G. A. YANOCHOWSKI.

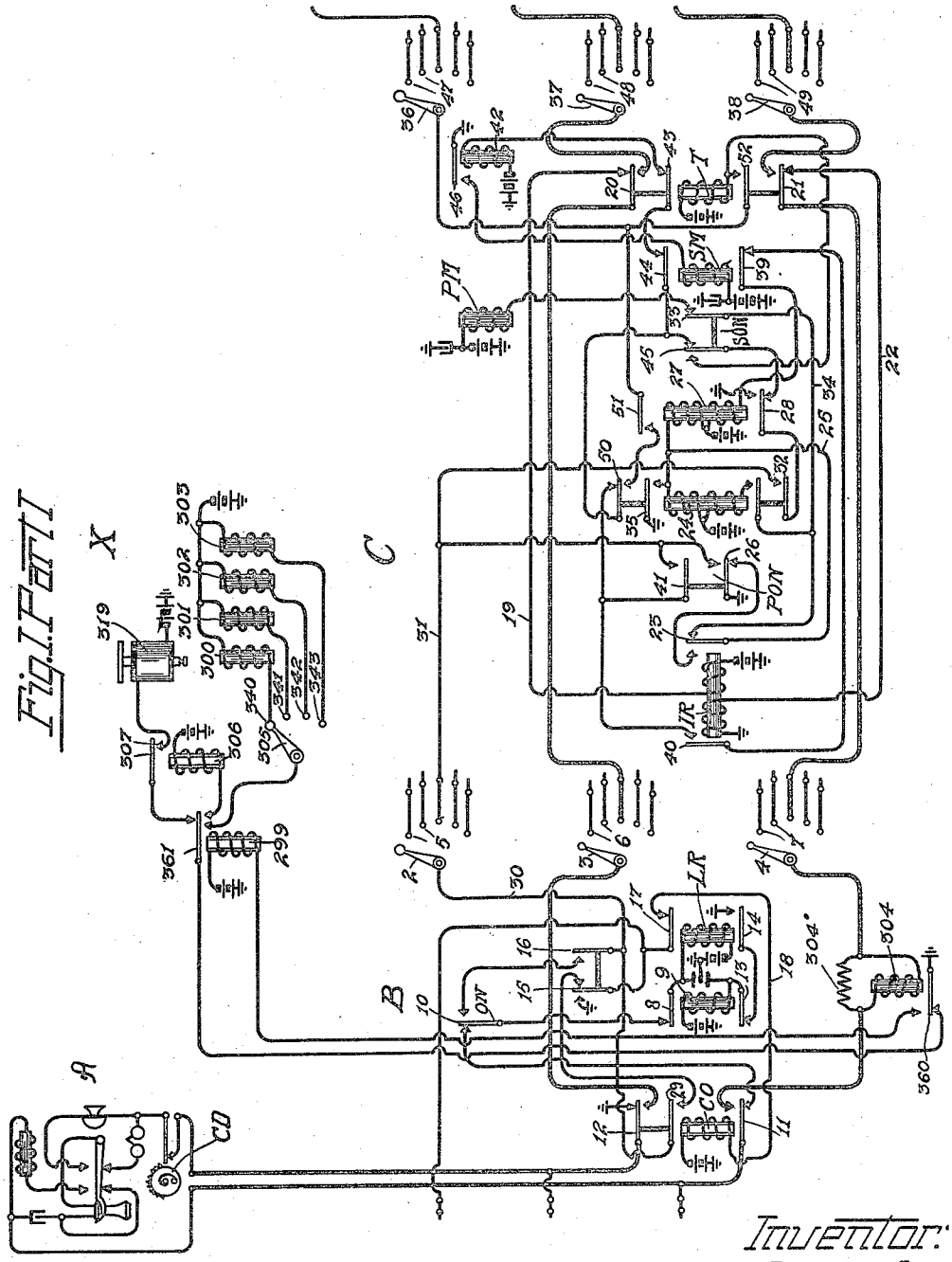
AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED JUNE 6, 1918.

1,423,898.

Patented July 25, 1922.

3 SHEETS—SHEET 1.



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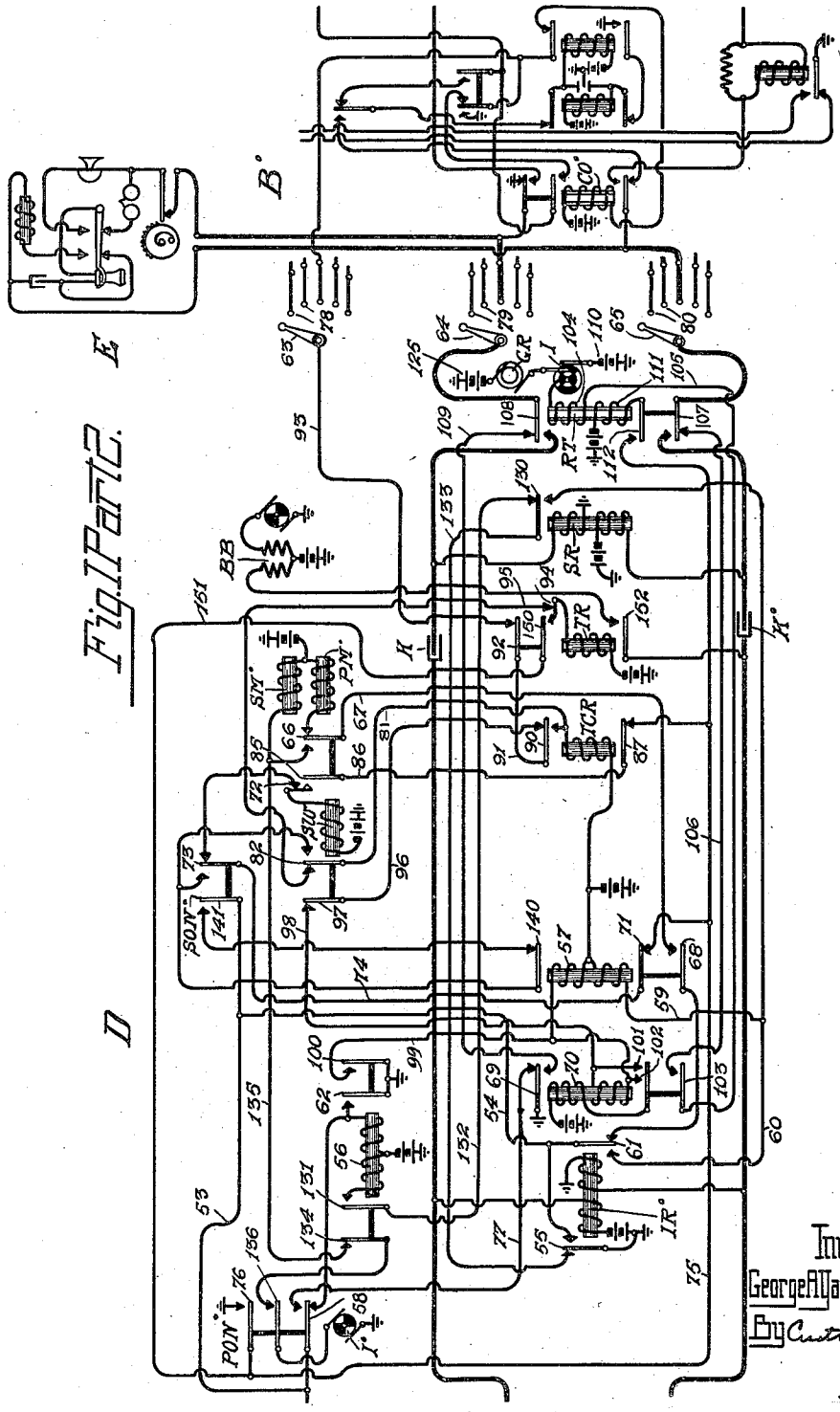

Fig. 1 Part 2.

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3 SHEETS—SHEET 3.

