

July 9, 1929.

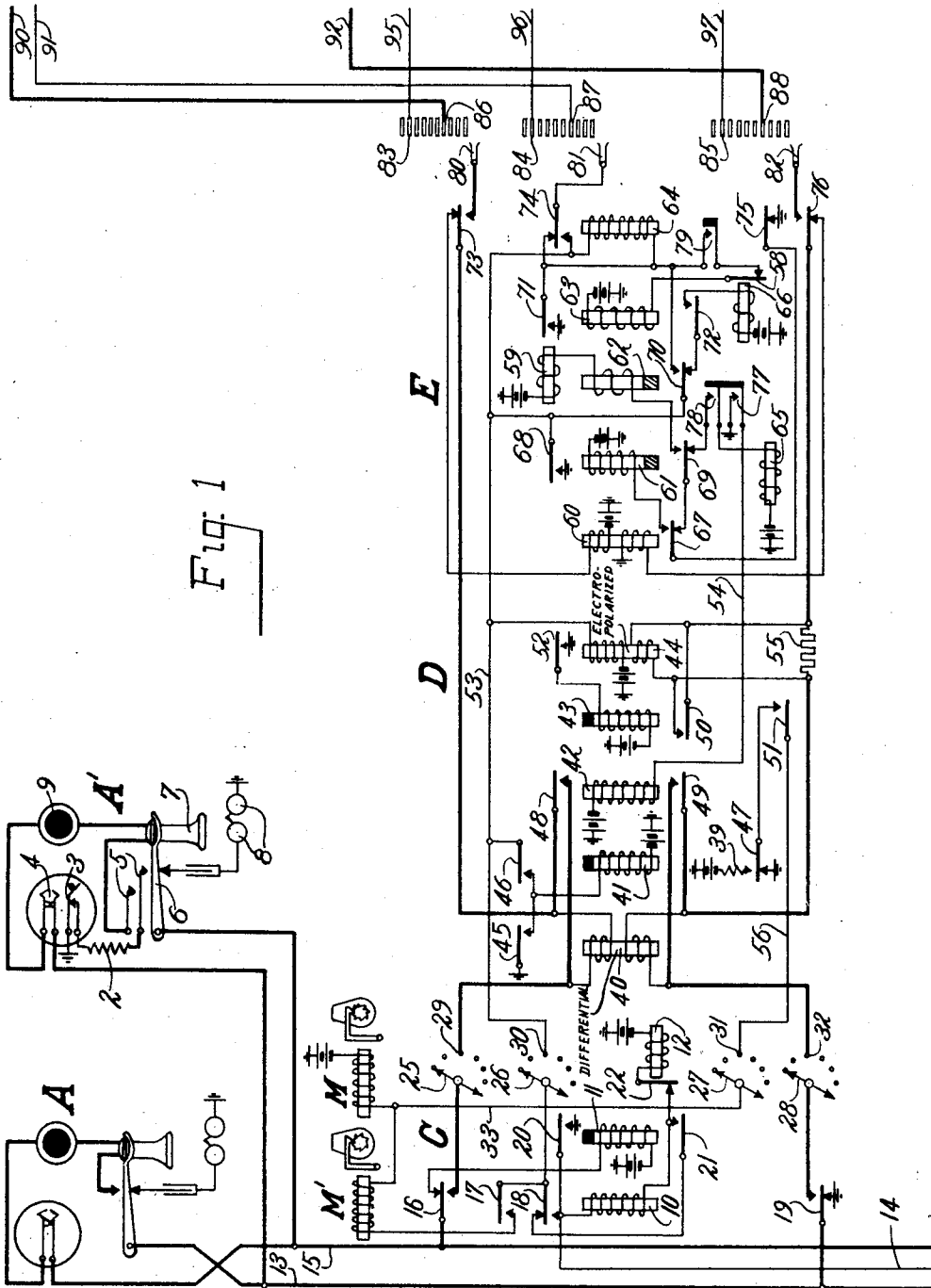
J. H. VOSS

1,720,157

MEASURED SERVICE TELEPHONE SYSTEM

Filed June 21, 1926

2 Sheets-Sheet 1



Inventor
John H. Voss
Walter C. Curran, Atty.

July 9, 1929.

