Aug. 16, 1949. J. C. POND 2,479,252

TELEPHONE CALL RECORDING SYSTEM

Filed March 10, 1947 3 Sheets-Sheet 1

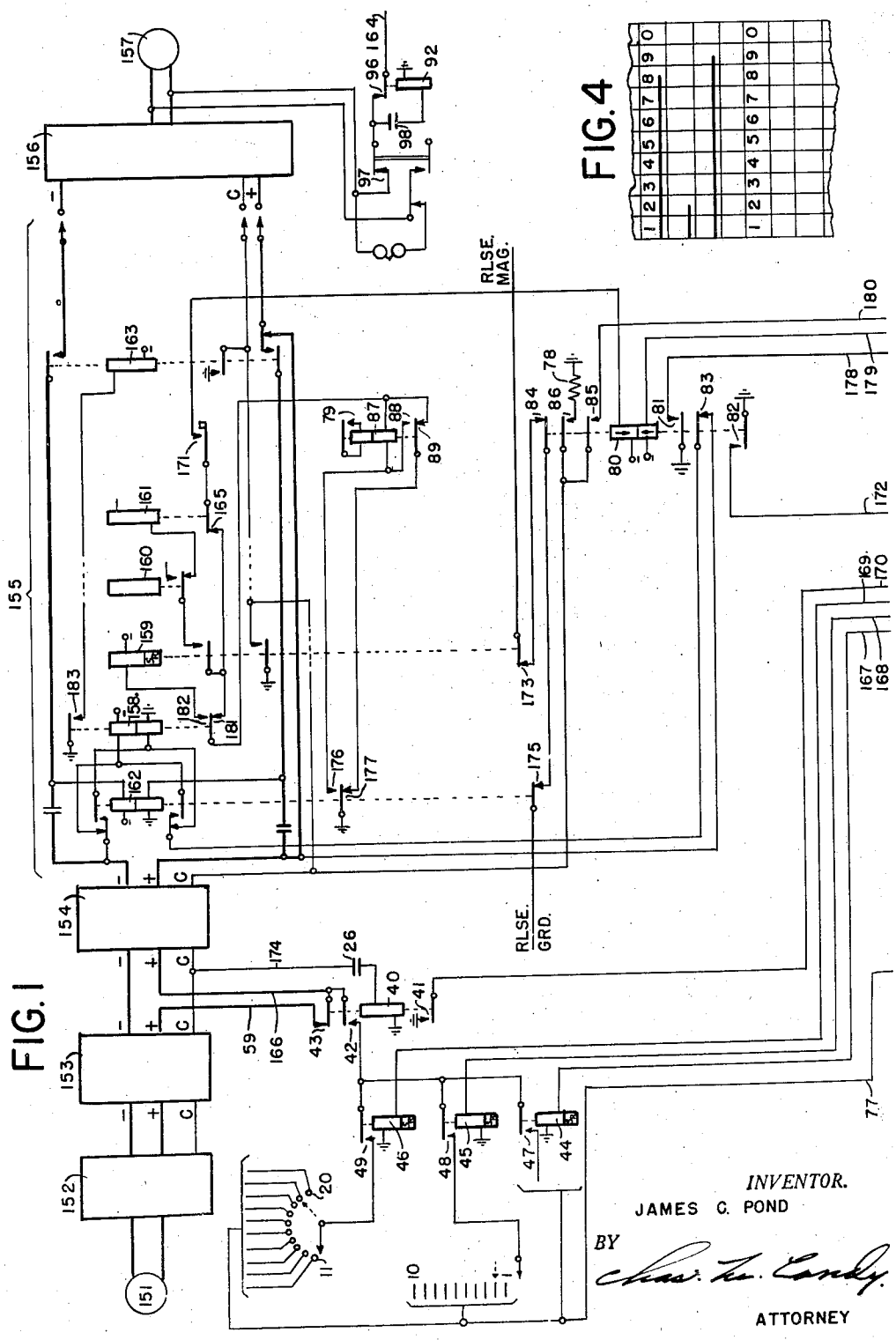


FIG. 1

FIG. 4

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TELEPHONE CALL RECORDING SYSTEM