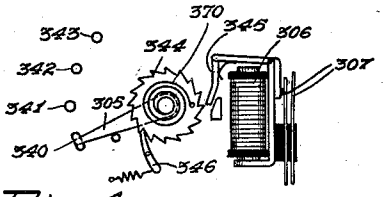

Fig. 4.

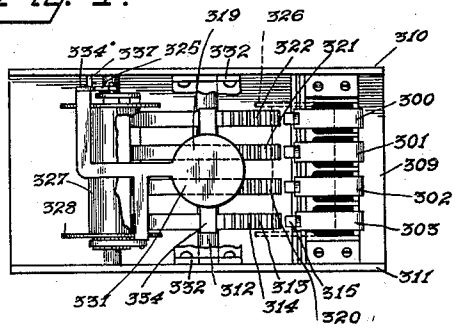

Fig. 2.

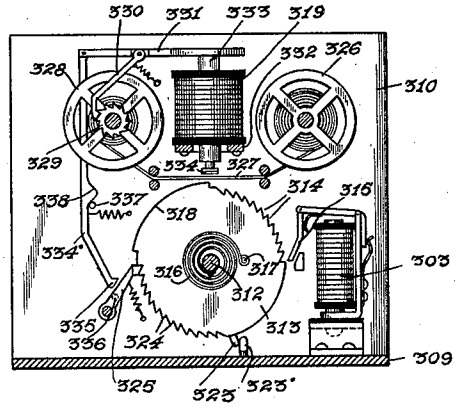

Fig. 3.

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UNITED STATES PATENT OFFICE.

GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,423,898. Specification of Letters Patent. Patented July 25, 1922.

Application filed June 6, 1918. Serial No. 238,461.

To all whom it may concern:

Be it known that I, GEORGE A. YANOCHOWSKI, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to telephone exchange systems of the kind in which automatic switches are employed in the exchange or central office for establishing connections between subscribers' lines, and relates more particularly to supervisory apparatus and registering and recording mechanism for use in such systems.

I have found that one of the common complaints made by the subscribers of an automatic telephone system is that they frequently obtain wrong numbers in calling, that is, they do not get the numbers that they call. In a commercial system, these complaints are generally made by the subscriber to a so-called complaint operator who in turn transmits them to a man who supervises the automatic switches. This supervisor then tries to locate the trouble that the subscriber has had in attempting to put through a connection, and in a great many of these instances the supervisor is unable to find any trouble whatsoever. This is due to various reasons, but is mainly due to the fact that on the test made by the supervisor the call goes through other switches than those used by the subscriber when he attempted to make the call.

Some of the common reasons found why calling subscribers fail to establish the desired connections are that they often make errors in calling the desired numbers, their substation dials may be improperly adjusted thereby causing the switches to fail, or the automatic apparatus at the central exchange which they used in completing connections may be at fault. In a great many instances, the subscriber, himself, is at fault in having erred in calling the desired number. I find that certain subscribers are more likely to make complaints that they are unable to establish connections, than other subscribers.

It is one of the objects of my invention to provide means that can readily be associated with the line of any subscriber, from whom a great many complaints are received, to supervise the calls that the subscriber makes. With my device, I am able to record the exact number that the subscriber has called and to record each call that the subscriber makes so that the attendant or the supervisor of the automatic apparatus may immediately tell, upon receiving a complaint from a subscriber whose line is equipped with one of the devices, whether the trouble which the subscriber complains of is due to the subscriber's error in calling the number of the party that he desired to converse with, or whether the automatic apparatus at the central exchange or the subscriber's calling device is at fault.

My device may also be used as a recording device to record the numbers called by a subscriber so that toll may be assessed against the subscriber for the number of calls made or for the subscribers called, provided that there is a difference in the toll assessed for subscribers whose numbers begin with a certain digit and those whose numbers begin with another digit. For example, it may be that trunks leading from a certain level of either the first, second or third selectors lead to a distant exchange which may be a nearby town. My recording device would immediately show all calls made to that exchange, and a subscriber could accordingly be assessed toll for these calls.

My device may also be attached to a trunk and placed before an operator. In a system of this kind, the subscriber in making a call causes his line to be connected to a trunk having one of these devices connected thereto. He then dials the desired number, causing the same to appear upon the registering device. The operator then completes the connection to the called subscriber whose number corresponds with the number appearing upon the registering device. The above and other features of my invention will be hereinafter described in the ensuing specification and will be more particularly pointed out in the appended claims.

For a better understanding of my invention, reference may be had to the accompanying drawings forming a part of this application.

Fig. 1, comprising parts 1 and 2, diagrammatically illustrates the complete circuit arrangement necessary for connecting a call-

ing subscriber to a called subscriber in an exchange system provided with the device of my invention;

Fig. 2 shows the top view of the mechanical arrangement of the device of my invention. Certain of the parts are omitted to more clearly show the apparatus.

Fig. 3 is an elevation of the device shown in Fig. 2, omitting certain parts and showing certain parts in section; and

Fig. 4 shows a circuit changing switch which will be hereinafter more fully described.

Referring to Fig. 1, parts 1 and 2, this circuit represents diagrammatically a calling substation A which terminates in an individual line switch B, which line switch B is adapted to connect with an idle first selector C. The first selector C is, in turn, adapted to connect with the idle connector D, and the connector D is adapted to connect with the terminals of the called substation E. The called substation E terminates at the central exchange in an individual line switch B'. At X, I show diagrammatically the controlling relays and circuits for the device of my invention. The mechanical parts of this device, as before mentioned, are illustrated in Figs. 2 and 3.

The substation A includes the usual talking equipment of a common battery telephone with the addition of a calling device CD adapted to break the continuity of the subscriber's line circuit. The circuit for the subscriber's substation A will be carried through a series of continuations, finally establishing connection with a called subscriber's telephone as E.

The line switch B is provided with a rotary shaft and carries a private test wiper 2 and a pair of line wipers 3 and 4. A line relay LR is provided which is energized over the subscriber's line conductors in series. A cut-off relay CO is also provided for disconnecting the subscriber's line circuit from the line relay LR and for connecting the switch wipers to the subscriber's line circuit. A motor magnet 9 is provided for stepping the switch wipers 2, 3 and 4 step by step over the bank contacts 5, 6 and 7. An off-normal switch ON is provided which is actuated upon the first step of the wipers off normal. The switch wipers are spring restored and are adapted to be released to normal when the cut-off relay CO is de-energized. For a more complete understanding of the structure of the line switch, reference may be had to H. H. Ide application S. N. 175,364, filed June 18, 1917, or H. H. Ide application S. N. 271,960, filed January 20, 1919.

The registering device X, as diagrammatically illustrated in Fig. 1, part 1, includes driving magnets 300, 301, 302 and 303, a combined printing and release solenoid 319, and a circuit controlling wiper 305, controlled by a slow-acting relay 306. A quick-acting line relay 304 and a slow-acting relay 299 are provided for controlling the device X. A fuller description of the mechanical arrangement of the registering device X and the circuit arrangement of the same will be hereinafter given.

The circuits shown for the selector C and connector D are adapted to work with a switch structure similar to that shown in application Serial No. 175,364, filed June 18, 1917, by H. H. Ide. It is to be understood, however, that the circuits shown may be used in connection with various other switch structures of the prior art.

The first selector C comprises an impulse relay IR, which relay is energized and de-energized by impulses from the calling device CD at the calling substation A, and the energization and de-energization of the relay IR brings about the actuation of the primary magnet PM to step the first selector switch wipers 36, 37 and 38 in a primary direction to a certain group of contacts. A secondary magnet SM is provided for said selector which automatically steps the wipers 36, 37 and 38 in a secondary direction over the contacts 47, 48 and 49 in the selected group to seek an idle set of contacts leading to a connector, as D. A switching relay T is also provided which, when energized, extends the connection of the calling substation A to the idle connector D. Primary and secondary off-normal contacts PON and SON, respectively, are provided. The said primary off-normal contacts PON assume their alternate position on the first step of the wipers in a primary direction, and the secondary off-normal contacts SON assume their alternate position upon the first step of the wipers in a secondary direction.

