

**Feb. 15, 1938.**

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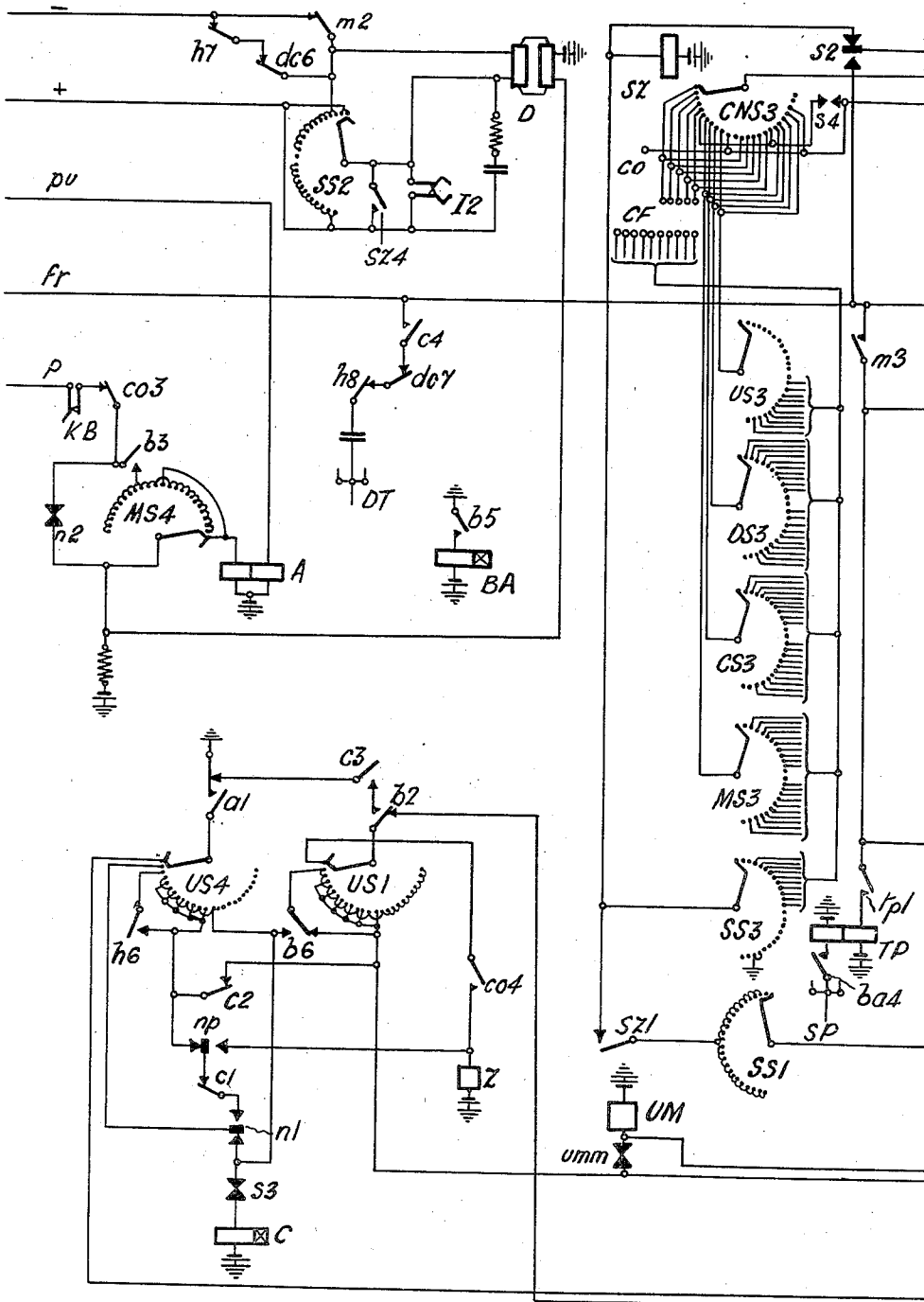
**2,108,140**

TELEPHONE SYSTEM

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3 Sheets-Sheet 1

**Fig. 1.**



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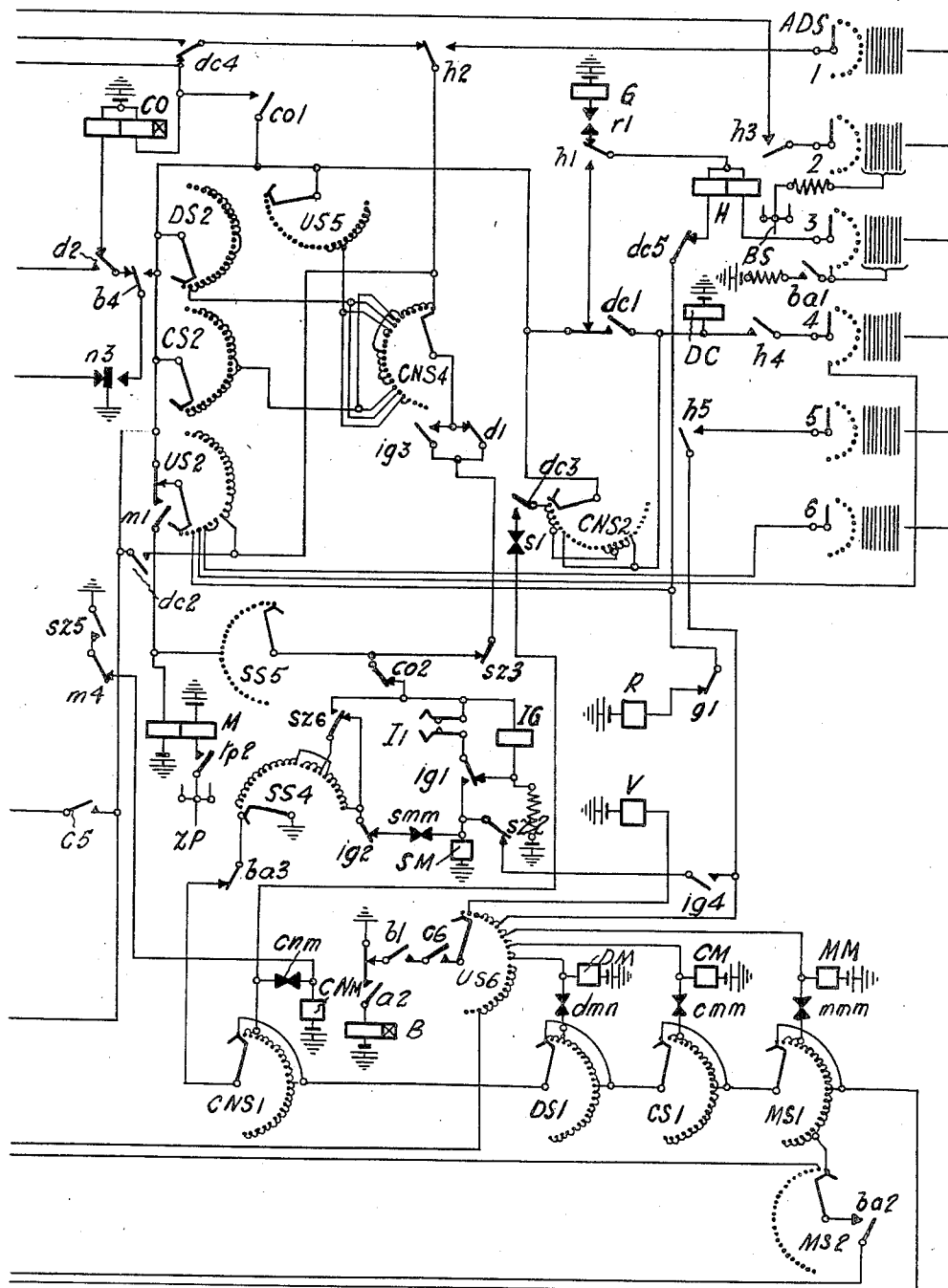
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FIG. 2.



