March 16, 1926.

1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 1

Fig. 1.

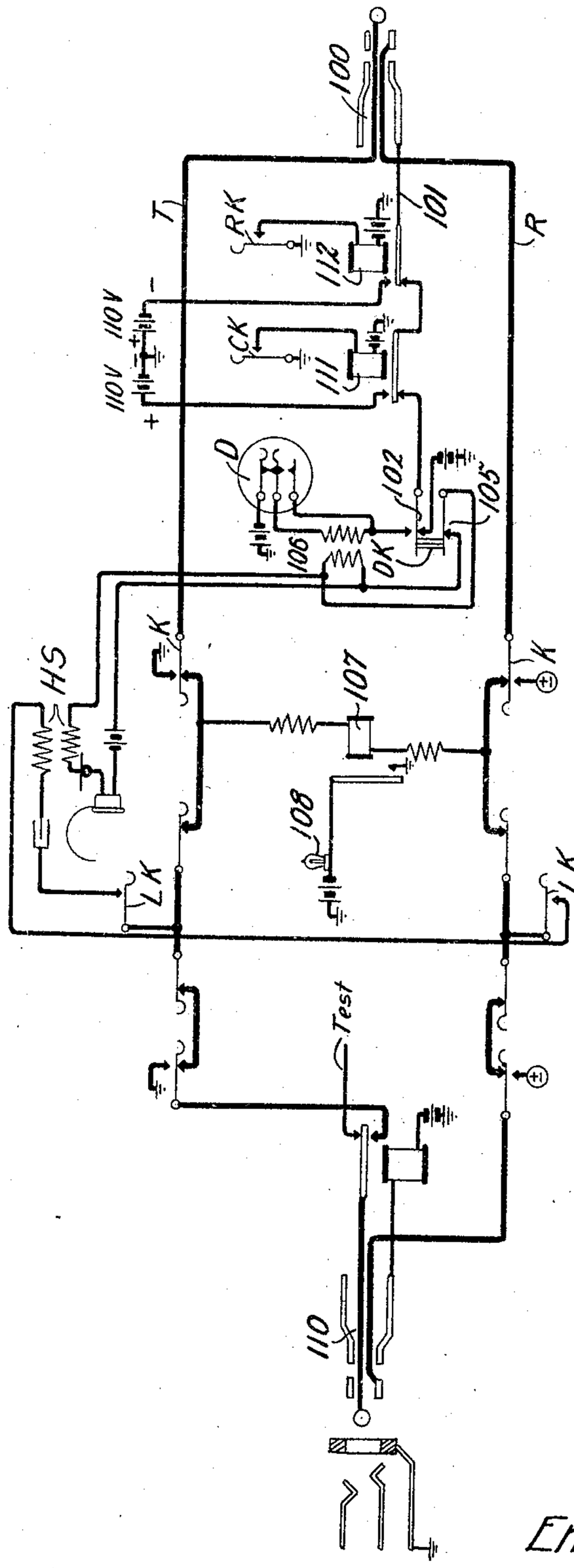


Fig. 10.

Fig. 5	Fig. 6.	Fig. 7

Fig. 9.

Fig. 7.	Fig. 2	Fig. 3.	Fig. 4.
Fig. 1.			

Fig. 0.

Fig. 5	Fig. 6.	Fig. 7.	
Fig. 2.	Fig. 3.	Fig. 4.	
Fig. 1.			

Inventor:
Emil Jacobsen,
by Geo. Atty.

March 16, 1926.

1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 2

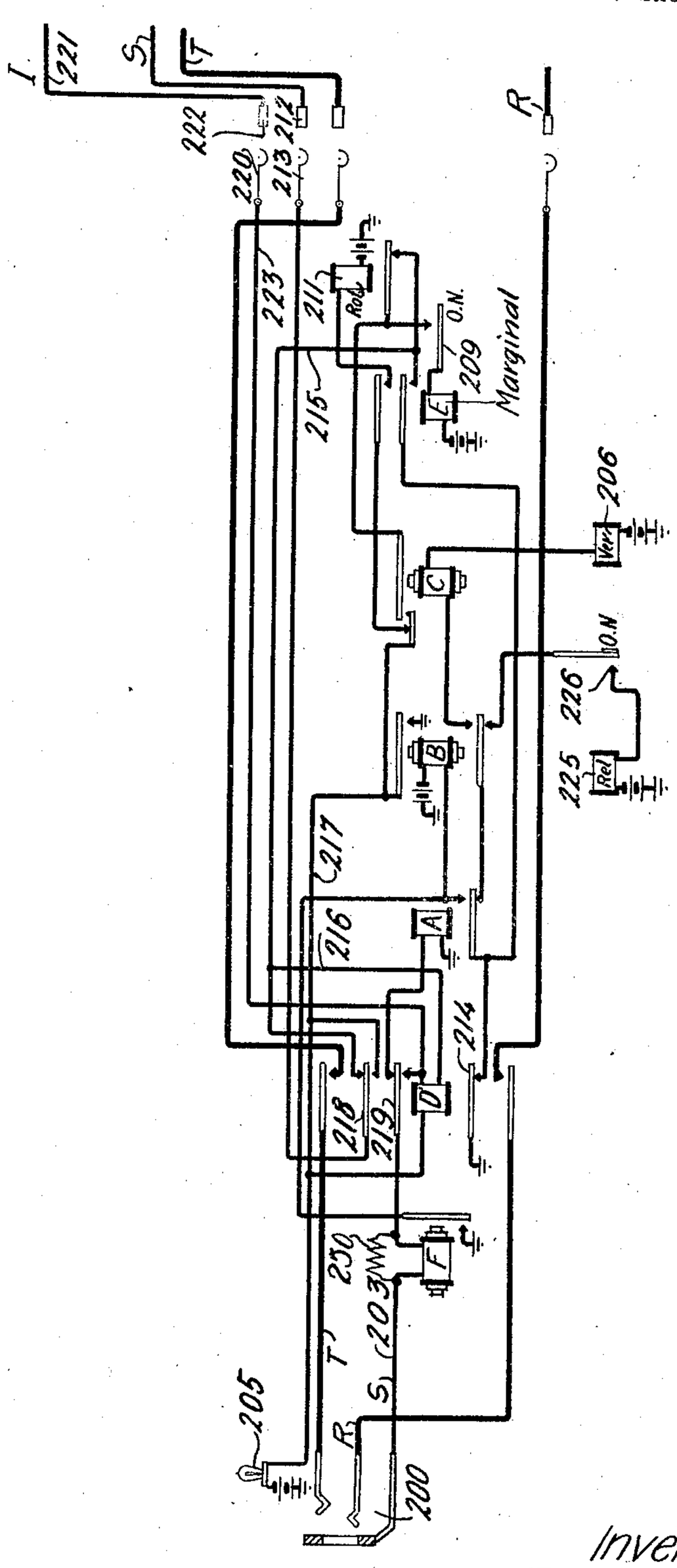


Fig.2.

Inventor:
Emil Jacobsen,
by gerson Atty.

March 16 , 1926. 1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 3

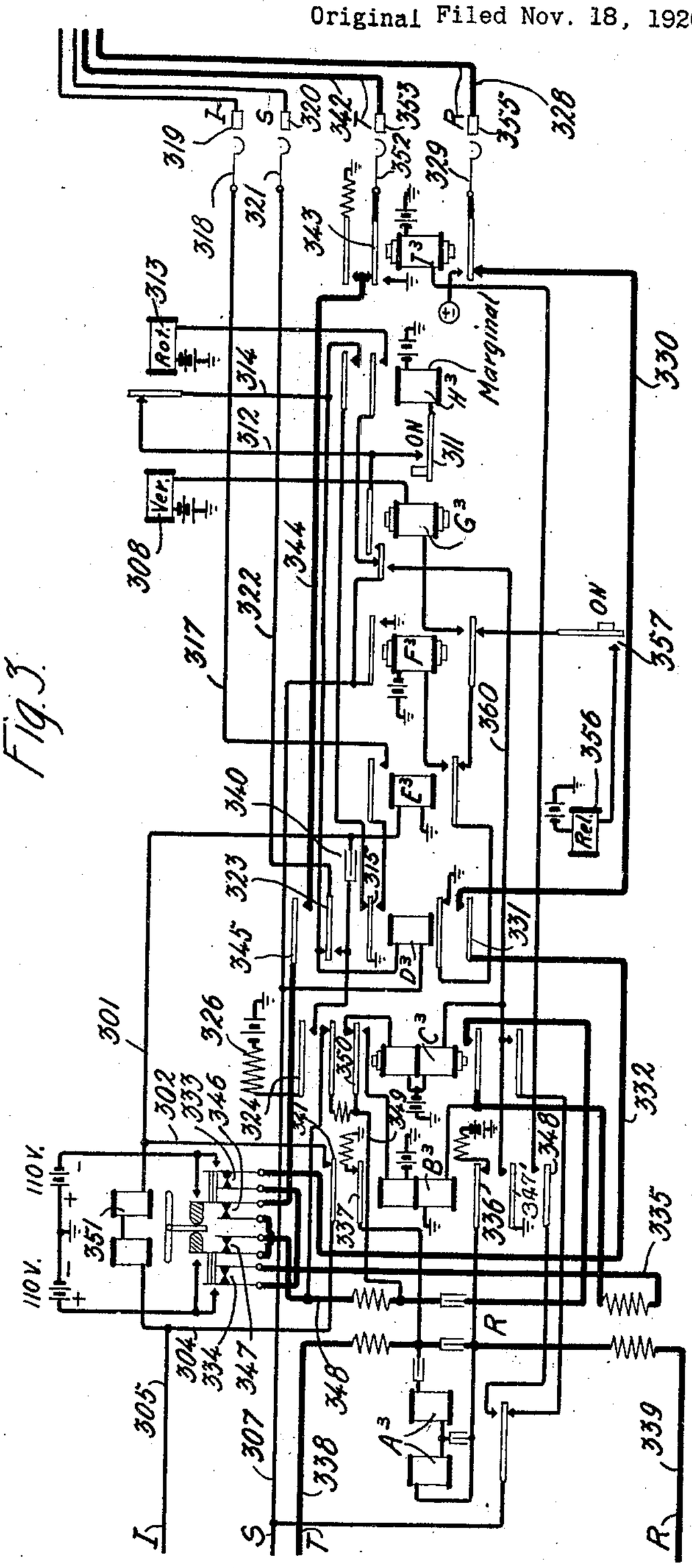


Fig. 3.

