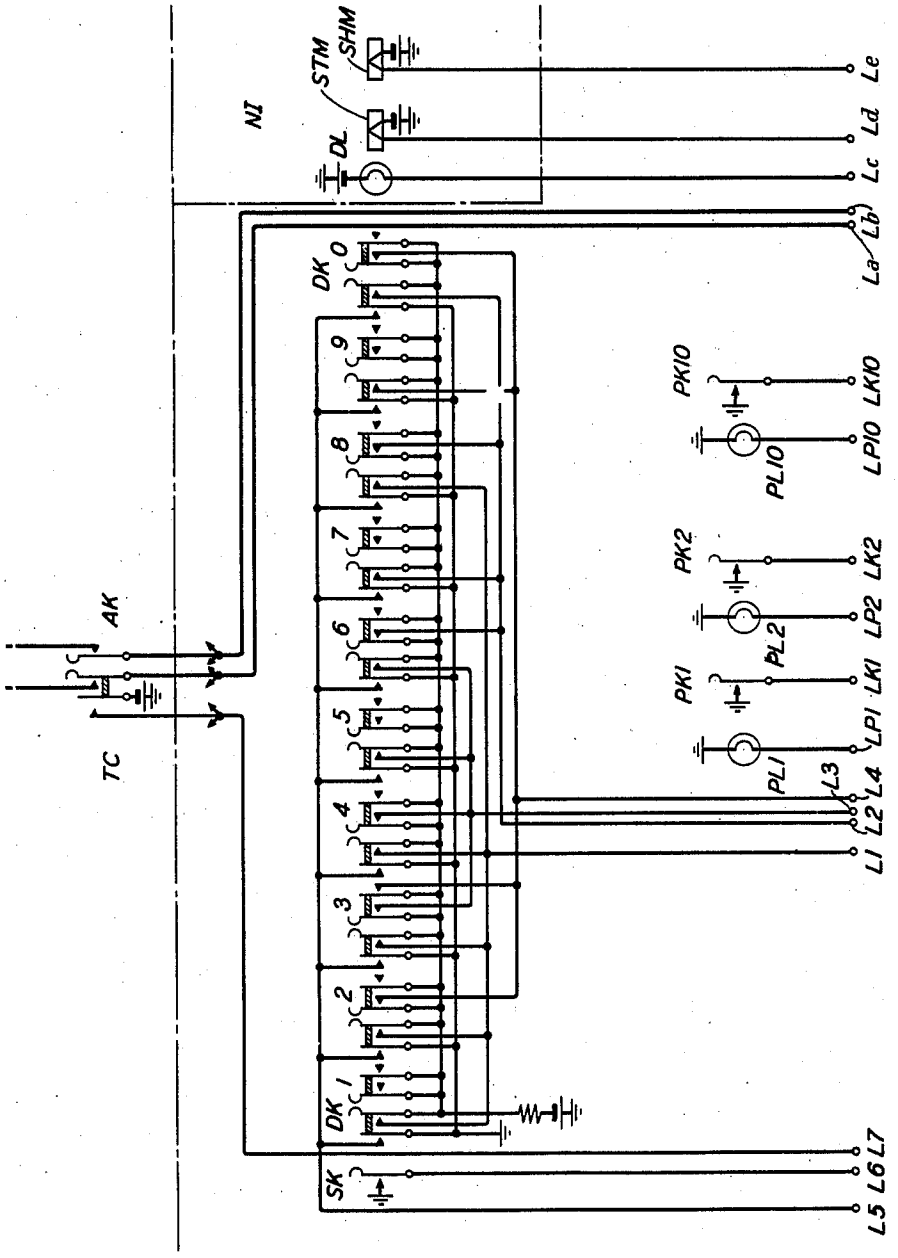
Nov. 2, 1943. W. POULIART 2,333,195

KEY PULSING SENDER FOR TELEPHONE SYSTEMS

Filed March 30, 1940 3 Sheets-Sheet 1

FIG. 1



INVENTOR
W. POULIART
BY
P. C. Smith
ATTORNEY

Nov. 2, 1943. W. POULIART 2,333,195

KEY PULSING SENDER FOR TELEPHONE SYSTEMS

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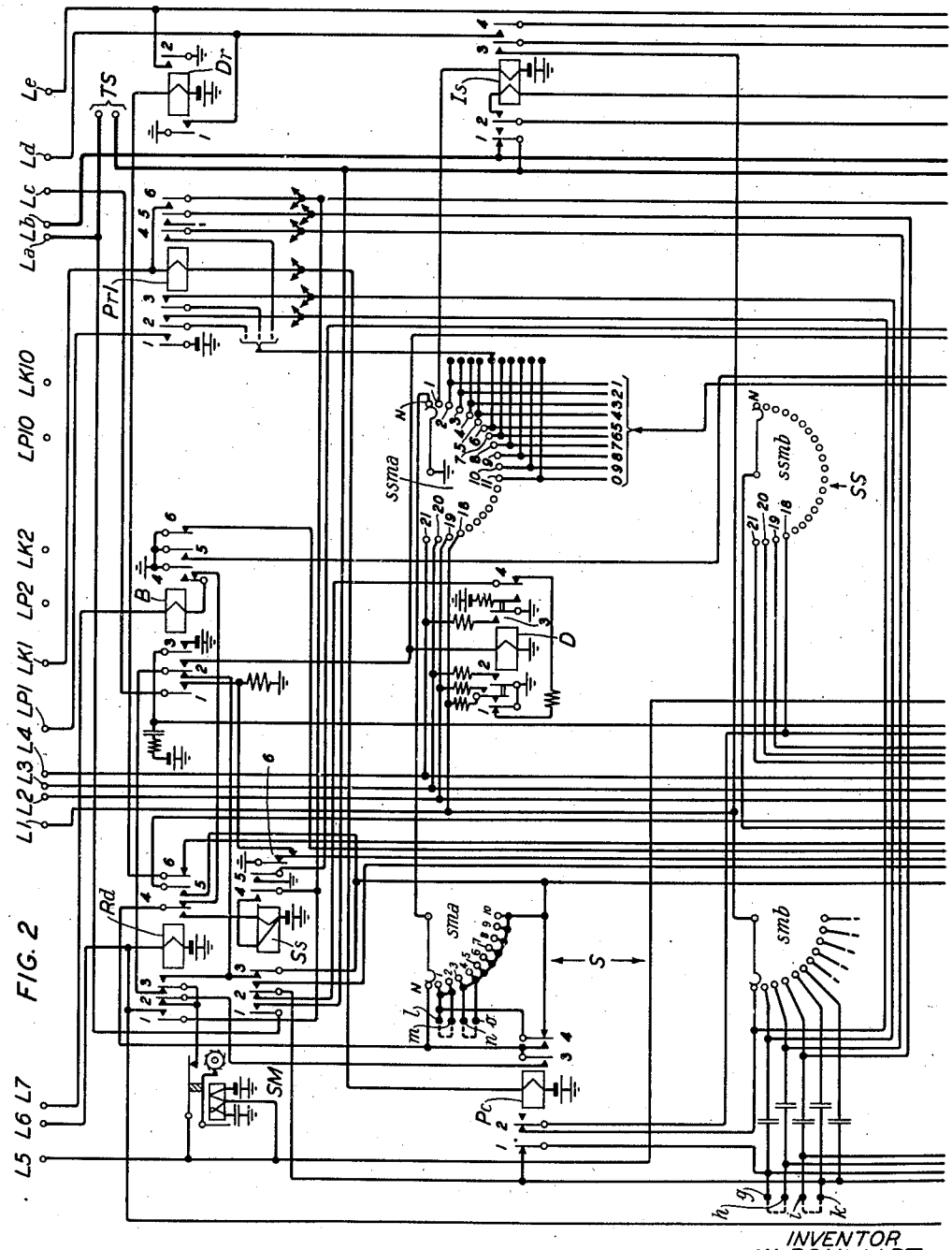


