

March 14, 1933.

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1,900,969

AUTOMATIC OR SEMIAUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1931

2 Sheets-Sheet 1

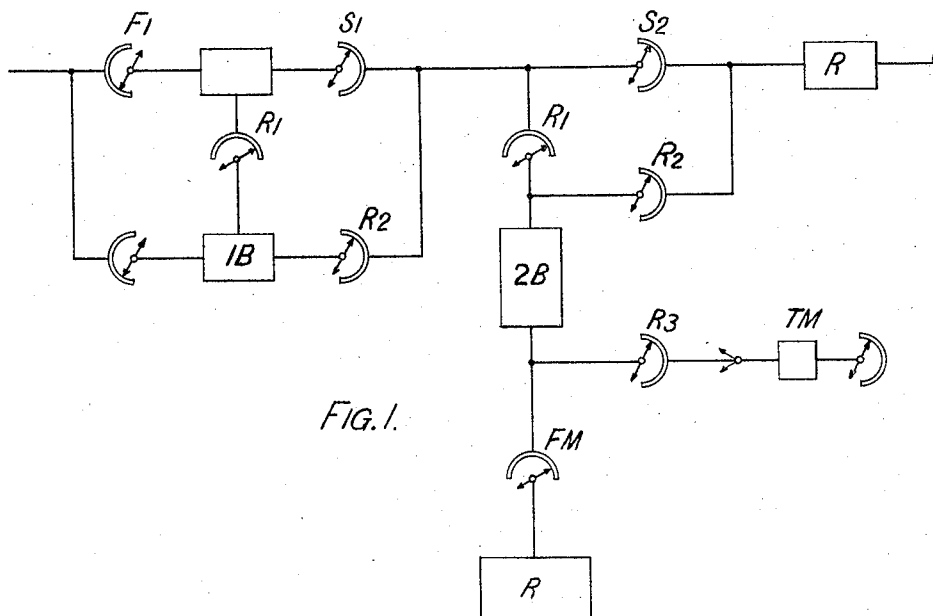


FIG. 1.

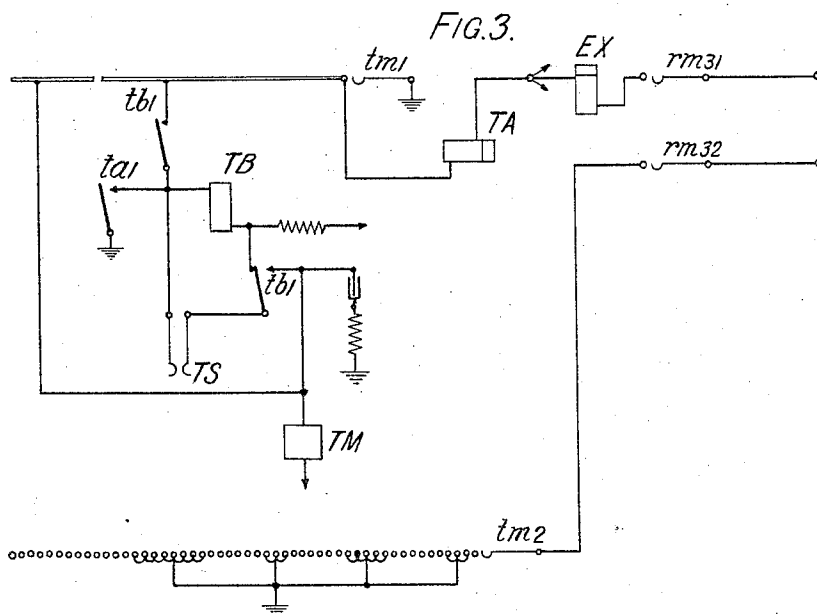


FIG. 3.

