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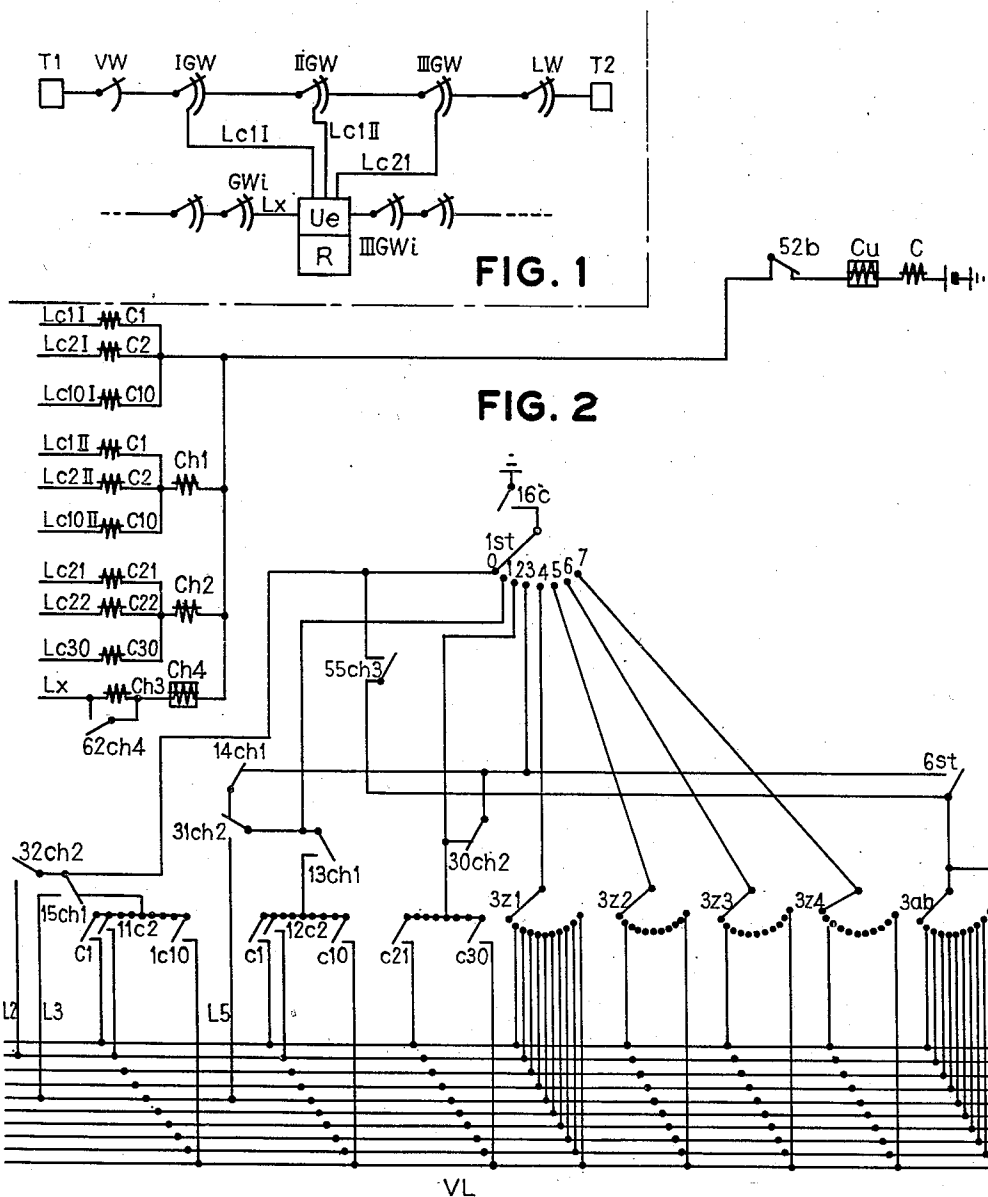
HERMANN-ERNST VON KÖNIG