Inventor:
Emil Jacobsen

by Geo. Atty.

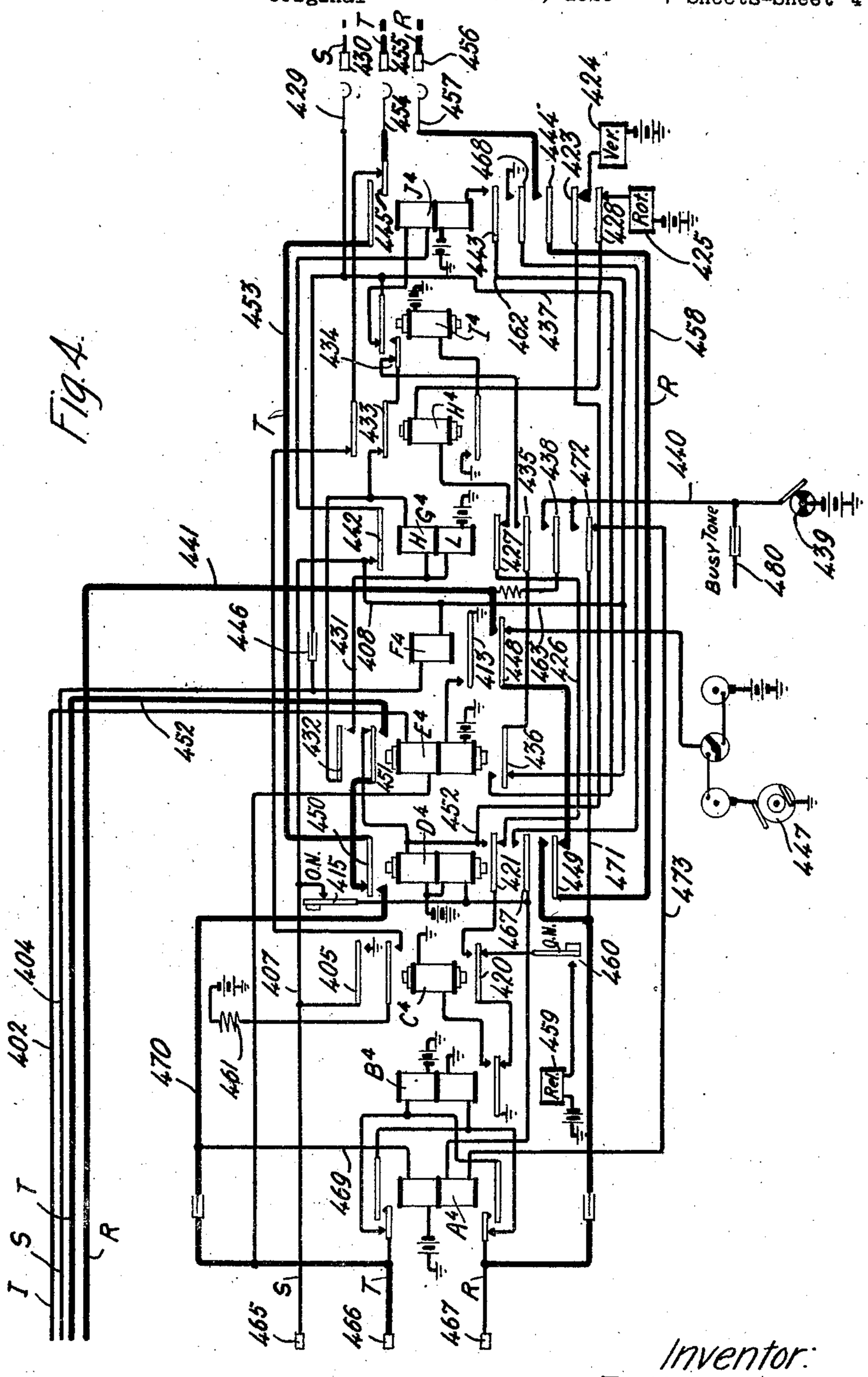
March 16, 1926. 1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 4

Fig. 4.



Inventor:
Emil Jacobsen,
By Atty.

March 16, 1926. 1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 5

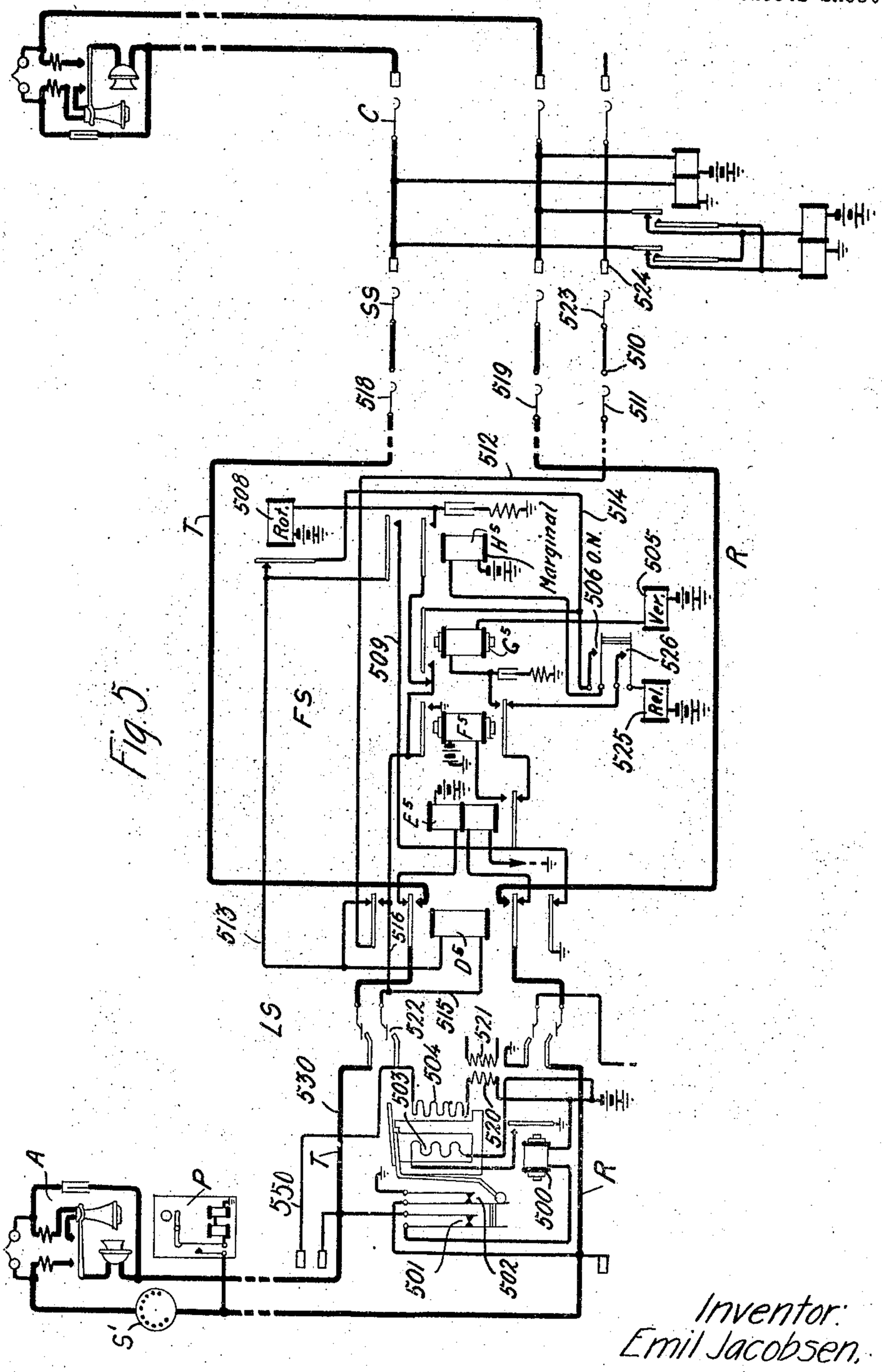


Fig. 5.