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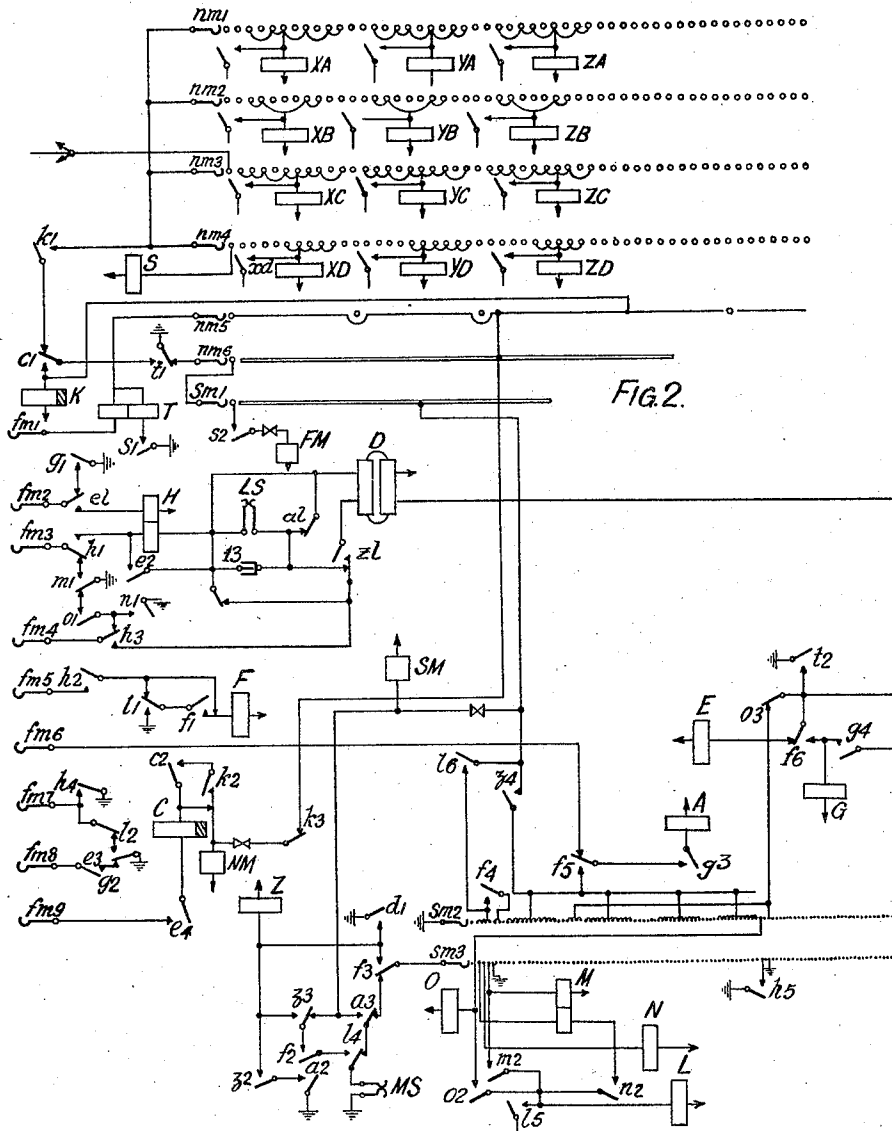
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AUTOMATIC OR SEMIAUTOMATIC TELEPHONE EXCHANGE SYSTEM

Application filed April 23, 1931, Serial No. 532,223, and in Great Britain May 13, 1930.

This invention relates to automatic or semi-automatic telephone systems and more particularly to arrangements adapted to be used for controlling the setting up of calls in networks comprising a number of exchanges.

In known arrangements, a so-called register translator is used which is set in accordance with the value of code digits dialled and transmits routing digits which may differ in number and value from those received.

In such arrangements, a number of proposals have been made to provide translating devices common to a number of register-translators instead of individual to each register-translator. Such arrangements have not come into practical use, due to certain operating drawbacks which are encountered therein.

We have previously proposed, in our U. S. application Ser. No. 506,884, filed Jan. 6, 1931, novel arrangements whereby these drawbacks are considerably overcome, and further progress has been made in the present invention in which it is thought that the difficulties encountered are practically obviated.

