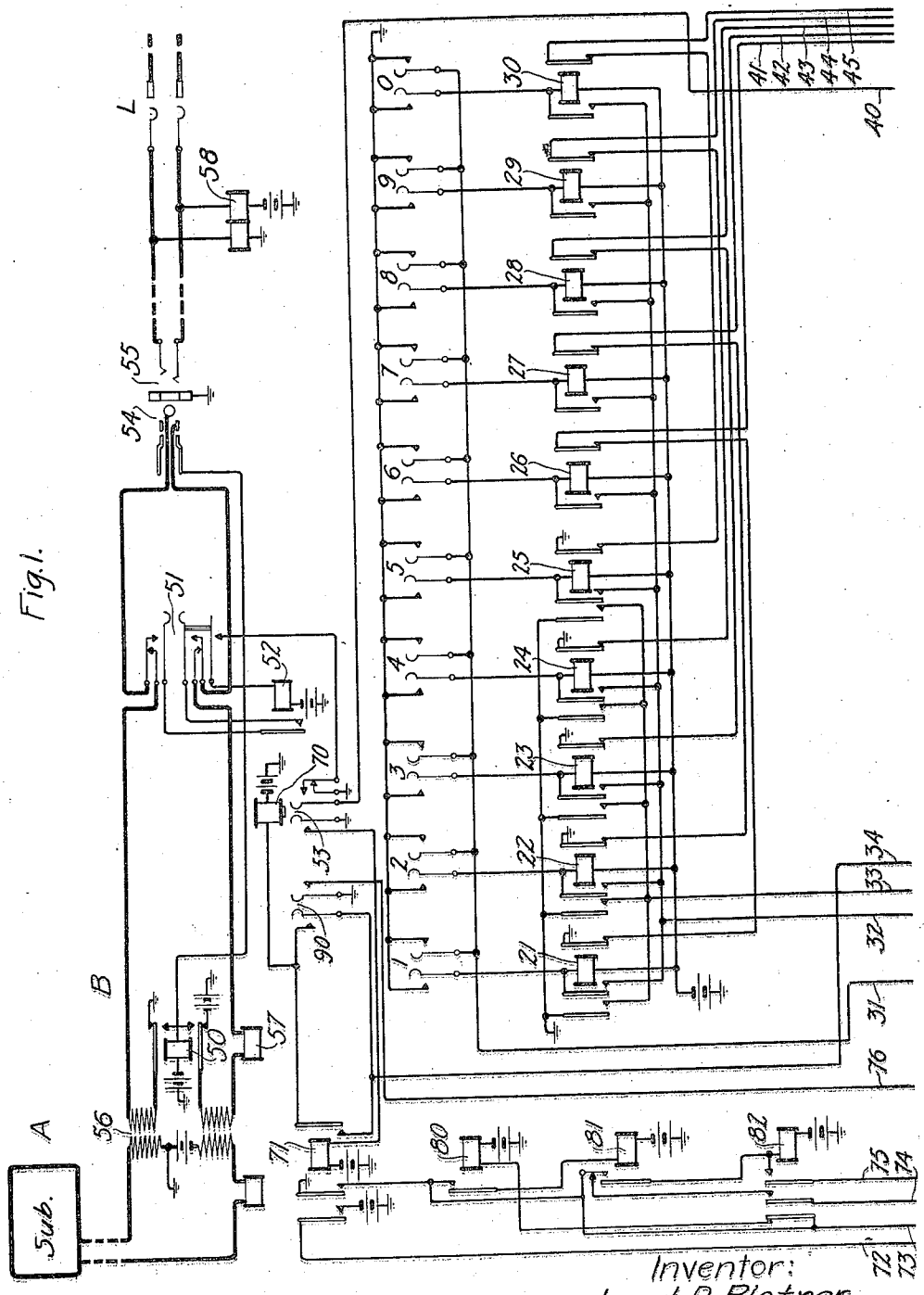
Feb. 13, 1923. 1,445,235.

L. D. PLOTNER.

IMPULSE TRANSMITTING DEVICE.

FILED APR. 14, 1920. 2 SHEETS—SHEET 1.

Fig. 1.



