

**Dec. 25, 1928.**

**1,696,267**

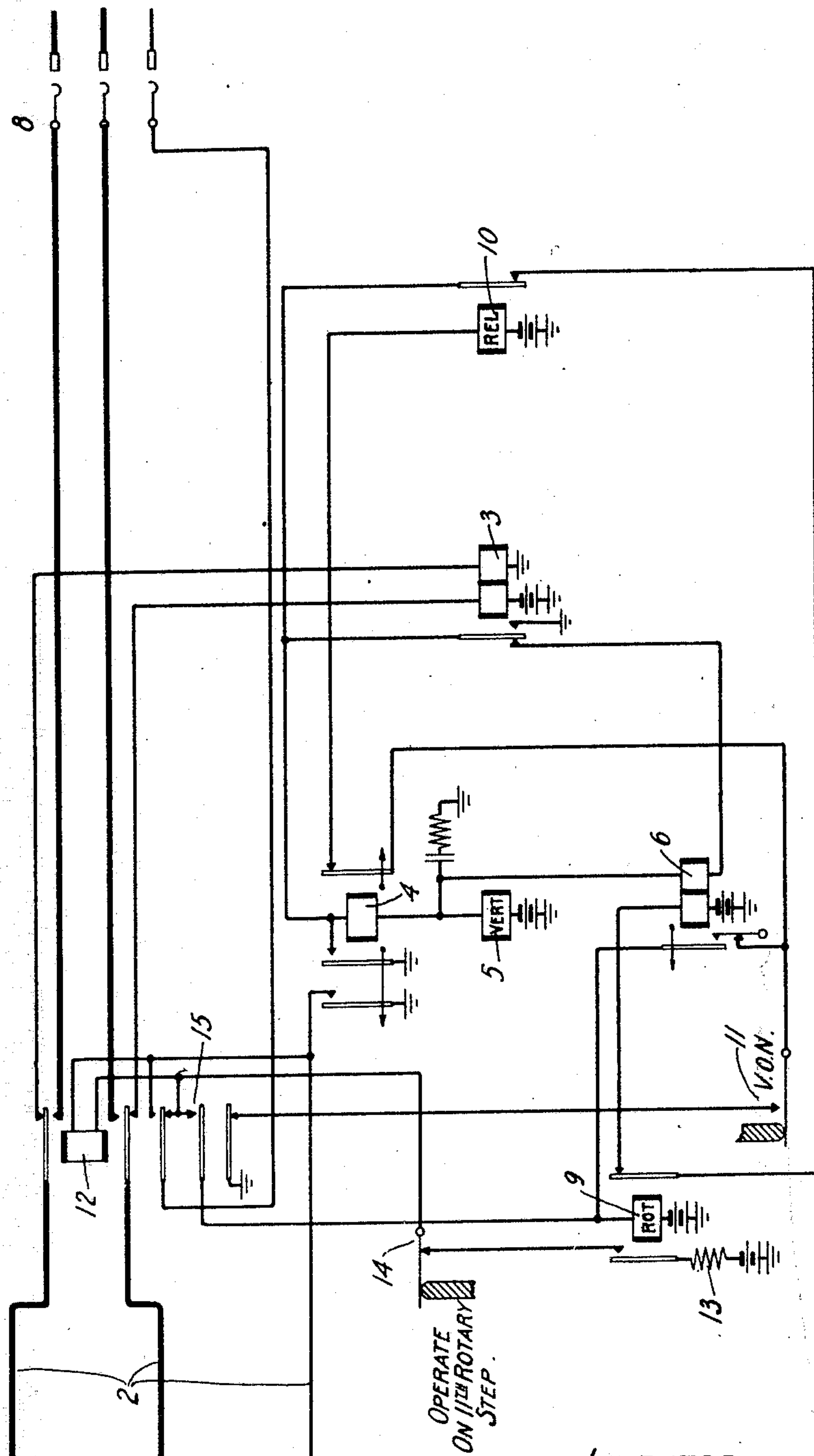
**B. G. DUNHAM**

## TELEPHONE SYSTEM

Filed June 13, 1927

2 Sheets-Sheet 1

FIG. 1.