Filed March 10, 1947 3 Sheets-Sheet 2

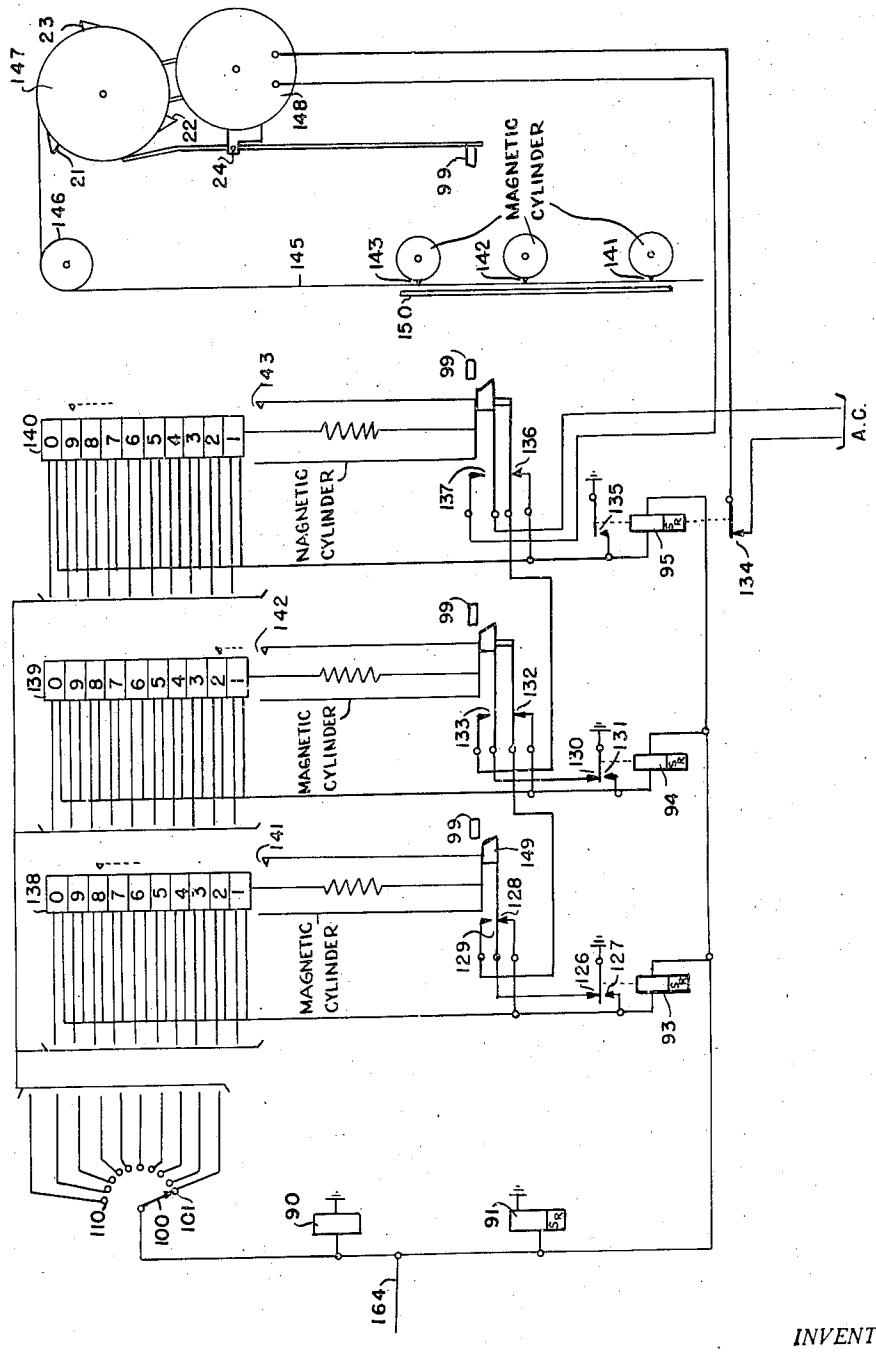


FIG. 2

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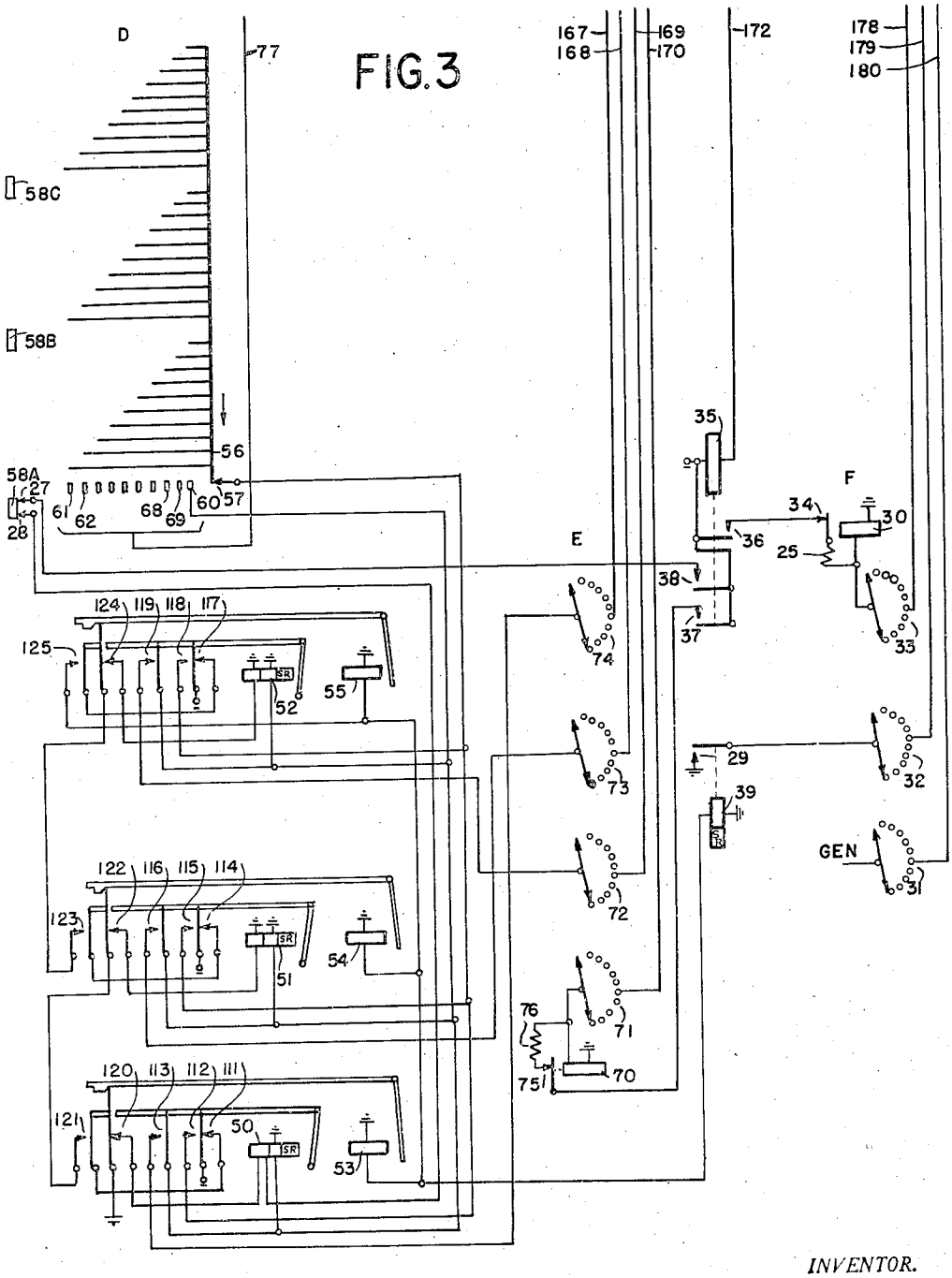
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Aug. 16, 1949. J. C. POND 2,479,252

TELEPHONE CALL RECORDING SYSTEM

Filed March 10, 1947 3 Sheets-Sheet 3

FIG. 3



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UNITED STATES PATENT OFFICE

2,479,252

TELEPHONE CALL RECORDING SYSTEM

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Application March 10, 1947, Serial No. 733,562

9 Claims. (Cl. 179—5.5)

1

This invention relates to telephone systems of the automatic type and more particularly to the provision in such systems, of a mechanism for use at subscribers' premises for recording the telephone number of lines which have called and which have not been answered and also apparatus in the central office which will respond to certain conditions of the connecting equipment to transmit impulses to the premises where the call has not been answered to operate the mechanism at the called station to display the calling number.

