

April 5, 1938.

R. TAYLOR ET AL

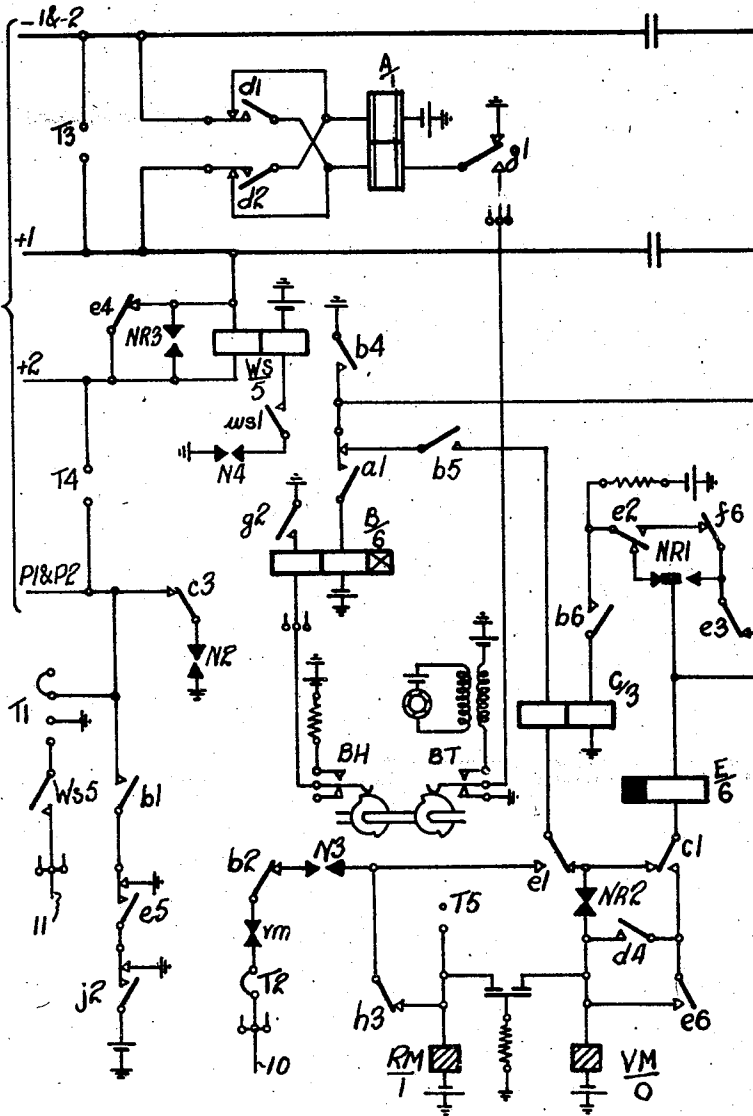
2,113,119

TELEPHONE SYSTEM

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4 Sheets-Sheet 1

Fig. 1.



-INVENTORS-
REGINALD TAYLOR
GEORGE THOMAS BAKER

By: *Chas. L. Candy*
ATTORNEY

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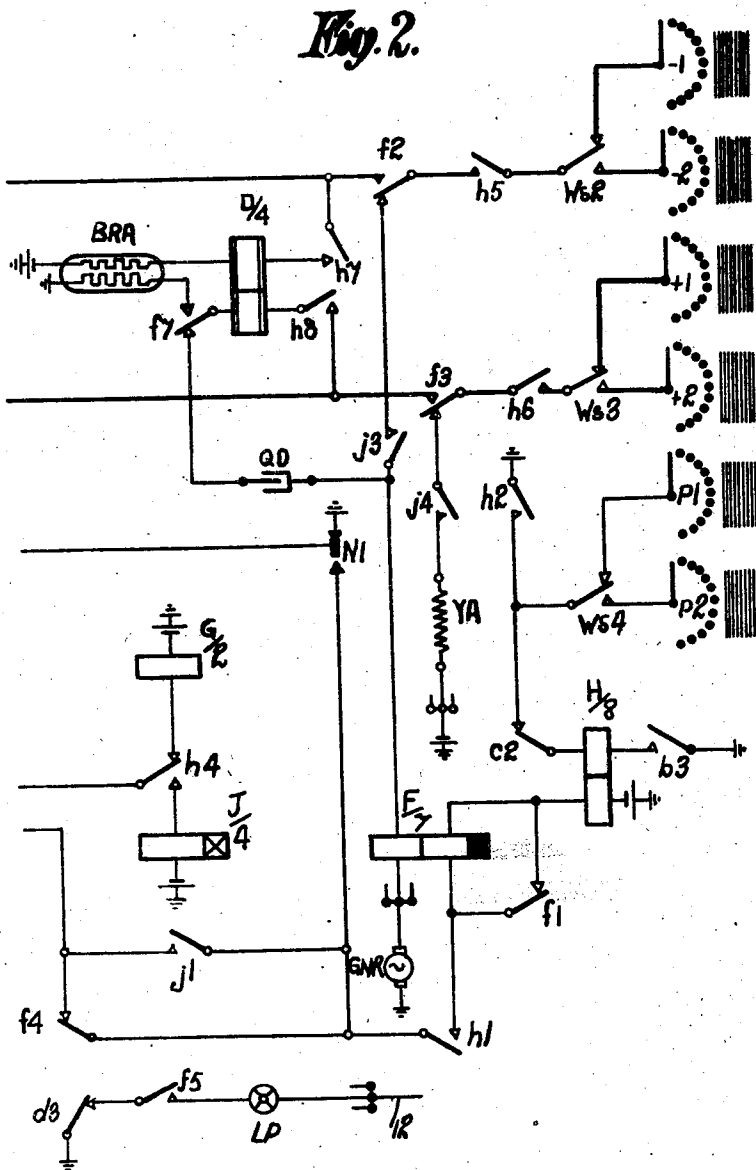
R. TAYLOR ET AL

