Aug. 8, 1944. J. H. WHEELOCK ET AL 2,355,349

SIGNAL IMPULSE SENDING SYSTEM

Filed June 21, 1940 3 Sheets-Sheet 1

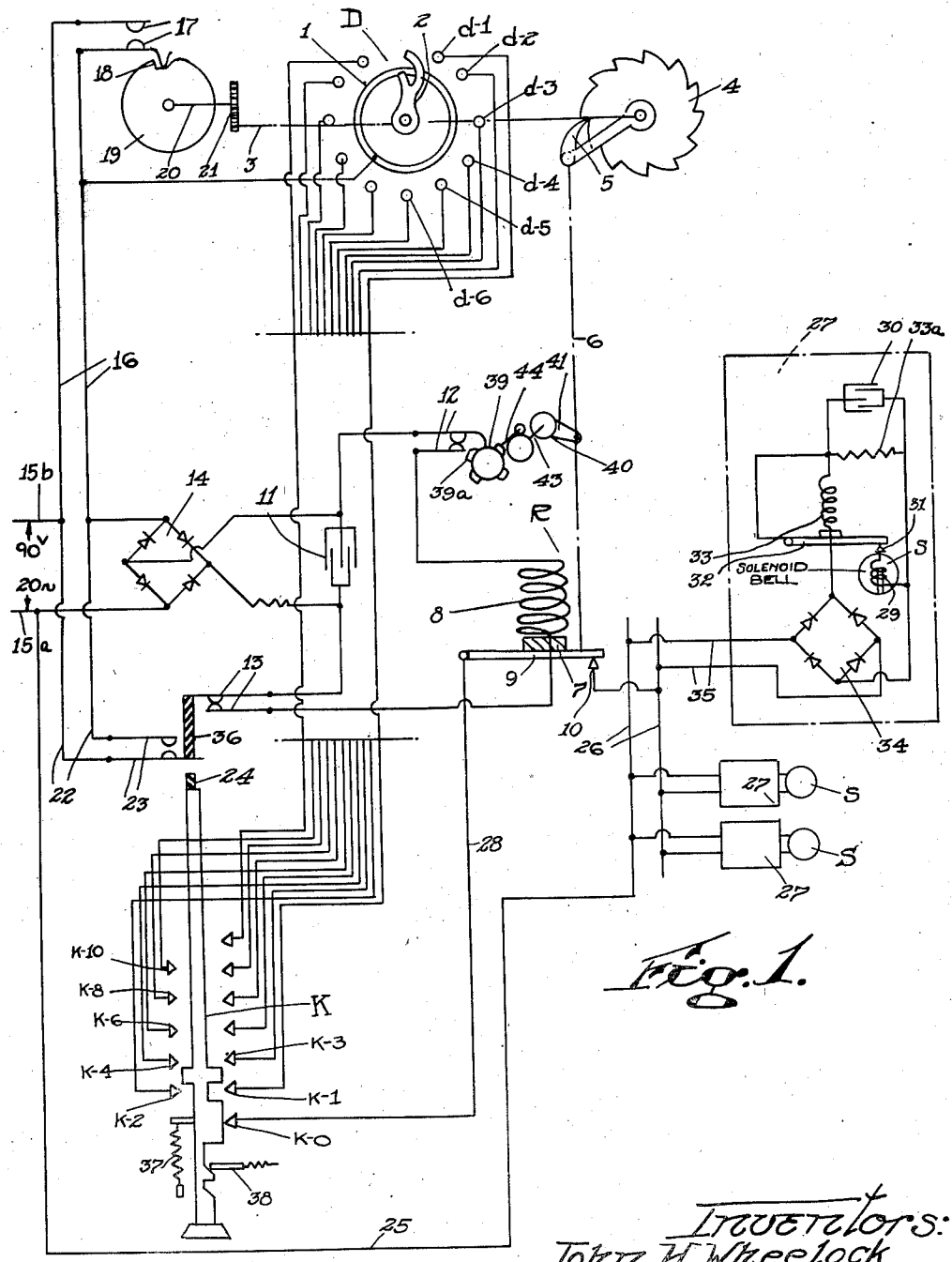


Fig. 1.

