

June 11, 1929.

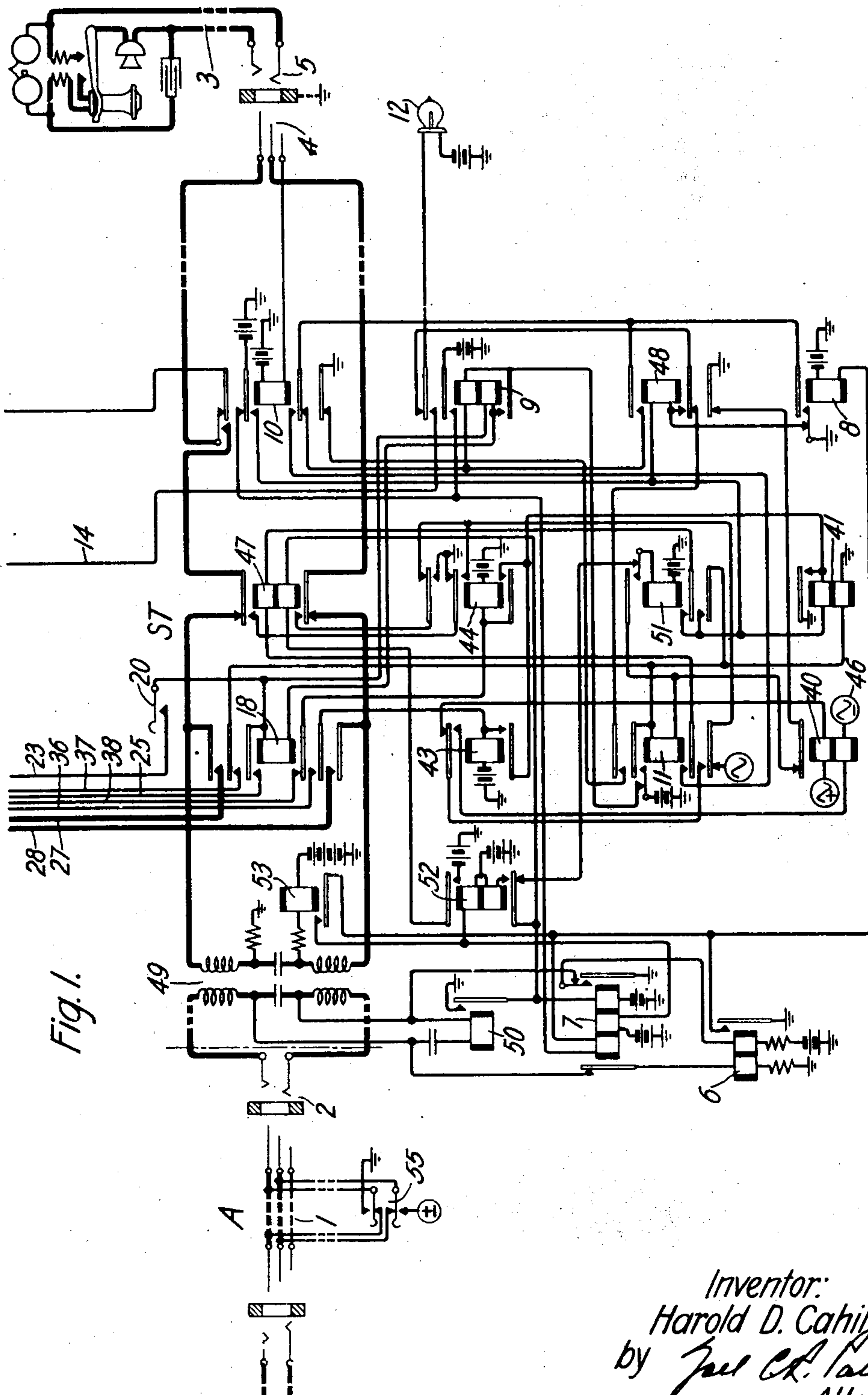
H. D. CAHILL

1,717,143

TELEPHONE SYSTEM

Filed Nov. 30, 1926

2 Sheets-Sheet 1