A called subscriber in the ordinary system who is absent when a call is initiated to his telephone has no means of knowing that he has been called or the number of the calling line. Also, a calling subscriber not receiving an answer to his first call will make several subsequent calls in an effort to obtain a response from the desired party. Should each line be equipped with a call recording mechanism it would not be necessary to make the subsequent calls, as each calling subscriber would know that his first unanswered call had been recorded at the called subscriber's premises and that the wanted party would, in due course, return the call.

An object of the invention is to provide means for recording incoming calls at called subscribers' stations and thus provide means for obtaining a record of all calls received during a period of time, and means for displaying such a record for the benefit of the called subscriber when he returns to his telephone and who may, at his convenience originate calls to the numbers so recorded.

A further object is to provide a recording system suitable for use with an automatic telephone system employing the well known types of two motion line finders together with selectors and connectors.

The present embodiment contemplates the recording of three digit numbers, although the principles herein disclosed could be employed to include arrangements for recording numbers of more or less than three digits.

A further object of this invention is to provide a novel mechanism for use in connection with a subscriber's telephone instrument and line for displaying on a movable tape or film, a visible record of the telephone numbers of any calls which have reached the telephone and have been unanswered during any absent period of the called subscriber.

Another object is to provide an unique impulse producing device for a central telephone

2

office which will be brought into use automatically whenever a called party does not respond to a regular call. The associated apparatus will hold the called subscriber's line connected to the connection, which has been established by the calling subscriber, for a sufficient length of time after the calling party has abandoned the call, for the impulse producing device to transmit impulses, representing the calling party's telephone number, to the recording device of this invention, at the station of the called party.

An embodiment of the invention as applied to a well known step-by-step automatic telephone system of the three digit type using line finders, selectors and connectors, will now be described and illustrated by drawings consisting of four figures on three sheets.

Figure 1, a typical connection through an automatic step-by-step three digit system wherein the well known subscriber's line finder equipment and selector switch are represented by boxes and only portions of the well known connector and telephone circuit are shown to simplify the explanation of the manner of connecting apparatus which forms a part of this invention.

Figure 2 is a schematic drawing illustrating the essential parts of the recorder of this invention as applied to a called subscriber's premises.

Figure 3 shows the connections of the impulse producing device of this invention as used in an automatic exchange system which is to be equipped to give recording service.

Figure 4 shows a typical recording of the telephone number eight hundred twenty nine, which was chosen as the number of the calling line in the description of operation.

For convenience in tracing the circuit, these drawings should be fitted together in the following order: Figure 2 at the right hand side of Figure 1 and Figure 3 underneath Figure 1.

A description of the operation of the circuit follows. A calling subscriber at a telephone, such as indicated by the circle 151, shown in the upper left of Figure 1, lifts his receiver or handset, which in the well known manner causes the telephone bell to be disconnected from the line, which consists of a pair of wires from the telephone instrument to the line equipment 152 in the central office, and to cause the receiver, transmitter and impulse dial to be connected into the line circuit. This operation causes the line equipment 152 to operate and set in motion a two motion line finder 153 which responds with an automatic vertical movement followed by an

automatic horizontal movement, of its shaft, to connect its line wipers to the terminals of the calling line.

Simultaneous with the vertical and rotary movements of the line finder shaft to connect the wipers with the positive and negative sides of the calling line, a single conductor vertical marking wiper has been moved over a single conductor vertical level of contacts to a contact in a position representing the tens digit of the calling line. Also another single conductor marking wiper has been moved over a single conductor horizontal level of contacts to a contact in a position representing the units digit of the calling line. These markings on the single conductor vertical and rotary levels are the means which control the recording of the tens and units of the calling line. This will be clear from the explanation of the operation of the circuit which follows. As the outgoing circuit of this particular line finder is permanently associated with a first selector, the calling line is, after the completion of the aforesaid vertical and horizontal movements, connected to a first selector **154**. The dialing tone is now connected to the calling line to indicate to the calling subscriber that dialing may commence. The calling subscriber dials the hundreds, tens and units of the desired number, first the hundreds digit, causing the selector to lift its shaft vertically and set the wipers on a level representing the hundreds digit of the called number, an automatic rotation of the selector shaft takes place causing the wipers to pass over the contacts of the selected level until an idle trunk to a connector is found, here the shaft stops, leaving the wiper, which represents the incoming side of the selector circuit to which the calling subscriber is connected, joined to a trunk circuit leading to an idle connector **155**, in the desired hundred group. The second digit of the desired number is now dialed by the calling subscriber causing the connector shaft to lift its wipers to a level representing the tens digit of the desired number, the final digit representing the units digit of the desired number is now dialed causing the connector shaft to rotate its wipers over the selected level to the contacts corresponding to the last digit of the desired number, thus completing the connection from the calling line to the called line through the line equipment **156** of the called line. In the well known manner the connector **155** automatically sends back to the calling party a suitable signal to indicate to the calling subscriber the condition of the connection, that is, a ring-back tone to indicate that the connection is complete to the dialed line and that the called subscriber's bell is being rung, or a busy tone to indicate that the dialed line is busy, or one of several other signals to appraise the calling party of the condition. Should the called line be engaged, the calling subscriber frees his line from the busy number by hanging up his receiver or restoring his handset to its cradle and he may repeat the call after waiting a reasonable length of time. Should the called line be free the ring-back tone will indicate that the bell is being rung and if the called party hears the bell and answers in due course, a regular normal call has passed through the exchange and the impulse sender and recorder of this invention have performed no function in such a call.

Attention should be called to relay **87** in Figure 1 which performs a function in connection with a call such as described above, that is a normal call through the exchange. Relay **87** is provided with a contact **79** to short circuit one of its windings as soon as the armature responds to the energization of the operating winding, this causes relay **87** to be slow to release. Relay **87** has been provided in this circuit to assure the non-starting of the recording apparatus in connection with a normal call, regardless of which subscriber, the calling or the called subscriber hangs up his receiver first.