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Filed June 21, 1940 3 Sheets-Sheet 2

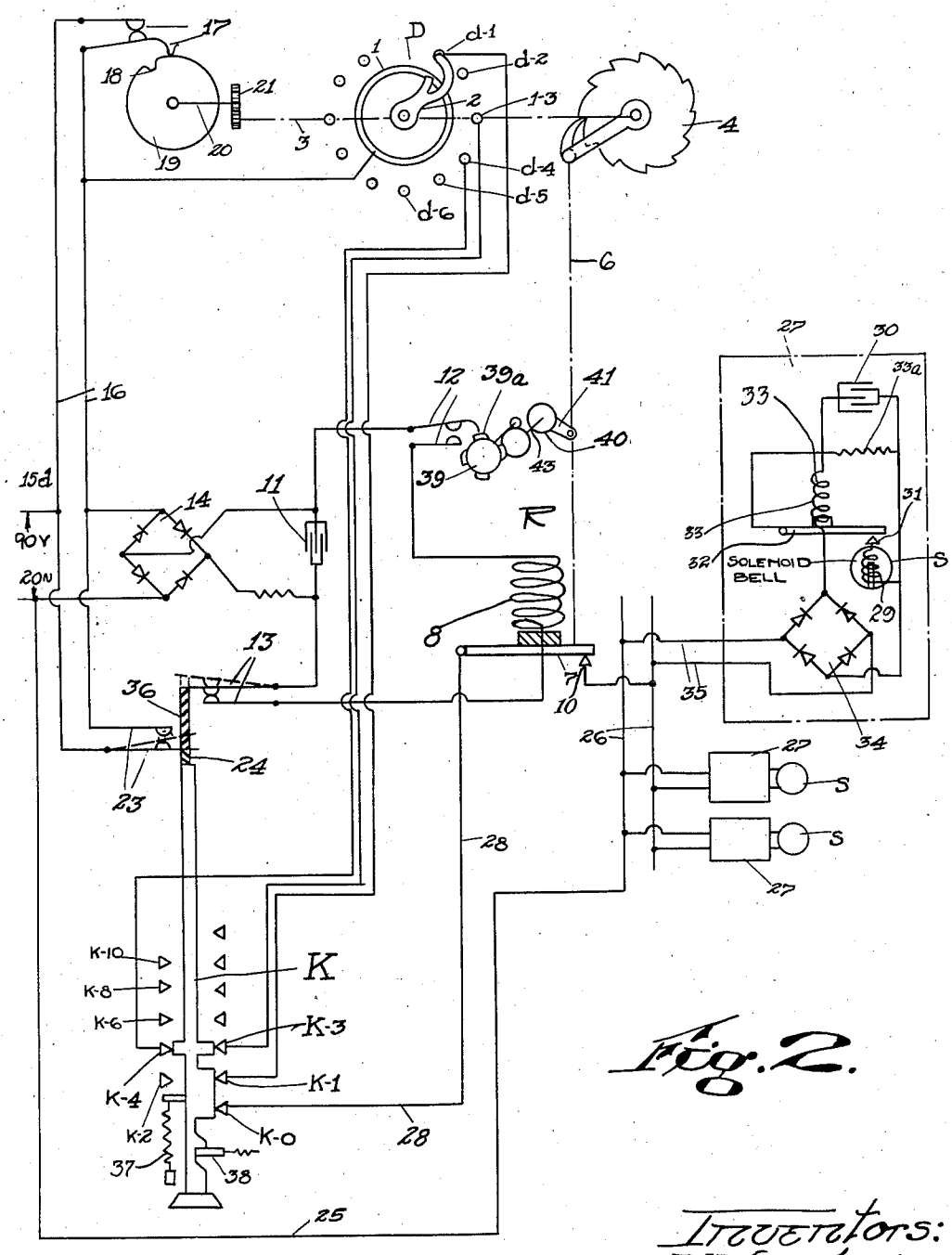


Fig. 2.