The connector switch D is provided with an impulse relay IR', responsive to the impulses of the calling device CD at the calling substation A, which relay IR' brings about the actuation of the primary magnet PM' to step the connector switch wipers 63, 64 and 65 in a primary direction to a certain group of contacts containing contacts of the called line E. A switching relay SW is provided which energizes upon the termination of the first set of impulses to connect the secondary magnet SM' in circuit with contacts of impulse relay IR', to be actuated by the energization and the de-energization thereof to step the connector switch wipers 63, 64 and 65 over the contacts 78, 79 and 80 in the selected group to seek the contacts of the called line. A test control relay TCR is provided which assists in the test of the called line as to its idle or busy condition, and a test relay TR is provided which is actuated upon connection with a busy called line through the agency of the relay TCR. The said relay TR operates to connect busy-back apparatus

BB to the calling subscriber to notify the said subscriber of the busy condition of the called line and disconnects the relay TCR from the test wiper 63. A ringing trip relay RT is also shown which is operated when a called subscriber removes his receiver in response to a call, the said relay opening the ringing circuit to disconnect the ringing current from generator GR which passes through the interrupter I. Should a called subscriber remove his receiver during either a ringing or a silent period, the ringing current is immediately disconnected, as will be more fully hereinafter described. The relay RT is provided with a locking winding to prevent a reapplication of ringing current to the called subscriber's line prior to a disconnection of the connector D from the line of the called subscriber. With this ringing arrangement, it is only necessary to provide one control relay for the ringing current. A back bridge or supervisory relay SR is also provided which operates upon the actuation of the ringing trip relay RT. Primary and secondary off-normal contacts PON′ and SON′ are provided and assume their alternate positions, respectively upon the primary and secondary movements of the wipers 63, 64 and 65.

To the right of the drawing in part 2, I show a called substation E, similar to that of A, the said subscriber being provided with a line switch B′, similar to line switch B.

In Figs. 2 and 3 is shown, to a certain extent diagrammatically, the preferred form for the mechanism of the registering device X shown in Fig. 1, part 1. A mounting plate 309 is provided with side pieces 310 and 311 to form a frame for supporting the different pieces of apparatus of the device. The stepping magnets 300, 301, 302 and 303 are suitably supported on a shelf extending across between the side plates 310 and 311. One of these magnets is provided for each digit of the called number, called by the calling subscriber. I have only shown four such magnets, but the system is arranged so that if any of the called numbers has more than four digits, it would only be necessary to provide more than four stepping magnets. The mechanism X may be constructed structurally with the individual line switch B, or may be built structurally independent of the mechanism of the line switch B, but so arranged that it can be electrically connected with the line switch B, if it is desired to provide the calling subscriber with a registering device.

A plurality of type wheels are mounted on a shaft 312, properly journalled in the side plates 310 and 311. The type wheel 313 is provided with ratchet teeth 314 for engagement by the driving pawl 315 of the magnet 303. A spring 316, one end of which is attached to the shaft 312 and the other end to a pin 317 of the type wheel 313, is provided for retaining the type wheel 313 in its normal position. The periphery or the face 318 of the type wheel 313 is provided with type numerals—ten in number—arranged in numerical order from 1 to 0, the same as the dial of the calling device CD at the subscriber's substation. If the type wheel 313 is moved one step by the stepping magnet 303, the numeral 1 of the type wheel will be moved immediately below the plunger of the solenoid 319, and, likewise, if the type wheel is moved two steps, the numeral 2 will be moved immediately below the plunger of the solenoid 319, etc., for any number of steps up to ten that the stepping magnet 303 may move the type wheel 313. The type wheel 320 is stepped by the stepping magnet 302 in the same manner as type wheel 313 is stepped by magnet 303, and type wheel 320 is provided with type arranged in the same manner. Type wheels 321 and 322 are advanced by stepping magnets 301 and 300, respectively, and are arranged the same as type wheel 313. Type wheel 313 is also provided with a stud 323 which normally rests against a pin 323′ to maintain the type wheel 313 in its normal position. A set of ratchet teeth 324 is provided for the type wheel 313, and a holding pawl 325, properly journalled in the plates 310 and 311, extends clear across the device and is arranged to hold each of the type wheels in its advanced position. When the pawl 325 is released, the type wheels are all returned to normal by their return springs. The holding pawl 325, of course, extends farther into the teeth of the first type wheel than it does into the teeth of the second type wheel, while the pawl 325 extends farther into the teeth of the second type wheel than it does into the teeth of the third type wheel, etc. With this arrangement, when the first type wheel is operated the holding pawl, of course, is entirely removed from the teeth of the other three type wheels. When the second type wheel is operated the holding pawl is removed from engagement with the teeth of the third and fourth type wheels, but not of the first type wheel. Likewise, when the third type wheel is operated, the pawl is removed from the teeth of the fourth type wheel, but not from the teeth of the first and second type wheels. When the fourth type wheel is operated, the pawl is not removed from the teeth of the first, second and third type wheels. If it is desired, individual holding pawls may be used and the master holding pawl 325 provided for releasing the individual holding pawls. Various types of well-known registers may be used in conjunction with applicant's invention.

The device also includes a suitable pivoted feed spool 326, carrying a supply of inked ribbon 327 which may be of paper in alter-

nate layers, and a receiving spool 328 to which is fastened a ratchet 329 which operates to wind the ribbon off the feeding spool onto the receiving spool, through the action of pawl 330 which is pivotally attached to the armature 331 of the solenoid 319. The attraction of said armature serves to place the pawl 330 in a position to engage the next tooth on ratchet 329 so that upon the retraction of armature 331, pawl 330 rotates ratchet 329 and spool 328 one step. The solenoid 319 is suitably supported by cross bar 332. Attached to the plunger 333 of the solenoid is a cross bar 334 which extends across above the ribbon 327, immediately above the portion of the type wheels 313, 320, 321 and 322 which carries the printing type, and when the plunger of the solenoid is moved downwardly the bar 334 is effective to give a blow upon the portion of the ribbon immediately below the bar and above the numbers on the type wheels that have been turned around until they are immediately below the bar, printing upon the record ribbon 327 whatever numbers appear upon the curved type faces of the type wheels. A curved pawl 334′ is pivotally attached to the armature 331 of the solenoid and is provided with a hooked end portion 335 for cooperation with a pin 336 carried by the retaining pawl 325. When the solenoid is energized, the hooked end portion 335 of the pawl 334′ is moved into a position so that when the solenoid is de-energized it will cause the holding pawl 325 to disengage the teeth of the printing wheels, permitting them to return to normal, and upon further restoration of the armature of the solenoid, a pin 337 co-operates with the surface of the cam 338 carried by the pawl 334′ to release the hooked portion 335 of the pawl 334′ from engagement with the pin 336 of the pawl 325.

In Fig. 4, I show a circuit controlling wiper 305 adapted to co-operate with the bank contacts 340, 341, 342 and 343. A ratchet 344 is provided, and a stepping magnet 306 is provided with a pawl 345 for cooperation with the ratchet 344 in moving the wiper 305 over the bank contacts 340 to 343, inclusive. A retaining pawl 346 is provided for maintaining the wiper 305 in its various positions. A coiled spring 370 is also provided for returning the wiper 305 to its normal position. The retaining pawl 346 is connected by a connecting link (not shown) to the armature 331 of the solenoid 319 in such a manner that upon the release of the armature 331 of the solenoid, the holding pawl 346 is operated to permit the wiper 305 to restore to normal. This is done in much the same manner as explained in connection with the pawl 334′ attached to the armature 331. The wiper 305 controls the circuits of the stepping magnets 300 to 303, inclusive. If it is desired, the ratchet 344 can be mounted on shaft 312 and if this is done then the holding pawl 334′ can be made use of to retain the wiper 305 in advanced position.