FIG. 2

Nov. 2, 1943. W. POULIART 2,333,195

KEY PULSING SENDER FOR TELEPHONE SYSTEMS

Filed March 30, 1940 3 Sheets-Sheet 3

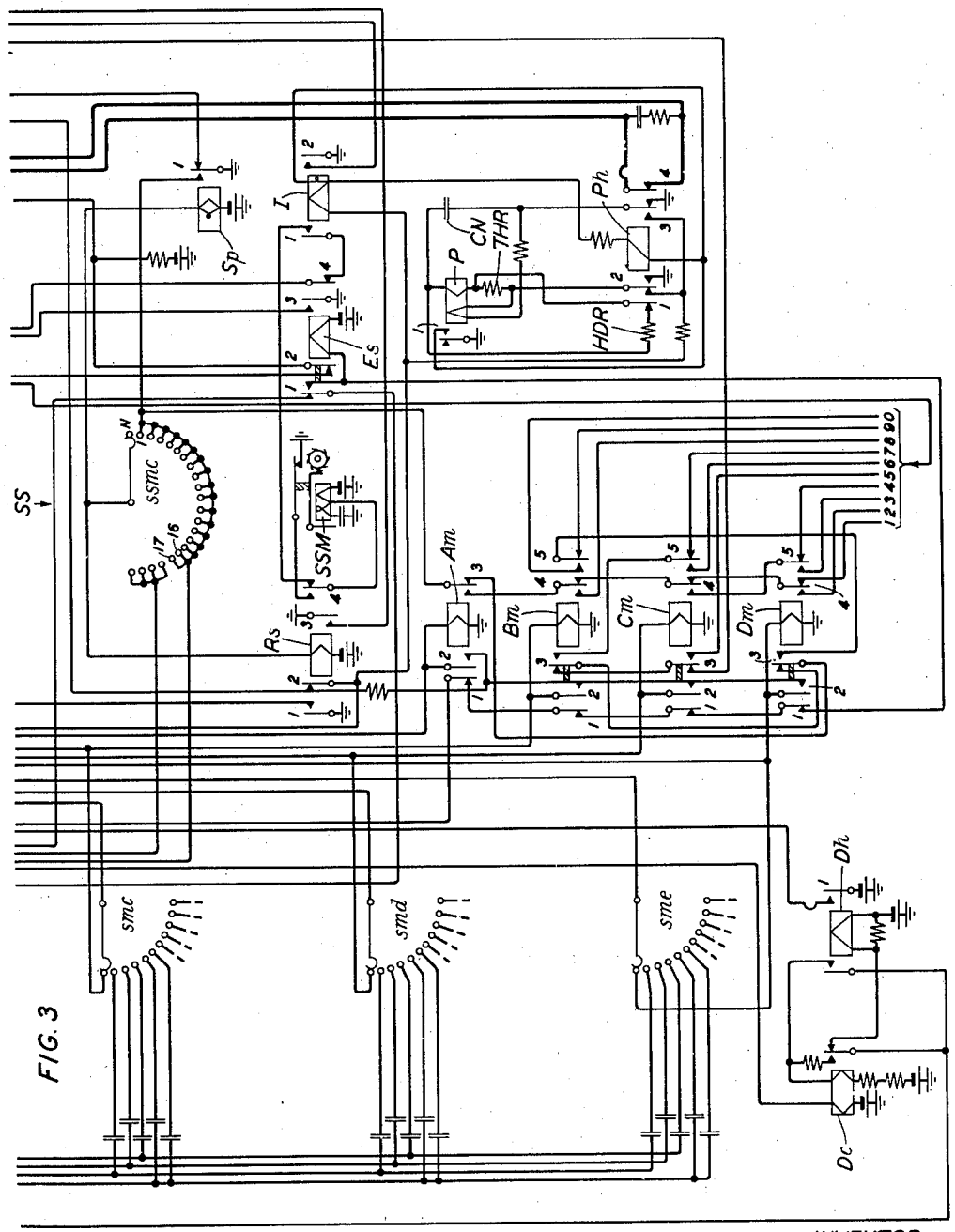


FIG. 3

INVENTOR
W. POULIART
BY
P. C. Smith
ATTORNEY

Patented Nov. 2, 1943

2,333,195

UNITED STATES PATENT OFFICE

2,333,195

KEY PULSING SENDER FOR TELEPHONE SYSTEMS

Willy Pouliart, Antwerp, Belgium, assignor, by mesne assignments, to International Standard Electric Corporation, a corporation of Delaware

Application March 30, 1940, Serial No. 326,864
In Great Britain April 4, 1939

9 Claims. (Cl. 177—380)

This invention relates to electrical character storage and transmission equipment.

It is particularly adapted for use in key controlled impulse sender equipment and register controllers for telephone exchange systems but is not limited in its application thereto.

The equipment may be arranged to control the forward transmission of characters or to exercise control in response to signals transmitted thereto from equipment to be controlled, as for instance, in a register of the kind used in the rotary system of automatic telephony.

The object of the invention is to provide cheap and reliable equipment of the above type.

The main feature of the invention comprises an electrical character storage and transmission equipment characterized by groups of condensers for storing different characters, means for transferring the characters in turn from the condenser group to an electromagnetic contact-making marker device arranged to control the value of impulse combinations transmitted from or to the equipment.

The invention will be clearly understood from the following description of one embodiment shown in the accompanying drawings in which:

Fig. 1 shows a telephone operator's key-set together with a number indicator;

Figs. 2 and 3 together show digit storage and transmission equipment. Fig. 3 should be placed below Fig. 2.

When a private automatic branch exchange attendant wishes to originate an outgoing city call, she throws the answering key of the cord or trunk over which the call is going to be set up. The fact that the aforementioned key is thrown, busies the attendant's key sending register circuit and a signaling lamp DL is made to light indicating that the register is ready for the reception of digits. The attendant then depresses one after the other, the keys corresponding to the wanted subscriber's number and after the complete insending is finished, she depresses a starting key in order to cause impulse trains corresponding to the aforementioned number to be sent out towards the exchange.

During the time that impulses are being sent out, the signaling lamp DL is made to light dimly. The full relighting of lamp DL after the depression of the starting key thus indicates that the complete number which was keyed has been retransmitted.

