

May 1, 1928.

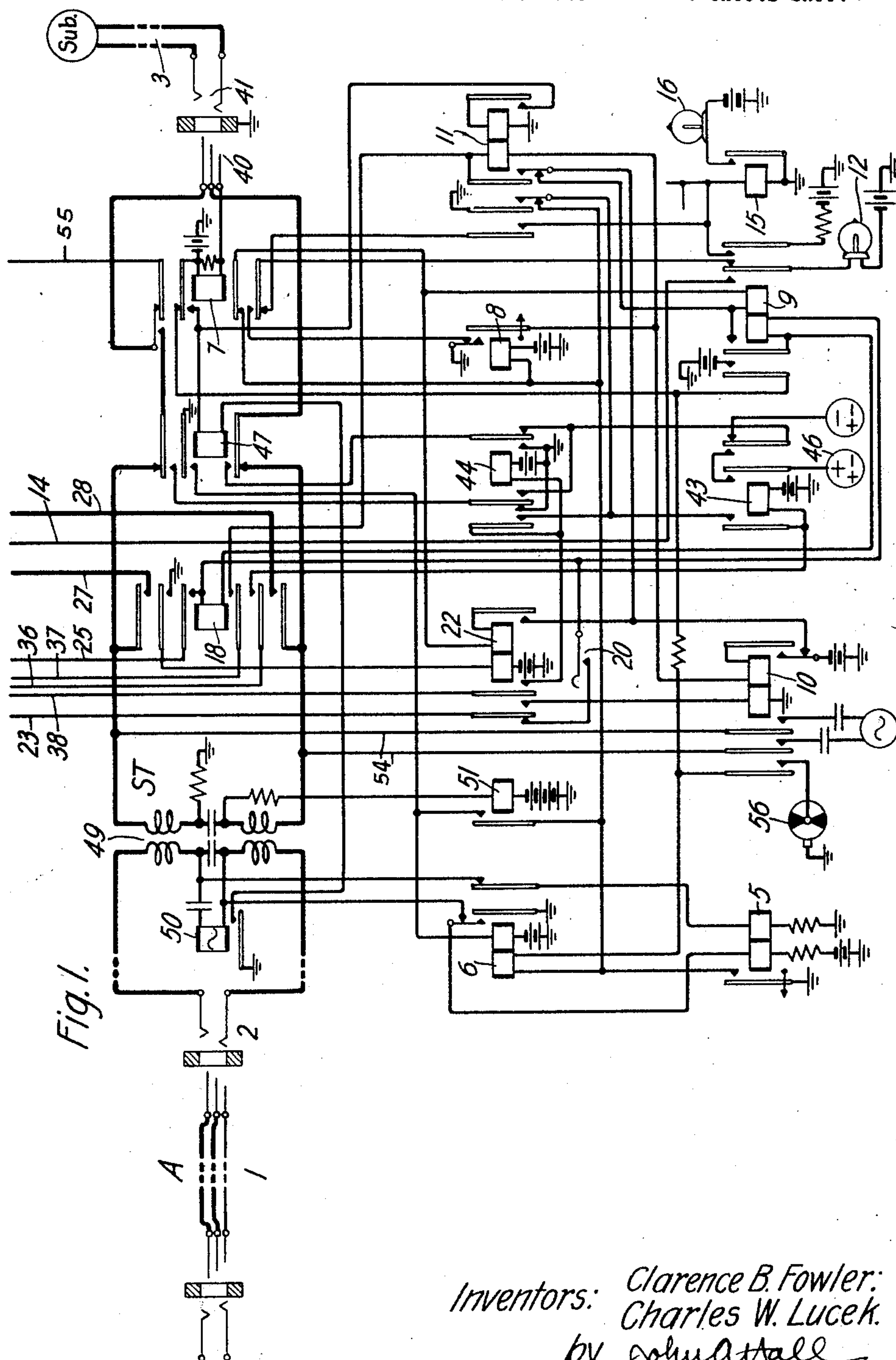
C. B. FOWLER ET AL

1,667,845

TELEPHONE SYSTEM

Filed Dec. 23, 1926

2 Sheets-Sheet 1



Inventors: Clarence B. Fowler:  
Charles W. Lucek.  
by John Hall  
Attorney.



May 1, 1928.

