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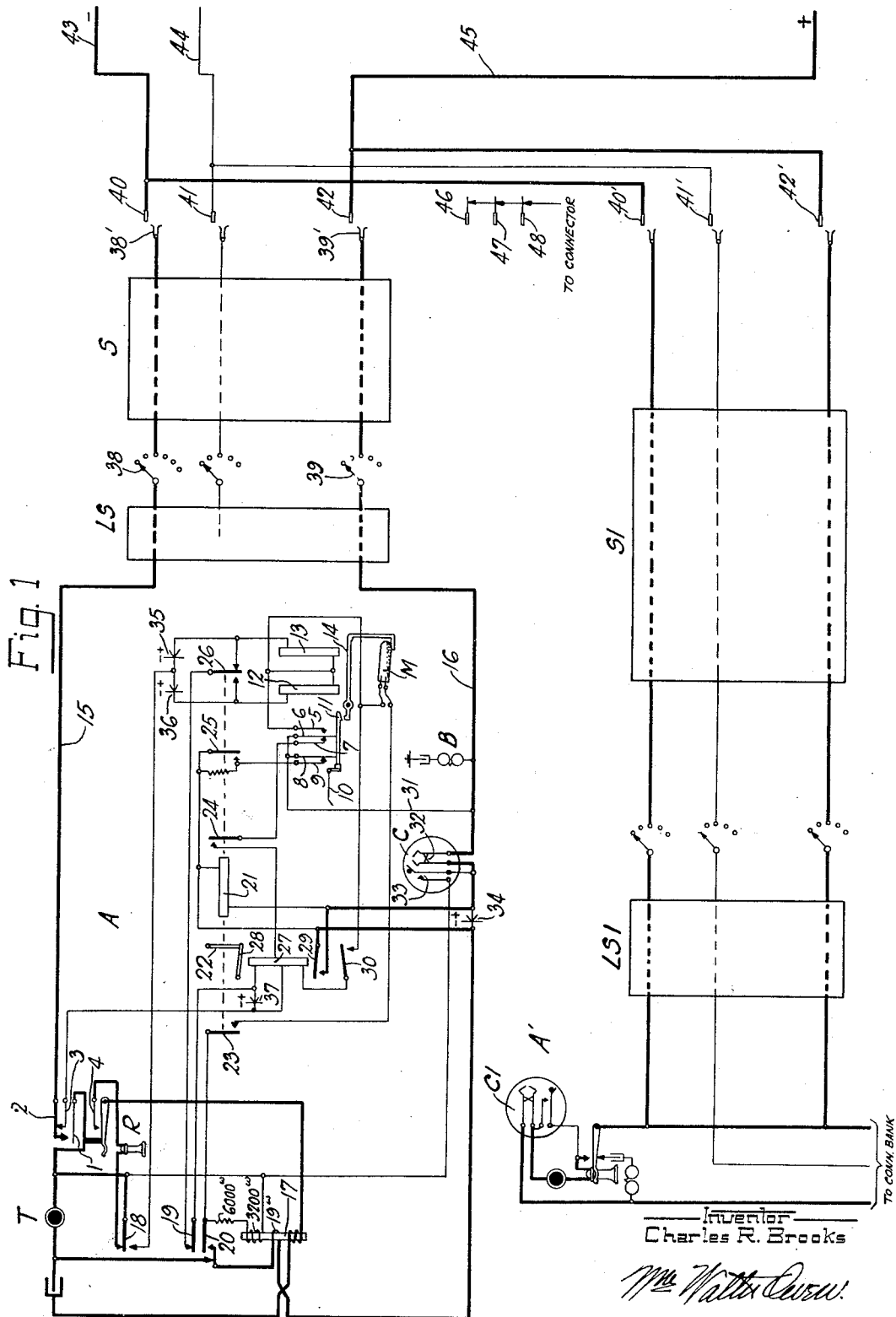
C. R. BROOKS

1,929,474

TELEPHONE SYSTEM

Filed July 10, 1931

3 Sheets-Sheet 1



Inventor
Charles R. Brooks

Wm. Walter Curran

Attg.

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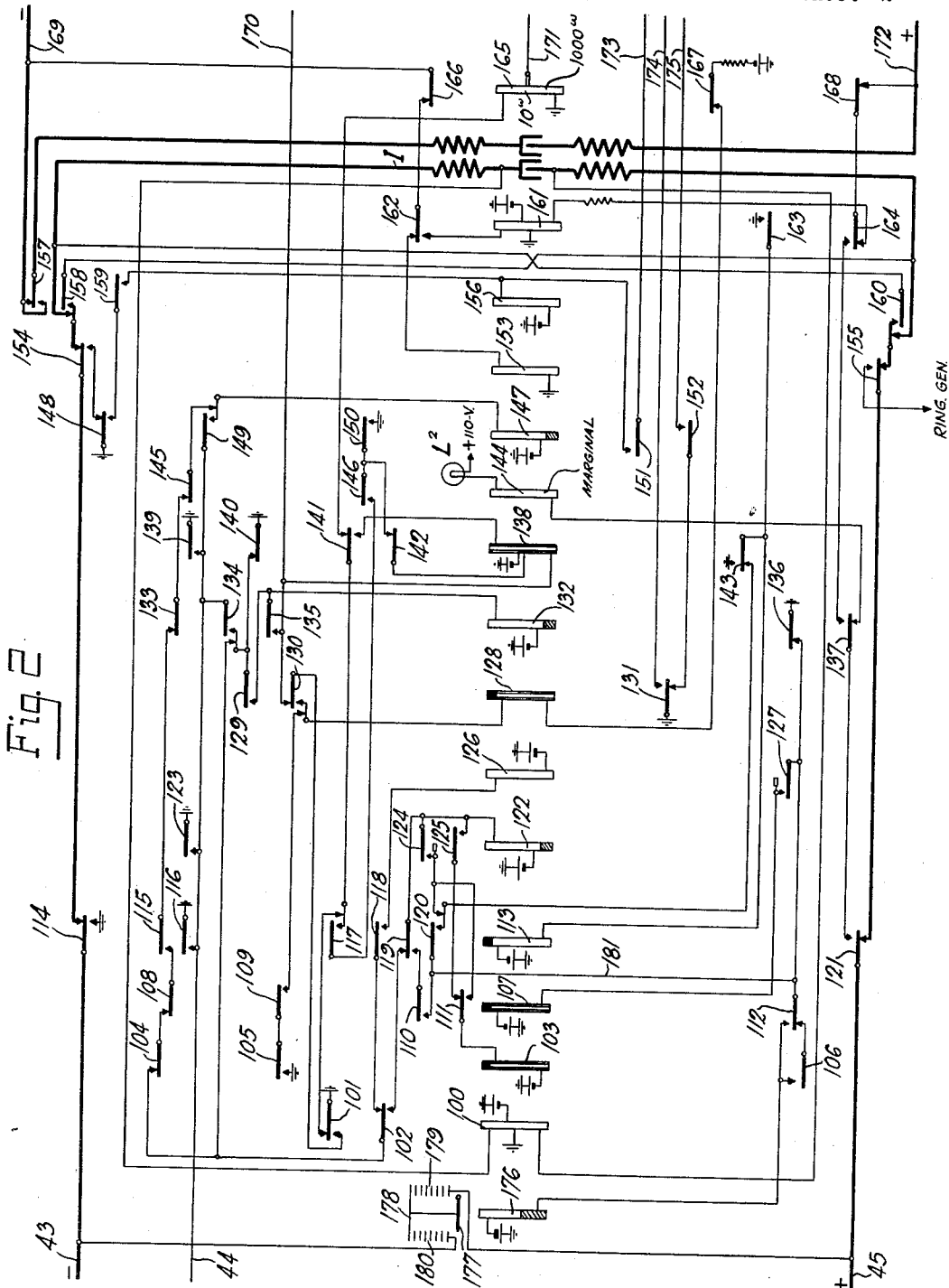
C. R. BROOKS

