

June 17, 1930.

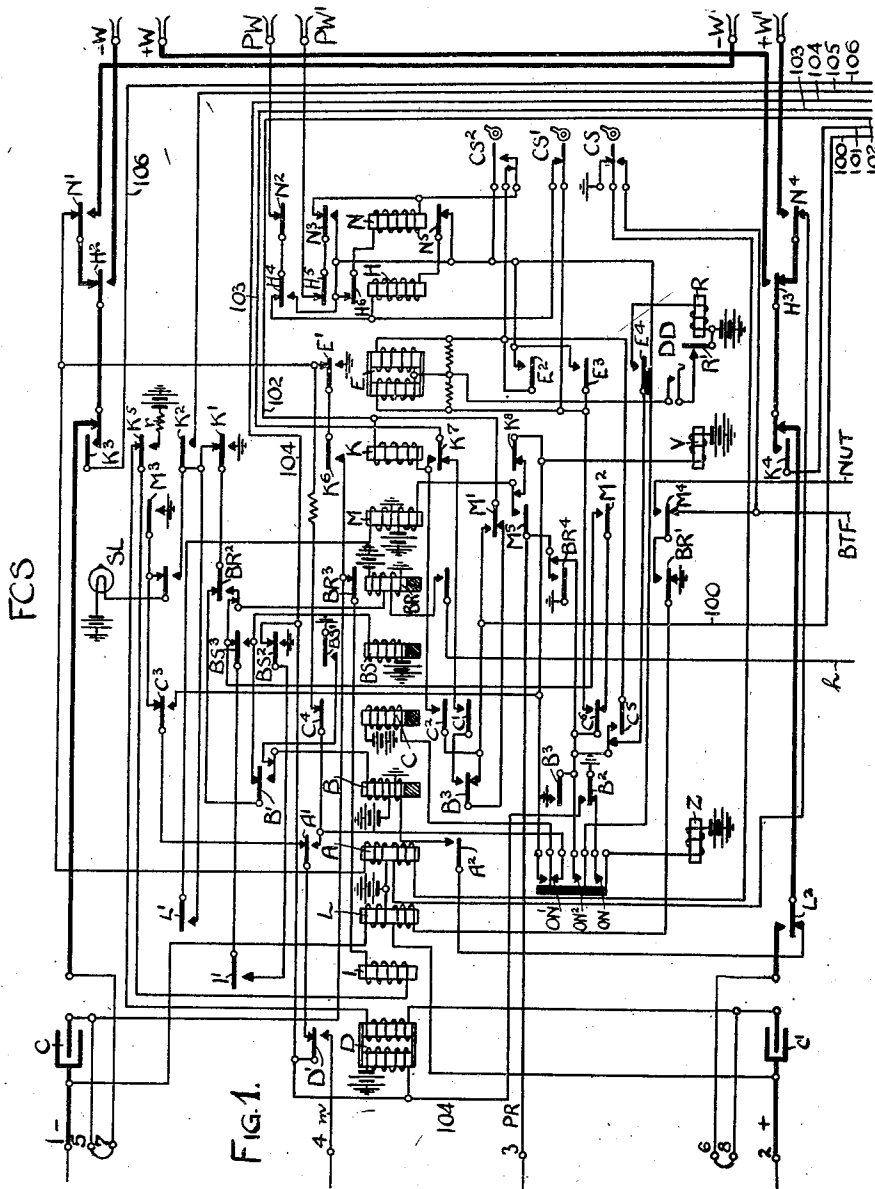
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1,763,901

TELEPHONE SYSTEM

Filed Nov. 13, 1926

3 Sheets-Sheet 1



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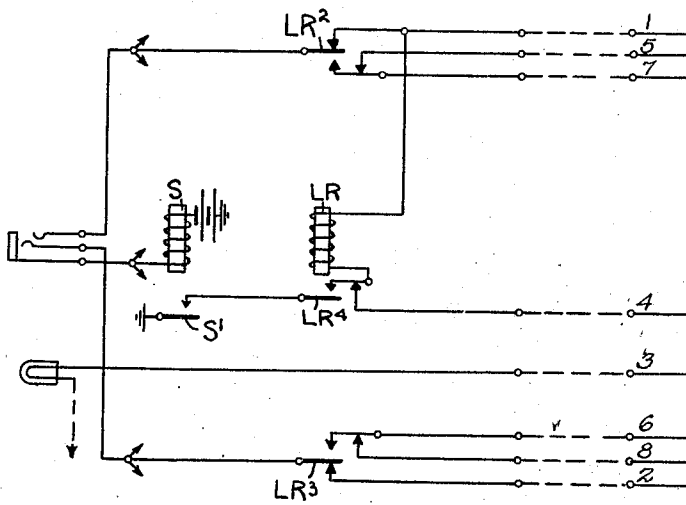
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3 Sheets-Sheet 2

FIG. 2.