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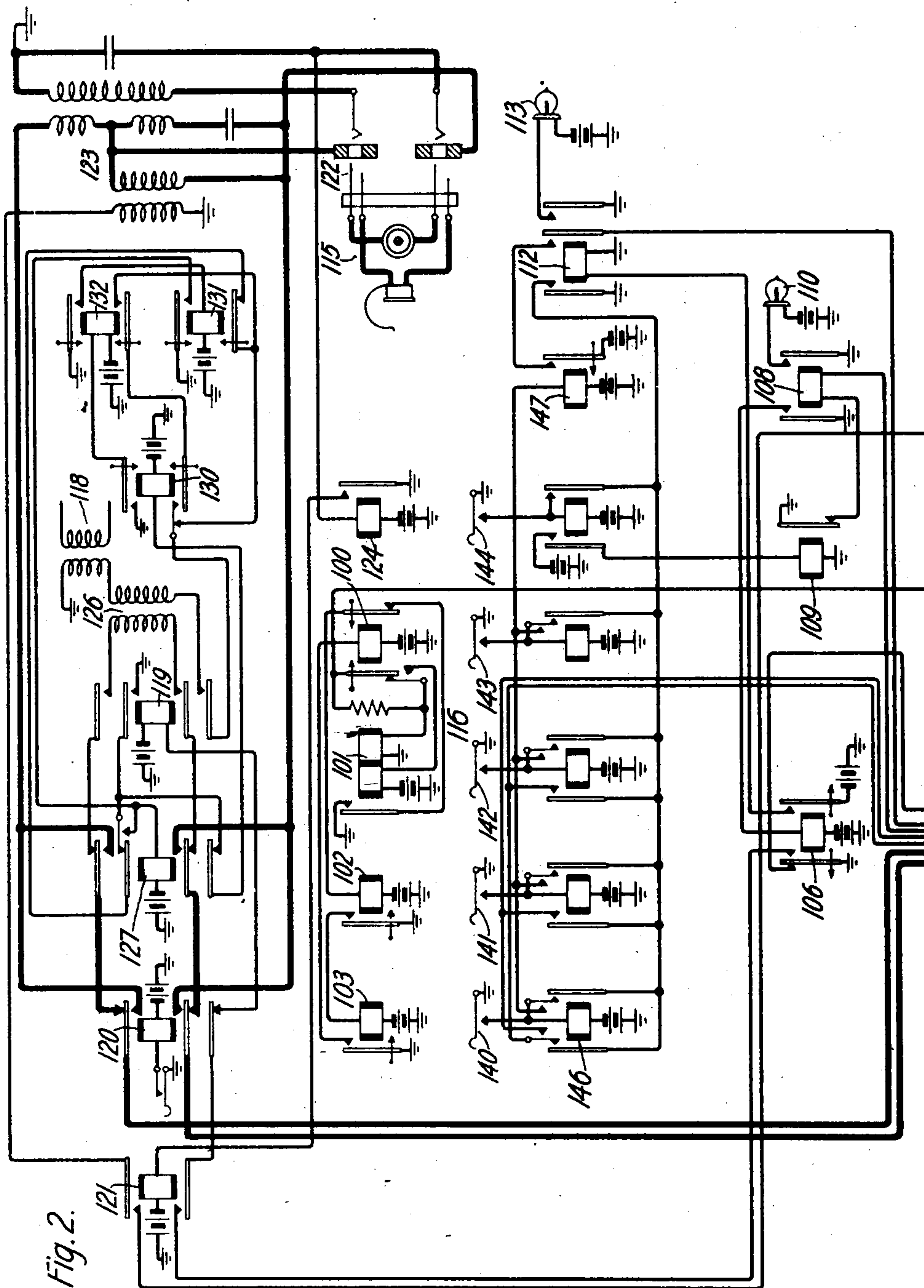
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed November 30, 1926. Serial No. 151,631.