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2 Sheets-Sheet 2

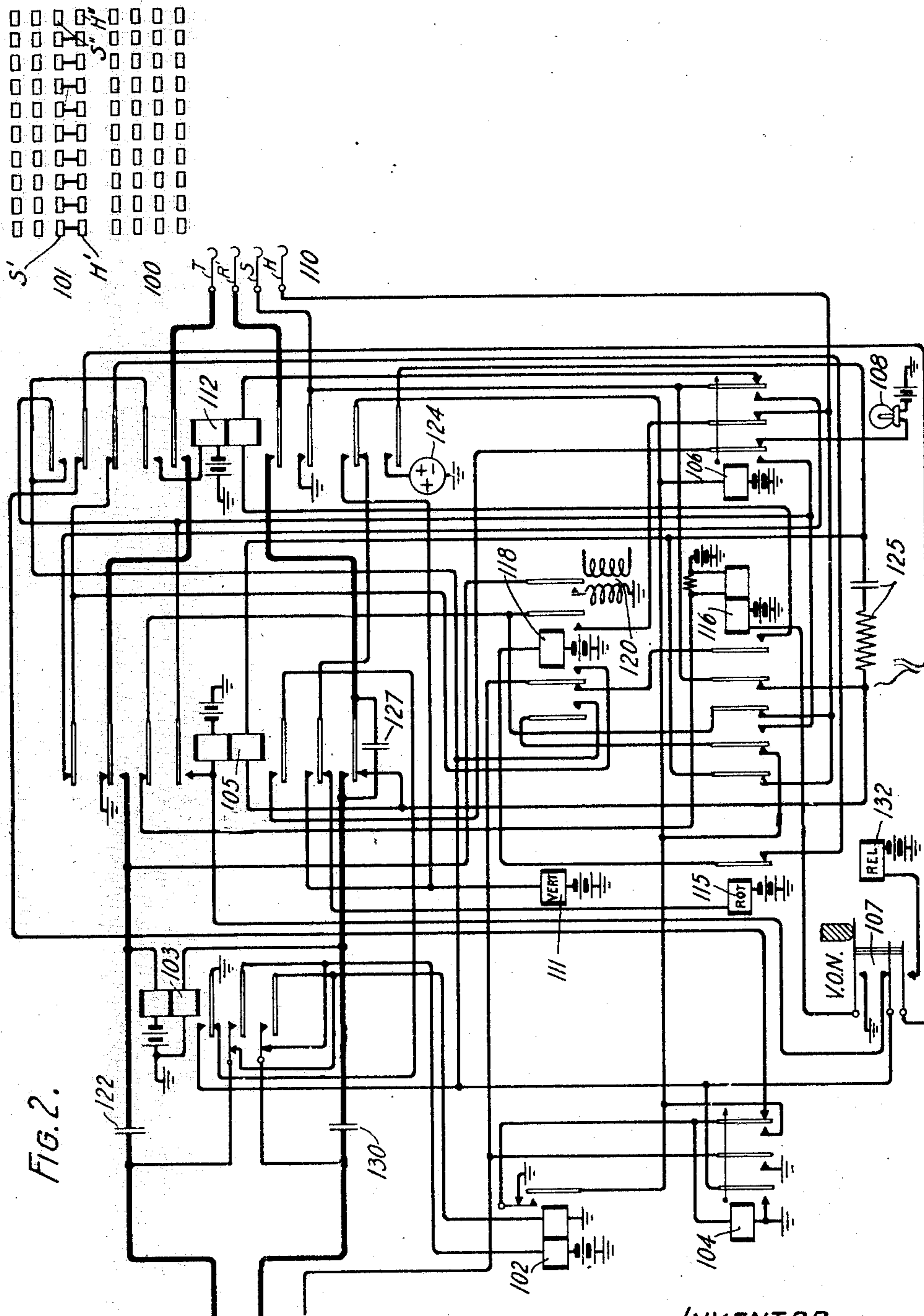


FIG. 2.

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## UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

Application filed June 13, 1927. Serial No. 198,487.

This invention relates to telephone systems and particularly to circuit arrangements for switches used in automatic telephone systems.

5 It is applicable to the circuits for selector and connector switches of any well-known step-by-step type.

10 A feature of this invention is an arrangement whereby a relay is fully operated during the vertical selective movement of the selector to prevent the rotary hunting movement from taking place and partially operated when the vertical movement ceases to provide a pulsing circuit for the rotary hunting movement.

15 Another feature of this invention is a connector circuit in which the usual ringing relay is also employed for actuating a so-called "permanent signal" the moment the connector is seized. This relay is also used to guide the selective impulses into the vertical magnet or into the rotary magnet as required. In case the connector is hunting for an idle private branch exchange trunk and all trunks in the group are busy this relay serves to stop the hunting action of the connector on the terminals of the last trunk in the group. The usual busy test relay of the connector is also employed in conjunction with the rotary magnet for producing the hunting movement of the connector.

