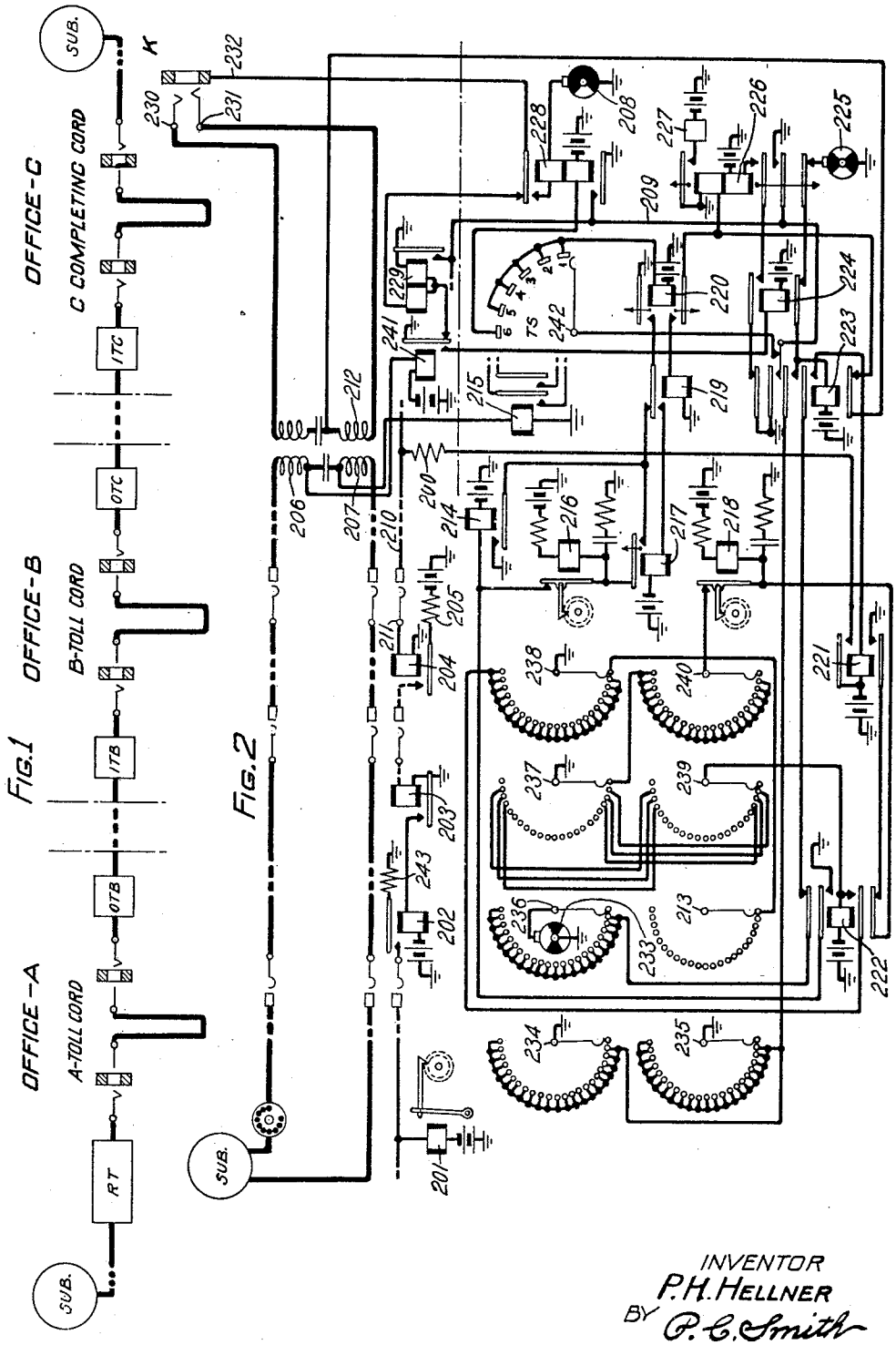
Jan. 12, 1932. P. H. HELLNER 1,840,359

METERING AND TIMING APPARATUS FOR TELEPHONE SYSTEMS

Filed June 19, 1930 4 Sheets-Sheet 1



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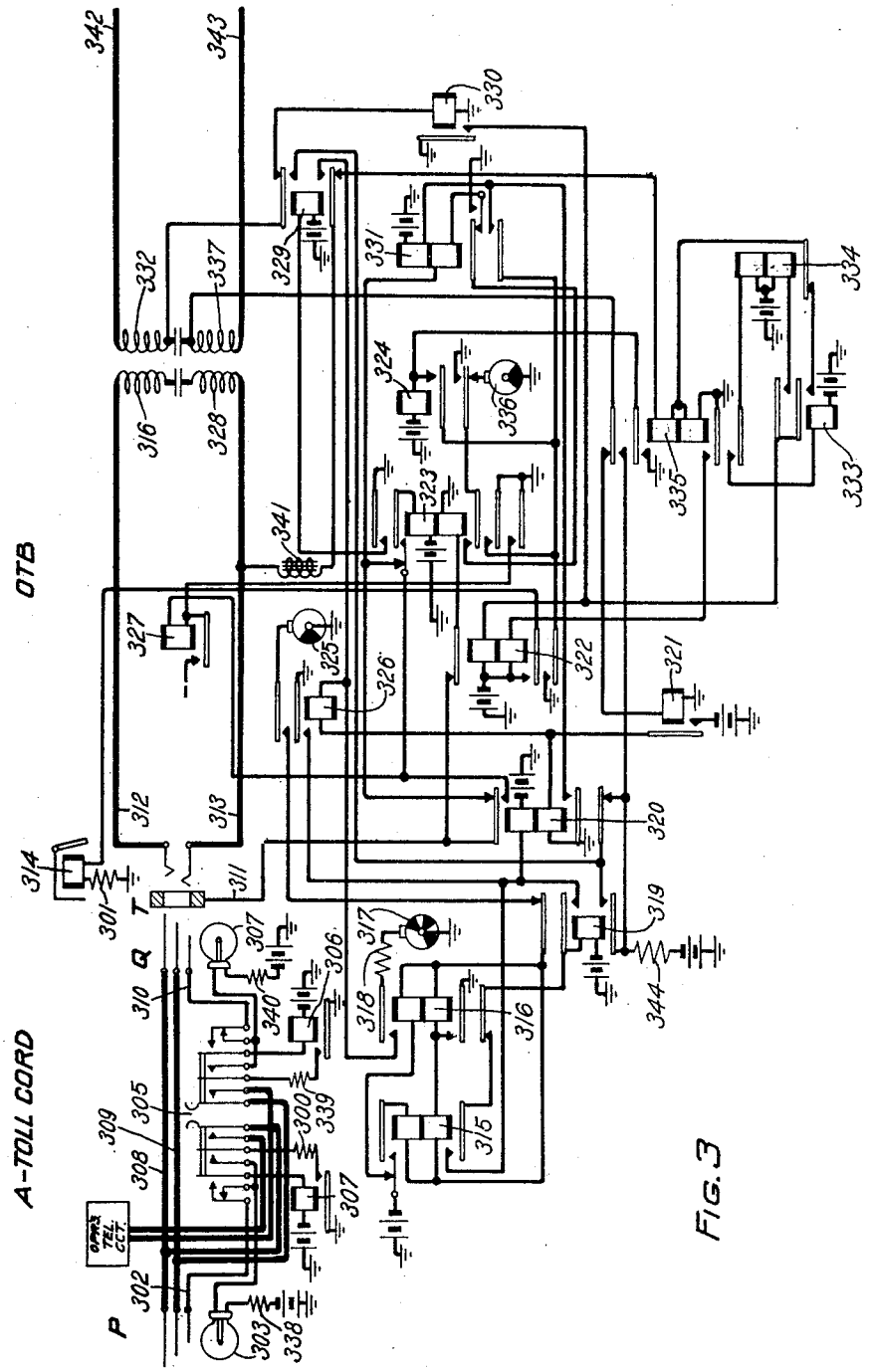

