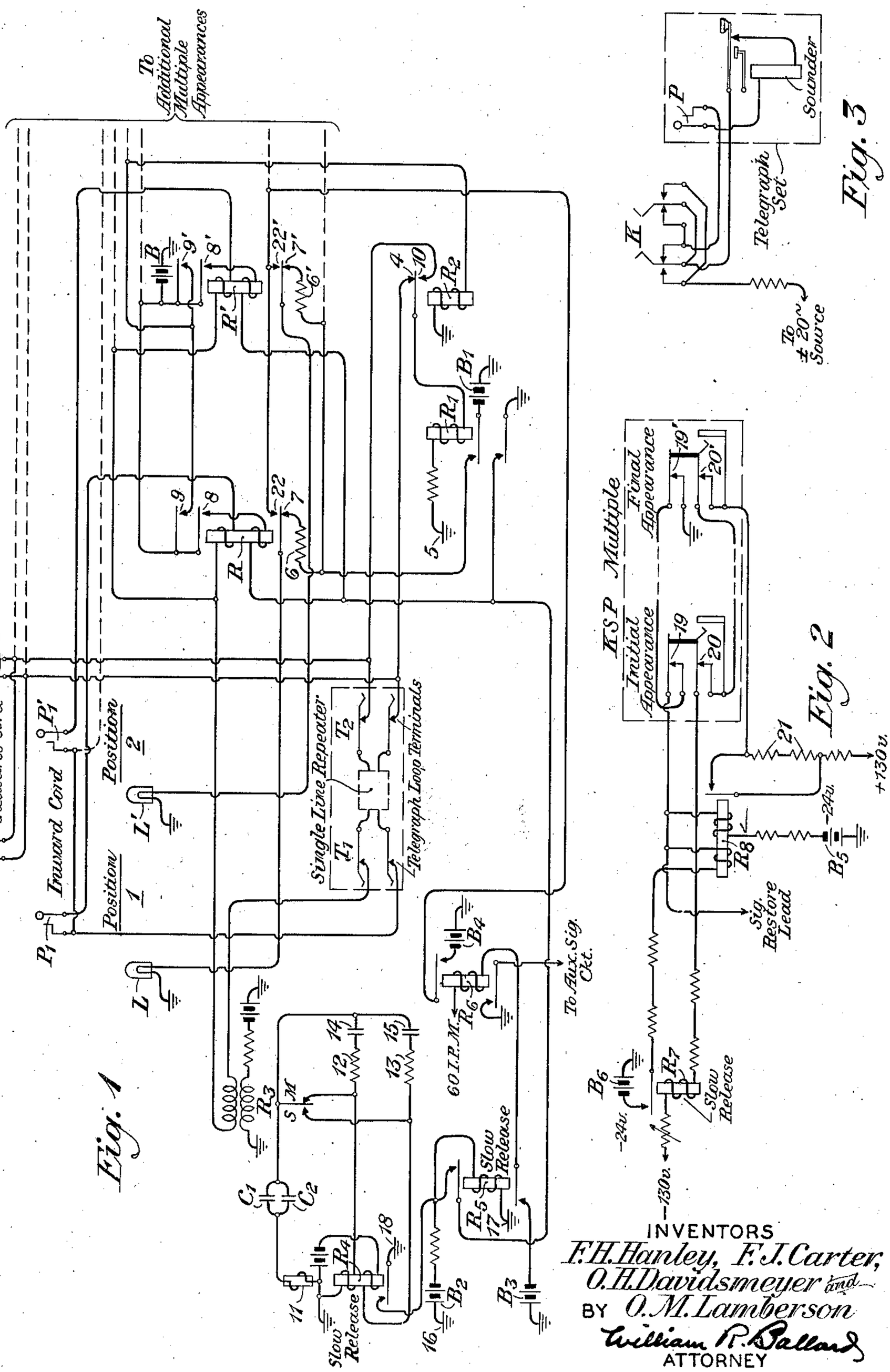
Aug. 12, 1941. F. H. HANLEY ET AL 2,252,629

SUPERVISORY SIGNAL SYSTEM

Filed April 19, 1940



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Patented Aug. 12, 1941 2,252,629

UNITED STATES PATENT OFFICE

2,252,629

SUPERVISORY SIGNAL SYSTEM

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Application April 19, 1940, Serial No. 330,594

12 Claims. (Cl. 178—75)

This invention relates to signaling systems, and more particularly to telegraph systems, including so-called "KSP" circuits. With greater particularity, the invention relates to systems in which "KSP" circuits are interconnected at a switching point for through operation by means of a two-conductor cord circuit repeater, with the requirement, for efficient operation, of certain supervisory signaling features.