Having described in general the apparatus embodying my invention, I will now describe more in detail the operation of the system as illustrated. Assuming now, for instance, that a call is to be traced from the calling substation A to the called substation E, upon the removal of the receiver by the subscriber at the substation A, a circuit for the line relay LR of the individual line switch B is established, this circuit being traced from battery through the winding of relay LR, normal contact 8 of relay 9, normal contact 10 of the off-normal switch ON, normal contact 11 of relay CO, and through the closed contacts of the switch hook at substation A to ground at normal contact 12 of relay CO. The line relay LR, upon energization, establishes an energizing circuit for the relay 9, which may be traced from battery through the winding of said relay 9, normal contact 13 of said relay 9, and alternate contact 14 of relay LR to ground. Relay 9 upon energizing opens the circuit of relay LR at its contact 8 and rotates the switch shaft and its wipers one step. A further result due to the energization of relay 9 is the opening of its own circuit at its contact 13 as well as at contact 14 of relay LR. Upon the first step of the switch shaft, the off-normal contacts ON assume their alternate position, and contacts 15 and 16 are also moved to their alternate position. The opening of alternate contact 14 of line relay LR brings about the de-energization of the relay 9, and should the private wiper 2 of the line switch B engage a busy contact 5, upon the first step of the wipers a substitute circuit for the line relay LR is established, traced from battery through the winding of relay LR, normal contact 8 of relay 9, alternate contact 10 of off-normal contacts ON, and alternate contact 16 to ground at the busy contact 5 engaged by private wiper 2. The closure of the alternate contact 14 of the line relay LR again establishes a circuit for relay 9, as previously described, causing the switch wipers to take another step and engage the second set of contacts 5, 6 and 7. If the next private contact 5 is busy, relay 9 and line relay LR are again energized and de-energized to step the wipers 2, 3 and 4 step by step until an idle private contact 5 is encountered. When the contacts leading to an idle first selector C have been found, the line relay LR de-energizes, bringing about the de-energization of the magnet 9. The closing of normal contact 17 of relay LR establishes an energizing circuit for the cut-off relay CO traced from battery through the winding of the said relay CO, conductor 18 and normal

contact 17 of relay LR to ground at alternate contact 15. The energization of the relay CO brings about the restoration of the contacts 15 and 16 to their normal position, opening the initial energizing circuit of the relay CO. The relay CO, being slow to release, has a substitute circuit established for it, as will be presently described, before it has had time to de-energize and permit its contacts to return to normal. The relay CO is adjusted not to pull up until relay LR de-energizes and a steady flow of current is established through the winding of relay CO. The relay CO does not respond to the pulsations of current which it receives by the rapid energization and de-energization of relay LR, but only energizes when it receives a steady flow of current. The energization of relay CO restores contacts 15 and 16 to normal. The wipers 3 and 4 having engaged contacts 6 and 7 of the idle first selector C bring about the energization of the impulse relay IR of the said first selector C over a circuit traced from battery through the right hand winding of the relay IR, conductor 19, normal contact 20 of the relay T, bank contact 6, wiper 3, alternate contact 12 of relay CO, through the substation and back through alternate contact 11 of relay CO, relay 304 and non-inductive resistance 304′ in multiple, wiper 4, bank contact 7, normal contact 21 of relay T, conductor 22, and through the left-hand winding of relay IR to ground. A non-inductive resistance is bridged across the terminals of relay 304 to shunt out the impedance offered by relay 304 to the talking currents. The closing of alternate contact 23 of relay IR establishes an energizing circuit for the relay 24 traced from battery through the upper winding of said relay 24, over conductor 25, and through alternate contact 23 of relay IR to ground at normal contact 26 of primary off-normal contacts PON. An energizing circuit for the relay 27 is also established when relay IR is energized, over a circuit traced from battery through the upper winding of the said relay 27, over conductor 25, and through alternate contacts 23 of relay IR to ground at normal contact 26. The closing of alternate contact 28 of relay 27 establishes a substitute circuit for the cut-off relay CO of the line switch B before it has had time to de-energize, said circuit being traced from battery through the winding of the relay CO, conductor 18, normal contact 17 of relay LR, normal contact 15, alternate contact 29 of relay CO, conductor 30, wiper 2, contact 5, conductor 31, and alternate contact 32 of relay 24 to ground at alternate contact 28 of relay 27, thus maintaining the relay CO of the switch B continuously energized until the conversation is terminated.

The relay 304 upon energizing closes its alternate contact 360, thereby closing a circuit for slow-acting relay 299, this circuit extending from battery through the winding of said relay 299, and through alternate contact 360 of relay 304 to ground. Relay 299 upon energizing, prepares circuits for slow-acting relay 306 and driving magnet 300 of the registering device. The driving magnet 300 is operated responsive to the first digit of the called number. The driving magnet 301 is operated responsive to the impulses sent for the second digit of the called number. The driving magnet 302 is operated responsive to the impulses sent for the third digit of the called number, and driving magnet 303 is operated responsive to the impulses sent for the fourth digit of the called number, if there happens to be a fourth digit in the called number.

The idle first selector C having been selected by the line switch B, the subscriber at the calling substation A now actuates his calling device CD to call the first digit of the called number. Assuming that the number of the subscriber of the called substation E is 345, the subscriber at substation A actuates the calling device CD to send three impulses of current over the line, which impulses bring about three successive deenergizations and energizations of the impulse relay IR and of relay 304. Upon the first de-energization of the impulse relay IR, the circuit for the primary magnet PM is established, traced from battery through the winding of the magnet PM, normal contact 33 of the secondary off-normal contacts SON, conductor 34, normal contact 23, and conductor 25 to ground at alternate contact 35 of relay 24. The primary magnet PM is energized and de-energized three times, due to the opening and closing of contact 23 of relay IR, which magnet operates to step the wipers 36, 37 and 38 of the first selector C in a primary direction to the third group of contacts corresponding with the desired second selector or connector. After the last impulse, the differential relay 27 de-energizes, due to a circut being closed through the lower winding of the relay 27, traced from battery through the lower winding of the said relay, normal contact 39 of relay SM, alternate contact 40 of relay IR, and alternate contacts 41 and 26 of primary off-normal contacts PON to ground. The said primary off-normal contacts PON move to their alternate positions upon the first step of the wipers of the first selector C. The energizing circuit for relay 27 just mentioned is closed upon the first step of the wipers off normal, but the relay 27 does not de-energize during the sending of impulses, due to the construction and adjustment of the said relay 27. The differential relay 27 only receives short impulses of current during the operation of relay IR which do not

affect the relay sufficiently to cause it to de-energize. As soon as the above-mentioned circuit through the lower winding of relay 27 is closed and receives a steady flow of current, the said differential relay 27 de-energizes. The opening of contact 28 of relay 27 disconnects ground from conductor 31 at this point but a substitute ground through alternate contact 26 of the primary off-normal contacts PON is substituted before said relay 27 de-energizes. The ground over conductor 31 also places a busy potential upon private contact 5, preventing any other individual line switch from engaging multiples of said contact. Owing to the construction and adjustment of differential relay 24, it is not de-energized during the rapid operation of relay IR. Upon the de-energization of the relay 27, an energizing circuit for the relay 42 is established, traced from battery through the winding of the said relay 42, normal contact 43 of relay T, normal contact 44 of secondary magnet SM, normal contact 45 of the secondary off-normal contact SON, normal contact 28 of relay 27, and alternate contact 32 of relay 24 to ground at alternate contact 26 of primary off-normal contacts PON.