Inventor:
Emil Jacobsen.

by George Atty.

March 16, 1926. 1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 6

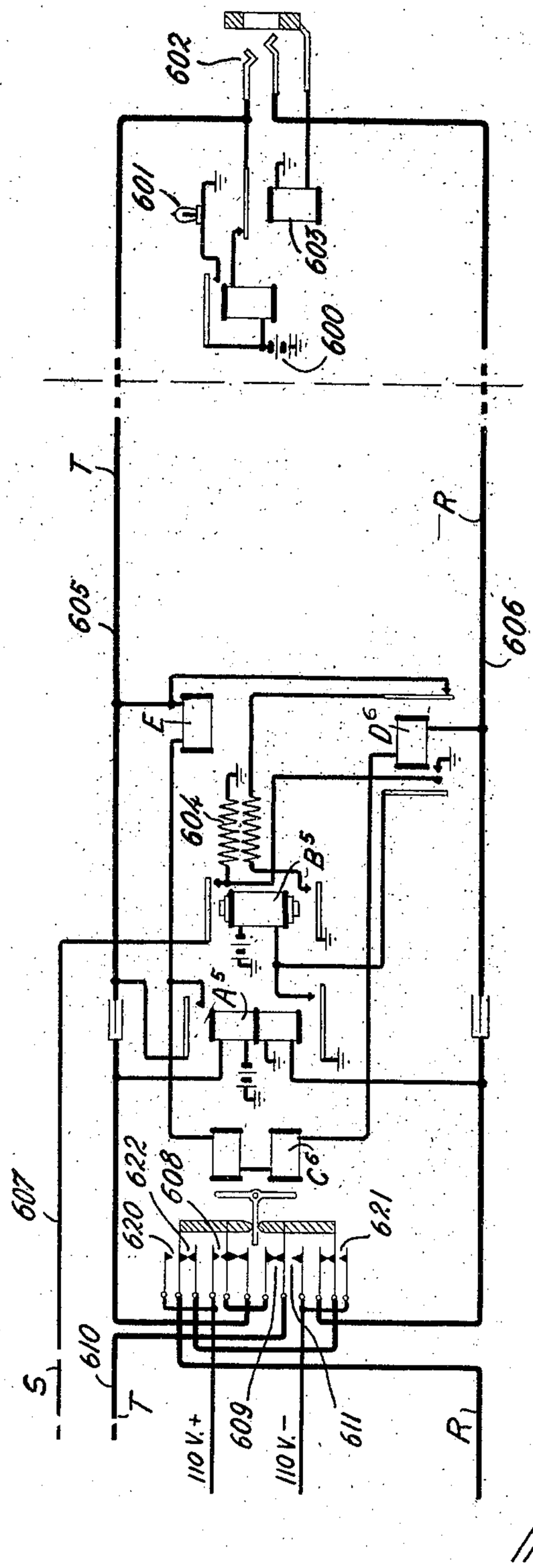


Fig. 6.

Inventor:
Emil Jacobsen,
by Gerlach Atty.

March 16, 1926.

1,576,658

E. JACOBSEN

TELEPHONE EXCHANGE SYSTEM

Original Filed Nov. 18, 1920 7 Sheets-Sheet 7

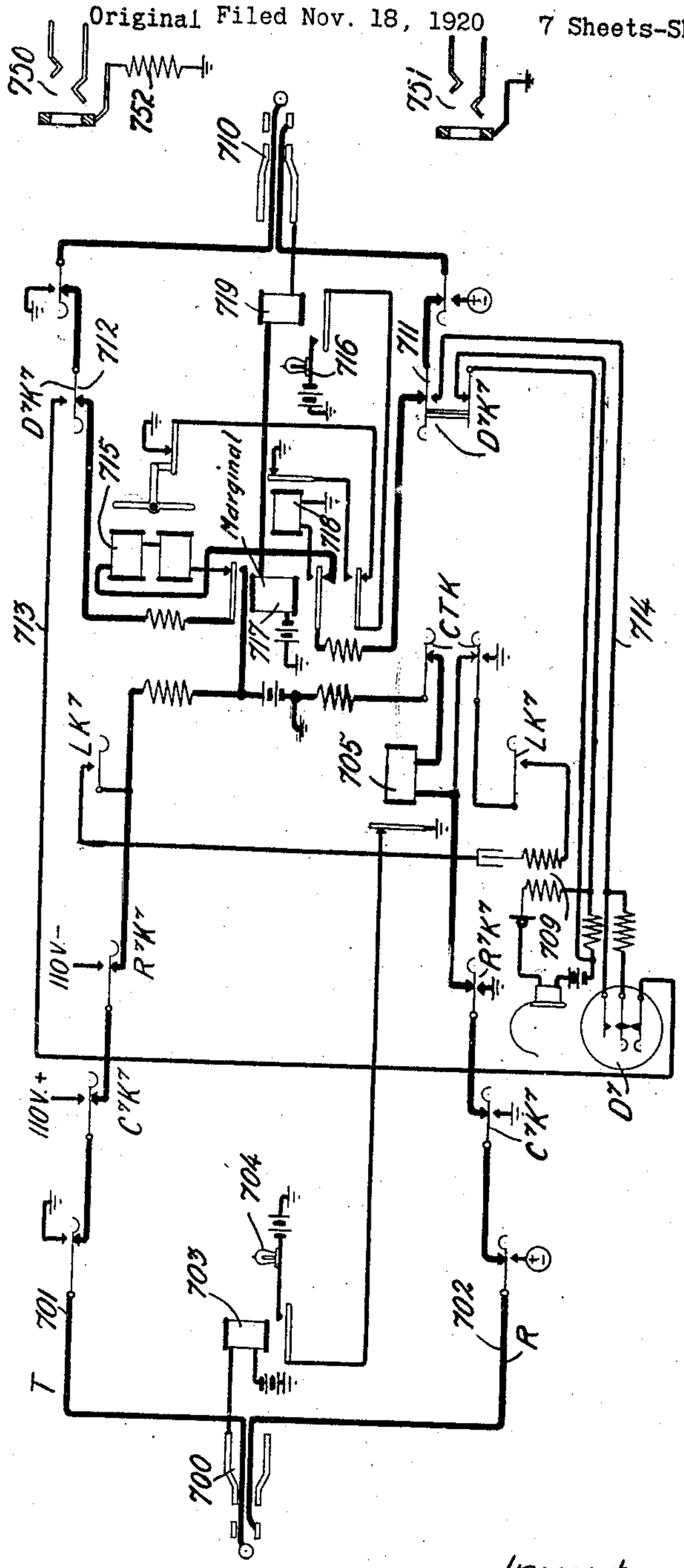


Fig. 7.

Inventor:
Emil Jacobsen

by Geo. Tolc Atty.

Patented Mar. 16, 1926. 1,576,658

UNITED STATES PATENT OFFICE.

EMIL JACOBSEN, OF PORT WASHINGTON, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Original application filed November 18, 1920, Serial No. 424,941. Divided and this application filed January 23, 1923. Serial No. 614,418.

To all whom it may concern:

Be it known that I, EMIL JACOBSEN, residing at Port Washington, in the county of Nassau and State of New York, have invented certain Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates to telephone exchange systems, and particularly to toll trunking, wherein the connections are built up over automatic switches controlled from a toll board.

This application is a division of my application Serial No. 424,941, filed Nov. 18, 1920.

Its object is to provide an improved toll trunking system for connecting local automatic subscribers' lines either as calling or called lines with long distance lines.

One of the features of this invention is the provision of a circuit arrangement wherein when the connector is set on the selected subscriber's line the toll operator can by actuating a manual switch at her position listen for a tone which is transmitted from apparatus individual to said line and thus is able to determine for herself the class to which the line belongs and therefore to what kind of service the subscriber is entitled. Assuming for example that the line selected is one from which a toll call has been originated by selecting the recording operator who has passed the information to the toll operator in accordance with standard practice, the toll operator after selecting the line of the originating subscriber, as described, over long distance or toll transmission selectors is able from the tone to determine whether the line is entitled to toll service.

It is desirable in some cases, for example in the so-called "short haul" toll calls, to hold the line of the originating subscriber busy from the time he secures a connection with the recording operator's position until the connection, including the toll selectors and connector, having the required transmission apparatus for toll calls, is built up to his line, in order to prevent a local call from being extending to said subscriber and thus delaying the toll call desired, and also to check the number of the calling party. This invention takes care of a call of this character, which is known in practice as a two number toll call. In accordance with this feature of the invention the recording operator herself builds up the call to the line of the originating subscriber over toll selectors and a connector, and the selection of the line of the originating subscriber by the connector automatically releases the switches which extended the originating line in the first instance to the recording operator. The line is thereafter held busy from the connector. More specifically, in case a local automatic party makes a toll call of this character he reaches a recording operator by dialing a certain code consisting of two digits. The recording operator answers the call with a cord equipped with a class tone key. While holding this key operated, she plugs into a jack terminating in an idle toll selector and proceeds to select the originating line over this and other selectors and a connector. Due to the maintained operation of the class tone key, when the connector tests the line, the automatic switches which extended the originating line in the first instance to the recording operator are automatically released and the line is thereafter held busy from the connector. The call is then extended to the desired distant party by the toll operator.