25 This invention has been illustrated in the accompanying drawings in which Fig. 1 shows a selector circuit and Fig. 2 shows a connector circuit embodying the features of this invention.

30 Referring to the drawing, a description will be made of the extension of a connection through the selector and connector from a calling subscriber's line that may be associated through any well-known line finder circuit with the trunk conductors 2. This connection may be extended through the connector to subscribers' lines terminating in the group of terminals shown at 100 or to private branch exchange trunks terminating in the group of terminals shown at 101. It should be understood that any well known step-by-step selector and connector switches may be employed in connection with these circuits and no attempts have therefore been made to illustrate them, except in diagrammatic form.

55 If it is assumed that the calling subscriber's line has been extended to the conductors at 2 a connection will be completed through the calling subscriber's dialing loop to battery and ground through the windings of relay 3. Relay 3 will thereby operate to close a circuit for the operation of the slow to release relay 4 as follows: battery, winding of vertical magnet 5, winding of relay 4, armature and front contact of pulsing relay 3 to ground. The resistance characteristics of relay 4 and vertical magnet 5 are such that the vertical magnet will not operate in this circuit. Relay 4 in operating closes a locking circuit for itself, through its inner left-hand armature and front contact to ground with the battery supplied through the vertical magnet 5. This relay 4 in operating also connects the sleeve conductor from the line finder to ground at the outer left-hand armature to maintain the connection as is well-known in the art.

60 If now the calling subscriber actuates his dial to select a wanted subscriber's line, relay 3 will be alternately released and operated in accordance with the impulses of the first digit. The first release of the relay 3 closes a circuit for the operation of the vertical magnet 5. This circuit may be traced from battery through the winding of the vertical magnet, right-hand winding of relay 6, armature and back contact of pulsing relay 3, to ground at the inner left-hand armature and front contact of relay 4. The vertical magnet now takes the first step to advance the brushes 8 towards the desired group of connector terminals. Relay 6 also operates and as it is slow in releasing it will remain operated during the pulsing of relay 3. Relay 4 is also slow to release so that it will remain operated during the operation of the relay 3 in response to the dialing. It should be noted that this latter relay will actually be locked in operated position after the first operation of the pulsing relay even though the armature of the pulsing relay may not be connected to the ground at its inner contact during the pulsing. Relay 4 releases when the pulsing relay releases its armature to connect with the back contact and when this connection remains established for a long enough period to overcome the slow to release characteristics of relay 4. This condition will be established only when the pulsing relay re-



leases due to the operation of relay 12 as will hereinafter be described. Hence the maintaining of relay 4 operated during dialing does not depend on the repeated closure of a circuit through the armature and front contact of the pulsing relay as is the case in ordinary pulsing relay and slow to release relay circuit combinations. The advantage of this arrangement is that the pulsing relay need not become fully operated by the dialing pulses, a condition that may be due to unusual line attenuations which in ordinary cases would interfere with the proper functioning of the selector circuits.

The operation of the vertical magnet 5 in response to the dialing is due to short circuiting of the winding of relay 4 each time the pulsing relay is released. This circuit for operating the vertical magnet may be traced as follows: battery, winding of vertical magnet 5, winding of relay 6, armature and back contact of pulsing relay 3 to ground at the inner left-hand armature and front contact of relay 4. The repeated operation of the vertical magnet 5 advances the brushes 8 of the selector to the desired level where hunting for the terminals of an idle connector may begin through the operations of the rotary magnet 9.

To cause the switch to hunt for an idle connector, circuits will be closed for the rotary magnet on the partial release of relay 6 after the last impulse of the first digit has been received. At this time the circuit through the right-hand winding of relay 6 will be opened at the armature and back contact of relay 3. Besides being slow to release the operating characteristics of relay 6 are such that it will only partially release at this time due to the fact that a circuit is closed through its left-hand winding as follows: battery, left-hand winding of relay 6, right-hand armature and back contact of rotary magnet 9, armature and back contact of release magnet 10, inner left-hand armature and front contact of relay 4 to ground. With relay 6 in this condition a connection will be established through the armature and make-before-break contacts of this relay to close a circuit for the rotary magnet 9 as follows: battery, winding of rotary magnet 9, armature and make-before-break contacts of relay 6, the operated vertical off-normal contacts 11, lower outer armature and back contacts of relay 12 to ground. The rotary magnet in operating advances the brushes 8 to the terminals of the first connector of the group selected. The rotary magnet in operating also opens the energizing circuit for relay 6 at the right-hand armature and back contact. Relay 6 is thereby fully released to open the energizing circuit for the rotary magnet which is thereby released.