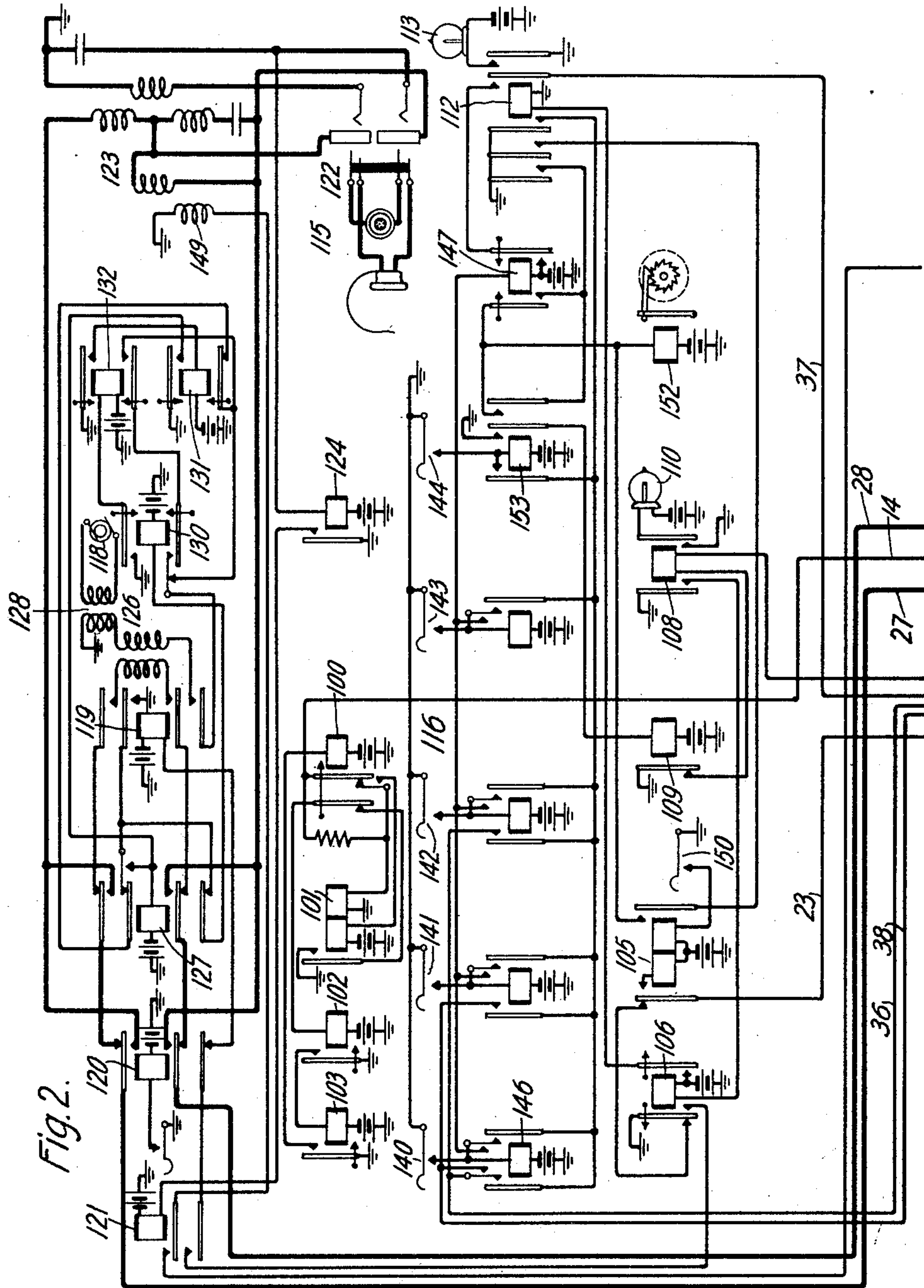
1,667,845

C. B. FOWLER ET AL

TELEPHONE SYSTEM

Filed Dec. 23, 1926

2 Sheets-Sheet 2



Inventors: Clarence B. Fowler:  
Charles W. Lucek.  
by *John A. Attall*  
Attorney.



Patented May 1, 1928.

1,667,845

# UNITED STATES PATENT OFFICE.

CLARENCE B. FOWLER, OF QUEENS VILLAGE, AND CHARLES W. LUCEK, OF ASTORIA,  
NEW YORK, ASSIGNORS TO BELL TELEPHONE LABORATORIES, INCORPORATED,  
OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## TELEPHONE SYSTEM.

Application filed December 23, 1926. Serial No. 156,574.

This invention relates to telephone systems and more particularly to straightforward trunking systems.

According to the invention a straightforward trunking system, in which a common control equipment is employed for the use of a plurality of trunks, is provided with means whereby busy back signals may be transmitted to the calling end of a trunk after the common control equipment has been associated therewith, the arrangement being such that the transmission of the busy back signals is effected by the operation of a key common to said plurality of trunks.