According to the main feature of the invention, a register sender comprises an impulse sending device which is adapted to transmit trains of impulses under direct control of a device common to a plurality of register senders.

Further features of the invention will be apparent from the following description of one embodiment of the invention and will be set out in the appended statement of claims.

Figure 1 of the accompanying drawings shows the relevant portion of a telephone system embodying the principles of this invention. The first stage is connected to a calling subscriber by means of a line finder such as F and the first path switch S1 is set under control of the first bye-path 1B which stores the first digit dialled by the subscriber. The second path switch S2 is set under control of the second bye-path 2B which stores the second and third digits in the manner set forth in our prior U. S. application Ser. No. 506,884. The second path S2 may either give access to other switches in the same office, or alternatively, to repeaters connected with

junctions to other offices. The second bye-path comprises three switches: R1 which helps to control the switch R3 as explained subsequently and is also a means of association between the second bye-path 2B and the second stage path S2: the bye-path switch R2 which searches for a free outlet and is subsequently replaced by the path switch S2: and the switch R3 which stores the second dialled digit under the control of the switch R1 and the third digit direct, bringing its wipers in consequence to a numerical position corresponding with the second and third digits. Over the wipers of the R3 switch connection is made with one of a plurality of translator switches TM common to the exchange. In the system described in our before-mentioned U. S. application Ser. No. 506,884, certain of the calls only were handled by the registers and the present invention concerns only those calls which are handled by a register. The register R is associated with the second bye-path 2B by means of the associating switch FM. When the register is taken into use the code digits have already been stored and the numerical digits are relayed from the second code bye-path to the register where they are stored. The register performs no function other than storing and transmitting the numerical digits and if necessary controlling zone-metering. The second bye-path 2B chooses a suitable outlet under the control of the code digits stored and sends a signal to the register as an indication that code sending may commence. The sending device in the register comprises a pair of loop interrupter springs which are opened and closed mechanically and which are controlled by sending control relay springs normally short circuiting the interrupter springs. The sending control relay is controlled from the translator over the wipers of the switches FM and R3 in accordance with the desired translation. When all the translation has been completed the numerical digits are sent from the register exactly as received. Certain supervisory signals particular to the office code called as, for example, special metering conditions are

signalled from the translator to the register before the code sending commences.

The translator switch TM comprises, in general, a ten wiper 50 point switch with 5 controlling relays. Nine of the wipers are particular to exchanges and the bank contacts are suitably wired to give the correct translation. The translator switch makes one complete operation for every call to be translated 10 although it is possible for a plurality of translations to be sent simultaneously from the same translator switch. The translator relays operate to prevent the register sending a mutilated portion of a translation due to 15 the translator switch already being in operation at the time when the connection to the register is established. On this account, it will be appreciated that the code sending does not necessarily commence immediately a suitable outlet has been found, but as the majority of the calls will not need to use a register at all the occasional delay will not result in any material delay to the subscriber.

According to one feature of the invention, 25 the interdigital delay period for the code digits is controlled from the translator switch. If the translation does not require the use of the full 50 contacts on the translator switch the remaining terminals will be 30 passed over by the switch right through its own interrupter and under the control of the tenth wiper. If the translation requires more than 50 positions the translator switch can be arranged as a five wiper 100 point 35 switch in which case provision will be made for four exchange wipers, the fifth wiper being used for controlling purposes. The operation of the second bye-path 2B forms no portion of the invention and is not described. The translator switches are operated from impulse springs which are in phase with the magnet and loop springs of all the 40 registers.

Referring now to the remainder of the accompanying drawings.

Figure 2 represents the register circuit. The switch FM is the finder associating the register with the second bye-path. The switch NM controls the storage of the numerical digits and the switch SM controls the 50 sending of numerical digits.