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-INVENTORS-
REGINALD TAYLOR
GEORGE THOMAS BAKER
BY: *Chas. W. Condy*
ATTORNEY

April 5, 1938.

R. TAYLOR ET AL

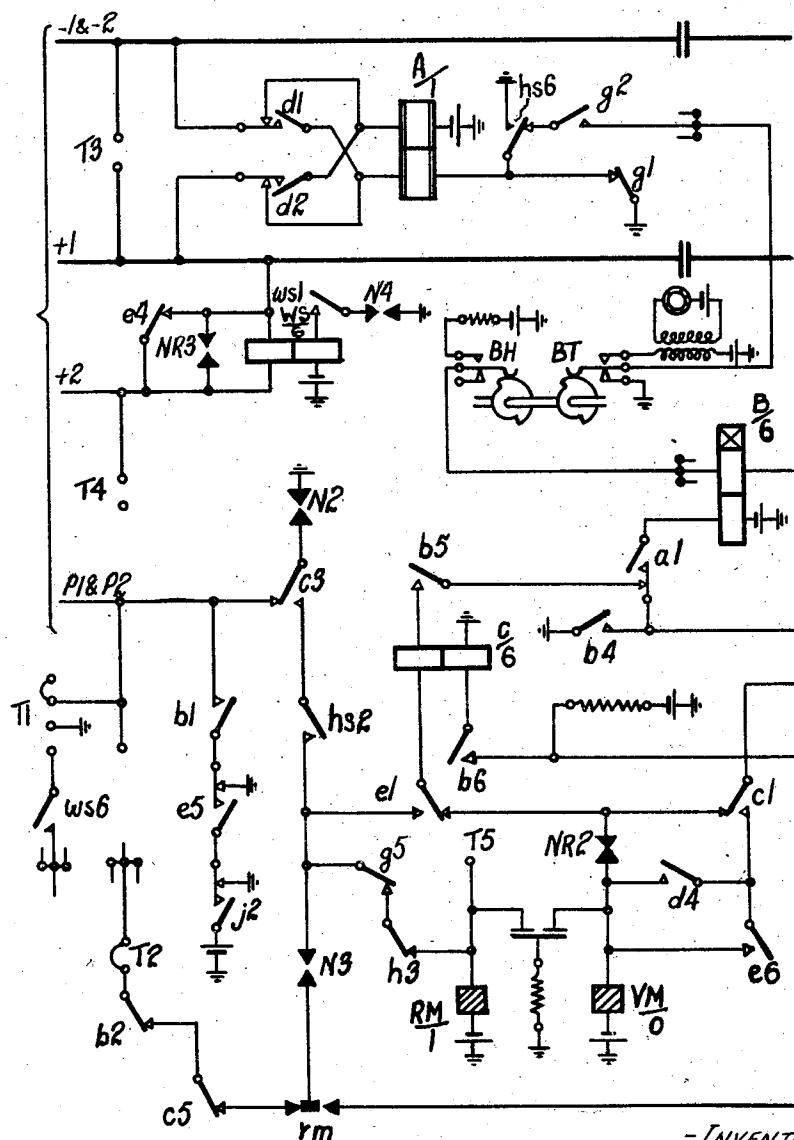
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Fig. 3.