Another feature of the invention is an arrangement whereby the busy back signal transmitting means also functions when actuated to disconnect the common control equipment from the trunk with which it has been associated and whereby said busy back signal continues until said trunk is disconnected at its calling end from the connection thereat to a calling subscriber's line.

This invention may be applied to a straightforward trunking system of the kind described in the copending application of Horace W. Ulrich, Serial No. 156,570, filed Dec. 23, 1926, or a similar system described in the copending application of Harold Cahill, Serial No. 151,631, filed Nov. 30, 1926. In these two systems means is provided whereby a ringing key equipment common to a plurality of trunks is adapted to be associated with the incoming end of any one of said trunks. This means operates if a trunk has been seized at its outgoing end and a key individual to this trunk has been actuated.

This invention has been illustrated in the accompanying drawings in which Fig. 1 shows a straightforward trunk of the toll switching trunk type. This trunk is shown terminating in a jack at a toll operator's position where a toll operator's cord is shown for completing a connection between this toll switching trunk and another trunk shown leading to a distant office where it may be extended to a calling subscriber. This straightforward trunk is shown terminating in a plug at a B operator's position and a called subscriber's line has been shown in diagrammatic form. Fig. 2 shows a common ringing key equipment and an associated B operator's telephone set which equipment may be associated with any one

of a group of trunks to which the straightforward trunk shown in Fig. 1 belongs.

Referring now to the drawings, if it is assumed that a toll operator at A has inserted a calling plug of cord 1 in jack 2 of trunk ST, the following description will relate to the association of the common ringing key equipment shown in Fig. 2 to this trunk and to the manipulation of the ringing keys in this circuit to prepare the usual ringing equipment associated with the trunk ST for the transmission of ringing signals to a wanted subscriber's line, such as 3. This description will be followed by a description of the invention as applied to this circuit, that is, how a busy signal may be transmitted back to the toll operator's cord 1 and how the peg count meter may be actuated.

As trunk ST is seized it is well known in the art how a loop circuit is established through cord 1 for the operation of relay 5. Relay 5 when operated closes a circuit for the operation of relay 6 as follows: Battery, upper inner armature and back contact of relay 7, left hand winding of relay 6, armature and front contact of relay 5 to ground. Relay 5 in operating also closes a circuit for the operation of relays 8 and 9. The circuit for the operation of relay 9 is as follows: Battery, make-before-break contact of busy back relay 10, inner left hand make-before-break contact of relay 11, right hand winding of relay 9, lower inner armature and back contact of relay 7, armature and front contact of relay 5 to ground.

Relay 9 in operating closes a circuit for the flashing of the guard lamp 12 as follows: Battery, lamp 12, inner right hand armature and front contact of relay 9, conductor 14, inner left-hand armature and back contact of relay 100, right-hand winding of relay 101 to ground. This circuit causes the lighting of lamp 12 and operation of relay 101. Relay 101 in operating closes an obvious circuit for the operation of the slow-to-operate relay 102. This relay in turn closes an obvious circuit for the slow-to-operate relay 103. Relay 103 in operating closes an obvious circuit for the operation of slow-to-operate relay 100 which in operating inserts a resistance in the circuit for lamp 12 and at the same time places a shunt comprising the left hand winding of relay



101 about the said resistance and lamp 12 whereby lamp 12 is now extinguished. On the operation of this relay 100, the circuit through the right-hand winding of relay 101 is extended through the make-before-break contacts of relay 100 and the left-hand winding of relay 101 to battery. This relay is therefore maintained operated. On the operation of relay 100, the circuit for relay 102 is opened at the outer left-hand armature and back contact of this relay and relay 102 in releasing causes the release of relay 103 and relay 103 releases relay 100. On the release of relay 100 the original circuit for lamp 12 is reestablished so that this lamp is again lighted and the operation and release of relays 100, 102 and 103 are repeated in this manner so as to alternately light and extinguish lamp 12. The flashing of lamp 12 indicates to the B operator in charge of trunk ST that a connection over this trunk is desired.

The operation of relay 9 also closes at its outer right-hand armature and front contact a circuit for the operation of the pilot relay 15 and this relay in operating lights pilot lamp 16. Another circuit is also partially prepared by the operation of relay 9 for the subsequent operation of relay 18 as will hereinafter be described.

