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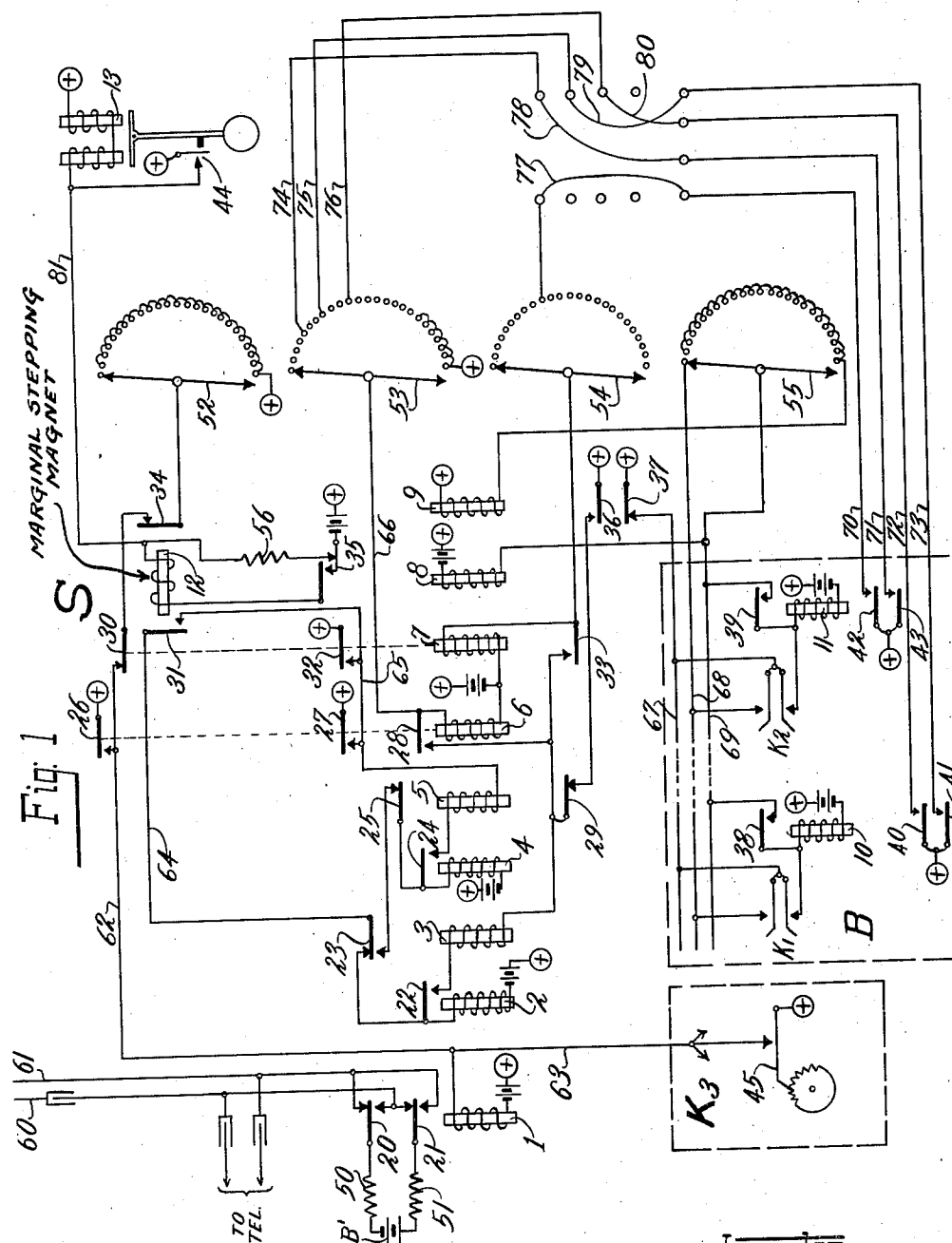
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1,882,010