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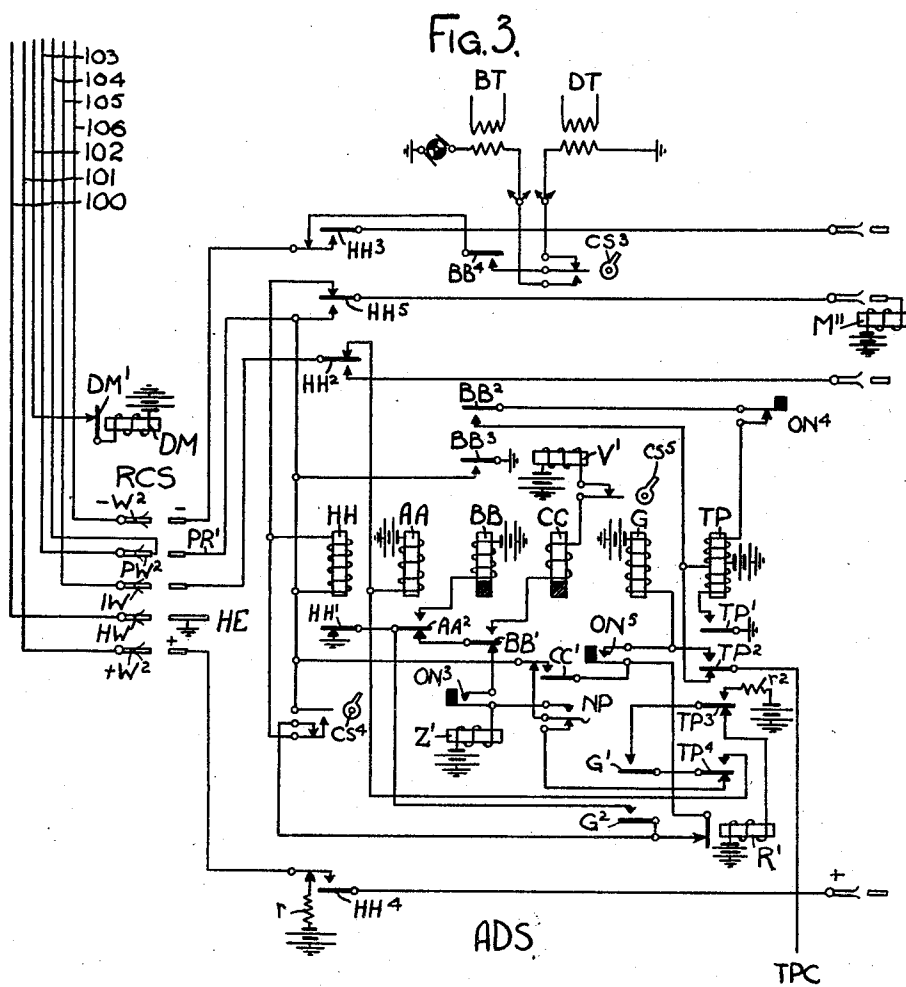
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed November 13, 1926, Serial No. 148,120, and in Great Britain January 16, 1926.

This invention relates to telephone systems and particularly concerns improvements in register controllers for use in such systems. According to the present invention a trunk relay group from which access is had to the register controller is combined with a first numerical switch as in British Patent 233,007, complete accepted May 1, 1925, and is hereinafter referred to as a first code selector.