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

According to this invention a straightforward trunking system is arranged so that the ringing equipment of a trunk, which has been set by the operation of a ringing key equipment common to a plurality of trunks at a B operator's position, is started in response to a signal applied to the trunk at its originating end by the originating operator and in response to the connection of the trunk at the B operator's position to a wanted subscriber's line.

The invention may be applied to straightforward trunking systems of the kind described in Patent No. 1,667,830 granted to Horace W. Ulrich May 1, 1928, in which there is provided circuit means whereby a ringing key equipment and a B operator's telephone set, common to a plurality of trunks are adapted to be associated with the incoming end of any one of said trunks. This means operates if a trunk has been seized by an A operator at its outgoing end and a key individual to this trunk has been actuated. The B operator's telephone set is associated with the trunk to enable the B operator to communicate with the A operator and the common ringing key equipment is associated with the trunk to control or set a ringing circuit equipment, individual to the trunk in accordance with the setting of its keys for the transmission of a corresponding ringing signal to a line in response to its subsequent connection to the trunk by the B operator.

The present invention is particularly adaptable for use in straightforward trunking systems where the trunks are toll switching trunks extending from toll operator's positions, and where it is consequently necessary to delay ringing the wanted subscriber until the toll operator has completed the connection to the calling subscriber as is well known in the art.

This invention has been illustrated in the accompanying drawings in which Fig. 1 shows a straightforward trunk of the toll switching trunk type embodying the features of this invention. This trunk is shown originating at a toll operator's position where a toll operator's cord is shown in diagrammatic

form for completing connections to a calling subscriber at a distant office. This straightforward trunk is shown terminating in a plug at a B operator's position and a called subscriber's line has also been shown in this figure in diagrammatic form. Fig. 2 shows a common ringing key equipment and a B operator's telephone set which may be associated with any one of the trunks of a group of trunks of which the straightforward trunk shown in Fig. 1 is representative.

Referring now to the drawings it is assumed that a toll operator at A has inserted the calling plug of a cord 1 into jack 2 of trunk ST that terminates at a B operator's position. The following description will relate to the association of the common ringing key equipment shown in Fig. 2 with this trunk and to the manipulation of the ringing keys thereof to prepare the usual ringing key equipment associated with the trunk ST for the transmission of ringing signals to a wanted subscriber's line, such as line 3. This description will explain how the ringing equipment of trunk ST is operated to transmit a ringing signal to the subscriber of line 3 in response to the connection of plug 4 of trunk ST into jack 5 of line 3 and to the reception of an alternating current signal from the toll operator at A.

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

Relay 9 in operating closes a circuit for the flashing of the guard lamp 12 as follows: Battery, lamp 12, upper outer 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 the 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 about the said resistance and lamp 12 comprising the left hand winding of relay 101 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 through the left-hand winding of relay 101 to battery. This relay is therefore maintained operated even though relay 100 is operated. On the operation of relay 100, the circuit for relay 102 is opened at the right-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 operations 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 lower armature a circuit 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 11, lower armature and front contact of relay 9, winding of relay 18, key 20, lead 23, left-hand armature and back contact of relay 106 to ground. Relay 18 in operating provides a locking circuit for itself after the release of key 20 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. It should be noted that this locking circuit for relay 18 is also provided for the locking of relay 9 by a circuit through the lower winding of relay 9 which circuit is in parallel with the circuit through the winding of relay 18, and that relay 108 is operated by the subsequent release of key 20. Relay 108 in operating lights a 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 the lighting of this lamp, reference may be had to the above mentioned copending

application of Horace W. Ulrich. The operation of relay 108 also causes an obvious circuit to be closed for the operation of relay 106 and relay 106 in operating closes an obvious circuit for the operation of relay 112. Relay 112 in operating closes a circuit for the lighting of lamp 113 to indicate 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. The connection of these equipments to the trunk is established through the operation of relay 18.