On a normal call, during the period of the conversation the following principal relays will be in operated position, **87**, **158**, **159**, **162** and **163**. Should the calling party hang up his receiver first relays **158** and **159** will restore, the latter (relay **159**) closing its contact **173**, a part of the release magnet circuit (not shown). Relay **162** however remains operated through the called subscriber's line loop. At the moment relay **158** restores, the holding circuit for relay **87** is transferred from the winding of relay **159** to the number one winding of relay **80**. Relay **87** will remain operated over the following circuit; battery, number one winding of relay **80**, rotary off-normal contact **171**, break contact **165**, break contact **181**, number one winding of relay **87**, make contact **176** of relay **162** to ground. However, relay **80** cannot operate when its number one winding is included in the above described circuit in series with the number one winding of relay **87** and therefore the recording apparatus cannot be started. Soon after the calling party hangs up, the called party will do the same, causing relay **162** to restore, closing a second part of the release magnet circuit (not shown) at contact **175** causing the switch to return the shaft to normal.

Should the called party hang up first, relay **162** will restore first, switching the holding ground for relays **87** and **159** from contact **176** to **177** through contact **88**, and close one part of the release magnet circuit (not shown) at contact **175**. Thus relays **87**, **158** and **159** remain operated but relay **80** will not operate to start the recording apparatus. A short time after the called party hangs up, the calling party will restore his receiver, relay **158** restores, opening contact **182** disconnecting ground from relay **159**, relay **159** restores and at contact **173** completes the circuit to the connector release magnet (not shown) causing the connector shaft to return to normal.

However, in the event that there is no answer from the called line and the calling party abandons the call by hanging up his receiver or replacing the handset to its cradle, the apparatus of this invention will function to record the number of the calling line on a recorder at the called party's premises. In the typical connector circuit **155**, the relay **158** furnishes battery and ground back to the calling line and this relay therefore is energized during the time the calling party's line is connected. Relay **158** through its contact **182** closes the circuit to relay **159** which also remains energized during the time the calling party's line is connected. Another contact, **183** on relay **158** connects ground to relay **163** through other contacts (not shown) which cause operation of relay **163** only after the connector wipers connect with the called line and controls a circuit to the positive and negative wipers and this relay **163** will also remain energized during the time the calling party is connected to the connector circuit **155**. The usual relays have functioned during the building up of the call, such as relay **160** which closes the circuit to the vertical magnet (not shown) during the vertical

movement of the connector shaft and relay 161 which functions during the horizontal movement of the shaft. As the connector is now in ringing position, that is, ringing current (not shown) is being applied, and the called party has not answered then switching relay 162 has not operated. Should the calling party now abandon the call, relay 158 will restore to normal, opening the circuit to relay 159, but as this relay is slow to release, its armature will remain operated a short time after the armature of relay 158 restores, but this feature has no function at the moment. The restoring of the armature of relay 158 and the closing of contact armature of relay 158 and the closing of contact 181 completes the following circuit; battery, number one winding of relay 80, rotary off-normal contact 171, back contact 165 of relay 161, back contact 181 of relay 158, back contact 89 of relay 87, back contact 177 of the unoperated relay 162, to ground, causing relay 80 to operate, opening two contacts and closing four contacts. The opening of contact 83 disconnects one winding of relay 158 from the positive side of the connector talking circuit. The opening of contact 84, which is a part of the connector release circuit, assures that the connector will not release its shaft until after relay 80 restores to normal, that is after the recording is completed. Contact 85 connects lead 180, from a contact on level 31 of the three level rotary switch "F", to the "C" lead of the connector. This connects alternating current over lead 180 to the control conductor and also over lead 174 and through condenser 26 to relay 40. The closing of contact 86 of relay 80, connects ground through resistor or choke coil 78, to the control conductor. This ground connection replaces the holding ground on the control or "C" conductors to prevent release of the connection. The choke coil 78 minimizes the amount of leak to ground of alternating current which, as explained later, operates relay 40. Contact 81, of relay 80 furnishes ground over lead 178 to a contact on level 33 of the rotary switch "F" and this ground functions as a shunt to stop the rotation of the rotary switch, when the wiper of bank level 33 has reached this particular bank contact. Contact 82 closes the following circuit; ground, contact 82, lead 172, winding of relay 35 to battery. Thus the operation of relay 35 follows the operation of relay 80 and through its contact 36, battery is available to operate the magnet 30 of the three level rotary switch "F". Immediately after contact 36 on relay 35 is closed, magnet 30 is energized over the following circuit; battery, make contact 36, break contact 34, resistance 25, winding of magnet 30 to ground. The magnet armature moves to step the three wipers of levels 31, 32 and 33 onto the first contact of their respective bank levels, at the same time the operation of the magnet armature breaks the circuit at contact 34, to the magnet winding causing the armature to restore, this recloses the circuit to the magnet and the switch will continue a step by step movement until the wiper on bank level 33 finds ground on a bank contact, such as described previously by the operation of relay 80 and the closing of contact 81, which placed ground on one of the contacts of level 33. Thus this three level switch "F" has acted as a finder to locate the particular relay 80 which is associated with a particular connector (in this case connector 155) on which a called line is being held following its abandonment by a calling line.