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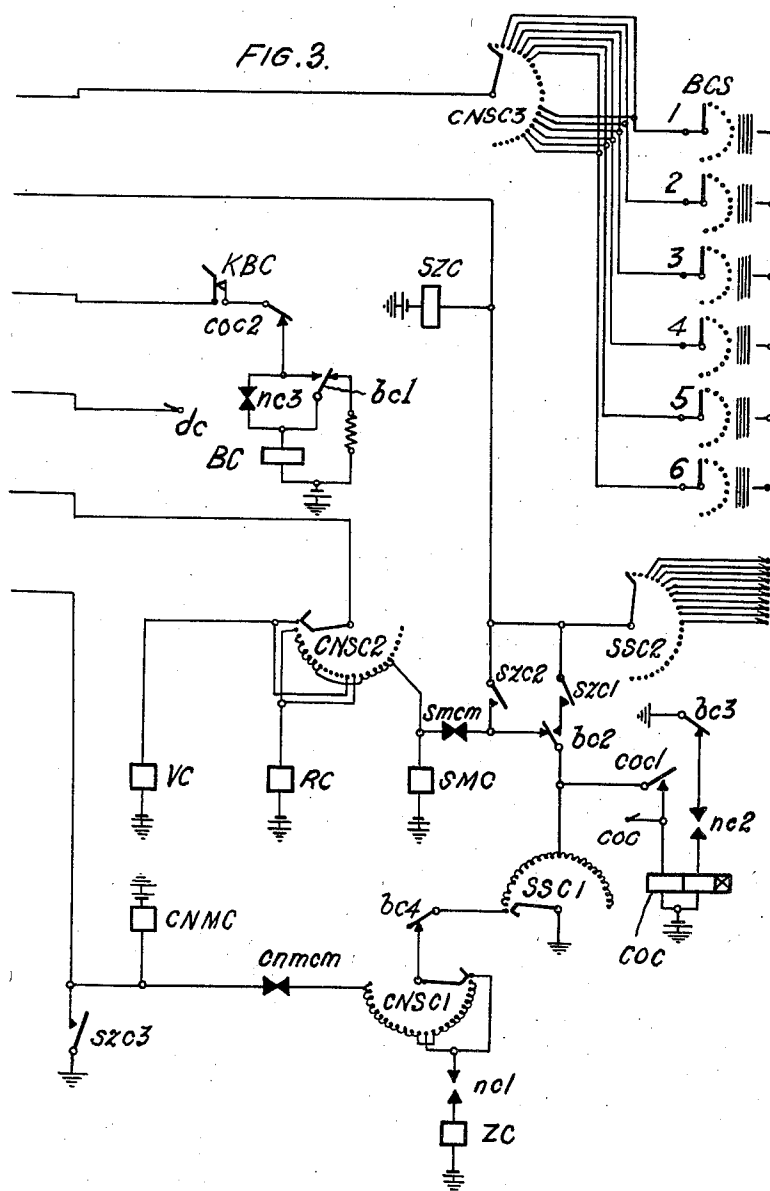
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TELEPHONE SYSTEM

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

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## TELEPHONE SYSTEM

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The present invention relates to automatic telephone systems and more particularly to systems employing register controllers.

In a multi-office area a subscriber's designation comprises two portions, one portion including the digits representing the subscriber's exchange and the other portion the digits representing the number of his line at that exchange. These portions for convenience will hereinafter be referred to as code digits and numerical digits.

Systems are now well known in which the code digits are recorded in registers and a translation of the digits into a routing designation is effected, the translated code comprising one or more trains of impulses, not necessarily bearing any relation to the code dialled by a calling subscriber, which are transmitted from a sending device under the control of a control switch for the purpose of setting selectors to select and set up a route to the wanted exchange. The registers for the code digits and the translating and sending arrangements are comprised in a register controller which also includes registers for the numerical digits, the numerical digits being transmitted under the control of the same sending and controlling mechanism. Since the primary function of the register controller is to effect the translation of the code digits and the transmission of the translated code, it is held in use for a longer time than that necessitated by this function in order that the numerical digits which have been stored so that dialling may proceed smoothly during the time that translation and transmission of the translated code is taking place may be transmitted.

The object of the present invention is to reduce the holding time of the register controller in a connection and so bring about a reduction in the number of translating register controllers hitherto required in an exchange and to effect other economies.

In the present invention the numerical registers are separated from the registers for recording the digits of that portion of the wanted subscriber's designation of which translation is required and the latter digits are recorded on registers in a second circuit accessible from a first circuit, the second circuit including arrangements for translating the digits and controlling the transmission of the routing trains of impulses to which they have been translated. The first circuit includes registers for the numerical portion of a wanted subscriber's designation which are not required to be translated and sending and controlling arrangements for their transmission

so that after the transmission of the routing trains has taken place the second circuit may be released and made free for use on another call. In a known system the translating registers are grouped, a group being associated with one or a plurality of first code digits which take effect on a selecting switch known as an A digit selector which thereupon selects a free translating register controller in the group determined by the impulses received. Accordingly the first circuit in the present invention may include an A digit selector and in what follows it will be assumed that this is the case. The second circuit then deals with the remaining code digits which generally comprise two in number and are referred to as the BC digits.