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FILED APR. 14, 1920. 2 SHEETS—SHEET 2.

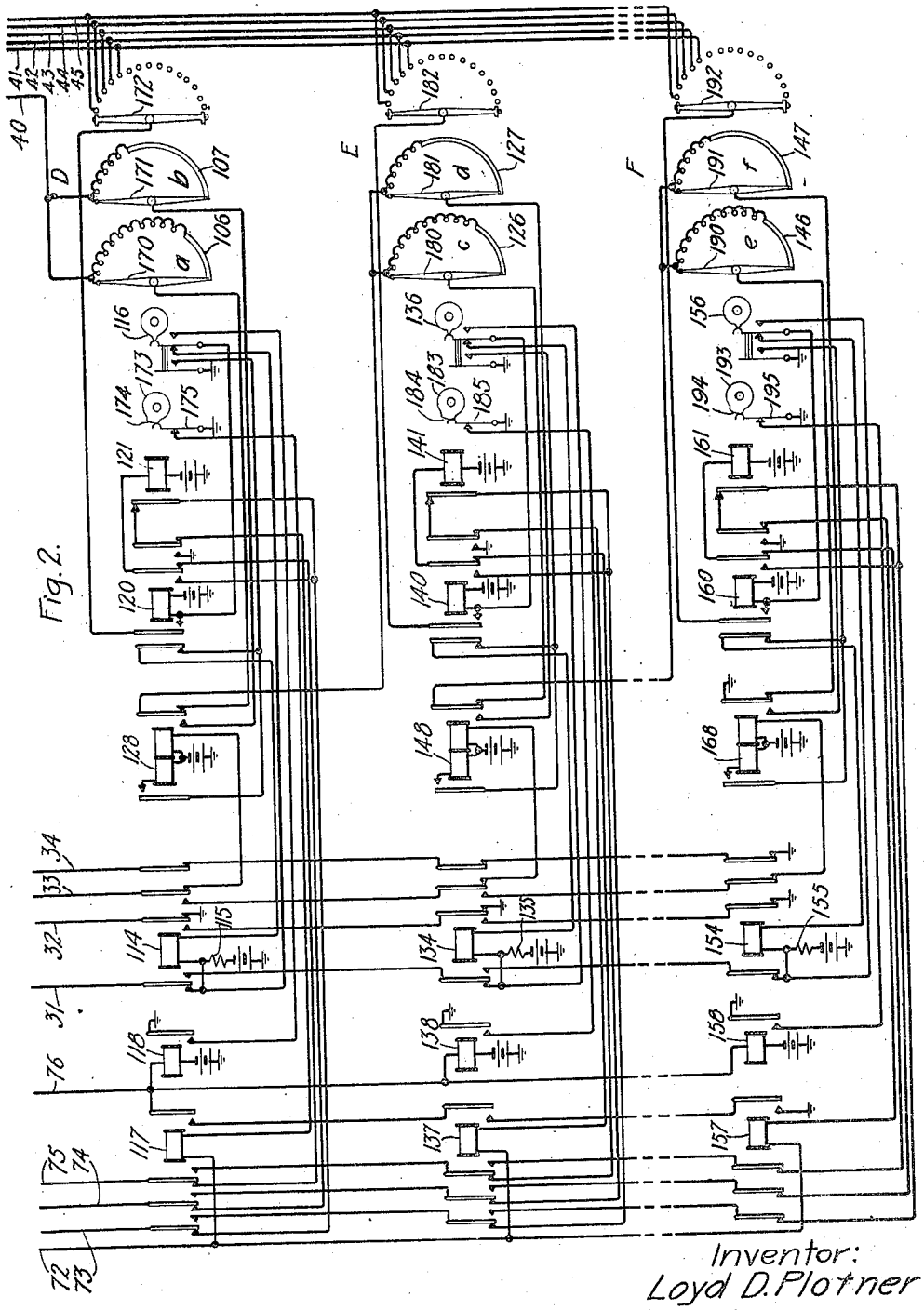


Fig. 2.

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Patented Feb. 13, 1923. 1,445,235

UNITED STATES PATENT OFFICE.

LOYD D. PLOTNER, OF BROOKLYN, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

IMPULSE-TRANSMITTING DEVICE.