FIG. 3

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METERING AND TIMING APPARATUS FOR TELEPHONE SYSTEMS

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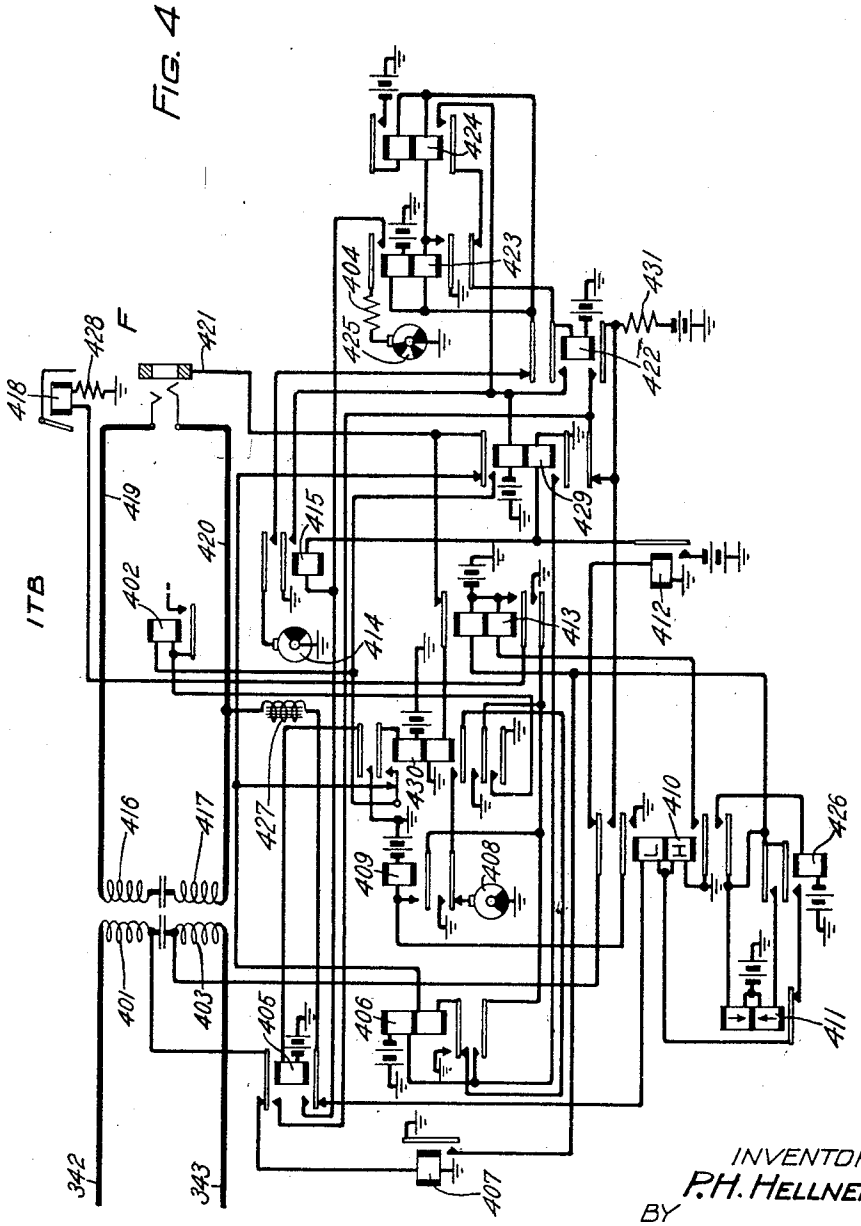
FIG. 4



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METERING AND TIMING APPARATUS FOR TELEPHONE SYSTEMS

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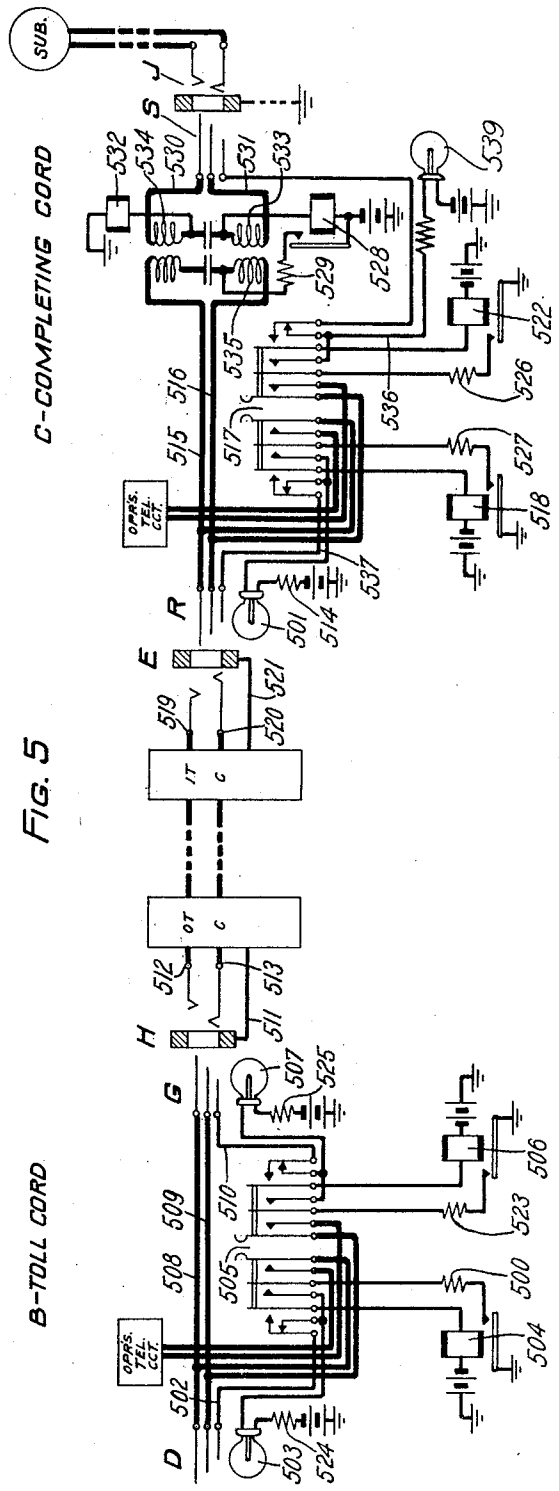

FIG. 5

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UNITED STATES PATENT OFFICE

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METERING AND TIMING APPARATUS FOR TELEPHONE SYSTEMS

Application filed June 19, 1930, Serial No. 462,213, and in the Netherlands July 5, 1929.

This invention relates to automatic timing and rating of interoffice telephone calls and is more particularly concerned with the automatic recording, metering, and supervision of toll calls. In general, the invention consists in the provision of means for registering in the recording trunk of a toll connection, groups of impulses transmitted to it by the individual trunk lines of a toll train wherein each group of such impulses is individual to each trunk and indicates the charge for the use therefor in a connection in which it is used for a standard period of conversation time regardless of the length of the toll train. The calling subscriber's meter is then operated in accordance with the sum total of all these impulses. The circuits also provide a signal to in the first connecting cord in the train for denoting the termination of the period of conversation time for which the charge was made. It includes, as well, other circuit conditions for providing visual supervision of the call by the operator at the originating office during conversation and also supervision at the intermediate and terminating operator's positions during the set up of the call and at disconnection.