The operation of relay 106 removes the ground, at its left-hand armature and back contact for the original energizing circuit for relay 18 and as 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 these common equipments.

The operator's telephone set 115 and the common ringing key equipment 116 are connected to trunk ST and a signal is transmitted to the toll operator's cord 1 at A to indicate that the B operator is ready to receive the information relating to the extension of a call as follows: The signal consists of two successive applications of tone current from a source 118. Upon the operation of relay 106 a 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 armature and front contact of relay 121, left-hand armature and front contact of relay 106 to ground. It should be noted that this circuit is traced through the lower armature and front contact of relay 121. It is evident, by examining the circuits in this drawing, that this relay is operated as soon as the operator's telephone set 115 is connected through 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 119 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 relay 120, upper outer and lower inner armatures and back contacts of relay 127, upper outer and lower inner arma-

tures 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 118, 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 118 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. This relay in operating opens the circuit for the secondary winding of repeating coil 118 and primary winding of repeating coil 126 so that the impulse of tone current applied through these windings to the trunk ST is presently cut off.

The operation of relay 130 closes an obvious circuit for the operation of slow-to-operate relay 132. Relay 132 in operating again completes a coupling between the ringing 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 this relay, the circuit for the secondary winding of repeating coil 118 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 presently 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 a connection from the secondary winding of repeating coil 126 to the tip and ring conductors of the trunk and also the original circuit through the secondary winding of repeating coil 118 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, 37 and 38 for the control of the ringing equipment associated with the trunk by manipulations 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 and when this information is received, the B operator will operate a 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 call is to be advanced over an automatic trunk when machine ringing is not required, key 144 is operated.

If a party M is desired, key 140 is depressed to prepare the ringing equipment associated with the trunk ST for the sending of the proper signal. 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. The operation of relay 146 completes circuits for the operation of relays 43 and 44. A 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 a front contact of relay 146 to ground at relay 112, while the circuit for relay 44 may be traced from battery, through the winding of relay 44, lower inner armature and front contact of relay 18, conductor 38, left-hand armature and a front contact of relay 146 to ground at relay 112. Relays 43 and 44 provide locking circuits for themselves through their lower armatures and front contacts to ground at the armature and front contact of relay 41, when this relay operates as will be described hereinafter. The operation of relays 43 and 44 causes circuits from the ringing source 46 and from ground to be completed for the application of ringing current to the conductors of trunk ST as follows: Source 46, winding of tripping relay 40, upper armature and front contact of relay 43, lower outer armature and front contact of relay 11, when this relay operates as will be presently described, upper inner armature and front contact of relay 44 to the front contact associated with the upper armature of relay 47 connected to the tip conductor of trunk ST, and from ground, upper outer armature and front contact of relay 44 to the front contact associated with the lower

armature of relay 47 connected to the ring conductor of trunk ST. The 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, middle upper armature and front contact of relay 18, winding of relay 11, armature and back contact of tripping relay 40 to ground at lower outer armature and back contact of relay 48. Relay 11 in operating prepares a locking circuit for itself from battery, through its upper armature and front contact, to ground at the armature and back contact of relay 48. Relay 11 in operating, by opening its make-before-break contacts to battery opens the holding circuit for relays 9 and 18 which will now be released to disconnect leads 25, 27, 28, 36, 37 and 38 from the trunk ST to disconnect the common ringing key equipment from the trunk. It should be noted that a circuit for the operation of relay 11 also extends through lower winding of relay 41 to ground, thus causing this relay to operate and this relay in operating prepares the above mentioned locking circuits for relays 43 and 44.