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TELEPHONE SYSTEM

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3 Sheets-Sheet 2



Inventor
Charles R. Brooks

Wm. Walter Cullen

Att'y

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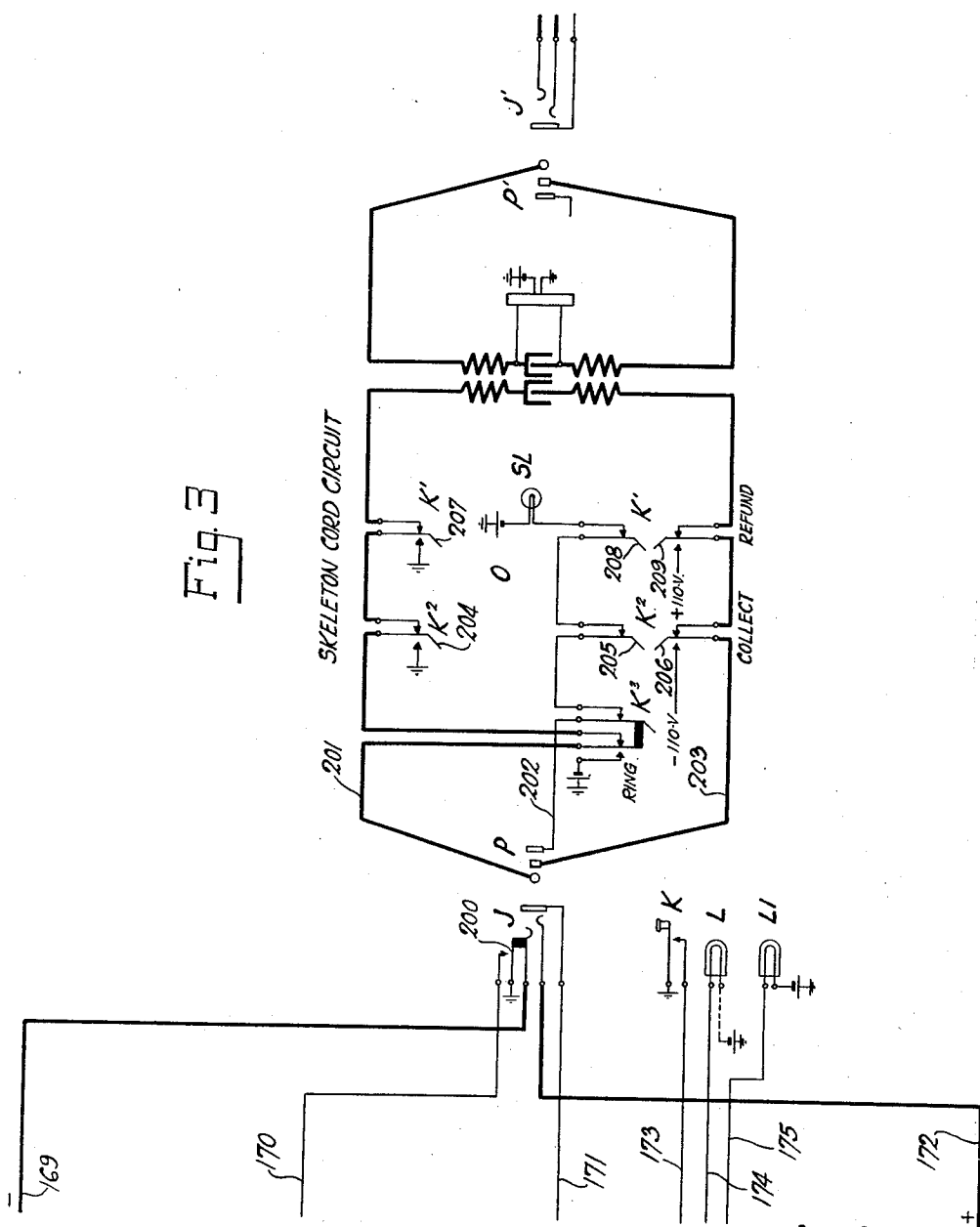
C. R. BROOKS

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TELEPHONE SYSTEM

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3 Sheets-Sheet 3



Inventor
Charles R. Brooks

Charles R. Brooks

Mr Walter Owen.

Atty.

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Charles R. Brooks, Chicago, Ill., assignor, by
mesne assignments, to Associated Electric Lab-
oratories, Inc., Chicago, Ill., a corporation of
Delaware

Application July 10, 1931. Serial No. 549,967

35 Claims. (Cl. 179—6.3)

The present invention relates to telephone systems in general, but is particularly concerned with paystation circuits and trunk circuits used to give toll service to paystations and to regular subscribers', or local, stations.

The principal object of this invention is to produce an automatic telephone system in which toll service can be given to both paystations and local stations by means of equipment which is common to both types of stations and which will meet all requirements of standard practice.

Another object is to provide a paystation circuit in which ordinary types of relays and not polarized relays are used for controlling the distribution of coins. The manner in which this object is accomplished by the use of electronic valves of the copper-oxide type constitutes one of the features of this invention.

It is now the common practice in automatic telephone systems to segregate the paystations from the local stations as regards trunks accessible thereto for the extension of calls and to provide those trunks accessible to the paystations for toll service with what are commonly known as paystation repeaters. The present invention contemplates the use of a trunk which is capable of use by both paystations and local stations and which does not require a paystation repeater. The features of this trunk circuit and other features and objects of the invention not specifically mentioned at this time will be apparent from the detailed description, which follows, when studied in conjunction with the accompanying drawings comprising Figs. 1 to 3, inclusive, which by means of appropriate symbols diagrammatically depict the system of the present invention.

In Fig. 1 are shown two stations, the paystation A and the local station A'. These stations are provided with the usual automatic substation instrumentalities. Paystation A, in addition to these, is provided with a coin-collecting-and-refunding apparatus which includes a collect magnet 12 and a refund magnet 13 for controlling the coin distributing mechanism in its functions. Coin-collect mechanism is well known, but in the instant case coin-collect mechanism is employed which is similar to that shown and described in the co-pending application of Hans Sengebusch, Serial No. 546,968, filed June 26, 1931.

Each substation is provided with an individual line switch, such as LS, which is of the well-known rotary type of switch, the wipers of which move in a forward direction only and have no

normal position, remaining in the position last used.

These line switches have access to selector switches, such as S, which are of the well-known Strowger type of two-directional-motion switch. In the present system it is assumed that the selector switches have access to connector switches for the completion of local calls and access to trunks, such as that comprising conductors 43 to 45, inclusive, regardless of the type of calling substation, for calls to a toll operator.

The combined line and recording trunk of this invention—that is, the trunk common to both paystations and local stations—is shown in Fig. 2. This trunk terminates in a jack in a toll operator's position, Fig. 3. The toll operator's position is represented by a skeleton cord circuit O.

It will be assumed that a subscriber at paystation A desires to call and converse with the subscriber at station A'. This is termed a local paystation call and usually requires the payment of a single five-cent coin. It is the general practice to arrange an automatic telephone system for what is termed "post-pay" service. Under these conditions, a paystation subscriber can obtain a connection in a local call without first depositing a coin or token, but cannot converse with the called party until after a coin has been deposited. This class of service is usually desirable, since it permits such calls as fire, police, other emergency calls, and toll calls to be made without a coin first having to be deposited.

When pre-pay service is used, a short circuit is usually placed around the impulse springs of the calling device of an automatic paystation, which circuit is opened only by the depositing of a coin, thus preventing the extension of a call until a coin is deposited. In the present illustration it will be assumed that the paystation equipment is arranged for post-pay service.

Therefore, when a subscriber at paystation A desires to make a call, he will remove the receiver from the switchhook and proceed to dial the desired number. The removal of the receiver at paystation A causes contact 2 of the contacts controlled by the switchhook to move out of engagement with contact 3 and into engagement with contact 1, and causes contact 4 to engage its make contact. Engagement of contacts 1 and 2 completes the loop circuit for the line relay of the line switch LS over the loop circuit starting with ground through resting contacts of the cut-off relay (not shown) of the line switch, positive line conductor 16, impulse contacts 32 of calling

device C, copper-oxide valve 34, primary winding of induction coil relay 17, normally closed contacts controlled by armature 20 of relay 17, transmitter T, switchhook contacts 1, 2, negative line conductor 15, to battery through resting contacts of the cut-off relay and the winding of the line relay (not shown) of the line switch. The line switch LS thereupon operates to select a trunk leading to an idle selecting switch which, it will be assumed, is selector switch S. The calling subscriber now dials the first digit of the desired number. The selector S responds in the well-known manner to the impulses generated by the calling device C to elevate its wipers to the appropriate level and then automatically rotate them to select a trunk to an idle connector switch. It will be assumed that the trunk selected is that which is represented in the drawings by the bank contacts 46 to 48, inclusive. The connector switch has not been shown, since connectors of the Strowger type are well known and their operation is well understood.

The subscriber now dials the last two digits of the desired number, whereupon the connector selects the desired called line and, if the line is idle, applies ringing current thereto to signal the called subscriber. When the called subscriber answers, the back bridge relay of the connector reverses the battery feed to the calling line in the well-known manner.

When this reversal occurs, the normally positive line conductor 16 becomes the negative conductor and the normally negative conductor 15 becomes the positive conductor. Current flowing in this reversed direction through the paystation circuit cannot pass through the copper-oxide rectifier 34 and therefore flows through the winding of relay 21, the direction of current flow through the electronic valves being indicated by the plus and minus signs. When this occurs, relay 21 begins to energize and to attract its armatures 22 to 26, inclusive. These armatures are so adjusted that armature 25 engages its contact a considerable time before the other armatures complete their strokes. Engagement of armature 25 and its make contact short circuits the winding of relay 21 by way of coin contacts 9, 8 and conductor 31. Relay 21 thereupon deenergizes and restores its armatures before any of them, except armature 25, has completed its stroke. At armature 25 the short circuit of relay 21 is removed and the relay again commences to energize and attract its armatures. This cycle of operation is continuously repeated and a tone signal is generated thereby in the line circuit, which tone is loud enough to prevent conversation taking place.

The called subscriber can cause the tone to cease by depositing a coin in the coin collector, the coin when deposited striking the lever 10, moving the latch 11 to the right where it catches on the armature 14 of the coin control magnets. Movement of latch 11 moves coin contacts 8 and 6 to the right. This opens the short circuit of relay 21 at contacts 9, 8, allowing that relay to completely energize, and at contacts 6—5 prepares the circuit of collect magnet 12 in order to collect the deposited coin when the conversation is terminated.