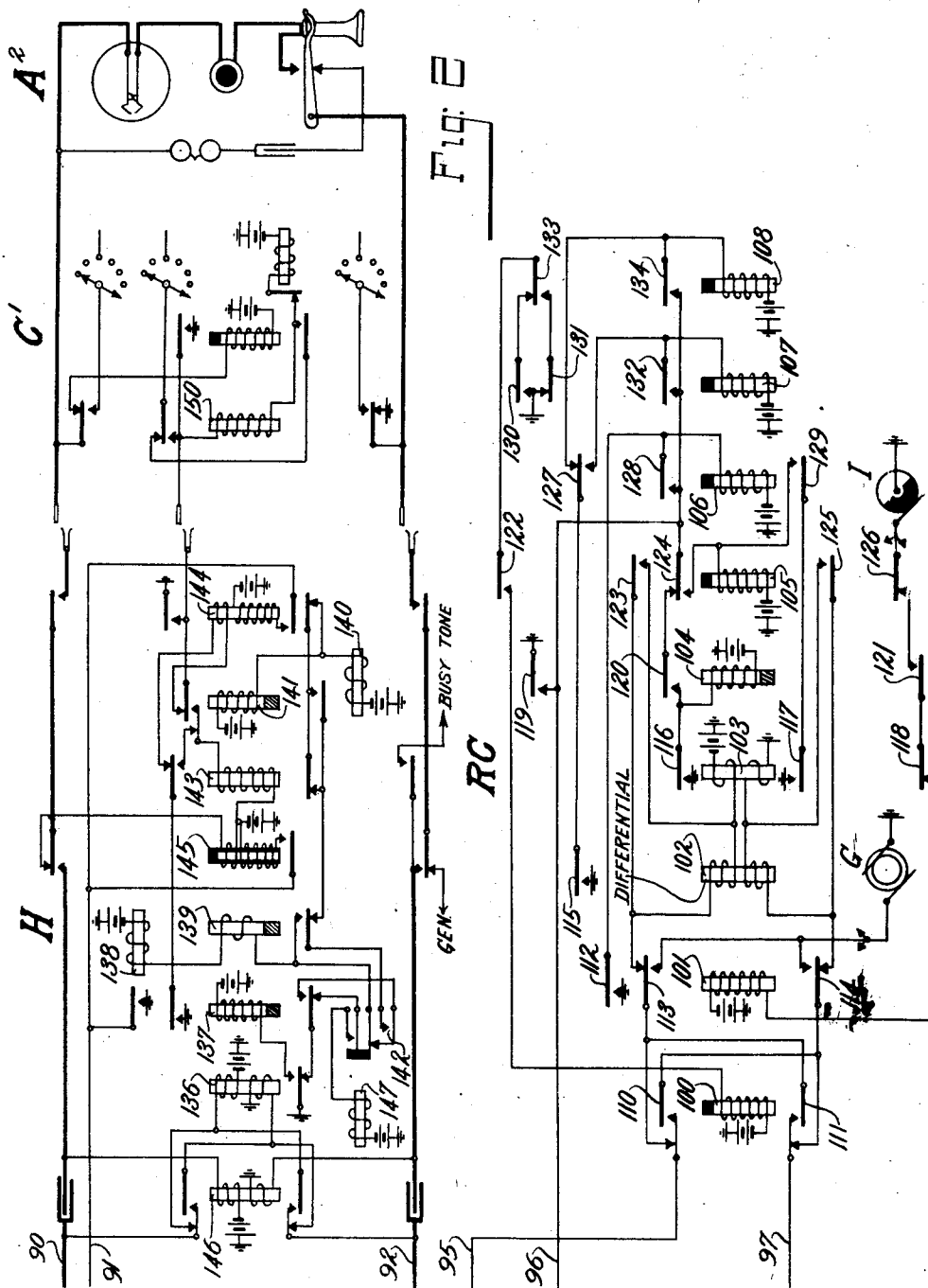
J. H. VOSS

1,720,157

MEASURED SERVICE TELEPHONE SYSTEM

Filed June 21, 1926

2 Sheets-Sheet 2



—Inventor—
John H. Voss

John H. Voss

Walter Cusw. Atty.

UNITED STATES PATENT OFFICE.

JOHN H. VOSS, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

MEASURED-SERVICE TELEPHONE SYSTEM.

Application filed June 21, 1926. Serial No. 117,230.

This invention relates in general to measured service telephone systems, but more particularly to automatic party line measured service systems and the principal object of the invention may be stated to be specifically, the provision of a system wherein a meter or call register is provided for each station on a multi-party telephone line, and wherein each meter is adapted to be subsequently connected for registering a call after its associated station is taken into use and has completed a call.

Another object consists of means whereby only the meter corresponding to the calling station is operated when both the calling and the called stations are on the same party line.

Still another object consists of new and improved reverting call relay equipment.

Other objects consist of the provision of improved circuit arrangements whereby the foregoing is accomplished as efficiently as possible all of which will be described in the following description and illustrated in the accompanying diagrammatic drawings forming a part thereof.

Referring now more particularly to the drawings consisting of Figs. 1 and 2, with Fig. 1 placed to the left of Fig. 2, the system and apparatus shown therein will be briefly explained:

The operation and construction of the various switches will be described only generally, such switches being well known in the art. At A and A', Fig. 1, there are shown two parties connected on a line leading to the exchange. These substations are of the well known two wire type having the usual telephone instrumentalities, the ringers being connected at one station to one side of the line and at the other station to the other side of the lines 13 and 15. The substation A' differs from substation A in that a resistance 2 is connected from one side of the line to ground through the shunt springs 3 of the calling device when the receiver is removed from the switch hook 6. Each time the calling device is operated the shunt springs 3 are opened and the resistance 2 is removed from the line. When the calling device returns to normal again this resistance is again connected to one side of the line. This is done to prevent interference with the transmission of impulses over the

lines to the various line relays of the switches.

At the exchange the line terminates in the rotary line switch C of well known construction, which is provided for the purpose of extending the line, responsive to the removal of the receiver at a calling station, to a trunk line terminating in an idle selector switch. The wipers of this line switch always rest on the set of bank contacts last used. The meters or call registers indicated at M and M' are associated, respectively, with the substations A and A' and are located in any preferred point in the exchange. These meters are of very high resistance so that they will not operate when they are energized in series but only when they are energized separately and after a calling station has made a call and the called party has answered. The meter relay equipment indicated by the reference character D includes the differential relay 40, which is only operated when a substation such as A' is calling. The electro-polarized relay 44 operates when the called party has answered and effects the operation of the calling party's meter. The selector switch E is of the well known Strowger type wherein the wipers are stepped up to the desired level under control of the calling subscriber's calling device, and then automatically rotated to find an idle trunk in that level leading to a connector switch such as indicated at H or reverting call relay equipment such as RC.