In communication systems such as those provided for private line telegraph and teletypewriter exchange services it is, under some circumstances, desirable that the attendants at telegraph repeater offices handle the service from fixed positions at the telegraph boards. In such cases is may be necessary to make available at the boards direct communication facilities between offices in order to enable the attendants at one office to communicate promptly with attendants in other offices regarding service problems and calls for attention. These requirements can be met by the provision of direct point-to-point telegraph circuits, which are known as "KSP" circuits, the letters indicating inter-office communication circuits formerly known as "communication spare patching" circuits. In some instances it is found that between certain offices the number of the attendants' communications is not large enough to justify the provision of direct KSP circuits. Accordingly, it becomes necessary or desirable to provide at certain points switching arrangements by the use of which connections can be built up to handle the attendants' calls between those offices.

The desired switching is satisfactorily taken care of through the instrumentality of a two-conductor cord circuit repeater provided at the switching office. The use of such a repeater, however, involves problems of supervisory signalling between attendants. More particularly, there must be provision for "busy" and "disconnect" signals without undue interference with the communication over the KSP circuits. To meet satisfactorily the requirement just stated with a single indicator per repeater appearance is the principal object of the present invention.

Another object of the invention is to provide for supervisory signaling in association with a cord circuit repeater, which signaling will be satisfactory in cases of operation at the switching office on a multiple basis.

A further object of the invention is to provide for the supervisory signaling indicated hereinbefore by means of apparatus which is simple and reasonably economical.

The invention may be generally described as the combination of a cord circuit repeater with supervisory signal indicating means and associated means for causing the signal indicating means to function for the indication of both a "busy" (or "idle") condition and the reception of a "disconnect" signal.

Other objects and advantages of the invention will be made clear in the following detailed description of one desirable embodiment thereof, which is to be read with reference to the accompanying drawing.

It is deemed desirable to describe the invention in a form adapted to operation on a multiple basis. The modifications of this form which leave the apparatus and circuits adequate for operation on a non-multiple basis either will be obvious or will be pointed out.

In the drawing—

Figure 1 shows diagrammatically and in part schematically the arrangement of the cord circuit repeater and the directly associated apparatus and circuits for providing the desired supervisory signals at the repeater positions;

Fig. 2 shows diagrammatically suitable apparatus directly associated with a KSP circuit multiple, which apparatus functions in cooperation with the apparatus shown in Fig. 1; and

Fig. 3 shows diagrammatically and in part schematically suitable apparatus at the "calling" office for transmitting the "disconnect" signal to the repeater point.

With reference to the details of the drawing and first with particular reference to Fig. 1, the apparatus at the switching office includes a single line telegraph repeater and telegraph loop terminals T_1 and T_2. The repeater is terminated on an inward cord and an outward cord. Two appearances of the repeater are shown, representative of any suitable number of multiple appearances, at positions 1 and 2. The inward cord terminations are on plugs P_1 and P'_1, respectively; similarly the outward cord terminates on plugs P_2 and P'_2 at the two positions respectively. The signal indicator at position 1 takes the form of a lamp L while lamp L' is provided at the second position. Directly associated with each repeater position on the board is a board relay R or R' with a plurality of armatures and contacts. It will be understood that if the operation is on a non-multiple basis, one set of plugs, lamp and board relay—for example, P_1, P_2, L and R—suffices, and the associated connecting circuits are accordingly simplified. The remaining apparatus of Fig. 1 includes a leak relay R,

a transfer relay R_2, a line relay R_3 having a winding in circuit with the inward cord, an alternating current relay R_4, a delay relay R_5 and a signal relay R_6, all with suitable connections and arrangements for voltage supply, as will be more clearly understood from the following detailed description of the operation of the system as particularly affecting the apparatus of Fig. 1.