Relays 21 and 27 are arranged as mechanically interlocking relays whose armatures 22 and 28 maintain either one or the other in the operated position. As diagrammatically represented in Fig. 1, the armature 22 of relay 21 is in such position when the relay 21 is deenergized as to

prevent the armature 28 of relay 27 from restoring to normal position after the circuit of relay 27 is opened. When relay 21 completely energizes and completely attracts its armature 22, the armature 28 of relay 27 retracts and assumes a position back of the armature 22 of relay 21 so as to prevent the retraction of armature 22 when relay 21 deenergizes. Preventing the armature 22 from retracting maintains armatures 23 to 26, inclusive, in engagement with their make contacts. When relay 27 energizes, it attracts its armature 28 which frees the armature 22, allowing that armature and consequently the other armatures of relay 21 to restore. Armature 22 thereupon assumes the position shown in the drawings and when the relay 27 deenergizes the armature 28 thereof is prevented from retracting as are also armatures 29 and 30. Thus in the normal condition of the apparatus, although the relay 27 is not energized, its armatures 28, 29, and 30 are in their attracted positions.

Therefore, when the relay 21 energizes completely after the short circuit about its winding has been opened at coin contacts 9—8, the armature 28 of relay 27 retracts and assumes the position to prevent restoration of the armatures of relay 21. Upon completely energizing, relay 21 at its armature 23 and make contact prepares a holding circuit for the coin control magnets, at its armature 24 and make contact prepares a circuit for the upper winding of relay 27, and at its armature 26 and make contact prepares an auxiliary circuit for the collect magnet 12. When the armature 29 of relay 27 retracted following the complete energization of relay 21, it engaged its resting contact and short circuited both the winding of relay 21 and the electronic valve 34. This removes the winding of relay 21 and the valve from the talking circuit to reduce the impedance thereof. Although the winding of relay 21 is short circuited, its armatures cannot retract because of the retracted position of armature 28 of relay 27 as explained.

Conversation between the two subscribers may now take place and when finished will be followed by the replacement of the receivers. Replacement of receiver R opens switchhook contacts 1—2 and closes switchhook contacts 2—3. When the current flow in the calling line is restored to normal by the connector, the current flows from the positive conductor 16 over conductor 31, through coin contacts 6—5, winding of collect magnet 12, make contact and armature 26 of relay 21, resting contact and armature 19 of relay 17, electronic valve 37, by way of switchhook contacts 3—2, and over the negative line conductor 15. The collect magnet 12 thereupon operates and collects the deposited coin, also operating the armature 14 which releases the latch 11 and restores the coin contacts to normal. Attraction of armature 14 tilts the mercury switch M, thereby closing its contacts, which operation is without any effect at this time.

Restoration of coin contact 6 opens the circuit of the collect magnet 12 and at contact 7 completes the following circuit for relay 27; positive conductor 16, conductor 31, coin contacts 7—6, armature 24 and make contact of relay 21, upper winding of relay 27, electronic valve 37, to negative line conductor 16 by way of switchhook contacts 3—2. Relay 27 operates in this circuit and completely attracts its armatures, thereby at armature 28 releasing armature 22 of relay 21 to permit relay 21 to restore. Restoration of relay 21 at its armature 24 opens the circuit of relay 27

which thereupon deenergizes. The armatures 28, 29, and 30 are held mechanically in their attracted positions by armature 22 of relay 21.

Opening of the circuit of the upper winding of relay 27 at armature 24 of relay 21 also opens the loop circuit to the line relay of the connector, thereby permitting the connector to release and to release the selector S and line switch LS. The apparatus at pay station A is now in the condition shown in the drawings and in readiness for another call.

Assuming that the subscriber of substation A had inadvertently deposited a coin before removing the receiver from the switchhook, this coin would have been immediately refunded because with the coin contact 6 in engagement with contact 5, caused by the depositing of the coin, and the switchhook contacts in their normal position, the following circuit would be completed for the refund magnet 13: ground on conductor 16 from the line switch, conductor 31, coin contacts 6—5, winding of refund magnet 13, resting contact and armature 26 of relay 21, resting contact and armature 19 of relay 17, electronic valve 37, switchhook contacts 3—2, and back to negative battery in the line switch over the line conductor 15. The refund magnet 13 will thereupon operate to refund the deposited coin and restore the coin contacts.

Should the subscriber at paystation A deposit a coin after removing the receiver from the switchhook but before dialling, the relay 21 would not operate as described to set up a tone in the calling line when the connector reverses battery upon the response of the called party because the short circuit of relay 21 established under the previous condition at armature 25 and its make contact of that relay would be open at coin contacts 9—8. Under these conditions, relay 21 will completely energize immediately and mechanically lock itself by restoring the relay 27 which at its armature 29 and resting contact would again remove the electronic valve 34 and the winding of relay 21 from the talking circuit, leaving the transmitter connected through a low resistance path.

From the foregoing it will be appreciated that paystation coin-collecting-and-refunding apparatus has been controlled in a local connection through collect and refund magnets without the usual polarized relay by the use of electronic valves. It will also be appreciated that by the use of these valves the flow of current through the paystation apparatus has been directed to prevent conversation between a paystation subscriber and any other subscriber in a local connection until a coin has been deposited, even though the connection has already been established.

When the subscriber at the paystation A desires to make a toll call, he will, after removing his receiver from the switchhook, operate his calling device in accordance with the proper number to obtain connection to the toll operator. It is immaterial in this case whether or not the subscriber deposits a coin after removing his receiver but before operating his calling device. For the sake of description, it will be assumed that the subscriber deposited a coin before attempting to establish connection to the toll operator. This depositing of the coin operates the coin contacts which are then locked in their operated positions, as before explained.

It will also be assumed that, after the line switch LS has selected the selector S and the selector S has been operated in accordance with the number necessary to obtain connection with the toll operator, the wipers 38', 39', and the test

wiper of the selector come to rest in engagement with contacts 40 to 42, inclusive, of the trunk 43—45, leading to the toll operator's position. When this occurs, the selector functions in the usual manner to extend the calling loop to this trunk circuit, whereupon the relay 100, Fig. 2, operates over this loop circuit which extends from ground through the lower winding of relay 100, lower left-hand winding of repeating coil I, normally closed contacts controlled by armature 160 of relay 156, resting contact and armature 155 of relay 153, resting contact and armature 121 of relay 113, positive trunk conductor 45, bank contact 42 and wiper 39' of selector S, lower talking conductor through the selector S, wiper 39 of line switch LS, lower talking conductor through the line switch, positive line conductor 16, impulse contacts 32 of calling device C, electronic valve 34, primary windings of induction coil relay 17, normally closed contacts controlled by armature 20 of relay 17, transmitter T, switchhook contacts 1—2, negative line conductor 15, through the line switch to wiper 38, negative talking conductor through the selector S, line wiper 38' and bank contacts 40, negative trunk conductor 43, armature 114 and resting contact of relay 113, armature 154 and resting contact of relay 152, normally closed contacts controlled by armature 158 of relay 156, upper left-hand winding of repeating coil I, and through the upper winding of relay 100 to battery. Relay 100 operates in this circuit.

The operation of relay 100 at armature 102 and make contact completes the following circuit for relay 122: ground, armature 140 and resting contact of relay 138, normally closed contacts controlled by armature 134 of relay 132, armature 102 and make contact of relay 100, resting contact and armature 119 of relay 113, and winding of relay 122 to battery. Relay 122 operates in this circuit and at armature 125 and make contact extends its energizing ground by way of resting contact and armature 111 of relay 107 to battery through winding of relay 103. At armature 123 relay 122 extends holding ground back to the selector S over release trunk conductor 44, and at armature 124 starts the contact of this armature vibrating. The make contact of armature 124 is provided with a weight which causes the contact to vibrate when it is struck by this armature 124 upon the attraction thereof, which contact vibrates for a considerable length of time before coming to rest in engagement with armature 124, thereby delaying the closing of the circuit therethrough.

Relay 103 operates and attracts its armatures 104 to 106, inclusive, performing no particular function at this time at its armature 104 and 105 but at armature 106 completing the circuit of relay 176 from grounded armature 136 and resting contact of relay 132, armature 112 and resting contact of relay 107, armature 106 and make contact, and winding of relay 176 to battery.

Relay 176 is shown diagrammatically as provided with two piles of carbon disks 179 and 180 which are compressed by a plunger 178 attached to the armature 177 when armature 177 is attracted upon the energization of relay 176. These two piles of carbon 179 and 180 are serially connected in a bridge circuit across the trunk conductors 43 and 45 and when the disks are in the uncompressed condition they present a bridge circuit of more than 20,000 ohms. When the disks are compressed by the operation of

relay 176, this resistance is gradually reduced to approximately 10 ohms.

Therefore, when relay 176 operates upon the closure of its circuit by relay 103, a low-resistance short circuit is placed across the trunk conductors 43 and 45, thereby cutting off the current flow over the line to the paystation A.

The vibrating contact of armature 124 of relay 122 is so timed that it comes to rest immediately after relay 176 has placed the short circuit on the calling loop. When this occurs, the circuit of relay 113 is completed in parallel with that of relay 122 by way of normally closed contacts controlled by armature 120 of relay 113 and resting contact and armature 143 of relay 138. Relay 113 operates in this circuit and at its armature 120 and make contact locks itself to ground by way of conductor 181 and resting contact and armature 136 of relay 132. At its armatures 114 and 121 relay 113 disconnects the windings of relay 109 from conductors 43 and 45 and connects the conductors respectively to direct ground and to positive 110-volt current through make contacts of armature 121, armature 137 and resting contact of relay 132, winding of relay 144, resistance lamp L2, to the 110-volt current source. This 110-volt current does not flow over the calling loop because of the low-resistance short circuit through the carbon piles of relay 176.