Figure 3 shows a portion of the translator switch, one exchange wiper TM2 only being shown and two levels of the R3 switch 55 of the second bye-path. It will be understood that there are eight other exchange wipers TM3—TM10.

Turning now to Figure 2, the detailed operation for an interexchange call will be 60 described.

The second code bye-path in response to the second and third code digits selects a direct or tandem junction as required in the manner disclosed in our U. S. application No. 65 506,884 and also selects the required trans-

lator switch and the correct wiper thereon as indicated in Figure 3.

When the second code requires a register a ground is connected to the start wire which is extended through wipers NM3, NM4 to the start relay S. Relay S completes the driving circuit for the finder magnet FM through its interrupter springs, contacts s2, home position wiper sm1 the home position of wiper nm6 to ground at t1. Contacts s1 prepare 70 the circuit of the testing relay T to wiper fm1. The calling second code will be characterized by a battery potential on its test contact which will cause the operation of relay T. The operation of contacts t1 short-circuits the high resistance winding of the relay T which remains operated on its low resistance winding to the test battery. Relay T completes the circuit for relay E 75 through contacts t2 and o3. Relay E connects ground through contacts e3, t2 to the wiper fm7 to hold the second bye-path, contacts e2 place a short circuit on one winding of the relay H. Contacts e1 prepare an operating circuit for the relay H via wiper fm2. 80 The numerical digits are stored via switch NM on relay sets such as XA—XD in a manner described later. When the second bye-path has found a free outlet ground is connected to a bank terminal associated with the wiper fm2 causing the operation of relay 85 H. Contacts h4 maintain the ground on the wiper fm7 and contacts h2 connect the relay F to the wiper FM5. If the translator switch is in its home position relay F will operate via wiper fm5 and a wiper rm31, Fig. 3 of the switch R3, in the second code, relays EX and TA, the home contact and wiper tm1 to ground. If the translator switch is not in its home position the circuit for relay F will be delayed until the switch returns home. Relay F in operating closes a circuit for the relay G through contacts f6 and t2; relay G locks through contacts g4. 90 Contacts g3 prepare the circuit for the relay A which is not at present operated. The operation of relay TA in the translator Fig. 3 prepares a circuit for the relay TB, which is, however, short-circuited by the magnet springs TS and in consequence relay TB does not operate unless the springs TS are open. 95 When the relay TB operates the circuit is completed for the magnet TM through contacts tb2, interrupter springs TS, and the contacts ta1 to ground causing the switch TM to step. At the completion of its first step the wiper tm1 completes a locking circuit for the relay TB through contacts tb1 and the ground is removed from the relay TA causing that relay and the relay F in the register to release. With relay G operated and relay F released relay A in the register is connected via g3, f5 to the wiper fm6 in a circuit which is extended through wiper rm32 Fig. 3 of the second bye-path to the wiper tm2 of the 100 105 110 115 120 125 130