If the first connector is busy a ground connection will be encountered on the sleeve ter-

minal of this connector which will prevent relay 12 from operating. It will be noted that on the operation of the rotary magnet 9 an energizing circuit is closed for the operation of this relay 12 as follows: battery, resistance 13, left-hand armature and front contact of rotary magnet 9, 11th step rotary contacts 14, winding of relay 12, outer left-hand armature and front contact of relay 4 to ground. The winding of relay 12, however, is now short-circuited due to the ground from the sleeve terminal of the busy connector. This ground being connected through the sleeve brush of the selector brushes 8, the second left-hand lower armature and back contact of relay 12, contacts 14, armature and front contact of rotary magnet 9 resistance 13 to battery. As relay 12 is not operated the rotary magnet will again operate to advance the brushes 8 to the terminal of the next connector. When therefore the rotary magnet 9 releases, as hereinbefore described, the circuit through the left-hand winding of relay 6 is again closed. Relay 6 will operate sufficiently to establish a connection through its armature and make-before-break contacts for the original energizing circuit for rotary magnet 9, so that this magnet will now again be operated to advance the brushes 8 to the terminals of the next connector. These functions of the rotary magnet and relay 6 will continue until the brushes 8 have found the terminals of an idle connector. It will be seen from this description that the ground on idle sleeve need not be a direct ground but may be a ground through a resistance, as all it is required to do is to prevent relay 12 from operating. This arrangement is of advantage as the selector may be used with connector circuits having different ground characteristics on their sleeve terminals.

When an idle connector is found the above mentioned short-circuit to prevent relay 12 from operating will not be encountered as the sleeve of the idle connector has no ground connection. Relay 12 will therefore now operate through the above mentioned circuit which is completed from battery at the left-hand armature and front contact of rotary magnet 9 and the ground at the outer left-hand armature and front contact of relay 4. The arrangement of the armatures of relay 12 is such that the armature 15 closes with its front contact before connections are made through any of the other front contacts. Thus, a circuit will immediately be completed from battery through the winding of the rotary magnet 9, armature 15 and its corresponding front contact, winding of relay 12 to ground at the outer left-hand armature and front contact of relay 4.

This circuit will then produce, due to the removal of the ground connection through the sleeve, a momentary inductive kick or rise in the energizing current for relay 12 so that



this relay will now be quickly and fully energized to pull up the remaining armatures. In other words, relay 12 will be quickly energized after the brushes 8 land on the terminals of an idle connector. Relay 12 is held operated under control of relay 4, and the ground, through the outer left-hand armature and front contact of relay 4, will be extended through the second lower armature and front contact of relay 12 to the sleeve brush of the group 8 of the selector and the sleeve terminal of this idle connector to make it busy to other selectors.

The operation of relay 12 also opens the circuit from the calling subscriber's loop through the windings of relay 3 and extends this connection over the tip and ring conductors from the subscriber's loop through to the tip and ring conductors of the associated connector. A circuit will thereby be completed for the operation of relay 102 as follows: battery, left-hand winding of relay 102, lower outer make-before-break contacts of relay 103, ring conductor of the associated connector, its ring terminal, the ring brush of the group 8, the lower inner armature and front contact of relay 12, ring conductor through the calling subscriber's loop back to the tip conductor, the upper armature and front contact of relay 12, tip brush of the group 8, tip terminal of the associated connector, inner make-before-break contacts of relay 103, right-hand winding of relay 102 to ground. Relay 102 in operating closes a circuit for the operation of the slow to release relay 104 as follows: battery, winding of relay 106, armature and front contact of relay 102, winding of relay 104, to ground and also from battery, through the winding of rotary magnet 115, lower middle armature and back contact of relay 105, lower third armature and back contact of relay 112, armature and front contact of relay 102 and winding of relay 104 to ground. The operating characteristics of relay 106 and magnet 12 are such that they will not be actuated in this circuit. Relay 104 in operating closes a circuit to ground for the sleeve conductor to the sleeve terminal of this connector so that this ground connection will now extend over the sleeve terminal, the sleeve brush of the group 8, and the second lower armature and front contact of relay 12 to provide a substitute holding ground for the relay 12. This holding circuit is necessary as the original holding circuit controlled by relay 4 is broken soon after the operation of relay 12. That is, the operation of relay 12 causes the release of relay 3 and this relay in releasing closes a short-circuiting connection for relay 4 from battery, winding of vertical magnet 5, winding of relay 6, and armature and back contact of relay 3 to ground at the inner left-hand armature and front contact of relay 4. Relay 4 is thereby released to open this orig-