Relay 144 operates from this 110-volt current and at its armature 145 opens a point in the circuit of relay 147.

Relay 113 at its armature 115 prepares a point in the circuit of relay 147, at its armature 116 connects ground to conductor 44, operates its armature 117 without any effect at this time, and at its armature 119 opens the energizing circuits of relays 122 and 103. These relays thereupon release slowly because of the copper slugs on their cores and also in the case of relay 103 because of the copper sleeve on its core.

Relay 103 slowly releases relay 176 which also releases slowly because of the copper slug on its core. Relay 176, slow-releasing, gradually decreases the pressure on the carbon piles, thereby gradually increasing the resistance of the short circuit until the maximum of approximately 20,000 ohms is reached. This high resistance no longer short circuits the 110-volt current from the calling loop and the current therefore flows over conductor 45, through the selector and line switch, through the primary winding of induction coil relay 17, and back through the line switch and selector and over conductor 43 to ground at armature 114 and its make contact. The paystation apparatus thereupon functions to refund the deposited coin and to increase the resistance of the loop circuit, as will be explained later.

When the resistance of the loop circuit is increased, relay 144, being marginal, deenergizes and at its armature 145 and resting contact completes the following circuit: ground, armature 140 and resting contact, normally closed contacts controlled by armature 134, resting contact and armature 104 of relay 103, resting contact and armature 108 of relay 107, make contact and armature 115 of relay 113, resting contact and armature 133 of relay 132, resting contact and armature 145 of relay 144, normally closed contacts controlled by armature 149 of relay 147, and winding of relay 147 to battery. Relay 147 operates in this circuit, at its armature 149 and make contact locks itself to ground on conductor 44 supplied through make contact

and armature 116 of relay 113, at armature 151 and make contact prepares a circuit for relay 156, and at armature 152 prepares a circuit for the paystation lamp L', Fig. 3.

Relay 126 operates when its circuit is closed by relay 113 and at its armature 127, starts its contact vibrating. This contact is similar to that with which relay 122 is provided and comes to rest an interval after relay 176 has restored, to complete the circuit of relay 107 from ground by way of resting contact and armature 136. Relay 107 thereupon attracts its armatures 108 to 112, inclusive, at armature 108 opening a point in the energizing circuit of relay 147, at armature 109 preparing the circuit of relay 128, at armature 110 completing a second energizing circuit for relay 122 from ground on conductor 181, make contact and armature 110, make contact and armature 119, and winding of relay 122 to battery, and at armature 111 and make contact connecting winding of relay 103 to vibrating contacts of armature 124 of relay 122. Relay 107 at its armature 112 completes the obvious circuit of relay 176 which again operates to short circuit the calling loop circuit to remove the 110-volt current therefrom.

Relay 122 operates when its second energizing circuit is closed by relay 107 and at its armature 124 starts the contact vibrating. This contact finally comes to rest and completes the circuit of relay 103 in parallel with that of relay 122 by way of resting contact and armature 111 of relay 107. Relay 103 operates and at its armature 105 completes the circuit for relay 128 by way of armature 109 and make contact, normally closed contacts controlled by armature 130 of relay 128, winding of relay 128, resting contact and armature 167 of sleeve relay 165, and through the resistance to battery.

Relay 128 operates and at its armature 129 and make contact completes the circuit of relay 132 from ground through resting contact and armature 140 of relay 132. At its armature 131 relay 128 completes the circuit of the line lamp L, Fig. 3, over conductor 174.

Relay 132 operates when its circuit is closed, at its armature 134 and make contact connecting ground to release trunk conductor 44 and at the break contact of that armature, opening the circuit of relay 126, at armature 135 preparing a locking circuit for itself, at armature 136 opening the circuits of relays 176, 103, 107, 113, and 122, and at armature 137 disconnecting positive 110-volt current from conductor 45.

Relay 113 upon releasing after its circuit is opened, reconnects the relay 100 to the conductors 43 and 45, and relay 176 upon releasing, removes the short circuit from the calling loop by gradually increasing the resistance of the short circuit to the maximum presented by the carbon piles.

Relay 100 operates immediately when connected to the trunk and at armature 101 and make contact completes a locking circuit for relay 128 over armature 130 and make contact before slow-to-release relay 128 has had time to release after opening its energizing circuit at the normally closed contacts of its armature 130. Engagement of armature 102 with its make contact has no effect on relay 122 at this time since the circuit of this relay is opened at the normally closed contacts of armature 134 of relay 132.

In this condition of the equipment relays 100, 128, 132, and 147 are operated and the line lamp

L, Fig. 3, is lighted in front of the toll operator in whose position the trunk 169—175 terminates.

With reference to Fig. 1, the operation of the paystation equipment at substation A, when the positive 110-volt current is applied to the calling loop by relay 113 as described, will now be explained. The path of the positive 110-volt current is as follows: conductor 45, bank contact 42 and wiper 39' of selector S, lower talking conductor of the selector and a contact in the banks of wiper 39 of line switch LS, wiper 39, conductor 16, impulse contacts 32 of calling device C, copper-oxide valve 34, primary winding of induction-coil relay 17, normally closed contacts controlled by armature 20 of relay 17, transmitter T, switchhook contacts 1—2, conductor 15 through line switch LS, wiper 38, upper talking conductor through selector S, wiper 38' and bank contact 40, and trunk conductor 43. It will be remembered that conductor 43 is connected to ground in the trunk circuit and the conductor 45 is connected to positive 110-volt current source through the winding of relay 144.

Relay 17 operates by means of its primary winding in this circuit and immediately attracts its armatures, at its armature 20 opening the normally closed contacts and closing its make contact, thereby cutting the transmitter T out of the line circuit and including the 6,000-ohm resistance and the 3200-ohm holding winding in series with the primary winding. By this means the relay 17 will remain operated as long as the 110-volt current flows. At its armature 18 and resting contact, relay 17 opens the circuit through the receiver R, at the make contact of this armature completes the circuit for the refund magnet 13, and at its armature 19 and resting contact opens a point in the circuit of the upper winding of relay 27. Since it has been assumed that a coin has been deposited, the coin contacts will be in their operated position. Therefore, the circuit of the refund magnet is as follows: positive 110-volt current on conductor 16, conductor 31, coin contacts 6—5, winding of refund magnet 13, copper-oxide valve 35, make contact and armature 18 of relay 17, switchhook contacts 1—2, and over line conductor 15 to ground. Refund magnet 13 operates in this circuit to refund the deposited coin and to restore the coin contacts by attracting its armature 14 to release the latch 11. Attraction of armature 14 closes the contacts of mercury switch M with no effect at this time. Opening of the coin contacts opens the circuit of the refund magnet 13 and this magnet releases, allowing the automatic restoration of the coin apparatus.

When the 110-volt current is cut off from the calling loop by the operation of relay 176 as described, the relay 17 restores and reconnects the transmitter T and receiver R to the line.

The inclusion of the 6000-ohm resistance and the 3200-ohm holding winding in series with the calling loop circuit increases the resistance of that circuit sufficiently to cause the release of the marginally adjusted relay 144, Fig. 2, after the circuit of the refund magnet 13 has been opened at the coin contacts, which relay upon releasing closes the circuit of relay 147 which energizes and locks itself up as described.

Since no reversal of current has occurred in the calling loop circuit, the relay 21 will not have energized and will be in the position in which it is shown.

From the foregoing it will be appreciated that each time a paystation extends a call to a toll

operator and a coin is deposited in the coin apparatus, the coin is automatically returned to the calling subscriber upon seizure of a toll operator's incoming trunk by the application of positive 110-volt current to the normally positive side of the paystation line and that the 110-volt current is applied to the trunk and removed therefrom in such a manner as to avoid any disagreeable clicks or sounds in the receiver of the paystation.

If no coin has been deposited, the coin contacts would not have been in an operated position and the refund magnet 13 would not have operated. The rest of the equipment would function as described, however, in order to obtain the release of relay 144 and the consequent operation of relay 147.

It will be remembered that by the operation of relay 128, Fig. 2, the circuit of the line lamp L, Fig. 3, was completed over conductor 174 at armature 131 and make contact of relay 128. The toll operator, noticing the lighted condition of the lamp L, answers the call by inserting the answering plug P of her cord circuit O into the answering jack J. The cord circuit O has been shown in skeleton form only with those parts necessary for a complete understanding of this invention, since this cord circuit may be similar to those shown in the two U. S. Patents Nos. 1,770,392 and 1,771,842, issued to Thomas F. Crocker on July 15, 1930, and July 29, 1930, respectively.

This insertion of plug P in jack J completes the following circuit for the sleeve relay 165, Fig. 2: ground, lower 1000-ohm winding of relay 165, conductor 171, sleeve contacts of jack J and plug P, sleeve conductor 202, right-hand normally closed contacts of ringing key K3, spring 205 of key K2 and its normally engaging contact, spring 208 of key K1 and its normally engaging contact, and through supervisory lamp SL to exchange battery. Relay 165 operates in this circuit and attracts its armatures 166 to 168, inclusive, thereby disconnecting relay 153 from conductor 169 at armature 166, disconnecting relay 161 from trunk conductor 172 at armature 168, and at armature 167 opening the circuit of relay 128, which relay deenergizes. The supervisory lamp SL fails to light in series with relay 165 because of the comparatively high resistance of the lower winding.