Application filed April 14, 1920. Serial No. 373,689.

To all whom it may concern

Be it known that I, LOYD D. PLOTNER, a citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Impulse-Transmitting Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to impulse transmitting devices and more particularly to an impulse-transmitting device for use at an operator's position in a semi-automatic telephone system.

The object of this invention is to provide an impulse-transmitting device, which is simple to operate, and which will rapidly and efficiently transmit impulses and provide for the proper spacing between impulses.

A feature of the invention consists in the provision of a single set of digit keys, common to a plurality of impulse sending mechanisms, which are adapted to be successively operated in a first movement to positions predetermined by successive actuations of any of said digit keys, and to be operated in a second movement to deliver impulses to an impulse circuit in accordance with the digits represented by the actuated keys.

A further feature of the invention is the provision of means for reducing the time required for the impulse producing mechanisms to register the indications of the depressed keys.

The various features of the invention may be more readily understood by reference to the accompanying drawings which disclose one arrangement for embodying the invention in a sender circuit for a semi-automatic telephone system.

Referring to the drawings, Fig. 1, when placed over Fig. 2, shows so much of the system as is necessary for an understanding of the invention. Fig. 1 shows a subscriber's line having a station A which may be connected in any well known manner to a cord circuit B. Accessible to the cord circuit B there may be trunk circuits terminating in jacks such as 55 at an operator's position. Connected to the jack there may be a non-numerical switch which may have access to the usual selectors and connectors. A selector schematically represented at L having an impulse responsive relay 58 is shown. The operator's position may be provided with ten keys, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0, respectively corresponding to the ten digits of the decimal notation. A dialing key 51 is provided in the cord circuit for connecting the impulse transmitting device to the cord circuit. A start key 53 may be provided for initiating the movement of the impulse transmitting device. A train of stepping relays 80, 81 and 82 provide for the uniform operation of the impulse transmitting device in delivering the impulses. In Fig. 2 of the drawings three registers or senders are indicated as D, E, and F. These registers may be similar in construction to the structure described in an application of Forsberg and De Vignier Serial No. 317,126 filed August 13, 1919, but modified as hereafter described.

A brief description of register D will be given, registers E and F shown in the drawing being similar thereto. Fixed to a rotatable shaft (not shown) are three brushes 170, 171 and 172, and a pair of cams 173 and 116 each being insulated from the other in the usual manner. Cooperating with brush 170 is a contact bank having eleven contacts and a solid segment 106 all strapped together. Cooperating with brush 171 is a contact bank having 6 contacts and a solid segment 107, all strapped together. For brush 172 only 6 contacts are necessary although more than 6 are shown. The brush 172 differs from brushes 170 and 171 in that it is of the bridging type, i. e., it makes before breaking in passing from one contact to the next. Cam 116 is so constructed that the contacts associated therewith are operated as soon as the brushes of the switch have been moved one step from normal and are restored to normal, when the brushes are restored to normal. Cam 173 is so constructed that its contacts are opened as soon as the brushes of the switch have taken one step from normal and are closed as soon as the brush 170 has taken one step, or a number of steps, if desired, to provide for spacing between series of impulses, after reaching the solid segment of its bank.

Brush 170 and its associated bank constitute an impulser *a* and brush 171 and its associated bank constitute an impulser *b*. One or the other of these impulsers is included in the impulse circuit depending upon the character of the digit key actuated. For the purpose of this specification, brush 172 is termed a point finder. Connected to the con-

tacts of the bank associated with the point finder are five conductors leading to five pairs of relays associated with the set of ten digit keys. In the drawings the second contact of the point finder is connected to relays 30 and 25, the third to relays 29 and 24, the fourth to relays 28 and 23, the fifth to relays 27 and 22 and the sixth to relays 26 and 21. If either of the first five keys of the set is actuated, relay 128 will be operated and impulser *b* will be included in the impulse circuit, whereas if either of the last five keys of the set is actuated, relay 128 will not be actuated and impulser *a* will be included in the impulse circuit. For example, if key 1 is depressed, relay 21 will be operated and the register D will be operated under control of a stepping magnet until the point finder rests on the sixth contact. Relay 128 will also be operated thus including impulser *b* in the impulse circuit. When the start key 53 is actuated, the register will again be operated under control of magnet 121 and impulser *a* will deliver one impulse to the impulse circuit. If key 6 is actuated, the register will again be operated until the sixth contact is reached, relay 128 will not be operated, and impulser *a* will be included in the impulse circuit. When the start key is actuated the register will be operated under control of magnet 121 and impulser *a* will deliver one plus five or six impulses.