inal holding circuit for the rotary magnet 9 and relay 12, but the slow to release characteristic of relay 4 allows sufficient time for the new holding circuit to be closed before this original circuit is opened. The busy ground for the line finder will now therefore be supplied from the middle right-hand armature and front contact of relay 104 as it should be noted that the sleeve conductor from the line finder is connected to the second lower armature and front contact of relay 12 to this ground. This ground will of course also serve as a busy ground for the connector.

The operation of relay 104 as hereinbefore mentioned closes a circuit for the operation of relay 105 as follows: battery, upper winding of relay 105, middle normally made contacts of the vertical off-normal contacts 107, inner right-hand armature and front contact of relay 104 to ground. The connector circuit is now ready for the reception of impulses to actuate it to select a wanted subscriber's line. It should be noted that a circuit for lighting the permanent signal 108 is completed when relay 105 is actuated as follows: battery, signal 108, inner right hand armature and back contact of relay 106, inner lower armature and front contact of relay 105, inner lower armature and back contact of relay 103 to ground. This signal 108 is generally called a "permanent signal" and is located in a convenient place for inspection purposes. That is, if the calling subscriber abandons the call at this stage or does not dial within a certain period, this signal will indicate to an inspector the switch involved in this connection. If the subscriber dials within that period this signal will be extinguished at the proper time, namely when relay 106 is operated as will be described hereinafter. If the wanted subscriber's line terminates in contacts in bank 100 the brushes 110 will be advanced to this level by the vertical movement of the switch and then rotated by the rotary movement of the switch over this terminal bank until the terminals of the desired lines are found.

The pulsing relay 102 will be alternately released and operated in accordance with the second digit to cause the advance of the brushes to the bank 100. On the first release of relay 102 a circuit is closed for the operation of relay 106 and the vertical magnet 111. The circuit for the vertical magnet may be traced from battery through the winding of the vertical magnet, middle lower armature and front contact of relay 105, third lower armature and back contact of relay 112, outer right-hand armature and front contact of relay 104, make-before-break contacts of relay 102 to ground. The circuit for relay 106 may be traced from battery through the winding of this relay to the same ground at the make-before-break contacts of relay 102. Relays 104 and 106 are slow to release so that



they will remain operated during the pulsing, while the vertical magnet will respond to the pulses. The operation of relay 106 opens the circuit for signal 108 so that this signal will be extinguished when the dialing begins. It will be noted that on the first step of the brushes 110, the vertical off-normal contacts 107 will be opened and thus cause the original energizing circuit for relay 105 to be opened. A locking circuit for relay 105 is, however, provided through contacts of relay 106 over a circuit as follows: battery, upper winding of relay 105, upper inner armature and front contact of this relay, inner right-hand armature and front contact of relay 106, lower inner armature and front contact of relay 105, lower inner armature and back contact of relay 103 to ground. When the bank 100 has been reached the vertical magnet 111 and relay 106 will release, and the release of 106 releases relay 105.

A circuit is now completed for the rotary magnet 115 on the first impulse of the last digit as follows: battery, winding and rotary magnet 115, lower middle armature and back contact of relay 105, third lower armature and back contact of relay 112, outer right-hand armature and front contact of relay 104, make-before-break contacts of relay 102 to ground. The hereinbefore traced circuit for relay 106 is also completed at this time. The rotary magnet will now respond to the impulses of the last digit and advance brushes 110 to the terminals of the desired line. It should be noted that when the vertical off-normal contacts 107 were operated an obvious circuit was completed through the left-hand winding of relay 116 so that this relay is operated at this time for a purpose as will hereinafter be described.