The reverting call relay equipment indicated at RC, Fig. 2, controls the application of ringing current on reverting calls and also feeds battery to the line for talking purposes and in addition reverses this battery for effecting the operation of the calling party's meter after the called party has answered. The differential relay 102 is only operated when a party line station such as A' for example, initiates a call.

The connector switch H, Fig. 2, is of the usual type and is controlled by the last two digits of the called number transmitted by the calling subscriber. The wipers of the switch are raised to the desired level and then rotated to the set of bank contacts to which the called station is connected. The relay 150 of the line switch C', which is similar to C, Fig. 1, then operates its armature springs

half way due to a mechanical inter-lock. Substation A² is similar to A, Fig. 1, but the ringer is not connected to ground as this is a straight line station, no other parties

5 on the same line.

It will now be assumed that a call is to be made by the subscriber at the substation A' to the subscriber at the substation A, both stations being on the same line leading 10 to the exchange. The subscriber at substation A' removes his receiver 7 from the switch hook 6 and closes a loop to the line switch C in the exchange over conductors 13 and 15 in series. A circuit is then com- 15 pleted for line relay 11 as follows: battery, winding of line relay 11, back contact and armature 16 of relay 10, conductor 15, switch hook 6, switch hook springs 5, receiver 7, transmitter 9 and impulse springs 4, and 20 then in series over line conductor 13 to armature 19 and back contact of relay 10 to ground. Line relay 11 energizes over this circuit and places ground at the front con- 25 tact of armature 20 on conductor 14 to make this line busy to incoming calls. Should the bank contact on which wiper 26 is resting be busy, a circuit is completed from ground on that contact, wiper 26, armature 18 and its back contact, armature 21 and its front 30 contact, interrupter springs 22, through the winding of the rotary magnet 12 to battery. Rotary magnet 12 energizes and breaks its own circuit at contacts 22 and upon deenergizing steps the wipers 25, 26, 27 and 28 35 onto the next set of bank contacts. This operation continues until a bank contact is found upon which no ground is present. During this testing period the cut-off relay 10 is prevented from operating by being short 40 circuited from the grounded bank contact through armature 21 on one side of its winding, and on the other side by armature 20 of relay 11. As soon as an ungrounded contact is found, relay 10 is energized and op- 45 erates its armatures. At armatures 16 and 19, the line conductors are extended through the lineswitch and the line relay 11 is disconnected and falls back. At armature 17 the circuit of meter M' is prepared. The 50 operation of rotary magnet 12 is stopped because it does not energize in series with relay 10, due to the high resistance of relay 10. The wipers of the lineswitch C are now in engagement with the set of bank contacts 55 of a trunk leading to the idle selector E through the meter relay equipment D.

A circuit is now closed over the line wires 13 and 15 through the differential relay 40, to the line relay 60 of the selector E as fol- 60 lows: battery through the upper winding of relay 60, armature and back contact 73 of switching relay 64, upper winding of the differential relay 40, bank contact 29 and wiper 25 of the lineswitch C, front contact 65 and armature 16 of relay 10, over the line

wire 15, through the substation, back on con- ductor 13, through armature 19 and its working contact of relay 10, wiper 28, bank contact 32, lower winding of differential re- lay 40, through the non-inductive winding 70 55, and polarized relay 44 in parallel, arma- ture and back contact 76 of relay 64, and through the lower winding of relay 60 to ground. Line relay 60 of the selector E upon operating closes a circuit for slow-re- 75 lease-relay 61 as follows: battery through the winding of slow-release-relay 61, front contact and armature 67 of relay 60, arma- ture 75 and its back contact to ground. Re- lay 61 at armature 68 places ground on the 80 release trunk conductor 53 to busy the switch to other calls, and at armature 69 prepares a circuit for the low resistance series relay 62 and the vertical stepping magnet 59 in series and in addition opens the circuit of 85 the release magnet 65.

The differential relay 40 is a relay that is so adjusted that it will not operate with cur- rent of equal strength flowing through both windings in opposite directions and only 90 operates when the current flowing through one winding is reduced. As the substation A' has initiated the call, ground through resistance 2 will be connected to the line conductor 15 thereby reducing the current 95 flow in the lower winding of differential re- lay 40 and allowing it to operate. The polarized relay 44 however, does not operate in the above circuit as its lower winding remains in opposition with its upper wind- 100 ing and therefore it cannot operate. Differ- ential relay 40 upon operating closes a cir- cuit for relay 41 from ground on armature 45 through the winding of relay 41 to bat- tery. Relay 41 energizes and locks up 105 through its own armature 46 to the grounded release trunk conductor 53 and at armature 47 prepares the metering circuit.

The subscriber at substation A' now oper- ates his calling device in accordance with the 110 first series of impulses corresponding to the first digit of the called number which will be assumed to be 9. The impulse springs 4 are intermittently opened and closed and there- fore alternately energize and deenergize re- 115 lay 60. Release relay 61 being slow acting maintains its armature attracted throughout the series of deenergizations. Each time the line relay 60 falls back a circuit is closed for the vertical stepping magnet 59 as follows: 120 battery through winding of stepping magnet 59, winding of slow-release-relay 62, front contact and armature 69 of relay 61, back contact and armature 67 of relay 60, arma- ture 75 and its back contact to ground. The 125 vertical stepping magnet 59 receives nine impulses and the wipers 80, 81 and 82 of the selector E are therefore positioned opposite the ninth level of bank contacts.