When, after the call has been set up, the answering key is restored to normal, lamp DL is extinguished and the key sending register is available for a new call.

In case a number of prefix keys are provided in addition to the ordinary digit keys, the attendant, in order to reach a subscriber belonging to an exchange area characterized by a given prefix, may depress the prefix key corresponding to that area and then send in by means of the digit keys the local number of the subscriber; the attendant can, however, also reach the same subscriber by keying up the complete number by means of the digit keys. If required, a signaling lamp may be associated with each prefix key in order to provide a means of checking, during the setting up of the call the direction which has been picked up.

The restoration of the answering key at any moment during the setting up of a call immediately releases the key sending register which returns to normal and thus becomes available for a new call.

The connection of the attendant's key sending register and key-set to a private automatic branch exchange only requires the opening up of the *a* and *b* wires to the attendant's positional circuit in order to insert the register in series with the dial, and the connection of one wire towards the answering keys of the trunks or cords in order to receive an indication when an answering key is depressed. In case there is no contact available on the answering keys, it is generally possible to obtain the same indication by adding a common pilot relay in series with a circuit controlled from one of the existing make contacts on the answering keys.

Although the attendant's key sending register is inserted in the *a* and *b* wires of the attendant's positional circuit, the aforementioned wires remain normally closed when the register circuit is not in use, so that the attendant may in case of circuit failure, use the dial instead of the key-set without having to effect any special operation for the purpose.

The operation of the circuit is such that whenever the starting key is depressed after a number of digits have been keyed, the corresponding impulses are sent out on the line and impulsing stops automatically after out-sending of the train corresponding to the last digit keyed. The line then remains closed towards the exchange as in the case of a dial and the circuit is restored to the conditions existing before the digits had been keyed. This last-mentioned feature makes the register circuit also suitable for open-numbering systems, where the complete subscrib-

er's number may have to be transmitted in two or more parts, each part being sent out after reception of a new dialing tone; in that case, the attendant must, after the reception of each dialing tone, key up and send the corresponding part of the subscriber's number.