If the desired line is busy a connection to ground will be made through the brush S from the corresponding brush of the connector engaging the corresponding terminal of this busy line. This closes a circuit for the operation of relay 118 and this circuit will be closed before relay 106 has time to release after the last rotary impulse is received. This circuit may be traced as follows: battery, winding of relay 118, armature and back contact of the rotary magnet 115, third upper armature and back contact of relay 112, upper outer armature and back contact of relay 105, outer right-hand armature and front contact of relay 106, to ground on the S brush. Relay 118 is locked in operated position over the following circuit: battery, winding of relay 118, armature and back contact of rotary magnet 115, third upper armature and back contact of relay 112, inner left-hand armature and front contact of relay 118, middle right-hand armature and front contact of relay 104 to ground. When relay 106 is released the connection from ground on the S brush is opened at the outer right-hand ar-

mature and front contact of this relay so that when the connector releases as will hereinafter be described, there will be no connections through any relay from the brush S and consequently the circuits of this connector cannot be disturbed from grounds on the corresponding terminals of other busy lines as the brush S of this connector in returning to normal passes over these busy terminals. The operation of relay 118 provides a busy tone for the calling subscriber, the circuit for which may be traced as follows: from ground through the left-hand winding of the repeating coil 120, the right-hand winding of which is connected to a suitable ringing source, through the outer right-hand armature and front contact of relay 118, tip conductor of the connector, through the condenser 122 to the tip conductor over the selector of Fig. 1 to the calling subscriber's line.

If the desired line is not busy relay 106 releases and relay 118 will not operate. Relay 112, however, will be operated over a circuit as follows: battery, winding of the usual cut-off relay (not shown) of the wanted subscriber's line, through the sleeve terminal of this line, sleeve brush S, outer right-hand armature and back contact of relay 106, lower winding of relay 112, inner left-hand armature and front contact of relay 116, inner left-hand armature and back contact of relay 118, middle right-hand armature and front contact of relay 104 to ground. Relay 112 in operating provides a locking circuit for itself as follows: battery, upper winding of relay 112, second upper armature and front contact of relay 112, inner right-hand armature and front contact of relay 104 to ground. The operation of relay 112 provides a direct ground connection at its second lower armature and front contact for the brush S to operate the cut-off relay to disconnect battery and ground from the tip and ring conductors of the associated subscriber's line as is well-known in the art. Relay 112 also causes ringing current to be transmitted from source 124 to call the wanted subscriber. This circuit may be traced as follows: ringing source 124, lower outer armature and front contact of relay 112, condenser and resistance 125, lower outer armature and back contact of relay 105, lower inner armature and front contact of relay 112, ring brush R through the ring conductor of the wanted subscriber's line and the loop through his bell back through the tip conductor, tip brush T, upper inner armature and front contact of relay 112, third upper armature and back contact of relay 105 to ground. It should be noted that the circuit from source 124 also extends through the lower winding of relay 105 in parallel with a condenser and resistance 125. When the called subscriber answers the call by removing his receiver from the hook the tripping direct current battery which is supplied dur-



ing the silent periods at the ringing source 124 will find a path through the lower winding of relay 105 and the subscriber's loop to ground so that relay 105 will now operate to trip the ringing. That is, the operation of this relay 105 opens the connection for the above mentioned circuit at the lower outer armature and back contact, and the third upper armature and back contact of this relay. It should be noted that the ringing signal is transmitted through the condenser 127 over the ring conductor to the calling subscriber's line, so that he will hear the calling of the wanted subscriber. Relay 105 in operating provides a locking circuit for itself from battery through its upper winding, upper inner armature and front contact, upper outer armature and front contact of relay 112, to ground at the inner right-hand armature and front contact of relay 104.

The operation of relay 105 also extends the connection from the tip and ring conductors from the called subscriber's loop at the third upper armature and front contact, and lower outer armature and front contact to battery and ground through the windings of relay 103. This connection is also extended through the condensers 122 and 130 so that a talking connection will now be completed to the calling subscriber, the battery for the called subscriber being furnished from the battery and ground through the windings of relay 103. Relay 103 operates in this circuit from the called subscriber to reverse the battery and ground connections through the windings of relay 102 and the third and fourth lower armatures and front contacts of relay 103 for calling subscriber supervision. This battery and ground through the windings of relay 102 furnishes the talking battery for the calling subscriber. The locking circuits for relays 105 and 112 are now controlled from the ground at the inner lower armature and front contact of relay 103 so that in case the calling subscriber operates his dial to interrupt the circuit for relay 102 it will have no effect on the established connection.