The control of the output impulsing circuit is vested in the A digit selector circuit which accordingly includes the spring sets for the generation of impulses. This makes it convenient to include the impulse guard relay in the same circuit and the forced release arrangements may also be included in this circuit. As regards the routing trains, the commencement and termination of these is controlled over wipers of the A digit selector by signals, the output impulsing wires not being taken through to the second circuit, and a sending switch multiple between the two circuits being avoided. For the exercise of this control the second or translating register controller circuit is provided with a sending switch adapted to be marked in accordance with settings of the BC switch, the several markings being applied under the control of a control switch. The encountering of a marked contact by the sending switch brings about the operation of the stop relay in the A digit selector to terminate impulse transmission and a local stop relay may be provided for the homing of the sending switch and the advancement of the control switch to apply a further marking to the sending switch or to signal the end of routing train transmission. The stop relay may be held until the sending switch has completed its rotation in the usual manner.

The control switch may serve also as a digit distributor for the incoming BC digits, its stepping for this function being controlled by steering arrangements in the A digit selector.

For the transmission of the numerical digits a sending switch and control switch are provided in the A digit selector which operate in the same manner as regards these functions as those normally employed in known register controller circuits. For the transmission of the routing digits

this sending switch may be stepped synchronously and by the same impulsing contacts as the sending switch in the translating register controller circuit thereby serving to connect the output impulsing springs into the output impulsing circuit, arrangements being provided to prevent the commencement of transmission of a further train of impulses until both sending switches have reached their home positions.

The control switch in the A digit selector may be stepped by the operation of the stop relay to connect up in turn the several marking wipers of the numerical registers and since no circuits are required to be completed by it until all the routing digits have been sent the early contacts in the control switch may be utilized for another purpose, for example for providing, by means of connections over a local cross connecting frame to the sending switch multiple, for the transmission of one or more routing trains in connection with a single digit call which may be had without engaging a translating register controller. The relevant wiper of the A digit selector control switch would only be connected up consequent on digit-cut-off action in the translating register controller or a simulated operation over a bank contact in the level or group to which the A digit selector is stepped by the single digit. If the maximum number of routing trains is sent out consequent on translation in the register controller, the stepping of the A digit selector control switch after transmission of the last routing train may itself bring about the connection of this wiper which may then be arranged to rest on contacts connected to the first numerical register to be connected up.

All the dialled impulses are preferably received on an impulse relay in the A digit selector which repeats them to the several registers concerned. The routing of the impulse trains to the several switches may be effected under the control of a single steering relay which releases to determine the end of an impulse train and is thereupon re-operated before the commencement of the next impulse train. The routing of the repeated impulse trains is conveniently effected by a distributing switch stepped on the release of the steering relay and for this purpose the units register switch may be utilized. This would provide in successive positions for the routing of the A digit to the A digit selector stepping magnet, and then, over a wiper of the A digit selector and a wiper of the control switch in the translating register controller circuit for the BC digits to the two magnets of a two motion BC switch. The numerical digits are then routed in turn to the numerical registers. Two successive contact positions may be assigned to each incoming digit and the steering relay may be connected to even contacts in one bank of the distributor the wiper of which is connected to a front contact of the impulse relay and to odd contacts in another bank of the distributor the wiper of which is connected to a back contact of the impulse relay the distributor magnet being connected for distribution purposes over self interrupting contacts to the even contacts in the last mentioned bank and over the self-interrupting contacts and a back contact of the steering relay to the odd contacts in the first mentioned bank.

The impulse relay may be operated on seizure of the A digit selector by one winding connected to the incoming test wire, arrangements being provided to disconnect this winding and provide an alternative holding circuit over the test wire

consequent on the operation of the impulse relay, another winding of the relay being connected to the pulsing circuit. The connection of the impulse relay to the test wire may include a wiper and normal contact of one of the numerical register switches which is given a preliminary step on the operation of the impulse relay.

The BC impulses and the steering impulses may be transmitted over different wipers of the A digit selector and the translating register controller is engaged over a test wiper of the A digit selector in the usual manner. The marking circuit of the BC switch may extend back over a further wiper to the A digit selector circuit and another wiper may provide a circuit for the transmission of the signals to the stop relay.

In the A digit selector a release relay may be connected to a further wiper, the wire outgoing from its associated bank being cross connected to the digit-cut-off terminal on the translating frame. When operated this relay brings about the opening of the test wire and the release of the translating register controller. If no numerical trains are to be transmitted release may be brought about by opening the test wire circuit by the operation of a cut-off relay in the translating register controller circuit. Under this condition, with the non-operation of the release relay, a cut-off relay in the A digit selector may be operated to bring about its release.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings.

In the drawings Figs. 1 and 2 show an A digit selector and numerical registers on which are recorded the numerical portion of a subscriber's designation together with the necessary control circuits and impulse repeating arrangements. Fig. 3 shows the translating register on which are recorded the code portion of a subscriber's designation and control circuits therefor. Relays and magnets performing like functions are similarly designated in the two cases but for differentiation the designations of the relays and magnets in Fig. 3 have the letter C added.

In Figs. 1 and 2 the A digit selector ADS is of the two motion type and is provided with six wipers and contact banks and its movements are controlled by vertical magnet V, rotary magnet R, and release magnet Z. The outlets from levels 2 to 9 of this switch lead to translating registers of the kind shown in Fig. 3. Level 0 which corresponds to calls to a manual board position has no outlets, a connection only being made to the last contact in the bank of wiper 4, and level 1 is not used. The registers MS, CS, DS, US for the usual 4 numerical digits of a subscriber's designation are 25 point single motion reverse drive stepping switches, i. e. the switch wipers are advanced on retraction of the magnet armature, the magnets of which are designated MM, CM, DM, and UM for the thousands, hundreds, tens and units digits respectively. The hundreds and tens registers have each three wipers, the units register has six wipers and the thousands register four wipers. These are designated CS1—CS3, DS1—DS3, US1—US6, and MS1—MS4 respectively. SM is the magnet of the sending switch SS which is provided with five wipers designated SS1—SS5, and which operates to determine the number of impulses to be sent out in each numerical train. CNM is the magnet of the control switch CNS which effects the connecting up of the several registers in turn for the sending of impulses indicative of the sub-