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Filed June 21, 1940 3 Sheets-Sheet 3

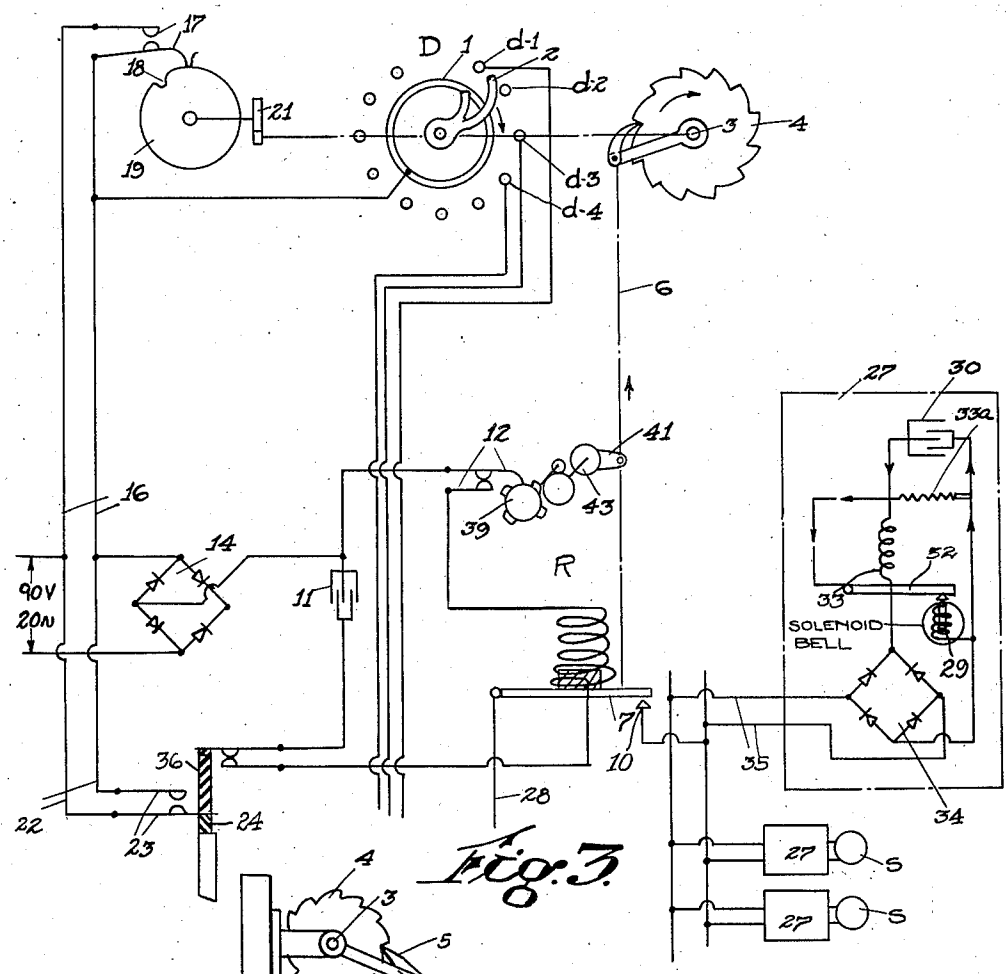


Fig. 3.

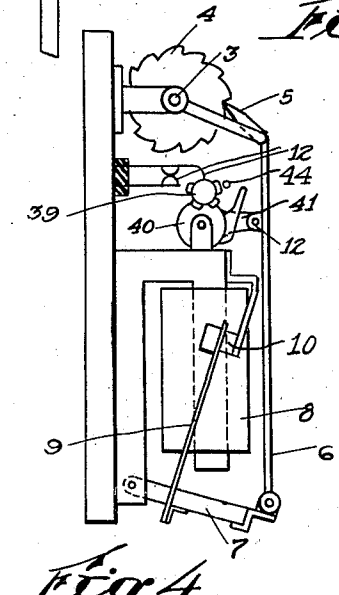


Fig. 4.

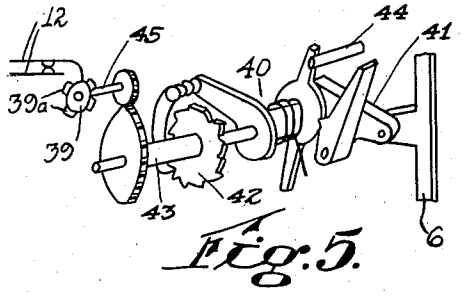


Fig. 5.