Upon deenergizing, relay 128 at its armature 131 and make contact opens the circuit of the line lamp L and at the resting contact of that armature completes the circuit of paystation lamp L1 by way of armature 152 and make contact of relay 147 and conductor 175 since, it will be remembered, relay 147 operated and locked itself to the release trunk conductor 44 upon the restoration of relay 144. This lighting of the lamp L1 informs the toll operator that a paystation is calling. This lamp remains lighted as long as the connection is maintained, serving as a constant reminder to the toll operator.

Additional results of the restoration of relay 128 are the opening of the energizing circuit of relay 132 at armature 129 and the completion of a locking circuit for that relay which is traceable from ground, armature 101 and make contact of relay 100, armature 130 and resting contact of relay 128, make contact and armature 135 of relay 132, and winding of relay 132 to battery.

A locking circuit for relay 132 is also completed over conductor 170 and make contact and

spring 200 of jack J, which were closed by the insertion of the plug in the jack. Therefore, it is evident that relay 132 will remain energized until the calling subscriber has hung up the receiver, thereby opening the loop circuit of relay 100, and until the toll operator removes the plug from the jack.

The toll operator now converses with the calling subscriber and after determining the destination of the desired call requests the subscriber to deposit the necessary coins for the call. The toll operator is apprised of the amount deposited in the well-known manner and, if the amount is correct, proceeds to extend the call by inserting the plug P' into the jack J' and performing the things necessary depending on whether or not the system is an automatic telephone system or a manual telephone system.

The depositing of the first coin, if more than one is required for the call, causes the operation of the coin lever 10 which moves the latch 11 and consequently the coin contacts to the operated position. This prepares circuits for the collecting and refunding magnets which are later controlled by the operator.

The toll operator, after receiving the usual tone caused by the deposited coin, will momentarily operate the coin control key K, thereby momentarily completing the following circuit: ground through contacts of key K, conductor 173, armature 151 and make contact of relay 147, and winding of relay 156 to battery. Relay 156 operates in this circuit and locks itself through its armature 159 and make contact to ground at make contact and armature 148 of relay 147. Relay 156 at its armatures 158 and 160 and make-before-break contact arrangements reverses the connection of the relay 100 to the line conductors 43 and 45 to reverse the flow of current over the calling loop. This reversal causes the operation of relay 21 at the paystation, as explained in connection with the local call, which relay mechanically locks itself in its operated position by releasing the armatures of relay 27. With relay 21 in its operated position, the deposited coins can be refunded only by a voluntary action on the part of the operator. Relay 21 cannot operate as a buzzer in this case because, when the current reversal occurs, the coin contacts 9 and 8 are separated.

If the call is successfully extended by the toll operator, she will collect the deposited coins by the operation of collect key K2 of her cord circuit. At the make contact of spring 206 of key K2 negative 110-volt current is connected to the ring conductor 203 of the cord circuit, at spring 204 and its make contact the tip conductor 201 is connected to ground, and by the separation of spring 205 and its resting contact battery is disconnected from the sleeve conductor 202, thereby causing sleeve relay 165, Fig. 2, to restore and retract its armatures. At armature 168 and its resting contact the lower winding of relay 161 is connected to the negative 110-volt current over conductor 172, spring contacts of jack J and plug P, and conductor 203. Relay 161 thereupon operates, at its armature 162 and make contact locking itself to ground on tip conductor 201 over resting conductor and armature 166 of relay 165, trunk conductor 169, and tip contacts of jack J and plug P. At its armature 163 and make contact, relay 161 completes the obvious circuit of relay 113. The negative 110-volt current now flows from conductor 172, by way of resting contact

and armature 163 of relay 165, armature 164 and make contact of relay 161, make contact and armature 137 of relay 132, make contact and armature 121 of relay 113, since this relay operated when its circuit was closed by relay 161, conductor 45, lower talking conductor through the selector S and line switch LS, and thence over the previously traced circuit of the primary winding of relay 17 to ground on conductor 43 supplied through armature 114 and make contact of relay 113. Relay 17 operates in this circuit as when positive 110-volt current was applied to its winding, and at its armature 18 and make contact completes the following circuit for the collect magnet 12: negative 110-volt current on conductor 16, conductor 31, coin contact 6—5, winding of collect magnet 12, electronic valve 36, armature 18 and make contact of relay 17, and through hook-switch contacts 1—2, to ground on conductor 15. The collect magnet operates in this circuit to collect the deposited coin and release the coin contacts. The refund magnet 13 is prevented from receiving this negative 110-volt current by the electronic valve 35.

In order to insure complete operation of the collect magnet 12, a circuit therefor, which is independent of the coin contacts, is completed when the magnet 12 attracts its armature and tilts the mercury contact switch M. This circuit is as follows: negative 110-volt current through the primary winding of relay 17, make contact and armature 20 thereof, armature 23 and make contact of relay 21, contacts of mercury switch M closed by the mercury when the switch is tilted, and thence through the winding of collect magnet 12 to ground on conductor 15 over the previously traced circuit. Magnet 12, therefore, receives current as long as relay 17 remains operated, which is until the toll operator restores her collect key K2. Upon the restoration of key K2, the negative 110-volt current is removed from the trunk and relay 17 restores, at its armature 18 and 20 reconnecting the receiver and transmitter to the line. Restoration of key K2 also results in the unlocking of relay 161 followed by the restoration of relay 113 and the reoperation of sleeve relay 165. Conversation between the calling and called subscribers may now take place.

If the toll operator should be unsuccessful in extending the call, she will operate her refund key K1 to return the deposited coins to the calling subscriber. Operation of this key connects ground to the tip conductor 201, opens the sleeve conductor 202, and connects positive 110-volt current to the ring conductor 203. Relays 165, 161, and 113 function the same as when key K2 was operated. Relay 17 functions the same as when positive 110-volt current was applied upon seizure of the trunk by the selector S and completes the circuit of the refund magnet 13 as previously described, which magnet thereupon operates and returns the deposited coins to the calling subscriber.

It is sometimes the practice for the toll operator to request the calling subscriber to hang up while she is extending the call. The only result of the replacement of the receiver R on the switchhook when this occurs is the restoration of relay 100 which causes the lighting of supervisory lamp SL of the cord circuit by completing the following circuit therefor: ground, armature 101 and resting contact of relay 100, normally closed contacts controlled by armature 117 of

relay 113, armature 141 and resting contact of relay 138, and through the upper 10-ohm winding of relay 165, and over the previously described circuit to the lamp SL and battery. The upper 10-ohm winding of relay 165 short circuits the lower winding of this relay, thereby permitting the supervisory lamp SL to light in a low resistance circuit to inform the operator that the calling subscriber has hung-up as requested. Relay 165 remains energized in series with the supervisory lamp SL.

The connection is maintained with the paystation since relay 132 remains locked up to ground on conductor 170 from springs of jack J and maintains the holding ground for the selector S and line switch LS on the release trunk conductor 44 through its armature 134 and make contact and resting contact and armature 140 of relay 138. When the operator has extended the connection or when she desires to inform the calling subscriber that she is unable to extend the connection, she operates her ringing key K3 which opens sleeve conductor 202 to restore sleeve relay 165 and connects negative exchange battery to the tip conductor 201. Relay 153 of the trunk circuit thereupon operates from ground, winding of relay 153, resting contact and armature 162 of relay 161, resting contact and armature 166 of relay 165, conductor 169, tip contacts of jack J and plug P, and over tip conductor 201 to negative battery supplied through the make contacts of ringing key K3.

Relay 153, upon operating, at its armature 155 and make contact connects ringing generator by way of resting contact and armature 121 of relay 131 to conductor 45 and thence over the lower talking conductor through the selector and line switch to the conductor 16, and through the ringer B and condenser to ground to signal the subscriber at the paystation. Restoration of the ringing key K3 causes the release of relay 153 and the reoperation of relay 165. The operator, upon the response of the party, either requests the depositing of coins or informs the party that she has been unsuccessful in extending the call.

It may happen that the toll operator, because of some abnormality, may request the calling subscriber to hang-up after the coins have been deposited and after relay 21 has operated following the momentary operation of key K, until she is ready to call back. When the switchhook springs are restored by the replacement of the receiver, the following circuit is completed: ground supplied through conductor 16 through the upper winding of relay 100, conductor 31, coin contacts 6—5, resting contact and armature 30 of relay 27, lower winding of relay 27, switchhook contacts 3—2, to battery supplied to conductor 15 through the lower winding of relay 100. Relay 27 energizes in this circuit and at the commencement of the moving of its armatures opens the contacts 30, thereby interrupting its own circuit before it has had time to completely attract its armature 28 and release the relay 21. This opening of the circuit of relay 27 causes that relay to restore and at its armature 30 and resting contact again completes its circuit. Relay 27 therefore repeatedly energizes and deenergizes and by so doing generates a tone which is heard by the operator and which informs the operator that there are coins in the coin hopper to be either collected or refunded. If, after a time, the operator determines that the coins must be refunded, she rings the calling subscriber, as before explained, by the operation of key K3. After the

party has responded, the operator operates the refunded key K1 to refund the coins as explained. Ringing the calling party in order to refund the coin is necessary because with relay 21 in operated position and with the hookswitch springs at normal, any application of 110-volt current, regardless of polarity, operates the collect magnet 12, since relay 17 cannot operate to operate the refund magnet because of the open condition of hookswitch contacts 1—2.