2,217,084

TELEPHONE SYSTEM

Filed Feb. 3, 1938

2 Sheets-Sheet 1



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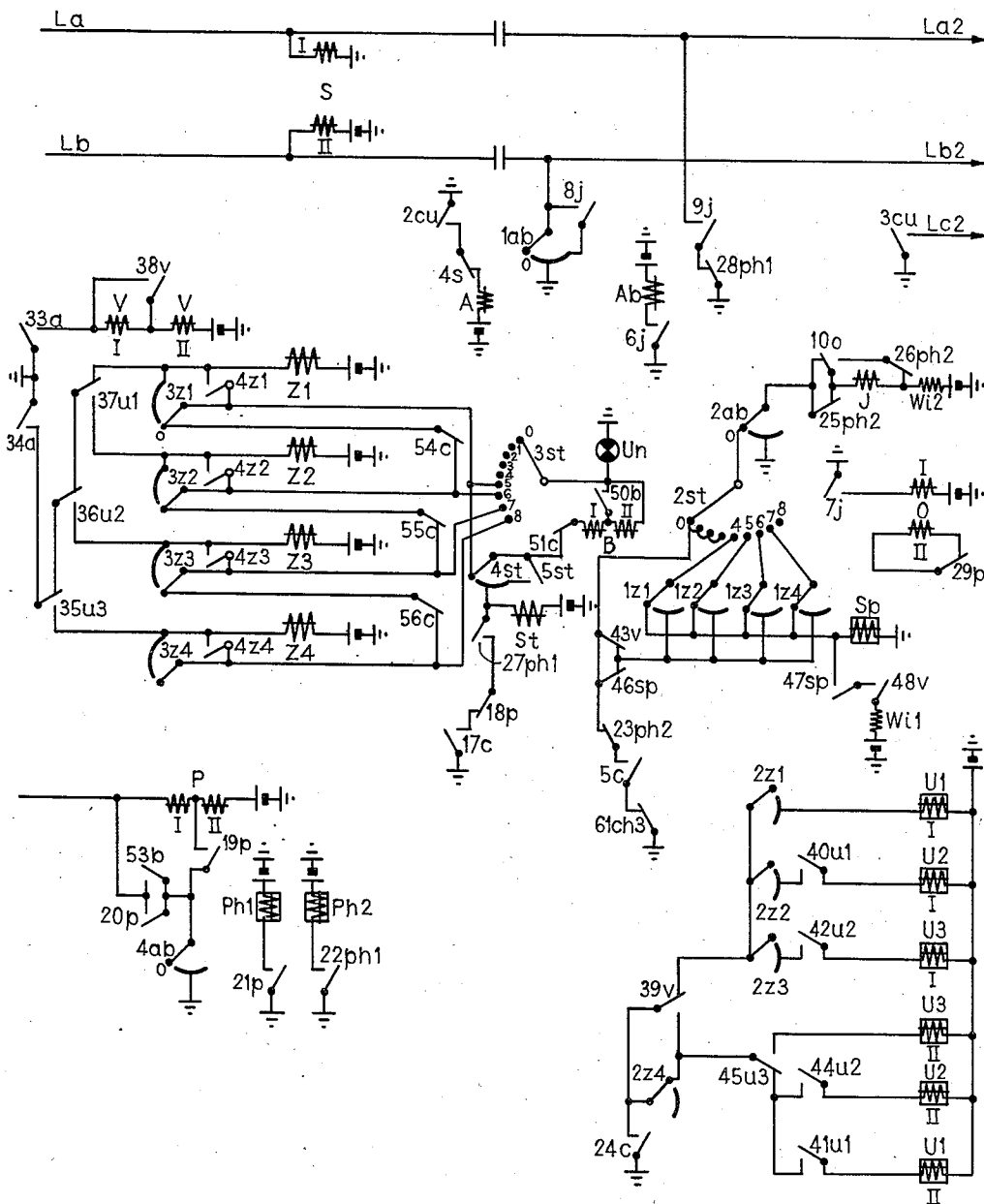
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2 Sheets-Sheet 2

FIG. 2a



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TELEPHONE SYSTEM

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The present invention relates to circuit ar-
rangements for telephone systems employing reg-
isters. Depending upon the form of the network
in which the registers are to be employed it may
be necessary when setting up particular calls to
cause the register to transmit additional impulse
trains. In particular cases the number and the
value of the initial impulse trains must be de-
termined in accordance with the setting of the
switches over which the register has been
reached.

The present invention sets out the way of con-
structing a register so that in accordance with
the seizure of the register over one or the other
of a plurality of approaches not only is the num-
ber of the impulse trains to be automatically
transmitted determined but also the value of
these.

The number of the additional impulse trains
to be transmitted can be varied at will without
having to make any alterations in the assessor
switches of the register.

The invention resides in that in accordance
with the seizure of one or other of a plurality of
approaches associated with a register markings
are effected both in the contact field of the
assessor switch of the register for determining
the value of additional impulse trains to be trans-
mitted and also in the control switch for deter-
mining the number of additional impulse trains
to be transmitted. By the process of marking
the control switch in accordance with the seizure
of one or other of the approaches the number
of additional impulse trains to be transmitted can
be varied within wide limits and thus a consid-
erable elasticity is imparted to the network.

A further characteristic of the invention resides
in the manner of arranging the characterizing
means in the approaches and in the manner of
effecting the marking in a multiple field of the
assessor which is provided in common with the
register switches.

Embodiments of the invention are represented
in the drawings but the invention is not limited
to these embodiments. Fig. 1 shows a layout of a
telephone system employing a register R equipped
according to the invention. Figs. 2 and 2a when
placed side by side with Fig. 2 to the left of Fig.
2a, show the detailed circuit arrangements of
the register R.

Referring now particularly to Fig. 1, it will be
seen that the register R cooperates with a re-
peater Ue and may be reached over any of a
plurality of approaches. If the register R is
seized over the group selector IGW a single im-

pulse train is automatically transmitted for set-
ting the selector IIIGW while the other impulse
trains required for setting up the call are taken
up by the register R and are transmitted again
either translated or if necessary untranslated.
The value of the additional impulse trains to be
transmitted can be determined in accordance
with the level over which the register R was
seized by the group selector IGW. In such a case
the digits serving to set the selector IGW are re-
peated automatically by the register R.

If the register R is seized over a level of the
second group selector IIGW two impulse trains
are automatically transmitted before the trans-
mission of the impulse trains transmitted by the
calling station and registered in the register R.
In the case of this transmission also the value
of the levels of the switches IGW and IIGW over
which the register was seized can be characterized
in the register so that the impulse trains trans-
mitted by the latter correspond in value to the
digits which served to set the switches IGW and
IIGW.

When the register R is seized over the third
group selector IIIIGW three impulse trains are
automatically transmitted before the digit regis-
tered in the register. When the register R is
seized over the group selector GWi no automatic
transmission of impulse trains takes place but
merely the registration and retransmission of the
impulse trains transmitted by the calling station.
Naturally if necessary translation can take place
or the number of impulses can be changed or
corrected.

Fig. 2 represents the details of the register R
indicated in the Fig. 1. St represents a control
switch having wipers 1st, 2st, 3st and 4st and
contacts 5st and 6st associated with it. The
wipers 1st—4st are advanced in steps when the
rotary magnet St is operated. Contacts 5st and
6st are closed each time the magnet St energizes
and opened again when it deenergizes. Ab in-
dicates the rotary magnet of an assessor with
which are associated the wipers 1ab, 2ab, 3ab
and 4ab. Z1, Z2, Z3 and Z4 indicate the mag-
nets of switches which serve to receive the im-
pulse trains transmitted by the calling station.
Four wipers are associated with the individual
switches Z1—Z4 and advance in steps on the op-
eration of the corresponding magnets. In addi-
tion these switches possess off-normal contacts
4z1—4z4 which are closed each time the asso-
ciated magnet energizes and are opened again
when this deenergizes.