As soon as the brushes have been moved under control of magnet 121 to provide for spacing between series of impulses, a transfer relay such as 114 operates to connect the succeeding register of the train to the impulse circuit.

Having given a detailed description of the component parts, a description will now be given of the operation.

The subscriber at the station A having initiated a call and the answering end of the cord circuit B having been associated therewith in any well-known manner, the operator may actuate a listening key (not shown) thereby connecting the operator's telephone set in circuit so that the operator may converse with the calling subscriber to ascertain the number of the line with which connection is desired. Assuming, for example, that number 368 is desired, the operator after restoring the listening key to normal, may insert calling plug 54 into jack 55, whereupon relay 50 of the cord circuit is energized over a circuit including ground, the sleeves of jack 55 and plug 54, winding of relay 50 and grounded battery. Relay 50 in energizing establishes a loop across the cord circuit resulting in the operation of a non-numerical switch (not shown) at the automatic exchange in the well-known manner. The loop includes the tips of jack 55, plug 54, upper normal contacts of key 51, upper right-hand winding of repeating coil 56, upper and lower alternate contacts of relay 50, lower right-hand winding of repeating coil 56, winding of relay 57, lower normal contacts of key 51, and rings of plug 54 and jack 55.

The operation of the non-numerical switch may extend the calling line to an idle selector L in the well-known manner. The impulse relay 58 may respond to the impulses sent by the impulse transmitting device in a manner now to be described and may set any switch such as L in accordance with the impulses sent.

The operator may then actuate the dialing key 51, thus disconnecting the answering from the calling end of the cord circuit B and preparing the impulse transmitting device for connection to the calling end. In actuating the key 51, relay 52 is energized over a circuit extending from ground, through the normal contacts of key 53, lowermost alternate contacts of key 51, and the winding of relay 52 to grounded battery. Relay 52 in operating establishes at its armature and contact, a loop for the selector switch, replacing the loop through the repeating coil 56.

The operator may then proceed to actuate keys in accordance with the number desired, which has been assumed to be 368. In this instance, the first key actuated will act as the hundreds digit, and a momentary depression of key 3 completes circuits for relays 23 and 120, the former extending from ground, through the left-hand contacts of key 3, winding of relay 23 to grounded battery, and the latter from ground, through the right-hand contacts of key 3, conductor 31, left-hand armature and back contact of relay 114, right-hand normal contacts of cam 116 and winding of relay 120 to grounded battery. Relay 23 in attracting its outer left-hand armature completes a circuit for relay 128, said circuit extending from ground, through the outer left-hand armature and front contact of relay 23, conductor 33, middle right-hand armature and back contact of relay 114, right-hand winding of relay 128 to grounded battery. Relay 23 completes a locking circuit for itself extending from grounded battery through the winding of relay 23, inner left-hand armature and front contact of relay 23, conductor 32, and inner right-hand armature and back contact of relay 114 to ground. Relay 128, in operating, disconnects impulser *a* or the brush 170 and its associated contact bank, from the impulse circuit which includes conductor 40, and connects impulser *b* or the brush 171 and its associated contact bank, thereto. Relay 120 in operating completes a circuit for motor magnet 121, said circuit extending from grounded battery, through the winding of magnet 121, inner right-hand armature and front contact of relay 120, armature and

back contact of magnet 121, outer right-hand armature and front contact of relay 120 to ground. Magnet 121 therefore operates moving the brushes 170, 171 and 172 of register D from the first to the second position, thereby opening the contacts associated with cam 173, and opening the normal and closing the alternate contacts associated with cam 116. As soon as the alternate contacts of cam 116 are closed a circuit, for maintaining relay 128 energized, is completed, said circuit extending from grounded battery through the left-hand winding, front contact and left-hand armature of relay 128, and left-hand alternate contacts of cam 116 to ground. Relay 120 is maintained energized over a path including grounded battery, winding of relay 120, front contact and inner left-hand armature of relay 120, brush 172 and its second contact, conductor 45, back contacts and right armatures of relays 30 and 25, to ground. Motor magnet 121 continues to operate in the well-known manner and step the brushes until an ungrounded terminal is found by brush 172, when relay 120 releases thereby opening the circuit of magnet 121 and bringing the switch to rest upon the terminals representing the depressed key.