As soon as the selector E had taken its 130

first vertical step, the off-normal springs were operated and at contacts 77 a circuit for relay 42 was closed from ground through off-normal contacts 77, conductor 54, through the winding of relay 42 to battery. Relay 42 at its front contacts and armatures 48 and 49, short circuited differential relay 40, in order to make a clear path for dialing. Differential relay 40 falls back but does not effect relay 41, because this relay is locked up through its own contact 46 to grounded release trunk conductor 53, armature 68 and front contact of relay 61 to ground. During the transmission of the first series of impulses, relay 61 completed a circuit for rotary stepping control relay 63 as follows: ground on armature 68 and its front contact, armature 70 and its front contact on relay 62, off-normal springs 79, contacts 58 of rotary magnet 66 through winding of relay 63 to battery. Relay 63 energizes and locks up to the following circuit: ground on armature 71 and its front contact, off-normal springs 79, contact 58 of rotary magnet 66, through the winding of relay 63 to battery. Relay 63 also closes one point in the circuit of the rotary magnet at armature 72. After the first series of impulses cease relay 62 restores but relay 61 does not, and the circuit of the rotary magnet is completed as follows: ground on front contact and armature 68, armature 70 and back contact of relay 62, armature 72 and front contact of relay 63 through winding of rotary magnet 66 to battery. The rotary magnet 66 operates and advances the switch wipers 80, 81, and 82 one rotary step. It also opens the locking circuit of relay 63 at contacts 58. Relay 63 upon falling back opens the circuit of the rotary magnet at contacts 72 which upon falling back closes contacts 58 again. Should the first trunk in the ninth level be busy, ground will be found by wiper 81. Relay 63 will again become energized and then locked up from ground fed back on conductor 96, wiper 81, armature 74 and its back contact, off-normal springs 79, contacts 58, through winding of relay 63 to battery, and consequently the rotary magnet 66 will again become energized and deenergized and the switch will take another rotary step. The alternate energization of rotary magnet 66, and energization of relay 63 continues until an idle trunk is found in the level. As the wipers rotate over the busy contacts the switching relay 64 is short circuited and therefore prevented from energizing by ground present on the busy bank contacts, through wiper 81, armature 74 and back contact, to one side of relay 64, and from ground on armature 68 and front contact of relay 61 to the other side of relay 64. As soon as an idle reverting call relay equipment such as RC, Fig. 2, is found, there will be no ground present on the bank contact to which wiper 81 has access. Switching relay 64 therefore is not short circuited as formerly and energizes in series with relay 63, but due to the high resistance of relay 64, relay 63 does not again operate. Relay 64 energizes and locks itself up from the ground sent back subsequently from the reverting call switch, and at armatures 73 and 76 switches the line conductors to the wipers 80 and 82, and cuts off the line relay 60 which in turn releases the relay 61.

With the wipers of the selector E positioned on contacts 83, 84 and 85 a circuit is completed for the differential relay 102 and the line relay 103 of the equipment RC over the following circuit: battery through the upper winding of relay 103, upper winding of differential relay 102, back contact and armature 113 of relay 101, break contacts of armature 110 of relay 100, line conductor 95, bank contact 83, wiper 80, front contact and armature 73 of relay 64, front contact and armature 48 of relay 42, bank contact 29 and the wiper 25 of the lineswitch C, front contact and armature 16 of relay 10, over line conductor 15, through the substation equipment of station A', back on line 13, armature and front contact 19 of relay 10, wiper 28 and bank contact 32, armature 49 and the front contact of relay 42, non-inductive resistance 55 and the lower winding of polarized relay 44 in parallel, armature 76 and front contact of relay 64, wiper 82 and bank contact 85, through conductor 97, break springs of armature 111 of relay 100, armature and back contact 114 of relay 101, lower winding of differential relay 102, and then through the lower winding of relay 103 to ground. Due to the ground through resistance 2 at the substation A' the differential relay 102 is unbalanced and therefore operates and completes a circuit from grounded front contact and armature 115, armature 127 and its back contact, to slow-to-pull-up relay 108. It may be here stated that relays 41, 43, 100, 105, 106, 107 and 108 are of the type wherein there is a copper slug on the armature end of the core so that the relays upon energizing will be slow in pulling up and falling back and are different from other slow relays such as 104 which are only slow-to-release but pull up fast. Relays 105, 106, 107 and 108 are slow-to-energize and operate, so that relay 104 can pull up and furnish the locking ground for them from armature 119 when they operate. Relay 103 which energizes in series with relay 102, operates its springs 116 and places ground on one side of relay 104 to battery, and at armature 117 prepares the circuit of relay 105. Relay 104 energizes and locks up from battery through its own winding to armature 120, back contact and armature 124, front contact and armature 119 to ground. This ground on armature 119 maintains the

reverting call relay equipment RC busy to all other incoming calls and also locks up the relay 108 at its armature spring 134. In addition this same ground holds the selector E in operated position over release conductor 96.

The calling subscriber A' now hangs up his receiver to start the automatic ringing. Relays 102 and 103 thereupon fall back and a circuit for ringing relay 101 is completed as follows: ground through constantly rotating interrupter I, armature 126 and its back contact, front contact and armature 121 of relay 104, which is locked up, armature and back contact 118 through the winding of relay 101 to battery. At the front contacts and armatures 113 and 114, relay 101 projects ringing current from generator G to ground over both sides of the line to ring the bells of the calling and called parties. As the interrupter I continues to rotate, the relay 101 alternately energizes and deenergizes, thereby interrupting the ring. The electro-polarized relay 44 may slightly flutter from this ringing current but relay 43 being slow-to-pull-up will not get sufficient current to energize and the meters will not be operated. When the relay 101 was first energized, it completed a circuit for slow-to-pull-up relay 106 as follows: grounded front contact and armature 112 of relay 101 through the winding of relay 106 to battery. Relay 106 locks up to its armature 128 to ground on armature spring 119.