The energization of the relay 42 establishes an energizing circuit for the secondary magnet SM, traced from battery through the winding of the said magnet to ground at alternate contact 46 of relay 42. Secondary magnet SM energizes and steps the wipers 36, 37 and 38 one step in a rotary secondary direction to engage the first set of contacts 47, 48 and 49. The energization of the secondary magnet SM brings about the restoration of the relay 42 due to the opening of normal contact 44 or said magnet SM. The opening of contact 39 of magnet SM again permits the energization of relay 27 by opening the circuit of its lower winding. The restoration of the relay 42 opens its alternate contact 46, bringing about the restoration of the secondary magnet SM. Upon the first step of the wipers 36, 37 and 38, the secondary off-normal contacts SON assume their alternate position, and the opening of the normal contact 45 of secondary off-normal contacts SON removes the initial ground from the relay 42; and should the private wiper 36 of the first selector C engage a contact leading to a busy connector D, an energizing circuit for the relay 42 is again established over a circuit traced from battery through the winding of the relay 42, normal contact 43 of relay T, normal contact 44 of magnet SM, alternate contact 50 of relay 24, alternate contact 51 of relay 27 and wiper 36 to the grounded busy contact 47. The closing of the alternate contact 46 of relay 42 brings about the energization of secondary magnet SM, as before described. The relay 42 and magnet SM are thus alternately energized and de-energized to step the wipers 36, 37 and 38 in a secondary direction to seek the contacts of an idle connector switch D. When a contact 47 leading to an idle connector as D is encountered by the wiper 36, the energizing circuit of the test relay 42 is maintained opened, thereby preventing further energizations of the secondary magnet SM. It will thus be seen that by this see-saw action of relay 42 and magnet SM a positive driving operation of the secondary magnet is secured, and that it is impossible to stop the selector C on a busy contact or to drive the said selector past an idle contact because unless relay 42 is energized, magnet SM cannot be energized, and relay 42 can only be energized when magnet SM is at normal and private wiper 36 is resting on a busy contact.

The relay 27 does not de-energize during the secondary movement of the wipers, due to its adjustment and the rapidity of the interruptions of normal contact 39 of secondary magnet SM. The closure of normal contact 39 of secondary magnet SM, after its last de-energization, closes a circuit for the lower winding of the relay 27 over a circuit previously described, and due to its differential action it de-energizes. Upon the restoration of the relay 27, an energizing circuit for the relay T is established, traced from battery through the winding of the said relay T, alternate contact 45 of the secondary off-normal contacts SON, normal contact 28 of relay 27, alternate contact 32 of relay 24, to ground at alternate contact 26 of primary off-normal contacts PON. The opening of normal contacts 20 and 21 of relay T opens the energizing circuit of the impulse relay IR. The relay IR upon de-energizing, closes a circuit through the lower winding of the relay 24 traced from battery through the said lower winding, normal contact 23 of said relay IR, to ground at alternate contact 35 of said relay 24. The relay 24, due to its differential windings, neutralizes and restores to normal. The relay 24 restoring, opens the circuit of relay 27, permitting the said relay 27 to restore. The closing of alternate contacts 20 and 21 of relay T extends the connection of the calling subscriber A to the idle connector D, engaged by wipers 36, 37 and 38 of selector C. The closing of alternate contacts 20 and 21 of relay T brings about the energization of the impulse relay IR′ of connector D, over a circuit traced from ground through the right hand-winding of said relay IR′, bank contact 49, wiper 38, alternate contact 21 of relay T, bank contact 7, wiper 4, alternate contact 11 of relay CO, through the substation A, the alternate contact 12 of relay CO, wiper 3, bank contact 6, alternate con-

tact 20 of relay T, wiper 37, bank contact 48, and through the left-hand winding of the relay IR′ to battery and ground. The restoration of the relay 24 of the first selector C opens the initial energizing circuit of relay T of the first selector C, but the relay T being slow to release has a substitute circuit established for it, traced from battery through the winding of said relay, its alternate contact 52, wiper 36, bank contact 47, conductor 53, and conductor 54 to ground at alternate contact 55 of the impulse relay IR′ before it has had time to de-energize. The said relay T remains energized until the termination of the conversation.

Returning now to the operation of the registering relay 304, this relay upon its first de-energization establishes a circuit for the slow-acting relay 306, and a circuit for the driving magnet 300. The circuit for the slow-acting relay 306 extends from battery through the winding of said relay, alternate contact 361 of relay 299, and through normal contact 360 of relay 304 to ground. The relay 306 receives three impulses of current over this circuit during the operation of the subscriber's calling device for the first digit, and remains energized during this interval. The relay 299 being slow acting, also remains energized during the time that the relay 304 is sending impulses to relay 306 and to the driving magnet 300. The driving magnet 300 receives three impulses of current over a circuit traced from battery, through the winding of said driving magnet, bank contact 340, wiper 305, alternate contact 361 of relay 299, and alternate contact 360 of relay 304 to ground. The driving magnet 300 operates to rotate the type wheel 322, rotating the wheel until the numeral 3 appears immediately below the cross bar connected to the plunger of the solenoid. Upon the cessation of the impulses sent from the subscriber's calling device for the first digit, the relay 306 de-energizes owing to the fact that its circuit is held open at contact 360 of relay 304. The relay 306 falling back steps the ratchet 344 ahead one step through the medium of its pawl 345, thereby placing the wiper 305 on the next bank contact, 341, thereby associating the driving magnet 301 with the impulse contact 360 of the relay 304.

The energization of the relay IR′ of connector D brings about the energization of the relays 56 and 57, the circuit of relay 56 extending from battery through the right-hand winding of said relay, normal contact 58 of the primary off-normal contacts PON′, conductor 53 and conductor 54 to ground at alternate contact 55 of relay IR′. The circuit for relay 57 extends from battery through the lower winding of the relay 57, conductor 59, conductor 60, and alternate contact 61 of relay IR′ to ground at alternate contact 55 of impulse relay IR′. Upon the energization of relay 56, a locking circuit is closed for the said relay 56 extending from battery through its alternate contact 62 to ground.

The subscriber now operates his calling device CD to send the second series of impulses, which are four in number, over the line. These four impulses bring about four de-energizations and energizations of the relay IR′, causing the primary magnet PM′ to energize and de-energize four times to step the wipers 63, 64 and 65 in a primary direction to the fourth group of contacts containing the contacts of the called line. The four impulses sent from the subscriber's substation for the second digit of the called number cause the relay 304 to energize and de-energize four times, thereby causing the stepping magnet 301 to rotate the type wheel 321 four steps in a manner to be hereinafter described. The circuit of the primary magnet PM′ may be traced from battery through the winding of the said magnet, normal contact 66 of switching relay SW, conductor 67, alternate contact 68 of relay 57, normal contact 61 of relay IR′, conductor 54, conductor 53, and normal contact 58 of the primary off-normal contacts PON′ to ground at alternate contact 62 of relay 56. The primary off-normal contacts PON′ assume their alternate positions upon the first step of the wipers off normal. The opening of the primary off-normal contact 58 substitutes the ground fed from contact 69 of relay 70 for the ground fed through contact 62 of relay 56. After the last impulse of the series has been sent, the steady flow of current through both windings of relay 57 causes the said relay 57, due to its differential action, to neutralize and restore its contacts to normal. Relay 57 does not restore during the sending of impulses due to its adjustment, construction, and the rapidity of the interruptions of contact 61. The closing of normal contact 71 of relay 57 brings about the energization of the switching relay SW traced from battery through the winding of said relay SW, the make-before-break contact 72 of said relay SW, normal contact 73 of secondary off-normal contacts SON′, conductor 74, normal contact 71 of relay 57, and conductor 75 to ground at alternate contact 76 of primary off-normal contacts PON′, the said primary off-normal contacts PON′ having been moved to their alternate position on the first step of the wipers 63, 64 and 65 of the connector switch D. The closing of alternate contact 85 of relay SW closes a locking circuit for itself traced from battery through the winding of relay SW, alternate contact 85, conductor 86, normal contact 87 of