It is assumed that the repeater and the KSP circuits are operated on a multiple basis. If the repeater is in use by an attendant at any position, the attendants at all other positions are advised of this fact by a repeater busy signal, as will be discussed more fully hereinafter; this indication is given by the lighting of lamp L or L' associated with the particular repeater appearance. If it is noted that the repeater is idle, the attendant who has to make a switched KSP call makes with the tip of the outward cord a "busy" test of the KSP multiple. The apparatus provided for this test will be fully disclosed hereinafter in connection with the discussion of Fig. 2 of the drawing. It suffices to state at this point that if the tested KSP circuit is busy, the lamp will light. If the test indicates that the particular KSP circuit is idle, the plug of the outward cord is inserted into the jack of the KSP multiple. By circuit arrangements which will be more fully disclosed in connection with Fig. 2, battery is applied to the tip of the outward cord and the circuit is completed through contact 4 of relay R_2 and the winding of the leak relay R_1 to ground, this circuit constituting a leak circuit on the tip of the cord. Relay R_1 operates and by the closing of its upper armature and contact completes a circuit from battery B_1 through resistances 6 and 6' and contacts 7 and 7' of relays R and D', respectively, to the lamps L and L', it being understood that lamps corresponding to any additional multiple appearances of the repeater will have their filament circuits similarly completed. The lighting of the lamps thus produced gives a busy indication at all appearances of the repeater. The operation of relay R_1 also closes the lower armature and contact to apply ground over that armature to the lower or secondary windings of relays R and R' and any other board relays which may be added to correspond to additional multiple appearances. When the inward cord of the repeater is inserted by the attendant at one position into the jack of the calling KSP circuit, the upper or primary winding of the associated board relay—which for the purpose of illustration will be taken to be relay R corresponding to position 1—is energized, the source of the energy being more fully discussed hereinafter in connection with Fig. 2. Relay R will now operate and by the action of the armature shown below the electromagnet in the drawing opens contact 7, thus extinguishing lamp L at position 1 where the connection is being made. By the upper contact of the armature now made, this lamp L is connected to the armature of the signal relay R_6 and is thus placed in position to receive a disconnect signal from the calling office. When relay R operates, the closing of contact 8 completes a locking circuit for the relay from battery B through contact 8, the lower winding of the relay and the lower contact and armature of relay R_1 to ground over the last mentioned armature.

The closing of contact 9 upon the operation of relay R connects battery B to ground through the winding of the transfer relay R_2. This transfer relay operates to open contact 4 and close contact 10, thus transferring the winding of the leak relay R_1 from the tip of the outward cord to the sleeve of that cord. This transfer operation places the leak relay in a position such that the relay does not interfere with the transmission path and yet is maintained in operated condition.

It will be noted that with the connection completed through the repeater at the switching office, the upper or line winding of the line relay R_3 is included in the inward cord circuit. As stated hereinbefore one of the objects of the invention is to indicate by the signal indicator, such as lamp L, the reception of a disconnect signal from the connected calling office. It is, of course, necessary that there be satisfactory discrimination between the disconnect signal and any other signals transmitted over the built-up circuit. As will be more fully considered hereinafter in connection with Fig. 3 of the drawing, the distinctive signal transmitted for disconnect purposes may take the form of a 20-cycle ringing current. It will be noted that relay R_3 includes a biasing winding and has certain circuits associated with the marking and spacing contacts of its armature. When the distinctive 20-cycle ringing current comes in from the calling office, the operation of relay R_3 causes the alternate charging of condensers C_1 and C_2 through the lower or secondary winding of the alternating current relay R_4 and the discharging of these condensers through the upper or primary winding of relay R_4. This relay is designed for slow release. Condensers C_1 and C_2 form a part of the resonant circuit including the retard coil 11 and this resonant circuit is tuned very closely to 20 cycles per second; accordingly, the condensers can be fully charged and discharged only at a rate which corresponds to or is very close to the resonant frequency. Resistances 12 and 13 and condensers 14 and 15 are provided for the purpose of reducing sparking at the contacts of the line relay R_3. The alternating current relay R_4 operates on the charge and discharge of condensers C_1 and C_2 at the predetermined frequency, the marginal feature of the relay preventing its operation when the interrupting frequency of the signaling current differs from the predetermined frequency.