The first code selector according to the present invention is arranged so that it may be used interchangeably either as an automatic subscriber's first code selector or as an operator's first code selector there being separate groups of similar switches provided for completing calls from the two sources. In the former case battery for talking purposes is supplied from the operator's position and in the latter case from the first code selector. When the first code selector is taken into use from a manual position the battery feeding apparatus in the first code selector is disconnected upon response of the called party and the connection is held under the control of the operator over a single conductor which is separate from the speaking circuit. Moreover this first code selector is arranged to have access to twenty trunks from each of its ten levels. In addition to feeding talking battery this improved first code selector controls the connecting up of busy tone currents, number unobtainable tone currents, the metering of completed connections and in the event of a busy line or group of lines being encountered during the setting up of a wanted connection the release of the partly established connection and the transmission of the necessary signalling currents to the calling party (subscriber or operator). In addition this first code selector is arranged to bring about the release of the registering apparatus and the connecting up of signalling currents to the calling line when the number transmitted by the calling party is not correctly recorded on the register switches.

It will be understood that the selector is manufactured without regard as to which

of the two services it is to perform, and that the conductors are brought out to the terminals 1—8, located to the left, so that the switch may function in one manner or the other, depending upon how these terminals are connected through the usual jack contacts, with which these terminals engage in practice.

In order that the invention may be more fully understood and readily carried into effect, a telephone system according to the present invention will now be described with reference to the accompanying drawings in which Fig. 1 shows the combined operators' or subscribers' first code selector switch FCS. Fig. 2 shows a jack ending trunk circuit at an operator's position. Fig. 3 shows the "A" digit register ADS of a register controller and a register controller selector switch RCS.

A detailed description will now be given of the operation of the switch FCS when functioning as a subscribers' first code selector and for this purpose we will assume that the terminals 5 and 7, and 6 and 8 are strapped together as shown in Fig. 1, and that the conductors extending to terminals 1, 2, 3 and 4 terminate in banks of subscribers' rotary line switches. When a calling subscriber removes his receiver his rotary line switch will in known manner hunt for an idle trunk and assuming the trunk comprising conductors 1, 2, 3 and 4 is the one taken into use relay L will operate over the following circuit; battery, upper winding of L, incoming negative conductor 1, the calling party's loop, incoming positive conductor 2, lower winding of L, BR², earth. Relay L, upon energizing, performs the following functions: at L¹ energizes relay BS over the circuit earth, low resistance winding of relay M, L¹, K¹, BR², B¹, BS, battery; and at L² completes the following circuit for the high impedance relay I and impulse relay A; battery, upper winding of A, N¹, H², K³, strapped terminals 7 and 5, BR³, winding of relay L, K³, right hand winding of polarized relay D, strapped terminals 6 and 8, L², normally closed contacts controlled by K⁴, H³, N⁴, lower winding of re-

lay A, 11th stepped cam springs CS to earth. Relays I and A accordingly operate their armatures I^1 and A^1 , A^2 respectively. The polarized relay D however does not operate at this time. Relay BS, upon energizing
 5 completes at BS^1 an energizing circuit for the upper winding of relay B and at BS^2 and at BS^3 completes a locking circuit for itself as follows: earth, BS^2 , I^1 , BS^3 , BS, battery. Relay B, upon energizing, earths
 10 the release trunk PR at B^3 over the normally closed contacts controlled by BR^4 and at B^1 completes the following locking circuit for itself: battery, upper winding of B, B^1 , BR^2 , K^1 , L^1 , low resistance winding of M to earth. Relay M, however, does not operate at this time owing to the comparatively
 15 high resistance of the upper winding of relay B. Relay A, upon energizing, completes at A^1 the following circuit for relay C: battery, winding of C, off normal springs ON^1 , A^1 , D^1 , conductor 104, B^2 , earth and at A^2 prepares a holding circuit for the lower winding of B. Relay B at B^2 now
 20 starts the register-controller-selector RCS, Fig. 3, hunting for an idle "A" digit switch ADS as follows: earth, B^2 , 104, home position contact and test wiper, PW^2 , conductor 103, K^1 , C^1 , B^3 , M^1 , to one side of switching relay K and conductor 102, interrupter contact DM^1 and driving magnet DM to battery. As soon as the hunting switch RCS
 30 steps off normal, holding earth for switching relay K is extended from the homing earth HE over home wiper HW, conductor 100, C^2 to the other side of relay K. Relay K will be short circuited as long as earth potential is encountered by test wiper PW^2 , but when an idle "A" digit switch is found
 40 relay K will energize in series with driving magnet DM. Relay C, upon operating, also prepared at C^3 the operating circuit for vertical magnet V and at C^4 disconnected itself from the upper winding of relay A and at contacts C^5 and C^6 prepared circuits for the shunt field relay E.