Thus the operation of relay 146 prepares the ringing equipment associated with trunk ST for the transmission of signals for calling party M on the desired line when trunk ST is connected thereto and disconnects the ringing key equipment and the operator's telephone set from the trunk ST.

Relay 9 when released as hereinbefore described opens the circuit for the guard lamp 12 to the equipment shown in Fig. 2 so this lamp will now cease flashing and will be lighted steadily over a circuit as follows: Battery, lamp 12, upper outer armature and back contact of relay 9, lower armature and back contact of relay 48, upper outer armature and front contact of relay 11, lower outer armature and back contact of relay 10 to ground. The steady lighting of lamp 12 indicates to the B operator that the signaling equipment associated with 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 ringing equipment that the operation of any of the ringing keys 141 to 143 or the trunk key 144 will set up similar conditions in the ringing equipment of trunk ST by causing the operation of either or both of the relays 43 and 44 in connection with the operation of relays 11 or no operation at all of any of these relays. For example, the op-

eration of key 144 will simply release the ringing key equipment from the trunk.

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 B operator will now insert plug 4 into jack 5 of the desired line 3. This causes the operation of relay 10 over the sleeve circuit. The operation of this relay extends the tip conductor of the trunk ST through to 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 by opening the connection for this lamp through its outer armature and back contact. The operation of relay 10 also causes the release of relay 7. The release of relay 7 causes battery and ground to be connected at the repeating coil 49 for trunk ST to cause the lighting of the usual supervisory signal in the cord circuit 1 at the toll operator's position to indicate to the toll operator that the ringing equipment of trunk ST has been set for the transmission of a ringing signal to the wanted subscriber's line.

The toll operator may now operate the usual ringing key such as 55 to transmit an alternating current signal to the trunk ST for the operation of its ringing equipment to transmit a ringing signal to the wanted subscriber's line. This alternating current signal causes the operation of relay 50 and this relay in operating closes circuits for the operation of relay 7 and relay 51. Relay 7 in reoperating prevents relay 6 and relay 8 from releasing and displaying the disconnect signal. The circuit for relay 51 is as follows: Battery, winding, and make-before-break contacts of relay 51, right-hand armature and back contact of relay 52, armature and front contact of relay 50 to ground. The operation of relay 10 and relay 51 also provides a locking circuit for relay 41 to prevent the release of relays 43 and 44. Relay 51 provides a locking circuit for itself through its upper armature and front contact to ground at the lower outer armature and back contact of relay 48. The operation of relay 51 closes a circuit for the operation of relay 47 as follows: From battery at the upper inner armature and front contact of relay 10, lower inner armature and front contact of relay 51, upper winding of relay 47, lower inner armature and front contact of relay 11, inner lower armature and front contact of relay 10, armature and front contact of relay 8 to ground. Relay 47 in operating applies the prepared ringing signal to the tip and ring conductors of the trunk over plug 4 and jack 5 to line 3. In this case if the party M is the party desired, ringing current from source 46 is applied to the tip conductor and ground is connected to the ring conductor as hereinbefore described.

When the wanted subscriber answers this call by removing his receiver from the hook, ringing trip relay 40 operates and this relay in operating causes the release of relays 11 and 51. Relay 11 in releasing opens the circuit for the ringing relay 47, which now disconnects the ringing current from the line causing the release of the tripping relay 40 and closes a talking connection from the called subscriber to the repeating coil 49 and permits relay 53 to operate. The operation of relay 53 closes a circuit through the middle winding of relay 7 which is now reoperated to extinguish the supervisory lamp in cord 1 to indicate to the toll operator that the wanted subscriber has answered the call. It should be noted that the relay 7 will be released when the toll operator discontinues to send the alternating current signal causing the relighting of the supervisory signal at the toll cord at that time, but that relay 6 remains operated over the loop circuit in the toll operator's cord 1. The operation of relay 53 also closes an obvious circuit for the operation of relay 52 which performs no useful function at this time but prepares the circuits for reringing the called subscriber as will hereinafter be described.