These and other features of the invention will be more readily apparent from a detailed consideration of the circuits.

Referring to the drawings, Fig. 1 illustrates a toll operator's cord circuit; Fig. 2 illustrates a toll first selector; Fig. 3 illustrates a toll transmission selector; Fig. 4 illustrates a combination toll and local connector; Fig. 5 illustrates the calling line, a line switch, and the first and second local selectors diagrammatically; Fig. 6 illustrates a trunk terminating at a pay station operator's position; Fig. 7 illustrates a pay station operator's cord circuit, and Figs. 8, 9 and 10 indicate the manner in which Figs. 1 to 7 should be arranged to trace the various type of calls.

Toll call when the coins are to be collected from local party whether the call is incoming or outgoing.

A call of this nature would be made by a toll operator having cord circuits as shown in Fig. 1 on an order for a call from a local pay station. The calling party at such station operates his dial to set a first selector

FS (Fig. 5) to select a recording operator who secures the number of the called party and any other necessary information, which she writes on a ticket. This ticket is delivered to a toll or line operator, who has control of suitable long distance equipment shown in Figs. 1, 2, 3 and 4. This type of toll call is termed a "long haul" toll call.

Referring to Figs. 1, 2, 3 and 4, the toll operator will insert plug 100, Fig. 1, into jack 200, Fig. 2, leading to an idle toll first selector. Relays A and F then energize over the following circuit: ground, relay A, Fig. 2, armature 219 and back contact of relay D′, slow relay F, sleeve wire 101, normal contact 102 of the dial key DK to free pole of battery. Relay A closes an energizing circuit for slow relay B and relay F at its armature and front contact closes an additional circuit for slow relay B. Relay B, in attracting its upper armature, lights the lamps 205 associated with multiples of jack 200 to inform the other operators that this trunk is busy. The operator will now operate her dial key DK which, in closing the spring 102 to its alternate contact will switch the sleeve conductor 101 to the free pole of battery in series with one side of induction coil 106 and a dial D and proceed to dial the desired number. Relay A in responding as the dial restores, transmits impulses over the following circuit to the first selector vertical magnet 206, which steps the shaft to the desired level; free pole of battery, magnet 206, slow relay C, lower armature and front contact of relay B, armature and back contact of relay A, armature 214 and back contact of relay D′ to ground. Relay C, being slow, holds up during the impulses. A non-inductive shunt 250 is placed around the winding of relay F to improve the impulse circuit. On the first step of the shaft off-normal contact 209 closes, energizing relay E over front contacts of relays C and B. Relay E, upon attracting its inner armature, locks itself over the back contact of rotary magnet 211 to ground at the armature 214 of relay D′. Upon the cessation of the impulses slow relay C releases and rotary magnet 211 receives an impulse in a circuit including the upper armature and front contact of relay E, normal contact of relay C, and upper armature and front contact of relay B to rotate the selector onto the first trunk. The armature of magnet 211, at the end of its stroke, opens the locking circuit of relay E, whereupon this relay releases opening the circuit of magnet 211 which releases. If the first trunk is busy ground is present on the test or sleeve multiple 212. This ground is transmitted over test brush 213, armature 218 and back contact of relay D′, armature and back contact of magnet 211, off-normal contact 209 to relay E. Relay E thereupon energizes and closes its locking circuit previously traced. In attracting its upper armature it again energizes magnet 211, which rotates the selector brushes into engagement with the next trunk, and at the end of its stroke opens the locking circuit of relay E, releasing the same. Assuming this trunk to be idle no ground is present on the sleeve multiple 212 thereof and consequently relay E is not again energized. The following circuit is now closed to energize switching relay D; free pole of battery, relay E, contact 209, armature and back contact of magnet 211, conductors 215 and 216, relay D′, conductor 217 to ground at the upper armature and front contact of relay B. Relay E is marginal and does not operate in this circuit. Relay D′ extends the tip and ring conductors of the jack to the tip and ring conductors of the seized selector. In attracting its armature 218, relay D′ applies a direct ground to test brush 213 and thence to test multiples 212 to cause the seized trunk to test busy to other selectors. In attracting its armature 219, relay D′ extends the sleeve conductor 203 to the brush 220 now connected by multiple 222 to the impulse wire 221 which energizes impulse relay E^3 of the seized toll selector shown in Fig. 3. In practice there would be a number of intermediate selectors between the selector of Fig. 2 and that of Fig. 3, the number being determined by the capacity of the exchange. These selectors would be substantially the same as that shown in Fig. 2 and are therefore omitted. The toll selector of Fig. 3 immediately precedes the connector, Fig. 4, which has access to the desired subscriber's line. Assuming therefore that the connection has been built up to the toll selector of Fig. 3, relay E^3 is energized over the following circuit: ground, relay E^3, conductors 301 and 302, armature 341 and back contact of relay B^3, conductor 304, impulse conductor 305, conductor 221, multiple terminal 222, brush 220, conductor 223, armature 219 and front contact of relay D′ slow relay F, over the circuit previously traced to the free pole of battery at the dial D. Relay E^3, attracting its lower armature, operates slow relay F^3 which, in attracting its upper armature, grounds the sleeve wire 307. The operation of the dial in transmitting the hundreds digit of the called line intermittently operates relay E^3, which transmits impulses to the vertical magnet 308 of the toll selector. Relay B (Fig. 2) being slow, holds the circuit of lamp 205 closed. The circuit of vertical magnet 308 is as follows: lower armatures and back contacts of relays D^3 and E^3, lower armature and front contact of relay F^3, slow relay G^3, magnet 308 to free pole of battery. Relay G^3, being slow, remains energized during the transmission of the impulses. Upon the first vertical step of the

shaft, relay H^3 operates over the following circuit: free pole of battery, relay H^3, off normal contact 311, armature and front contact of relay G^3, upper armature and front contact of relay F^3 to ground. Relay H^3 thereupon locks itself over the following circuit: free pole of battery, relay H^3, contact 311, conductor 312, armature and back contact of rotary magnet 313, conductor 314, upper armature and front contact of relay H^3 to ground at the armature 315 and back contact of relay D^3. These circuits are similar to those traced for the selector of Fig. 2, and, therefore, need not be further described, it being sufficient to say that, upon the cessation of the impulses through the vertical magnet, slow relay G^3 releases and causes the hunting operation to take place, and upon the finding of an idle trunk switching relay D^3, which corresponds to relay D' of Fig. 2, operates and connects the incoming and outgoing tip and ring conductors together. When slow relay G^3 energized at the beginning of the impulse series a slow relay C^3 operated by its lower winding over conductor 360 to ground at the upper armature of relay F^3, and in attracting its lowermost armature locked itself to the grounded sleeve wire 307 over a back contact of relay A^3. The connector of Fig. 4, to which the connection is now extended, is a combination toll and local connector; that is to say, this switch may be seized either by local selectors operated by the subscribers themselves, or by toll selectors, such as shown in Fig. 3, which are operated by the toll operators in a connection such as the one being described. Relay D^3, in attracting its armature 315, closes the following circuit to energize relays E^4 and B^4 of the connector: ground, armature 315 and front contact of relay D^3, upper armature and front contact of relay E^3, conductor 317, brush 318, multiple 319, impulse conductor 402, upper winding of relay E^4, upper winding of relay B^4 to free pole of battery. Relay B^4 operates slow relay C^4 which, in attracting its armature 405, grounds the sleeve conductor 407 to cause this connector to test busy to testing local selectors. This armature in closing its front contact also closes the following circuit: ground, armature 405, conductors 407 and 408, relay F^4, conductor 410, sleeve conductor 404, sleeve multiple 320, sleeve brush 321, conductor 322, armature 323 and front contact of relay D^3, armature 324 and front contact of relay C^3 resistance 326 to free pole of battery. It will be remembered that relay C^3 is locked up to the grounded sleeve conductor 307. Relay F^4, in attracting its armature 413, closes a circuit to the lower winding of relay E^4. When relay C^4 attracted its armature 405, slow relay D^4 operated over the following circuit: ground, armature 405, conductor 407, off-normal contact 415, lower winding of relay D^4 to free pole of battery.