When the subscribers have completed their conversation after a successful connection, they replace their receivers upon the switchhooks. The replacement of the receiver at the paystation A causes the release of relay 100 and the lighting of the supervisory lamp SL as previously explained to provide the operator with disconnect supervision. The operator thereupon withdraws the plug P from the jack J and the plug P' from the jack J'.

Removal of plug P from jack J results in the removal of ground from conductor 170 at jack contacts 200 and the removal of battery from the sleeve conductor 171. Relay 165 restores when the battery is removed from conductor 171 but relay 132 remains operated in the following circuit after the ground is disconnected from conductor 170 at the jack: ground, make contact and armature 150 of relay 147, resting contact and armature 142 of relay 138, lower winding of slow-release relay 138, conductor 170, make contact and armature 135 of relay 132, and winding of relay 132 to battery. Relay 138 operates in this circuit and locks itself to ground at resting contact and armature 101 of relay 100 by way of its own make contact and armature 141. Other results of the operation of relay 138 are the completion of the obvious circuit of relay 113 at make contact and armature 143, the opening of the circuit of its lower winding and consequently the circuit of relay 132 at armature 142, the removal of ground from the release trunk conductor 44 at armature 140, and at armature 139 the application of another ground connection to the release trunk conductor 44.

Relay 113 operates, when its circuit is completed, at armature 116 and make contact makes an additional ground connection to the release trunk conductor 44, at armature 114 and make contact connects trunk conductor 43 to ground, at armature 117 opens the locking circuit of relay 138 and at the make contact of that armature prepares another locking circuit for that relay, and at armature 121 and make contact connects trunk conductor 45 to the armature 137 of relay 132.

Relay 132 restores when its circuit is opened by relay 138 and at armature 137 and resting contact connects positive 110-volt current through relay 144 and through make contact and armature 121 of relay 113 to trunk conductor 45 and consequently through the selector and line switch to conductor 16. Since relay 21 is mechanically locked in its operated position and since the receiver at this time is on the hook, the positive 110-volt current operates the collect magnet 12 in the following circuit: conductor 16, conductor 31, coin contacts 6—5, winding of collect magnet 12, make contact and armature 26 of relay 21, resting contact and armature 19 of relay 17, electronic valve 37, hookswitch contacts 3—2, and conductor 15 to ground on conductor 43. Relay 144 and collect magnet 12 operate on this flow of 110-volt current. Relay 144 at its armature 146 completes a lock-

ing circuit for slow-to-release relay 138 before that relay has had time to energize after its circuit was opened at armature 117 of relay 113. Collect magnet 12 operates to collect the coins in the hopper and to restore the coin contacts. Restoration of coin contact 6 into engagement with contact 7 completes the following circuit: positive 110-volt current on conductor 16, conductor 31, coin contacts 6—5, armature 24 and make contact of relay 21, upper winding of relay 27, electronic valve 37, hookswitch contacts 4—3, and thence over conductor 16 to ground on conductor 43. Relay 27 operates in this circuit and mechanically unlocks relay 21 which, upon releasing, opens the circuit of relay 27. The opening of this circuit causes relay 144 to restore and at its armature 146 open the locking circuit of relay 138. Relay 138 thereupon restores and releases relay 113 which in turn restores.

Restoration of relays 138 and 113 removes all ground connections from the release trunk conductor 44, thereby causing the restoration of the selector S and the line switch LS in the well-known manner.

This application of positive 110-volt current upon the release of the connection by both the calling party and the toll operator is a safeguard for the collection of coins in case the toll operator should have neglected to operate her collect key K3 after having received the usual tone caused by the depositing of the coin at the paystation.

If the coins had previously been collected by the operator in the way described, the application of positive 110-volt current upon the termination of the connection would have merely operated the relay 27 to release the relay 21, since coin contact 6 would have been in engagement with contact 7 instead of contact 5.

From this description of the establishment of a toll connection from the paystation A, it has been seen that the application of positive 110-volt current to the normally positive side of the calling line when the receiver is off the hook at the paystation results in the refunding of any deposited coin, that the application of negative 110-volt current to the normally positive side of the line under the same conditions results in the collection of the deposited coin, and that the application of positive 110-volt current to the same side of the line after the calling subscriber at paystation A has replaced the receiver on the switchhook results in the collection of any deposited coin. It has also been seen that after the current in the calling loop circuit has been reversed by the toll operator no refunding of coins can take place except by deliberate action on the part of the operator. It has also been seen that means has been provided whereby, should an operator fail to collect coins in the usual manner, these coins are automatically collected when the connection is broken down and therefore are not left in the hopper to be automatically refunded in the manner described when a succeeding call is extended to a toll operator. It has also been seen that the operations of the collect magnet 12 and refund magnet 13 by the application of various polarities of 110-volt current to the same side of the line are selectively controlled because of the direction of the current flow as governed by the copper oxide valves.

When the subscriber at the regular or local station A' desires to make a toll call, he will take down his receiver, whereupon the line

switch LS1 individual to the station A' will select a trunk leading to an idle selector such as S1. In response to the operation of the calling device C1 in accordance with the appropriate number to obtain connection with the toll operator, the selector S1 operates in the well-known manner to select an idle outgoing trunk to an operator's position. It will be assumed that the idle trunk selected by the selector S1 is that comprising conductors 43 to 45, inclusive, which terminates in the bank of the selector S1 at bank contacts 40' to 42', inclusive. When this trunk is seized by the selector S1, the relay 100 in the trunk circuit operates and the equipment in Fig. 2 thereupon functions as described to send the pulse of 110-volt current over the calling line. This functioning of the trunk circuit at this time is without effect as far as the local station A' is concerned, since it is not provided with any coin-collecting apparatus, and results only in the lighting of the line lamp L at the operator's position.

It is to be noted in this type of a call that since the station A' is not provided with paystation apparatus the resistance of the line is not noticeably increased when application of 110-volt current takes place. Therefore, the relay 144 will remain energized as long as 110-volt current remains on the line, thereby maintaining the circuit of relay 147 open at armature 145 of relay 144 until this circuit has been opened at armature 115 of relay 113 when the 110-volt current is disconnected from the line. Therefore, relay 147 will not be operated at any time in this connection and when relay 128 is restored to normal upon the answering of the call by the operator, as described, the circuit of the paystation lamp L1 will not be completed. By this means, the toll operator will know that the call is being extended from a local station and that there will be no need for her to perform any coin-controlling operation.

Since in this case relay 147 is in the deenergized position when the connection is taken down by the toll operator, no operation of the relay 138 takes place, inasmuch as the circuit of its lower winding is open at armature 150 of relay 147 and consequently the relay 138 cannot operate and operate the relay 113 to send a pulse of positive 110-volt current to the calling line.

It will be noted that the signalling bells at the local station A' are bridged across the line when the receiver is on the switchhook. Under these conditions, operation of the ringing key K3 in the operator's cord circuit, when she desires to ring the station A' after having requested the subscriber thereat to hang-up, operates the relay 153 of the trunk circuit as before. This time, however, instead of ringing over the negative side of the calling line to ground at the substation through the bells and a condenser, the ringing circuit extends over the normally negative line conductor 15 back to ground over conductor 43, armature 114 and resting contact of relay 113, armature 154 and make contact of relay 153, and resting contact and armature 148 of relay 147.

With the few exceptions just noted, the operation of the trunk circuit is the same for both calls from paystations and calls from local stations, and it can be seen from this that the amount of equipment required in an automatic exchange employing such a trunk circuit is materially reduced, since it is unnecessary to pro-

vide different groups of trunks for paystations and local stations.

The invention having been thus described, what is considered new and what it is desired to have protected by Letters Patent will be evident from the claims which follow.

What is claimed is:

1. In a telephone system, a station having coin collecting apparatus, a trunk circuit, an automatic switch controllable from said station to seize said trunk to extend a call, and means associated with said trunk circuit and responsive to the seizure thereof by said switch for operating said apparatus to refund any coin deposited therein.

2. In a telephone system, a paystation provided with coin collecting and refunding apparatus, an operator's position provided with a link circuit for extending calls, a trunk circuit terminating at said position, an automatic switch controllable from said substation for seizing said trunk to extend a call to said position, means in said trunk circuit and responsive to the seizure thereof by said switch for signalling said position and for operating said apparatus to refund any deposited coin, said link circuit thereupon being connected to said trunk to extend the call beyond said position, and means responsive to the disconnection of said link and trunk circuits when the call is terminated for operating said apparatus to collect any deposited coins.

3. In a telephone system, a paystation provided with a coin collector, a trunk circuit terminating in an operator's position, a source of special current associated with said trunk circuit, an automatic switch controllable from said paystation to seize said trunk circuit to extend a call to said position, and means in said trunk circuit responsive to the seizure of said trunk for momentarily applying said special current thereto to operate said collector to refund a deposited coin.

4. In a telephone system, a paystation provided with a coin collector, an operator's position provided with a link circuit for extending calls therethrough, a trunk circuit terminating at said position, an automatic switch controllable from said station, after the receiver thereat has been removed from the receiver hook, to seize said trunk circuit to extend a call to said position, a source of special current associated with said trunk circuit, means in said trunk circuit responsive to the seizure thereof for signalling said position and for momentarily applying said special current thereto to operate said collector to refund a deposited coin, said link circuit thereafter being connected to said trunk circuit to extend the call, and means in said trunk circuit responsive to the disconnection thereof from said link circuit after the call has been terminated for again momentarily applying said special current to the trunk to operate said collector to collect coins deposited after said refunding has taken place.