-INVENTORS-
REGINALD TAYLOR
GEORGE THOMAS BAKER

BY: *Chas. L. Candy*
ATTORNEY

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Reginald Taylor and George Thomas Baker,
Liverpool, England, assignors to Associated
Telephone & Telegraph Company, Chicago, Ill.,
a corporation of Delaware

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5 Claims. (Cl. 179-18)

The present invention relates to telephone systems and is more particularly concerned with systems employing final selector switches provided with two or more sets of wipers, the required set being connected up by the operation of one or more discriminating relays. The object of the invention is to provide for more satisfactory operation of such switches and for new trunking arrangements whereby their improved facilities may be used to better advantage.

According to one feature of the invention in an automatic switch provided with a plurality of sets of wipers determination of the set of wipers to be used is effected in accordance with the route over which the switch has been seized but only after the setting operation has commenced.

According to another feature of the invention in an automatic switch provided with a plurality of sets of wipers the determination of the set of wipers to be used is effected in the interdigital pause between two trains of impulses transmitted for setting the switch.

A further feature of the invention is that in a telephone system employing automatic switches with a plurality of sets of wipers wiper discrimination at the final selectors is effected in accordance with the route over which the switch is seized, all the possible routes extending from the same position of a preceding switch over the same set of wipers.

The invention will be better understood from the following description of one method of carrying it into effect, reference being had to the accompanying drawings. These comprise Figs. 1 and 2 which show a 200-line final selector arranged for ordinary operation and Figs. 3 and 4 which show a 200-line final selector adapted to perform a P. B. X. hunting operation on any level.

The mechanical construction of the switch to which the circuits apply is assumed to be similar to that described in the application of R. N. Saxby, Serial No. 634,265, filed 22nd September 1932, now Patent 2,028,689, granted Jan. 21, 1936, in which only two magnets are provided for a vertical and rotary type switch and release is brought about by the further operation of the rotary magnet which advances the wipers clear of the banks.

Referring now to Figs. 1 and 2, it will first be assumed that the switch is taken into use over the odd set of conductors negative 1, positive 1 and P1, in which case its operation does not involve the energization of the wiper switching

relay WS. When the speaking leads are looped, relay A operates and at armature a1 brings up relay B which guards the circuit by placing earth on the release trunk conductor at armature b1 and at armature b6 operates relay C. Upon the reception of the tens digit, relay A repeats the impulses through the low resistance left-hand winding of relay C to the vertical magnet VM which accordingly raises the wipers to the desired level.

On the first vertical step the off normal springs are mechanically operated thereby at springs N1 short circuiting the right-hand winding of relay C which however, remains held during impulsing over its other winding. It will be understood that the short-circuited winding of relay C acts as a copper slug and the relay is thus made slow releasing. Relay B is also held during impulsing by the assistance of the copper slug on its core.

At the end of the tens digit, relay A remains energized and relay C releases after a short interval and at armature c1 completes a circuit for operating relay E in series with the vertical magnet VM. Relay E at armature e1 transfers the impulsing circuit to the rotary magnet RM and at armature e2 removes the short circuit from relay C which thereupon re-operates and transfers the holding circuit for relay E to the control of its own armature e6. The units digit when received is similarly repeated by relay A through the low resistance winding of relay C to the rotary magnet RM which advances the wipers into engagement with the required subscriber's line.

On the first rotary step the rotary off normal springs are mechanically operated, thereby at springs NR1 short circuiting the left-hand winding of relay C which again holds during impulsing over its other winding.

At the end of the units digit, relay C releases and opens the circuit of relay E and during the slow release period of the latter a testing circuit is completed for relay H to the test wiper P1. If the line is free, relay H operates in series with the cut off relay of the called subscriber's line circuit and at the make-first armature h1 completes a locking circuit for itself. Moreover, at armature h2 direct earth is connected to the test wiper P1 to busy the called line and at armatures h5 and h6 the ringing circuit is prepared. Upon the release of relay E after its slow period a circuit is completed over armature e3 for operating relay J which thereupon locks over its armature j1 and at armatures j3 and j4 completes the ringing circuit including the generator GNR, the left-hand winding of relay F and the ringing re-

turn resistance YA. During the ringing period ringing tone is extended to the calling subscriber over a leak circuit provided by the low capacity condenser QD and through the lower winding of relay D to inform him that the call is proceeding. Meanwhile owing to the release of relay E, relay C has re-operated and at armature c1 prepares a circuit for re-operating relay E.