The circuit has been designed for a capacity of 11 digits, that is, it is possible to key an 11-digit number and retransmit the aforementioned number by a single depression of the starting key.

The storing of the digits keyed by the attendant is based on the condenser charge principle, four condensers being required for each digit stored.

The register circuit is provided with three terminals for connection of a number indicator by means of which it is possible to check the number which is effectively sent out in the form of impulse trains.

The number indicator is of the type comprising a number of indicator wheels arranged to be set in turn by common stepping mechanism which is shifted from wheel to wheel between digits received. It comprises a stepping magnet and a shift magnet and simultaneous operation of the magnets causes all the indicator wheels to be homed.

Switch and Relay Functions

The register circuit comprises a switch S of the marker type used as distributing switch for the successive digits keyed. The same switch is also used as distributing switch during the transmission of the successive impulse trains corresponding to the digits received and stored on the condensers.

A second marker switch SS is used for counting the number of impulses to be transmitted towards the exchange.

A group of relays A*m*, B*m*, C*m* and D*m* is provided to record the combination of charged condensers corresponding to a given digit and translate the combination into "marking" of one out of 10 marking wires connected to the outstepping switch SS. These relays are used over and over again and give the required marking for each impulse train.

Reception of digits keyed on number keys

When the attendant throws the answering key AK of a trunk or cord circuit TC over which a call is to be set up, battery is connected to lead No. 7 in the key-set and causes the energization of relay B in the register circuit, battery, winding of B, *b*4, *rd*4, wipers *sma* and *ssma* in home positions, ground.

Relay B once energized locks to direct ground via *b*4 before opening its energizing circuit, and introduces the following conditions in the circuit:

(1) A full ground via *ss*6, *b*1 is connected to terminal Lc in order to light the signaling lamp DL of the number indicator NI thus indicating that the key sending register is ready for reception.

(2) A circuit is completed for energizing relay D in series with the winding of the switch magnet SM via *b*2, *rd*3, interrupter and winding of SM. The resistance of relay D is such, however, that the power magnet SM of the switch S is not energized.

(3) Via *b*3 and *b*5, relay B gives respectively the general battery and ground required for further circuit operations.

(4) Contacts *b*6 disconnect the ground which may be required for restoring switch SS on a premature release.

Reception of first digit

When the digit key corresponding to the first digit is depressed, a ground is given on lead L5 whichever key is depressed for energizing the marker switch magnet SM and battery is connected to certain of the wires L1 to L4 in accordance with a code combination corresponding to the keyed digit. The 10 combinations used are as follows: digit 1, battery on L1; digit 2, battery on L1 and L4; digit 3, battery on L1, L3, L4; digit 4, battery on L1, L3; digit 5, battery on L3; digit 6, battery on L2, L3; digit 7, battery on L2; digit 8, battery on L1, L2; digit 9, battery on L4; digit 0, battery on L2, L4.

Relays A*m*, B*m*, C*m* and D*m* energize in accordance with the battery connections on terminals L1, L2, L3 and L4 via *pc*2, *smb*, *smc*, *smd* and *sme*, respectively.

During the time that the digit key is maintained depressed and magnet SM is operated, relay D is short-circuited and deenergizes thus removing the earth shunts which would otherwise be connected to relays A*m*, B*m*, C*m* and D*m*. The operated relays lock via their contacts 2, *rs*2, *b*3.

At the moment the digit key is released, the marker switch S makes one step and when its interrupter is reclosed, relay D reenergizes in series with the marker switch magnet SM.

Reception of the second digit

At the moment relay D has reclosed its make contacts, and switch S is standing in position 1, the condenser connected to terminal 1 of arc *smb* is charged as follows: battery *d*4, *ss*2, *pc*1, *smb*, *d*1, earth.

The other three condensers connected to arcs *smc*, *smd*, *sme* in position 1 are charged in similar circuits.

When the digit key corresponding to the second digit is depressed, the power magnet SM is energized as explained previously for the first digit and relay D releases.

When, however, relay D has closed its break contacts the condensers connected to certain of the leads L1, L2, L3, L4 will be charged in the opposite direction to the charge given previously by relay D provided that on the leads in question, battery is connected by the depression of the digit key. The condensers connected to the remaining leads retain their previous charge. When the digit key is released, switch S makes one step and relay D reenergizes. The condensers connected to the terminals 1 on arcs *smb* to *sme* are all charged, those which correspond to the code of the keyed digit being charged in the opposite direction to those which do not form part of the combination.

Reception of following digits

The reception of all following digits is similiar to that described for the second digit. In each case, charges are received on four condensers connected to corresponding terminals on arcs *smb* to *sme*.

At the end of in-sending, switch S will therefore have made a number of steps equal to the number of digits which have been keyed, this number never exceeding eleven.

Reception of keyed prefix

In case the wanted subscriber's number com-

prises a prefix corresponding to a direction for which an individual key has been provided on the attendant's key-set, and the attendant instead of keying the complete number on digit keys, sends in the number by means of the prefix key and digit keys, the circuit operation is modified as follows:

At the moment one of the prefix keys PK1 to PK10, for instance PK1, is depressed on the attendant's key-set, a ground is given for the energization of the corresponding relay Pr1 and the common relay Pc in the register circuit. These relays energize in series and remain locked via *pr*16.