5. In a telephone system, a calling line provided with a coin collector at the substation of the line, a trunk circuit terminating in an operator's position, a source of special current associated with the trunk circuit, means controllable over said line for connecting said line to said trunk circuit to extend a call to said position, and means in said trunk circuit responsive to such connection for gradually applying said special current to said line and gradually removing said special cur-

rent therefrom, said coin collector operated by the special current to refund a deposited coin.

6. In a telephone system, a calling line provided with a coin collector, a trunk circuit terminating in an operator's position, a source of special current associated with the trunk circuit, means controllable over said line for connecting the line to the trunk circuit to extend a call to said position, and means operating automatically responsive to such connection for gradually short circuiting said line, connecting said special current to said trunk circuit, gradually removing said short circuit to apply said current to said line, again gradually short circuiting said line to remove said circuit therefrom, disconnecting said current from said trunk circuit, and again removing said short circuit from said line, said coin collector operated by said special current when applied to said line to refund a deposited coin.

7. In a telephone system, a calling line having a coin collector, a trunk circuit terminating in an operator's position, a source of special current associated with said trunk, means operable from the substation on said line for connecting said line to said trunk to extend a call to said position, a high resistance bridge circuit connected across the line end of said trunk, means responsive to the connection of said line to said trunk for decreasing the resistance of said bridge circuit to short circuit the line, means for then connecting said special current to said trunk and causing said second means to gradually increase the resistance of said bridge circuit to gradually apply said special current to said line, said coin collector operated by said current on said line to refund a deposited coin.

8. In a telephone system, a calling line having a coin collector, a trunk circuit terminating in an operator's position, a source of special current associated with said trunk, means controlled from said calling line for connecting said line to said trunk, a high resistance bridge circuit across said trunk including a series of non-compressed carbon discs, a relay in said trunk circuit adapted when operated to compress said discs to decrease the resistance of said bridge circuit and adapted to release slowly to gradually remove the pressure from said discs to gradually increase the resistance of said bridge circuit, the line end of said trunk circuit being short circuited when the bridge resistance is low, means responsive to the connection of said line to said trunk to momentarily operate said relay to short circuit said line and then connect said special current to said trunk, said relay releasing slowly after the momentary operation and gradually increasing the resistance of said bridge circuit, thereby gradually removing said short circuit to gradually apply said current to said line, said coin collector thereupon operating to refund a deposited coin.

9. In a telephone system, a calling line, a trunk circuit, a source of special current associated with said trunk, means for connecting the line to the trunk, a high resistance bridge circuit across the line end of said trunk, a relay in said trunk operated responsive to the connection of the line to the trunk, means responsive to the operation of said relay for decreasing the resistance of said bridge circuit to short circuit said line, and means also responsive to the operation of said relay for connecting said special current to said trunk and slowly releasing the second-mentioned means to gradually increase the resistance of said bridge circuit to gradually remove the short

circuit of said line, thereby gradually applying said special current to said line.

10. In a telephone system, a calling line, a trunk circuit, a source of special current associated with said trunk, means for connecting said line to said trunk, a normally high resistance bridge circuit across the line end of said trunk, a relay in said trunk operated responsive to the connection of said line to said trunk, means responsive to the operation of said relay for gradually decreasing the resistance of said bridge until said line is short circuited, means also responsive to the operation of said relay for connecting said special current to said trunk and controlling said second-mentioned means to gradually increase the resistance of said bridge circuit, thereby gradually removing the short circuit of said line to gradually apply said special current thereto, and means for thereafter controlling said second-mentioned means to again gradually and momentarily short circuit said line to remove said special current therefrom and disconnect said special current from said trunk while said line is momentarily short circuited.

11. In a telephone system, a calling line having a substation provided with coin collecting and refunding apparatus, a trunk circuit terminating in an operator's position having a link circuit for extending a call therethrough, a source of special current of positive and negative polarities, means for connecting said line to said trunk to extend a call to said position, means in said trunk responsive to the connection of the line thereto for connecting the special current of positive polarity to the normally positive side of said line, whereby said coin collector is operated to refund a deposited coin, means for connecting said link circuit to said trunk, means in said link circuit for applying said special current of either polarity through said trunk to the same side of said line, whereby said coin collector is operated when the current of the negative polarity is applied to collect any deposited coins or is operated when the current of positive polarity is applied to refund deposited coins, and means operating automatically when said link is disconnected from said trunk after the call is terminated by said substation to again apply the special current of positive polarity to the same side of said line, whereby said coin collector is operated if any coins are therein to collect those coins.

12. In a telephone system, a calling line, a coin collector at the substation of said line having a collect magnet and a refund magnet, a trunk circuit terminating in an operator's position having a link circuit for extending a call therethrough, a source of special current of positive and negative polarities, means for connecting said calling line to said trunk to extend a call from said line to said position, means in said trunk responsive to such connection for momentarily connecting the special current of positive polarity to said trunk and to said line and for signalling said position, means at said substation for directing said positive polarity current through said refund magnet to operate that magnet to refund a deposited coin, and means in said link circuit effective after said link has been connected to said trunk to extend the call through said position for applying at will either of said polarities of the special current to said trunk and line, said means at said substation directing the special current of negative polarity through the winding of the collect magnet to collect coins deposited at the request of the op-

erator or directing the special current of positive polarity through the winding of the refund magnet to refund such coins.

13. In a telephone system, a calling line, a coin collector at the substation of said line having a collect magnet and a refund magnet, a trunk circuit terminating in an operator's position having a link circuit for extending calls therethrough, a source of special current of positive and negative polarities, means for connecting said calling line to said trunk circuit to extend a call to said position, means in said trunk operating automatically responsive to that connection to momentarily apply the special current of positive polarity to said line, and means in said link circuit effective after said link circuit is connected to said trunk for applying at will the special current of either polarity over said trunk to said line, and circuit means including electronic valves at said substation for directing the flow of said special current of positive polarity through the refund magnet and that of negative polarity through the collect magnet.

14. In a telephone system, a paystation line, a coin collector at the paystation having a collect magnet and a refund magnet, a local line, a trunk circuit terminating in an operator's position having a link circuit for extending calls therethrough, a source of special current associated with said trunk circuit, means for connecting either of said lines to said trunk circuit to extend a call to said position, means in said trunk operating automatically responsive to the connection of a calling line thereto to momentarily apply said special current to that line, circuit means at the paystation effective when the paystation line is the calling line for directing said special current through the winding of said refund magnet to refund a deposited coin, and means in said trunk circuit operating automatically upon the disconnection of said link circuit from said trunk upon the termination of a call by the calling station for momentarily applying said special current to the calling line only when the calling line is said paystation line, said circuit means at said paystation under these conditions directing the special current through the winding of the collect magnet to collect coins deposited at the request of the operator.

15. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs controlled by the receiver hook of the telephone, and circuit connections for said magnets including said contact springs, whereby operating current of a positive polarity applied to said connections operates the refund magnet to refund a deposited coin when the receiver is off the hook and operates the collect magnet to collect a deposited coin when the receiver is on the hook.

16. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs controlled by the receiver hook of the telephone, current flow directing devices, and circuit connections for said magnets including said contacts and said devices, whereby operating current of one polarity applied to said connections is directed to operate the refund magnet when the receiver is off the hook and to operate the collect magnet when the receiver is on the hook.

17. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs associated with said collector and moved to an operated position by a

deposited coin, contact springs controlled by the receiver hook of the telephone, and circuit connections for said magnets including said coin contact springs and said hook contact springs, whereby operating current of constant polarity applied to said connections operates the refund magnet when the receiver is off the hook to refund a deposited coin and operates the collect magnet when the receiver is on the hook to collect a deposited coin.

18. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs associated with said collector and operated by a coin deposited therein, contact springs controlled by the receiver hook of the telephone, current flow directing devices, and circuit connections for said magnets including said coin-controlled springs, said hook-controlled springs, and said devices, whereby operating current of a constant polarity applied to said connections after said coin contacts have been operated by a deposited coin is directed to operate the refund magnet when the receiver is off the hook to refund the deposited coin and directed to operate the collect magnet when the receiver is on the hook to collect the deposited coin.

19. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs associated with the collector and operated by a deposited coin, means for maintaining the coin contacts operated, contact springs controlled by the receiver hook of the telephone, current flow directing devices, circuit connections for said magnets including both of said contact springs and said devices, whereby operating current of a single polarity applied to said connections after a coin has been deposited operates the refund magnet when the receiver is off the hook to refund the deposited coin and operates the collect magnet when the receiver is on the hook to collect the coin, and means operated by each magnet to restore said coin contacts.

20. In a telephone system, a telephone instrument, a coin collector having a collect magnet and a refund magnet and associated with said instrument, a line connecting said instrument with the exchange, contact springs controlled by the receiver hook of said instrument, current flow directing devices associated with said collector, and circuit connections for said magnets including said springs and said devices, whereby operating current of a positive polarity applied to one side of said line operates the refund magnet when the receiver is off the hook to refund a deposited coin and operates the collect magnet when the receiver is on the hook to collect a deposited coin, and whereby operating current of a negative polarity applied to the same side of said line operates said collect magnet when the receiver is off the hook.