Upon the register-controller-selector RCS Fig. 3 finding an idle "A" digit switch ADS, switching relay K Fig. 1 operates and performs the following functions: at K^1 it completes a holding circuit for release relay B independently of line relay L, at K^2 it completes the following circuit for relay AA in the "A" digit switch ADS Fig. 3, earth, low
 55 resistance winding of forced release relay M, L^1 , K^2 , 105, impulse wiper IW, HH^2 , winding of AA to battery. Relay AA energizes in this circuit but relay M does not owing to the comparatively high resistance of the former. Relay AA, upon energizing
 60 completes at AA^2 an energizing circuit for release relay BB and relay BB earths the release trunk PR^1 at BB^3 , and at BB^4 prepares a circuit for connecting the dialing tone to the calling line. Relay K in the

switch FCS Fig. 1 at K^3 and K^4 switches the upper and lower windings of the impulse relay A across the negative and positive wipers $-W^2$ and $+W^2$ of the register-controller-selector RCS. Dialing tone current is now fed to the calling party as follows: earth, dial tone transformer DT, 11th
 70 step cam springs CS^3 , BB^4 , HH^3 , wiper $-W^2$, conductor 106, K^3 , H^2 , N^1 , E^1 , K^6 , condenser c to the incoming negative speaking conductor 1. A branch of this circuit also extends from N^1 to the upper winding of relay A and battery. Holding battery in the "A" digit switch Fig. 3 is now connected to the lower winding of relay A in the first
 80 code selector switch FCS Fig. 1 as follows: battery, resistance r , HH^4 , positive wiper $+W^2$, conductor 101, K^4 , H^3 , N^4 , lower winding of A, CS, earth. Relay K at K^5 connects battery through resistance r' to one side of relay I and at K^6 connects the other side of relay I to dial tone earth in the "A" digit switch over conductor 106. Relay K also at K^7 completes a holding circuit for itself over conductor 103, wiper PW^2 to the
 90 earthed released trunk conductor PR^1 and at K^8 disconnects the lower winding of relay M from the vertical magnet. Contacts L^1 of line relay L now serve as pulsing contacts and hold relay AA in the "A" digit switch Fig. 3 over the following circuit: battery, winding of AA, HH^2 , impulsing wiper IW, conductor 105, K^2 , L^1 , low resistance winding of relay M to earth.

The calling party having received the dialing tone may now dial the digits of the wanted number. Relay L responds to these digits and repeats the first digit to relay AA of the "A" digit switch ADS and the second and third digits to the office register magnets of the register-controller taken into use by the "A" digit switches a result of the dialing of the first digit. Subsequent digits in the wanted number are repeated by relay L to the various numerical registers associated with the register controller. Relay I is held during the setting of the "A" digit switch and office register over a loop circuit in the switches which extend over the negative wiper $-W^2$ of switch RCS, conductor 106, K^3 , H^2 , N^1 , E^1 , K^6 , BR^3 to one side of relay I, the other side of relay I being connected to battery via K^5 and resistance r while the positive wiper $+W^2$ of RCS is connected to earth over conductor 101, K^4 , H^3 , N^4 , lower
 120 winding of A, CS, earth. As soon as the three code digits of the wanted number have been registered, the register controller starts sending impulses in known manner over the negative and positive wipers of switch RCS and conductors 106 and 101. Relay A of the first code selector FCS responds to the first series of impulses sent out by the register controller and repeats them at A^1 to the vertical magnet V. As soon as the vertical
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magnet V operates it releases the double dog springs DD and a circuit is completed for both windings of shunt field relay E.