If we assume, for instance, that the prefixes comprise 3 digits, then the jumpering between terminals *g* to *k* associated with the storage condenser groups and terminals *l* to *o* associated with the contact bank *sma* must be effected as shown dotted on the drawings, and the contacts 2, 3 and 4 of the prefix relay Pr1 must be connected to the marking wires of bank *ssma* corresponding to the prefix digits, contact 2 controlling the marking for the first digit, contact 3 for the second digit and contact 4 for the third digit. A lamp PL1 corresponding to prefix key PK1 is energized via LP1 and *pr*11.

When relay Pc is energized, switch SM is made to rotate under the control of its own interrupter via *rd*2, *pc*3 and *pc*4 in parallel, contacts N, 1, 2 of *sma*, *ssma* to earth.

The value of the three prefix digits is stored by the energization of relay Pr1 and switch S will therefore be rotated until terminal 3 is reached. Terminal 3 corresponds to the position in which the switch must be standing in order to receive the fourth digit of the subscriber's number.

Relays A*m*, B*m*, C*m*, D*m* remain deenergized and none of the condensers connected to terminals 1 and 2 of arcs *smb* to *sme* are charged. Relay D remains deenergized as long as switch S has not reached position 3, being short-circuited by earth via *ssma*, *sma*, *pc*3, *rd*2, *rd*3, *b*2.

At the moment, however, the switch stops in position 3, relay D is made to operate in series with SM and the four condensers corresponding to the fourth digit of the number are charged. Depression of the digit key for the fourth digit releases D, operates SM and changes the charge on certain of the condensers of the group to store the digit as previously explained.

The reception of the following digits is made in exactly the same manner as that described previously for digits sent in by the digit keys. However, the storing of digits on the condensers starts from the third group of condensers corresponding to the fourth digit of the number.

Translation of stored digits into impulse trains sent out towards the distant exchange

When the attendant has finished keying the distant wanted subscriber's number, she depresses the starting key SK of her key-set thus causing the energization of relay R*d* over lead L6. As soon as R*d* has closed its make contacts, the marker switch S is restored to normal as follows: battery, winding SM, interrupter contact of SM, *rd*3, *ss*3 arc and brush *sma*, normal terminal and brush *smsa* to ground.

Switch S stops at normal, the resetting circuit being then opened at *sma*. At this moment relay S*s* is energized via *rd*4, *sma*, *ssma*. Relay S*s* once deenergized locks via *ss*4, *es*2, *b*5. Contacts *ss*3 open the resetting circuit for switch S. Relay S*s* when energized introduces in the circuit the conditions necessary to send out the impulse trains corresponding to the digits which have been recorded by the register.

The opening of contacts *ss*6 removes full ground from contacts *b*1, so that a resistance is introduced in series with lamp DL in the key-set so that the lamp burns dimly indicating that selection has started.

Earth via *ss*5, *es*4, prepares a circuit controlled by contacts *i*1, which are not yet closed, via *rs*4 for SSM. On the other hand, from the moment the register circuit is busied, a circuit was completed in order to cause relays P, P*h* and I to pulsate as described below.

Impulse generation

At the moment relay B energized when the register circuit was seized, the condenser CN in series with the right-hand winding of P was charged in the following circuit: ground *ph*3, condenser CN, winding of P in parallel with a 100-ohm resistance HDR, 1000-ohm resistance THR, *ph*2, *b*3, battery.

At the same time current flows in the left-hand winding of the polarized relay P so that the armature of P is made to come in contact with the right-hand spring. Relays P*h* and I energize in series; battery *b*3, left-hand winding of I, P*h*, *p*1, earth. P*h* reverses the battery and ground in the circuit of the condenser CN and disconnects the 100-ohm resistance HDR which was placed in parallel with the right-hand winding of P. At the same time the current in the left-hand winding of P is reversed and has therefore a tendency to repulse the armature of P from the right contact spring.

However, the condenser CN which has been charged, over the break contacts of P*h* must first of all discharge itself and to a certain extent charge itself in the opposite direction through the right-hand winding of P (which is in opposition with the left-hand winding) before the relay P opens its right contact under the influence of the ampere turns in the left-hand winding.

When relay P opens its right contact, relays P*h* and I release, and as soon as P*h* recloses its break contacts, the conditions on relay P are reversed. The condenser CN discharges itself, and charges itself in the opposite direction, and the flux thus created in the right-hand winding of P is such that the armature is repulsed from the right contact spring, while the current flowing in the left-hand winding of P has a tendency to reclose the right contact.

Relay P*h* being deenergized, the discharge and charge of the condenser CN is effected over the right-hand winding of P shunted by 100 ohms, and the 1000 ohms outside resistance, so that after a time shorter than the previous discharge time, relay P recloses its right contact under the influence of the ampere turns in the left-hand winding.

The cycle starts over again and relays P*h* and I will create impulses, the period and break to make ratio being determined by the characteristics of the discharge circuits for the condenser in series with the right-hand winding of relay P.