translator. This wiper will be connected to ground for a number of steps determined by the translation and during the period when ground is connected to the wiper *tm2* the relay A in the register will be held operated the wipers of switch TM being of the bridging type. The operation of relay A closes a circuit for the sender magnet SM through contacts *a3*, *l4* and the magnet interrupter springs MS to ground causing the switch SM to take one step for each of the preliminary positions grounded for the wiper *tm2*. Loop springs LS are at present short-circuited at *l3*. As has already been pointed out the magnet springs TS and MS open and close at the same time. When the ground is removed from the wiper *tm2* the relay A releases and a circuit is completed from ground, contacts MS, *l4*, *a3*, *f3* to the wiper *sm3*. If the switch SM has taken only one step the wiper *sm3* will be connected to the relay O. If it has taken two steps connection will be made with the relays M and N in series. For three steps the relay N alone and four steps the relay M alone. The operation of relays M or N or M and N together represent the metering conditions to be applied to the message register if the call is connected successfully. The operation of relay M or N will cause the operation of the relay L through contacts *m2* or *n2*, contacts *l5* and *f2* providing a lock to maintain the relays operated. The relay O signifies that the call is to be extended to an operator and that there will be no numerical portion to be received or sent. Relay O will also cause the operation of relay L through contacts *o2*. It is assumed that all calls to an operator will require only single fee metering and in consequence the operation of relay O is equivalent to the operation of the relay N but it will be understood that arrangements could be made without departing from the spirit of the invention to cause any combination of the metering relays to be operated for different operator calls. The relay L in operating provides a driving circuit for magnet SM through its interrupter springs, contacts *l6*, bank contact and wiper *sm2* to ground, causing the switch to advance to position 6 in which position ground is connected to the wiper *sm3*. Contacts *l3* remove a short-circuit from across the loop springs LS which remain short-circuited, however by springs *a1*. Meanwhile, the translator switch TM continues stepping and after passing over a number of blank terminals provided to produce a delay, the wiper *tm2* comes into contact with a number of bank terminals which are grounded in accordance with the first translated digit. Relay A is re-operated as already described and as the loop springs LS in the register will open once in each of these grounded positions an impulse will be sent out to line in a loop through wipers *fm3*, *h1*, *e2*, LS, *a1*, *h3*, to wiper *fm4*. At the end of the digit A releases to stop impulse sending but the switch TM continues stepping over another series of bank contacts which provide a period for switch hunting and subsequently make contact with the grounded terminals representing the second translated digit. Relay A re-operates causing a corresponding series of impulses to be sent out to line. If the code is to be translated to three digits the switch TM will pass over a third set of blank terminals and subsequently make connection with a third set of grounded terminals representing the third translated digit. When all the grounded sets of terminals in bank *tm2* have been passed the locking circuit for the relay TB will be opened due to wiper *tm1* passing from one off-normal arc to the other and a driving circuit is completed for the switch TM through its interrupter springs, bank contact and wiper *tm1* to ground causing the translator switch to return to its home position. In the home position ground will again be extended through wiper *rm31* and *fm5* to the relay F which will lock up via contacts *f1* to ground at *l1*. It should be understood here that relay F is quick operating whereas the relay TA in the translator is slow to operate and because the relay F, in operating cuts itself off from the relay TA the latter will not operate in series with relay F if the relay L is already operated. The re-operation of relay F causes the operation of relay Z through contacts *f3*, wiper *sm3* and bank contact to ground. The circuit for the magnet SM is now re-established through its interrupter springs, contacts *l6*, *f4*, bank contact and wiper *sm2* to ground causing the switch to advance to position 8. The operation of relay Z inserts the relay D into a forward loop from wiper *fm3*, contacts *h1*, *e2*, winding of relay D, *a1*, *h3*, wiper *fm4*. If, for any reason, sending is to be delayed, the battery feed will be reversed, relay D which is of the polarized type, is operated and closes a locking circuit for Z at *d1*. When the sending may be restarted the direction of the current in the loop is changed causing relay D to release thereby removing the ground at contacts *d1*. Relay Z will remain operated, however, if the magnet springs SM are closed by virtue of the ground through contacts *l4*, *f2*, *a3* but the relay Z will fall back when the springs SM open. When the magnet springs re-close a ground will be extended to the magnet SM through contacts *l4*, *f2*, and *a3* causing the switch to step. Having made one step and reached position 9 a circuit is completed for the relay A through contacts *g3*, *f5*, bank contact and wiper *sm2* to ground. Contacts *a1* open the short-circuit from across the loop springs LS, causing an impulse to be sent to line for each step taken by the switch SM.