When the called subscriber replies, the direct current loop completed across the line causes the ring trip relay F to energize whereupon by operating its light armature f1 it locks up over its right-hand winding in series with relay H. Relay F cuts off the ringing current at armatures f2 and f3 and completes the talking circuit between the calling and called parties. Relay D now operates over the called subscriber's loop in series with the iron-hydrogen current limiting resistance BRA. This resistance has the property of limiting the current passing therethrough to a predetermined value and its purpose is to maintain a constant battery feed to the called side of the circuit over a wide range of loop resistances. Relay D at armatures d1 and d2 provides the usual supervision by reversing current to the calling side of the circuit and at armature d4 operates relay E which locks up at armature e6 and at armature e5 connects booster battery to the release trunk conductor to operate the calling subscriber's meter in the well-known manner. Relay E also at armature e3 releases relay J the release time of which determines the duration of application of the metering pulse after which earth is re-connected to the release trunk conductor at the resting springs of armature j2 to guard the circuit. Relay J upon releasing opens the circuit of relay E which also releases after its slow period without any material change to the circuit connections. Clearly if relay D initially operates intermittently due to clumsy removal of the receiver by the called party, relay E remains locked and there will be no false interruption of the metering pulse.

If the called subscriber is busy, relay H will not operate owing to the absence of battery on the test contact and upon the release of relay E a circuit is completed over armature e3 for operating relay G which at armature g1 connects busy flash and tone from the cam assembly BT to the lower winding of relay A and at armature g2 connects the busy hold cam assembly BH in circuit with the left-hand winding of relay B in order that this relay shall be held during the flash period when relay A releases.

At the end of the conversation when the calling party replaces his receiver, relay A releases and allows relays B, C, F and H to fall away whereupon earth on the release alarm common 10 provides a self-interrupted driving circuit for the rotary magnet RM to advance the wipers clear of the bank so that they restore to the home position where the circuit is opened by the off-normal springs N3. Relay B upon releasing, at armature b1 removes the guarding earth from the release trunk conductor to enable the preceding switches to restore but upon the release of relay C earth is re-applied to the release trunk conductor over armature c3 until the switch arrives at its home position where the earth is disconnected by the off-normal springs N2. Under all conditions of release it is arranged that relay B releases relay C in the manner described and therefore the unguard period on the release trunk conductor is determined by the releasing time of relay C which is substantially constant. It should

also be noted that seizure of the switch during the unguard period does not interfere with the release because the initial operating circuit of relay B is available only when the switch is in its normal position.

When the switch is taken into use over the even set of conductors negative 2, positive 2, and P2, the circuit operations are the same as described up to the end of the tens digit where relay E operates on the release of relay C. In these circumstances the operation of armature e4 removes a short-circuit from the left-hand winding of the wiper switching relay WS and enables it to operate in series with the line relay A. Relay WS locks over its other winding and armature ws1 and as soon as the rotary movement of the switch begins its operating winding is again short-circuited by the normal rotary springs NR3. This arrangement provides constant seizure time regardless of the route over which the switch is taken into use. Operation of the switch now proceeds as described with the exception that the lower set of wipers are connected up to enable selection to take place in the even hundred group of lines. It will be noted that with relay WS operated the conductor 11 extending to a common buzzer is connected to the test jack T1 so that if a link is inserted in the appropriate test jack springs the buzzer may be operated to indicate to an attendant when the lower set of wipers is in use. In the event of the test wiper P1 or P2 encountering booster battery from a line in the metering condition there is no danger of false switching since the windings of relay H are arranged to neutralize as soon as the make-first armature h1 closes and full operation of the relay is prevented.

The circuit including armatures d3 and j5 and lamp LP extends by way of common conductor 12 to an alarm and serves to indicate if the called subscriber is held unduly owing to the calling subscriber failing to hang up.

Referring now to the operation of the P. B. X. final selector switch shown in Figs. 3 and 4 it will be understood without further description that as regards the setting of the wipers and the selection of an ordinary line the operation of the circuit is the same as in Figs. 1 and 2.

When the wipers of the switch are set into engagement with the first line of a P. B. X. group, one or other of the group testing wipers P2 will encounter battery since the P2 contacts are wired as shown in the lower corner of Fig. 4. Consequently if relay H fails to operate owing to the first line being busy, relay HS operates over its upper winding to prepare the switch for automatic rotation and at armature hs4 switches one winding of relay G into the testing circuit of relay H. When relay E releases, relay C re-operates and at armature c3 in conjunction with armature hs2 completes a circuit for the rotary magnet RM which energizes to advance the wipers on to the next set of contacts. At the end of the magnet stroke the interrupter springs rm close and complete a circuit for energizing relay G over its lower winding so that this relay in turn at armature g5 opens the circuit for the rotary magnet RM. This interaction between the rotary magnet and relay G serves to rotate the wipers in search of a free line in the P. B. X. group. During hunting, relay HS is intermittently energized by armature g4 but remains held with the assistance of its copper slug and the shunting effect of the lower winding of relay H.