When the called party A answers only the relay 103 becomes again energized over the loop including substation A. The differential relay 102 does not pull-up this time because the windings remain in opposition when station A is only across the line. At armature and back contact 118, the interrupter I is removed from the circuit of relay 101 and it falls back, thereby cutting off the ring. At armature 129 and front contact, and ground from armature 117 of relay 103, a circuit is completed for the slow-to-pull-up relay 105. Relay 105 pulls up and locks through contact 124, to ground on the front contact and armature 119. The relay 104 does not fall back because its circuit is again completed from armature 116 to ground of relay 103. At armature 126 relay 105 opens another point in the interrupter circuit and at front contacts and armatures 123 and 125 a short circuit is placed around both windings of the differential relay 102 so that it will not again operate, and also to improve transmission. A circuit for reversing relay 100 is now completed as follows: ground and back contact of armature 131, front contact and armature 133, armature 122 and its front contact, through the winding of relay 100 to battery. Relay 100 operates and then at its front contacts and armatures 110 and 111 reverses battery and ground from relay 103

over the conductor 95 through the selector E, meter relay equipment D, lines-switch C, through the substation A back on the other side of the line through electro-polarized relay 44, the selector, conductor 97 to relay 103. The electro-polarized relay 44 is so adjustable that it will not operate with current flowing in either winding alone or when both windings have current flowing through them in opposite directions, but it does operate when both windings assist one another. The reversal of battery and ground at the armatures and front contacts of relay 100 reverses the current through the windings of relay 44 so that they will assist each other and the relay will operate. At armature 52 and its front contact relay 44 places ground on the winding of relay 43 to battery. Relay 43 closes a short circuit around the lower winding of polarized relay 44 and the non-inductive resistance 55 at armature and front contact 50, to improve transmission, but relay 44 remains held up through its upper winding to release trunk conductor 53. When relay 43 was operated, at armature and front contact 51 it completed a circuit for the meter M' of the subscriber A' as follows: battery through resistance 39, front contact and armature 47 of relay 41, front contact and armature 51, conductor 56, bank contact 31, and wiper 27 of the lineswitch C, conductor 33, winding of meter M', front contact and armature 17, wiper 26 and bank contact 30, to ground on release trunk conductor 53. The meter M' is therefore energized in this circuit and registers the proper charge of the calling party. The meter M is not operated because it is short circuited by the battery through resistance 39 and also the resistance of meter M' is high enough so that meter M cannot operate in series with it. The calling subscriber A' will know that the called subscriber A has answered by the stopping of the ringing and he removes his receiver. This act however does not have any effect on the differential relays 40 and 102 because they are now short circuited. Both parties may now converse with each other, battery for talking purposes being furnished by relay 103 of the reverteive call equipment RC.

Should it happen that the subscriber at substation A does not answer to the ringing of his bell, the subscriber at substation A' again removes his receiver from the hook. This act again operates the differential relay 102 and the line relay 103. At armature 118 and its back contact the relay 101 is cut off from the interrupter and the relay falls back, thereby cutting off the ring at armatures 113 and 114. At armature 115 the differential relay 102 energizes relay 107 over armature 127 of relay 106 which had been previously locked up. Relay 107 locks itself up over armatures 132 and operates

its armature 130 and 131. Relay 108 had been originally locked up when the call was initiated and the differential relay 102 was first pulled up and operated. It will thus
 5 be seen that with relays 107 and 108 operated there will be no ground on armature 133 of relay 108 and reversing relay 100 cannot pull up to reverse the battery and consequently the meter of the calling station
 10 A' will not be operated. The subscriber at station A' then restores his receiver and the connection is released as will be hereinafter explained.

When the conversation is completed and
 15 both parties have replaced their receivers on their respective hooks the relay 103 is deenergized and falls back, and at armature and front contact 116 it removes ground from relay 104. Relay 104 upon deenergizing removes the locking ground of armature
 20 spring 119, from the relays 105, 106 and 108. Relay 100 also falls back at this time due to the opening of contacts 122 of relay 105. When these relays have become de-
 25 energized, the reverting call equipment RC stands in normal position. The ground leading from armature and front contact 119 and over conductor 96 which held switching relay 64 of the selector E locked
 30 up is now removed, and this relay falls back, and at armature 75 and its back contact energizes the release magnet 65 over armature and back contact 67, armature and back
 35 contact 69, off-normal springs 78 through the winding of the release magnet 65 to battery. The release magnet 65 upon operating releases the wipers of the selector and they drop back to normal position. When the
 40 switch wipers 80, 81 and 82 reach their normal position the off-normal springs 78 are opened, the release magnet is thereby deenergized, and the selector E is now in normal position. The off-normal contacts 77
 45 also remove ground from relay 42 in the meter relay equipment D. This relay deenergizes and returns the circuit of the differential relay 40 back into the line again. With the ground removed at armature 119
 50 from the release conductor 96 and from conductor 53, relays 41 and 44 fall back, and in the lineswitch C the switching relay 10 also is released. Relay 10 upon falling back places its armatures again in normal position and the lineswitch C is ready to receive
 55 another call.