It may be mentioned here that the shunt field relay E is identical with the shunt field relay shown in British Patent No. 170385 and is so constructed that it will only operate when both of its windings are energized at the same time. The energizing circuit for relay E is as follows: battery, interrupter springs R' of rotary magnet R, double dog springs DD to the common point of both windings of relay from the other side of the right hand winding via springs C⁵ and B³ to earth, while the other side of the left hand winding of relay E is connected to earth via springs C⁶ and B³. Relay E, upon operating, completes a locking circuit for itself at armatures E² and E³ as follows: battery, interrupter springs R¹, springs DD, both windings of relay E in parallel, armatures E² and E³, off normal springs ON², B³, earth. The first series of impulses is repeated to the vertical magnet V, as follows: earth, B², D¹, A¹, C³, V, battery. Upon the first vertical step the off normal springs ON, ON¹ and ON² operate and relay C is then maintained energized in parallel with the vertical magnet V during the transmission of remaining impulses in the series. Responsive to this series of impulses, both sets of wipers -W, +W, PW and -W¹, +W¹, PW¹ are raised opposite to levels of bank contacts corresponding to the digit dialed. At the end of the series of impulses to the vertical magnet V relay C will de-energize and complete the following circuit for the rotary magnet R: earth, B³ normally closed contacts controlled by C⁵, E⁴, winding of rotary magnet R to battery. Rotary magnet R now rotates the shaft carrying the two sets of wipers -W, +W, PW, and -W¹, +W¹, PW¹ on to the first two trunk lines in the respective levels of the wiper sets and at the same time opening the interrupter springs R¹ thereby opening the holding circuit of relay E which deenergizes. The further rotation of the wipers depends on whether or not both trunk lines are busy and supposing this is the case the private wipers PW, PW¹ of both sets will find earth potential and a circuit will be completed for both windings of relay E which will operate and close the rotary magnet circuit over the same circuit as previously described. Earth on PW will be connected to one winding of relay E over N², H⁴, CS¹ and earth over PW¹ to the other winding of relay E over H⁵, N³ and CS². This alternate operation of relay E and rotary magnet R will continue as long as both test wipers PW and PW¹ encounter busy contacts. Assuming that one of the wipers PW or PW¹ finds a free trunk, then only one winding of relay E will have a direct circuit while the other winding will

have a circuit completed for itself in series with one or other of the relays H or N depending on which trunk is idle. Since relay E does not operate under these conditions and since either relay H or N will operate in series with one of the coils of relay E the speaking conductors will be extended over the wiper-set -W, +W by the operation of relay H and the wiper-set -W¹, +W¹ by the operation of relay N. Should the test wipers PW and PW¹ both engage idle trunks, both relays H and N will energize in series with the windings of relay E but since relays H and N are so arranged that each opens the circuit of the other only one of them will remain energized and the speaking conductors will be extended only over one set of wipers. Relay E at contacts E¹ also disconnects relay I from the negative speaking conductor in order to prevent the calling party from hearing the impulses sent out by the register controller.

The subsequent series of impulses sent out by the register controller will be transmitted over the negative and positive wipers of the selected set and at the end of the impulse transmission, holding potential will be disconnected from conductors PR' and 103 and relay K will therefore fall back and complete the talking circuit between the calling and called parties at K³ and K⁴. The operation of relay K also releases the "A" digit switch and register controller in known manner, so that they may be available for setting up other connections. Upon the release of relay K, the holding circuit for relay B is transferred from K' to L' and the high impedance relay I is connected across the talking conductors in series with the right hand winding of polarized relay D. When the called party answers, relay D operates and at D' connects earth to conductor m which serves to operate the calling party's meter. During conversation the switches in the same exchange as the first code selector FCS are maintained energized by guarding potential connected up at B³ being fed forward over either wiper PW or PW¹. The release of the connection is brought about by the calling party replacing his receiver causing relay L to de-energize and open the circuit of release relay B. Relay B, upon de-energizing, completes the following circuit for release magnet Z: earth, B², off normal contacts ON, release magnet Z to battery. The release of relay B also removes holding potential at B³ and other operated relays in the first code selector de-energize.

Assuming now that a busy condition is encountered during establishment of the connection either by a selector or connector. In either case battery and earth alternately will be connected to the negative speaking conductor whereupon relay I will de-energize and re-energize. Since the battery pe-

riod will cause relay I to open the circuit of relay BS for a period long enough to allow it to release the following circuit will be completed for relay BR upon the re-energization of relay I: battery, upper winding of
 5 BR, normally closed springs controlled by BR², BS³, I', BS², 104, B², earth. Relay BR, upon energizing, will release the partly established connection in the same manner as
 10 if the calling party had replaced his receiver in the ordinary way, the only difference being that relay L is still energized and now controls relay BR which guards the calling line at BR³. It will be seen that relay BR
 15 upon energizing opens at BR² the energizing circuit for release relay B and that relay BR connects at BR' the combined busy tone and busy flash signalling conductor BTF, to the calling line through the lower winding of
 20 relay L. Responsive to this operation the calling party (subscriber or operator) will receive the usual busy signal i. e. tone to a calling automatic subscriber and a flashing signal to an operator. During the period
 25 that battery is connected to the lower winding of relay L as a result of a busy line being encountered, relay BR is held energized over its upper winding and the holding conductor h. It should be noted also that the
 30 release of the partly established connection is arranged to take place during the non-holding period of the switch where the busy condition originates and therefore no earth holding is required. In the case of a busy
 35 tone arising at the "A" digit switch, relay I will be interrupted as before and bring about the above condition as well as the release of the "A" digit switch.