It should be noted here that the three conductors 178, 179 and 180, two of which having been mentioned above, which extend from spring contacts on relay 80 to bank contacts on three different levels of the rotary switch "F", are connected to the same numbered contact on their respective levels. At the same time relay 35 closed its contact 36 to operate the magnet 30 of the three level rotary switch "F", two other contacts 37 and 38, on relay 35, were closed, contact 37 to extend battery to the magnet coil 70 of the four level rotary switch "E" and contact 38 to extend battery to an individual brush 27 on the commutator "D." The four level rotary switch "E" operates over the following circuit; battery through contact 37, contact 75, resistance 76, winding of magnet 70 to ground. It should be noted here that relay 40 has operated over the following circuit; one side of an alternating current circuit is grounded and the other side is connected to the wiper on level 31 of rotary switch "F," through the wiper and bank contact, lead 180, contact 85 on relay 80, the control conductor through the selector, lead 174, condenser 26, winding of relay 40 to ground. Therefore ground from contact 41 of relay 40, over lead 170, is available on the correct contact of level 71 of rotary switch "E" to act as a shunt to stop the rotation of the wipers of this switch as soon as the wipers reach this particular numbered contact. It will be understood that the three other wipers of this rotary switch E are now resting on the same numbered contacts in their respective levels 72, 73 and 74, as the bank contact in level 71 to which ground is furnished from contact 41 of relay 40, as above described. In this manner the line finder on which the call originated and on which the calling line has been marked, is electrically held in association with the connector which forms a part of the link for this particular call, irrespective of the fact that the calling party has hung up his receiver. This link will be maintained until the commutator "D," under the control of the auxiliary apparatus of this invention, has transmitted through the link and over the called subscriber's line, three series of impulses to actuate the recorder at the called subscriber's station to record the number of the calling line. It will be noted that relay 40 is being held in operated position by alternating current supplied through the wiper of bank level 31 as described above. The operation of relay 40 caused the positive side of the trunk, between the line finder 153 and the selector 154 to be opened at contact 43 separating lead 59 from lead 166 and through contact 42, the positive side of the trunk from selector 154 and connector 155 that is lead 166 is connected to springs on relays 44, 45 and 46. Relays 44, 45 and 46 will be operated in sequence as later explained. The first of these relays to operate is 44 and at its contact 47, the above mentioned lead 166, that is, the positive side of the trunk to the connector will be connected to brush number 68 on the commutator. It should be repeated here that eight hundred twenty nine was chosen for this description, as the number of the calling line. The eighth group of line finders are the only finders which are operated in connection with calls originating in the eight hundred group of lines and therefore, as our calling number is eight hundred twenty nine, one of the finders in the eighth group will pick up the call and the armature spring for contact 47 (on relay 44) will be connected to the eighth lead in

the cable 77 which connects ten brushes 61 to 69 and 60 of the commutator "D," to the ten contacts numbered 1 to 10, of the vertical bank and the ten contacts, numbered 11 to 20 of the horizontal level. Here it should be noted that the impulses to actuate the recorder are to be transmitted over this lead 166 and in sequence, in this instance there will be sent a series of eight impulses, then two impulses and finally nine. The lead 166 will therefore be connected first to the eighth brush of the commutator (which is brush number 68) through the operation of relay 44 as explained above. Secondly, lead 166 will be connected to the second brush of the commutator (which is brush number 62) through the operation of relay 45 and finally, lead 166 will be connected to the ninth, or brush number 69.

The commutator "D" comprises a revolving drum carrying three identical sets of metal bars, each set consisting of ten bars or segments of different lengths, the longest one also being wider than any of the other nine. The nine spaces between the bars are equal in width and are filled with insulating material similar in arrangement to the commutator of a dynamo, however, the insulated space between two different sets of bars is somewhat wider than the spacing of the bars in any one set. Ten brushes are mounted in such a manner that they rest in a single row across the face of the drum, parallel to the axis of the shaft and each brush makes contact with particular groups of bars, as the drum revolves. All bars are joined at one end by a metal ring which is supplied with current from brush 67 and as the drum revolves, brush number 61 at the left receives three sets of one impulse each of current during each revolution of the drum. Brush number 62 receives 3 sets of 2 impulses each and each brush receives impulses in accordance with its position, the tenth one at the right, brush number 60 receiving three sets of ten impulses during each revolution of the shaft. Due to the one rather wide bar and the other extra wide spacing between sets of bars, the first impulse of each series of ten on brush number 60 will be slightly longer than any of the remaining nine and the space between two series of impulses will be slightly longer than the space between any two impulses of a series.

In conjunction with the wider spacing between the sets of bars, each of these spaces is provided with a short metal segment such as 58A, 58B and 58C, in juxtaposition to two brushes 27 and 28 arranged in such a manner that the two brushes are joined together electrically, three times during each revolution of the drum, taking place before each series of ten impulses on brush number 60.

As mentioned above, the armature spring of contact 47 on relay 44 is connected to brush number 68 and lead 166 will first receive eight impulses, after which relay 44 is caused to return to normal and relay 45 operates, connecting lead 166 through contact 48 to the wiper resting on contact number 2 of the vertical bank which is connected to the second brush in the series, that is, brush number 62 and during the time relay 45 is energized, lead 166 will receive two impulses and finally relay 46 operates to connect lead 166 through contact 49 to the marked contact on the horizontal bank, which is contact number 19 and as before stated, is connected to brush 69 and from this brush, lead 166 will receive a series of nine impulses. It will be clear from the above that the number of impulses sent over lead 166 through the connected circuit and the telephone line to the recorder at the called party's premises, are governed by the group number of the line finder which picks up the calling line, the position of the wiper on the vertical bank and the position of the wiper on the horizontal bank of the particular finder which operated to connect itself to the said calling line and to extend that line to an idle selector.

In the above explanation it was stated that battery from contact 38 on relay 35, was extended to an individual brush 27 on commutator "D". Continuing on from the above statement, it should be noted at this time that, as the commutator drum revolves (in the direction of the arrow), this brush 27 will be connected to brush 28, three times during one revolution of the drum, by three segments 58A, 58B and 58C, and battery will be extended to the number one winding of the slow to release relays 50, 51 and 52 in sequence. When segment 58A connects brush 27 to brush 28, battery will be extended to relay 50 and through break contact 120 (on the 50—53 relay combination) to ground, operating relay 50. Here it should be noted that the armatures of relays 50 and 53 are mechanically in combination to function as follows: the energization of the number one winding of relay 50 moves its armature to close contacts 113 and 121, to open contact 120 and to operate the break-before-make set, wherein contact 112 will be made after 111 breaks. When the winding of relay 50 is de-energized, the armature restores but not all of the contacts return to normal at this time, contact 120 remaining open and contact 121 remaining closed, due to the above mentioned mechanical feature, until at a later stage the winding of relay 53 is energized. Relays 51 and 54, as well as relays 52 and 55 also operate as mechanical combinations, same as the mechanical combinations of relays 50 and 53, explained above. As contact 112 makes before 120 breaks, a holding circuit is completed to maintain the armature of relay 50 in operated position by energizing its number two winding through the following circuit; ground, number two winding of relay 50, brush number 60, ten segments of the commutator, common bar 56 of the drum, brush 57, contact 112 to battery. The series of ten impulses from brush 60 through the above described circuit being sufficient to hold in operated position, the armature of slow to release relay 50. Also, battery from brush 60 through contact 113 (of relay 50) and the wiper on bank level 14 of the four level rotary switch "E," lead 167, winding of slow to release relay 44 to ground, operates relay 44, closing its contact 47, through which impulses, in this case eight impulses, because we had previously selected number eight hundred twenty nine as the calling line number and as explained above, the call has been dealt with by the eighth group of line finders, will be transmitted from brush 68 over lead 166, through that part of the link circuit which is being held and over the subscriber's line to register the hundreds digit of the calling line on the recorder at the called party's station. Immediately after the above described actions, brush number 60 is deprived of current, due to the insulated space on the drum between the tenth bar of one series of bars and the first bar of the second series being wider than the insulated space between any two bars or segments of any series, for a sufficient length of time to