The seizure of the register takes place over

the preceding group selectors whose c-wipers test on one of the approaches Lc1I to Lc10I or Lc1II to Lc10II or Lc2I to Lc30. In accordance with the seizure of one of these approaches a marking is effected in the multiple field VL, which is hunted for by the wiper 3ab of the assessor Ab. Furthermore in accordance with the seizure of one of these approaches a contact is marked in the bank associated with wiper 1st of the control switch St for the purpose of determining the number of additional impulse trains to be transmitted.

If there is no additional transmission of impulses required on the seizure of the register the latter must take place over the approach Lx. In this case switching operations take place (at contacts 55ch3 and 61ch3) which prevent additional impulses from being transmitted.

In the individual approaches to the register relays C1 to C10, C21 to C30, Ch1, Ch2, Ch3 and Ch4 are arranged which determine the mode of operation of the register. Naturally in place of these relays switches could be used which would hunt for the approach seized after the seizure of the register and would effect corresponding markings in the multiple field VL of the register and at the contacts associated with wiper 1st of the control switch.

The establishment of a connection will now be explained with reference to the arrangement shown in Fig. 2. The register will be assumed to have been seized over lead Lc2II. This corresponds in Fig. 1 to the register being seized over the group selector IIGW and over the second level of this. Two impulse trains are automatically transmitted from the register the first impulse train being "Five" and the second "Two." It will be assumed that the group selector IGW has reached the group selector IIGW over the level 5. Those digits therefore which were selected in order to reach the register are repeated by the register. It will be understood, however, that according to the manner in which the system is arranged other digits could be arranged to be repeated by the register, the value of the individual digits being determined by the markings in the multiple field VL.

When the register is seized over the approach Lc2II the relays C2 (winding II), Ch1, Cu and C are operated. The register is guarded by switching means in the preceding group selector in known manner. Relay S energizes over its windings I and II in the leads La and Lb over the speaking wipers of the seizing group selector. Relay S operates its contacts and at contact 4s breaks the circuit for relay A before relay Cu closes contact 2cu. Contact 3cu connects earth to the outgoing line Lc2 thereby seizing succeeding devices. Through the energizing of relay C contacts 54c, 55c and 56c are opened without effecting any switching operation. In addition contacts 16c, 17c and 51c are also operated and similarly do not evoke any switching operations. Through the energizing of relays C2 and Ch1 on the seizure of the register the contacts 11c2, 12c2, 13ch1, 14ch1 and 15ch1 are operated. On the closing of contact 5c the following circuit is set up: earth, contacts 61ch3, 5c, 23ph2, wiper 2st in position 0, wiper 2ab in position 0, contact 25ph2, relay J, resistance Wi2, battery and earth. Relay J energizes and connects earth to the outgoing lead Lb2 over contact 8j. This connection of earth can be used for controlling succeeding devices. It remains connected during the transmission of impulses. Through the closing of con-

tact 8j earth is applied to lead La2 over contact 28ph2 whereby succeeding numerical impulse receivers, which are not shown, receive the first impulse. Contact 7j energizes winding I of relay O. Contact 8j effects the energizing of magnet Ab so that the wipers 1ab, 2ab, 3ab and 4ab are advanced one step. Over contact 10o relay J is short-circuited and releases. The first impulse which was transmitted over contact 8j is now terminated. The opening of contact 8j is not effective as regards lead Lb2 since wiper 1ab maintains the connection of earth. Through the opening of contact 7j relay O is deenergized. Contact 10o restores to normal, whereupon relay J energizes again and while advancing the assessor Ab transmits an impulse over the lead La2 over contact 8j. The earth serving to energize relay J during the further stepping of the assessor is applied over the segment traversed by wiper 2ab of the assessor. Winding II of relay O is short-circuited over contact 29p so that relay O is made slow-to-operate thus limiting the duration of the succession of individual impulses transmitted over the line La2. The relays J and O operate in rhythm while advancing the assessor. When wiper 3ab reaches contact 5 the following circuit is established for relay P: earth, battery, windings II and I of relay P, wiper 3ab in position 5, multiple field VL, contact 15ch1, contact O of the control switch wiper 1st, contact 16c and earth. Relay P energizes and prevents the transmission of further impulses. Since relay P energized after the fifth step of the assessor Ab five impulses have been transmitted over the outgoing line. A locking circuit for winding II of relay P is completed by contact 19p. This passes from earth over wiper 4ab of the assessor Ab, contact 19p and winding II of relay P to battery and earth. Contact 21p switches on relay Ph1 and contact 22ph1 switches on relay Ph2. The contacts 25ph2 and 26ph2 are opened so that relay J is now no longer caused to deenergize through being short-circuited but stands under the direct control of contact 10o. Contact 29p breaks the short-circuit across winding II of relay O so that relay O in association with relay J which is now controlled directly operates at a more rapid rate than during the preceding impulse transmission. Any further transmission of impulses over the line La2 is prevented after the operation of relay P by the opening of contact 28ph1. Relay J operates relay O again over contact 7j, whereupon relay O interrupts the energizing of relay J by switching over contact 10o. During this operation of relays J and O the assessor Ab is advanced over contact 6j until the wipers of this switch reach position 0. In this position relay P is deenergized since the locking circuit for winding II of relay P is broken at wiper 4ab in position 0. On the release of relay P the circuit for relay Ph1 is opened at contact 21p. Relay Ph1, however, is a slow to release relay and makes a delayed release. Accordingly before relay Ph1 has released the following circuit is set up for magnet St of the control switch. Earth, contacts 17c, 18p, 27ph1, control switch magnet St, battery and earth. The control switch St is advanced one step. On the release of relay Ph2 the following circuit is established for relay J: earth, contacts 61ch3, 5c, 23ph2, wiper 2st of the control switch St in position 2, wiper 2ab of the assessor in position 0, contact 25ph2, relay J, resistance Wi2, battery and earth. Relay J energizes and operates relay O (winding I). At contact 8j a control potential is again applied to