In this instance as soon as brush 172 has taken three steps and centers upon its fourth contact, the holding circuit for relay 120 extending through brush 172 and its fourth contact, conductor 43, right-hand armature and back contact of relay 28 is opened at the right-hand armature and back contact of relay 23. Relay 120 thereupon releases, thereby opening the circuit for magnet 121 and completing a circuit for relay 114. The circuit for the energization of relay 114 may be traced from grounded battery, through resistance 115, winding of relay 114, outer left-hand armature and back contact of relay 120, and left-hand alternate contacts of cam 116 to ground. Relay 114, in operating, releases relay 23 by opening the locking circuit therefor, and prepares a circuit for relay 140 controlling the motor magnet associated with the next sender.

Upon actuation of the key representing the next digit of the desired number, namely 6, circuits for relays 26 and 140 are completed, the former extending from ground, through the left-hand contacts of key 6, and winding of relay 26 to grounded battery, and the latter, from ground, through the right-hand contacts of key 6, conductor 31, left-hand alternate contacts of relay 114 (which is maintained energized through the outer left-hand normal contacts of relay 120 and left-hand alternate contacts of cam 116), left-hand normal contacts of relay 134, right-hand normal contacts of cam 136, and winding of relay 140 to grounded battery. Relay 26 upon energizing locks up over a circuit including its winding and left-hand contacts, conductor 32, and the inner right-hand normal contacts of relay 134. Relay 140 in operating, completes a circuit for motor magnet 141 over a path similar to that described for motor magnet 121 associated with switch D. It will be noted that relay 148 is not energized and that impulser *c* will be included in the impulse circuit, which includes conductor 40. Magnet 141 in operating moves the brushes 180, 181 and 182 of the register E one step, thereby completing a circuit for maintaining relay 140 energized, said circuit extending from grounded battery, through the winding of relay 140, front contact and inner left-hand armature of relay 140, brush 182, and its second contact, conductor 45, and right-hand normal contacts of relays 30 and 25, to ground. Motor magnet 141 continues to operate and step the brushes over the terminals until a terminal having no ground thereon is reached. In this instance, the brushes of register E will be moved five steps and upon reaching their sixth contact, the circuit for magnet 140 extending from grounded battery, through the left-hand alternate contacts of relay 140, brush 182 and its sixth contact, and conductor 41, will be open at the right-hand armature of relay 26. Relay 140 therefore deenergizes, and the movement of the brushes ceases. As soon as relay 140 retracts its armatures, relay 134 is energized over a circuit extending from grounded battery, through resistance 135, winding of relay 134, left-hand normal contacts of relay 140, and left-hand alternate contacts of cam 136 to ground, said contacts having been closed upon the first step of the switch. Relay 134, upon energization, prepares a circuit at its left-hand armature and front contact for relay 160 of the next register, and at its inner right-hand armature and front contact, opens the locking circuit for relay 26.

The operator then depresses the key representing the next digit of the number desired, which has been assumed to be 8. Actuation of key 8 completes circuits for relays 28 and 160, that of the former extending from ground, through the left-hand contacts of key 8, and winding of relay 28 to grounded battery, and that of the latter from ground through the right-hand contacts of key 8, conductor 31, left-hand alternate contacts of relays 114 and 134, left-hand normal contacts of relay 154, normal contacts of cam 156, and winding of relay 160 to grounded battery. Relay 28, upon energizing, locks up over a path including grounded battery, the winding, left-hand armature and front contact of relay 28, conductor 32, inner right-hand armatures and front contacts of relays 114 and 134, and inner right-hand armature and back contact of relay