allow the slow to release relay 50 to restore its armature causing relay 51 to be operated through the following circuit; battery, break contact 111, make contact 121, break contact 122, number one winding of relay 51 to ground. The energization of relay 51 causes its armature to close contacts 116 and 123, open contact 122 and operate the break-before-make combination 114 and 115. Contact 115 makes before 122 breaks, thus battery is furnished to brush 57 and the common bar 56, through ten segments on the drum, brush 60, winding number two of relay 51 to ground; this is termed the holding circuit to hold relay 51 during the next, or second, set of impulses. Also, battery from the above described circuit can be traced from contact 116, wiper and contact on bank level 73 of rotary switch "E", lead 168, winding of slow to release relay 45 to ground, operating relay 45. The operation of relay 45 causes its contact 48 to connect lead 166 to the wiper on the vertical level, which in this case, as indicated by the dotted lines is resting on contact number two, representing the second digit in the calling subscriber's number. From this contact two impulses will be transmitted over lead 166 and through that portion of the link which is being held, over the called subscriber's line to the recorder at the called station to record the second digit of the calling line number. When the second, rather wide insulated space on the commutator comes under brush 60, the current of the holding circuit to relay 51 will be interrupted a sufficient length of time for relay 51 to restore. The armature restores closing contact 114 to operate relay 52 over the following circuit; battery, break contact 114, make contact 123, break contact 124, number one winding of relay 52 to ground. Relay 52 operates, closing contacts 119 and 125, opening contact 124 and operating the break-before-make combination 118 and 117. At this time brush number 60 will again receive a series of ten impulses of battery which will pass through the number two winding of relay 52 to ground, to hold this relay. This battery current will also operate slow to release relay 46 through the following circuit; battery from brush 60, contact 119, wiper and bank contact on level 172 of the four level rotary switch "E", lead 169, winding of relay 46 to ground, operating relay 46. The operation of relay 46 will close contact 49 which will switch the lead 166 to the wiper of the horizontal level. As the wiper in this instance is resting on the ninth contact of the bank, that is, contact 19 as indicated by the dotted lines, nine impulses will be transmitted over lead 166 and through the other portions of the circuit, to record at the called subscriber's station the third series of impulses representing the third and last digit of the calling subscriber's number.

Following the above sequence of operations, brush number 60 will again be insulated from the battery on the drum segments for a sufficient length of time to allow relay 52 to restore, opening the circuit to relay 46 at contact 119 and closing contact 117. It will be remembered that, by mechanical means, two contacts on each of the three relay combinations 50—53, 51—54 and 52—55, are being held in operated position, therefore contacts 120, 122 and 124 are open and contacts 121, 123 and 125 are closed. At the moment when relay 52 restored, battery through contact 117 passed through contact 125 (on the 52—55 relay combination) to the windings of three relays 55, 54 and 53, energizing the relays and causing their armatures to move, to release

the spring sets which have been held off-normal, opening contacts 121, 123 and 125 and reclosing contacts 120, 122 and 124. This same battery current from contact 117 (on relay 52) through contact 125 is connected to the slow to release relay 39, which immediately operates closing its contact 29 to connect ground, through the wiper and band contact on level 32 of the three level rotary switch "F," lead 179, to the number two winding of relay 80 and as this current acts in opposition to the current which has been holding this relay 80 in operated position through its number one winding, the magnetism will be neutralized and the armature will restore, allowing all apparatus to restore to normal.

In the above description it has been shown how three series of impulses representing the calling subscriber's number has been transmitted from a commutator "D" in the central office through a part of the connecting circuit and over the positive side of the called subscriber's line to a recorder at the called subscriber's premises. It will now be explained how these impulses operate the recorder to produce a visual record of the calling number. Only a portion of the telephone circuit is reproduced to show the method of connecting the circuit of the recorder to the telephone line. The lead 164 from the recorder is connected to a spring of relay 92 and through contact 96 to a spring in the hook switch assembly and through contact 97 is connected to the positive side of the line circuit. When alternating current is coming in to the called subscriber's instrument to actuate the bell, it also operates relay 92 through the condenser 98. This causes contact 96 of relay 92 to remain open, for the duration of the ringing period, to completely isolate the circuit of the recording apparatus. Also during the time this telephone is being used on an outgoing call or when answering an incoming call, the circuit of the recorder is isolated by the opening of contact 97, which is in the hook switch spring assembly, which is actuated by lifting the receiver or handset from its resting place.

The recorder outlined in Figure 2 comprises three groups of cores and coils 138, 139 and 140 arranged to be progressively energized by impulses of current representing digits in a calling number. Each group of coils is provided with a cylinder which moves up and around the coils as the coils are energized in sequence beginning with coil number one, and returns to normal by spring action when the impulsing circuit is reopened. A stylus, such as 141, 142 and 143, is attached to each cylinder and moves up and down, or forward and back, over a paper tape and carbon, or a film or other material capable of receiving an impression, each impression indicating one of the digits in the calling number. After the last digit has been indicated on the tape, the tape is moved by the action of a motor, to display the recorded number and to again place under the styluses an unused portion of the tape in preparation for a subsequent recording.

The lead 164 is connected in the telephone instrument to the positive side of the telephone circuit and taken to the recorder where it is connected to the windings of relays 91, 93, 94, 95 and to the winding of magnet 90 and the wiper 100 of the single level rotary switch. Also, it should be noted that, as the wiper 100 is resting on the first bank contact 101, and this contact is multiplied to the coils numbered one of each of the three coil groups 138, 139 and 140 battery

current in the form of incoming impulses, is available for the energization of these windings as and when the respective common circuits are completed. It will be noted that the circuits of these windings, that is, the common conductors for one terminal of all coils in one group, are closed in sequence by the operation of relays 93, 94 and 95 and as relay 93 will be the first to operate, the common conductor to the coils of the first group 138, will be the first to receive current to complete the circuit of winding number one of group 138.