the line Lb2 and over contact 9j the first impulse of the second additional impulse train to be transmitted is sent out from the register. The release periods of relays Ph1 and Ph2 after the assessor has been restored to normal are such that a succeeding switch has sufficient time, while hunting freely to find a line. The stepping of the assessor Ab now proceeds in the same way under the control of relays J and O as has been described in connection with the transmission of the first impulse train. When during its stepping wiper 3ab of the assessor reaches position 2 the following circuit is established after two impulses have been transmitted: earth, battery, windings II and I of relay P, wiper 3ab of the assessor in position 2, lead 2 of the multiple field VL, contact 12c2 of relay C2, contact 13ch1, contact 1 in the bank of the control switch wiper 1st, contact 16c and earth. Relay P locks up over contact 18p and energizes relay Ph1 over contact 21p. Relay Ph1 energizes relay Ph2. Contact 28ph1 prevents the transmission of further impulses over contact 9j. The further stepping of the assessor to position 0 takes place in the same way as described in connection with the transmission of the first impulse train in that after the opening of contacts 26ph2 and 25ph2 relay J is directly controlled by contact 10o of relay O. When the assessor Ab reaches position 0 the earth connected to the lead Lb2 is disconnected at wiper 1ab. Moreover, at wiper 4ab the circuit for winding II of relay P is broken. Relay P releases and closes contact 18p. The following circuit is established for magnet St before relay Ph1 releases: earth, contacts 17c, 18p, 27ph1, magnet St, battery and earth. Accordingly the wipers 1st, 2st, 3st and 4st are advanced one step so that they now occupy position 2. Since now no further additional impulses are to be transmitted the control switch St is advanced before the assessor Ab becomes operative. In position 2 of the control switch St the following circuit is completed for relay P before relay Ph1 releases: earth, battery, windings II and I of relay P, contact 6st of the energized magnet St, contact 30ch2, contact 2 in the bank of the control switch wiper 1st, contact 16c and earth.

Relay P energizes and maintains relays Ph1 and Ph2 energized. At contact 18p it opens the energizing circuit of magnet St. Magnet St releases and opens contacts 5st and 6st. On the opening of contact 6st relay P releases. By closing contact 18p relay P energizes the control switch magnet St again whereupon the control switch passes to position 3. In this position relay P energizes over the closed contact 6st and causes the control switch magnet to release by opening contact 18p. Contact 6st is opened so that relay P releases again and switches on the control switch magnet St over contact 18p. The control switch accordingly takes a further step forward and passes to position 4. Contact 6st is closed but does not cause relay P to energize. Relay P thus remains deenergized for a prolonged period so that relays Ph1 and Ph2 also release. The magnet St similarly releases and opens contacts 5st and 6st. The repetition of the digits for setting the group selectors IGW and IIGW, assumed to be 52 in the present example, is thus terminated. During the impulse repetition just described the calling subscriber will in most cases have already dialled the further digits of the wanted call number. These impulses are taken up by the relay S connected to the leads La and Lb. On each impulse relay S releases where-

upon contact 4s each time closes a circuit for relay A. Relay A operates its contacts and at the first impulse of a train energizes relay V over its windings I and II by closing contact 33a. Relay V then operates its contacts and short-circuits its winding I over contact 38v so that it does not release between the impulses of an impulse train. Through the closing of contact 34a the magnet Z1 of the meter Z1 is energized. The meter switch advances its wipers stepwise. If therefore the subscriber dials the digit five, five impulses pass to the magnet Z1, whereby the wipers of this switch take up the position five. When the first impulse train is ended contact 33a is opened for a prolonged period. This causes the release of relay V. When relay V releases the following circuit is set up for relay U1 over contact 39v: earth, contacts 24c, 39v, wiper 2z1 of the meter switch Z1, winding I of relay U1, battery and earth. In this circuit relay U1 energizes. The metering switch Z2 is connected to the impulse contact 34a over contact 37u1.

On the first impulse of the second impulse train relay V is energized again. Relay U1 does not release when contact 39v is switched over since it remains energized over winding II in the following circuit: earth, battery, winding II of relay U1, contacts 41u1, 45u3, wiper 2z4 of the metering switch Z4 in position 0, contact 24c, and earth. If the metering switch Z2 has been set by transmitting for example the digit 6, then on the termination of this impulse train relay U2 becomes energized through the release of relay V. This circuit passes from: earth, over contacts 24c, 39v, wiper 2z2 in position 6, contact 40u1, winding I of relay U2 to battery and earth.