154 to ground. Relay 160 in energizing completes a circuit for motor magnet 161 similar to that described for magnet 121, whereupon the brushes 190, 191 and 192 of switch F are moved one step. Relay 160 is maintained energized in a manner similar to that previously described for relays 120 and 140 and the motor magnet continues stepping the brushes until the brush 192 reaches a contact on which no ground is found. In this instance, the motor magnet 161 moves the brushes three steps and when brush 192 centers on its fourth contact, the circuit for relay 160, extending from grounded battery, through the winding, front contact and inner left-hand armature of relay 160, brush 192 and its fourth contact, and conductor 43, is open at the contacts of relay 28. Relay 160 releases its armature thus opening the operating circuit for magnet 161 and bringing the register to rest. Relay 154 then operates over a circuit similar to that described for relays 114 and 134, thus releasing relay 28. Relay 168 was not energized when key 8 was actuated and the impulse circuit now includes impulser *e* and ground at the right-hand armature of relay 168.

The operator then depresses key 53 which may be restored to normal electromagnetically by the magnet 70. The arrangement of the key and magnet may be similar to that shown in Patent No. 555,707 of March 3, 1896, to J. J. O'Connell. In actuating key 53, a circuit is completed at the left-hand alternate contacts thereof for relay 71. Through the right-hand alternate contacts of key 53, conductor 40, extending to the registers D, E and F, is connected to the relay 52. Relay 71 in operating connects ground to a circuit for a train of relays 80, 81 and 82, which govern the movement of the registers in their impulse producing movement, and connects battery to the windings of relays 117, 137 and 157. Relays 117, 137 and 157 do not energize at this time, however, due to their circuits being open at the cams of their associated senders. Relay 80 is operated over a circuit extending from ground, inner left-hand armature and front contact of relay 71, outer left-hand armature and back contact of relay 82, and winding of relay 80 to grounded battery. Relay 80 in operating completes a circuit, at its armature and front contact, for relay 81. Relay 81 in operating completes a circuit, through its alternate contacts, for relay 82, which locks up over a circuit extending from grounded battery, through the winding, front contact and inner armature of relay 82, conductor 75, inner left-hand armature and back contact of relay 117, back contact and outer right-hand armature of relay 120, contacts of magnet 121, back contact and outer left-hand armature of relay 117, conductor 73, and front contact and inner left-hand armature of relay 71 to ground. Relay 82, in operating, opens the circuit for relay 80, which in releasing opens the circuit for relay 81. Relay 81 in releasing completes a circuit for motor magnet 121, said circuit extending from grounded battery, through the winding of magnet 121, inner right-hand armature and back contact of relay 120, back contact and middle left-hand armature of relay 117, conductor 74, middle armature and front contact of relay 82, normal contacts of relay 81, and front contact and inner left-hand armature of relay 71 to ground. Magnet 121, in operating, moves the brushes of switch D one step and opens the locking circuit for relay 82, which releases its armatures. When the brushes of switch D are moved one step, the impulse circuit, extending from grounded battery, through the winding of relay 52, lowermost contacts of key 51, right-hand alternate contacts of key 53, conductor 40, fourth contact and brush 171 of switch D, front contact and right-hand armature of relay 128, sixth contact and brush 180 of switch E, right-hand armature and back contact of relay 148, fourth contact and brush 190 of switch F and back contact and armature of relay 168 to ground, is interrupted as brush 171 passes from its fourth to the fifth contact. The cycle of operations heretofore described is repeated and continues until the brush 171 has reached the solid segment 107, at which time the circuit for relay 52 will have been interrupted three times resulting in three impulses being sent to the impulse responsive relay 58.

Under control of the stepping relays, the motor magnet 121 will continue stepping the brushes of switch D after the first series of impulses has been sent, (but the impulse circuit will not be interrupted) until the circuit for relay 117 is closed at the contacts of cam 173. Relay 117 in operating momentarily opens the conductors 73, 74 and 75 thereby deenergizing the relays 80, 81 and 82 and associating said relays with the second register E. The circuit for relay 117 is closed over a path extending from ground, through contacts of cam 173, winding of relay 117, conductor 72, and left-hand armature and front contact of relay 71 to grounded battery. Relay 80, and in turn relays 81 and 82, immediately deenergize.