relay TCR, conductor 75 to ground at alternate contact 76 of primary off-normal contacts PON′. The said relay SW remains energized until the relay TCR is actuated, as will be presently described. The four de-energizations of the relay 304 of the registering device send four impulses of current through its back contact 360 and through slow-acting relay 306 and driving magnet 301 in multiple. The driving magnet 301 rotates type wheel 321 until the numeral 4 appears immediately below the bar 334 attached to the plunger of the solenoid. Upon the cessation of impulses for the second digit of the called number, the relay 306 falls back and steps the wiper 305 from bank contact 341 to bank contact 342, thereby preparing a circuit for driving magnet 302 of the registering device which will be closed upon the following operation of the relay 304. The closing of alternate contact 66 of the switching relay SW now renders the secondary magnet SM′ operative so that when the calling subscriber at the substation A actuates his call device again to send the last set of impulses, which we have assumed are five in number, the said magnet SM′ will be energized and de-energized by the impulse relay IR′ five times over a circuit traced from battery through the winding of the said magnet SM′, alternate contact 66 of relay SW, conductor 67, alternate contact 68 of relay 57, normal contact 61 of relay IR′, conductor 54, conductor 53, alternate contact 58 of the primary off-normal contacts PON′, and conductor 77 to ground at normal contact 69 of relay 70. Relay 304 also de-energizes five times for the last digit of the called number. The secondary magnet SM′ now steps the wipers 63, 64 and 65 in a secondary direction to engage contacts 78, 79 and 80 of the called line. Upon the first impulse of the last set, that is, upon the opening of contact 61 of relay IR′, the relay 57 again energizes to permit the secondary magnet SM′ to be operated, and after the last impulse the relay 57 is again de-energized by having a circuit closed through its lower winding, as previously described. The restoration of the relay 57 closes a circuit for the relay TCR traced from battery through the winding of the said relay, conductor 81, alternate contact 82 of relay SW, alternate contact 73 of the secondary off-normal contacts SON′, (said contacts having been moved to their alternate position upon the first step of the wipers in their secondary direction) conductor 74, normal contact 71 of relay 57, conductor 75, to ground at alternate contact 76 of the primary off-normal contacts PON′, thus causing the said relay TCR to energize. The relay TRC, upon energizing, opens the locking circuit of relay SW at its contact 87, permitting the said relay to de-energize. The relay SW de-energizing, opens the circuit of the relay TCR at its contact 82, leaving the relay TRC dependent upon the potential found on the private contact 78 of the called line.

The closing of alternate contact 90 of relay TCR connects the test relay TR in multiple circuit with said relay TCR to the test wiper 63, the circuit of the test relay TR being traced from battery through the winding of said relay, its make-before-break contact 94, conductor 95, normal contact 82 of relay SW, conductor 81, alternate contact 90 of relay TCR, conductor 91, normal contact 92 of relay TR, conductor 93 to the test wiper 63. The circuit of the relay TCR may be traced from battery through the winding of the said relay, its alternate contact 90, conductor 91, normal contact 92 of relay TR and conductor 93 to the wiper 63. The relay 304 is de-energized five times for the last digit of the called number, as before mentioned. The said relay de-energizing operates to close a circuit from ground through its back contact 360 to relay 306 and to driving magnet 302 in multiple. The driving magnet 302 receives five impulses over this circuit and steps its tpye wheel 320 ahead five steps until the numeral 5 appearing upon the outer periphery of the type wheel appears immediately below the cross bar 344 attached to the plunger 333 of the solenoid 319. From the foregoing operation, it is apparent that driving magnets 300, 301, and 302 have been operated to rotate the type wheels 322, 321 and 320, respectively, until the number called by the calling subscriber appears immediately below the bar 334 of the printing solenoid 319. In the present instance, the fourth driving magnet 303 is not utilized, as the called number only has three digits.

Called line idle.

Assuming that the called line is idle, private contact 78 of the called line will have a battery potential upon it, and the relay TR will not be energized but will remain at normal and the relay TCR failing to find a ground upon wiper 63 returns to normal, having its initial energizing circuit opened at alternate contact 82 of relay SW, as before described.

The relay TCR de-energizing brings about the energization of the relay 70 over a circuit traced from battery through the cut-off relay CO′ of the individual line switch B′, bank contact 78, through wiper 63, conductor 93, normal contact 92 of relay TR, conductor 91, normal contact 90 of relay TCR, conductor 96, normal contact 97 of relay SW, conductor 98, through the lower winding of the relay 70, conductor 99, to ground at alternate contact 100 of the relay 56. Relays 70 and CO′ energize over this

circuit. Relay CO′ upon energizing, removes the called subscriber's control of the line switch B′.

The closing of alternate contact 101 of relay 70 short-circuits the lower winding of the said relay and feeds ground to the cut-off relay CO′ of the line switch B′, and at the same time supplies the busy potential to the multiple private contacts of the called line. The closing of alternate contact 102 of relay 70 closes a circuit through the upper winding of said relay 70 traced from battery through its winding, the alternate contact 102 of said relay 70, and conductor 99 to ground at alternate contact 100 of relay 56. The closing of alternate contact 103 of the relay 70 closes a circuit for ringing current from generator GR to signal the called subscriber's substation, the path of said ringing current being traced from battery through the ringing generator GR, through the live segment of the interrupter I, through the winding 104 of ringing trip relay RT, conductor 105, alternate contact 103 of relay 70, conductor 106, normal contact 107 of relay RT, wiper 65, contact 80, through the call bell and condenser of the called substation E, back through contact 79, wiper 64, normal contact 108 of relay RT and conductor 109, to ground at alternate contact 69 of relay 70. The ringing current is intermittently connected to the called line due to the constantly rotating interrupter I, thus bringing about an intermittent actuation of the call signal at the called subscriber's substation E. The interrupter I is so arranged that ringing current from the generator GR and battery 110 are alternately connected to the called line so that should the subscriber answer in either a silent or a ringing period, ringing current is instantly disconnected, thus eliminating the undesirable feature of ringing the answering subscriber at the called substation in the ear should the subscriber remove his receiver during a ringing period. During the ringing and silent periods, and before the subscriber at the called substation E answers, the condenser at the said substation prevents a flow of battery through the winding 104 of the relay RT. The subscriber in response to the call signal removes his receiver, and should he remove it during a ringing period the combined generator and battery current of the generator GR and battery 125 bring about the energization of the relay RT over a circuit traced from battery 125 through the said generator GR, through the interrupter I, the upper winding 104 of relay RT, conductor 105, alternate contact 103, conductor 106, normal contact 107, wiper 65 and contact 80, through the now closed contacts at the substation switch hook, back through contact 79, wiper 64, normal contact 108, conductor 109, to ground at alternate contact 69. The relay RT energizes over the circuit just traced and closes a locking circuit for itself, traced from battery through the lower winding 111 of relay RT, its alternate contact 112, and conductor 75 to ground at alternate contact 76 of the primary off-normal contacts PON′. Should the subscriber remove his receiver from the switch hook during a silent period, the relay RT will energize over a circuit from battery 110 through the live segments of the interrupter I, the upper winding 104 of relay RT, and over the previously described path to ground at alternate contact 69, which causes the relay RT to energize and close the locking circuit for itself through its winding 111, as before described. Thus it may be seen that ringing current is instantly disconnected from the called line either during live or silent periods by the opening of contacts 107 and 108 of relay RT. Upon the energization of the relay RT, an energizing circuit for the supervisory relay SR is established traced from battery through the lower winding of said relay SR, alternate contact 107 of relay RT, wiper 65, contact 80, through the substation back to the contacts 79, wiper 64, alternate contact 108 of relay RT and through the upper winding of the relay SR to ground. The subscribers are now in conversational circuit and the talking circuit may be traced over the heavily marked conductors, the said conductors having the condensers K and K′ interposed.