The B operator now depresses key 20 to associate the common ringing key equipment and her telephone set with this trunk. The operation of key 20 closes the circuit previously prepared by the operation of relay 9 for the operation of relay 18 as follows: Battery, make-before-break contacts of relay 10, inner left-hand make-before-break contacts of relay 11, left-hand inner armature and front contact of relay 9, winding of relay 18 and left-hand winding of relay 9 in parallel therewith, key 20, left-hand outer armature and back contact of relay 22, lead 23, left hand armature and back contact of relay 105, left-hand armature and back contact of relay 106 to ground. The operation of relay 18 causes an obvious circuit to be closed for the operation of relay 22. This relay in operating provides a locking circuit for itself as follows: Battery, make-before-break contacts of relay 10, right-hand armature and front contact and right-hand winding of relay 22, lower inner armature and break contact of relay 7, ground at the armature and front contact of relay 5. The operation of relay 22 opens the original energizing circuit for relay 18 through key 20. The operation of relay 22 also causes other connections to be made, the purpose of which will become apparent as the description proceeds. Relay 18 in operating provides a locking circuit for itself independent of the circuit through key 20 over its upper inner armature and front contact through lead 25, winding of relay

108, armature and back contact of relay 109 to ground. Relay 108 operates in this circuit and lights lamp 110 which indicates that this common ringing key equipment will be used by the B operator. For a more complete description of the specific purpose of lamp 110, reference may be had to the copending application of Horace W. Ulrich, mentioned above. The operation of relay 108 causes an obvious circuit to be closed for the operation of relay 106 and relay 106 in operating closes a circuit for the operation of relay 112. Relay 112 in operating closes a circuit for the lighting of lamp 113 which lamp now indicates to the B operator that her telephone set 115 and the common ringing key equipment generally indicated by the numeral 116 have been connected to a trunk such as ST.

It will be noted that the operation of relay 106 removes the ground at its left-hand armature and back contact to lead 23 for the original energizing circuit of relay 18 and as this lead 23 is common to all trunks in the group of which trunk ST is one, the common ringing key equipment and the operator's telephone set cannot be associated with any other trunk in this group as long as relay 18 of trunk ST is operated, that is, only one trunk at a time can be associated with this common equipment.

It will now be described in more detail how the "B" operator's telephone set 115 and the ringing key equipment are connected to the trunk ST and how a signal is transmitted to the toll operator's cord 1 at A to indicate that the B operator is now ready to receive the information relating to the extension of a call.

This signal consists of two successive applications of tone current from a source 118. Upon the operation of relay 106 the circuit is closed for the operation of relay 119 as follows: Battery, winding of relay 119, lower outer armature and back contact of relay 120, lower outer armature and front contact of relay 121, left-hand armature and front contact of relay 106 to ground. It is noted that this circuit is traced through the lower outer armature and front contact of relay 121. It is evident that by examining the circuits that this relay is operated as soon as the operator's telephone set 115 is connected to jacks and plugs 122 to the repeating coil 123. That is, when this connection is made a circuit is completed for the operation of relay 124 through the operator's transmitter. The operation of relay 124 closes an obvious circuit for the operation of relay 121. Hence these two relays remain operated as long as the operator's telephone set is connected at this point. The relay 119 in operating connects the secondary winding of repeating coil 126 to the tip and ring leads now connected through the



operation of relay 18 to the conductors of trunk ST. This circuit may be traced from the tip and ring conductors of trunk ST through the upper outer and lower outer armatures and front contacts of relay 18, tip and ring conductors 27 and 28, upper outer and lower inner armatures and back contacts of relays 120 and 127, upper outer and lower inner armatures and front contacts of relay 119 to the secondary winding of repeating coil 126. The primary winding of this repeating coil is connected by the operation of relay 119 as follows: Ground, secondary winding of repeating coil 128, primary winding of repeating coil 126, lower outer armature and front contact of relay 119, make-before-break contacts of relay 130, lower armature and back contact of relay 131, upper inner armature and back contact of relay 127 to ground at the inner upper armature and front contact of relay 119. The secondary winding of repeating coil 128 is associated with the tone source 118 so that an impulse of tone current is now transmitted from this source through trunk ST to the toll operator's telephone set connected to cord 1. The operation of relay 119 also closes an obvious circuit for slow-to-operate relay 130. When this relay operates it opens the circuit for the primary winding of repeating coil 128 and secondary winding of repeating coil 126 so that the impulse of tone current applied through these windings to the trunk ST is cut off. The operation of relay 130 also closes an obvious circuit for the operation of slow-to-operate relay 132. Relay 132 in operating again closes a circuit for the coupling between the tone source 118 and the secondary winding of repeating coil 126 by closing a circuit that now extends through the lower armature and front contact of relay 130, the lower armature and front contact of relay 132 through the lower armature and back contact of relay 131. Hence a second application of tone current from source 118 is now effected. Relay 132 also closes an obvious circuit for the operation of the slow-to-operate relay 131. On the operation of relay 131, the circuit for the secondary winding of repeating coil 128 and the primary winding of repeating coil 126 is again opened, this time at the lower armature and back contact of relay 131. Consequently, the second impulse of tone current is thereby removed from the trunk.