Although at the beginning of the pulsations the timing may be different from that obtained after stabilized operation, it is ensured that after a very short number of cycles the timing becomes normal, and therefore at the moment switch SS is placed under the control of the make contact of I, the impulsing is already correct.

Contacts *i2* prepare ground for operating magnet STM of the number indicator NI. At the same time contacts *ph4* prepare the opening of the line via the operator's telephone set TS, La and Lb, key AK, towards the automatic exchange but this opening is not yet effective because the line remains closed over contacts *is1*.

Out-sending of impulse trains for digits which have been singly keyed

When relays I and P*h* energize for the first time after the operation of Ss, switch magnet SSM energizes, and when I and P*h* release, SS makes one step and relay Is energizes over terminal 1 and brush *ssma*, Is immediately locks; *sp1*, left-hand winding of Is, *is2*, *rs2*, *b3*. At the moment relay Is energizes, relay P*h* is released so that the line still remains closed towards the distant exchange. When, however, relays I and P*h* reenergize, thus preparing the next step of switch SS, the line is opened and one impulse is sent out. At the same time, one impulse is given towards the number display apparatus via *i2*, *is4*.

The switch SS makes a step on each closure of the line and when the position marked by the combination of relays A*m*, B*m*, C*m* and D*m* is reached, relay S*p* energizes in the following circuit; battery, winding of S*p*, brush and arc *ssmc*, contacts of combination relays A*m*, B*m*, C*m*, D*m*, one of leads 1 to 0, marked terminal in arc *ssma*, brush *ssma*, ground.

As soon as relay S*p* is energized, it locks via *ssmc*, *sp1*, at the same time opening the locking circuit for relay Is, which deenergizes and recloses the outgoing line circuit permanently. The number of openings given on the line is therefore always equal to the number of steps effected by the switch SS from position 1 until it reaches a marked wire.

Relay R*s* energizes, and remains held in parallel with relay S*p*.

Relay R*s* when operated, causes the switch SS to rotate under the control of its own interrupter, opens the locking circuit for relays A*m*, B*m*, C*m*, D*m*, and via *rs1* provides a ground for energizing switch magnet SM. Contacts *rs3* provide a ground via Le for energizing the shift magnet SHM of the number indicator NI.

When switch SS reaches position 17, the locking circuit for relays R*s* and S*p* is opened, SM therefore makes one step and the switch SS is replaced under the control of the make contact *i1*.

From position 17 to position 1, switch SS therefore again steps under the control of the impulse generating relays P, P*h* and I. The time taken for effecting these steps corresponds to the minimum interdigital relay required and serves at the same time to check the state of the four condensers on which the second digit of the number is stored, that is the four condensers connected to position 1 of switch S.

Checking of condenser charges

Relay Ss energized after switch S had been reset at the beginning of out-sending and the high resistance left-hand winding of relay Dc is thereby connected via *ss2* to the common point of the storage condensers. On the other hand, when relay R*d* energized to the start key SK shortly before Ss, the operating circuit for relay D was opened at *rd3* and ground was thus removed from the four leads connected to the brushes *smb* to *sme*. At the same time a ground is given via *b5*, *es2*, *rd1*, to the armature of relay Dc thus causing the energization of relay D*h*. D*h* in turn causes the energization of relay Dc and the latter relay locks over its make contact before its operating circuit is opened owing to the release of relay D*h* when the circuit for the latter is reopened at the break contact of Dc.

The above operations taking place before the first impulse train is sent out, it is ensured that at the moment that the first interdigital time is counted out relay Dc is locked under the control of its make contact and relay D*h* is deenergized.

When switch SS reaches position 18, ground is connected to brush *smb* and thus completes a circuit for checking the charge of the first digit condenser in series with the high resistance winding of Dc; earth *ssma* in position 18, *smb* in position 1, condenser, *pc1*, *ss2*, left-hand winding of Dc, battery.

If we assume that this condenser was charged under the control of a digit key, the charge is such that the potential on the condenser is in series-aiding with the potential of the circuit battery, the high resistance winding of relay Dc being connected to battery.

The current which flows momentarily over the high resistance winding of Dc will thus result from a discharge of the digit condenser placed in series with it, followed by a charge in the opposite direction so that the energy released by the condenser is the same as if it were a single discharge from a potential equal to twice that of the circuit battery.

The flux created by the discharge current is in opposition to the holding flux of the relay Dc and the value of this discharge flux is sufficient to cause the resultant flux to pass below the holding value for relay Dc. Relay Dc deenergizes and causes the operation of relay D*h* which in turn reoperates Dc, and the latter relay again opens the circuit for D*h* as explained earlier.

Relay D*h* remains on its make contact for a time ranging between 37 and 55 milliseconds, these limits being the extreme values obtained with all possible variations of voltage and adjustment on relays D*h* and Dc.

When relay D*h* is energized, a circuit is closed for the energization of relay A*m* via *ssmb* in position 18, *dh1*.

A*m* immediately locks via *am2*, *rs2*, *b3*.

The total time taken by the release of Dc, the operation of D*h*, the reoperation of Dc and the release of D*h* is always less than the time during which the switch SS remains on a same terminal, so that it is guaranteed that relays Dc and D*h* are ready to effect a new condenser check by the time that switch SS reaches position 19.

The cycle of operations described above is therefore repeated but this time it is the condenser connected to position 1 on arc *smc* which is checked and in case it has been charged under the control of the digit key, it will cause the operation of relay B*m* which is connected in position 19 of switch SS.