scriber's local number or of a set of terminals especially provided for manual board calls and is provided with four wipers designated CNS1—CNS4. The units register is also employed as a digit distributor for routing the incoming dialled digits to the several registers in turn. With the exception of switches US and SS these switches have two normal positions one at the end of the bank in position 1 of their wipers and the other in position 13. Of the relays shown A is the impulse relay which responds to impulses received over the pulse wire *pu*, B and BA are slow releasing release relays, C is the slow releasing dialling relay which is controlled over wipers US1 and US4 of the units register and is pre-operated for each train of impulses, D is a shunt field relay connected to the positive and negative wires over which loop impulses are transmitted for setting the selecting switches in the several exchanges concerned, G is a stepping relay which by interaction with magnet R produces the hunting action of the A digit selector and H is the test relay. IG is the usual impulse guard relay provided in register controllers, SZ is the stop relay which determines the end of an output impulsing train and CO is the cut-off relay which is operated after the last impulse train has been sent to release the A digit selector circuit. TP and M are time pulse relays for bringing about a forced release of the selector in certain circumstances. DC is a relay which is operated to bring about the connection of the numerical registers to the control switch. Contacts *s1*, *s2*, *s3*, and *s4* are operated mechanically when the selector is stepped onto the last contacts in a level, *n1*, *n2* and *n3* are contacts operated when the selector makes its first vertical step. Contacts *mm*, *sm* and so on are self interrupting contacts operated by the magnets MM, SM and so on and contact *r1* is a contact operated by rotary magnet R towards the end of its stroke. A spark quenching circuit consisting of a resistance and condenser in series is shunted across each magnet and the battery. These circuits are not shown in the drawings but their use is well known. Impulses for stepping the sender switch SS and the sender switch SSC in Fig. 3 are generated by the impulsing springs I1 and loop impulses for the setting of selecting switches are generated by the springs I2.

In Fig. 3 the switch which receives the second and third code digits and which is commonly known as the BC switch is a two motion selector designated BCS with 6 wipers and contact banks designated 1–5. Its magnets are designated VC, RC and ZC, and contacts *nc1*, *nc2*, *nc3* are vertical off-normal contacts operated when the switch takes its first vertical step. SMC is the sender switch magnet, the wipers of this switch being SSC1–2. CNMC is the magnet of the control switch CNSC of which the wipers are designated CNSC1–3. This latter switch has normal contacts in wiper positions 1 and 13. Relays BC, SZC, COC correspond to relays B, SZ and CO in Figs. 1 and 2. The sending and control switches are also 25-point reverse drive switches.

The general operation of the circuits shown is as follows. Impulses are received by relay A and are repeated in turn to the vertical magnet V, vertical magnet VC, rotary magnet RC and the register magnets MM, CM, DM and UM, register US acting as a distributor for the routing of the impulse trains under the control of relay C which is operated before the commencement of each impulse train. In response to the first im-

pulse train, the A digit selector is stepped to a level in accordance with the number of impulses in the train and then hunts in that level in search of a free translating register. The second impulse train steps the BC switch vertically and the third train steps the wipers of the BC switch round the selected level, switch CNSC operated over wiper 6 of ADS acting as a digit distributor. The remaining impulse trains are repeated by relay A to the numerical registers which are connected up in turn by register US. After the third and last code digit has been received and repeated, sending commences, both sending switches being operated in parallel, springs I2 being connected in the output impulsing loop over wiper SS2. When the contact of the sending switch SSC marked over the first wiper of the BC switch is encountered by wiper SSC2, relay SZC operates and a signal is transmitted over wiper 2 of ADS to operate relay SZ to terminate impulse transmission. Both sending switches now home and switch SSC commences to search for the marking applied over wiper 2 of switch BC, this wiper being now connected up consequent on a step having been taken by switch CNSC when the sending switches are stepped to their normal contacts. Relays SZ and SZC are held in parallel over wiper 2 of ADS and wipers SS1 and SSC1. This action continues until all the routing trains have been sent out whereupon a circuit is then completed over a wiper of the BC switch and terminal *dc* to operate relay DC. This relay brings about the release of the register controller and the self-stepping of switch CNS to a position in which the thousands register is connected up. Transmission of the stored numerical digits then takes place in the usual manner. After the last impulse train has been sent, relay CO operates to release the A digit selector.

If the call is to a manual board position the A digit selector will be stepped to its 10th level and rotate to the last contacts in that level. Relay DC will be operated but since contacts *s* are operated no automatic advance circuit for the switch CNS will be provided but it will be stepped as a controller under the influence of relay SZ. The sending switch SS is started and proceeds to hunt for markings applied over a small cross connection frame CF and wiper CNS3, over the first and successive contacts in the bank of this wiper. Up to five routing trains may be had for the routing of a call to a manual board position.

If the call does not require the transmission of any numerical impulse trains as in the case of special service calls obtained by dialling TEL, TOL or TRU, both circuits are released as soon as the last routing train has been transmitted.

A detailed description of the operations involved in setting up a call will now be given, when subordinate features of the invention will become apparent.

On the initiation of a call the calling line is extended to a first code selector having a relay group which brings about the operation of a hunting switch to search for and extend the line to a free A digit selector. It will be assumed that the A digit selector shown in Figs. 1 and 2 is free and is seized by the hunting switch. The selector is marked free by reason of battery potential on wire *p* and the hunting switch tests in to this battery over wire *p*, key contacts KB, contacts *co3*, *n2*, resistance to battery and in parallel therewith over wiper MS4, contact 1, left-hand winding of relay A to battery and in parallel therewith over the right hand polarizing