In the case the subscriber at the substation A calls the subscriber A', who is on the same line, the call proceeds in the same manner as has just been described in connection
 60 with the call from substation A' to A. Upon the removal of the receiver by the subscriber from the substation A a circuit is closed for the line relay 11 of the lineswitch C as previously explained. The lineswitch
 65 wipers continue to rotate under control of the rotary magnet until an idle selector such as E is found whereupon the switching relay 10 of the lineswitch is operated. The circuit of the impulsing relay 60 of the selector and differential relay 40 of the equip-
 70 ment D, is now closed in series over the line to the subscribers station A as has been explained. The differential relay 40 in the meter relay equipment D, however does not operate in this circuit because there is no
 75 ground through a resistance present at the substation A as there was in connection with A' on the same line and therefore the windings of relay 40 remain in opposition and it does not operate. The subscriber at A
 80 now dials the first series of impulses in accordance with the called party's number. The wipers of the selector E are then stepped up and positioned opposite the desired level of bank contacts. As soon as the
 85 selector has taken the first vertical step the off-normal springs 77 are operated and complete the circuit of relay 42. At its front contacts and armatures 48 and 49 relay 42 short circuits the differential relay 40. The
 90 wipers are then automatically rotated onto the idle set of bank contacts under the continued action of relay 63 and the rotary magnet 66. With the line of the calling substation A extended to the reverting call
 95 equipment RC, relay 103 is energized, and operates over the line conductors through the substation. Differential relay 102 however does not operate in this circuit as its two windings remain opposed. At front
 100 contact and armature 116, relay 103 places ground on one side of slow relay 104. Upon operating relay 104 locks itself over its armature 120 and front contact and armature
 105 119 to ground. This same ground maintains the equipment busy over release trunk conductor 96 to all other calls and holds the preceding switches in operated position. At armature and front contact 121 relay 104
 110 also closes a point in the circuit of the ringing relay 101. The calling subscriber at substation A now restores his receiver on the hook. Line relay 103 immediately falls back and at armature 118 completes the circuit from the interrupter I to the
 115 ringing relay 101. Relay 101 is intermittently energized and deenergized and at its front contacts and armatures 113 and 114 projects ringing current over the line from generator G to ring the bells of the calling
 120 and called subscribers. At front contact and armature 112, relay 101 also completes a circuit for relay 106 which upon operating locks itself over armature 128 to ground on armature 119. As soon as the subscriber at
 125 substation A' answers he places ground through a resistance on one side of the line and the differential relay 102 is operated because its windings are no longer opposed. At its front contact and armature 115 it 130

completes a circuit for relay 107 over front contact and armature 127. Upon operating relay 107 locks itself through armature 132 and its front contact to the ground on armature 119. Line relay 103 is again operated in series with differential relay 102 and at its grounded front contact and armature 117 completes a circuit for relay 105 to battery over armature 129. At its front contact and armature 124 relay 105 locks itself to the grounded armature 119. At the back contact of armature 124 the locking circuit of relay 104 is opened but this relay is still held up by armature 116. At its front contacts and armatures 123 and 125 the differential relay 102 is short circuited and is removed from the line. At armature 126 another point in the interrupter circuit is opened. At armature 122 and its front contact a circuit is now completed for reversing relay 100 from battery through winding of 100, front contact and armature 122, armature 133 and its back contact, armature 130 and its front contact to ground. Relay 100 attracts its armatures 110 and 111 and reverses the battery and ground from line relay 103. This reversal operates the electro-polarized relay 44. At grounded front contact and armature 52, relay 44 energizes relay 43 and short circuits the polarizing winding of the relay 44 at armature 50 but the relay remains held up from its upper winding to the grounded release trunk conductor. Relay 43 also closes its contacts 51 and completes the circuit of the meter M as follows: ground on the back contact of armature 47, front contact and armature 51, conductor 56, bank contact 31 and wiper 27 of the lineswitch C, conductor 33, through the winding of the meter magnet M to battery. The meter M is operated and registers the required charge of the calling party A. The calling subscriber A will know that the called subscriber A' has answered when the ringing stops and he removes his receiver and commences the conversation, battery for talking being furnished by relay 103. Upon the termination of the call both parties hang up and the release of the connection is brought about in the manner as has been described heretofore.

The operation will now be described wherein the subscriber at substation A will call another subscriber not on the same line, the substation A², Fig. 2, for instance, and the subscriber at the substation A will be charged for the call. Upon the removal of the receiver by the subscriber at the substation A, a circuit is closed for the line relay of the lineswitch C as previously explained. The lineswitch C rotates until an idle selector such as E is found, whereupon the switching relay 10 of the lineswitch pulls up. The circuit of the impulsing relay 60 of the selector and the differential relay 40 of the equipment D, is now closed over the line to the subscriber's station A as previously explained. The differential relay 40, however, does not operate in this circuit because there is no ground through a resistance present at the subscriber's station A as there was in connection with subscriber A' on the same line and the windings of this relay remain opposed. The subscriber now dials the first series of impulses in accordance with the called party's number. The wipers of the selector E are positioned opposite the desired level which in this instance is assumed to be the fourth level. The wipers are then automatically rotated onto the idle set of bank contacts 86, 87 and 88 under the continued action of relay 63 and the rotary magnet 66 until an idle connector in that group is found over the conductors 90, 91 and 92 leading to the connector H. Relay 136 is thereupon energized and closes a circuit for the slow-to-release-relay 137 which places ground on the release trunk conductor back to the selector and prepares the circuit to the vertical magnet 138. With the relay 136 energized the next series of impulses control the vertical magnet in series with the slow relay 139 to step the wipers to the desired level in which are located the contacts of the called line. After this series of impulses the relay 139 falls back to prepare a circuit for the rotary magnet 140 and the slow relay 141 through the closed off-normal springs 142. When the relay 136 operates for the next series of impulses, the rotary magnet 140 is operated to step the wipers to the contacts of the desired line, and relay 141 energizes and remains energized through a short interval after the wipers reach the called line. If the called line is busy and with the ground present on the test conductors thereof, a circuit will be closed through the front contacts of relay 141 for the busy relay 143 which will lock up and transmit a busy signal. If the called line is idle, the relay 143 will not be energized, and as soon as relay 141 falls back after the line relay 136 comes to rest again, a circuit is closed for the upper winding of relay 144 in series with the cut-off relay 150 of the lineswitch C', which pulls up its armatures half-way due to the mechanical interlock. Relay 144 of the connector and relay 150 of the lineswitch energize in series. Relay 144 disconnects the rotary magnet to prevent further operation, and cuts the called line through the ringing circuit leads on the back contacts of relay 145 over one winding of relay 145 and battery so that when the called man responds to the signal he closes the circuit of relay 145 which disconnects the ringing circuit and cuts the called line through to the windings of the back bridge or reversing relay 146. Relay 146 thereupon energizes in series with the called line circuit