If we assume that the condenser had not been charged under the control of the digit key and has therefore been charged in the opposite direction under the control of relay D during the reception of the digits, no discharge current can take place in the high resistance winding of Dc, the potential on the condenser being in opposition with the equal circuit battery potential.

Relay D*h* therefore will not energize and the corresponding relay in the group A*m*, B*m*, C*m* and D*m* will also remain deenergized.

When the marker switch SS has effected its

four steps, 18 to 21, under the control of the pulsating relay I, the state of relays Am, Bm, Cm and Dm will correspond to the digit storage condition of the four condensers, and arc *ssma* is marked accordingly.

Switch SS continues to step under the control of relay I as explained for the out-sending of the first digit. A number of impulses will therefore be sent out and to the number indicator NI corresponding to the second digit which had been stored on the condensers connected to position 1 of S, and when switch SS reaches the wire marked by the combination relays Am, Bm, Cm and Dm it again runs to position 18 after having caused S to step to position 2. The four condensers corresponding to the third digit will be checked exactly as explained for the previous digit, the digit recorded on relays Am to Dm and so on.

Each digit is recorded on the number indicator, the shift magnet of which is operated after each digit transmission.

Since every digit is characterized by at least one condenser charged in opposition to the others, for each impulse train which has to be sent out, at least one of the combination relays will be energized during the interdigital time preceding the train. It follows that when switch SS returns to normal while none of the relays Am, Bm, Cm and Dm have been energized, this condition gives the indication that out-sending is finished. Relay Es is then made to energize via *dm1*, *cm1*, *bm1*, *am1*, *rd5*, *pc4*, arc and wiper *sma*, *ssma* to earth.

As soon as relay Es is energized, the holding circuits for relays Rd and Ss are opened at *es2*, but relay Es remains locked via *es1*, *sma*, *ssma*.

Switch S is then reset to normal via its interrupter, *rd3*, *b2*, *es3*.

When switch S reaches its home position, relay Es is unlocked and the circuit placed again in the same condition as when it was seized before reception of the digits. It is therefore possible when necessary, for instance, in the case of an open numbering scheme, to send in a new series of digits and cause these digits to be repeated in the form of impulse trains towards the automatic exchange, in the same manner as explained previously.

When relay Ss is released a full ground is reconnected towards lamp SL in the key-set, thus indicating the end of impulse transmission.

Translation of keyed prefix into impulse trains transmitted towards exchange

If the attendant, when keying the distant wanted party's number has made use of a prefix key characterizing the wanted direction or area, the retransmission of impulse trains corresponding to the prefix digits is effected as follows:

At the moment the starting key SK is depressed on the key-set, relays Rd and Ss energize as explained previously and switch S is restored to normal. Relays Am, Bm, Cm and Dm, however, are all deenergized since in the normal position of S no digit key has been depressed.

Switch SS will start to rotate under the control of the impulsing relay L as explained previously, but the marking circuit is closed differently and may be traced as follows: battery, winding of Sp, brush and arc *ssmc*, series break contacts *am3*, *dm3*, *bm3*, *cm3*, make contact *is3*, brush and arc *smb* in normal position, make contact 2 of the prefix relay Pr1, which is operated, marking wire on arc *ssma*, earth.

The energization of relay Sp, when the marked wire is reached causes impulse transmission to be stopped as explained previously and switch SS rotates under the control of its own interrupter to position 17, while relay Rs is energized.

Switch S makes one step and switch SS steps under the control of I beyond the normal position to terminal 1. As soon as relay Is energizes, the impulses corresponding to the second digit are sent out until the switch SS reaches again a wire marked in a circuit via contact 3 of Pr1 and brush *smb* in position 1.

It should be noted that the digit condensers connected in the various positions of S corresponding to the prefix digits, do not in any way interfere with the changed marking circuits, the common point of these condensers being disconnected at the left outer break contact of relay Pc.

In order to avoid giving the end of digit transmission signal owing to the fact that the four combination relays Am, Bm, Cm and Dm remain deenergized during transmission of the prefix digits, the circuit passing over the series break contacts *am1* to *dm1* of the combination relays is opened at *pc4* as long as switch S has not reached position 3 corresponding to the first digit which has been sent in by means of a digit key.

If we assume that the prefix comprised, for instance, 3 digits, contacts 2, 3 and 4 of the corresponding relay Pr1 are used for marking purposes and the 3 digits are translated into impulse trains as described above.

At the end of the third digit, however, switch S reaches position 3 which corresponds to a set of condensers on which the first digit set up by a number key has been stored. The operation of the circuit becomes then the same as that described for impulse transmission of a number set up entirely by means of digit keys.

If position 3 is reached and the corresponding storage condensers have all been charged solely under the control of relay D, thus indicating that the starting key has been depressed immediately after the depression of a prefix key, relay Es energizes as soon as switch SS returns to normal after the third digit of the prefix has been sent out. The circuit is then restored to the initial conditions, and is ready to receive a second set of digits.

When at the end of impulse transmission, relay Es energizes, the locking circuit for relays Rd, Ss, Pc and Pr is opened and full ground on lead LC for lighting the signaling lamp DL is replaced via *ss6*, thus causing lamp DL to burn brightly and give the end of selection signal.