In the case of a time pulse cut-off either
 40 at the "A" digit switch or in the register controller, relay M in the first code selector will be operated over its low resistance winding as follows: battery connected up as
 45 a result of the operation of the time pulse relay to conductor 105, K², L', low resistance, winding of relay M to earth. Relay M operates under these conditions and completes the following circuit for relay BR:
 50 battery, upper winding of BR, normally closed contacts controlled by BR², M², C⁵, B³, earth. Relay BR upon operating will release any partly operated equipment by bringing about the release of release relay B. With relays M and BR in operated positions,
 55 a number unobtainable tone and flashing signal current superimposed on conductor NUT is connected via contacts M⁴, BR¹ and the lower winding of relay L to the incoming positive speaking conductor in order
 60 to notify the calling subscriber or operator that the wanted number is unobtainable.

In the case where the calling party removes his receiver but does not dial in any
 65 digits, the "A" digit switch will be re-

leased by the operation of the time pulse relay TP causing battery to be connected to conductor 105 as follows: battery, r², TP³, G', TP⁴, HH², IW, conductor 105, K², L', low resistance of M to earth. Since this
 70 condition does not bring about the release of relay BS, relay BR will not be operated and relay M at M³ will complete a circuit for the supervisory lamps L but no tone or flashing signal is connected to the calling
 75 line.

A description will now be given of the operation of the first code selector FCS when used as an operator's first code switch and for this purpose it will be assumed that
 80 the switch FCS is taken into use from the manual board Figure 2. When the switch FCS is adapted to be taken into use by an operator the connections to the terminals 1—8, Figs. 1 and 2, are as indicated in Fig. 2 instead of as indicated in Fig. 1.

When the operator inserts a plug in the jack associated with the trunk leading to the first code switch FCS the sleeve relay S
 90 operates from earth on the sleeve of the plug and prepares at S¹ a holding circuit for relay LR. Relay L in the switch FCS energizes over conductors 1 and 2 in the following circuit: battery, upper winding of relay L, conductor 1, LR², tip of jack, operator's
 95 loop, ring of jack, LR³, conductor 2, lower winding of L, BR¹, earth. Relay L operates as before and completes a circuit at L¹ for relay BS and the latter relay completes at BS¹ a circuit for relay B. Relay B, (upon
 100 operating, earths the release trunk PR at armature B³. This earth extends over conductor 3 and causes the supervisory lamp associated with the jack of this trunk to glow. The operator now dials the digits in the
 105 wanted number which are recorded in the register controller taken into use by the first code selector FCS. The register controller sends out the necessary digits to establish connection with the wanted party
 110 and when the wanted party answers the polarized relay D in the first code selector will operate and connect earth to the metering conductor m as follows: earth, B², D¹, metering conductor m. The earth potential
 115 on the metering conductor m now extends over conductor 4, normally closed contacts controlled by armature LR⁴, winding of relay LR, conductor 1, upper winding of relay L to battery. Relay LR in the manual
 120 board energizes in series with the upper winding of relay L of switch FCS and at LR⁴ completes a locking circuit for itself and at LR² and LR³ disconnects the condensers c and c', the line winding of polarized
 125 D and the high impedance relay I from the speaking conductors of the first code switch FCS and extends the tip and ring conductors of the jack over the conductors 7 and 8
 130 to the speaking conductors of the first code

switch. Relay L remains energized in series with relay LR in order to complete the talking circuit at L² and to control the release of the connection at L¹. The removal of the polarized relay D from the speaking conductors will cause it to deenergize and remove earth from conductor 4. When the operator removes the plug from the jack the sleeve relay S will deenergize and at S¹ open a holding circuit for relays LR and L.