SELECTIVE SIGNALING SYSTEM

Filed Nov 28, 1927

2 Sheets-Sheet 1



Inventor
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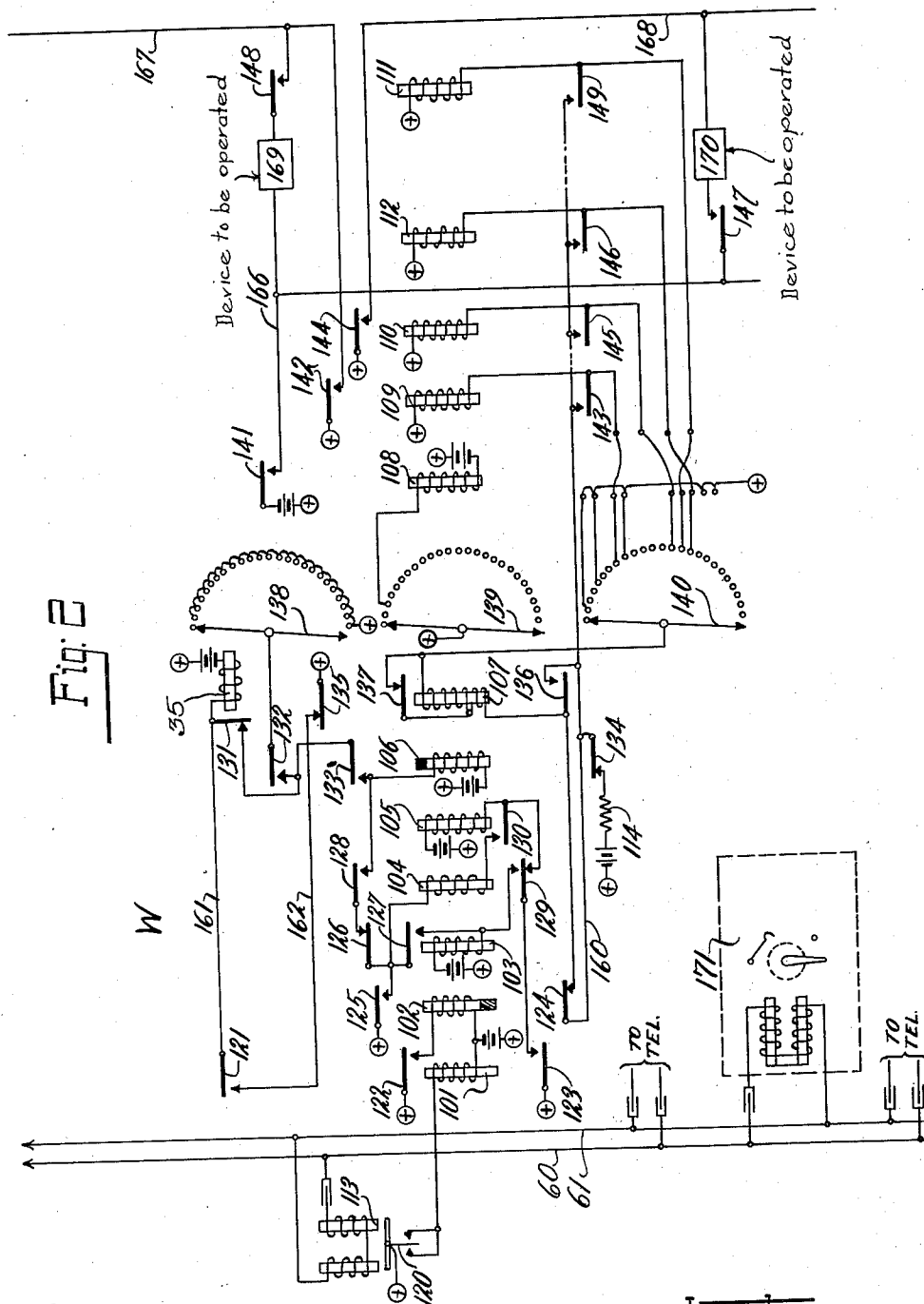
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UNITED STATES PATENT OFFICE

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SELECTIVE SIGNALING SYSTEM

Application filed November 28, 1927. Serial No. 236,301.

The present invention relates in general to selective signalling systems, more particularly to such systems in which a plurality of selectors are actuated by impulses of alternating current, and the principal object of the invention, briefly stated, is the production of a new and improved selective signalling system, the improvements making the system more flexible and more reliable in its operation.