The operator now operates the dial D to transmit the tens series of impulses which intermittently operates relay E^3. Each time the upper armature of relay E^3 is retracted and upon each consequent retraction of the armature of relay B^4 a circuit is closed as follows: armature and back contact of relay B^4, armature 420 and front contact of relay C^4, armature 421 and front contact of relay D^4, conductor 452, armature 423 and back contact of relay J^4, vertical magnet 424 to free pole of battery. The vertical magnet elevates the brushes to the desired level. On the first vertical step of the connector shaft, off-normal contact 415 opens and relay D^4 is thereafter dependent for its energization upon the grounds received from the back contact of relay B^4 through its upper winding. At the end of the series therefore relay D^4 releases, shifting the stepping circuit to the rotary magnet 425. The units impulses therefore will pass from the grounded armature of relay B^4 to the armature 421 and back contact of relay D^4, conductor 426, armature 427 and back contact of relay G^4, slow relay H^4, armature 428 and back contact of relay J^4, magnet 425 to free pole of battery. Slow relay H^4 remains operated during the transmission of the impulses to disconnect the test relay G^4 from the test brush 429 during the rotary motion of the switch. Relay H^4 in operating, operates the slow relay I^4. Upon the termination of the units series of impulses the relay H^4 releases shortly before the relay I^4. Relay G^4 is thus momentarily connected to the test brush 429 and if the line is busy the sleeve multiple 430 thereof will be grounded, closing the following circuit for the test relay G^4, free pole of battery, lower low resistance winding of relay G^4, conductor 431, armature 432 and front contact of relay E^4, armature 433 and back contact of relay H^4, armature and front contact of relay I^4, the test brush 429 to ground at the sleeve multiple 430. Relay G^4 then locks up over the following circuit: free pole of battery, lower winding of relay G^4, conductor 431, armature 432 and front contact of relay E^4 armature 433 and back contact of relay H^4, make-before-break contact 434 of relay I^4, armature 435 and front contact of relay G^4, armature 436 and front contact of relay E^4, conductor 437 to sleeve brush 429 to grounded sleeve multiple 430. Relay G^4, in attracting its armature 438, connects busy tone as well as interrupted battery to the ring conductor leading back to the toll selector. Consequently the following circuit is intermittently closed for relay B^3 of the toll selector, Fig. 3; free pole of battery, interrupter 439, conductor 440, arma-

ture 438 and front contact of relay G^4, ring conductors 441 and 328, brush 329, conductor 330, armature 331 and front contact of relay D^3, conductor 332, contacts 333 and 334, conductor 335, lower winding of relay B^3 to ground. Relay B^3, in attracting and retracting its armatures 336 and 337, removes and applies battery and ground to the tip and ring conductors 338 and 339 leading back to the operator's cord, which causes the intermittent operation of supervisory relay 107 and the flashing of the supervisory lamp 108. By the flashing of this lamp the operator knows the line is busy. The apparatus may remain in this condition until the selected line becomes idle and inasmuch as the relay G^4 is maintained operated by the ground on the multiple 430 of the busy selected line, the removal of this ground releases the relay G^4 which, in retracting its armature 438, releases relay B^3, Fig. 3, which maintains battery applied to the tip and ring conductors leading back to the operator's cord which causes the continued energization of the supervisory relay 107 and the sustained lighting of the supervisory lamp 108, whereby the operator knows the line has become idle. Relay G^4, in retracting its armature 442, extends the grounded sleeve conductor 407 through the upper winding of relay J^4 to the test brush 429, and thence to battery through the cut-off winding of the called subscriber's line switch thus causing this line to test busy to other connectors and removing the control of the line switch from the selected line. Relay J^4, in attracting its armature 443, locks itself to ground on sleeve conductor 407 over conductors 462, 463, 408. In attracting its armatures 423 and 428, relay J^4 cuts off the rotary and vertical magnets. In attracting its armatures 444 and 445, this relay connects the incoming and outgoing tip and ring conductors together. The operator can now listen for class tone on the called line to ascertain to what class of service the station belongs. This circuit leads from the tone coil secondary 520 (Fig. 5) through the holding winding 504 of the called station line switch, through the brush 429, condenser 446, sleeve conductor 404, sleeve multiple 320, sleeve brush 321, conductor 322, armature 323 and front contact of relay D^3, condenser 340, conductors 301 and 302, armature 341 and back contact of relay B^3, conductors 304 and 305, impulse conductor 221, multiple 222, brush 220, conductor 223, armature 219 and front contact of relay D', relay F, conductor 203, sleeve of the jack 200, sleeve of the plug 100, conductor 101, primary winding of induction coil 106 to free pole of battery. The key DK when operated opened at contact 105, the shunt about the secondary winding of coil 106. Having secured this information the operator can now cause the called party's bell to be rung. To do this she operates her ringing key K, (Fig. 1), which impresses alternating current over the tip and ring conductors which operates relay A^3, Fig. 3. Relay A^3, in attracting its armature, unlocks relay C^3. Relay C^3, in releasing, removes battery at its armature 324 from the sleeve conductor leading to the connector which is holding energized relay F^4 over the circuit previously traced. Relay F^4, in releasing closes the following signaling circuit: free pole of generator 447, armature 448 and back contact of relay F^4, armature 449 and back contact of relay D^4, armature 444 and front contact of relay J^4, ring conductor, called line, tip conductor, armature 445, and front contact of J^4, armature 450 and back contact of relay D^4, armature 451 and front contact of relay E^4, tip conductor 452, multiple 353, brush 352, armature 343 and back contact of relay I^3, tip conductor 344, armature 345 and front contact of relay D^3, contacts 346 and 347, conductor 348, armature 350 and back contact of relay C^3, upper winding of relay C^3 to free pole of battery.

When the called subscriber answers, relay C^3 operates and locks up to the grounded sleeve wire 307 over the circuit previously traced leading over the lower winding of relay C^3 and extends the called line loop to relay B^3, which thereupon operates to cut off battery and ground from the tip and ring wires leading back to the cord circuit of Fig. 1 which causes the deenergization of relay 107 and the extinguishment of supervisory lamp 108 to inform the operator that the called party has responded. In attracting its armature 324 relay C^3 again energized relay F^4 in the connector. Relay F^4 in attracting its armature 448 opens the ringing circuit and connects the incoming and outgoing ends of the ring conductor together. Relay B^3 in attracting its armature 341 removes the short circuit from about relay 351. In attracting its armature 347', relay B^3 closes a holding circuit for relay C^3 independent of that leading over the back contact of relay A^3. In attracting its armature 348, relay B^3 extends the front contact of relay A^3 to relay I^3 for the purpose of enabling the operator to signal a P. B. X. operator. The operator by depressing her listening key LK may now talk with the subscriber over the connection thus built up, and request him to deposit the necessary coins in a coin box which may be of the type shown in Patent 1,043,219, to O. F. Forsberg, issued November 5, 1912. These coins as they are deposited strike gongs in the coin box and thus convey to the operator information as to the character of the coins, deposited. The operator now builds up the connection over

the plug 110 in the direction of the called line, but since this forms no part of the present invention, it is not shown. The operator now depresses her collect key CK to cause the deposited coins to be collected. The depression of this key energizes a relay 111 which in attracting its armature connects positive 110 volt battery to the polarized relay 351, the shunt about the relay being now open at the armature 341 of relay B^3 (Fig. 3). This relay in responding connects positive 110 volt battery over both sides of the line from one side of which the polarized relay of the coin box is connected in a grounded branch (see Fig. 5). The polarized magnet in the coin box in responding to this current collects the coins and disconnects itself from ground as shown and described in detail in said patent. The springs controlled by relay 351 are arranged to eliminate annoying clicks. Talking current is fed to the calling or originating substation, shown for example in Fig. 5 over the windings of relay B^3 and to the other or called station from the office in which it terminates. The tip and ring conductors 338, 339, and 344, 330 are inductively united by the usual repeating coil R in accordance with the standard long distance practice. Talking current is fed to the original calling subscriber's substation over the following path, free pole of battery, upper winding of relay B^3, armature 350 and front contact of relay C^3, conductor 349, upper right hand winding of repeating coil R, contacts 347, 346 of polarized relay 351, armature 345 and front contact of relay D^3, tip conductor 344, armature 343 and back contact of relay I^3, tip brush 352, tip multiple 353, tip conductor 342, 452, armature 451 and front contact of relay E^4, armature 450 and back contact of relay D^4, tip conductor 453, armature 445 and front contact of relay J^4, tip brush 454, multiple 455 through the substation loop returning on the ring conductor multiple 456, brush 457, armature 444 and front contact of relay J^4, ring conductor 458, armature 449 and back contact of relay D^4, armature 448 and front contact of relay F^4, conductor 441, conductor 328, multiple 355, brush 329, lower armature and back contact of I^3, conductor 330, armature 331 and front contact of relay D^3, conductor 332, springs 333 and 334 of relay 351, conductor 335, lower right-hand winding of repeating coil R, lower winding of relay B^3 to ground. After the original calling subscriber has replaced his receiver at the end of the conversation, the operator can again start the automatic ringing operation at any time by operating her ringing key K which by energizing relay A^3, Fig. 3, unlocks relay C^3 which in retracting its armature 324 releases relay F^4 in the connector which starts the automatic ringing operation and upon response of the original calling subscriber, ringing is again cut-off as described. In case the coins were to be refunded the operator would have depressed her refund key RK and thereby energized relay 112 which would have applied negative current from the 110 volt source to operate relay 351 to apply negative current to the line to operate the polarized relay in the coin box in the other direction to refund the coins as shown and described in said patent.