The storage relays XA, XB, XC, XD, YA—YD and ZA—ZD have been operated in the following manner—

The lead from the second bye-path is extended through wiper *fm9*, contacts *e4*, winding of relay C contacts *k2*, to the numerical magnet NM causing the numerical switch to take a number of steps corresponding to the thousands digit. The relay C is of the slow releasing type and remains operated during the train of impulses. Contacts *c1* close a circuit via *c1*, *t1* for the relay K which is also of the slow to release type. At the end of the series of impulses relay C falls back and a circuit is established through contacts *t1*, *c1* and *k1* to the wipers *nm1*, *nm2*, *nm3*, *nm4*, causing the operation of a combination of the relays XA, XB, XC, XD, which will be locked up over a circuit which is not shown. When the relay K releases the switch NM is driven to position 12 through its interrupter springs, contacts *k3*, the bank contact and wiper *nm5* to ground at *t1*. The hundreds digit will be stored on the relays YA—YD in known manner and the tens digits on the relay ZA—ZD. The units digit will be stored by the switch NM and in this case the relay K will be maintained operated through the bank contacts of wiper *nm5* to ground at *t1*. The maintained operation of the relay K after the relay C has released prevents impulsing subsequent to the units digit by means of contacts *c2* and *k2*. The contacts of the relays XA—XD, etc., will be wired in a well known manner to the bank contacts of the wiper *sm3* to cause ground potential to be connected so that the relay Z will be operated after a definite number of steps depending upon the impulses stored. When the relay Z operates the loop springs are short-circuited by the springs *z1* and the sender switch runs forward through its interrupter springs and contacts *Z4*, bank contact and wiper *sm2* to ground until it reaches the home position prior to the home position for sending the hundreds digit. Relay A is also maintained operated until the new home position is found and relay Z will be maintained through contacts *z2* and *a2* so long as the A relay is operated and furthermore it will be maintained if the magnet springs MS are closed or it will be maintained by a connection in the home position for the 100's digit by ground potential connected thereto if all the relays YA, YC and YD are normal, thus indicating that the hundreds digit has not yet been dialled. When the relay Z eventually releases a stepping circuit for the magnet SM is re-established through the contacts *z3*, *f2*, *l4*, MS to ground. The switch passes over a number of dead terminals to provide an interdigital period and subsequently causes the re-operation of relay A causing the impulses to again be sent out to

line. Relay Z will be operated as before by contacts of the relay YA—YD and in a similar way the tens digit will be sent out under the control of relays ZA—ZD. The units digits will be sent out in similar manner, the relay Z being operated in this case by direct strapping between the bank contact associated with the wiper *nm4* and the bank contact associated with the wiper *sm3*. When the units digit has been sent relay O will be operated through bank contact and wiper *sm2* to ground. At the same time, the relay Z will be operated through *f3*, *sm3* from ground at *h5*. The operation of relay O opens the circuit of the relay E, relay F being already operated. Relay E removes at contacts *e2* the short circuit across the winding of relay H, which will remain operated so long as it receives a loop fed back. Contacts *e1* open the operating circuit of relay H connecting the wiper *fm2* to ground through contacts *g1* for the purpose of holding the second code circuit operated. Contacts *e3* extend ground through contacts *g2* to the wiper *fm8* which causes the operation of the switching relay in the second path thereby extending the calling subscriber's loop to the outgoing repeater and causing the removal thereby of the current passing through the second winding of the relay H. When the relay H releases contacts *h1* and *h3* connect the positive and/or negative lines to ground as determined by the metering relays M, N and O. The removal of ground by contacts *h4* causes the release of certain relays in the second bye-path in preparation for the general release. The removal of ground from contacts *h5* opens the circuit of relay Z thereby closing a stepping circuit from the magnet SM through contacts *z3*, *f2*, *l4*, MS to ground. The switch SM will take two steps before the relay Z re-operates and this period of time is sufficient for the operation of the metering relays in the repeater. The relay E is now re-operated through bank contact and wiper *sm2* to ground causing the removal of ground from the wiper *fm2* thereby causing a complete release of the second code which in turn removes battery from the wiper *fm1*, causing the release of the relay T in the register which now returns home. If the call was to be routed to an operator and there were no numerical digits to be sent relay O would have been operated as already described before the sending was commenced and when relay F operated at the end of code sending the circuit for relay E would have been opened, causing the release to take place as already described. The period for the release of relay H and metering being provided, by the time taken for the sender switch to advance from position 8 to position 21 where the circuit for the relay E will be re-established through the bank contact and

wiper *sm*2; this circuit for relay E will be maintained in positions 23, 24 and 25 in order to ensure the release of the relays.