Relay U2 energizes and at contact 36u2 switches on the meter Z3. On the commencement of the third impulse train transmitted to the register sender V is energized again, whereupon a locking circuit for winding II of relay U2 is established over earth and contacts 24c, 39v, 45u3 and 44u2. After the setting of the metering switch Z3 for example by the digit 7 relay V releases again because contact 33a remains open for a prolonged period. Contact 39v now energizes relay U3 over its winding I over wiper 2z3 of the meter Z3 in position 7. Relay U3 operates its contacts and connects the magnet of the metering switch Z4 to the impulse contact 34a over contact 35u3. At contact 45u3 it establishes a locking circuit for winding II of relay U3. The last impulse train transmitted to the register from a calling station, comprising for example eight impulses, passes to the switch Z4. On the first impulse of this train relay V is energized again whereby contact 39v is switched over. Accordingly a fresh locking circuit for winding II of relay U3 is completed over contact 45u3. The metering switch Z4 receives the impulses transmitted from the calling station and in accordance with the eight impulses transmitted is set in position 8. After the end of this impulse train relay V releases, whereupon contact 39v assumes its rest position. The relays U1, U2 and U3 are now held energized over earth and contacts 24c and 39v and the operated wipers 2z1, 2z2 and 2z3.

As already described, the control switch after automatically transmitting the impulse trains 5 and 2 passes into position 4. Having reached this position, provided the metering switch Z1 is already set, the following circuit is established for relay J: earth, contacts 61ch3, 5c, 23ph2 and 46sp, the contact bank of wiper 1z1 of the switch ZL, wiper 1z1 in position 5, contact 4, in the bank

associated with wiper 2st of the control switch St, contact O of wiper 2ab of the assessor Ab, contact 25ph2, relay J, resistance Wi2, battery and earth. Relay J commences to cooperate with relay O in the manner already described in order to step the assessor Ab and to transmit impulses. The impulse train registered in the switch Z1 is transmitted over contact 9j. When wiper 3ab of the assessor reaches contact 5 the following circuit is set up: earth, contact 16c, wiper 1st of the control switch St in position 4, wiper 3z1 of the switch Z1 in position 5, the lead in the multiple field VL, wiper 3ab of the assessor in position 5, windings I and II of relay P, battery and earth. Relay P energizes and energizes relay Ph1. Relay Ph1 by opening contact 28ph1 terminates the outgoing impulsing over the line La2. The contacts 26ph2 and 25ph2 are opened. Further stepping of the assessor now takes place under the direct control of relay J over contact 10o of the relay O which is now no longer slow in its operation so that after the energizing of relay P the assessor is advanced at a more rapid rate to position 0. When it has reached this position the circuit for relay P is broken at wiper 4ab. Relay P releases and over contacts 17c, 18p and 27ph1 sets up a circuit for the control magnet St. The control magnet St energizes and advances the wipers of the control switch to position 5. When now relay Ph1 releases the control switch magnet St is deenergized. In position 5 of the control switch the following circuit is established for magnet Z1 over wiper 3st: earth, interrupter Un, wiper 3st, contact 5 of wiper 3st, wiper 3z1, winding of magnet Z1, battery and earth. In this circuit the switch Z1 is advanced until wiper 3z1 and thus also the switch Z1 have reached the zero position. On the release of relay Ph2 relay J energizes in the following circuit over contact 23ph2: earth, contacts 61ch3, 5c, 23ph2, and 46sp, contact bank of wiper 1z2, wiper 1z2 in position 6, contact 5 associated with wiper 2st, wiper 2st, wiper 2ab, contact 25ph2, relay J, resistance Wi2, battery and earth. In cooperation with relay O relay J advances the assessor Ab and transmits impulses in the manner previously described. When wiper 3ab of the assessor Ab reaches position 6, the following circuit is established for relay P: earth, contact 16c, wiper 1st, contact 5, wiper 3z2 in position 6, wiper 3ab in position 6, windings I and II of relay P, battery and earth. Relay P energizes and energizes relays Ph1 and Ph2. At contact 28ph the transmission of impulses is interrupted. The further stepping of the assessor Ab proceeds in the manner already described until the zero position is reached. In this position the locking circuit over winding II of relay P is broken at wiper 4ab whereupon the control switch is advanced into position 6 over contact 18p in the manner already described. After relay Ph2 has released relay J is subjected to current over wiper 1z3 of the metering switch Z3 and wiper 2st of the control switch in position 6 and in cooperation with relay O advances the assessor Ab and transmits impulses. When the assessor reaches position 7 the following circuit is established over wiper 3z3: earth, contact 16c, wiper 1st, contact 6, wiper 3z3, position 7, wiper 3ab in position 7, windings I and II of relay P, battery and earth. By energizing relay Ph1 relay P terminates the transmission of further impulses over the line La2 because contact 28ph1 is opened. Relay J becomes energized over: earth, the contact bank associated with wiper 2ab and contact 10o and

in cooperation with relay O switches the assessor Ab into position 0. In this position relay P is again caused to deenergize. The control switch receives an impulse over contact 18p so that its wipers assume the position 7. In this position wiper 3z4 is switched on. The advancing of the assessor Ab is initiated after the release of relay Ph2 over contact 23ph2 and wiper 1z4. When the assessor Ab advances its wiper 3ab to position 8, relay P becomes energized over earth, contact 16c, wiper 1st, contact 7 associated with wiper St, wiper 3z4 in position 8, wiper 3ab in position 8, relay P (windings I and II) battery and earth. Relay P is operated and by energizing Ph1 terminates the transmission of impulses over line La2. Relay J energizes over: earth, wiper 2ab and contact 10o and in cooperation with relay O causes the assessor Ab to be advanced to the zero position in the manner previously described. In this position relay P releases because its locking circuit is opened at contact 4ab. The control switch St receives an impulse over earth and contacts 61ch3, 5c, 18p and 27ph1 whereupon it passes into position 8. Relay Ph1 releases. Relay J is no longer energized because earth is not connected to contact 8 of wiper 2st.