The operation of relay 131 closes an obvious circuit for the operation of relay 127 and this relay in operating closes a locking circuit for itself to ground at the upper inner armature and front contact of relay 119. Relay 127 operated opens the connection from the secondary winding of repeating coil 126 to the tip and ring contacts of the trunk and also the circuit through the secondary winding of repeating coil 128 and

primary winding of repeating coil 126. As long as relay 119 is operated no further application of tone current will therefore be made during the connection of the circuits shown in Fig. 2 to the trunk ST. On the operation of relay 127 the operator's telephone set 115 is connected through the repeating coil 123 to the tip and ring conductors of trunk ST at the upper outer and inner lower armatures and front contacts of relay 127.

The operation of relay 18 connects certain other leads between the common ringing equipment and the trunk ST such as leads 36 and 37 and the operation of relay 22, as hereinbefore mentioned, connects lead 38. These three leads are for the purpose of controlling the ringing equipment associated with the trunk through the manipulation of the ringing keys 116.

As the B operator's telephone set is now connected to the trunk and the toll operator at A has received a signal to this effect, this latter operator will pass the information relative to the extension of a connection by the B operator. When this information is received, the B operator will operate the corresponding key in the ringing key equipment. If the party wanted is one on a party line, one of the keys 140, 141, 142 or 143 is operated whereas if the wanted subscriber is on a private line, key 144 is operated. If it is decided to ring party M, key 140 is depressed to prepare the ringing equipment associated with the trunk ST for the sending of the proper signal when slug 40 of trunk ST is inserted in jack 41 of the party line 3. When key 140 is depressed relay 146 is actuated over an obvious circuit. This relay in operating prepares a locking circuit for itself through its right-hand armature and front contact to ground at the inner left-hand armature and front contact of relay 112. On the operation of relay 146 circuits are completed for the operation of relays 43 and 44. The circuit for relay 43 may be traced as follows: Battery, winding of relay 43, lower middle armature and front contact of relay 18, lead 36, left-hand armature and front contact of relay 146 to ground at relay 112, while the circuit for relay 44 extends from battery through the winding of relay 44, left-hand inner armature and front contact of relay 22, conductor 38, left-hand armature and front contact of relay 146 to ground at relay 112. Relays 43 and 44 prepare obvious locking circuits for themselves to ground that will be supplied at the left-hand middle armature and front contact of relay 11, when this latter relay operates as hereinafter described. The operation of relays 43 and 44 causes the current from the ringing source 46 to be connected for application to the tip conductor of trunk ST. The circuit in this instance may be traced as



follows: Ringing source 46, right-hand inner armature and right-hand outer armature and front contacts of relay 43, left-hand inner armature and front contact of relay 44 to the upper outer armature and front contact of relay 47, while the operation of relay 44 connects ground for application to the ring conductor of trunk ST as follows: Ground, right-hand armature and front contact of relay 44 to the front contact associated with the lower armature of relay 47.

It should be noted that operation of relay 146 also closes a circuit for the operation of the slow-to-operate relay 147 as follows: Battery, winding of relay 147, right-hand armature and a front contact of relay 146 to ground at the inner left-hand armature and front contact of relay 112. This relay in operating closes a circuit to battery for the operation of relay 11 as follows: Battery, right-hand armature and front contact of relay 147, inner right-hand armature and front contact of relay 112, lead 37, inner lower armature and front contact of relay 18, left-hand winding of relay 11, armature and front contact of relay 8 to ground. Relay 11 in operating prepares a locking circuit for itself through the right-hand winding to be subsequently closed on the operation of relay 7 and a locking circuit through the left-hand winding to battery at make-before-break contacts of relay 10. This relay also completes at its left-hand middle armature and front contact the above mentioned locking circuit to ground for relays 43 and 44. The operation of relay 11 by opening its make-before-break contacts to the battery at the make-before-break contacts of relay 10 opens the energizing circuit for the relays 9 and 18, which will now be released to disconnect the leads 25, 37 and 36 from the trunk ST to disconnect the common ringing key equipment from the trunk.