The toll operator will now complete the connection to the calling subscriber in the usual manner in toll practice and a conversation between the calling and called subscriber may then begin.

When the conversation is ended and the called subscriber replaces his receiver on the hook, relay 53 releases causing in turn the release of relay 52 and relay 7. The release of relay 7 connects battery and ground to the tip and ring conductors of the trunk which causes the toll operator's supervisory lamp to light as a disconnect signal. The toll operator will now remove the calling plug from jack 2 of trunk ST, thus causing the release of relays 6 and 8. Relay 8 in releasing permits relay 48 to operate over a circuit as follows: Battery, inner upper armature and front contact of relay 10, winding of relay 48 to ground at the make-before-break contacts of relay 8. Relay 48 in operating closes a circuit for the lighting of lamp 12 as a disconnect signal. The B operator will in answer to this signal remove plug 4 from jack 5, thus causing the release of relay 10 which in turn releases relay 48 to extinguish the disconnect lamp and restore the circuit to normal, that is, relay 41 is released and this relay in turn releases relays 43 and 44.

If it is desired to rering the called party after he has hung up his receiver the toll operator at A may do so by again operating relay 50. This relay in operating will reoperate relays 7 and 51. The operation of relay 7 prevents relays 6 and 8 from releasing to display a disconnect signal. Relay 51 in

operating causes the operation of relay 11 over a circuit as follows: Battery, inner upper armature and front contact of relay 10, lower outer armature and front contact of relay 51, winding of relay 11, back contact of relay 40, to ground at the lower armature and back contact of relay 48. Relay 11 in operating provides a locking circuit for itself through its inner upper armature and front contact to ground at the lower armature and back contact of relay 48. The operation of relay 11 causes relay 47 to operate and ringing current is thus applied from source 46 to the tip conductor of the trunk and from ground to the ring conductor of the trunk since relays 43 and 44 remain operated due to the fact that relay 41 has been maintained operated under the control of relay 10.

If it is desired to rering the called party before he has restored the receiver on the hook, relay 50 is operated thus causing relay 47 to become operated due to the operation of relay 52 as hereinbefore described. Relay 52 is locked in operated position by the operation of relay 50, while relay 53 is released during the operation of relay 47.

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

What is claimed is:

1. In a telephone system, a plurality of trunks, lines for association with said trunks, a ringing key equipment and an operator's telephone set common to said trunks, a key individual to each trunk, means responsive to the extension of a call to a trunk and to the actuation of the key individual to said trunk for associating the ringing key equipment and the operator's telephone set with said trunk, a ringing equipment individual to each trunk, the ringing equipment of a trunk being adapted to be set by the ringing key equipment for the transmission of a ringing signal when the ringing key equipment is associated with said trunk, means for disconnecting said operator's telephone set and said ringing key equipment from said trunk effective after the ringing equipment has been set, means for sending a signal over said trunk, and means responsive to the reception of said signal over said trunk and to the connection of said trunk to a line for actuating the corresponding ringing equipment to transmit the ringing signal over said connected line.

2. In a telephone system, a trunk, a called line, a plurality of sources of ringing current, a ringing equipment individual to said trunk for selecting and poling said sources of ringing current, a ringing relay for applying said selected and poled ringing current to said trunk, a set of keys common to said trunk for setting said ringing equipment, a key indi-

vidual to said trunk, and means jointly responsive to the seizure of said trunk and the actuation of said individual key for associating said keys with said ringing equipment, 5 means responsive to the setting of said ringing equipment for disassociating said keys from said ringing equipment, means for sending a signal over said trunk, and means responsive to the reception of said signal over said trunk and to the connection of the said 10 trunk to the said called line for actuating said ringing relay.

In witness whereof, I hereunto subscribe my name this 29th day of November, A. D. 1926.

HAROLD D. CAHILL.