A relay EX is provided individual to each exchange, and is operated in series with TA to record the call on a traffic meter.

What is claimed is:

1. In a telephone system the combination of a register sender comprising an impulse receiving device and an impulse sending device, a switching device common to a plurality of said register senders adapted to be set in accordance with code digits transmitted thereto and means whereby said sending device is adapted to transmit trains of impulses under direct control of said switching device and said impulse receiving device.

2. In a telephone system wherein subscribers numbers include code digits and numerical digits, the combination of a register sender, apparatus common to a plurality of said register senders for receiving said code digits, storage means in said register sender for receiving and recording said numerical digits, and sending means in said register sender operative under the control of said apparatus and of said storage means to transmit impulses to control the setting up of a connection in accordance with the value of both routing and numerical digits.

3. In an automatic telephone exchange forming part of an exchange network, the combination of means for registering routing digits, translating devices arranged to determine the translated digits to be transmitted for one of the exchanges in the network said translating devices being associated in common with a plurality of said registering means, means whereby said registering means is adapted to select in accordance with its setting the required translating device and a sending device operatively connected with said translating device and adapted to transmit impulses under the control thereof.

4. In a telephone exchange system, the combination of conversation circuits, exchange code digit registers associated in common with a plurality of said conversation circuits, translating devices associated in common with a plurality of exchange code digit registers and adapted to determine the routing digits to be transmitted for one exchange in the network, register senders associated in common with a plurality of code digit registers and means for transmitting impulses from said register senders under control of said translating devices.

5. In a telephone exchange forming part of a network, the combination of a digit controlling switch, a plurality of levels in said switch, an impulse sending device, means for operatively associating said impulse sending

device with a selected level of said digit controlling switch whereby the transmission of routing digits by said impulse sending device is controlled from said level, and relay means operable under the control of the selected level of said digit controlling switch for determining the metering tariff to be charged for a call so transmitted.

6. In an automatic telephone system the combination of a plurality of impulse sending devices, a digit controlling switch common to said devices, a plurality of levels in said controlling switch each of said levels being wired to represent translated routing digits individual to a particular wanted exchange, means for associating any of said impulse sending devices with a selected level of said controlling switch and means for operating the impulse sending device in synchronism with the stepping of said control switch when so associated, to transmit said translated routing digits.

7. In a telephone exchange forming part of a network in which inter-exchange calls are set up under control of code and numerical digits, the combination of register senders, a translated routing digit controlling device associated in common with a plurality of said register senders, means for operatively connecting said controlling device with one of said register senders to control the transmission of said translated routing digits and means in said controlling device to effect release of said register sender when routing digits only are to be sent by the register sender.

8. In a telephone exchange system, the combination of conversational switches, control circuits associated with the conversation switches, translating switches each associated in common with a plurality of said control circuits and each comprising a plurality of wipers each of which is adapted to control the transmission of the translated routing digits for setting up a particular inter-exchange call, register-senders each of which is associated in common with a plurality of said control circuits, registering means in said control circuits operative to select a particular wiper of a particular translating switch in response to one or more code digits, and impulse-sending means in said register-senders operative to transmit translated routing digits under direct control of said translating switch.

9. In a telephone system, the combination of a selecting stage comprising a selecting switch and control circuits, outgoing junction lines and local lines terminating in said selecting switch, a registering means in said control circuit, means to record code digits on said registering means, means for operating said selecting switch under control of said registering means to select an outgoing junction line, a routing-digit control device indi-

vidual to the wanted exchange, means for operatively connecting said device with said registering means, and a sending device operative under control of said routing-digit control device to transmit routing digits over said outgoing junction.