Long distance telephone systems may be divided broadly into two classes having, respectively, delay and no-delay methods of operating. In accordance with the delay method, the calling subscriber, after giving his number and that of the wanted subscriber to the recording operator restors the receiver. The operator writes both numbers upon a ticket and transmits it to a toll operator who has access to the toll lines leading in the wanted direction. The toll operator then proceeds to call the wanted subscriber through the medium of the various intermediate offices through which the connection must be routed in order to reach the called station and when the called subscriber answers, recalls the calling subscriber. In accordance with this method of establishing connections fewer toll trunks are required since the calling subscriber can be made to wait until a toll line is available.

In the no-delay method of operating, commonly known as the CLR method (combined line and recording), the operator who formerly only recorded the calling and wanted numbers upon a ticket also has access to toll lines leading in the wanted direction. By this method the calling subscriber's waiting time is reduced to such an extent that it is no longer necessary for him to restore the receiver and be called back after the connection is established. This makes it possible for the operator to expedite connections and permits her to handle more calls. The latter method, that is, the CLR method, is therefore more economical than the former, because it has been found that on short distance calls, the line costs are relatively small compared with the total costs and the increase, therefore, in the number of trunks to permit CLR service is compensated by the greater number of possible connections.

A no-delay service can also be furnished on long distance lines during the busy hour if the greater long line costs can be compensated for by lower operating costs. One of the chief causes for the reduction of operating costs of CLR service is the elimination of the expensive ticket distributing system when the complete toll line multiple is accessible to the recording operator. It is the object of the present invention to eliminate the necessity of ticketing and to perform automatically such functions as now require ticketing.

In the establishment of long distance telephone connections, successive attempts have been made to automatically check the conversation time and provide visual supervision of the call by the originating toll operator, but it has been necessary for the operator, in such cases, to record the call and perform metering operations as well. It is a further object of the present invention, therefore, to perform the function of metering automatically as well as to provide for supervision of the call so that the task of the operator in recording metering information is obviated. When the call is established there will be no further function to perform beyond taking down the connection when signaled to do so.

In accordance with the present invention,

therefore, one specific embodiment of which is disclosed herein by way of illustration, this is accomplished in the following improved manner: An individual timing impulse circuit capable of generating and transmitting a definite number of pulses in either direction is provided in each interoffice trunk; a given number of such pulses for any trunk representing the charge for the use of the trunk in any connection for which it is taken into use for a given unit of conversation time. These pulses are transmitted to and recorded in suitable switches in the recording trunk immediately after the called subscriber answers. These pulses remain so registered during the conversation period. When the conversation is terminated another switch in the recording trunk is connected to the subscriber's meter and also to the switch on which the impulses are registered. The subscriber's meter is then operated once for each pulse so registered, and, with each pulse, the metering switch is stepped until the number of steps taken equals the number of steps recorded on the register switch. In this manner the subscriber's meter is operated as many times as is necessary to satisfy the register switch which was stepped by the pulses received from the trunks in the toll train. If the called subscriber does not answer, the calling subscriber's meter, of course, is not operated even though the pulses representing the charge to be made for the call have been received and recorded in the registering switch of the recording trunk.

In addition to the usual flashing recall and switchhook supervision, the originating operator is also advised by a special interrupted lamp signal in the cord circuit as to when the standard period of conversation is terminated. The supervision of the call, other than this special signal, is furnished either on an alternating or direct current basis in the well-known manner depending on the nature of the connection.

A clearer conception of the scope and purpose of the invention will be obtained from a consideration of the following description taken in connection with the attached drawings in which:

Fig. 1 shows schematically an interoffice toll connection through an intermediate office;

Fig. 2 shows the recording trunk and associated call charging control circuit;

Fig. 3 shows a simplified toll cord at the left and the outgoing interoffice trunk at the right;

Fig. 4 shows the incoming end of the interoffice trunk whose outgoing end is shown in Fig. 3;

Fig. 5 shows another simplified toll cord, a schematic representation of an interoffice trunk similar in every respect to the interoffice trunk shown in Figs. 3 and 4, a simplified completing cord and a subscriber's line.

It will be assumed in the connection described hereinafter that the recording trunk is reached by the calling subscriber in any standard and well-known manner. For the purpose of this description, Fig. 2 illustrates schematically the conditions prevailing in the case of an automatic subscriber connected to a recording trunk by way of two group selectors.

Establishment of connection

Referring now to Fig. 1 a brief description of the general manner of operation for a toll call routed through three offices, namely, A, B and C and in which the operators A, B and C mentioned hereinafter refer to the operators respectively at each of these offices, will be given. When the A operator is informed that a recording trunk RT is calling she inserts the answering plug of the A toll cord into the jack of the recording trunk and ascertains from the calling subscriber the office, name and number of the wanted subscriber. She then takes into use an outgoing trunk OTB by inserting the calling plug of the A toll cord into the jack thereof and thereby extends the connection to the incoming trunk ITB terminating in intermediate office B through which the terminating office C is to be reached. The B operator takes up the call with the answering plug of the B toll cord and, by a procedure similar to the one which has been described as taking place at the A office, extends the connection to the C office by way of outgoing trunk OTC and incoming trunk ITC. The operator at the C office then takes up the call with the answering plug of the C completing cord and completes thereby the connection to the called subscriber's line with the calling plug of the C completing cord. When the called subscriber answers, an answering signal is repeated back along the toll train to the timing circuit in the recording trunk RT which, in turn, sends back a signal to the first outgoing trunk OTB to release the group of pulses designating the charge for the use of the trunk OTB—ITB. These pulses are then transmitted to and registered in the recording trunk registering switch and remain so registered until the end of the conversation. When the first trunk has finished sending its impulses it, in turn, transmits a signal to the incoming end of the trunk ITB which signal is then repeated to the next outgoing trunk OTC. This trunk now transmits its own impulses back to the timing circuit of the recording trunk and the process is repeated with each trunk in the train until all the groups of pulses individual to each trunk in the train have been transmitted to the recording trunk and recorded in the registering switch therein. When the conversation

is completed, means in the recording trunk cause the calling subscriber's meter to be operated a number of times in accordance with all the pulses recorded.

Refer now to Figs. 2, 3, 4, and 5 placed in juxtaposition to each other in the order named, for a detailed description of the circuit operations involved.

When the calling subscriber establishes a connection to the recording trunk, relays 241 and 215 operate over a circuit from battery on winding of relay 241, repeating coil winding 206, subscriber's loop extending through the line finder and the two group selector circuits, repeating coil winding 207, winding of relay 215 to ground. Relay 241 operates relay 224 while circuits controlled by the contacts of relay 215 are operated to signal the A operator in any well-known manner. When the A operator is informed that a recording trunk is calling she inserts the answering plug P of the A toll cord into the recording trunk jack K. Key 305 of the cord is operated, the operator's telephone circuit is connected across the line in the well-known manner, and winding of relay 229 of the recording trunk are connected in series with the relay 307 of the cord in the following circuit; ground through both windings in series of relays 229, top back contacts of relay 228, jack sleeve 232 of recording trunk jack K, sleeve conductor 302 of the cord, operated outer left contacts of key 305, winding of relay 307 to battery. Relay 307 is marginal, does not operate in series with both windings of relay 229 and therefore no circuit is closed for lamp 303 which remains extinguished. No useful function is performed by the relays at this time. The operator ascertains from the calling subscriber the office and number of the wanted subscriber and inserts thereafter the calling plug Q of the A cord into the jack T of the outgoing trunk OTB leading in the wanted direction, which, it is assumed, is through intermediate office B. A circuit is now closed for operating relay 323 from battery through the winding of relay 306, operated right outer contacts of key 305, cord sleeve conductor 310, jack sleeve conductor 311, top contacts of relay 322, lower winding of relay 323 to ground. The circuit from battery through the winding of relay 306 has a parallel path by way of the top back contacts of relay 320 and normally closed inner top contacts of relay 323, winding of relay 327 to ground on the bottom outer most make contacts of relay 323. Relay 327 also operates at this time. Relay 323, on operating, closes a locking circuit over its upper winding and its top inner front contacts to ground through the winding of relay 327 over the previously described path so that relays 323 and 327 are now locked in series. Relay 323 when operated, connects ground through interrupter 336, to relay 306 by way of the bottom back contacts of relay 324, bottom inner front contacts of relay 323, normally made back contacts and inductive lower winding of relay 331, top back contacts of relay 320, sleeve conductor 311, cord sleeve conductor 310, operated right outer contacts of key 305, winding of relay 306 to battery. Relay 306 operates from the interrupter ground but relay 331 does not, and the intermittent operation of relay 306 flashes supervisory lamp 307 over a circuit closed from the ground on contacts of relay 306 resistance 339, middle right contacts of key 305, lamp 307, resistance 340, battery.