When the original calling subscriber replaces his receiver, relay B^2 releases again applying battery and ground at its armatures 336 and 337 to the tip and ring conductors leading back to the operator's cord circuit. This results in the energization of supervisory relay 107 which in attracting its armature lights supervisory lamp 108 to indicate to the operator the termination of the conversation. In order to release the connection, the operator merely removes plug 100 from Jack 200. This causes relay E^3 in the toll selector (Fig. 3) to release which opens the circuit of slow relay F^3 which in closing its lower back contact closes one break in the circuit of the release magnet 356. Relay F^3 releasing its upper armature removes ground from the sleeve conductor 307 leading back to the selector of Fig. 2 which causes release relay D′ thereat to restore, and also release relay D^3 to complete the circuit of release magnet 356. Relay F Fig. 2 released when the plug was withdrawn, consequently releasing relay B. A circuit is therefore closed for the release magnet 225 of this selector over off-normal contact 226 and back contacts and armatures of relay B, A and D. Relay E^3 in releasing its upper armature removes ground from the conductor 317 thus interrupting the circuit previously traced through the upper windings of relays E^4 and B^4. Relay B^4 in releasing its armature releases relay C^4. Relays C^4 and B^4 at their lower armatures and back contacts close the circuit of release magnet 459 over off-normal contact 460.

In the case of incoming toll calls the toll operator would build up calls to the subscribers as directed by the distant toll operator in the same manner, but would not require the deposit of coins to allow conversation to be carried on, unless the charges were to be reversed.

A toll call when local party originates the call and is to be charged, his line being held busy while the operator sets up a connection to his line over toll switches.

A call of this kind would be what is known in practice as a two number toll call. This type of call is known as a "short haul" toll call, the switches used by the calling party in reaching the recording operator

being used in the conversational circuit, and the calling party remaining on the line until the toll call is built up by the operator who answers the call, no second operator being involved. The call being a "short haul" call, the equipment at the originating office does not need long distance transmission equipment as in the case of the "long haul" toll call described. The station, as A, desiring a toll call of this character is extended to a recording operator by dialing a certain code which will cause the line to be connected over a line switch LS, (Fig. 5), a first selector FS and a second selector SS to the recording operator's trunk circuit shown in Fig. 6. This operator's position is equipped with cords shown in Fig. 7. This operator responds to the call by inserting the plug 700, Fig. 7, into the jack 602, Fig. 6, and secures from the calling party the number of his line and that of the desired line. She then takes a plug 100, Fig. 1 and calls the number of the calling station A (Fig. 5) over the switches shown in Figs. 2, 3, and 4, as described.

When the connector is set on the calling line A a circuit change is brought about which releases the line switch LS, the first selector FS and the second selector SS, i. e., the original connection from the calling line to the recording operator. Thereafter this line is maintained busy from the connector. The apparatus remains in this condition until the connection has been built up in the direction of the desired distant subscriber over plug 110 as before and when this subscriber has responded the operator by depressing her key K, Fig. 1, will start the automatic ringing operation of the connector, Fig. 4, from which the operations are the same as those previously traced. In this character of toll call however the line of the calling party, is maintained busy and inaccessible to other testing connectors or to other manual operators from the time the call is initiated until the toll connection is broken down.

Considering more in detail the operations involved in the setting up of a connection of this character, the removal of the receiver at the substation A closes the following circuit to operate the line switch LS to seize an idle first selector FS: free pole of battery, relay 500, contact 501, tip side of the line, the substation loop, ring side of the line, contact 502 to ground. Relay 500 in attracting its armature closes a circuit for the pulldown winding 503 of the line switch which in the well-known manner, operates the line switch to seize the preselected first selector FS, whereupon impulse relay E^5 operates over the substation loops. In attracting its armature relay E^5 operates slow relay F^5. Relay F^5 in attracting its upper armature closes a circuit for the holding winding 504 of the line switch and in closing its lower armature prepares a circuit for the vertical magnet 505 of the first selector. While the circuit of the line relay 500 over the substation loop is opened when the line switch operates, this relay is slow to release and holds the pull down circuit 503 closed until after relay F^5 operates and closes the circuit of the holding winding 504, thus maintaining the line switch operated. The calling party now operates his sender S′ for the first digit of the code thus interrupting the circuit of the impulse relay E^5. Each time relay E^5 retracts its armature, an impulse is transmitted to the vertical magnet 505 in series with the slow relay G^5 to lift the brushes of the first selector to the level corresponding to the digit in question. When the sender restores relay E^5 remains energized and, consequently relay G^5 releases. When relay G^5 operated upon the first impulse, it prepared a circuit for relay H^5 which was closed over off-normal contact 506 on the first step of the selector shaft. This relay thereupon locked up over the following circuit: free pole battery, relay H^5, off-normal contact 506, conductor 514, armature and back contact of rotary magnet 508, upper armature and front contact of relay H^5, conductor 509 to ground at the lowermost armature of relay D^5. When the slow relay G^5 releases at the termination of the impulses, rotary magnet 508 is energized over the inner upper armature of relay H^5, normal contact of relay G^5, upper armature and front contact of relay F^5 and rotates the set of brushes on to the first trunk. At the end of the stroke of the rotary magnet, the locking circuit of relay H^5 is opened, which relay in releasing releases magnet 508. The brushes are now in engagement with the first trunk in the selected group. If this trunk is busy, a ground is present on the test multiple 510 and this ground is transmitted over the test brush 511, conductor 512, uppermost armature and back contact of relay D^5, conductor 513, armature and back contact of the rotary magnet, conductor 514, contact 506, relay H^5, free pole of battery. Relay H^5 thereupon operates and again locks itself over the circuit previously traced to ground at the lowermost armature and back contact of relay D^5. In attracting its inner upper armature, relay H^5 again energizes the rotary magnet which rotates the brushes on to the next trunk. Assuming this trunk to be idle, no ground is present on the test multiple 510 and consequently relay H^5 remains deenergized, after its locking circuit is opened by magnet 508. Switching relay D^5, however, is now operated over the following circuit free pole battery, relay H^5, contact 506, armature and back contact of magnet 508, conductor 513, relay D^5, conductors 515 and

516 to ground at the upper armature and front contact of relay F^5. Relay H^5 is marginal and does not operate in this circuit. Relay D^5, however, operates and places a direct ground from the upper armature of relay F^5, the uppermost armature of relay D^5, conductor 512, brush 511 to the test multiple of the seized trunk to cause the same to test busy to other selectors. Relay D^5, in attracting its inner armatures, extends the tip and ring conductors of the calling line to the tip and ring conductors of the trunk which terminate in the talking brushes 518 and 519. The extension of the calling line to the second selector SS operates the impulse relay thereat, and since this selector is similar to the first selector, it is not shown. The calling party at the substation A now dials the second figure of the code, setting the second selector SS to the corresponding level, whereupon it automatically picks out an idle trunk in this level. In this level the leads shown in Fig. 6 terminate. Assuming now that the calling line has been extended to an idle trunk, shown in Fig. 6, relay A^5 thereat operates over the calling line loop and operates slow relay B^5. Relay B^5 in attracting its upper armature grounds the test wire 607 leading back in the direction of the calling line, this ground maintaining a switching relay at the second selector SS such as D^5, and relay D^5 of the first selector and the holding winding 504 of the line switch operated to prevent release, in the well known manner. Relay B^5 in attracting its lower armature energizes relay 600, which in attracting its armature, lights the calling lamp 601. In response to the lighting of this lamp, the operator inserts plug 700, Fig. 7, into the jack 602 whereupon cut-off relay 603 operates opening the circuit of relay 600 to extinguish the calling lamp. Relay 703 also operates in this circuit to prepare a circuit for the supervisory lamp 704, which circuit however, is simultaneously opened by relay 705 through the closure of the following circuit—free pole of battery, tip conductor 701 of the cord, tip of the plug 700, tip of the jack 602, tip conductor 605 of the trunk, Fig. 6, impedance coil E, relay C^6, relay D^6, ring conductor 606, ring of the jack 602, ring of the plug 700, ring conductor 702 of the cord, relay 705 to the grounded side of the battery. Relay D^6 operates in this circuit and applies ground to the winding of slow relay B^5, thus transferring the control of the release of the automatic switches to the operator, that is, in case the calling subscriber hangs up his receiver. However, as long as the calling subscriber remains on the line, the control over the release of the automatic switches is also dependent upon the calling subscriber, as relay A^5 applies ground to operate relay B^5 as hereinbefore described.

Relay C^6 does not operate from the talking battery bridged across the cord. The attraction of the left hand armature of relay D^6 also shunts out the primary winding of induction coil 604 and at its right hand armature disconnects the secondary winding of this coil from the tip conductor 605 of the trunk. The operator now actuates her listening key LK^7, and asks the calling subscriber his number. She may ascertain for herself the character of the calling line by operating a class tone key CTK. The actuation of this key breaks the circuit previously traced leading over the tip and ring conductors to the trunk circuit of Fig. 6 which releases relay D^6. The retraction of the left hand armature of relay D^6 removes the shunt from around the primary winding of induction coil 604, which primary winding is connected with the secondary winding 520 of the tone coil 521 associated with the line switch Fig. 5. The character of this tone will indicate to the operator the character of the calling line. This tone is transmitted to the operator over the following circuit: free pole of battery, secondary winding 520 of the induction coil 521, Fig. 5, holding winding 504 of the line switch, contact 522 of the line switch, the uppermost armature and front contact of relay D^6, conductor 517, brush 511, multiple 510, test brush 523, of the second selector, test multiple of the second selector, test wire 607 of the trunk Fig. 6, upper armature and front contact of relay B^5, primary winding of induction coil 604 to ground. Through the windings of induction coil 604, this tone is transmitted to the operator's head set over the following circuit: grounded lower armature and front contact of B^5, the secondary winding of coil 604, the right hand armature and back contact of relay D^6, tip 605 of the trunk, tip of the jack 602, tip of the plug 700, tip side 701 of the cord, contact of listening key LK^7, the secondary winding of the induction coil 709 associated with the operator's head set, the contact of key LK^7, contact of key CTK, to ground.