Selective signalling systems of the type disclosed in this invention have been devised heretofore and employed in train despatching systems, systems for the remote control power switching devices, and many other uses. One of these systems, used principally in train despatching work, employs a key for each station to be called, that key being usually of the type disclosed in the Patent 1,155,640, issued to G. Brown, on October 5, 1915. This system employs as selectors, the device shown in Patent 1,200,095, issued to Joseph C. Field on October 3, 1916, there being as many of these devices on the line as there are circuits to be closed. In a system embracing the devices of these inventions, each time a key is operated 27 impulses are sent out on the line, all of the station selectors are operated by the impulses, but only one of the selectors comes to reset in a circuit closing position. The 27 impulses are divided into three series, each of the three series containing a variable number of impulses, the series being separated by pause periods. During the pause period, certain of the selector switches will come to rest against a stop pin which retains them in their operated position. The remaining switches do not come to rest against the stop pin, and are returned to their normal positions by a restoring spring. In a system of this kind, employing the 27 digit codes, a maximum of 253 stations may be called. This apparatus is also adaptable to a 17 digit code, in which case 78 stations can be called. In either of these adaptations, a large number of selecting keys are employed, and the cabinet containing the keys is necessarily quite bulky. Moreover, since the individual key generates its own impulses, there are as many sources of impulses as there are keys in the system.

Each key is equipped with a fly ball governor, to regulate the speed of impulsing, and with adjustable cams and springs to regulate the characteristics of the impulses in the code to be transmitted by the key. In systems of this kind, considerable difficulty has been experienced in maintaining the keys in proper adjustment so that the impulse rate and ratio will be uniform.

Accordingly, as an object of my invention, I provide a new and improved impulse sender, in which the keys individual to the station to be selected merely control the impulses sent out over the line by a common impulse generating device, thereby eliminating any inaccuracy due to a variable impulse speed and ratio.

The selector switches mentioned in the foregoing patent can close but one local circuit, when employed as a 17 or 27 digit selector, and this number can be increased to four when the selector is used as a modified 17 digit code selector. The closure of four local circuits is adequate for most train despatching systems, for which the selector was originally designed. However, when this selector is used in a remote control system, it is frequently necessary to close more than four circuits at one point, that is, at one substation, in which case added selectors are installed, the number of these selectors being dependent upon the number of circuits that must be closed at the substation.

Accordingly, as a further object of my invention, I provide a new and improved selector, responsive to alternating current impulses, and capable of closing a large number of circuits.

Further objects of my invention, not specifically mentioned here, will be apparent from a reading of the detailed description and claims which follow.

The drawings comprising Figs. 1 and 2, when arranged with Fig. 2 above Fig. 1 with correspondingly numbered lines in alignment, show sufficient details to enable a clear understanding of my invention.

Referring now to Fig. 1 in more detail, I show there the sender S, and associated equipment located at the dispatcher's or

sending station. The sender S comprises the impulse generator 13, which is constantly moving, the stepping switch comprising motor magnet 12 and wipers 52 to 55, inclusive, the switch being in one embodiment of mine, a rotary line switch mechanism such as is commonly used in automatic telephone systems. The sender also comprises the relays 1 to 9, inclusive, which are operated to control the sender in the transmission of all signals. In the lower part of Fig. 1, and within the dotted square B, I show the keys K1 and K2, each with its associated individual relay. The operation of one of these keys, energizes the individual relay to strap the banks of the sender switch in such a manner as to cause the sender to send out the code of impulses necessary to select the particular device associated with that key. The key K3, is a representation of the train despatching key, shown in the aforementioned Brown patent, that key being shown to illustrate that the sender S and the Brown key may be interchanged and either used to control the selecting switches. Leading out from the sending station are the trunk conductors 60 and 61, those connectors leading to all of the stations in multiple. Bridged across this trunk is an ordinary magneto local battery telephone, not shown, through which telephone conversations may be carried on with a selected one of the substations. In Fig. 2, I show a substation comprising the train despatching selector 171, which is of the type shown in the aforementioned Field patent, that substation being bridged across the line conductors 60 and 61. I also show the selector switch W, which is the selector of my invention, comprising the switch mechanism driven by magnet 35 and including wipers 138 to 140, inclusive. This switch mechanism may also be the mechanism of the well known rotary lineswitch, commonly employed in automatic telephone systems. Associated with the selector W is the polarized pulsing relay 113, which is bridged across the line conductors, and operated in response to the alternating current impulses sent over the line by the sender to position the switch W upon a set of contacts in accordance with the code of impulses transmitted. Relays 101 to 107 are employed to control the selector switch in a manner which will be brought out hereinafter. The selector switch, upon being operated, operates relays in the group comprising relays 108 to 112, inclusive, energizing a combination of those relays to close a circuit to a particular device. These devices, which may be the call bells of a train despatching system, the circuit breakers of a remote control system, the semaphore of a train signaling system, or any other electromagnetic device, are represented by the squares 169 and 170. It is immaterial to the operation of the present invention just

what the character of these devices is, since the present invention is concerned merely with selecting of a particular device and the closing of a local circuit thereto.