When additional trunks are taken into use at other switchboards in extending the connection there-through and the cords at the respective switchboards are inserted into the outgoing trunk jacks of these trunks, similar circuit conditions are closed and the flashing lamp signal is similarly given at these switchboards.

Relay 329 now operates from ground at the top outer front contacts of relay 323 and connects battery through resistance 344, lower back contacts of relay 320, top front contacts of relay 329, winding 332 of the outgoing trunk repeating coil, conductor 342, winding 401 of the incoming trunk repeating coil, top back contacts of relay 405, winding of relay 407 to ground, operating this relay. Relay 407 closes ground at its front contacts and operates relay 413 over its upper winding and also relay 411 over its upper winding. Relay 413 operates the switchboard busy signal 418 over a circuit from battery on the bottom inner front contacts of relay 413, winding of signal 418, resistance 428 to ground. This indicates to the operator at the B office that a call is awaiting on the trunk. When the B operator plugs into jack F with the answering plug D of the B toll cord and takes into use another outgoing trunk, such as OTC—ITC, by inserting calling plug G into jack H of the outgoing trunk leading to office C, schematically indicated in Fig. 5 and similar in circuit structure and apparatus arrangement to the trunk shown in Figs. 3 and 4, the above operations are repeated at the outgoing OTC and the incoming end ITC of this second trunk and the C operator after inserting answering plug R of the completing cord into jack E and inquiring the wanted line in the well-known manner of the preceding operator, completes the connection by inserting the calling plug S of the completing cord into jack J of the called subscriber's line and rings the said line in the well-known manner. Only such portions of the completing cord C are shown as is necessary to a complete understanding of the present embodiment of the invention. All other

elements of the said cord are well-known in the telephone art and are therefore omitted.

The following operations take place in the trunk circuit OTC—ITC as a result of the called subscriber removing his receiver from the hook, except those operations which are specific to other circuits such as, for example, the C completing cord. Since, circuit OTC—ITC is only diagrammatically represented in Fig. 5, the description will be referred back to the trunk circuit OTB—ITB, which is fully disclosed in Figs. 3 and 4. The two circuits are identical in every respect and the circuit operations described with reference to characters and apparatus mentioned in connection with the trunk circuit in Figs. 3 and 4 are understood to be taking place in identical manner with apparatus in the trunk circuit OTC—ITC.

On the reply of the wanted party the C completing cord supervisory relay 528 operates over the following circuit: ground, winding of coil 532, repeating coil winding 534, tip conductor 530, subscriber's loop, ring conductor 531, repeating coil winding 533, winding of relay 528, battery. Relay 528 connects battery through high resistance 529 to the repeating coil winding 535, thence to ring conductor 516, ring conductor 520 in trunk ITC corresponding to conductor 420 of the incoming trunk, retard coil 427, lower back contacts of relay 405, both windings in series of relay 410 to ground, thereby operating relay 410 in incoming trunk ITC. A path is now closed to operate relay 409 from ground on the top inner front contacts of relay 410, and when relay 409 operates, it locks over its inner front contacts to ground at the bottom front contacts of relay 413. The operation of relay 410 closes a circuit for relay 426 from ground at the contacts of relay 407, bottom outer front contacts of relay 410 to the winding of relay 426 and also to the upper winding of relay 411 causing relay 426 to operate; relay 411 already having been operated from the contacts of relay 407. When relay 426 operates however, the closure of its outer front contacts connects the lower differential winding of relay 411 to ground on the contacts of relay 407 over the path previously described, thereby releasing relay 411. Battery through resistance 431 is now connected to the winding of relay 321 in the outgoing end of the trunk OTC, by way of the top outer front contacts of relay 410, winding 403 of the incoming trunk repeating coil, conductor 343, outgoing trunk repeating coil winding 337, top outer back contacts of relay 335, winding of relay 321, to ground, operating this relay. Relay 321 operates relay 320 over its lower winding and relay 320 disconnects battery through resistance 344 at its bottom back contacts from conductor 342 thereby causing the release of relay 407 in the incoming trunk ITC. Relay 407 releases relay 426. The operation of relay 320 closes a circuit for relay 331 from ground on the bottom inner front contacts of relay 320 to upper winding of relay 331 operating this relay and locking it through the same winding over its bottom outer contacts to ground on the bottom middle front contacts of relay 323. Relay 331 disconnects interrupter 336 at its inner back contacts, releasing relay 306 and, in consequence, extinguishing the cord supervisory lamp 307 or specifically lamp 507 of the B toll cord.

When relay 321 operates, battery is connected on its front contact to the lower winding of relay 320 as described, but also to winding of relay 326, and winding of relay 410 in the next preceding trunk in the train which, in this case, would be trunk OTB—ITB by way of the bottom front contacts of relay 329, retard coil 341, ring conductor 313 of the trunk, cord conductor 309, ring conductor 420 of the next preceding trunk, retard coil 427 of the next preceding trunk, bottom back contacts of relay 405 of the next preceding trunk to both windings in series of relay 410. The effect of this signal is the operation of relay 410 in the incoming end of the next preceding trunk and the consequent operation of relay 321 in the outgoing end of the same trunk. In this way the resistance battery signal is repeated in every trunk of the train. We will assume, therefore, that the operations which have taken place in trunk OTC—ITC have been repeated in the trunk OTB—ITB immediately preceding and, remembering that there is no other intermediate trunk between OTB—ITB and the recording trunk, we will proceed to describe the effect of the transmission of the resistance battery signal from trunk OTB—ITB to the recording trunk.