When a free line is found, relay H operates in

series with the called subscriber's cut-off relay and relay G which now holds to prevent further rotation of the wipers. Relay H then locks independently over its other winding and armature h1, and at armature h2 connects direct earth to the test wiper and bank contact to hold the called subscriber's cut-off relay and short circuits relay G. Relay G thereupon releases relay HS which at armature hs5 completes a circuit for operating relay J which thereupon applies ringing current to the selected line.

When the called subscriber replies, the ringing is tripped and a booster battery pulse is applied to the release trunk conductor in the manner described in connection with Figs. 1 and 2, to effect the operation of the calling subscriber's meter. The metal rectifier MRA is provided to prevent relay G from operating if the P1 wiper should pass over busy lines in the metering condition.

If all the lines in the group are busy, the group testing wiper P2 encounters earth on the last contact which holds relay G over its lower winding in series with resistance YC. Relay G opens the circuit of relay HS which releases after its slow period and extends the busy flash and tone signal to the calling subscriber.

In the event of the wipers of one switch passing over contacts engaged by the wipers of another switch which has just been directly set to an intermediate line, there is a possibility that the G relay of the hunting switch and the HS relay of the stationary switch will operate in series. To obviate this a high resistance YC is connected in circuit with the lower winding of relay G which definitely prevents relay HS from operating. Relay G however can operate but only during the comparatively short slow release period of relay E in the stationary switch, and accordingly there will be little or no interruption to the hunting movement of the first switch.

A switch of the kind above described is particularly suitable for inclusion in a system whereby switching stages not fully utilized are eliminated. Thus if the switch is seized from a 200-outlet group selector arranged to respond to a preliminary digit without an effective setting of its wipers, a 4000 line exchange can be provided with only two ranks of switches. The group selector would need to be of 800 points capacity with two sets of wipers each having access to 400 contacts and associated with a different group of final selectors. The preliminary digit would determine which set of wipers was to be used and hence which group of final selectors would handle the call and also which positive lead was to be used so as to determine wiper selection in the final selector. The preliminary digit might operate a relay counting chain or a small auxiliary rotary switch or the main switch might be given a preliminary vertical setting and then drop back in readiness for resetting by the subsequent digit.

Alternatively of course, the final selector according to the invention may be arranged for seizure from two different groups of group selectors or from different levels of the same group selector.

We claim:

1. In combination, an automatic switch having two sets of wipers, two routes over which said switch may be seized, means for directly operating said switch after seizure over either route, and means effective only after the switch has been operated for selecting one of said two sets of wipers in accordance with the route over which seizure of the switch has been effected.

2. In combination, an automatic switch having two sets of wipers, two routes over which connections may be extended to said switch, means in said switch responsive to primary and secondary control exercised over the particular route used in extending connection to the switch for effecting the setting thereof, and means in said switch controlled in accordance with the route in use and during a pause between the primary and secondary controlling operations for effecting wiper selection.

3. In combination, an automatic switch having two sets of wipers, wiper selecting means, two trunk conductors over which a plurality of series of impulses may be transmitted to said switch to set the same on a called line, said trunk conductors being used alternatively depending on which set of wipers has access to the called line, and means for controlling said selecting means during the spacing between two successive series of impulses and in accordance with the trunk conductor over which the impulses are being transmitted.

4. In combination, an automatic switch having two sets of wipers, a line relay in said switch, a circuit for said line relay including a talking conductor incoming to said switch, a wiper switching relay included in said circuit, said switching relay being normally short circuited, setting means in said switch controlled by said line relay responsive to impulses transmitted over said circuit, and means effective after impulses have been received for momentarily removing the short circuit from said switching relay to permit the same to energize in series with said line relay.

5. In a telephone system including a selector switch having a set of wipers which includes two wipers used alternatively, a connector switch having two sets of wipers, two routes over which said connector may be seized from said selector, both said routes extending from the same position of the said selector wiper set and the route used being determined by which of said alternative wipers is used, and wiper selecting means in said connector controlled in accordance with the route over which the connector is seized.

REGINALD TAYLOR.

GEORGE THOMAS BAKER.