As soon as relay 117 attracts its armatures a circuit for motor magnet 141 is completed, said circuit extending from grounded battery, through the winding of magnet 141, inner right-hand armature and back contact of relay 140, back contact and middle left-hand armature of relay 137, front contact and middle left-hand armature of relay 117, conductor 74, middle armature and front contact of relay 82, normal contacts of relay 81, and front contact and inner left-

hand armature of relay 71 to ground. As soon as magnet 141 operates, the locking circuit for relay 82 is opened whereupon relays 80 and 81 again energize. Relay 82 then operates thus releasing relays 80 and 81 whereupon the motor magnet again operates to move the brushes another step. This operation continues until six steps have been taken and six impulses have been sent to the impulse responsive relay 56. Under control of the stepping relays, magnet 141 continues to step the brushes until the contacts of cam 183 are closed. As soon as the contacts of cam 183 are closed, a circuit for relay 137 is completed, said circuit extending from ground through contacts of cam 183, winding of relay 137, conductor 72, outer left-hand armature and front contact of relay 71 to grounded battery.

Relay 137 in operating prepares a circuit for stepping magnet 161 and in a manner similar to that previously described for magnet 141, the brushes of register F are stepped until the contacts of cam 193 are closed. A circuit for relay 157 is thus established from ground, through contacts of cam 193, winding of relay 157, conductor 72, outer left-hand armature and front contact of relay 71 to grounded battery. Relay 157, in attracting its armatures, disconnects the stepping magnet 161 from the stepping relays, and completes a circuit at its right-hand armature for the energization of relays 118, 138 and 158 in parallel. Relay 118 in attracting its armature completes a circuit for relay 120, said circuit extending from ground, through the armature and front contact of relay 118, right-hand alternate contacts of cam 116, and winding of relay 120 to grounded battery. Relay 120, upon energization, completes a circuit for motor magnet 121, previously described, which operates to restore the brushes of sender D to normal. Upon reaching normal position, the contacts of cam 116 are restored to normal position resulting in the opening of the circuit for relays 128, 120 and in turn the opening of the operating circuit for magnet 121. In a similar manner the brushes of senders E and F are restored to normal. When the brushes of all switches have reached normal position, a circuit for release magnet 70 is completed, said circuit extending from ground through the back contacts and outer right-hand armatures of relays 154, 134 and 114, conductor 34, front contact and right-hand armature of relay 71 and winding of magnet 70 to grounded battery. Upon energization, magnet 70 may restore the key 53 to normal. As soon as the key 53 returns to normal the operator may restore the dialing key 51 to normal and the sender is ready for the next call.

If the operator desires to restore the switches to normal before they are restored automatically, she may actuate the key 90 which connects ground, through conductor 76 to relays 118, 138 and 158 thereby causing such switches that are not on normal position to return to normal in the manner previously described. Actuation of key 90 also completes a circuit for release magnet 70, which upon energization restores key 53 to normal, said circuit extending from grounded battery, through the winding of magnet 70, right-hand armature and front contact of relay 71, conductor 34, and outer right-hand armatures and back contacts of relays 114, 134 and 154 to ground.

It will be noted that with the arrangement of apparatus and circuits, only as many senders are actuated as keys are depressed. For example, actuation of one key actuates sender D, actuation of two keys actuates senders D and E, etc. By operating the "start" key, after the digit keys have been actuated in each case, a number of impulses would be sent over the impulse circuit corresponding to the digits set up in the sender. Although means are shown in the drawings for sending impulses for numbers having a maximum of three digits only, it is obvious that other registers having circuit arrangements identical with that of D and E may be interposed between registers E and F, thus providing a device capable of sending impulses for numbers having more than three digits.

What is claimed is:

1. In an impulse transmitting device, the combination with a single set of digit keys and an impulse responsive means, of an electromagnetic step-by-step mechanism adapted to register the indication of any key when actuated, and thereafter independently of the actuated key to actuate said impulse responsive means.