When relay 321 of trunk OTB—ITB operates, battery is connected over its front contacts to the lower winding of relay 320 and also to relay 326 as described. The other end of the winding of relay 326 is, at the same time, connected in series with the upper winding of relay 226 in the recording trunk circuit by way of the bottom front contacts of relay 329, retardation coil 341, conductor 313, cord conductor 309, conductor 231 of the recording trunk, winding 212 of the recording trunk repeating coil, bottom back contacts of relay 223, upper winding of relay 226 to ground. Relay 226 operates over this circuit and locks over its lower winding in a circuit to ground on the top outer back contacts of relay 223 by way of the top contacts of relay 224 and its own bottom inner locking contacts. Relay 326, however, does not operate. Relay 320 in the outgoing trunk circuit also connects relay 327 to the sleeve of the trunk over the top front contacts of relay 320 so that the flashing recall circuits may be controlled by relay 327 in

any suitable manner. Relay 224 is operated at this time, it being held locally from the contacts of the recording trunk supervisory relay 241 as previously described. When relay 226 operates, a circuit is closed to the timing switch magnet 227 by ground on the top front contact of relay 226. The timing switch magnet starts the associated brush 242 to advance over terminals 1—6. When the timing switch wiper 242 reaches contact 1 of the arc, relay 220 operates over the switch brush 242 over a circuit from ground on the bottom middle front contacts of relay 226, normally made top middle back contacts of relay 223, wiper 242, contact 1, winding of relay 220 to battery. The operation of relay 220 connects the low resistance relay 219 to the bottom front contacts of relay 220 in parallel with the upper winding of relay 226 and this combined parallel circuit of relays 226 and 219 is connected to relay 326 in the outgoing trunk by way of the bottom contacts of relay 223, repeating coil winding 212, conductor 231, cord ring conductor 309, trunk ring conductor 313, retard coil 341, bottom front contacts of relay 329, winding of relay 326 to battery on contacts of relay 321. Relay 219, in parallel with relay 226, reduces the effective resistance in series with relay 326 so that relay 326 now operates. Relay 217 also operates from ground on the top front contacts of relay 220 through the front contacts of relay 219.

When relay 326 in the outgoing trunk operates, it connects slow speed interrupter 325 to relay 316 by way of the top outer front contacts of relay 326, top back contacts of relay 319, upper winding of relay 316 to battery on the top normally made contacts of relay 315, causing relay 316 to be operated during the grounded period of interrupter 325. Relay 316 energizes and closes its bottom inner grounded front contacts to both its own lower winding and also to lower winding of relay 315. Relay 316 also closes its top front contacts and connects grounded impulse interrupter 317, through resistance 318 to the grounded side of the winding of relay 326. During the interval when the grounded segment of interrupter 317 is connected to the winding relay 326, this ground is also connected to the windings of relays 219 and 226 in the recording trunk and short-circuits these relays. The circuit path is as follows: ground on interrupter 317, low resistance 318, top contacts of relay 316, bottom front contacts of relay 329, retard coil 341, trunk ring conductor 313, cord ring conductor 309, recording trunk ring conductor 231, repeating coil winding 212, lower back contacts of relay 223, upper winding of relay 226, to ground, and bottom front contacts of relay 220, winding relay 219 to ground. Relay 226 is held locked through its lower winding as previously described but relay 219 releases with each pulse of ground coming from interrupter 317 to perform a function to be described hereinafter. Relay 217 which holds operated over the front contact of relay 219 is a slow release relay and does not release during the pulse release of relay 219. Likewise, relay 220 is a slow release relay so as to hold operated over the terminals 1—5 of the timing arc of switch 227 over which brush 242 is advancing.

When interrupter 325 makes with an insulated segment and removes ground from the top outer front contacts of relay 326, relay 315, previously short-circuited over its lower winding by ground on the locking contacts of relay 316 and ground through the interrupter 325, now operates from ground on the aforementioned locking contacts of relay 316, lower winding of relay 315, upper winding of relay 316, to battery on the normally made top contacts of relay 315 and locks up on its upper winding from battery on its top front contacts, both windings in series to ground on the locking contacts of relay 316 and, in so doing, disconnects the battery from the upper winding of relay 316, causing this relay to hold only on its lower winding from ground on its locking contacts in series with battery through the upper winding of relay 315. When the interrupter 325 again connects ground to relay 316, it short-circuits its lower winding, causing it to release, but relay 315 will now hold over a local circuit from battery on its upper front contacts, upper winding to ground on the interrupter 325 and will continue to so hold until ground is removed by the operation of relay 319 as described hereinafter. During this cycle of counting operations of relays 316 and 315, interrupter 317 is connected to the ring conductors of the outgoing trunk, cord and recording trunk, as already described, and intermittently releases relay 219 of the timing circuit in the recording trunk as already described. During one complete revolution of interrupter 317 the timing relationship between interrupter 325, relays 315 and 316 is such that relay 316 is held operated for a length of time just sufficient for interrupter 317 to make one complete revolution. At each release of relay 219, a circuit for the register switch magnet 216 is closed from ground on the top front contacts of relay 220, back contacts of relay 219, front contacts of relay 217, winding of switch magnet 216, to battery. A parallel circuit is also closed to relay 214 which closes a supplementary ground to the switch magnet 216 so that the stepping of the switch is insured if relay 219 should reoperate before the switch magnet has operated sufficiently to break its interrupter contacts. The circuit controlled through the back contacts of relay 219 causes the switch to take as many steps as the intermittent release of relay 219 closes the back

contacts of this relay. The length of time, therefore, which the grounded and insulated segments of interrupter 325 allow for each cycle of operations of relays 315 and 316, and the number of grounded segments on the circumference of interrupter 317 determines the number of impulses sent by the interrupter 317, the number of times relay 219 is operated and released for the particular outgoing trunk which is transmitting the pulses and the consequent number of steps taken by switch 216. For outgoing trunks for which various charges are to be made, different interrupters 317 may be used while interrupter 325 can be common to all of the trunks. If it is desired to vary the charge at any time, this can be done by substituting for interrupter 317 any other interrupter having the required number of impulses for the new charge.

When relay 316 releases, relay 319 is operated by a circuit over the bottom back contacts of relay 316, bottom contacts of relay 315 to ground on inner front contacts of relay 326. Relay 319 locks to the same ground over its own top inner front contacts. The operation of relay 319 opens, at its top back contacts, the connection of interrupter 325 to relays 315 and 316 and prevents further reoperation of these relays after the described first cycle of operation of these relays has taken place.

When the first outgoing trunk has finished sending its impulses, relay 319 connects battery through resistance 344 over its bottom front contacts and top front contacts of relay 329 to the winding of relay 407 in the incoming trunk by way of winding 332 of the outgoing trunk repeating coil, conductor 342, winding 401 of the incoming trunk repeating coil, top back contacts of relay 405 to the winding of relay 407. Relay 426 again energizes over the circuit previously described and the ground on the inner front contacts of relay 426, back contacts of relay 411 to both windings of relay 410, short-circuits the bottom high resistance winding of relay 410. The relay corresponding to relay 326 in the succeeding outgoing trunk circuit OTC is connected to the ring conductor of the trunk and connecting cord to the preceding incoming trunk as relay 326 of the outgoing trunk OTB is connected to the ring conductor of trunk OTB, connecting cord and recording trunk, so that the upper winding of relay 410 of the incoming trunk ITB is in series with relay 326 of the outgoing trunk OTC over the following circuit: ground through the upper low resistance winding of relay 410, bottom back contacts of relay 405, retard coil 427, trunk ring conductor 420, cord ring conductor 509, ring conductor 513 of the outgoing trunk OTC, retard coil 341 of outgoing trunk OTC, bottom front contacts of relay 329 of the outgoing trunk OTC to winding of relay 326 of the outgoing trunk OTC. Relay 326 in the outgoing trunk OTC now operates to initiate impulses in the same manner as described for the outgoing trunk OTB and these pulses are now transmitted back to the recording trunk as follows:

Each time a ground is presented to conductor 313 of the succeeding outgoing trunk, such as OTC, by the interrupter 317 located therein, the upper winding of relay 410 in the preceding trunk is short-circuited, causing this relay to release and disconnect resistance battery 431 from conductor 343 connecting with the outgoing end of the trunk. This releases relay 321 which, in turn releases, relay 320. Since relay 219 in the recording trunk is held by battery through the front contacts of relay 321 in series with the winding of relay 326, the release of relay 321 will cause a corresponding release of relay 219. Relay 326 also releases, thereby releasing relay 319 by the removal of locking ground from the front contacts of relay 326. With each succeeding ground pulse the foregoing operation is repeated, causing relay 219 to be impulsed a corresponding number of times and register switch 216 in the recording trunk to be stepped again a number of times corresponding to the impulses transmitted from the succeeding trunk in the train. When the short-circuit from the last impulse is removed, relay 410 reoperates, reconnects battery through resistance 431 to the outgoing end of the trunk circuit, operating relay 321 which, in turn, reconnects battery through the winding of relay 326 in the first outgoing trunk to relay 219 in the recording trunk.