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UNITED STATES PATENT OFFICE

2,355,349

SIGNAL IMPULSE SENDING SYSTEM

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Application June 21, 1940, Serial No. 341,740

4 Claims. (Cl. 177—380)

The present invention relates to an electrical impulse sending system for controlling the operation of suitable devices for sounding or displaying signals at different locations throughout a building, or other establishment in which the system is installed. Calling and locating individuals by code number, or transmission of special signals are well known uses of such a system.

Signal code sending systems of the above indicated character are customarily employed in association with telephone apparatus, a usual arrangement being to have the code determining and sending mechanism of the system installed where it may be conveniently actuated by the operator at a telephone switchboard. While a source of energy for operating telephone apparatus is available at any switchboard, it has been the accepted practice to provide for the energization of such code sending mechanism, as well as the signals under the control thereof from the usual commercial lighting circuit, largely due to the fact that telephone current does not provide sufficient power. As a result all parts of the system must be installed in accordance with the regulations governing the distribution of current at 110 volts or higher, in contrast to the relatively low cost installation of apparatus operated from power available at a telephone switchboard.

According to the present invention, there is provided a signal impulse sending system that is adapted to be operated from the electrical energy available at a telephone switchboard, both as regards the signal impulse sending mechanism, and the signals operated thereby. The improved system is so arranged as to draw energy from a source of telephone ringing circuit only at the rate available, and to utilize this energy at a greatly increased rate to operate signals of the loud sounding type ordinarily requiring energization from a commercial power source. Thus the entire system of the present invention is adapted to be installed with the same facility and low cost as associated with the installation of ordinary telephone apparatus.

The above and other advantageous features of the invention will hereinafter more fully appear from the following description, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic view of a system embodying the invention, in its normal, non-operating condition.

Fig. 2 illustrates the system of Fig. 1, after the initiation of the sending of a signal impulse.

Fig. 3 illustrates the system of Fig. 1 in the act of transmitting a signal impulse.

Fig. 4 is a view in side elevation of the stepping relay employed in the system.

Fig. 5 is a detail perspective view of a timing device cooperating with the relay.

Referring first to Fig. 1, the system includes a code determining device of any suitable type shown, for purposes of illustration, as comprising a key K, manually operable to set up a code combination with respect to associated contacts *k*—1, *k*—2, *k*—3, etc. These key operated contacts are connected to correspondingly designated contacts *d*—1, *d*—2, *d*—3, etc. of a distributing device D. The contacts *d*—1, *d*—2, etc. are arranged around the periphery of a ring 1, and a double arm 2 mounted on a shaft 3 passing through the ring 1, is adapted to successively engage the contacts *d*—1, *d*—2, etc., while continuously bearing on the ring 1. The shaft 3 of the distributing device D, also carries a ratchet wheel 4 that is adapted to be turned by a pivotally mounted pawl 5, connected by a link 6 to the armature 7 of a stepping relay R. The relay provides a winding 8, energization of which attracts the armature 7 and causes the pawl 5 to turn the ratchet wheel 4 through an angle sufficient to move the arm 2 from one distributor contact to another. The armature 7 carries a pivoted contact member 9 normally in engagement with a stationary back contact 10 when the winding 8 is in its deenergized condition.

One terminal of the stepping relay winding 8 is connected to one terminal of a condenser 11 through a pair of normally closed contacts 12, forming part of the relay, as shown in Fig. 4. The other terminal of winding 8 is connected to the other terminal of the condenser 11 through a pair of normally closed contacts 13 adapted to be operated by the key K, as hereafter described. The winding 8 is thus normally connected across the terminals of condenser 11, so as to maintain the same in a discharged condition.

The terminals of condenser 11 are also connected to the output side of a full wave rectifier 14, the input side of which is connected to one main 15*a*, energized from a source indicated as being that usually employed in a telephone ringing circuit, namely, a source operating at 90 volts, 20 cycles. The other main 15*b* from the 90/20 source, is adapted to be connected to the input side of the rectifier 14 through conductors 16 leading to a pair of normally open contacts 17, one of which is received in a notch 18 provided on the periphery of a control disk 19. The disk 19 is mounted on a shaft 20 connected by reduction gearing 21 to the shaft 3 of the distrib-

uting device D, for a purpose which will later appear.