and reverses the connections of the line relay 136, reversing battery on the calling party's line, and thereby reversing the battery through to the electro-polarized relay 44, which energizes and operates its front contact 52 to connect ground to the relay 43 and battery. Relay 43 pulls up slowly and cuts off the polarizing winding of the electro-polarized relay 44 at armature 50 but relay 44 remains held up through its upper winding to the grounded release trunk 53. Relay 43 also closes a circuit from ground on the back contact of armature 47, front contact and armature 51, conductor 56, bank contact 31, and wipers 27 of lineswitch C, conductor 33, through the winding of meter magnet M to battery. The meter magnet M thereupon operates and registers the call of the subscriber A. Meter M' is prevented from operating by ground over the circuit just traced on one side of its winding and ground on the release trunk conductor 53 on the other side of the winding.

When the called party A² hangs up his receiver the back bridge relay 146 falls back. Upon the subscriber A replacing his receiver he allows relay 136 of the connector H to fall back. This in turn releases relay 137 which removes ground from the release trunk conductor 91 and also closes the circuit to the release magnet 147 which restores the wipers of the switch back to normal position. With ground removed from the wiper 81 of the selector the switching relay 64 falls back and at contacts 75 completes the circuit of the release magnet 65 which restores the switch to normal. With ground removed from conductor 53 the polarized relay 44 and slow relay 41 are deenergized. Relay 10 of the lineswitch falls back and the circuits are again in normal position ready to receive another call.

When either one of the subscribers A or A' on the line 13 and 15 are called by some other subscriber on another line such as A², the lineswitch C' will operate in a manner similar to the operation of the lineswitch C on an outgoing call as hereinbefore described. A selector will be seized similar to that shown at E and the operation thereof will also be somewhat similar. The bank contacts in a connector to which the line conductors 13, 14 and 15 are connected would be similar to those shown in the connector described in Patent #1,640,568, filed Aug. 28, 1925 and issued to Roy F. Gould, on Aug. 30, 1927 wherein a wiper switching relay is disclosed which operates on a critical level, but does not on another level, to effect the ringing of the proper subscriber by switching generator to one side of the line or the other and therefore projecting the ringing current to one side of his line to ground at the bell. The line conductors 13 and 15 are therefore transposed at the substation A.

The remaining parts of the relays of that connector are somewhat similar to that connector as shown at H. The release of the connection is also similar to that as previously described.

Having fully described and ascertained the various features and aspects of this invention, what is considered new and desired to have protected by Letters Patent will be pointed out in the appended claims:

What is claimed is:

1. In a measured service telephone system, a party line, a plurality of stations on said line, a plurality of meters, one individual to each station, a trunk for association with said line, means responsive to such association for automatically preparing the proper meter for operation when one station initiates a call to another station on the same line, and means for operating said meter when the wanted station responds.

2. In a measured service automatic telephone system, a party line, a trunk line provided with a polarized relay, stations on said line, a meter individual to each station, said meters being connected in series, and means for controlling the operation of said polarized relay over said trunk line for operating the calling station's meter upon the response of the called station connected to the same line.

3. In a measured service automatic telephone system, party lines, a plurality of stations on each of said lines, a meter individual to each of said stations on said lines, a trunk for association with said lines, means responsive to such association for preparing a calling station's meter for operation when a call is initiated to another station on the same line or to another line, and means for operating said meter when the wanted station responds.

4. In a telephone system, a party line, stations on said line, a trunk line, a meter at the exchange associated with each station for registering calls from said line, said meters being connected in serial relation, means in said trunk line for automatically preparing one of the meters for operation when a call is extended from the associated station to another station on the same line or any other line, and means for operating said meter when the called station responds.

5. In a measured service telephone system, a party line, a plurality of stations assigned thereto, a plurality of meters, one individual to each station, a switch for extending said line, when calling, to an idle trunk, a relay in said trunk for determining which of said meters is to be actuated, and means for energizing said relay when a call is made from one of the stations on said line to another station on said line, or another line.

6. In a measured service telephone system, a party line, a plurality of stations as-

signed thereto, a plurality of meters, one individual to each station, a switch for extending said line when calling, to an idle trunk, a relay in said trunk for determining
 5 which of said meters is to be actuated, and means for preventing the energizing of said relay when a call is made from one of the stations on said line to another of said stations on said line or another line.