If the wanted subscriber is a private branch exchange subscriber the brushes 110 of the connector will advance to the terminal bank 101 to hunt for an idle trunk leading to the desired private branch exchange in the manner hereinbefore described in connection with the relation of a wanted subscriber's line terminating in bank 100. That is, brushes 110 will be advanced to bank 101 and connected with the terminals of the first trunk in this bank. It will be noted that each pair of terminals such as S' and H' of the trunks in the bank 101 are connected together except the corresponding terminals S'' and H'' for the last trunk. If the first private branch exchange trunk is busy a ground connection will be established to the

terminals S' and H' of this trunk, and a circuit for relay 118 established as hereinbefore described except that the ground will be supplied from terminal S'. Relay 118 in operating provides a locking circuit for itself as hereinbefore described to the ground at the middle right-hand armature and front contact of relay 104. A circuit is also established for the release of relay 116 as follows: from battery, right-hand winding of relay 116, second upper armature and back contact of relay 105, inner right-hand armature and front contact of relay 118, second right-hand armature and back contact of relay 106, through brush H, and terminal H' to the ground supplied through terminal S'. As relay 116 is polarized this circuit causes this relay 116 to release even though the circuit through the left-hand winding of this relay is still intact and tends to keep the relay operated. A circuit is thereby completed for the operation of the rotary magnet 115 as follows: battery, winding of rotary magnet 115, middle lower armature and back contact of relay 105, third lower armature and back contact of relay 112, fourth left-hand armature and back contact of relay 116, outer left-hand armature and front contact of relay 118, inner right-hand armature and front contact of relay 104. Relay 106 also operates at this time. The operation of the rotary magnet 115 advances brushes 110 to the terminals of the next private branch exchange trunk. Rotary magnet in operating opens the circuit for relay 118 and this relay in turn opens the circuit for rotary magnet so that the connector will now rest with its brushes on the terminals of the second trunk.

If the second trunk is busy relay 118 will again operate as soon as rotary magnet 115 is released and relay 116 is held released through its third left-hand armature and back contact. The rotary magnet will therefore continue to operate until an idle trunk is found. When an idle trunk is found relay 118 will not operate and relay 116 will operate, consequently the rotary magnet circuit can not again be closed. Due to this condition a circuit will be closed for relay 112 as follows: battery, through the winding of the usual cut-off relay (not shown) of the idle private branch exchange trunk through the brush S, outer right-hand armature and back contact of relay 106, lower winding of relay 112, inner left-hand armature and front contact of relay 116, inner left-hand armature and back contact of relay 118, middle right-hand armature and front contact of relay 104 to ground. Relay 112 in operating causes ringing current from the source 124 to be transmitted over the selected private branch exchange trunk as hereinbefore described and when the operator at the private branch exchange answers the call the



loop circuit through her cord circuit causes the tripping relay 105 to be operated to disconnect the ringing and extend the connection to the calling subscriber as hereinbefore described.

If all of the trunks connected to the terminals in group 101 are busy the rotary magnet will operate as hereinbefore described to step the brushes 110 from the terminals of one trunk to another until the terminals of the last trunk are reached. The terminals S'' and H'' of this trunk are not connected together. In this case, however, relay 116 will be maintained released even though there is no ground on the terminal H'' of this trunk. It will be noted that a circuit under these circumstances will be completed not only for maintaining relay 116 released but also to energize relay 105. This circuit may be traced as follows: battery, right-hand winding of relay 116, second upper armature and back contact of relay 105, third left-hand armature and back contact of relay 116, outer left-hand armature and back contact of relay 116, lower winding of relay 105, second left-hand armature and back contact of relay 116, brush S to ground on terminal S''. Relay 118 will also be operated through the ground on the S'' terminal as hereinbefore described to send a busy tone to the calling subscriber. Rotary magnet 115 is thus prevented from operating at this time due to the operation of relay 105, as its circuit is broken at the middle lower armature and back contact of this relay. Immediately upon the operation of relay 105 relay 116 is permitted to operate as the original circuit for relays 105 and 116 as traced above is opened due to the operation of relay 105, but relay 105 is maintained operated over a locking circuit closed on the operation of relay 116 as follows: battery, upper winding of relay 105, upper inner armature and front contact of this relay, fourth left-hand armature and front contact of relay 116, outer left-hand armature and front contact of relay 118, inner right-hand armature and front contact of relay 104 to ground. Hence the ringing trip relay 105 is also involved in the stopping of the hunting movement of the rotary magnet 115 when all of the private branch exchange trunks are busy and the last trunk is reached.