The conductors 16 leading to open contacts 17 are connected in parallel to conductors 22, leading to a pair of normally open contacts 23 operable by the key K, which provides an insulating tip 24, adapted to engage one contact 23. The input side of the rectifier 14 is thus normally disconnected from the main 15b, as energized from the source of telephone ringing current, with the rectifier 14 being adapted for energization upon closure of either pair of contacts 17 or 23.

The ring 1 of the distributing device D is connected to one contact 17, so that closure of the contacts 17 by turning of the control disk 19, is adapted to connect the ring 1 to the supply main 15b. The other supply main 15a is connected by a conductor 25 to one of a pair of parallel signal energizing mains 26 extending through the system, across which mains 26 are connected a plurality of signal units 27, of a particular construction adapted for the present system. The other signal energizing main 26 is connected to the contact 10 of the stepping relay R, the other contact of which is connected by a conductor 28 to a common key contact k—0, which is always in engagement with the key K. Consequently, the signal energizing mains 26 will be connected to the source of telephone ringing current energizing the mains 15a and 15b, only in accordance with the arrangement of those particular key contacts k—1, k—2, etc. that are connected to the common contact k—1 upon depression of a particular key K.

Each signal unit 27 comprises the apparatus enclosed within the dot and dash lines at the end of the mains 26, such a unit being more fully shown and described in the co-pending application of Hugo F. Cypser, one of the applicants herein, filed of even date, Serial No. 341,739. For the purposes of the present application, it is sufficient to state that each unit 27 consists of a suitable signal S of the single stroke solenoid type, having a winding 29 adapted to be connected across the terminals of a condenser 30 when the relatively movable contacts 31 and 32 of a relay are engaged. One terminal of the condenser 30 is connected in series with the winding 33 of the relay, and the condenser is adapted to be charged from the output side of a rectifier 34, when the relay pulls up to disengage the movable contact member 32 from the stationary contact 31. The input side of the rectifier 34 is connected across the signal energizing mains 26 by conductors 35, and normally the elements of each unit 27 are in the condition of Fig. 1, with the condenser 30 discharged through the operating winding 29 of the signal S.

Upon pressing the key K all the way in, as shown in dotted lines in Fig. 2, its insulating tip 24 closes the normally open contacts 23, and simultaneously opens the contacts 13, movement of the lower contact 23 being imparted to the upper contact 13 by an operating member 36 of insulating material. Closure of contacts 23 establishes a shunt circuit around the then open contacts 17 and completes the circuit to the input side of the rectifier 14 from the mains 15a and 15b, thereby causing the rectifier to impress a charging voltage on the condenser 11. The condenser thus becomes fully charged, since it is not for the moment short circuited by the operating winding 8 of the stepping relay, due to the opening of the contacts 13 in circuit with the winding 8, by the depressed key K.

Upon release of the key K, a spring 37 returns the key to an intermediate position, in which it is held by a latch 38. In the latched position of the key K, code determining contacts k—1, k—3 and k—4 are engaged by the key K, so that all three of these contacts are connected to the common contact k—0 leading to the contacts 9 and 10 of the stepping relay R through the conductor 28. The particular construction of the key K and its associated latching mechanism, forms no part of the present invention, such a latching mechanism being shown, for example, in Burdick Patent No. 1,823,585, issued September 15, 1931.

Upon return of the key K to its latched position, the contacts 23 are reopened, while the contacts 13 are reclosed, as the insulating tip 24 of the key permits these contacts to assume an unflexed condition. When the contacts 13 close, the winding 8 of the stepping relay R is connected directly across the terminals of the then charged condenser 11, whereupon the relay R pulls up, in response to the full energization of its winding 8 by the condenser discharge. It is to be noted that the relay R is operated entirely by energy stored in the charged condenser 11, and without drawing any current from the 90 volt, 20 cycle ringing current source.

Pulling up of the relay armature 7 by the winding 8 turns the ratchet 4 through the space of one tooth, thereby engaging the distributor arm 2 with the first contact d—1. This initial turning of the shaft 3 is also imparted to the control disk 19 through the reduction gearing 21, so as to close the contacts 17 as the lower contact rides out of the notch 18. The contacts 17 will then remain closed during one complete revolution of the disk 19, which will require thirty-six successive operations of the relay R, with twelve teeth on the ratchet 4 and a speed relation of three to one between the shafts 3 and 20. Closure of the contacts 17 on the first pull up of the relay R, therefore establishes a circuit from the supply main 15b through to the common key contact k—0, but the signal energizing mains 26 are not immediately energized, due to the fact that the stepper relay contacts 10 are then open, as indicated in dotted lines in Fig. 2.