If another trunk were connected to the train beyond trunk OTC—ITC the operation of relay 319, in the trunk immediately preceding, at the completion of the pulsing cycle, would cause the operation of relay 407 in the incoming end of the same trunk, in the same manner as described for trunk OTB—ITB, the short-circuit of the high resistance winding of the associated relay 410 and the transmission thereafter of the signal to send pulses from the succeeding trunk by the operation of relay 326 therein. The transmission of pulses so started will then be the same as already described, namely, the intermittent short-circuiting of relay 410, its consequent release and the subsequent intermittent removal of battery on the ring conductor to the immediately preceding trunk; the signal being repeated until the first outgoing trunk is reached, in which the removal of battery from the ring conductor by the release of relay 321, effects the release of relay 219 in the recording trunk.

Referring now to the operations in the recording trunk which have taken place simultaneously with those described above, the op-

eration of pulsing relay 219 as many times as there are pulses to be transmitted from all the toll trunks in the train takes place before the timing switch brush wiper 242 leaves the group of terminals designated 1—5 of the timing arc. The time taken for switch 242 to arrive on terminal 6 represents the standard period of conversation, and the travel of the switch brush over the timing arc is regulated in any suitable manner by the operating company. When switch brush 242 leaves terminal 5, relay 220 releases in turn disconnecting relay 219 from conductor 231 so that relay 326 in the outgoing trunk releases, but relay 226 does not release since it is held locked over the path previously described. Timing switch magnet 227, therefore, will continue to be energized and advances the switch brush 242 to terminal 6 thereby measuring the time to that terminal as the standard conversation period.

When the conversation has terminated, and it is assumed in this case that it terminates before switch brush 242 reaches terminal 6, and the calling subscriber restores his receiver, relays 241 and 215 release. Relay 241, in turn, releases relay 224. Relay 224 releases relay 226. Interrupter 225 is now connected over the bottom outer back contacts of relay 226 and bottom contacts of relay 224 to operate relay 223 which locks over its top middle front contacts to off-normal ground on the contacts of the arc associated with brushes 234 and 235 respectively. Arcs associated with brushes 234, 236, 237 and 238 are associated with switch magnet 216, while arcs associated with brushes 235, 213, 239 and 240 are associated with switch magnet 218. The former of these two switches has been stepped by pulses under the control of relay 219 as previously described, while the latter is still in its normal position. Relay 221 is now intermittently operated over an interrupted circuit from ground on interrupter 233, brush 236 and associated arc contact, top outer back contacts of relay 222, top inner front contacts of relay 223, winding of relay 221 to battery. Relay 221 intermittently connects battery over its top front contacts and low resistance 200 to conductor 210 of the recording trunk, cooperating group selector brush 211, winding of relay 204 in the local group selector, to ground operating this relay. Each time relay 221 operates and connects battery to conductor 210, relay 204 operates and a battery through resistance 205 is then connected by this relay over the third wire of the first group selector to energize a relay 203 in the local line finder circuit which in turn energizes relay 202 over an obvious circuit. Relay 202 connects ground through resistance 243 to the third wire of the subscriber's line circuit to energize the subscriber's meter 201. The impulsing of relay 221 also steps switch 218 in a circuit from ground on the bottom contacts of relay 221, bottom back contacts of relay 222 to battery through the winding of switch 218 so that this switch takes one step for each impulse sent by the relay 221. It is evident, therefore, that each time the subscriber's meter 201 is operated, switch 218 takes one step.

When the brushes of switch 218 reach the same corresponding position on their respective arcs as those occupied by the brushes of switch 216, relay 222 is operated from ground on brush 237, the arc contact upon which it is standing, corresponding arc contact engaged by brush 239 of switch 218 to winding of relay 222. Relay 222 locks to ground on brush 238 and associated commoned arc contacts. Relay 222 disconnects switch magnet 218 at its bottom back contacts and opens the circuit of relay 221 at its top outer back contacts, thereby releasing this relay. The release of relay 221 opens the metering impulse circuit to relay 204. Relay 222 also closes a self-stepping circuit for switch 216 from ground on its top inner front contacts causing it to return to normal at which time the circuit for relay 222 is opened at the normal arc contact connecting with brush 238 and thereby causing switch 216 to stop. A parallel path is also closed to relay 214 during the returning to normal of switch 216, but since relay 217 is normal at this time the operation of relay 214 performs no useful function. A self-stepping circuit is now formed for switch 218 from ground on brush 237 of switch 216 and its normal arc contact, the off-normal commoned contacts and brush 240 of switch 218 causing switch 218 to return to normal. When switch 218 reaches normal the self-stepping circuit is disconnected by brush 240 engaging its normal contact on the associated arc and relay 223, which is also locked to off-normal arcs associated with brushes 234 and 235 now releases. The release of relay 223 removes ground from the top middle front contacts to conductor 209 which, when grounds from other parts of the circuit are removed, serves to keep the trunk busy as long as the registering circuit of the recording trunk is off-normal.

If the conversation extends beyond the predetermined interval of time as measured by the time taken for the timing switch brush 242 to reach terminal 6, relay 224 will not release and the above described operations will not take place. In this case relay 226 is still locked and the ground on its bottom middle front contacts is extended by way of the top middle normally made contacts of relay 223 to the switch brush 242, contact 6 of the timing arc and operates relay 228 over its lower winding. Interrupter 208 is now connected through upper winding of relay 228 and its locking contact, sleeve conductor 232 of the recording trunk jack, sleeve conductor 302, normally made outer left con-

tacts of key 305, lamp 303, resistance 338 to battery. Lamp 303 in the A operator's cord circuit is now flashed in a particular manner to apprise the operator that the maximum time for the connection has elapsed. Should the subscriber desire to talk for another period of time the conversation proceeds without any disturbance. The timing switch wiper 242 again engages contact 1 of the timing arc, relay 220 is operated and relays 219 and 226 are again placed in parallel to the ring conductor of the connection. Relay 321, being operated and relay 319 released, the charging impulse circuit in trunk OTB functions again and an additional set of impulses is registered by switch 216 in the manner previously described. Similar pulsing operations, followed by corresponding registration of the pulses by switch 216 then takes place with respect to all the trunks in the train in the manner described. When the subscriber restores the receiver, the operation of the subscriber's meter then takes place as previously described except that, in this case, the meter is operated in accordance with the total number of pulses recorded in the pulse recording circuit.

It will be noted that the present embodiment of the invention is disclosed with relation to two-way two-wire interoffice trunks so that the charging impulses must be transmitted in either direction depending upon which end of the trunk is used as the outgoing end. In the above description it has been assumed that the part of the trunk shown in Fig. 3 serves as the outgoing end of a trunk leading to office B while that part of the same trunk shown in Fig. 4 is the incoming end at office B. A consideration of the above figures, however, discloses that both ends of the trunk are perfectly symmetrical both with respect to the charging impulse equipment and also as regards switchboard signals so that the incoming end of the trunk may function as the outgoing end and vice versa. Thus the call may originate in office B, for example, for a subscriber in office A or beyond. The charging pulses would then have to be transmitted to a recording trunk in office B by the trunk shown in Fig. 4, now serving as an outgoing trunk, connecting with office A. For this purpose the impulse circuit shown by relays 423, 424, 422, 415 and interrupters 414 and 425 are used for the purpose and the operation of this combination is the same as has been described for the impulse circuit shown for the trunk in Fig. 4 which is used to transmit pulses in the opposite direction.