10. In a telephone system, the combination of a selecting stage comprising a selecting switch and control circuits, outgoing junction lines and local lines terminating in said selecting switch, a registering means comprising a single motion switch adapted to record two code digits under supervision of a control circuit, means for operating said selecting switch under control of said registering means to select an outgoing junction line, a routing digit control switch the wiper of which is connected to a single bank of said registering switch, means for operatively connecting said device with said registering means, and a sending device operative under control of said routing-digit control device to transmit routing digits over said outgoing junction.

11. In an automatic telephone system the combination of a plurality of impulse sending devices, a single motion digit control switch common to said devices, a plurality of levels in said control switch each level comprising a plurality of groups of linked contacts separated by a plurality of independent contacts whereby the digits to be transmitted and the inter-digital periods are determined, means for associating any of said impulse sending devices with a selected level of said controlling switch and means for operating the impulse sending device in synchronism with the stepping of said control switch when so associated, to transmit said translated routing digits.

12. In a telephone exchange forming part of a network, the combination of a metering control switch, a plurality of levels in said switch, an impulse sending switch, means for operatively associating said impulse sending switch with a selected level of said metering control switch whereby the setting of the impulse sending switch is controlled from said level, and storage means connected with said impulse sending switch and operated in accordance with the setting of said switch.

13. In a telephone exchange system the combination of register-senders adapted to transmit trains of impulses corresponding to translated code digits and numerical digits, translated code digit controlling switches associated in common with a plurality of register senders, means for selecting one of said controlling switches in accordance with the value of the code digits dialled, a numerical digit sender control switch in each register sender, and an impulsing machine having a plurality of synchronously operated pairs of impulsing springs, two pairs forming part of each register sender, one for transmitting

trains of impulses, and the other stepping the numerical digit sender-control switch in synchronism as required and a further pair associated with each translated digit controlling switch for stepping said switch in synchronism with impulse transmission.

14. In a telephone system as claimed in claim 9, the combination of a register-sender, means to connect said register sender to said control circuit during the setting up of a connection, means in said register sender to transmit routing digits under direct control of the selected routing digit control device and means to transmit numerical digits under control of storage devices in said register sender.

15. In a telephone system, the combination of a register sender, means independent of said register sender adapted to be set in accordance with the code digit or digits dialled, a plurality of routing digit controlling means each of which is adapted to control the transmission of the digits required for reaching a particular exchange, means whereby said first mentioned means is adapted to select one of said controlling means in response to said code digit or digits and means in said register sender to transmit impulses under control of said controlling means.

16. In combination a plurality of register senders, means for registering code digits independent of said register senders, a plurality of routing digit control devices each associated with a wanted exchange and common to a plurality of said register senders and said means, means for automatically connecting one of said register senders with said means and with a selected control device, and means in said register sender for transmitting impulses under control of said selected control device.

17. In combination a plurality of register senders, storage devices in said register senders for recording numerical digits, means independent of said register senders for registering code digits, a plurality of routing digit control devices each associated with a wanted exchange and common to a plurality of said register senders and said means, means for automatically connecting one of said register senders with said means and with a selected control device, and means in said register sender for transmitting impulses under control of said selected control device and of said storage device.

18. In a telephone system, the combination of a register sender, a switching device independent of said register sender actuated by code digits, a routing digit control device selectable by said switching device, means for operatively connecting said register sender with said control device and impulse sending means in said register sender controlled by said control device.

19. In a telephone system, the combination
of a register sender, means in said register
sender for recording numerical digits, a
switching device independent of said register
5 sender and adapted to be operated by code
digits, control means selectable by said
switching device and comprising a predeter-
mined record of routing digits individual to
a wanted exchange, and impulse sending
10 means in said register sender operative to
transmit impulses first under control of said
control means and later under control of
said numerical digit recording means.

In witness whereof I hereunto subscribe
15 my name this ninth day of April, 1931.

ESMOND PHILIP GOODWIN WRIGHT.

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