Just after the stepper relay armature 7 pulls up, upon energization of the winding 8 by discharge of the condenser 11, an actuator 39, forming part of a timing device 40, opens the contacts 12 that are connected in the circuit of the winding 8. Thereupon, the relay armature 7 drops back, leaving the condenser 11 in a discharged condition. When this occurs, the movable contact member 9 again engages the stationary contact 10 of the relay, thereby completing connection of the signal energizing mains 26 to the 90/20 mains 15a and 15b through the circuits previously prepared by depression of the key K and turning of the arm 2 and control disk 19. Energization of the mains 26 then connects the input side of the rectifier 34 of each signal unit 27 to the 90/20 source, with the result that each relay winding 33 pulls up through the signal winding 29, to remove the winding 29 from across the terminals of the condenser 30, as shown in Fig. 2. The condenser 30 then becomes charged from the output side of the rectifier 34, and remains in this condition, due to the fact that sufficient current traverses the relay winding 33 through the resistor 33a, to hold up the movable contact member 32. There-

fore, all the condensers 30 of the several signal units 27 become charged, in response to the first dropping back of the armature 7 of the stepper relay.

The actuator 39, which opens the contacts 12 after the pull up of the armature 7, holds the contacts open an appreciable period after the armature drops back, upon breaking of the circuit of the winding 8. As best shown in Fig. 5, the actuator 39 forms part of a timing device 40 of the spring wind-up type, such as is shown in Wheelock & Humphreys application, Serial No. 183,058, filed January 3, 1938, now patent No. 2,235,273. As the armature 7 pulls up, the link 6 turns an arm 41, which winds up a spring driven ratchet 42 on a shaft 43, before being released by a pin 44 as the armature completes its upward movement. Thereafter, the shaft 43 turns the actuator shaft 45 through an angle represented by the displacement of one projection 39*a*, which opens the contacts 12, and then recloses them after a predetermined interval.

Assuming that the contacts 12 are held open through a period of one or more seconds, it is obvious that the condenser 11 will again become charged, due to the fact that the contacts 17 remain closed after the first step of the relay R, and throughout the operating cycle of the system. Therefore, when the timing device 40 permits contacts 12 to reclose, the condenser 11 again discharges into the winding 8, to cause the armature 7 to again pull up and turn the shaft 3 through another step. Since the relay breaks the circuit of its winding 8 at the contacts 12, on each pull up, it follows that the successive charging and discharging of the condenser 11 will cause the stepper relay R to be operated intermittently, until a complete revolution of the disk 19 again permits the lower contact 17 to enter the notch 18 and bring the stepping mechanism to rest.

Since the dropping back of the relay armature 7 after its first pull up results in charging of all the condensers 30 of the several signal units 27, as shown in Fig. 2, it follows that the next or second pull up of the relay armature 7 will result in simultaneous operation of all of the signals S through discharge of the several condensers 30. This is due to the fact that as the relay contacts 9 and 10 open in response to pulling up of the armature 7, the resulting disconnection of one main 26 from the 90/20 source, deenergizes all of the signal unit relay windings 33, whereupon each charged signal condenser 30 discharges into its associated signal winding 29, as the contact 31 is engaged by the contact 32, as shown in Fig. 3.

The first impulse of the signal code is therefore given by the signals as the relay R pulls up, to turn the shaft 3 through its second step, and thereby move the arm 2 from the contact *d*—1 to the contact *d*—2. However, when the relay armature 7 drops back a second time, the several signal operating condensers 30 are not charged, due to the fact that the code determining contact *w*—2 is not engaged by the depressed key K. However, as continued operation of the stepping relay R causes the arm 2 to successively engage the distributor contacts *d*—3 and *d*—4, the resulting dropping back of the armature 7 after each such engagement, will result in charging of the several condensers 30, and the operation of the signals S by the discharge of the condensers, as the relay R pulls up for its fourth and fifth steps. Therefore, with the form of the key K shown in the drawings, continued step-by-step operation of the distributor arm 2 through a complete revolution will result in the operation of the signals S once, then a pause, followed by operation of the signals twice, to transmit the code sequence "Twelve." This sequence will be transmitted three times before the opening of contacts 17 by the disk 19 disconnects the rectifier 14.