winding of shunt field relay D to battery. Relay A operates over wire *p* and when the pulse wire *pu* is switched through in the first code selector relay group, relay A is also energized in its right-hand winding over wire *pu*. Contact *a2* closes a circuit for relay B which operates and at contact *b5* closes an operating circuit for relay BA. Contact *b1* closes a point in an impulse repeating circuit to the several register magnets, contacts *b2* and *b6* close points in an eventual holding circuit for relay C over wiper US1, contact *b3* prepares a circuit for holding the A digit selector over wiper MS4 and wire *p* and contact *b4* prepares a connection for a general holding earth. Relay BA having operated, contact *ba1* connects battery to the last contacts in all levels in the bank of wiper 3, contact *ba2* closes a circuit from earth over contact *a1*, wiper US4 in position 1, wiper MS2 in position 1, commoned off-normal contacts in the bank of wiper MS1, contacts *mmm*, magnet MM to battery in which magnet MM operates, contact *ba3* opens a point in the homing circuits for the several numerical registers and contact *ba4* prepares a circuit for the time pulse relay TP. Magnet MM operates and by interrupting its own circuit at contact *mmm* steps switch MS to position 2. In this position a circuit is completed from earth over contact *a1*, wiper US4, contact *ba2*, wiper MS2, contact *umm*, magnet UM to battery and the magnet operates and by interruption of its own circuit at contact *umm* steps switch US to position 2. The circuit for the left-hand winding of relay A is now interrupted at wiper MS4 and the relay is left dependent on its right-hand winding. Battery over a resistance is now connected over wiper MS4 and the commoned off-normal contacts, contacts *b3*, *co3*, key contacts KB to wire *p*. The stepping of switch US has disconnected earth from wiper MS2 and connected it over unoperated vertical off-normal contacts *n1* of the switch ADS and contacts *s3* to relay C. Relay C operates and at contact *c1* disconnects itself from the commoned odd contacts in the bank of wiper US4 and at contact *c2* disconnects itself from the commoned even contacts in the bank of wiper US1. Contact *c3* prepares a holding circuit for relay C over wiper US1, contact *c4* connects dialling tone over wire DT to wire *fr* which at this time is connected over a condenser to one of the incoming speaking wires in the first code selector. Contact *c5* prepares a holding circuit for relay TP and contact *c6* prepares the impulse repeating circuit which in position 2 of switch US extends over wiper US6 to vertical magnet V of switch ADS.

The circuit is now in a condition to accept dialled impulses which are received over wire *pu* on relay A. Relay A at contact *a2* repeats the impulses of the first impulse train over the above traced circuit to magnet V which responds and steps the switch ADS vertically. During the break periods of the impulses, relay C is held by earth over back contact *a1*, contacts *c3*, *b2*, wiper US1 in position 2 for the first impulse train and in a subsequent odd position for later trains, and contact *b6*. At the first vertical step of the switch the vertical off normal contacts are operated and contact *n1* disconnects relay C from contact 2 in the bank of wiper US4. It may here be noted that contacts *np* are normal post springs which are changed over when the wipers of switch ADS are opposite the first level of contacts but which are restored when the wipers are stepped to the second level. At the end of the first train of im-

pulses relay A remains steadily operated, and contacts *a1* and *n1* being in their front positions relay C releases and disconnects dialling tone at contact *c4*. Contacts *c1* and *c2* close the following circuit; earth over contact *a1*, wiper US4 in position 2, contacts *n1*, *c1*, *np1*, *c2*, *umm*, magnet UM to battery. Magnet UM operates and by opening its contacts *umm* steps the units register to position 3. In this position a circuit is closed from earth over contacts *n3*, *b4*, wiper US2, contact *g1*, magnet R to battery. Magnet R operates and the switch hunts for a free outlet to a translating register. The test for a free outlet is battery on the contact in the bank of wiper 3 and in the case of a free translating register this will be found over contacts KBC, *coc2*, *nc3* and relay BC and in parallel therewith contact *bc1* and a resistance. The test circuit is then from this battery over wiper 3, right-hand low resistance winding and higher resistance left-hand winding of relay H, contact *dc5*, wiper US2 to earth over contacts *b4* and *n3*. The test wires of busy outlets will be at substantially earth potential applied over the low resistance winding of the test relay of the selector engaging it. When a busy outlet is encountered by switch ADS, relay G operates in a circuit from the busying earth over wiper 3, right-hand winding of relay H, contacts *h1* and *r1*. Relay H does not operate in this circuit. Contact *g1* opens the circuit of magnet R which in turn opens the circuit of relay G. The magnet releases and on the release of relay G re-operates, steps the switch wipers to the next contacts and closes again the circuit for relay G. When a free outlet is encountered, battery potential will be present on the junction point of contact *h1* and relay H so that relay G is shunted and does not operate and magnet R continues energized. Relay H is operated over its two windings in series. Contact *h1* disconnects relay G and closes a holding circuit for relay H over its low resistance right-hand winding, contacts *dc1*, *b4* and *n3*, independently of switch US, and contact *h6* closes a stepping circuit for magnet UM. This extends from earth over contact *a1*, wiper US4, contacts *h6*, *c2* and *umm* and the units register is stepped to position 4 in which the circuit of magnet R is opened at wiper US2. Contact *h2* prepares to extend earth over wiper US2 to wiper 1 of ADS, contact *h3* connects relay SZ to wiper 2, contact *h4* connects relay DC to wiper 4, contact *h5* prepares the impulsing circuit over wiper 5 for the magnets of the BC switch, contact *h7* opens a point in a short circuit path about contact *m2* in the connection of the negative wire to relay D and contact *h3* disconnects the dialling tone circuit. In position 4 of wiper US4 a circuit is closed for relay C and this relay operates and prepares the impulsing circuit as before. In the meantime relay BC (Fig. 3) has operated in the test circuit and locked itself to the test wire over contact *bc1* and contact *bc4* has opened the homing circuit for switch CNSC.

The first impulse of the second train is received by relay A and repeated over wiper US6 in position 4, contact *h5*, wiper 5, wiper CNSC2 in position 1 to magnet VC. At the same time magnet UM is energized in a self stepping circuit over the back contact *a1* and wiper US1 and switch US is stepped to position 5. Contacts 4 to 7 in the bank of wiper US6 are connected together and the wiper is a bridging wiper so that no interference with impulsing takes place. Succeeding impulses of the second train are repeated over wiper US6 in position 5. In this position of switch US a

holding circuit during impulsing for relay C is completed over wiper US1, and over wiper US2 earth is extended over wiper 6 to magnet CNMC which is thereby operated. At the end of the impulse train relay C releases as in the case of the first impulse train and closes a stepping circuit over wiper US4 and contact c2 to magnet UM and switch US is stepped to position 6 in which the operating circuit for relay C is again closed. In position 6 of wiper US2 the circuit of magnet CNMC is opened and the switch CNSC is stepped to position 2 in which magnet RC is connected in place of magnet VC in the bank of wiper CNSC2. The third impulse train is repeated to magnet RC in positions 6 and 7 of switch US and magnet CNMC is energized as before to step switch CNSC at the end of the train to the third position. Relay C releases at the end of the train and switch US is stepped to position 8 in which relay C is re-operated. The fourth impulse train is repeated over wiper US5 in positions 8 and 9 to magnet MM of the thousands numerical digit register and the fifth and sixth impulse trains are similarly repeated over successive pairs of contacts in the bank of wiper US6 to magnets CM and DM. Switch US is therefore stepped from position 13 to position 14 at the end of the sixth impulse train and contacts 14 to 23 are commoned and connected to magnet UM which is impulsed over this circuit to set the register in accordance with the units digit.