As previously noted in the description of the commutator "D," one of the segments is wider than the other nine for the purpose of producing at the recorder, a longer impulse as the first impulse in any one series of impulses. This has the effect of preparing or setting up conditions in the recorder so that the series of impulses to follow will represent the digit to be recorded. Another point to be noted here is that magnet 90 and relay 91 are always in parallel, the magnet when energized moves its ratchet forward and the wiper is moved forward by the ratchet when the magnet de-energizes by spring pressure on the return cycle, step by step according to the number of impulses in any series, whereas relay 91, being slow to release, remains operated during any series of impulses, releasing the pawl only at the end of each series to allow the rotary switch wiper assembly to return from any one of the contacts, back to its normal position, that is, resting on contact number one.

The first battery impulse, the so called longer impulse, energizes the magnet 90, moving the ratchet but not the wiper, energizes relay 91 and through the following circuit operates relay 93; battery, that is, the first impulse of battery, winding of slow to release relay 93, break contact 128, break contact 126 to ground. Contacts 126 and 127 form a break-before-make combination and therefore after relay 93 operates as described above, ground through contact 127 completes the holding circuit to maintain relay 93 in operated position during the first series of impulses and also from contact 127, ground is furnished to the common of the ten coils of the first group. As soon as relay 93 is energizzed and its contact 127 is closed, current is available to energize coil one of group 138, causing the cylinder 141 with its stylus to move, which operation releases the pressure from bushing 149 allowing the spring and bushing to move away from normal and in so doing, becomes engaged and held by a mechanical latch 99, closing contact 129. The latch 99 holds the spring in such a position that the contact 129 remains closed until the latch is released by an armature 24 on the motor, which becomes operative after the recording has taken place and the electric motor 148 has operated to move the tape 145 on which the recording has taken place. The balance of the impulses of the first series will cause the wiper 100 to move one step for each impulse and, as the wiper 100 moves over the bank contacts, the coils of group 138 are progressively energized and the cylinder with stylus 141 moved to a position where its pointer marks the highest number of the series (in this case 8).

During the interval between the first and second series of impulses, the wiper 100 returns to the first, or contact number 101, on the single level bank, the cylinder 141 returns to a position slightly off-normal, relay 93 de-energizes, contact 127 remains open, contact 126 is closed while contact 128 is open and 129 remains closed due to the mechanical latch. Ground through break contact 126, make contact 129 and break contact 132 is now connected to one terminal of the winding of relay 94, while the other terminal is directly connected to the incoming lead 164, therefore, relay 94 will operate from the first (the rather long) impulse of the second series, also the number one coil of group 139 will be energized from this same impulse, the cylinder 142 will move to a position where its pointer is opposite the figure 1, further this same impulse will energize relay 91 and magnet 90. As previously explained the first energization of the magnet 90, in any one series, moves the ratchet controlling the wiper assembly, but does not move the wiper 100, as the mechanical arrangements between the armature of magnet 90 and ratchet and pawl of relay 91, are such that the wiper is moved forward during the restoring cycle of the magnet armature. The second and last impulse of the second series causes the wiper 100 to be moved to the second contact of the bank and the cylinder 142 with its stylus to be moved into second position where the pointer indicates number two as the second digit of the number being recorded.

During the interval between the second and third series of impulses, the wiper 100 returns to the number one contact on the bank, the cylinder 142 returns to a position slightly off-normal, contacts 131 and 132 remain open, while contacts 130 and 133 remain closed, the latter contact 133 being held closed due to the mechanical latch. Ground through break contact 130, make contact 133 and break contact 136 is now connected to one terminal of the winding of relay 95, while the other terminal is directly connected to lead 164, therefore relay 95 will operate from the first (the rather long) impulse of the third series, also as previously explained in connection with the first and second series of impulses, this first impulse of the third series will energize relay 91 and magnet 90, also the number one coil of the third group 140 and the subsequent impulses will raise the cylinder 143 and stylus to a position where its pointer indicates the figure nine as the third digit of the number being recorded. Thus, each of the three cylinders with their stylus have been moved upward by a series of impulses and returned by spring action and a recording has been made on a tape similar to the illustration in Figure 4. It now remains to prepare the device for a second recording and finally return all apparatus to normal. After the last impulse of the third series, battery current is no longer available over lead 164 to maintain relay 95 in operated position and although relay 95 has slow to release characteristics, it will release its armature shortly after the last impulse, contact 135 will open, contact 134 will close, but due to the mechanical latch, contact 137 will remain closed, as well as contacts 129 and 133 on relays 93 and 94 respectively and at the moment of closure of contact 134, as mentioned above, an alternating (or direct) current, from a commercial source will be connected to the terminals of the motor 148, of that part of the recorder which moves the tape after each recording. The commercial current may be traced through contact 137 to one terminal of the motor 148 and through contact 134 to the other terminal of the motor. The motor 148 will continue to rotate its armature until the current supply is disconnected by opening contact 137.

A portion of Figure 2 shows the edge of a paper tape 145, which is similar in appearance to the

illustration in Figure 4. This tape is stored on a cylinder 147 and as it is released by the rotation of the cylinder 147, passes over a free roller 146 and between the three styluses of the three cylinders 141, 142 and 143 and a fixed surface 150. The cylinder 147, which is rotated by the motor, carries three equally spaced projections or bosses 21, 22 and 23, one of which, after each recording acts to stop the rotation of the cylinder 147 and, by the magnetic armature 24, the mechanical latch 99 is tripped to release the off-normal condition of the spring sets associated with cylinders 141, 142 and 143. The contact 137 associated with cylinder 143 will open the circuit to the motor, the motor will stop. The tape has been moved a sufficient distance to display the recorded number and at the same time, a second portion of the tape has been brought into position for a subsequent recording.