The delay relay R_5, which is provided for the purpose of guarding against false operation of the signal receiving circuit on Morse signals, for example, is made slow-releasing and is normally in operated position, the relay circuit being shown as extending from ground at 16 through battery B_2 and the relay winding to ground at 17. In this position of the relay, its contacts are open. When the alternating current relay R_4 operates, ground at 18 is connected through the armature of relay R_4 to complete a circuit for the battery B_2, and thus the winding of relay R_5 is short-circuited and that relay releases after a suitable interval. It will be noted that upon the release of relay R_5, it is locked in the released position, the locking circuit extending from ground at 16 through battery B_2, the upper contact of relay R_5 and the lower contact of the leak relay R_1 to ground. The closing of the lower contact of relay R_5 upon its release completes a circuit through battery B_3, that contact and the winding of the signal relay R_6 to any suitable device for interrupting the circuit thus completed at a frequency of 60 interruptions per minute, the interrupting device being one well

understood in the art and indicated on the drawing as "60 I. P. M." The signal relay R_6 follows the 60 interruptions per minute and intermittently connects battery B_4 through its upper armature and the closed contact 22 of board relay R to lamp L at the position where the through connection has been made. The resultant flashing of this lamp indicates the reception of the disconnect signal from the calling KSP office. It will be noted that the armature of relay R', which is unoperated, rests on its lower contact 7', leaving contact 22' open, and consequently there is no disconnect signal circuit completed through the lamp L'. Thus provision is made for the appearance of the flashing disconnect signal at the repeater position where the through disconnection has been made and at no other appearance of the repeater.

After the reception of the flashing disconnect signal the attendant removes the inward and outward cords simultaneously and the leak relay R_1 is released. The release of this relay removes the ground on the locking circuit of the board relay R (or any other board relay which may have been operated) and this board relay is restored to normal position, causing the release of the transfer relay R_2. As a result of the release of relays R_1, R and R_2, the repeater busy lamps at all appearances are extinguished and the locking circuit for the delay relay R_5 is opened, relay R_5 returning to its normal operated position. Consequently, the circuit through the winding of the signal relay R_6 is opened and the disconnect signal circuit thus broken.

It will be noted on Fig. 1 of the drawing that the signal relay R_6 may be provided with a second (lower) armature and contact for the purpose of controlling an auxiliary signal circuit if such is desired.

When the repeater is provided at offices having a KSP circuit multiple, there must be circuit arrangements at the repeater position whereby it may be ascertained by the attendant whether or not a desired KSP circuit is busy. A satisfactory arrangement is one in accordance with which each KSP circuit is equipped with a relay and other apparatus for placing the sleeve of each multiple jack at zero potential if the circuit is idle and at some potential such as 65 volts if the circuit is busy. It is desirable that this provision be made without interference with the transmission paths of the circuit, which also utilize the sleeves of the jacks. The arrangement for producing the non-voltage and voltage condition of the jack sleeves, used in conjunction with the tip test circuit on the outward cord of the repeater, is shown in adequate detail in Fig. 2 of the drawing. This disclosure includes an indication of the KSP multiple with an initial appearance and a final appearance, relays R_6 and R_7 and suitable resistances and sources of potential, as will now be described in further detail.

With no connection established to the KSP circuit multiple, a circuit is completed from ground through battery B_5, the right-hand or primary winding of relay R_6 and the auxiliary contacts 19 and 19' of the KSP multiple jacks to ground. In this condition, the shunt across resistances 21 between the armature of relay R_8 and the contact of that relay is open and the sleeves of all of the jacks of the KSP circuit multiple are in the electrical center of the KSP loop circuit. This condition has the result that there is no potential to ground on the sleeves of the jacks associated with the KSP multiple. If an attendant makes a tip busy test with the outward cord of the repeater by touching the tip to the sleeve of the KSP multiple, no voltage is applied to the test circuit and the leak relay R_1 (Fig. 1) does not operate to light the signal lamps. If, now, an incoming KSP signal is received, the operating circuit of relay R_7, which is completed through contacts 20 and 20' of the KSP multiple circuit, if opened, relay R_7 releases and battery B_6 is connected through the relay armature in a circuit including the left-hand or secondary winding of relay R_8, this latter circuit being completed over the auxiliary contacts 19 and 19' to ground. The current thus caused to flow through the secondary winding of relay R_8 is equal and opposite in direction to the current of the primary winding and, as a result, relay R_8 is released to close its contact. The closing of the contact of this relay applies a shunt to resistances 21 and, consequently, the sleeve of the KSP multiple is placed otherwise than at the electrical center of the circuit; in the specific disclosure of the drawing there will be applied to the sleeve a potential amounting to about 65 volts to ground. If, under this condition, the tip of the outward cord of the repeater is touched to the sleeve of the called KSP circuit, this potential of 65 volts causes a current to flow through the winding of the leak relay R_1 (Fig. 1) to ground, the result being the operation of the leak relay and the connection of battery B_1 to the lamps L and L'. When a plug is inserted in the KSP multiple, the auxiliary contact 19 or 19' is opened and relay R_8 is released.