The subscribers having finished conversation, and assuming that the subscriber at the substation A is the first to replace his receiver upon its switch hook, the opening of the switch hook contacts brings about the de-energization of the impulse relay IR′ of the connector D. The restoration of the relay IR′ brings about the opening of the holding circuit of the relay T of the first selector C, and the closing of normal contact 43 of the restored relay T of the first selector C closes an energizing circuit for the relay 42 which may be traced from battery through the winding of the relay 42, normal contact 43, normal contact 44 of magnet SM, normal contact 50 of relay 24, and alternate contacts 41 and 26 of primary off-normal contacts PON to ground. The closing of alternate contact 46 of the relay 42 brings about the energization of the secondary magnet SM. The relay 42 and the secondary magnet SM are alternately energized and deenergized, as previously described, the secondary magnet SM thus stepping the wipers 36, 37 and 38 beyond the last contacts of the row of bank contacts, from which point the wipers are restored to normal. The secondary off-normal contacts SON and primary off-normal contacts PON restore to normal, and the opening of alternate contact 26 of the primary off-normal

contacts PON opens the energizing circuit of the cut-off relay CO of the individual line switch B. The restoration of the cut-off relay CO of the line switch B places the line switch B in a condition so that it may be used to extend subsequent calls. The subscriber E placing his receiver upon the switch hook interrupts the circuit of the relay SR of the connector D at the switch hook contacts, causing the said relay to de-energize. The closing of normal contact 130 of relay SR closes a circuit through the left-hand winding of the relay 56, which may be traced from battery through the said left-hand winding of relay 56, through its alternate contact 131, conductor 132, normal contact 130, and conductor 133 to ground at normal contact 55 of the relay IR'. Due to the differential construction of the relay 56, the said relay neutralizes and restores to normal. The closing of normal contact 134 of relay 56 closes the circuit of secondary magnet SM', which may be traced from battery through the winding of said secondary magnet SM', conductor 135, normal contact 134 of relay 56, alternate contact 136 of primary off-normal contacts PON', through the interrupter I' to ground. The secondary magnet SM' thus steps the wipers 63, 64 and 65 beyond the last set of contacts in the group, and the wipers then restore to normal from this position. The restoration of the relay 56 also brings about the opening of the circuit of the relay 70 at alternate contact 100, bringing about the restoration of the said relay 70. The primary off-normal contacts PON' having restored upon the restoration of the switch, the opening of alternate contact 76 of the contacts PON' brings about the restoration of the relay RT. The relay 56 also causes the deenergization of cut-off relay CO' of the line circuit B', which is associated with the called subscriber's substation E. All of the apparatus used in establishing the connection between the calling subscriber at the substation A and the called subscriber at the called substation E is now at normal and available for use in establishing other connections.

The replacing of the receiver at the calling substation also de-energizes the relay 304, which relay upon de-energizing opens the circuit of slow relay 299 and closes the circuit of relay 306 and of driving magnet 303. In this instance, relay 306 upon energizing closes its contacts 307, thereby preparing a circuit for the printing solenoid 319. Relay 299, upon de-energizing, opens the circuit of relay 306 and of driving magnet 303. The relay 306, however, is slow to de-energize, holding its contact 307 closed momentarily while a circuit is closed through printing solenoid 319 over a path extending from battery through the winding of solenoid 319, alternate contact 307 of relay 306, normal contact 361 of relay 299, and back contact 360 of relay 304 to ground. This circuit is finally opened by relay 306 falling back. The falling back of relay 304 also closes a circuit for magnet 303, causing it to take one step before the number is registered. If it is so desired, the last type wheel will be so constructed that it will take two steps before the figure 1 is brought into a position to be stamped upon the tape. The solenoid 319, upon energizing, causes the cross bar 334 attached to plunger 333 of the solenoid to print the number called upon the paper 327. The solenoid, upon de-energizing, causes its arm 330 to turn the ratchet 329 ahead one step, thereby rotating the wheel 328 and moving the roll of paper one step until an unused portion of the paper appears immediately below the cross bar 334 of the solenoid 319. The arm 334' attached to the armature of the solenoid moved forward when the solenoid was energized and the hooked end portion of said arm is now immediately below the pin 336 of the pawl 325. The solenoid upon de-energizing causes the pawl 325 to be moved from engagement with the teeth of the type wheels, thereby permitting the said type wheels to return to their normal position, and, at the same time, as before explained, the holding pawl 346 is moved from engagement with the ratchet 344 attached to the wiper 305, thereby permitting the wiper 305 to be restored to its normal position by the restoring spring 370. If the calling subscriber had only called one digit and then replaced his receiver, only that digit called would have been printed upon the paper 327.

Assuming now that the subscriber at the called substation E is the first to replace his receiver upon the switch hook, the opening of the switch hook contacts at the substation E brings about the de-energization of the relay SR. Nothing else happens at this time as the relay IR' is still maintained energized over the line of the calling substation A. The calling subscriber at the substation A replacing his receiver interrupts the circuit of the impulse relay IR' at the switch hook contacts. The relay IR' de-energizing, closes a circuit through the left-hand winding of relay 56, causing the said relay to de-energize, as herein-before described. The restoration of the individual switch B, first selector C and connector D is the same as previously described from this point on.

Should the called subscriber E fail to replace his receiver upon the switch hook after the conversation is terminated, the replacing of the receiver at the substation A brings about the de-energization of the impulse relay IR' of connector D, the same as before, and the opening of alternate contact 55 of the impulse relay IR' opens the circuit of the relay

T of the first selector C, as before described, and causes the release of the selector C and individual switch B. The subscriber at the called substation failing to replace his receiver upon the switch hook permits the continued energization of the relay SR, thus holding contact 130 of said relay in its alternate position, preventing the differentially wound relay 56 from restoring to normal and closing the energizing circuit for the secondary magnet SM'. The relay 57 energizes when the impulse relay IR' drops back but is immediately restored to normal due to the closure of an energizing circuit through the lower winding of the said relay 57, which may be traced from battery through the lower winding of the relay 57, conductor 59, conductor 60, alternate contact 130, conductor 133, to ground at normal contact 55 of the now restored impulse relay IR'. The relay 57 being differentially wound restores to normal, and the closing of normal contact 140 of said relay 57 places a ground upon the private contact of the connector D over a circuit which may be traced from ground to alternate contact 76 of primary off-normal contacts PON', through conductor 75, normal contact 71 of relay 57, conductor 74, alternate contacts 73, normal contact 140 of relay 57, alternate contact 141 of secondary off-normal contacts SON' and conductor 53 to the private contact 47. The placing of the busy potential upon the private contact prevents any first selector switch C from engaging the contacts of this busy connector.

Called line busy.

Assuming now that the called line is busy, the operation of the circuit is the same up to and including the time when the relay TCR energizes, as previously described. The line being busy, private contact 78 has a busy potential placed upon it, thus closing the multiple circuit for the relay TCR and the test relay TR, the circuit of the relay TCR being traced from battery through the winding of the said relay TCR, its alternate contact 90, conductor 91, normal contact 92 of relay TR, conductor 93, to the busy grounded private contact 78. The circuit of the test relay TR is traced from battery through the winding of the said relay TR, the make-before-break contact 94 of said relay, conductor 95, normal contact 82 of relay SW, conductor 81, alternate contact 90 of relay TCR, conductor 91, normal contact 92 of relay TR, conductor 93 and wiper 63 to ground at busy private contact 78. The contacts 94 and 92 of the relay TR are so adjusted that the alternate contact 150 makes before the contact 92 breaks, thus closing a locking circuit for relay TR through its alternate contact 150 before the normal contact 92 of the said relay breaks. The locking circuit of the said relay TR extends from battery through the alternate contact 150 of the relay TR, conductor 151, to ground at alternate contact 76 of primary off-normal contacts PON'. The locking circuit for the said test relay TR is independent of the grounded private contact and the opening of the normal contact 92 of the relay TR opens the circuit for the relay TCR which restores to normal. The falling back of relay TCR does not affect relay 70 due to the fact that the test conductor 93 is held open at contact 92 of relay TR. The locking circuit for the test relay TR is thus independent of the busy grounded contact 78. This arrangement does away with the method usually employed of locking the busy relay up to the busy private contact of the called busy line. The closing of alternate contact 152 of relay TR connects the busy-back signal BB to the calling line to transmit a busy signal to the said calling subscriber at the substation A, thus notifying him of the busy condition of the said called substation E.

The calling subscriber now replaces his receiver upon the switch hook, bringing about the de-energization of IR' and of relay 304. The relay IR' restoring opens the circuit for the relay T of first selector C, which closes the circuit of the secondary magnet SM, as previously described, thus bringing about the release of the first selector C and individual switch B. The de-energization of the relay 304 causes the printing solenoid 319 to operate in the same manner as hereinbefore described. The relay IR' de-energizing brings about the restoration of the relay 56, due to the fact that the relay SR is not energized. The closing of normal contact 134 of the said relay 56 closes the circuit for the secondary magnet SM' which magnet steps the wipers 63, 64 and 65 beyond the last set of contacts. The wipers then restore to normal. Primary off-normal contacts PON' and secondary off-normal contacts SON' are also restored. The apparatus used in this busy connection is now at normal and available for use in establishing other connections. Should the called line become idle during the time of the transmission of the busy signal and the time the calling subscriber replaces his receiver, nothing happens as the contact 92 of relay TR is in its alternate position, preventing the energization of relay 70, and thus preventing ringing current from being sent out to the now idle called line.