The operation of relay 146 therefore prepares the ringing equipment associated with trunk ST for the transmission of the signal for calling party M on the desired line when the trunk ST is connected thereto.

Relay 9 in releasing opens the flashing circuit for the guard lamp 12 through the equipment shown in Fig. 2, so that this lamp will now be lighted steadily over a circuit as follows: Battery, lamp 12, inner right-hand armature and back contact of relay 9, lower outer armature and back contact of relay 7, outer left-hand armature and front contact of relay 11, winding of pilot relay 15 to ground. This causes the maintenance of the operation of pilot relay 15 and the lighting of lamp 12 steadily. The steady lighting of lamp 12 indicates to the B operator that the signaling equipment associated with the trunk ST has been set in accordance with the operation of a ringing key.

It is evident from the above description

of the operation of the ringing key equipment that the operation of any of the other ringing keys 141, 142 or 143 will set up similar conditions in the ringing equipment of trunk ST by causing the operation of either of relays 43 and 44 in connection with relay 11 or the operation of relay 11 alone and that the operation of trunk key 144 will cause no operation at all of any of these relays. The operation of key 144 will simply release the ringing key equipment from the trunk ST.

As stated, lamp 12 is now lighted steadily to indicate that the trunk is ready for extension to the wanted subscriber's line. Hence, the operator will now insert plug 40 into jack 41 of the desired line 3. This causes the operation of relay 7 over the sleeve circuit. The operation of relay 7 extends the tip conductor of trunk ST through the upper armature and back contact of relay 47 to ground at the repeating coil 49. The operation of this relay also extinguishes the guard lamp 12 and pilot lamp 16 by opening the connection for these lamps through its lower armature and back contact. The operation of this relay also closes a circuit for the release of relays 22 and 6. Relay 22 is released by the opening of the connection at the lower inner armature and back contact of relay 7, while relay 6 is released by opening the connection at the upper inner armature and back contact of relay 7. Relay 5 remains operated over the loop in the toll operator's cord 1. A second locking circuit is provided for relay 11 on the operation of relay 7 as follows: Battery, upper inner armature and front contact of relay 7, right-hand armature and front contact and right-hand winding of relay 11 to ground. The purpose of this locking circuit will become apparent as the description proceeds. The battery at the upper inner armature and front contact of relay 7 is also connected to the winding of relay 47 for the operation of this relay later, as will hereinafter be described. The release of relay 6 causes battery and ground through the windings of relay 5 to be connected at the repeating coil 49 for trunk ST to cause the lighting of the usual supervisory signal in the toll operator's cord circuit to indicate to this operator that the ringing equipment in trunk ST has been set ready for the transmission of a ringing signal to the wanted subscriber.

The toll operator may now operate her ringing key to transmit an alternating current signal over the trunk ST for the operation of the ringing equipment as follows: This signal causes the operation of relay 50 and relay 50 in operating completes the above mentioned circuit for relay 47 by establishing a connection to ground through its armature and front contact. Relay 47



in operating applies the prepared ringing signal to the tip and ring conductors of the trunk over plug 40 and jack 41 to line 3. In this case party M is the party desired, hence ringing current from source 46 is applied to the tip conductor and ground to the ring conductor. The operation of relay 47 causes the operation of relay 6 over an obvious circuit during the ringing period to prevent relays 5 and 8 from releasing to light lamp 12 as a disconnect signal during the ringing period. It will be observed that a circuit was partly closed for this lamp through the operation of relay 7 at the lower outer armature and front contact of this relay and in case relay 8 were to release during this period this circuit would be completed at the make-before-break contacts of this relay.

When the wanted subscriber answers this call by removing his receiver from the hook and when the toll operator stops ringing, the relay 51 will operate as on the release of relay 47, due to the release of relay 50, the circuit is completed for relay 51 to the repeating coil 49 and the subscriber's loop. Relay 51 causes the operation of relay 6 as follows: Battery, right hand winding of relay 6, armature and front contact of relay 51 to ground at the armature and front contact of relay 5. Relay 6 in operating causes the supervisory lamp in the toll operator's cord 1 to be extinguished as a signal that the called subscriber has answered. Conversation may now begin, that is, as soon as the toll operator has completed the connection to the calling subscriber in a manner well known in the art. If the toll operator has discontinued to send a ringing signal before the wanted subscriber answers, relay 6 will release to operate the supervisory signal to indicate this condition to the toll operator.