In Figure 1, a relay 92 and condenser 98 are shown wired into the circuit of the called party's telephone instrument, these serve to completely isolate the recording apparatus and circuits from the telephone line during certain periods. For instance, when alternating ringing current is incoming over the subscriber's line to announce an incoming call, a part of this alternating current will pass through the condenser 98 and the winding of relay 92, to ground, operating relay 92, causing its armature to open contact 96 to isolate the recorder, but which will be re-connected to the line when ringing current ceases and the armature of relay 92 is restored. Again, when this telephone is in use for an outgoing call, the lifting of the receiver, or handset opens contact 97, which also acts to isolate the recorder. This contact 97 is a part of the hook switch assembly and therefore acts to disconnect the recorder when the subscriber answers an incoming call.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent is:

What is claimed is:

1. In an automatic telephone system, a plurality of calling and called subscribers' lines, a plurality of connecting links in said system for connecting said lines, a recording device associated with each said called lines, an impulse sending apparatus consisting of a rotatable drum carrying three sets of bars or segments each set consisting of ten metal strips of varying lengths uniformly arranged around the periphery of said drum and all electrically connected by a common metal ring, a brush resting on said ring to furnish electrical current to all said segments, means for rotating said drum, ten stationary brushes resting against the surface of said drum in such a manner that the first brush receives three impulses per revolution of the said drum, the second brush receives six impulses per revolution of the said drum, and similarly all brushes receive impulses according to their respective positions from the first to the tenth which receives thirty impulses per revolution, three individual metal segments equally spaced around said drum, two brushes so arranged as to be short circuited three times during each revolution of said drum by said three segments, means controlled by a calling subscriber for extending a connection to a called line including one of said links and associating said sender with the connection, means effective when said established connection has been abandoned by said calling subscriber before the said called subscriber has answered to cause said impulse transmitting apparatus to transmit impulses over one conductor

of the said established connection and over one conductor of said called subscriber's line to actuate said recorder thereon to record and display an impression indicating the calling subscriber's number.

2. In an automatic telephone system, a plurality of subscribers' lines, automatic switching means controlled from a calling one of said lines to select a called one thereof, a recording apparatus individually connected with said called line including a recording medium and a stylus for each order of digits of a subscriber's number, an impulse sender controlled by said switching means in response to the subscriber on said calling line abandoning a call before the selected called subscriber has answered to transmit a plurality of series of impulses to the recording apparatus of the called line, and means in said apparatus responsive to the first series to move one said stylus forward and back across said medium to make an impression thereon with its far end in a position to indicate the hundreds digit of the calling subscriber's number, and responsive to subsequent series of impulses to move a second and third stylus forward and back across said medium to make similar impressions indicating the tens and units digits of the number of the calling subscriber.

3. In an automatic telephone system, calling and called subscriber lines, a plurality of connecting links, means including said links for extending connections from calling ones of said lines to called ones thereof, a recorder for each called line having a series of movable elements each carrying a stylus which is movable over a recording medium, an impulse sender, means for automatically connecting said sender with a link included in a connection extended to a called line and for automatically causing said sender to transmit a plurality of series of impulses over one conductor of said link and over a conductor of the called line in response to the calling subscriber abandoning the call before the called subscriber answers, said elements of the called line recorder moved in sequence in response to said series of impulses to move the stylus of each element to make marks on said medium of lengths representing digits of a calling subscriber's number.

4. In an automatic telephone system equipped with an impulse transmitting device, a plurality of calling and called subscribers' lines each provided with a telephone number recorder, a plurality of links for connecting said lines, means controlled for a calling line for extending a connection including one of said links to one of said called lines, means operable in case said called line does not answer and in response to the calling line abandoning the call to cause said impulse transmitting device to transmit impulses through said link to said recorder of said called subscriber's line to record the number of said calling line.

5. In an automatic telephone system, a plurality of calling lines, a plurality of called lines, a plurality of means for connecting said lines, means on each said calling line for controlling said connecting means to extend a connection to a called line, means at said called line for recording and displaying a number, means automatically operated in response to the calling subscriber abandoning the call in case said called line does not respond for holding the said connecting means and transmitting thereover to said recording means of said called line a signal for actuating

said recording means to record and display the number of the said calling line.

6. In a telephone system, an impulse transmitting device, a recorder, said recorder responsive to a series of impulses from said impulse transmitting device, a magnetic cylinder in said recorder, sets of coils for said cylinder arranged to be progressively energized to cause said magnetic cylinder to move, a marker attached and movable with said cylinder, a tape of paper or other material capable of receiving an impression when said marker moves over the surface of said tape, means for connecting said impulse transmitting device to said recorder and operating said device for transmitting impulses in series of one to ten into said recorder to progressively energize said series of coils to cause said cylinder to move said marker over the surface of said tape to leave an impression to indicate or record any numeral from one to ten.

7. In a telephone system, calling and called lines, means for extending connections from calling to called lines, a sender common to said lines having a plurality of brushes each capable of sending impulses for a particular digit, means operated during the extension of a connection for selecting the brushes corresponding to the digits of the line calling, a recorder on each called line including a plurality of recording units, means automatically operated in response to the subscriber on the calling line abandoning the call in case called subscriber fails to answer said call for sequentially connecting said selected brushes to the extended connection between said calling and called lines to transmit a series of impulses for each selected brush, and means in the recorder for sequentially connecting up the units thereof so that each is operated by one of said series of impulses to record thereon the number of the party calling.

8. In a telephone system, subscribers' lines, means for extending a connection from a calling to a called one of said lines, an impulse sender

common to said lines, means operated during the extension of a connection for preparing a marking for said sender corresponding to the number of the calling subscriber's line, means controlled from the calling party over said connection under certain conditions for associating said common sender with the connection and transferring the prepared marking thereto and means determined by said markings for operating said common sender to transmit impulses over said connection corresponding to the calling party's number.

9. In a telephone system, link circuits, means for establishing a connection including one of said link circuits between a calling and a called subscriber's line, a sender common to said links, a series of relays for each link, one of said relays for each order of digits in a calling number, means operated during the establishment of a connection for marking each relay with a different order of digits in accordance with one of the digits in the calling subscriber's number, means operated by a calling subscriber after a called subscriber fails to answer a call for associating said sender with the connection and for connecting the relays of the connected link with the sender to transfer the digit markings thereof to the sender, said sender operated thereafter to transmit impulses over the connection in accordance with the digit markings of the connected relays.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
512,413	Thomson	Jan. 9, 1894
974,955	Dyson	Nov. 8, 1910
1,089,394	Clement	Mar. 10, 1914
1,793,762	Tilden	Feb. 24, 1931
1,810,865	Warwich	June 16, 1931