21. In a telephone system, a two-conductor line terminating in an exchange, a substation on said line having a telephone instrument and a coin collector provided with a collect and a refund magnet, contact springs controlled by the receiver hook of said instrument, current flow directing devices at said substation, and circuit connections for connecting said magnets to said line including said contact springs and said devices, whereby operating current of a positive polarity applied to one conductor of the line at the exchange after a coin has been deposited is directed to operate the refund magnet when the receiver is off the hook, operating current of a negative polarity

applied to the same conductor of the line at the exchange is directed to operate the collect magnet when the receiver is off the hook, and operating current of either polarity applied to the same conductor is directed to operate the collect magnet when the receiver is on the hook.

22. In a telephone system, a paystation line having a coin collector at the substation, a local line, a trunk circuit common to both of said lines and terminating in an operator's position provided with a pair of trunk signals and link circuit for answering and extending calls, means for connecting either of said lines as a calling line to said trunk circuit, a source of special current, means in said trunk circuit responsive to the connection of a calling line thereto for momentarily connecting said special current to the calling line and operating one of said signals to signal the operator at said position, said coin collector operated by said momentary connection of said special current when said paystation line is the calling line to refund a deposited coin, means in said trunk circuit responsive to the connection of the link circuit to the trunk circuit when the paystation line is connected thereto for wiping out said one signal and operating the other signal, and means in said trunk circuit responsive to the disconnection of the link circuit therefrom when the paystation line is connected thereto for momentarily connecting said special current to the paystation line, said coin collector thereupon operated by the special current to collect any coins deposited at the request of the operator.

23. In a telephone system, a calling paystation line, a trunk circuit terminating in an operator's position, a line lamp and a paystation lamp associated with the position end of said trunk circuit, a link circuit at said position for answering calls extended thereto, means controlled from the paystation of said line for connecting said line to the trunk circuit to extend a call to said position, a special current supply circuit, a marginal relay included in the supply circuit, means in said trunk circuit responsive to the connection of said line thereto for momentarily connecting said supply circuit to said trunk, thereby causing said special current to flow through the marginal relay and over the line to the paystation whereupon said relay is operated, and for completing a lighting circuit for said line lamp to signal the operator at said position, means at the paystation momentarily operated by the flow of special current over the line to momentarily and materially increase the resistance of the line to cause the restoration of said marginal relay, means responsive to the restoration of said marginal relay for preparing a lighting circuit for said paystation lamp, said lamp circuit means responsive to the connection of said link circuit to said trunk circuit when the call is answered for opening the line lamp circuit and completing the prepared lighting circuit of the paystation lamp.

24. In a telephone system, a calling paystation line provided with a coin collector at the paystation, a toll operator's position, a trunk circuit terminating therein, a link circuit at said position for answering and extending calls, a source of special current of positive and negative polarities, means for connecting said calling line to said trunk circuit to extend a call to said position, means in said trunk responsive to such connection for momentarily connecting the special current of positive polarity to said trunk and the calling line, said coin collector operated by the special current to refund a deposited coin, means

for connecting said link circuit to said trunk to answer said call, means at said paystation operated over the calling line and trunk by the toll operator after coins have been deposited in the collector at her request for preventing operation of the coin collector to refund the deposited coins except at her direction, this means mechanically locking itself operated upon being operated by the toll operator, operator controlled means in said link circuit for connecting the special current of either polarity to said trunk and calling line, whereby the toll operator can control said coin collector to collect or refund at will, and means in said trunk circuit responsive to the disconnection of the link circuit from the trunk circuit after the call has been terminated at the paystation for momentarily connecting the special current of positive polarity to said trunk and line, and means at the paystation operated by this momentary connection of special current to restore said mechanically locked means.

25. In a toll service telephone system, a calling paystation line having a coin collector at the paystation, a toll operator's position, circuit means for connecting said line to said position to extend a call thereto, means at said position for controlling said coin collector to collect or refund coins deposited at the operator's request, and means at the paystation operating automatically upon the termination of the connection by the paystation when there are coins in said collector to signal the operator that there are coins in the collector.

26. In a toll service telephone system, a calling paystation line having a coin collector, a toll operator's position, circuit means for connecting the calling line to the operator's position to extend a call thereto, and means at the paystation operating automatically upon the replacement of the receiver at the paystation when there are coins in the collector to be disposed of to audibly signal the operator to that effect.

27. In a toll service telephone system, a calling line, a substation on said line having paystation apparatus, a trunk circuit terminating in an operator's position provided with a link circuit, means controlled from said substation for connecting said line to said trunk circuit to extend a call to said position, whereupon the operator connects said link circuit to said trunk circuit to extend said call through said position, means responsive to the connection of said line to said trunk circuit for transmitting a first impulse of current over said line, circuit connections at the substation whereby said first impulse of current operates said apparatus to refund a deposited coin, means whereby the operator manipulates said circuit connections to cause a second impulse of current to operate the apparatus to collect a coin deposited at her request, and means responsive to the disconnection of said link circuit from said trunk circuit for transmitting a third impulse of current over said line.

28. In a toll service telephone system, a calling line having paystation apparatus, a trunk circuit terminating in an operator's position, means controlled from the substation of said line for connecting said line to said trunk circuit to extend a call to said position, means in said trunk circuit responsive to the connection of said line thereto for operating said paystation apparatus to refund a deposited coin, and means whereby the operator renders said apparatus unoperable to refund any coins deposited at her request except under her control.

29. In a telephone paystation apparatus, a coin collector having a collect magnet and a refund magnet, contact springs controlled by the receiver hook of the telephone, and circuit connections for said magnets including said contact springs whereby operating current applied to said connections operates said refund magnet when the receiver is off the hook to refund a deposited coin and operates the collect magnet when the receiver is on the hook to collect a deposited coin.

30. Telephone paystation apparatus for use in an automatic telephone system wherein the final switch in the switch train reverses the normal flow of exchange current over the calling line upon response of the called party, said apparatus comprising a coin collector having a refund magnet and a collect magnet, contacts controlled by the receiver hook of the telephone, a relay responsive to the reversal of the normal current flow, and circuit connections for said magnets controlled by said relay and completed by said contacts upon the replacement of the receiver on the hook whereby the normal current flow operates the refund magnet to refund a deposited coin upon termination of an incomplete connection and operates the collect magnet to collect a deposited coin upon termination of a completed connection.

31. Telephone paystation apparatus for use in an automatic telephone system wherein the final switch in the switch train reverses the normal flow of exchange current over the calling line upon completion of a connection by the called party and restores the normal current flow upon termination of the connection by the called party, said apparatus comprising a coin collector having a collect magnet and a refund magnet, a relay having an armature with a break contact and a make contact, a current flow directing device, circuit connections for said relay including said device whereby said relay is operatively energized by the exchange current when the normal flow thereof has been reversed, contacts controlled by the receiver hook of the telephone, circuit connections for the refund magnet including said receiver hook contacts and the armature and break contact of said relay whereby the normal flow of exchange current operates said refund magnet to refund a deposited coin upon the termination of an incomplete connection, and circuit connections for the collect magnet including said receiver hook contacts and said armature and make contact whereby the normal flow of exchange current operates said collect magnet to collect a deposited coin upon the termination of a completed connection.

32. In a telephone system, a calling line terminating in an exchange having a central source of current, a toll device on said line, a trunk circuit, a source of current other than said central source associated with said trunk circuit, means operated by current from said central source and controlled from the substation of said line for connecting said line to said trunk circuit, and means in said trunk circuit operated by current from said central source responsive to said connection for momentarily applying said special current to said line to operate said device.

33. In a telephone system, a calling line having a toll device and terminating in an exchange having a central source of current, a trunk circuit for extending calls, a source of special current other than said central source associated with said trunk circuit, means controlled by said calling line for connecting said line to said trunk

circuit, whereupon a current flow from said central source is established over the talking strands of the connection including the line and trunk circuit, means operating automatically responsive to said establishing of the current flow for momentarily interrupting that current flow and momentarily establishing a flow of said special current over the talking strands to operate said measured service device.

34. In a telephone system, a paystation line, a regular subscriber's line, a trunk circuit terminating in an operator's position, a source of special current associated with said trunk circuit, means controlled from the substation of either line for connecting either line to said trunk circuit to extend a call to said position, means in said trunk circuit responsive to the connection of either of said lines thereto for transmitting an impulse of said special current over the connected line and for signalling the operator to indicate the extension of a call thereto, and means at the substation of the paystation line operated by said impulse of special current when the paystation line is connected to said trunk circuit for con-

trolling said signalling means to indicate that the call is being extended over the paystation line.

35. In telephone system, a paystation line provided with coin collecting and refunding apparatus, a regular subscriber's line, a trunk circuit terminating in an operator's position, a source of special current associated with said trunk circuit, means controlled from the substation of either line for connecting either line to said trunk circuit, means in said trunk circuit responsive to the connection of either line thereto for transmitting an impulse of said special current over the connected line and for signalling the operator that one of said lines has extended a call to said position, said apparatus responsive to said impulse of special current when said paystation line is connected to said trunk circuit for refunding a deposited coin, and means associated with said apparatus and responsive therewith to said impulse for controlling said signalling means to indicate at said position that the paystation line is the calling line.

CHARLES R. BROOKS.

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