If an attendant at one repeater position has established a connection by plugging in at one appearance of a certain KSP circuit in the KSP circuit multiple, and another attendant desires to build up a connection over that circuit, the tip test will produce a busy indication since the established connection will have resulted in the opening of either contact 19 or contact 19', the removal of the ground from the right-hand winding of relay R_8 and the closing of the shunt around resistances 21.

It will be observed that the 130-volt circuit shown in Fig. 2 not only provides the holding current for relay R_7 but also furnishes the potential for the operation of the leak relay R_1 of Fig. 1 under appropriate conditions.

As has been indicated hereinbefore, in order that there may be adequate discrimination at the switching office between a disconnect signal and Morse signals, for example, a distinctive signal must be sent from the calling office connected in a built-up KSP circuit. The diagram of Fig. 3 indicates a suitable arrangement which may be provided for this purpose at an office which will be regarded as a "calling" office. When this office has completed the communication over the built-up KSP circuit, the non-locking key K associated with the telegraph test set is operated for approximately two seconds. This operation applies ±20-cycle ringing current through the sounder of the telegraph set to the tip of plug P, which terminates the cord, and on over the telegraph circuit to the KSP repeater point. The transmission of the 20-cycle ringing current through the sounder of the telegraph set is necessary in order that the attendant at the calling office may be assured that the disconnect signal has been transmitted. As has been described in some detail in connection with

Fig. 1, the reception at the KSP repeater office of this distinctive disconnect signal is indicated by the flashing of the signal lamp at the repeater position through which the connection is made.

While the invention has been disclosed specifically as applied to KSP circuits used in certain telegraph systems, it will be understood that it may be applied to other communication systems. Likewise, it will be understood that many changes from the specific arrangement shown may be made within the scope of the appended claims.

What is claimed is:

1. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, a signal indicator associated with said repeater, and means associated with said indicator for indicating thereby whether a certain direct circuit is in use and the reception of a distinctive signal from the calling office.

2. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater and said direct circuits being adapted for operation on a multiple basis, said repeater having at each of its appearances a signal indicator, and means associated with said indicator for indicating thereby whether the repeater is in use at another position, whether a certain direct circuit is in use, and the reception of a disconnect signal from the connected calling office.

3. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a two-conductor cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, a signal indicator associated with said repeater, and circuit means associated with said indicator for indicating thereby the idle or busy condition of a certain direct circuit and the reception of a distinctive signal from the connected calling office.

4. In a signaling system, including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a two-conductor cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater and said direct circuits being arranged for operation on a multiple basis, a signal indicator associated with said repeater at each of its appearances, and circuit means associated with said indicator and indicating thereby the use of the repeater at another position, the idle or busy condition of a certain direct circuit and the reception of a distinctive disconnect signal from the connected calling office.

5. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater having an inward cord, an outward cord and a single signal indicator, means associated with said indicator for indicating thereby whether a certain one of said direct circuits is in use, and means associated with said indicator and operable when a connection has been established for indicating by said indicator the reception of a disconnect signal from the connected calling office, said last stated means being responsive only to current of certain distinctive characteristics.

6. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater and said direct circuits being arranged for operation on a multiple basis, said repeater having an inward cord and an outward cord each adapted for switching operations at each appearance of the repeater, a signal indicator associated with each multiple appearance of the repeater, means associated with said indicator for indicating thereby whether the repeater is in use at another position, means associated with said indicator for indicating thereby whether a certain one of said direct circuits is in use, and means associated with said indicator and operable when a connection has been established at the corresponding position of the repeater for indicating by said indicator the reception of a disconnect signal from the connected calling office, said last stated means being responsive only to current of certain distinctive characteristics.

7. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, a signal indicator associated with said repeater, means for sending to said repeater from a distant calling office connected therethrough a distinctive supervisory signal, means associated with said repeater and responsive only to the reception of said supervisory signal for producing a distinctive operation of said indicator, and means for indicating by said indicator the idle or busy condition of a certain one of said direct circuits.

8. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater and said direct circuits being arranged for operation on a multiple basis, a signal lamp associated with each appearance of said repeater, means for sending to said repeater from a distant calling office connected therethrough current of distinctive characteristics, means including a chain of relays associated with said repeater for causing said lamp to flash in response to the reception of said distinctive current, and means for causing said lamp to indicate the use of the repeater at another position and the idle or busy condition of a certain one of said direct circuits.

9. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater including an inward cord, an outward cord and a signal lamp, a direct circuit multiple associated with said direct circuits and said repeater, means responsive to the touching of the tip of said outward cord to a jack sleeve of the direct

circuit multiple associated with a busy direct circuit for lighting said lamp, and means operable when a connection has been established through said repeater for flashing said lamp in response to the reception of a disconnect signal from the connected calling office, said last stated means being responsive only to current of certain distinctive characteristics.

10. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater including an inward cord and an outward cord and being adapted for operation on a multiple basis, a signal lamp associated with each appearance of the repeater, a direct circuit multiple associated with said direct circuits and said repeater, means for lighting said lamp when the repeater is in use at another position, means responsive to the touching of the tip of said outward cord to a jack sleeve of the direct circuit multiple associated with a busy direct circuit for lighting said lamp, and means operable when a connection has been established through said repeater at one of its positions for flashing the lamp at that position in response to the reception of a disconnect signal from the connected calling office, said last stated means being responsive only to current of certain distinctive characteristics.

11. In a signaling system, including a plurality of offices and a plurality of direct point-to-point circuits interconnecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater including an inward cord and an outward cord, a signal lamp associated with the repeater, a direct circuit multiple at said office including a plurality of jacks, means associated with said multiple for impressing a voltage on the sleeves of the jacks corresponding to a certain direct circuit when said circuit is in use and for removing the voltage when the circuit is idle, and circuit and switching arrangements associated with said repeater and said lamp whereby the lamp will give a plurality of indications, said arrangements including means responsive to the touching of the tip of said outward cord to a multiple jack sleeve when a voltage is impressed thereon for lighting said signal lamp, means responsive to the connection of the outward cord with said direct circuit multiple for lighting the lamp, means responsive to the completion of a connection through the repeater for extinguishing the lamp and preparing the same for the reception of a disconnect signal from the connected calling office and means responsive only to current of certain distinctive characteristics transmitted from said calling office for causing the flashing of said lamp as a disconnect signal.

12. In a signaling system including a plurality of offices and a plurality of direct point-to-point circuits interconononecting certain of said offices, a cord circuit repeater at one office for connecting two of said direct circuits for through operation between two other offices, said repeater including an inward cord and an outward cord and being designed for operation on a multiple basis, a signal lamp associated with each appearance of the repeater, a direct circuit multiple at said office including a plurality of jacks, means associated with said multiple for impressing a voltage on the sleeves of the jacks correponding to a certain direct circuit when said circuit is in use and for removing the voltage when the circuit is idle, and circuit and switching arrangements associated with said repeater and said lamps whereby the lamps will each give a plurality of indications, said arrangements including means responsive to the touching of a tip of the outward cord to a multiple jack sleeve when a voltage is impressed thereon for lighting said signal lamps, means responsive to the connection of the outward cord with said direct circuit multiple for lighting the lamps at all repeater positions, means responsive to the completion of a connection through the repeater at one position for extinguishing the lamp at that position and preparing the same for the reception of a disconnect signal from the connected calling office, and means responsive only to current of certain distinctive characteristics transmitted from said calling office for causing the flashing of said lamp as a disconnect signal.

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