In positions 3 to 24 of switch US earth is applied over wiper US2, contact h2 and wiper 1 to wiper CNSC3 to provide for the operation of relay SZC. After wiper US4 leaves position 14 the operating circuit of relay C is disconnected so that the relay releases at the end of the seventh impulse train and is not re-operated. When switch US has stepped from position 7, magnet CNMC releases and steps switch CNSC to its 3rd position in which wiper 1 of switch BCS is connected to earth over wiper CNSC3. In position 3 and successive positions of switch US earth is connected to relay IG in the following circuit; earth over contacts n3, b4, m1, wiper US2, contact 1, in the bank of wiper CNS4, contacts d1, m4, sz3, and co2. When springs I1 open, relay IG operates and disconnects at contact ig1 the short-circuit imposed by the closure of impulsing springs I1 and connects these springs in a circuit for magnet SM. Contact ig2 opens the homing circuit for switch SS, contact ig3 substantiates contact d1 and contact ig4 extends the circuit over impulsing springs I1 and contact h5 to wiper 5 thence over wiper CNSC2 to magnet SMC. Magnets SM and SMC are thereby stepped in synchronism and when wiper SS2 reaches position 3 the output impulsing loop which was previously closed over the winding of relay D has springs I2 included in it, the winding of relay D being short-circuited over wiper SS2. Springs I1 and I2 are arranged so that when one opens the other closes. When therefore, magnet SM is energized the loop is opened and the de-energization of the magnet steps the sending switch and when this reaches the next contacts the loop is closed over springs I2. Impulsing continues until wiper SS2 reaches the contact marked over wiper 1 of switch BCS whereupon a circuit is completed for relay SZC from earth over contacts n3, b4, m1, wiper US2, contact h2, wiper 1 of ADS, CNSC3 and wiper 1 of BCS, the cross connection to the bank of wiper SSC2, wiper SSC2, relay SZC to battery. A circuit in parallel with relay SZC is closed over wiper 2 of ADS, contacts h3 and s2

for relay SZ. Both these relays operate and lock up over their respective contacts 1 and wipers 1 of the sending switches. Contact sz4 short circuits springs I2 to prevent further impulses being transmitted over the loop, contact sz3 opens the circuit for relay IG and the stepping circuit for magnet SM, contact sz2 opens the stepping circuit for magnet SMC, contact sz5 closes a circuit over contact m4 for magnet CNM which steps switch CNS on the release of relay SZ, and contact sz6 closes a homing circuit over wiper SS4 in positions 15—18 and impulsing springs I1, for magnet SM to home the sending switch. Contact szc2 closes the homing circuit for magnet SMC and contact sz3 connects earth to operate magnet CNMC. It will be seen that the holding earth for relays SZ and SZC passes over wipers SSC1 and SS1 in parallel so that both relays are held until the two switches have reached their home position. Switch SS drives to position 15 in a circuit over contacts ig2 and smm and from 15 it is stepped to position 19 by impulsing spring I1 over contact sz6, the former driving circuit being again completed in positions 19—25. When both switches have reached normal, magnet CNMC releases and wiper 2 of switch BCS becomes connected up in place of wiper 1.

Successive trains of impulses are transmitted in the same manner in accordance with the cross connections between the bank of wiper SSC2 and the several contacts marked over successively connected wipers of switch BCS, switches CNS and CNSC being stepped after the completion of each train, until, the requisite routing trains having been transmitted, a wiper of switch BCS set to a contact strapped to terminal dc is encountered. Thereupon earth over wiper CNSC3 is extended over the relevant BCS wiper, terminal dc, wiper 4 of switch ADS, contact h4 to relay DC. If six routing trains are to be transmitted there will be no cross connection between switch BCS and terminal dc but the stepping of switch CNS to position 7 closes a circuit from earth over wiper CNS2 for relay DC. Relay DC operates and locks up over contacts dc1, b4, and n3 and opens the holding circuit of relay H and at contact dc5 opens the operating circuit of relay H. Relay H releases and a circuit is now completed from earth over contacts n3, b4, dc2, h2, dc4, to wiper CNS3. At contact dc3 a self drive circuit for switch CNS is closed as follows if less than 6 routing trains have been sent out: earth over wiper CNS2, commoned contacts 2 to 6, contacts dc3, s1, and cnmm and switch CNS is driven to position 7 in which wiper CNS3 rests on the contact connected to wiper MS3 of the thousands digit register. Contact dc6 opens the short circuit about contact m2 against the closure of contact h7 and contact dc7 opens a further point in the dialling tone circuit.

The release of relay H disconnects earth from wiper 3 of ADS and relay BC releases. Contact bc1 opens the test circuit to guard against seizure of the translating register until all the switches have homed whereupon contact nc3 becomes closed, contact bc2 completes a homing circuit for switch SSC over wiper SSC1 and contact smcm, contact bc3 operates relay COC and contact bc4 prepares the homing circuit for switch CNSC to be completed when switch SSC reaches its home position. In its home position wiper CNSC1 completes a circuit for release magnet ZC of the BC switch. The BC switch is released and when it is fully restored contacts nc are restored, contact nc1 opening the circuit of magnet ZC,

contact *nc2* opening the circuit of relay COC and contact *nc3* re-closing a point in the test-in circuit. Relay COC performs no useful function in this type of call and its release re-closes the test-in circuit at contact *coc2*.