Now while the operator holds her class tone key CTK operated, she will take a cord such as shown in Fig. 1 and dial the number of the originating or calling station over the switches shown in Figs. 2, 3 and 4. The operation of these switches will in this case be exactly the same as previously described to the point where the testing of the line occurs. It will be noted that while the operator has her class tone key operated, the primary winding of the induction coil 604, Fig. 6, is included in sleeve wire 607 leading to the holding winding 504 of the line switch LS, Fig. 5. When the connector of Fig. 4 tests the selected line the lower low resistance winding of relay G^4 will be in parallel with the holding winding 504 of

the line switch LS. This condition will cause the demagnetization of the holding winding 504 sufficiently to release the line switch. The line switch in releasing, releases the bridged relay A^5 in the trunk, Fig. 6 which in retracting its lower armature opens one of the alternative circuits through the slow releasing relay B^5 and since the class tone key is now operated and relay D^6 inert, the alternative circuit for slow relay B^5 to ground at the armature and front contact of relay D^6 is opened. Relay B^5 therefore releases. In retracting its upper armature it removes ground from the sleeve wire 607 leading back to the second and first selectors which releases the switching relays thereat, thereby causing the switches to be restored. The release circuit of the first selector is as follows: free pole of battery release magnet 525, off normal contact 526, lower armature and contact of relays F^5, E^5 and D^6 to ground. A similar circuit is closed at the second selector which causes its restoration. The result of these operations is that the original connection to the recording operator's position is released and the line is now maintained busy from the connector due to a ground applied to the sleeve multiple 430, Fig. 4, as follows: armature 405 and front contact of relay C^4, sleeve conductor 407, armature 442 and back contact of relay G^4, upper winding of relay J^4, armature and back contact of I^4, sleeve brush 429, sleeve multiple 430. The switch remains in this condition until the connection has been built up in the other direction to the distant called subscriber. When this subscriber has responded, the operator will actuate her ringing key K, Fig. 1, which will start the automatic ringing operation of the connector, Fig. 4, as previously described.

It will be noted that when the connector selects the line and before slow relay I^4 releases to close the circuit of relay J^4 as described a low resistance shunt 461 is connected by relays C^4 and H^4 around the line relay of the called line to prevent this relay from energizing and again operating the line switch which it would otherwise do after the line switch is released, by the shunting of the holding winding. The low resistance shunt referred to includes a normal contact of test relay J^4. It will be remembered that the test multiple of the calling line was grounded when the line switch of Fig. 5 extended the calling line to the first selector. This ground is applied at the upper armature and front contact of relay F^5 (Fig. 5). Due to this ground connection relay J^4 (Fig. 4) is not operated when the connector selects the line, and consequently the shunt about the holding winding 504, of the line switch (Fig. 5) is closed. As soon as the line switch releases, however, the said ground is removed and relay J^4 operates as described through its upper winding and conductor 550, (Fig. 5) to battery through the cut off winding 504 of the line switch. The cut off winding opens springs 501, 502 without plunging the line switch, in the well known manner. The operator may pull out the plug 700 from the jack 602 as soon as the lamp 108 is extinguished due to the response of the called party.

A call from the manual pay station to any other local station.

It will be understood that some of the stations may be manual stations, i. e. not equipped with dials S′ at the substation. Lines of this character terminate in line switches which have access to trunks terminating directly in jacks as 602 before the pay station operators whose positions are equipped with plugs similar to those of the operator's positions shown in Fig. 7. A call of this character would be handled as follows: The removal of the receiver by the calling party will cause the line switch to seize a preselected trunk terminating in a jack 602, Fig. 6, whereupon the relay A^5 operates over the calling line circuit energizing the slow relay B^5 which causes the relay 600 to operate and light the calling lamp 601 as described.

From this point the operation is exactly the same as previously described up to the point where the operator by pressing her class tone key CTK, learns the character of the calling line. In this class of calls, however, she immediately releases the class tone key and, if the desired subscriber is an automatic subscriber, she will insert the plug 710 into a jack 750 terminating in a line switch (not shown) and operate her dial key D^7K^7.

The shifting of the springs 711 and 712 to their alternate contacts bridges the dial D^7 across the outgoing tip and ring conductors which operates the line relay of the line switch to operate the pull down winding in the well known manner, to cause the line switch to seize a preselected selector the impulse relay of which then operates over the loop including the dial D^7. The operator will then by means of her dial build up a connection to the desired line over local selector switches as shown for example in Patent 1,377,225, issued May 10, 1921, to A. J. Seymour, the last one of which will seize an idle combination local and toll selector shown in Fig. 4. Assuming, therefore, that the connection has been extended from the cord shown in Fig. 7 to the connector shown in Fig. 4, the impulse relay B^4 is energized over the following circuit: free pole battery, the upper winding of relay B^4, normal contact of relay A^4, tip multiple 466, over the

tip side of the talking conductors of the selectors, tip of the plug 710, spring 712, of key D^7K^7, conductor 713, normal contact of the dial, conductor 714, spring 711, and its alternate contact, ring of the plug, over the ring conductors of the selectors, ring multiple 467, lower normal contact of relay A^4, lower winding of relay B^4 to ground. Relay B^4 in operating energizes slow relay C^4 which in attracting armature 405, grounds sleeve wire 407 leading back to the preceding selectors to hold the same set in the well known manner, and to cause this connector to test busy to local second selector. The ground applied to the sleeve 407 by the armature 405 is extended over the following circuit to the sleeve multiple 320 of the toll selectors in which this connector appears to render the same busy to testing toll selectors: grounded armature 405, conductor 407, conductor 408, relay F^4, conductor 410, conductor 404, sleeve multiple 320. The operator now transmits the tens digit of the desired number by operating her dial D^6. Upon each retraction of the armature of relay B^4, Fig. 4, of the connector, a circuit is closed through the vertical magnet 424, this circuit being as follows: grounded armature and back contact of relay B^4, armature 420 and front contact of relay C^4, armature 421 and front contact of relay D^4, conductor 452, armature 423 and back contact of relay J^4, magnet 424 to battery. It will be noted that this circuit is exactly the same as that traced when the connector was set from the toll selector of Fig. 3. Relay D^4, as in the former case, was energized when relay C^4 attracted its armature 405 and upon the opening of the off normal contact 415 is dependent for its maintained energization on the impulses received from the armature and back contact of relay B^4. Upon the termination of the impulses the retraction of the armature 421 of relay D^4 shifts the stepping circuit to the rotary magnet 425 which now rotates the brushes due to the operator transmitting the units digit of the wanted number. When the connector is seized by a local second selector, relays E^4 and F^4 are not energized as in the case when the connector is seized by the toll selector. The testing and seizure of the selected line is the same as previously described except that the locking circuit for the relay G^4 which is closer if the line is busy, extends over the armature 436 and back contact of relay E^4, conductor 463, conductor 408, conductor 407 to the armature 405 and front contact of relay C^4 to ground, instead of over the armature 436 and front contact to the ground on the busy line. Thus the becoming idle of the selected line does not remove the busy signal, which in this case is to tone from source 480 as in the case when the connector was seized from the toll selector, but the busy signal is maintained applied until the operator breaks down the connection by pulling out the plug 710. This is in accordance with standard practice. If the line is idle, however, relay J^4 energizes as described when the connector was seized from the toll selector, and at its armatures 445 and 444 applies ringing current to the selected line. When the called subscriber answers, the following circuit is closed to operate the ringing cut off relay D^4; free pole ringing generator 447, armature 448 and back contact of relay F^4, armature 449 and back contact of relay D^4, ring side of the line 458, armature 444 and front contact of relay J^4, brush 457, multiple 456, ring side of the subscriber's line, through the substation loop returning over the tip side of the line, multiple 455, brush 454, armature 445 and front contact of relay J^4, tip conductor 453, armature 450 and back contact of relay D^4, armature 451 and back contact of relay E^4, upper winding of relay D^4 to free pole battery. Relay D^4 in attracting its armature 449 cuts off the ringing current and in attracting this armature and armature 450 connects the incoming and outgoing tip and ring conductors together. In attracting its armature 467, it locks itself up by its lower winding and armature 468 of relay J^4 to ground. Relay A^4 now energizes over the called substation loop as follows: free pole battery, upper winding of relay A^4, conductor 469, tip conductor 470, armature 450 and front contact of relay D^4, tip conductor 453, armature 445 and front contact of relay J^4, brush 454, multiple 455, tip conductor of the called line, through the telephonic line of the substation, returning over the ring conductor, multiple 456, brush 457, armature 444 and front contact of relay J^4, ring conductor 458, armature 449 and front contact of relay D^4, conductor 471, armature 472 and back contact of relay G^4, conductor 473, lower winding of relay A^4, armature 467 and front contact of relay D^4, armature 468 and front contact of J^4 to ground. Relay A^4 in operating reverses the direction of the current in the tip and ring conductors leading back to the operator's cord in the well known manner, which operates polarized relay 715 thereat. This relay, in operating, opens the circuit of the calling supervisory lamp 716. It is noted in this connection that the sleeve relay 717 is marginal and does not operate when plug 710 is inserted in a jack 750, due to resistance 752 in the sleeve conductor leading to a line switch but does not operate to cut off the polarized relay 715 and substitute an ordinary supervisory relay 718 when the plug is inserted in a jack 751 leading to a manual line. The sleeve relay 719 operates when the plug is inserted in either jack. The operator may now require the deposit of the coins and