In case a number indicator is used as we have assumed in the present description, it shows up the number which has been effectively sent out. At the end of selection, however, the number indicator is not restored and the number will remain apparent until the register circuit is used for setting up a new call or a new series of digits at the end of the impulse transmission. The resetting of the number display apparatus is caused by the energization of relay Dr during the time that the marker switch S is off-normal, before the start key is operated, Dr, *rd6*, *es1*, *pc4*, *sma* off-normal, *ssma* normal. Both magnets SHM and STM are thus energized simultaneously and release the number wheels.

Premature release

A premature release is characterized by the deenergization of relay B, before the retransmission of impulses has been completed.

When relay B is released, the locking circuits for all relays are opened and the switches are reset.

Terminals 1 to 22 on arc *ssmc* are connected to ground via *ss*6 and *b*6 so that relay R*s* energizes and causes the switch to rotate under the control of its own interrupter until the home position is reached. Relay R*s* is then released.

As soon as switch SS has returned to normal the resetting circuit for S is completed over brush and arc *ssma*, brush and arc *sma*, *ss*3, *b*2, *rd*3, interrupter and winding of SM to battery. This circuit is opened by *sma* when the switch S arrives in the home position.

What is claimed is:

1. In a key-controlled electrical character storage and transmission equipment, a plurality of groups of condensers, means for storing characters on said groups of condensers, an electromagnetic contact making marker device, means for transferring the stored characters in turn from said condenser groups to said marker device, prefix keys characterizing exchange areas, an impulse counting wiper, means for generating impulses, contacts for said wiper, means to normally mark said contacts under the control of said marker device, means under the control of one of said prefix keys to mark said contacts and to prevent the storage of characters on certain of said groups of condensers, and means under the control of said wiper to control the number of said impulses to be transmitted.

2. In an electrical character storage and transmission equipment, registers comprising groups of condensers for storing different characters, condenser charging means for giving all condensers of a group a preliminary charge of one polarity, means for subsequently charging one or more of the condensers of the group to opposite polarity to store a character, and condenser-charge detecting means unresponsive on connection to a condenser containing said preliminary charge and responsive on connection to a condenser having a charge of opposite polarity.

3. In an electrical character storage and transmission equipment, groups of condensers for storing different characters, condenser charging means for giving all condensers of a group a preliminary charge of one polarity, means for subsequently charging one or more of the condensers of the group to opposite polarity to store a character, an electromagnetic contact making marker device, means for transferring the stored characters in turn from said condenser groups to said marker device, impulse generating means, and means under the control of said marker device to control the value of impulses sent out by said impulse generating means.

4. In a key-controlled electrical character storage and transmission equipment, a plurality of groups of condensers, means for storing characters on said groups of condensers, an electromagnetic contact making marker device consisting of a group of relays equal in number to the condensers in a group, means for transferring the stored characters in turn from said condenser groups to said marker device, means for generating impulses, an impulse counting wiper, contacts for said wiper, means under the control of said marker device to mark said contacts, and means under the control of said wiper to control the number of said impulses transmitted, said wiper also effective over other contacts to control the transfer of said stored characters from said condenser groups to said relay group.

5. In a key-controlled electrical character storage and transmission equipment, a plurality of groups of condensers, an electromagnetic contact making marker device, an impulse counting wiper, means for storing a first character on said marker device, means for storing a plurality of other characters on said groups of condensers, means for generating impulses, and means under the control of said wiper during each rotation to control the value of said impulses in accordance with the setting of said marker device, to restore said marker device and to reset said marker device in accordance with the condition of a condenser group.

6. In a key-controlled electrical character storage and transmission equipment, a plurality of groups of condensers, a group of relays equal in number to the condensers in a group, an impulse counting wiper, means for storing a first character on said relays, means for storing a plurality of other characters on said groups of condensers, means for generating impulses, means under the control of said wiper during successive rotations to control the value of said impulses in accordance with the setting of said relays, to restore said relays and to reset said relays in accordance with the condition of a condenser group, a test relay, a normal contact for said wiper, means for operating said test relay over said normal contact and back contacts of all relays of said relay group, and means under the control of said test relay to release said storage and transmission equipment.

7. In a key-controlled electrical impulse sender equipment, individual digit keys, prefix keys characterizing exchange areas, separate digit storing means operated by said individual keys and by one of said prefix keys, and digit transmitting means controlled by either storage means to send out the same plurality of digital impulse combinations.

8. In a key-controlled electrical impulse sender equipment, individual digit keys, prefix keys characterizing exchange areas, storage means for a plurality of individual digits, separate storage means operated by said prefix keys for storing digit combinations characterizing said exchange areas, means responsive to the operation of individual digit keys for distributing successive digits to corresponding individual storage means, and means under the control of a prefix key to cause said distributing means to skip a plurality of individual storage means to prepare other storage means to respond to subsequently operated individual digit keys.

9. In an electrical character storage and transmission equipment, registers comprising groups of condensers for storing different characters, condenser charging means for giving all condensers of a group a preliminary charge of one polarity, means for subsequently charging one or more of the condensers of the group to opposite polarity to store a character, condenser-charge detecting means unresponsive on connection to a condenser containing said preliminary charge and responsive on connection to a condenser having a charge of opposite polarity, impulse generating means, a marker device for controlling said impulse generating means, and means for setting said marker device under the control of said condenser-charge detecting means.

WILLY POULIART.