devices associated with each of said link circuits, and means thereafter responsive to the release of any one of the lines to operate the signal devices of said link circuits.

12. In a telephone system, a group of outgoing telephone lines, overflow jacks associated with said group of lines, link circuits adapted for connection to said group of lines or to said overflow jacks, signaling means associated with each of said link circuits, signaling means associated with each of said overflow jacks to indicate the busy condition of said group of lines, and means associated with said group of lines and said overflow jacks for operating in a distinctive manner the signals means in any of said link circuits connected to said overflow jacks when

all of the lines of said group are busy and for operating said signaling means in a different manner when one of the lines of said group becomes idle.

13. In a telephone system, a group of outgoing telephone lines, overflow jacks associated with said group of lines, link circuits adapted for connection to said group of lines or to said overflow jacks, signaling means associated with each of said link circuits, signaling means associated with each of said overflow jacks to indicate the busy condition of said group of lines, means associated with said group of lines and said overflow jacks for operating in a distinctive manner the signal means in any of said link circuits connected to said overflow jacks when all of the lines of said group are busy and for operating said signaling means in a different manner when one of the lines of said group becomes idle, and additional means associated with said overflow jacks for releasing the signaling means associated with each of said overflow jacks when a predetermined number of said link circuits are connected to said overflow jacks.

14. In a telephone system, a group of outgoing telephone lines, link circuits associated with said group of lines, overflow jacks associated with said group of lines and adapted to receive the connection of a plurality of said link circuits, means associated with said overflow jacks and said group of lines whereby all of said connected link circuits will receive the same signals when said group of lines are busy and whereby all will receive another signal when one of said group of lines becomes idle, and means whereby the number of said link circuits which may be connected to said overflow jacks will be limited to a predetermined number.

15. In a telephone system, a group of outgoing telephone lines, overflow jacks associated with said group of lines, link circuits adapted for connection to said group of lines or to said overflow jacks, marginal signaling means in each of said link circuits, an operating circuit for said marginal signaling means completed over the sleeve contacts of said overflow jacks, and means associated with said overflow jacks for reducing the resistance in said operating circuit for said marginal relays in proportion to the number of said link circuits connected to said overflow jacks.

16. In a telephone system, a group of outgoing telephone lines, overflow jacks associated with said group of lines, link circuits adapted for connection to said group of lines or to said overflow jacks, signaling means in said link circuits, means responsive to the connection of a link circuit to one of said overflow jacks and again responsive to the connection of a second link circuit to another of said overflow jacks for operating the signal-

ing means in said connected link circuits, and means responsive to the disconnection of any of said link circuits from said overflow jacks for restoring the mechanism to normal condition.

In testimony whereof, I have signed my name to this specification this 27th day of April, 1931.

EDGAR P. BROE.

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