actuate collect key C^7K^7 which closes the following circuit including a 110 volt source of positive current to operate the polarized relay C^6, Fig. 6, which will in turn apply current from a positive 110 volt source to the calling line to operate polarized magnet P at the calling substation to collect the coins or coin. The circuit for operating relay C^6 is as follows: positive pole of the generator, alternate contact of coin collect key C^7K^7, tip conductor 701, tip of the plug 700, tip of the jack 602, tip conductor 605, of the trunk, upper armature and front contact of relay A^5, polarized relay C^6, relay D^5, ring conductor 606 of the trunk, ring of the jack 602, ring of the plug 700, ring conductor 702 of the cord, alternate contact of key C^7K^7 to ground. The circuit for operating polarized relay P in the substation coin box is as follows: positive side of the generator, contact 608, contact 609, tip conductor 610, tip conductor 530 of the calling line. Positive current is also connected over contact 620 to the ring side of the line. This current passes over the sides of the line in parallel to ground through the polarized relay P which is connected in a grounded branch. Relay P in responding to this current collects the coin and disconnects itself from ground as described in detail in said Forsberg patent. If the coins are to be returned the operator actuates refund key R^7K^7 which operates relay C^6 in the opposite direction closing the following circuit to impress negative current on the calling line to cause the polarized magnet P to refund: negative generator, contacts 611, 621, 622 to the tip and ring conductors in parallel to ground through polarized relay P at the calling station. The polarized relay in responding to this current causes the refund of the coins to the subscriber. The spring combinations of the polarized relay C^6, Fig. 6, and 351, Fig. 3 are arranged to eliminate annoying clicks in the calling subscriber's ear, by simultaneously applying the positive or negative current to both sides of the line as shown and described in Patent No. 1,262,912, issued April 16, 1918, to H. M. Bascom.

The replacement of the receiver by the called subscriber deenergizes relay A^4, Fig. 4, which reverses the direction of the current flow of the conductors leading back to the cord circuit, Fig. 7, which causes polarized relay 715 to restore, whereupon the lamp 716 is lighted. The operator observing the lighting of this lamp pulls out the plug 710 which restores the automatic switches in the direction of the called line including the connector, Fig. 4. The removal of the plug 700 from the jack 602 and the replacement of the receiver by the calling party causes the slow relay B^5 to release and in retracting its upper armature this relay opens the circuit of the line switch LS, restoring the same. If the calling party had not replaced his receiver, the removal of the plug 700 from jack 602 would have caused the lighting of the calling lamp 601 due to the attraction of the armature of relay 600, and the operator would then reinsert plug 700 into the jack and ascertain the subscriber's wants.

What is claimed is:

1. In a telephone exchange system, the combination with a telephone line, an operator's position, a head set thereat, means including automatic switches for extending said line to said position, means including automatic switches controlled by the operator for building up a connection from said position to said line, means controlled from said operator's position and individual to said line for transmitting a tone to the operator's telephone set over said first connection, a key mechanism at said operator's position, means controlled jointly by the operation of said key mechanism from said operator's position over said first connection and by the seizure of said line through said second connection for breaking down said first connection, and means individual to the line for transmitting a tone to the operator's head set operative over the first mentioned connection.

2. In a telephone exchange system, the combination with a telephone line, an operator's position, means including automatic switches for extending said line to said position, means controlled by one of said switches for rendering said line busy to other switches, means including automatic switches controlled by the operator for building up the connection from said position to said line, a key mechanism at said operator's position, means controlled jointly by the operation of said key mechanism from said operator's position over said first mentioned connection and by the seizure of said line through said second connection for breaking down said first connection, and means for maintaining said line busy over said second connection.

3. In a telephone exchange system, the combination with a telephone line, an operator's position, means including an automatic switch for extending said line to said position, a circuit means responsive to the connection of the line for holding said switch actuated, means including automatic switches controlled by the operator for building up a connection from said position to said line, and a second circuit means responsive to the seizure of the line through said second connection to close in shunt of said holding circuit means to cause the automatic switch held actuated by said first circuit means to break down the first connection to said position.

4. In a telephone exchange system, the combination with a telephone line, an operator's position, trunks leading thereto, means including an automatic switch for extending said line to said position by means of one of said trunks, a line relay operated by the closure of the line loop to cause said switch to seize a trunk, a holding circuit for said switch responsive to the extension of said line, means including automatic switches controlled by the operator for building up a connection to said line, and a circuit responsive to the seizure of said line in said second connection to close in shunt of said holding circuit to cause the automatic switch held actuated by said holding circuit to release to break down the original connection to said position, and a circuit in shunt of the said line relay to prevent its operation over the line loop after the said automatic switch is released.

5. In a telephone exchange system, the combination with telephone lines, means for interconnecting the same including a connecting circuit having a calling supervisory lamp, a normally closed bridge across the calling end of said connecting circuit having a polarized relay, a normally open connection for the calling end of said connecting circuit having a supervisory relay and a source of current, means operated when the connecting circuit is connected to a manual line for opening the bridge containing the polarized relay and closing the connection containing the supervisory relay and the source of current across the calling end of said circuit, means controlled by the response of the subscriber at the called automatic station for reversing the current supplied on an automatically extended connection to operate the polarized relay to extinguish the calling lamp, and means controlled by the response of the subscriber at the manual station for operating said supervisory relay included in the circuit of a manually extended line to extinguish the lamp.

6. A telephone exchange system, the combination with automatic and manual lines, means including a connecting circuit for interconnecting the same, a calling lamp therein, a bridge for the calling end of said connecting circuit including a polarized relay, a second bridge for said connecting circuit having a supervisory relay, means for extending the call over one of two paths to connect with either a manual or an automatic line, means controlled by the path selected to operatively associate the corresponding bridge with the connecting circuit, means controlled by the response of the subscriber at a calling automatic station for reversing the battery to operate the polarized relay to extinguish said lamp, and means controlled by the response of the subscriber at a called manual station for energizing said supervisory relay to extinguish the lamp.

7. In a telephone exchange system, the combination with telephone lines, an operator's position, means including an automatic switch for extending a calling line to said position, a tone circuit individual to the calling line, an induction coil for inclusion in said circuit to transmit tone to the operator's head set, a relay for rendering said induction coil inoperative, said relay being energized when the line is extended to said position, and a key actuated by the operator for causing said relay to become deenergized to render said coil operative.

8. In a telephone exchange system, the combination with telephone lines, an operator's position, means including an automatic switch for extending a calling line to said position, a tone circuit individual to the calling line, an induction coil for inclusion in said tone circuit to transmit tone to the operator's head set, a relay operated upon the extension of the line to the position for shunting the primary winding of said coil, and a key controlled by the operator for releasing said relay to remove said shunt whereby tone is transmitted to her head set.

9. In a telephone system, a subscriber's line, automatic switches controlled thereover for completing telephone connections, means for making said line busy responsive to the establishing of said connection, an automatic switch controlled by a party who has been called by said subscriber for completing a connection to said line in the reverse direction, and means controllable over a connection established from said subscriber's line by a party called and responsive to the establishing of a connection to said subscriber's line for rendering said line non-busy to said connection to the subscriber's line.

10. In a telephone system, a calling line, and an operator's position, an automatic switch controllable by the subscriber on said line to extend a connection to said operator's position, means for rendering said line busy responsive to the establishing of said connection, an automatic switch controllable by the operator for connecting with said line over another path, and means under control of the operator over said first connection responsive to the establishing of the connection over said other path for rendering said line non-busy to said last mentioned switch in the establishing of the second connection.

11. In a telephone system, a calling line and an operator's position, an automatic switch controllable by the subscriber of said line to extend a connection to said operator's position, means for rendering said line busy responsive to the establishing of a connection therefrom, an automatic switch controll-

able by the operator for connecting with said line over another path, means responsive to the busy condition of said line for holding said last switch in a condition of suspended operation, and means controllable over said first connection by said operator and responsive to the establishing of said second connection for rendering said line non-busy to enable said last switch to complete said second connection.

12. In a telephone system, a calling line and an operator's position, an automatic switch controllable by the subscriber on said line to extend a connection to said operator's position, means for rendering the said line busy responsive to the establishing of a connection therefrom, an automatic switch controllable by the operator for connecting with said line over another path, means responsive to the busy condition of said line for holding said last switch in a condition of suspended operation, means controllable over said first connection by the operator responsive to the establishing of said second connection for rendering said line non-busy to enable said last switch to complete said second connection, and means for giving the operator a signal while said last switch is held on the busy line.

In testimony whereof, I have signed my name to this specification this 15th day of January 1923.

EMIL JACOBSEN.