When the wiper 3st is set in positions 6, 7 and 8 the switches Z2, Z3 and Z4 release in the manner which has already been described in the case of the switch Z1 when the wiper 3st was set in position 3. The control switch St is only set in the rest position on the release of the connection and the deenergizing of relay C. When the connection over the leads La and Lb is released the seizing potential which is connected in any known manner to the c-lead of the seizing group selector is disconnected. Accordingly relays C, Cu and the relays disposed in the leads to these relays release. Relay C restores its contacts to normal whereby the following circuit is set up for the control switch St: earth, interrupter Un, windings II and I of relay B, contact 51c, wiper 4st of the control switch St in position 8, advancing magnet St, battery and earth. The interrupter Un now advances the control switch in steps until it has reached the zero position in which wiper 4st breaks the circuit for magnet St.

As has already been stated, when the control switch St was set in position 5 the counting switch Z2 had its setting assessed and the switch Z1 was restored to normal. By means of this successive release of the individual switches at the time of the assessing operation it is possible to use the individual receiving switches several times in succession in that the switches Z1, Z2, etc., are again connected to the control switch contacts which lie beyond the contact over which the switch Z4 is influenced.

When the transmission of additional impulse trains is terminated the control switch St occupies position 4 as previously described. In the event of no impulses having been transmitted to the register meanwhile from the calling station, relay Sp now becomes operative. As soon as the assessor Ab has reached its rest position and relay Ph2 has released, the following circuit is set up: earth, the winding of relay Sp, wiper 1z1 of the switch Z1 in position 0, position 4 of wiper 2st, position 0 of wiper 2ab, contact 25ph2, relay J, resistance Wi2, battery and earth. In this circuit relay Sp energizes while relay J obtains insufficient current to energize. Relay Sp opens contact 46sp and closes contact 47sp. The failure of relay J to energize prevents the operation of the assessor Ab. If impulses are transmitted

from the calling station relay A is impulsively operated in the manner already described and relay V energizes over contact 33a on the first impulse. Through the closing of contact 48v a locking circuit is set up for relay Sp which passes from earth over the winding of relay Sp and contacts 47sp and 48v, resistance W1 to battery. This circuit is maintained throughout the impulse train transmitted from the calling station. Contact 43v is similarly opened so that the earth connected at contact 61ch3 cannot pass to relay J over wiper 121 of the switch Z1 which is now set and no premature advance of the assessor Ab occurs. The setting of switch Z1 is first assessed after the termination of the impulse train setting this switch in that the following circuit is established for relay J on the release of relay V through the closing of contact 43v: earth, contacts 61ch3, 5c, 23ph2, 43v, wiper 121, contact 4 associated with the wiper 2st of the control switch, wiper 2st, wiper 2ab, contact 25ph2, relay J, resistance W12, battery and earth. Relay Sp releases through the opening of contact 48v. On account of the energizing of relay J relay O is operated whereupon the assessor is advanced in the manner already described. When wiper 3ab reaches the position marked at wiper 321, the circuit already described for relay P is established. The transmission of further impulses is prevented by the energizing of relay Ph1. The contacts 25ph2 and 26ph2 are opened so that the assessor Ab moved to the rest position in small steps as already described. When the rest position is reached relay P releases and by opening contact 21p promotes the release of relay Ph1. The control switch magnet St receives an impulse through the closing of contact 18p so that the wipers of the control switch pass to position 5.

If the control switch has reached position 5 and the switch Z2 has not yet been set, relay Sp energizes again. Contact 46sp is opened and contact 47sp closed. No energizing of relay J and consequent energization of relay O takes place so that the assessor is not set in operation. If now impulses are transmitted to the switch Z2 by the calling station the wiper 122 is advanced. No energizing circuit for relay J is set up for this wiper, however, since on the reception of impulses relay V is energized as previously described so that contact 43v is opened. Over contact 48v a locking circuit is set up for relay Sp passing over contact 47sp. Only on the termination of the impulse train setting the switch Z2 is an energizing circuit established for relay J on the release of relay V.

Relay Sp therefore ensures that the energizing circuit for relay J shall be broken so long as impulses are being sent to a counting switch which has been prepared to be assessed by the control switch. The transmission of impulses can accordingly only commence when the counting switch to be seized has terminated its setting.

If the register is seized over one of the approaches Lc21 to Lc30 a relay characterizing the particular approach in this group energizes as well as the group relay Ch2. If for example the seizure takes place over the lead Lc30 the relays C30 and Ch2 energize in the approaches and relays C and Cu in the register as was made clear in the description of the first embodiment. Relay Ch2 operates the contacts 30ch2, 31ch2 and 32ch2. Accordingly in addition to the marking of the multiple field over contact c30 further markings are made which cause the digit 2 to be transmitted as the first impulse train, the digit

5 as the second impulse train and the digit 0 as the third impulse train automatically from the register. These digits correspond to a seizure of the register after the group selector IGW (Fig. 1) has been set on level 2, the group selector IIGW has been set on level 5 and the group selector IIIGW has been set on level 10.

The assessing operations correspond fundamentally to the operations already described in connection with the seizure of the register over the group selector IIGW in Fig. 1. The difference resides merely in the number of impulse trains to be transmitted. The operation differing from those already described will be described briefly.

After relay C has energized in the register relay J is energized on the closing of contact 5c over the circuit commencing at contact 61ch3 and passing to relay J over wipers 2st and 2ab. Relay J causes relay O to energize, whereupon these two relays energize and release intermittently and thus transmit impulses over contact 9j. The assessor Ab is advanced through the impulsive operation of contact 6j. When the assessor Ab with its wiper 3ab reaches the line L2 marked over contact 32ch2 an energizing circuit is established for relay P over wiper 1st of the control switch and wiper 3ab of the assessor. Thus the further transmission of impulses is prevented in the manner previously described. Two impulses have been transmitted. The relays J and O are now switched over so that the assessor passes rapidly to the zero position. In this position the circuit for relay P is broken at wiper 4ab and the control switch St receives an impulse which passes over the contact 21ph1 which has not yet released. The control switch passes into position 1. When relay Ph2 releases after the release of relay Ph1 the energizing circuit for relay J is reestablished. Accordingly the assessor is advanced and now hunts for lead 5 in the multiple field VL marked over contact 31ch2 in position 1 of the control switch St. When wiper 3ab stands on this lead the transmission of impulses is terminated and the assessor Ab is brought to position 0 at a more rapid rate, whereupon through the deenergizing of relay P the control switch is brought to position 2. Five impulses are transmitted. Relays Ph1 and Ph2 release so that the energizing circuit for relay J which has frequently been referred to is established. The assessor now hunts for the line in the multiple field VL marked by contact c30 whereupon 10 impulses are transmitted.