From the foregoing, it is at once apparent that the device X operates to register whatever number the calling subscriber may call. Should the supervisor at the automatic exchange receive a complaint that the calling subscriber is unable to call the subscriber whose number is 345, the supervisor would immediately go to the device X and ascer-

tain whether or not the calling subscriber actually called number 345, and in the event that he notes that the number called by the calling subscriber was 335, he immediately knows that the subscriber has erred in calling, and that the automatic apparatus is not at fault. He then instructs the calling subscriber to recall his number and to pay particular attention to the calling of such number. However, if he finds that the calling subscriber actually did call number 345, he then tests out and watches the operation of the automatic apparatus to ascertain why the calling subscriber failed to receive the proper connection.

In the event that the calling subscriber is assessed toll for each call that he makes, it is only necessary at predetermined periods to remove the roll of paper from the device and check over the numbers called by the calling subscriber and to assess him toll accordingly.

If the device is to be used to indicate to the operator the number that the calling subscriber desires, the device is connected in a cord circuit in such a manner as to have the line relay 304 operate the device X as previously described, and at the same time to operate a signal to notify the operator that the calling subscriber desires a connection. After the device X has been operated to register the number the calling subscriber desires, the operator then completes the connection with the called subscriber's line in any desired manner.

While I have shown a system of 1,000 line capacity, it is to be understood that by inserting second selectors this system may be increased to 10,000 lines, etc.

While I have described my invention operating in connection with a well-known system, I do not wish to be limited to this exact disclosure as my invention may be applied to other systems without departing from the spirit of the invention, and I, therefore, do not wish to be limited to this exact disclosure but aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including subscribers' telephone lines provided with calling devices, switching means controlled by said calling devices for interconnecting said subscribers' telephone lines, and recording devices including means for automatically and permanently recording the numbers called by the calling devices.

2. A telephone system including subscribers' telephone lines provided with calling devices, switching means controlled by said calling devices for interconnecting said subscribers' telephone lines, and recording devices for printing on a paper roll operatively associated with said devices the number of impulses in each series of impulses sent by the said calling devices the printing of the number being effected automatically when the calling subscriber signals for disconnection.

3. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a calling device for said calling subscriber's telephone line, automatic switching means controlled by said calling device for establishing connection between said calling subscriber's line and said called subscriber's line, and a recording device for automatically recording on a paper roll operatively associated with said recording device the number called by the calling subscriber in completing connection with the called subscriber's line the recording of the number being effected when the calling subscriber signals for a disconnection.

4. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, means for connecting said subscribers' lines in telephonic communication, a registering device, means for adjusting said registering device, said first means and said second means both being controlled by the calling subscriber simultaneously, and automatic means for making a record of the numbers displayed on said registering device.

5. A telephone system including a calling subscriber's telephone line, a called subscriber's telephone line, automatic means for connecting said lines, a registering device, a calling device at the substation of said calling line for controlling both said automatic means and said registering device simultaneously, and means including a solenoid magnet for recording the operations of said registering device.

6. A telephone system including a calling subscriber's telephone line, called subscribers' lines, automatic switching means, a calling device at the calling subscriber's substation for controlling the operation of said switching means in completing connections with said called lines, and a recording device including a solenoid magnet for making permanent records of the operations of said calling device in completing said connections with said called lines.

7. A telephone system including a calling subscriber's telephone line, called subscribers' lines, automatic switching means, a calling device at the calling subscriber's substation for controlling the operation of said switching means in completing connections with said called lines, and a registering device for registering the numbers called by the calling subscriber when operating said switching means to complete said connections, said switching means and said register-

ing means responsive simultaneously to the actuation of said calling device, said registering device being provided with means operable after the connections are completed to record the numbers called.

8. A telephone system including a calling subscriber's telephone line, called subscribers' telephone lines, automatic switching means under the control of the calling subscriber for completing connections with said called subscribers' lines, and a registering device individual to the calling subscriber's line for recording the numbers called by the calling subscriber in completing connections with said called subscribers' lines for record, such record being automatically made after the connections are completed.

9. A telephone system including a calling subscriber's telephone line, automatic switching means controlled over the calling subscriber's telephone line, type frames individual to the calling subscriber's line, means for adjusting said type frames when said calling subscriber actuates said switching means, and a paper tape cooperative with said type frames adapted to visualize the numbers shown on the type frames.

10. A telephone system including a calling subscriber's telephone line, automatic switching means for extending calls from said calling line, a calling device individual to said line for sending series of impulses for operating said switching means, and a recording device for permanently and automatically recording each call made from said line.

11. A telephone system including a calling subscriber's line provided with an individual call sending device for sending series of impulses of different digit values, and a recording device for automatically and permanently recording the digit values of the series of impulses.

12. A system of the character described a calling subscriber's line, including an individual impulse sender for sending a plurality of series of impulses, and a recording device for automatically and permanently recording the digit value of each of said series of impulses.

13. A telephone system including a calling subscriber's line, automatic means controlled over said calling line for extending connections to called subscribers' lines, and a registering and recording device operable to visualize and to automatically record the numbers of the called subscribers' lines to which the calling subscriber extended connections, said registering and recording device being so arranged that at any time it will disclose the prior called numbers of the subscribers.

14. A telephone system including a calling subscriber's line, called subscribers' lines, means for extending connections from said callling subscriber's line to said called subscribers' lines, and a device individual to said calling subscriber's line for automatically and permanently recording the number of each called subscriber's line that connections are extended to from the said calling subscriber's line.

15. A telephone system including a calling subscriber's telephone line, automatic switching means for extending connections from said calling line, an impulse sending device individual to said calling subscriber's line for controlling the operations of said automatic means, and a device for recording the operations of said impulse sending device, said device being operable to automatically and permanently record such operations at the time the receiver is replaced at the calling substation.

16. A telephone system including a calling subscriber's telephone line, a called subscriber's telephone line, means for connecting said lines in conversational circuit, and a device operable when the calling subscriber replaces his receiver to automatically record and visualize the number of the called subscriber.

17. A device of the character described adapted to automatically and permanently record the number called by a calling subscriber when the calling subscriber signals for disconnection.

18. A device of the character described adapted to register the number called by a calling subscriber, said device adapted to record said number automatically when the calling subscriber signals for disconnection.

19. A system of the character described including a call sending device, a plurality of type frames, means including a plurality of stepping magnets for adjusting said type frames responsive to operations of said call sending device, and means responsive thereafter to record the operations of said type frames.

20. A telephone system including a calling subscriber's line and a called subscriber's line, an automatic switch individual to the calling subscriber's line, other automatic switches, a device at the calling substation for controlling said other automatic switches to extend a connection from said calling line to said called line, and a device including a solenoid magnet for recording the operations of said calling device.

21. A telephone system including a calling subscriber's line and a called subscriber's line, an automatic switch individual to the calling subscriber's line, other automatic switches, a device at the calling substation for controlling said other automatic switches to extend a connection from said calling line to said called line, and a device controllable at the will of the calling subscriber for visualizing the number of the called subscriber, said device adapted to automatically and

permanently record said number when the calling subscriber replaces his receiver.

22. A telephone system including a calling subscriber's line and a called subscriber's line, an automatic switch indivdual to the calling subscriber's line, other automatic switches, a device at the calling substation for controlling said other automatic switches to extend a connection from said calling line to said called line, and a device adapted to record upon a paper tape the number called by the calling subscriber when the calling subscriber signals for disconnection.

23. A telephone system including a calling subscriber's line and called subscribers' lines, automatic switches controllable over the calling subscriber's line for completing connections with the called subscribers' lines, and a recording device individual to the calling subscriber's line for permanently recording upon a paper tape operatively associated with said recording device the numbers of the called subscribers' lines called by the calling subscriber.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 4th day of June, 1918.

GEORGE A. YANOCHOWSKI.