The release of the connection will now be described: When the calling subscriber restores the receiver, the recording trunk supervisory relay 241 releases and short-circuits the right hand high resistance winding of sleeve relay 229 thereby closing a circuit from ground on the back contacts of relay 241, left hand winding of relay 229, top back contacts of relay 228, sleeve conductor 232 of the trunk, sleeve conductor 302 of the cord, normally made left outer contacts of key 305, which is now normal, lamp 303, resistance 338, to battery, lighting said lamp continuously as an indiction to the A operator that the calling subscriber has restored. This signal is not repeated at this time to the B and C switchboards. When the called subscriber restores the usual sleeve supervisory circuit of the called subscriber's line causes the lighting of lamp 539 in the well known manner. The supervisory relay 528 of the C switchboard completing cord releases thereby removing high resistance battery 529 from the ring conductor 516. This has the effect of releasing relay 410 in the incoming trunk ITC. Battery through resistance 431 is therefore removed from the ring conductor 343 connecting the incoming trunk ITC with the outgoing trunk OTC. The removal of this battery from the ring conductor releases relay 321 which, in turn, releases relay 320. Since relay 329 is still energized to ground from relay 323, battery thru the winding of relay 326 is likewise removed from the ring conductor 313 between the outgoing trunk OTC and the incoming trunk ITB. Due to the release of relay 320, battery through resistance 344 is connected through the bottom back contacts of relay 320, top front contacts of relay 329, repeating coil winding 332, conductor 342, to relay 407 energizing this relay and thus keeping relay 413 operated, which otherwise would have released by the release of relay 410. The release of relay 320 in the outgoing trunk OTC connects the grounded lower winding of relay 331 to lamp 307 of the connecting cord circuit, via top back contacts of relay 320, trunk sleeve conductor 311, cord sleeve conductor 310, right outer normally made contacts of key 305, lamp 307, resistance 340 to battery. This will light lamp 307 steadily as an indication to the B operator that the called subscriber has restored. The removal of battery from the ring conductor of the trunk OTC and ITC causes the release of relay 410 in the incoming trunk ITB and the operations following the release of this relay in trunk OTB—ITB are identical with those described above in connection with the trunk OTC—ITC so that lamp 307 at the A operator's position is likewise made to light steadily. It will be noted, therefore, that while the release of the calling subscriber operates the calling subscriber's supervisory lamp at the A board, such a signal is not repeated at the intermediate and terminating boards, yet the release of the called subscriber, not only operates the called supervisory signal of the completing cord in the terminating office, but also causes the re-

lease signal to be repeated back to all the switchboards over the ring conductors of the connection train to light the called supervisory lamps of the respective cords at all intermediate switchboard positions as well as at the originating position.

Both lamps 303 and 306 in the A operator's cord circuit are now lighted and the operator will remove the cord. The removal of battery through the lamp 307 from sleeve conductor 311 causes relays 323, 329, 331 and 327 to release. Relays 407 and 413 in the incoming trunk release and in consequence relay 430 now operates over its grounded lower winding, back contacts of relay 413, sleeve conductor 421 of the trunk jack and sleeve conductor 502 of the cord, normally made left outer contacts of key 505, lamp 503, resistance 524 to battery. Lamp 503 in the B operator's cord circuit lights steadily. Relay 405 now operates from ground on the top front contacts of relay 430 while relay 409 is held locked through its inner front contacts to ground on the bottom middle contacts of relay 430. Relay 330 now operates from battery through resistance 431, through the bottom back contacts of relay 429, top front contacts of relay 405, winding 401 of the incoming trunk repeating coil, conductor 342, winding 332 of the outgoing trunk repeating coil, top back contacts of relay 329, winding of relay 330 to ground. Relay 330 operates relay 322 over its upper winding. This operation serves to maintain an open circuit busy test on the outgoing end of the trunk until the B operator removes the cord. When the B operator removes her cord circuit relays 330, 322, 430, 405 and 409 release. Lamp 501 in the C operator's cord circuit will be lighted in the same manner causing her to release the connection in turn.

What is claimed is:

1. In a telephone exchange system, a calling line, a charging device for said calling line, a called line, a local trunk, a pulse recording circuit in said local trunk, a plurality of interoffice trunks, a pulsing circuit in each of said interoffice trunks capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive to said latter means, means in said local trunk responsive to said means in each of said interoffice trunks, means in one of said interoffice trunks connected to said local trunk responsive to said means in said local trunk for starting said pulsing circuit in said interoffice trunk to generate its said definite number of pulses, means in each of said interoffice trunks responsive to the termination of operation of said pulsing circuit in said interoffice trunk connected to said local trunk to start said pulsing circuit in each of said interoffice trunks in succession to generate their respective number of pulses, means in each of said interoffice trunks responsive to pulses from that one of said interoffice trunks immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, and means in said local trunk, under control of said pulse recording circuit, for operating said charging device a number of times in accordance with the number of all of said pulses recorded in said pulse recording circuit.

2. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, an interoffice trunk, a pulsing circuit in said interoffice trunk capable of generating a definite number of pulses, means for extending said calling line to said called line over said local trunk and said interoffice trunk, means in said interoffice trunk responsive to said called line, means in said local trunk responsive to said means in said interoffice trunk, means in said interoffice trunk responsive to said means in said local trunk for starting said impulse circuit to generate said definite group of pulses, means in said local trunk responsive to said pulses, means for recording said pulses in said pulse recording circuit, and means in said local trunk under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of all of said pulses recorded in said pulse recording circuit.

3. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulsing circuit in said local trunk capable of generating a definite number of pulses, a pulse recording circuit in said local trunk, means for extending said calling line to said called line over said local trunk, means in said local trunk responsive to said called line for starting said pulsing circuit to generate said group of pulses, means in said local trunk responsive to said pulses for recording said pulses in said pulse recording circuit, and means in said local trunk responsive to said calling subscriber and under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of all said pulses recorded in said impulse storing circuit.

4. In a telephone exchange system, a calling line, a called line, a local trunk, a pulse recording circuit in said local trunk, a plurality of interoffice trunks, a pulsing circuit

in each of said interoffice trunks capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive to said means in said link circuit means in said local trunk responsive to said means in each of said interoffice trunks, means in one of said interoffice trunks connected to said local trunk responsive to said means in said local trunk for starting said pulsing circuit in said interoffice trunk to generate its said definite number of pulses, means in each of said interoffice trunks responsive to termination of operation of said pulsing circuit in said interoffice trunk connected to said local trunk to start said pulsing circuit in each of said interoffice trunks in succession to generate their respective said definite number of pulses, means in each of said interoffice trunks responsive to pulses from that one of said interoffice trunks immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, and means in said local trunk, responsive to restoration of said calling line and under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of all said pulses recorded in said pulse recording circuit.

5. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a plurality of interoffice trunks, a pulsing circuit in each of said interoffice trunks capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive successively to said means in said link circuit, means in said local trunk responsive to said means in each of said interoffice trunks, means in one of said interoffice trunks connected to said local trunk responsive to said means in said local trunk for starting said pulsing circuit in said interoffice trunk to generate its said definite number of pulses, means in each of said interoffice trunks responsive to the termination of operation of pulsing circuit in said interoffice trunk connected to said local trunk to start said pulsing circuit in each of said interoffice trunks in succession to generate their respective number of pulses, means in each of said interoffice trunks responsive to pulses from said interoffice trunk immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, and means in said local trunk responsive to restoration of said calling line and under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of all said pulses recorded in said pulse recording circuit.

6. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, an interoffice trunk, a pulsing circuit in said interoffice trunk capable of generating a definite number of pulses, means for extending said calling line to said called line over said local trunk and said interoffice trunk, means in said interoffice trunk responsive to said called line, means in said local trunk responsive to said means in said interoffice trunk, means in said interoffice trunk responsive to said means in said local trunk for starting said pulsing circuit to generate said definite number of pulses, means in said local trunk responsive to said pulses for recording said number of pulses in said recording circuit, and means in said local trunk responsive to restoration of said calling line and under control of said pulse recording circuit for operating said charging device a number of times in accordance with the number of all said pulses recorded in said local trunk.

7. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a plurality of two-way interoffice trunks, two pulsing circuits in each of said interoffice trunks each capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive successively to said means in said link circuit, means in said local trunk responsive to said means in said interoffice trunks, means in one of said interoffice trunks connected to said local trunk responsive to said means in said local trunk to start one of said pulsing circuits in said interoffice trunk depending on the direction of said connection, to generate its definite number of pulses, means in each of said interoffice trunks responsive to termination of operation of said pulsing circuit in said interoffice trunk connected to said local trunk to start said corresponding pulsing circuits in each of said interoffice trunks in succession to generate their respective said definite num-

ber of pulses, means in each of said interoffice trunks responsive to pulses from that one of said interoffice trunks immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, and means in said local trunk responsive to restoration of said calling line and under control of said pulse recording circuit for operating said charging device a number of times in accordance with the number of all of said pulses recorded in said pulse recording circuit.

8. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a two-way interoffice trunk, two pulsing circuits in said interoffice trunk each capable of generating a definite number of impulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, said interoffice trunk and said link circuit in the order named, means in said link circuit responsive to said called line, means in said interoffice trunk responsive to said means in said link circuit, means in said local trunk responsive to said means in said interoffice trunk, means in said interoffice trunk responsive to said means in said local trunk for starting one of said pulsing circuits in said interoffice trunk depending upon the direction of said connection to generate its definite number of pulses, means in said local trunk responsive to said pulses for recording all of said pulses in said pulse recording circuit, and means in said local trunk responsive to restoration of said calling line and under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of said pulses recorded in said pulse recording circuit.

9. In a telephone exchange system a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a timing circuit in said local trunk, a plurality of interoffice trunks, a pulsing circuit in each of said interoffice trunks capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive to said means in said link circuit, means in said local trunk responsive to said means in each of said interoffice trunks for operating said timing circuit, a predetermined time interval, means in said interoffice trunk connected to said local trunk also responsive to said means in said local trunk for starting said pulsing circuit to generate said definite group of pulses, means in each of said interoffice trunks responsive to termination of operation of pulsing circuit in said interoffice trunk connected to said local trunk to start said pulsing circuit in each of said interoffice trunks in succession to generate their respective definite group of pulses, means in each of said interoffice trunks responsive to pulses from that one of said interoffice trunks immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, means responsive to said calling line after expiration of said predetermined time interval for generating another series of said definite number of pulses, and for recording said other series of pulses in said pulse recording circuit, and means in said local trunk under control of said pulse recording circuit for operating said charging device a number of times in accordance with number of all of said pulses recorded in said pulse recording circuit.

10. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a timing circuit in said local trunk, an interoffice trunk, a pulsing circuit in said interoffice trunk capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, said interoffice trunk and said link circuit in the order named, means in said link circuit responsive to said called line, means in said interoffice trunk responsive to said means in said link circuit, means in said local trunk responsive to said means in said interoffice trunk to start said timing circuit to measure a predetermined time interval, means in said interoffice trunk also responsive to said means in said local trunk for starting said pulsing circuit to generate said definite group of pulses, means in said local trunk responsive to said pulses for recording all of said pulses in said pulse recording circuit, means responsive to said calling line after expiration of said predetermined time interval for generating another series of said definite number of pulses, and for recording said other series of pulses in said pulse recording circuit, and means in said local trunk under control of said pulse recording circuit for operating said charging device a number of times in accordance with a number of all of said pulses recorded in said pulse recording circuit.

11. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a local trunk, a pulse recording circuit in said local trunk, a timing circuit in said local trunk, a plurality of two-

way interoffice trunks, two pulsing circuits in each of said interoffice trunks each capable of generating a definite number of pulses, a link circuit, means for establishing a connection between said calling line and said called line over said local trunk, each of said interoffice trunks and said link circuit in the order named, means in said link circuit responsive to said called line, means in each of said interoffice trunks responsive to said means in said link circuit, means in said local trunk responsive to said means in said interoffice trunks for starting said timing circuit to measure a predetermined time interval, means in said interoffice trunk connected to said local trunk also responsive to said means in said local trunk to start one of said two pulsing circuits in said interoffice trunk depending on the direction of said connection, to generate its definite number of pulses, means in each of said interoffice trunks responsive to termination of operation of said pulsing circuit in said interoffice trunk connected to said local trunk to start said corresponding pulsing circuit in each of said interoffice trunks in succession to generate their respective number of pulses, means in each of said interoffice trunks responsive to pulses from that one of said interoffice trunks immediately succeeding in said connection, means in said local trunk responsive to pulses from said interoffice trunk immediately connected therewith for recording all of said pulses in said pulse recording circuit, means responsive to said calling line after the expiration of said predetermined time interval for generating another series of said definite number of pulses, and for recording said other series of pulses in said pulse recording circuit, and means in said local trunk under control of said pulses recording circuit for operating said charging device a number of times in accordance with number of all of said pulses recorded in said pulse recording circuit.

12. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a calling cord circuit, an interoffice trunk, a terminating cord circuit, a pulsing circuit in said interoffice trunk capable of generating a definite number of pulses, means for extending said calling line to said called line over said cord circuits and said interoffice trunk, means in said terminating cord circuit responsive to said called line, means in said interoffice trunk responsive to said means in said latter cord circuit for starting said pulsing circuit to generate said group of impulses, and means for operating said charging device a number of times in accordance with number of said pulses.

13. In a telephone exchange system, a calling line, a called line, a call charging device for said calling line, a first local cord circuit having a supervisory lamp, a second local cord circuit, a timing circuit in said first local cord circuit, an interoffice trunk, a pulsing circuit in said interoffice trunk capable of generating a definite number of pulses, means for extending said calling line to said called line over said first local cord circuit, said interoffice trunk and said second local cord circuit, means in said second local cord circuit responsive to said called line, means in said interoffice trunk responsive to said means in said second local cord circuit, means in said first local cord circuit responsive to said means in said interoffice trunk for starting said timing circuit, to measure a predetermined time interval, means in said interoffice trunk also responsive to said means in said first local cord circuit for starting said pulsing circuit to generate said definite number of pulses, means for operating said charging device a number of times in accordance with the number of all of said pulses, means in said timing circuit for operating said supervisory lamp after the expiration of said predetermined time interval, and means responsive to said calling line after the expiration of said predetermined time interval for generating another series of said definite number of pulses and operating said charging device a number of times in accordance with the number of pulses in said other series of pulses.

14. In a telephone exchange system, a calling line, a called line, a local trunk, a timing circuit in said local trunk, an interoffice trunk, a cord circuit having a supervisory lamp, means for extending said calling line to said called line over said local trunk, said cord circuit and said interoffice trunk, means in said interoffice trunk responsive to said called line, means in said local trunk responsive to said means in said interoffice trunk for starting said timing circuit, and means in said timing circuit for intermittently operating said supervisory lamp in said cord circuit after the expiration of a predetermined time interval.

In witness whereof, I hereunto subscribe my name this 26th day of May, 1930.

PONTUS H. HELLNER.