2. In an impulse transmitting device, the combination of a single set of digit keys, electromagnetic step-by-step mechanism common to said keys, adapted in one movement to register the indication of any of said keys when depressed, impulse responsive means operating under the control of said mechanism during a subsequent movement thereof, and means for thereafter restoring said mechanism to normal.

3. In an impulse transmitting device, the combination with a single set of digit keys and a selector, of electromagnetic step-by-step mechanism common to said keys adapted to register the indications of a plurality of said keys when actuated, and thereafter during a subsequent movement to cause the operation of said selector.

4. In an impulse transmitting device, the combination of a single set of digit keys, electromagnetic step-by-step mechanism, operating in a first movement to register the

indications of any of said keys when actuated, impulse responsive means operating under control of impulses transmitted by said mechanism in a second movement, and means for automatically restoring said mechanism to normal in a third movement.

5. In an impulse transmitting device, a plurality of keys each representing a different digit of the decimal system of notation, a plurality of registers, one for each digit of the highest number designed to be signaled, said registers having contacts corresponding to said keys, means responsive to the successive actuation of any of said keys for successively setting the registers to points predetermined by the keys actuated, an impulse circuit, and means for causing the further movement of said registers to transmit impulses over said impulse circuit in accordance with digits represented by the actuated keys.

6. In an impulse transmitting device, a single set of digit keys, a register adapted to move in one stage to register the indication of either one of two keys of said set, a pair of impulsers associated with said register, an impulse circuit, and means for moving said register in a second stage to deliver impulses to said impulse circuit from one or the other of said impulsers depending upon the character of the digit.

7. In an impulse transmitting device, an impulse circuit, a single set of digit keys, a register having a pair of impulsers associated therewith, means responsive to the actuation of any key for causing said register to move in a first stage to a position predetermined by a key when depressed and for including one or the other of said impulsers in said impulse circuit, and means for causing said register to move in a second stage to deliver impulses in accordance with the digit key depressed.

8. In an impulse transmitting device, a single set of digit keys, a plurality of registers capable of movement in three stages, means responsive to the successive actuation of any of said keys for successively moving said registers in their first stage, means for causing the further movement of said registers in their second stage, impulse responsive means responsive to the extent of the movement of the registers in their second stage, and means for restoring said registers to normal in their third stage.

9. In an impulse transmitting device, a single set of digit keys, a switch having a point finder and a pair of impulsers associated therewith, an impulse cricuit, means responsive to the actuation of any of said keys for operating said switch to cause said point finder to move to a point predetermined by the actuation of said actuated key and for including one or the other of said impulsers in said impulse circuit, and means for operating said switch in a further movement to cause said impulse circuit to be interrupted by said impulsers a number of times corresponding to the digit represented by the actuated key.

10. In an impulse transmitting device, a single set of digit keys, each representing a different digit of the decimal system of notation, a plurality of registers controlled by said keys, one register being provided for each digit place of the highest number designed to be signaled, means responsive to the successive actuation of any of said keys for moving in a first movement as many of said registers to predetermined positions as keys have been actuated, means for locking said registers in the positions to which they have been moved, an impulse circuit, means for successively moving said registers in a second movement, and impulse responsive means actuated by said registers in their second movement.

11. In an impulse transmitting device, a single set of digit keys, each representing a different digit of the decimal system of notation, a plurality of switches controlled by said keys, one switch being provided for each digit place of the highest number designed to be signaled, means responsive to the successive actuation of any of said keys for moving in a first movement as many of said switches to predetermined positions as keys have been actuated, means for locking said switches in the positions to which they been moved, an impulse circuit, means for successively moving said switches in a second movement, impulse responsive means actuated by said switches in their second movement, and means for restoring said switches to normal in a third movement.

12. In an impulse transmitting device, a set of ten digit keys, a relay for each key responsive to the actuation of its associated key, said relays being grouped in pairs, a register adapted to be set in one of a plurality of positions in response to the actuation of either one of a pair of such relays, a pair of impulsers associated with said register for subsequently producing impulses, a switching relay controlled by one relay of the pair of said first mentioned relays, and means controlled jointly by said switching relay and the set position of said register for determining the number of impulses to be produced.

In witness whereof, I hereunto subscribe my name this 10th day of April A. D., 1920.

LOYD D. PLOTNER.