When the receiver is replaced on the switchhook at the end of conversation at the called subscriber's station, relay 51 releases, causing the release of relay 6. Relay 6 in releasing causes the supervisory lamp at the toll operator's position to light as a disconnect signal. When the plug of cord 1 is removed from jack 2 of trunk ST, relay 5 is released. This relay in turn releases relay 8 and the above mentioned circuit for lamp 12 is completed at the make-before-break contacts of this relay to cause this lamp to be lighted as a disconnect signal. The B operator will now remove plug 40 from jack 41, causing the release of relay 7 to extinguish the lamp 12 and release relays 11, 43 and 44.

As is well known in the art, the B operator may test the wanted subscriber's line by touching the sleeve of jack 41 with the tip of plug 40 and if the wanted subscriber is busy she will receive a busy signal through the lead 55 and winding 149 of coil 123.

If the wanted subscriber's line is found busy, the B operator may notify the toll operator at "A" of this fact by sending a "busy back" tone signal to this operator's telephone and to cause the flashing of the supervisory lamp in cord 1 as a "busy back" signal for this cord. The "busy back" tone may be applied as follows: The busy back key 150, which is common to the group of trunks at the B operator's position, will when depressed initiate the transmission of the busy back tone and busy back cord signals. This key may be operated before or after the common ringing key equipment is actuated.

If the key is operated before the ringing key equipment is operated, it will not only cause the transmission of the busy back tone and busy back cord signals, but also release the ringing key equipment and the B operator's telephone set from the trunk ST. The operation of key 150 causes the operation of relay 105. This relay in operating applies battery through its left hand winding and left hand armature and front contact to lead 23 to cause the operation of the busy back relay 10. The connection from lead 23 may be traced through the left-hand outer armature and front contact of relay 22 and left winding of busy back relay 10 to ground. It should be noted that relay 22 is held operated at this time through an obvious circuit maintained by relay 18. Relay 10 in operating provides a locking circuit for itself through its right winding as follows: Battery, right-hand armature and front contact and right hand winding of relay 10, armature and front contact of relay 8 to ground. Relay 10 applies a tone current from an alternating current source connected to leads 54 to the tip and ring conductors of the trunk ST. This ringing tone is transmitted through the repeating coil 49 to the toll operator's telephone at A.

Relay 10 in operating also causes the flashing of the supervisory lamp in cord 1 by causing the alternate operation and release of relay 6 as follows: Relay 6 is operated from battery at the upper inner armature and back contact of relay 7. This circuit is alternately short-circuited through an interrupter 56 to ground connected through the lower inner armature and front contact of relay 10, so that relay 6 is alternately operated and released to alternately connect battery and ground to the trunk ST and this causes as is well known the flashing of the supervisory lamp in cord 1. The operation of relay 10 also by opening its make-before-break contacts removes battery from the locking circuits for relays 22, 18 and 9, so that these relays release. Relay 18 in releasing removes the common ringing key equipment and the B operator's telephone set from the trunk ST and relay 9 in releasing extinguishes the lamp 12.



If the key 150 is operated after the ringing key equipment is operated, relay 10 will release relays 22 and 11 and relay 11 will cause the release of either or both of the  
 5 relays 43 and 44 if operated and thus restore the ringing equipment to normal. Relay 10 is released when a toll operator removes her plug from jack 2 of trunk ST by the release of relay 8.

10 The operation of the peg count meter 152 will now be described: This meter will operate on the operation of any of the ringing keys at 116 or on the operation of the busy back key 150, if this key is operated before  
 15 the key in the ringing key equipment is operated, but will not operate on the operation of ringing key 150 if it is operated after a key in the ringing key equipment has been operated. Thus, the operation of the peg  
 20 count meter can only be effected once during each connection of the ringing key equipment to a trunk.

The operation of the meter 152 on the operation of a ringing key such as, for  
 25 example, key 140 is established through the operation of relay 147. It has already been shown how relay 147 is operated in this case and the circuit for meter 152 is completed as follows: Battery, winding of meter 152,  
 30 outer left hand armature and front contact of relay 147, outer left-hand armature and front contact of relay 112 to ground. If trunk key 144 is operated relay 153 is actuated over an obvious circuit and the circuit  
 35 for meter 152 in this case is as follows: Battery, winding of meter 152, outer right-hand armature and front contact of relay 153, outer left-hand armature and front contact of relay 112 to ground.

40 If the busy back key is operated before a key in the ringing key equipment is operated, relay 105 in operating will close a circuit for the operation of the meter 152 as follows: Battery, winding of meter 152,  
 45 right hand armature and front contact of relay 105, middle left-hand armature and front contact of relay 112 to ground. If the busy back key 150 is operated after the operation of a key in the common ringing  
 50 key equipment this circuit completed through the lower armature and front contact of relay 105 will not be completed through the meter 152, as relay 112 will be released at this time.