When the assessor passes to position 10 relay P energizes thereby promoting the energization of relays Ph1 and Ph2. Contact 28ph1 prevents the transmission of further impulses. Relay J is operated over wiper 2ab so that the assessor Ab passes to position 0. In this position the circuit for relay P is broken at wiper 4ab so that the magnet St receives an impulse. The control switch advances to position 3. Here relay P energizes immediately since earth is connected at contact 16c over control switch contact 3 (wiper 1st) over the still closed contact 6st to winding I of relay P. Contact 18p is opened so that the control magnet Sp releases. Contact 6st is accordingly also opened whereupon relay P releases again. The magnet St therefore receives another impulse over contact 18p whereupon the wipers of the control switch pass to position 4. The relay now remains deenergized over a prolonged period so that relay Ph1 and thereupon relay Ph2 release. Contact 21ph1 opens the energizing cir-

cuit of the control switch magnet *St*. In position 4 of the control switch the setting of the switch *Z1* is assessed in the manner already described.

- 5 When the register seized over one of the approaches *Lc11* to *Lc101* only a single additional impulse train is transmitted. In this case the relays *Ch1* and *Ch2* remain deenergized so that the multiple field *VL* is connected over one of the contacts of relays *C1*—*C10* only in position 0 of the control switch. In positions 1 and 2 of the control switch the multiple field *VL* is not connected. Accordingly if for example the register is seized over the approach *LC21* in addition to relays *Cu* and *C* only relay *C2* energizes when the register is seized. Relay *C2* operates contacts *11c2* and *12c2*. The energizing of relays *Cu* and *C* starts an assessor *Ab* and seizes succeeding devices in the manner previously described. The assessor *Ab* is advanced through the closing of contact *5c*. When wiper *3ab* reaches contact 2 relay *P* energizes in the following circuit: earth, battery, windings *II* and *I* of relay *P*, contact 2, associated with wiper *3ab*, contacts *11c2* and *15ch1*, contact *O* associated with wiper *1st*, wiper *1st*, contact *16c* and earth. Relay *P* energizes relays *Ph1* and *Ph2*. The opening of contact *23ph1* terminates the transmission of impulses although the assessor *Ab* is advanced further.
- 30 When the assessor reaches position 0 relay *P* releases whereupon the control switch magnet *St* receives an impulse over contact *18p*. The control switch passes to position 1. Here relay *P* is energized again since in position 1 the following circuit is completed: earth, contact *16c*, control switch wiper *1st*, contacts *31ch2* and *14ch1*, contact *6st*, relay *P*, battery and earth. Relay *P* energizes and opens contact *18p*. Accordingly the control switch magnet *St* releases and contact *6st* is opened. Relay *P* releases and magnet *St* receives a fresh impulse over contact *18p* so that the control switch passes into position 2. In this position relay *P* energizes again over wiper *1st* (position 2) and contacts *30ch2* and *6st*. The control switch magnet *St* releases and contact *6st* opens. This interaction between the magnet *St* and relay *P* continues until the control switch has reached position 4. In this position relay *P* remains deenergized for a prolonged period so that relays *Ph1* and *Ph2* also release. When relay *Ph2* releases relay *J* receives current action over: earth, contacts *61ch3*, *5c*, *23ph2* and *46sp*, wiper *121*, wiper *2st* in position 4, wiper *2ab* in position 0, contacts *25ph2*, relay *J*, resistance *W12*, battery and earth. In cooperation with relay *O* relay *J* now advances the assessor while transmitting the impulse train registered in the switch *Z1* over contact *9j*. The further switching operations take place in the manner already described.
- 60 If the register is seized over the approach *Lc* relays *Ch3* and *Ch4* energize in the approaches and relays *Cu* and *C* in the register. Relay *Ch4* makes a delayed operation. Contacts *55ch3* and *61ch3* are operated. No automatic transmission of impulse trains takes place in this case. On the closing of contact *16c* the following circuit is set up: earth, contact *16c*, wiper *1st* (position 0) contact *55ch3*, windings *I* and *II* of relay *P1* battery and earth. Relay *P* energizes and energizes relays *Ph1* and *Ph2*. Contact *61ch3* is opened and prevents an energizing circuit being established for relay *J* on the closing of contact *5c*. When relay *Ph1* energizes contact *27ph1* is closed thereby preparing for the stepping of the control switch. When the slow relay *Ch4* energizes in the meanwhile it

closes contact *62ch4*. Relay *Ch3* is thus released by being short-circuited. Accordingly contact *55ch3* is opened so that relay *P* releases. Relay *P* closes contact *18p* whereupon the control switch magnet *St* receives an impulse over earth and contacts *17c*, *18p* and *27ph1*. The wipers of the control switch pass into position 2. Contact *6st* is closed so that relay *P* energizes again. The control switch magnet *St* releases through the opening of contact *18p* and opens contact *6st* whereupon relay *P* is also deenergized again. The interaction between the relay *P* and magnet *St* continues until the control switch *St* has reached position 4. The stepping of the assessor *Ab* during the advancing of the control switch is prevented since relay *Ph2* does not release during the reciprocal operation of relay *P* and magnet *St* and accordingly contact *23ph2* remains open. In position 4 of the control switch relay *P* is kept deenergized for a prolonged time so that relays *Ph1* and *Ph2* can release. The stepping of the assessor *Ab* is then promoted in the manner already described through the energizing of relay *J* by closing of contact *23ph2* and the digits registered in the switches *Z1*—*Z4* are transmitted as already described.