By the time the routing trains have been transmitted the hundreds digit will probably have been received and stored in register CS. When, therefore, wiper CNS4 is stepped to its seventh contact earth over wipers CS2 and CNS4 will be applied to relay IG and the transmission of the thousands digit will commence. Switch SS will be stepped until wiper SS3 encounters the contact marked over wipers MS3 and CNS3, impulses being transmitted over the loop at each step of the switch as before described until relay SZ operates in the marking circuit just referred to. On the operation of relay SZ the relay locks up over contact *sz1*, and at contact *sz4* short circuits the impulsing springs I2, at contact *sz3* releases relay IG and opens the impulsing circuit for magnet SM and at contact *sz5* energizes magnet CNM. The sending switch homes and releases relay SZ. Magnet CNM thereupon de-energizes and steps switch CNS to position 8 in which wiper CS3 is connected up in place of wiper MS3. The hundreds digit is transmitted, followed by the tens and units digits in a similar manner, switch CNS being stepped one contact after the transmission of each digit. When wiper CNS3 is stepped onto its eleventh contact after the transmission of the units digit, earth is applied thereover to the right hand winding of relay CO and this relay operates and locks up over its contact *co1*. Contact *co2* opens a point in the circuit for relay IG and contact *co3* opens a point in the circuit over wire *p*. This latter operation results in the release of a relay in the first code selector relay group which opens the circuit over wire *pu* and disconnects the remaining wires which lead to the A digit selector. Relay A releases and releases relay B which in turn releases relay BA. The restoration of contact *b4* closes a holding circuit over contact *d2* for the left-hand winding of relay CO, relay CO being of the slow releasing type. Contact *b4* also releases relay DC. Contact *ba3* on closing completes a circuit as follows: earth over wiper SS4 when this switch has reached its home position, contact *ba3*, wiper CNS1 in an off-normal position, contacts *cmm*, magnet CNM to battery. Switch CNS is homed by the self driving of magnet CNM in the above traced circuit and when the home position is reached wiper CNS1 extends earth over wiper DS1 to magnet DM and switch DS is homed. Switches CS and MS are homed in a similar manner whereupon earth is extended over wiper MS1, contact *b2*, wiper US1, contacts *umm*, to magnet UM and the switch US is homed. In its home position earth is extended over wiper US1 and contact *co4* to the release magnet Z of the switch ADS and that switch is released and restored to normal. Contact *n1* re-closes a point in the initial operating circuit for relay C, contact *n2* closes a point in the test-in circuit over wire *p* and contact *n3* releases relay CO. Contact *co3* closes a further point in the test-in circuit to make the circuit available for further use and contact *co4* opens the circuit of magnet Z. All the apparatus in the A digit selector is now in its normal condition and ready for further use.

The above described operations are those which take place for a call to a subscriber connected to an automatic exchange and in which no congestion is encountered.

If the A digit selector is unable to find a free outlet to a translating register, the wipers are stepped round the level to the last contacts where they are stopped by the operation of relay H from battery connected over contact *ba1* and wiper 3. As the wipers are stepped to these contacts, contacts *s1*, *s2*, *s3* and *s4* are operated. Contact *s1* opens the stepping circuit over wiper CNS2 for switch CNS contact *s2* disconnects wiper 2 of ADS from relay SZ and applies a busy signal over wire BS, last contacts in levels 2—9, wiper 2 of ADS, contacts *h3* and *s2* and wire *fr* to the first code selector relay group from which it is repeated over the calling line. Switch US is stepped from position 3 to position 4 on the operation of relay H but relay C is not re-operated as contact *s3* is now open. Any further impulses received are not repeated as contact *c6* is open and the selector circuit remains in the condition it now assumes until the subscriber clears whereupon the release of relays A, B and BA in succession brings about the release of relay H and the operation of relay CO over its left hand winding and the circuits are thereupon restored in the manner previously described.

If a call is made to a manual position by dialling the single digit "0" the A digit selector is stepped to its 10th level over which the wipers rotate to the last contacts. Contacts *s* are operated as before but a busy signal is not transmitted as wire BS is not connected to the last contacts in the 10th level. In position 4 of wiper US2 earth is extended over the last contact of the 10th level in the bank of wiper 4 and contact *h4* to relay DC. Relay DC operates and releases relay H and earth is extended over contact *dc2* and wiper CNS4 to relay IG and magnet SM and sending starts. The sending switch multiple is marked over the small cross connecting frame CF and wiper CNS3, contacts *dc4*, *h2*, *dc2*, *b4* and *n3* and when the contact marked is reached by the sending switch, relay SZ operates with the results before described and at contact *sz5* steps switch CNS to position 2 in which a further contact is marked for the transmission of another routing train. The self-stepping circuit for switch CNS is open at contact *s1*. Markings are applied to contacts in sending switch bank over wiper CNS3 in its successive positions until as many trains of impulses as are required to route the call to the manual position have been transmitted. When this has been done or when the wiper CNS3 is stepped to position 6 a connection is made over the wiper to terminal *co* whereupon relay CO is operated either by earth over terminal *co* or by earth over contact *s4* and the selector is released.

If a call is required to a subscriber connected to a manual exchange with coder call indicator working, operations can take place as above described for setting up the route to the exchange until a junction to the required manual exchange is taken into use. A coder is associated with the junction at its outgoing end in which the numerical portion of the wanted subscriber's designation is recorded and arrangements are provided at the outgoing end of the junction whereby a current reversal over the line wires is effected which brings about the operation of relay D until a free coder is available and ready to receive the number. Contact *d1* opens the circuit for relay IG to hold up impulse transmission until the coder is ready whereupon relay D is released and the transmission of the output impulses proceeds in the normal manner.

If a call is made to a special service position such as may be had for example by dialling TEL, TOL or TRU, no numerical digits are dialled and it therefore becomes necessary to release the A digit selector after the transmission of the last routing train. When the last routing train has been transmitted, the next wiper of the BC switch to be connected up will be found resting on a contact connected to terminal *coc*. Earth over this wiper and terminal *coc* operates relay COC by means of its left hand winding. Contact *coc2* releases relay BC and this relay on releasing closes at contact *bc3* a holding circuit for relay COC over its right hand winding and the translating register is released. Relay H (Fig. 2) releases and the units register now being in position 8 a circuit is completed for relay CO from earth over contacts *n3*, *b4*, wiper US2, contacts *h2*, *dc4*, (relay DC has not been operated), right-hand winding of relay CO to battery. Release of the A digit selector follows.

Attention may now briefly be given to the operations which take place under certain irregular conditions.

If a spare exchange code is dialled switches SSC and SS continue to step as there will be no marking over the wipers of the BC switch. When switch SS reaches position 14 a circuit will be closed over wiper CNS4 and contacts *m4*, *sz3* and wiper SS5 for relay M. Relay M operates and locks up over contacts *m1*, *b4* and *n3* and earth is connected over contacts *n3*, *b4*, *c5* and *m3* to wire *fr* which brings about the release of the A digit selector from the first code selector relay group.

If the digit 1 is dialled as one of the BC digits a similar operation takes place while if this digit is dialled for the A digit the A digit selector is stepped to the first level and springs *np* are operated. At the end of the impulse train relay C releases but the stepping circuit for magnet UM is now open at contact *np* and a circuit is closed over contact *a1*, wiper US4 in position 2, contacts *n1*, *c1* and *np* for the release magnet Z. Magnet Z operates and releases the selector whereupon relay C re-operates and the circuit is prepared for normal operation.