55 It should be understood that the particular system shown merely illustrates one application of the invention and that the invention could be applied to other systems without departing from the spirit thereof.

60 What is claimed is:

1. In a telephone system, a plurality of straightforward trunks, a control equipment common to the incoming ends of said trunks,  
 65 a key individual to each of said trunks at the incoming end thereof, a relay individual

to the incoming end of each of said trunks, a source of current connected to said trunks through the windings of said relays, means for operating said relays from the outgoing ends of said trunks, means jointly responsive  
 70 to the operation of one of said relays and the operation of a corresponding one of said keys for connecting said common control equipment to a corresponding one of said trunks, means included in said common control  
 75 equipment for causing the simultaneous transmission of a plurality of signals to the outgoing end of said trunk, one of said signals being in the form of direct current impulses, and means for propagating said direct  
 80 current impulses by alternately connecting and disconnecting said relay from said trunk.

2. In a telephone system, a plurality of straightforward trunks, a control equipment  
 85 and a source of tone common to the incoming ends of said trunks, a key individual to each of said trunks at the incoming end thereof, a relay individual to the incoming end of each of said trunks, a source of current connected to said trunks through the windings  
 90 of said relays, means for operating said relays from the outgoing ends of said trunks, means jointly responsive to the operation of one of said relays and the operation of a corresponding one of said keys for connecting  
 95 said common control equipment to a corresponding one of said trunks, a key included in said common control equipment for connecting said source of tone to said trunk and for causing the transmission of direct current  
 100 impulses to the outgoing end of said trunk by alternately connecting and disconnecting said relay from said trunk.

3. In a telephone system, a plurality of straightforward trunks, a control equipment  
 105 and a source of tone common to the incoming ends of said trunks, a key individual to each of said trunks at the incoming end thereof, a relay individual to the incoming end of each of said trunks, a source of current connected to said trunks through the  
 110 windings of said relays, means for operating said relays from the outgoing ends of said trunks, means at the incoming ends of said trunks for alternately connecting and disconnecting said relays from said trunks, means jointly responsive to the operation  
 115 of one of said relays and the operation of a corresponding one of said keys for connecting said common control equipment to a corresponding one of said trunks, a key included in said common control equipment for connecting  
 120 said source of tone to said trunk and for actuating said means for alternately connecting and disconnecting said relay from said trunk.

4. In a telephone system, a plurality of straightforward trunks, a common control  
 130 equipment for said trunks, a busy back sig-



nal key common to said trunks, a key individual to each of said trunks, means jointly responsive to the initiation of a call over a trunk and to the operation of the corresponding individual key for connecting said common control equipment and said busy back signal key to said trunk, means responsive to the actuation of said common control equipment for disconnecting said common control equipment from said trunk, means for preventing the disconnection of said busy back signal key from said trunk when said common control equipment is disconnected from said trunk, and means responsive to the actuation of said busy back signal key for transmitting a busy signal back over said trunk.

5. In a telephone system, a plurality of straightforward trunks, a common control equipment for said trunks, a busy back signal key common to said trunks, a key individual to each of said trunks, means jointly responsive to the initiation of a call over a trunk and to the operation of the corresponding individual key for connecting said common control equipment and said busy back signal key to said trunk, means responsive to the actuation of said common control equipment for disconnecting said common control equipment from said trunk, means for preventing the disconnection of said busy back signal key from said trunk when said common control equipment is disconnected from said trunk, means responsive to the ac-

tuation of said busy back signal key for transmitting a busy signal back over said trunk, and means responsive to the actuation of said busy back signal key for disconnecting said busy back signal key from said trunk.

6. In a telephone system, a called line, a plurality of straightforward trunks, a common control equipment for said trunks, a busy back signal key common to said trunks, a key individual to each of said trunks, means jointly responsive to the initiation of a call over a trunk and to the operation of the corresponding individual key for connecting said common control equipment and said busy back signal key to said trunk, means responsive to the actuation of said common control equipment for disconnecting said common control equipment from said trunk, means for preventing the disconnection of said busy back signal key from said trunk when said common control equipment is disconnected from said trunk, means responsive to the actuation of said busy back signal key for transmitting a busy signal back over said trunk, and means responsive to the extension of said trunk to said called line for disconnecting said busy back signal key from said trunk.

In witness whereof, we hereunto subscribe our names this 20th day of December A. D., 1926.

CLARENCE B. FOWLER.  
CHARLES W. LUCEK.