10 7. In a telephone system, a line, two stations on said line, a meter at the exchange normally connected for registering calls from one of said stations, a second meter for registering calls from said other station,
 15 a differential meter selecting relay for switching from one meter to the other, a switch for extending said line when calling, means for energizing said differential relay when the call is made from said first station
 20 to said second station, and means for preventing the operation of said differential relay when a call is made from said second station to said first station.

8. In a telephone system, a party line, a plurality of stations on said line, a meter at the exchange normally connected for registering calls from one of said stations on
 25 said line, a second meter for registering calls from another station on said line, a meter selecting relay for switching from one meter to the other, a switch for extending
 30 said line when calling, means for operating said relay when the call is made from one of said stations to the other, and means
 35 for preventing the operation of said relay when a call is made from the other of said stations to the first of said stations.

9. In a telephone system, a party line, a plurality of stations on said line, meters at the exchange, one individual to each station
 40 on the line, a progressively movable switch for extending said line when calling, a trunk line accessible to said switch, and differential means in said trunk line for controlling the selection of the proper meter when one
 45 station calls another on the same line or another line.

10. In a telephone system, a party line, meters at the exchange, one individual to
 50 each party on the line, a progressively movable switch for extending said line when calling, a trunk line accessible to said switch, a differential relay in said trunk line responsive to a certain station on said line,
 55 another relay in said trunk line, said second relay controlled by said differential relay to select the meter of said certain station when calling another station on the same line or another line.

60 11. In an automatic telephone system, a party line, individual call registers at the exchange one for each station on the line, a trunk hunting switch for extending said line when calling, a selector switch, a trunk
 65 line accessible to said first switch, and ter-

minating in said selector switch, a locking meter selecting relay controlled by a differential relay in said trunk line, and a third relay responsive when said selector is stepped off-normal for short circuiting said
 70 differential relay to permit the transmission of impulses from said party line.

12. In a measured service system, a party line, individual meters at the exchange for each party on the line, a trunk selecting
 75 switch for extending said line when calling, a trunk line accessible to said switch, a differential relay in said trunk line controlled by one party on said line, a meter selecting relay controlled by said differential relay
 80 having a circuit for directly controlling said meters, an electro-polarized relay in said trunk line responsive when the called party answers, and a slow relay in said trunk line controlled by said electro-polarized relay to
 85 complete the circuit and effect the operation of the calling party's meter.

13. In a measured service telephone system, a party line, a meter at the exchange individual to each station on said line, auto-
 90 matic means responsive to the removal of the receiver at one of said stations when calling another of said stations for extending said line to an idle selector switch and to prepare the meter circuit of said station, and
 95 means accessible to said selector and operative when a called station responds, for effecting the operation of said calling station's meter.

14. In a measured service telephone system, party lines, stations on said lines each having an individual meter at the exchange, metering and revertive call equipment accessible to and common to said lines, means responsive to a call from one of said lines to
 105 extend a connection to said equipment, and means in said equipment for determining which party on said line initiates the call and for subsequently operating the associated meter when the called party answers.
 110

15. In a measured service telephone system, a party line, an individual meter for each station on said line, metering equipment and revertive call equipment accessible to
 115 said line, means responsive to a call from one station for extending a connection to said revertive equipment, means in said revertive call equipment for determining which station initiates the call and means for then applying ringing current to the line to ring
 120 both parties simultaneously.

16. In a telephone system, a party line, stations on said line provided with individual meters, metering and revertive call equipment accessible to said line, means in
 125 said reverting call equipment responsive to a call from said line for ringing the calling and called stations, and means responsive to the removal of the receiver at the called station for stopping the ringing and for effect-
 130

ing the operation of the calling station's meter.

17. In a measured service telephone system, a party line, stations on said line, metering equipment and reverting call equipment accessible to said line, means responsive to the initiation of a call on said line to extend a connection to said reverting call equipment, means operable subsequent to the replacement of the receiver at the calling station for ringing both calling and called stations, and means responsive to the removal of the called station's receiver for operating the calling station's meter.

18. In a measured service telephone system, a party line, stations on said line, metering and reverting call equipment accessible to said line, means responsive to a call from said line to extend a connection to said reverting call equipment, means responsive to the replacement of the calling station's receiver for ringing the calling and called stations, and means responsive to the removal of the receiver at either station for cutting off the ring and for operating said metering equipment only if the call is answered by the called station.

19. In a measured service party line telephone system, metering and reverting call equipment accessible to each station on said

line, means responsive to the initiation of a call from one station to another on said line for extending the connection to said reverting call equipment, a differential relay and a line relay operated by said calling station, a slow to pull up relay locked up by said differential relay, a slow release relay furnishing locking means to said slow to pull up relay, a ringing control relay responsive to the replacement of the receiver by the calling station for ringing both stations, and another slow to pull up relay responsive to the answering of the calling station for cutting off the ring and operating a reversing relay to effect the metering of the called station's meter through said metering equipment.

20. In a measured service telephone system, a party line, a plurality of stations on said line, a meter individual to each of said stations, means for automatically preparing the proper meter for operation when one station on said party line initiates a call for another station, a polarized relay common to said meters, and means for operating said relay when the wanted station responds to operate the meter prepared for operation.

In witness whereof, I hereunto subscribe my name this 17th day of June, A. D. 1926.

JOHN H. VOSS.

CERTIFICATE OF CORRECTION.

Patent No. 1,720,157.

Granted July 9, 1929, to

JOHN H. VOSS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 7, lines 89 and 90, claim 2, strike out the words "stations on said line" and insert the same to follow after the word "line" in line 88, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of September, A. D. 1929.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.