If no impulses are received within a predetermined time after the A digit selector is taken into use or if a delay between the dialling of consecutive digits ensues, the following operations take place. Earth is connected periodically to wire SP and the first application after the operation of relay BA and closure of contact *ba4* operates relay TP over its left-hand winding. Relay TP locks up over its right hand winding and contacts *tp1* and *n3*. After the elapse of a prescribed interval from the earthing of wire SP earth is applied to wire ZP. If relay TP has been operated and locked, relay M is now operated over its right-hand winding, contact *tp2* and wire ZP and the wire *fr* is earthed over contacts *n3* and *m3* if no digit has been dialled and the forced release is initiated. If a digit has been already dialled relay TP locks up over contacts *tp1*, *c5*, *b4* and *n3* as relay C is always operated prior to receipt of an impulse train and relay M locks up and the impulsing loop is opened at contact *m2* since relay H or DC will have been operated. A circuit is now closed from earth over contacts *n3*, *b4*, *c5*, *m3* and wire *fr* to bring about at the first code selector the release of the A digit selector and the translating register if the latter is at the time in connection with it.

In the case of a call to a distant manual ex-

change, relay D is operated when a junction to that exchange is seized. Should the caller now release the connection the circuit over wire *pu* is opened and relays A and B release. Earth is now extended over wire *fr* over contacts *n3*, *b4* and *d2* and release of the A digit selector is brought about.

In the event of any switch failing to return to normal after use, relay CO or COC as the case may be remains operated and a lamp is flashed and a delayed alarm system set into operation. Also if it is desired to busy artificially the A digit selector or the translating register key KB or KBC is thrown thereby opening the test in circuit and causing a supervisory lamp to glow steadily. These alarm and supervisory lamp circuits are not shown as they are well known and are of no particular interest in the carrying out of the invention.

We claim:

1. In a register sender, numerical registers for registering the numerical digits of called subscriber's telephone numbers, a plurality of office registers for registering the office code digits of the called numbers, means responsive to a call for taking one of said numerical registers into use and for connecting one of said office registers with said numerical register, a stepping switch associated with said office registers, registers in said office register operated responsive to the receipt of the office code digits of a called number for marking said stepping switch in accordance with the office code digits received, said stepping switch operated step-by-step in search of said marking, an output impulsing circuit associated with said numerical register, an impulsing device associated with said impulsing circuit operated in step with said stepping switch for interrupting said impulsing circuit, means for transmitting a signal from said office register in response to said switch finding said marking, and means responsive to said signal for rendering further operation of said impulsing device ineffective to interrupt said impulsing circuit.

2. In a register sender as claimed in claim 1 including a stepping switch associated with said numerical register having a wiper included in said impulsing circuit, and means for stepping said last switch in synchronism with the switch associated with the office register during the hunting operation for a marking.

3. In a register sender as claimed in claim 1 including a self-interrupting circuit for returning said stepping switch to its normal position effective in response to said switch finding a marking, and means responsive to said stepping switch reaching normal position for transmitting a signal to prepare said impulsing circuit for further transmission.

4. In a register sender as claimed in claim 1 including a self-interrupting circuit for returning said stepping switch to its normal position effective in response to said switch finding a marking, and means responsive to said stepping switch reaching normal position for applying another of said office markings to said switch for the purpose of transmitting another office digit.

5. In a register sender as claimed in claim 1 including an impulse receiving relay associated with said numerical register for receiving the incoming impulses, and means controlled by said relay for repeating the received impulses to set said office and numerical registers in accordance therewith.

6. In a register sender as claimed in claim 1

including means associated with said numerical register for receiving the office and numerical digits of a called telephone number transmitted from a calling line, a switch associated with said numerical register operated in accordance with the first transmitted office digit to select an idle office register in a corresponding group, a wiper on said last switch, and means for repeating the remaining office digits over said wiper to operate said selected office register and for repeating the numerical digits to operate the registers of said numerical register.

7. In a register sender as claimed in claim 1 including a switch associated with said numerical register for selecting an idle office register in accordance with the first received digit in the office code, and means effective in case said selecting switch is operated in accordance with a particular first digit for preventing the selection of an office register and for effecting a translation independent of an office register to transmit one or more routing digits.

8. In a register sender as claimed in claim 1 including a relay associated with said numerical register, and means controlled by said relay for distributing the digits in the received call number to the corresponding registers in the office and numerical registers.

9. In a register sender as claimed in claim 1 including a relay associated with said numerical register, means controlled by said relay for distributing the digits in the received called number to the corresponding registers in the selected office and numerical register, and means for operating said relay before the commencement of each digit and for releasing said relay at the end of each digit.

10. In a register sender as claimed in claim 1 including an impulse receiving relay for receiving the office and numerical digits dialled by a calling line, and means for repeating said digits over a wiper of the units register of said numerical register to successively set said registers in accordance with the dialled digits.

11. In a register sender as claimed in claim 1 including a wiper of the units register in said numerical register, and means for operating said wiper to distribute the dialled digits to the successive registers in said office and numerical registers.

12. In a register sender as claimed in claim 1 including means for transmitting a signal from said office register to said numerical register after the transmission of said office code by said office register, and means dependent upon the nature

of said signal for determining whether further digits are to be transmitted or whether said numerical register is to be released.

13. In a register sender as claimed in claim 1 including an output control switch associated with said numerical register, means for stepping said control switch at the end of each transmitted digit, means for skipping the transmission of one or more office code digits, and means for automatically stepping said control switch for each office code digit skipped in case the maximum number of office code digits provided for are not required.

14. In a register sender as claimed in claim 1 including a plurality of operating magnets for operating said office register, and a control switch associated with said office register sequentially connecting said magnets for operation.

15. In a register sender as claimed in claim 1 including a plurality of operating magnets for operating said office register, a control switch associated with said office register for sequentially connecting said magnets for operation, means for operating said control switch one step after receipt of each office digit, and means for operating said control switch to apply said markings successively for said stepping switch in response to successive office code digit transmissions.

16. In a register sender as claimed in claim 1 including a control switch associated with said office register for successively applying said markings for said stepping switch, and a stop relay for operating said control switch in response to said stepping switch encountering a marking.

17. In a register sender as claimed in claim 1 including a sending switch, a distributing frame and an output control switch associated with said numerical register, means for marking said sending switch over said distributing frame and the bank contacts of said control switch in case the first digit received is a particular digit, means for operating said sending switch to find said marking, means for transmitting a digit in accordance with said marking, and means for operating said control switch at the end of each transmitted digit to apply another marking to said sending switch.

18. In a register sender as claimed in claim 1 including a relay associated with said numerical register for initiating the stepping operation of said stepping switch, and means for operating said relay after the registers in the office register have been set.

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