It may be mentioned that by suitably wiring the contacts of relays *C1*—*C10* and *C21*—*C30* in the multiple field *VL* any desired translation of the impulse trains to be transmitted can be brought about. Furthermore separate approaches to the register can be provided in which relays are operated which effect a plurality of direct markings in the multiple field *VL* and so bring about the automatic transmission of a plurality of impulse trains. Such an arrangement can be of importance for example for reaching supervisory positions and the like. The contacts *421*, *422*, *423* and *424* controlled by the magnets *Z1* and *Z4* serve to render partial impulses transmitted when the interrupter *Un* is connected up, inoperative.

What is claimed is:

1. In an impulse sender which may be seized over any of a plurality of paths, means for generating impulses, discriminating means operated in accordance with the path over which the sender is seized thereby to prepare one or more controlling circuits for said generating means, and means operated step-by-step to complete the prepared controlling circuits successively, said generating means operating under control of each circuit in turn to transmit a train of impulses.
2. In a register sender which may be seized over any of a plurality of paths, means for generating impulses, discriminating means operated in accordance with the path over which the sender is seized thereby to prepare one or more controlling circuits for said generating means, an incoming line, registering means controlled over said incoming line also to prepare one or more controlling circuits for said generating means, and means for completing in a predetermined sequence the circuits prepared both by the discriminating means and by the registering means, said generating means operating to transmit a train of impulses under control of each circuit in turn when that circuit is completed.
3. A register sender as claimed in claim 2, wherein the means for completing the prepared circuits includes a switch having a contact bank in which the prepared circuits appear and a wiper operated step-by-step, said circuits being completed in turn over said wiper.

4. A register sender as claimed in claim 2, wherein the circuits prepared by said discriminating means are completed in turn by the last-named means before or during the time the registering means is controlled over the line, those trains of impulses depending upon the path over which the register sender was seized thereby being transmitted independently of the operation of said registering means.

5. A register sender adapted to at times transmit impulses depending upon the mode of seizure of the register sender, including means for generating impulses, a plurality of paths over which the register sender may be seized, discriminating means operated in accordance with the path over which the register sender is seized thereby at times to prepare one or more controlling circuits for said generating means and at other times to prevent transmission of any impulses depending upon the mode of seizure of the register sender, an incoming line, registering means controlled over the incoming line also to prepare one or more controlling circuits for said generating means, and means for completing in a predetermined sequence the circuits prepared by the discriminating means, if any, and the circuits prepared by the registering means, said generating means operating to transmit a train of impulses under control of each circuit in turn when that circuit is completed.

6. In an impulse sender which may be seized over any of a plurality of paths, two switches, means for completing one or more circuits between the banks of said two switches depending upon the path over which the sender is seized, and an impulse generator operating under control of said two switches, said two switches co-operating during the sending of impulses by said generator to control in accordance with said completed circuits both the number of trains of impulses sent and the number of impulses in each train.

7. An impulse sender as claimed in claim 6, wherein as many trains of impulses are sent as there are circuits completed between the banks of said two switches.

8. An impulse sender as claimed in claim 6, wherein as many trains of impulses are sent as there are circuits completed between the banks of said two switches, and wherein each circuit determines the number of impulses in one train of impulses.

9. In an impulse sender which may be seized over any of a plurality of paths, discriminating means operated in accordance with the path over which the sender is seized, a switch, means for marking the bank of said switch one or more times in succession, the number of times the bank of said switch is so marked depending upon the path over which the sender was seized as

determined by said discriminating means, and means controlled by said switch for sending successive trains of impulses each dependent in number upon one of said markings of the bank of said switch.

10. In a register sender which may be seized over any one of a plurality of paths, discriminating means operated in accordance with the path over which the register sender is seized, an incoming line, digit registering means controlled over the incoming line, a switch, means for marking the bank of said switch one or more times in succession depending upon the path over which the register sender was seized and for marking the bank of said switch one or more times in another succession depending upon the digits registered by said registering means, and means controlled by said switch for sending trains of impulses each dependent in number upon one of said markings.

11. A register sender as claimed in claim 10, wherein said other succession of markings follow said first succession.

12. An impulse sender having seizing paths of different classes, discriminating means operated in accordance with the class of path over which the sender is seized, and an impulse generator controlled by said last means for transmitting, responsive to seizure of the sender, one, two, or three trains of impulses, the number of trains of impulses depending upon the class of path over which the sender was seized.

13. An impulse sender adapted to at times transmit impulses depending upon the mode of seizure of the sender, including seizing paths of different classes, discriminating means in the seizing paths operated to determine the number of trains of said impulses to be transmitted depending upon the mode of seizure, and an impulse generator controlled by said last means at times transmitting, responsive to seizure of the sender, one, two, or three trains of impulses.

14. An impulse sender which has seizing paths of different classes and which may be seized over any of a plurality of paths in each of said classes, having primary discriminating means and secondary discriminating means operated in accordance with, respectively, the class of the path over which the sender is seized and the particular path over which the sender is seized, and means controlled by both the primary and the secondary discriminating means for transmitting trains of impulses, the number of trains of impulses transmitted depending upon the class of path over which the sender was seized, and the number of impulses in one of the trains depending upon the particular path of that class over which the sender was seized.