If a connection has been established to a subscriber through terminals in either of the groups 100 and 101 and the conversation between the calling subscriber and the called subscriber is finished, the connection through the connector and selector may be released by the called subscriber hanging up his receiver on the hook. Relay 103 will thereby be released to reverse battery and ground through the windings of relay 102 to release the connection to the calling subscriber. When this connection is released relays 102 and 104 are released. The release of relay 104 causes the

release of relays 112 and 105 to return the circuit of the connector to normal condition. That is, a circuit is completed for the release magnet 132 as follows: battery, winding of release magnet 132, lower closed contacts of the vertical off-normal contacts 107, fourth upper armature and back contact of relay 112, outer right-hand armature and back contact of relay 104, make-before-break contacts of relay 102, to ground. When the connector has returned to normal, the vertical off-normal contacts 107 will be restored to normal and thus open the circuit for relay 116. The release of relay 104 removes the ground from the sleeve brush of the selector in Fig. 1, so that relay 12 will now release, to complete the connection for the release magnet 10 as follows: battery, winding of release magnet 10, right-hand armature and back contact of relay 4, vertical off-normal contacts 11, lower outer armature and back contact of relay 12 to ground. The operation of release magnet 10 restores the selector to normal condition.

Although the various features of the invention have been illustrated as applied to one type of selector and connector circuits, it is evident that the invention may be applied in many other circuit arrangements without departing from the spirit thereof, and that the invention should only be limited by the scope of the appended claims.

What is claimed is:

1. In a telephone system, a two movement switch, circuits therefor, and a relay in said circuits operated in one manner during the first movement of the switch and operated in another manner during the second movement of the switch to control said second movement.

2. In a telephone system, a switch having a selectively controlled movement and a hunting movement, circuits therefor, and a relay fully operated during the selective movement of the switch and partially operated when said selective movement ceases for controlling the hunting movement of the switch.

3. In a telephone system, a switch, a subscriber's line, a relay, a signal, means for operating said relay to actuate said signal in response to the seizure of said switch, a ringing current source, means for operating said switch to seize said line, means for releasing said relay for disabling said signal and for applying ringing current from said source to said line, and means responsive when the subscriber of said line answers the call for operating said relay to disconnect the ringing source from the line.

4. In a telephone system, a switch capable of two directive movements, a magnet for directing said switch in one of its movements, a second magnet for directing said switch in its other movement, a relay, means responsive to the seizure of said switch for operating said relay to disable said second magnet and pre-



pare said first magnet for its directive operation, and means responsive after the first directing movement of said switch ceases to release said relay to disable the first magnet  
5 and prepare the second magnet for its directive operation.

5. In a telephone system, a switch, a group of trunks terminating in said switch, means for hunting for an idle trunk in said group,  
10 a source of ringing current, means for stopping the hunting movement of the switch when an idle trunk is found and for transmitting ringing current from said source to said trunk, a relay operated in response to  
15 the seizure of the selected trunk at the distant end for removing the ringing current from said trunk, and means for operating said relay to stop the trunk hunting movement of the switch on the terminals of the last  
20 trunk of the group, if all of said trunks are busy.

6. In a telephone system, an incoming line, a switch connected thereto, lines accessible by said switch, means for actuating said  
25 switch to select a line or a group of lines, a source of busy tone, a relay actuated when the line selected is busy for transmitting a tone from said source to the incoming line, means including the said relay for hunting  
30 for an idle line in a selected group of lines, and means for actuating said relay if all of

the lines in the selected group are busy for transmitting a busy tone from said source to said incoming line.

7. In a telephone system, a two-movement 35 switch, a pulsing relay to control the first movement of the switch, a slow to release relay actuated in response to the operation of the pulsing relay, means for locking said relay during the two movements of the 40 switch, and another relay actuated in one manner during the first movement of the switch and in another manner to control the second movement of the switch.

8. In a telephone system, a selector switch, 45 a pulsing relay, a vertical movement magnet, a rotary movement magnet, a slow to release relay actuated when the pulsing relay is operated, means for locking said relay in actuated position, during and after pulsing, an- 50 other relay, means for actuating said vertical magnet in accordance with the operation of the pulsing relay and for fully operating said last mentioned relay during pulsing, and means responsive at the ceasing of the puls- 55 ing for partially operating said last mentioned relay to provide a pulsing circuit for the rotary magnet.

In witness whereof, I hereunto subscribe my name this 10th day of June, A. D. 1927.

BERT G. DUNHAM.