What I claim as new and desire to secure by Letters Patent is:—

1. In a telephone system employing registering apparatus and in which access to such apparatus is had from a trunk relay group, circuit connections in said trunk relay group for supplying talking current to one of the subscribers involved when the call is set up from an automatic line, and means effective in case the call is coming from a manual switchboard for altering the connections in the trunk relay group upon the response of the called subscriber so that talking current is supplied to the called line from the switchboard through such relay group.

2. In a telephone system employing registering apparatus and in which access is had to such apparatus from a trunk relay group, circuit connections in such relay group arranged to secure the proper functioning when the call extended thereto is from an automatic subscriber's line, and circuit changing means operated automatically upon the response of the called subscriber for suitably altering the circuit connections in case the call is coming from a manual switchboard.

3. In a telephone system employing registering apparatus and in which access is had to such apparatus from a battery-feeding relay group, means for automatically disconnecting the battery feeding apparatus of the relay group upon the response of the called subscriber in case the call originates at a manual switchboard.

4. In a telephone system employing registering apparatus and in which access is had to such apparatus from a trunk relay group, said relay group being arranged so that it is readily adaptable for use either for completing calls originated on a calling subscriber lines and for completing calls originating at a manual switchboard, a metering conductor at said relay group together with means for operating a meter thereover when the called subscriber responds in case the call is from an automatic subscriber line, and circuit-changing apparatus operated over said metering conductor instead of said meter in case the trunk relay group is functioning in connection with a manual switchboard instead of in connection with automatic lines.

5. In a telephone system employing registering apparatus and in which access is had

to such apparatus from a trunk relay group, an impulse responding relay in said relay group arranged to be controlled over a loop circuit during the setting up of a connection, and means effective upon the response of the called subscriber for disconnecting the impulse responding relay from the talking circuit and for holding up the connection by holding it operated in an independent circuit.

6. In a telephone system claimed in claim 5, a supervisory relay in the trunk relay group having a low resistance winding, and a circuit controlled by the impulse responding relay for repeating impulses to the registering apparatus through such low resistance winding.

7. In a telephone system employing register switches and in which access is had to the register switches from a trunk relay group, a relay in said trunk relay group arranged to be controlled over a partly established connection, and means responsive to a prolonged deenergization and a reenergization of said relay for releasing such partly established connection and for giving the calling party a busy signal.

8. In a telephone system as claimed in claim 7, means effective in case the number transmitted by the calling party is not correctly recorded on the register switches for releasing the register switches and for connecting up a signaling current to the calling line.

9. In a telephone system, an automatic switch arranged to extend an incoming trunk line of either of two different types, the types of said trunk line being such that they must be differently connected to said switch, and terminal facilities so arranged that the switch may be used interchangeably to extend connections from an incoming trunk line of either type.

10. In a telephone system, a trunk line of one type having a given number of conductors, a trunk line of another type having a larger number of conductors, an automatic switch arranged with the proper number of incoming conductors to extend a connection from the last named trunk, but capable of use with said first named trunk, and terminal facilities so arranged that when the switch is used in connection with the trunk line having the smaller number of conductors the excess conductors incoming to the switch are looped together.

11. In a telephone system, a trunk line having a plurality of conductors, a trunk line having a larger plurality of conductors, an automatic switch arranged to extend a connection from either trunk line and having conductors brought out to terminals and corresponding respectively to the conductors of said trunk line having the larger plurality of conductors, and terminal facilities

such that, when a switch is used to extend the trunk line having the smaller number of conductors, each of the conductors brought out to terminals and which does not correspond to a conductor of the trunk line last named is connected to another of the said conductors of the switch.

12. In a telephone system, an automatic switch having talking conductors therein, each of said talking conductors being opened with the open ends brought out to terminals, and terminal facilities such that the open ends of the talking conductors may be closed locally in case the switch is used as the terminus of an incoming trunk of one type and may be connected to incoming trunk conductors in case the switch is used as the terminus of an incoming trunk of another type.

13. In a telephone system, a trunk line having a plurality of conductors, a trunk line having a different number of conductors, an automatic switch arranged to serve as the terminus for either trunk line interchangeably, and means including terminal wiring for completing local circuits over unused conductors when the switch is used to terminate the trunk line having the smaller number of conductors.

In testimony whereof I have signed my name at Liverpool, England, this 21 day of October 1926.

JOHN ELLIS OSTLINE.

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