The net result of the above described operation of the system is that when the signals S are operated on the pull up of the stepper relay R, very little current is broken at the contact 10, due to the fact that the windings 33 of the signal control relays are then in series with the resistors 33*a* across the terminals of the then charged condensers 30. Furthermore, when the arm 2 moves from one distributor contact to another, there is no current flowing, due to the fact that the circuit from the supply main 15*b* has already been broken at the contact 10. Therefore, arcing in the system is reduced to a minimum, since the signal operating current, due to the discharge of a condenser 30, is no longer flowing when the contacts 31 and 32 of a signal operating relay are opened.

In considering the operation of the system as a whole, it is apparent that the only current flow from the 90/20 source of telephone ringing current is that required to first charge the condenser 11 to store up energy for operating the stepper relay R, and then to simultaneously charge the several signal unit condensers 30 to store up energy for operating the signal windings 29. Assuming even a relatively high condenser charging current of as much as 15 mil. amperes for each signal unit, six bells can be operated from a 90/20 source, with a current consumption of less than 100 mil. amperes, which is well within the limits of the power available at any telephone switchboard. It is apparent then that by the present invention there is provided a complete impulse sending system, in which the operating mechanism, as well as the signals, can be energized entirely from a source of telephone ringing current available at any telephone switchboard, without any connection whatsoever with a commercial power source. Furthermore, it is possible to employ in this system, standard signals of the loud sounding type, each requiring an operating current considerably in excess of the current available at a telephone switchboard, due to the fact that each signal is operated by energy stored within a condenser, rather than through its direct connection to an energizing source.

We claim:

1. An impulse sending system, comprising in combination, a source of electrical energy having a limited instantaneous rate of power output, electrically operated signals, an electrically operated device for sending electrical impulses to said signals, with said signals and sending device having instantaneous rates of power intake higher than the power output rate available at said source, condensers for receiving charges of current from said source at the limited power output rate available, and means in the system, including said impulse sending device, for successively charging said condensers and discharging the stored energy of said condensers, for each impulse sent, to operate first said sending device and then said signals at instantaneous rates of power input greater than the charging rates of said condensers from said source.

2. A signal sending system, comprising in combination, a source of electrical energy of the character that is employed for telephone ringing current, said source having a limited instantaneous rate of power output, signals providing operating windings, a step-by-step impulse sending device having an operating winding, with said windings requiring instantaneous rates of power input greater than that available at said source in order to actuate said device and signals, a code determining device associated with said impulse sending device, means for rectifying current into unidirectional current, condensers adapted to be charged by the rectified current, and means including said step-by-step impulse sending device and set in operation by the initial actuation of said determining device for alternately charging said condensers by rectified current, and discharging them into the operating windings of said sending device and signals.

3. A signal sending system, comprising in combination, a source of electrical energy of the character that is employed for telephone ringing current, said source having a limited instantaneous rate of power output, electrically operated signals providing windings, an electrically operated step-by-step impulse sending device having a winding, with each of said windings requiring instantaneous rates of power input greater than that available at said source in order to actuate said device and signals, a code determining device associated with said impulse sending device, means for rectifying the source current into unidirectional current, condensers associated with each of said windings, and means including said step-by-step sending device and set in operation by the initial actuation of said code determining device for alternately charging said condensers by rectified current and discharging them into the operating windings of said sending device and signals.

4. A signal sending system, comprising in combination, a source of electrical energy of the character that is employed for telephone ringing current, said source having a limited instantaneous rate of power output, electrically operated signals providing windings, an electrically operated step-by-step impulse sending device having a winding, with each of said windings requiring instantaneous rates of power input greater than that available at said source in order to actuate said device and signals, a code determining device associated with said impulse sending device, means for rectifying the source current into unidirectional current, condensers associated with each of said windings, means including contacts in circuit with the winding of said sending device and responsive to the initial actuation of said code determining device for alternately charging and discharging the condenser associated with the sending device winding to cause step-by-step operation of said device, and means including other contacts of said sending device for charging and discharging the remaining condensers with respect to their associated signal windings to cause operation of the signals in accordance with a code set up by said determining device.

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