The terminals in the bank over which wipers 140 of the selector W and wipers 53 and 54 of the sender S move are connected to terminal blocks, indicated by a row of small circles on the drawings. Each of these blocks will contain a contact for each contact in the bank, and by means of jumper wires cross connected from these contacts to the terminals of the selecting relays and the individual relays in the sending station, the sender can be made to transmit any combination of impulses desired, and the selector can be made responsive to any combination of impulses. The sender shown in the drawings, and the selector shown in the drawings, are arranged to be responsive to a 27 digit code, that is, the signal will comprise 27 impulses. This drawing is made by way of example only, as both the sender and the selector are capable of being made responsive to any number of impulses as may be required. The 27 impulse code was selected because that is the code most generally used by the train despatching system employing the devices mentioned in the aforementioned patents, that particular code being selected to illustrate the interchangeability of the sender and selector of this invention with the sender and selector mentioned in those patents.

In Fig. 1, I show the battery B1, which is connected to the trunk line 60 and 61, and which is reversed by an impulsing relay to generate impulses of alternating current in the trunk line. This battery, is preferably of about one hundred volts potential, the particular battery shown may be replaced by connections to a 110 volt direct current power supply. Throughout the drawings I have connected the positive line terminal of battery to a symbol comprising a positive sign enclosed in a circle. This symbol is to represent a bus bar, extending throughout the particular station, that bus bar may be connected to ground. Throughout the drawings I have shown a plurality of bus bars, and batteries to avoid an unnecessary complication of the drawings. In an actual installation there would be but one battery to each station, preferably a storage battery of about 50 volts potential.

The drawings illustrate an adaptation of my invention to an existing selecting system, either a train despatching system or a remote control system employing the key sender and selector mentioned in the foregoing patents. The selector W, is installed on the system at a point where it is desired to close a relatively large number of circuits, that being the adaptation to which my selector is best adapted.

To illustrate the operation of the inven-

tion, assume that the despatcher desires to call the station associated with the key K2, and that the code of that station is 7-7-13. The despatcher presses the key K2, to lock up the relay 11, which at armatures 42 and 43 prepares the circuit through conductors 70 and 71 to the banks of the sender switch, arranging the sender to transmit the digits 7-7-13. The constantly moving impulse generator 13 operates to transmit impulses, and when the key K2 is thrown, starts the counting switch in operation by energizing the magnet 12. After the switch has taken one full step and moved the wiper 52 into engagement with the multiplied ones of its bank contacts, relay 1 is alternately energized and deenergized as the motor magnet 12 operates. When the relay 1 is energized, it reverses the polarity of the trunk conductors 61 and 62, thereby transmitting one impulse which operates the motor magnets of the selectors such as motor magnet 113 and the motor magnet of the selector 171 which are bridged across the trunk. When the relay 1 deenergizes, it again reverses the polarity of the trunk to transmit another impulse. When seven impulses have been transmitted, the relay 1 comes to rest, in this case it comes to rest in an energized position, that control being exercised by the relay 6, associated with the sender S. Since the station 171 is not the station preselected by the digits 7-7-13, when that selector comes to rest the retaining pin will not be in the proper position, and the selector will rotate back and return to normal. While the relay 1 is maintained in its energized position, the sender switch S takes two steps, those steps being taken to put a pause in the impulsing of sufficient length of time to permit the restoration of the selector 171 and other selectors of that type which may be connected to the trunk line. In the station containing the selector W, which is assumed to be the selector which is to be operated by the digits 7-7-13 to select a particular device, the first pause, with the wiper 140 upon its seventh bank contact energizes the relay 109, to prepare a point in an operating circuit. It may happen that the switch W has access to a plurality of devices whose first digit is a 7, in which case either the second or the third digits or both are necessary to select a particular one of these devices. The energization of the relay 109 therefore closes a circuit to the common bus bar 167, which is connected to a plurality of devices, all of whose numbers begin with a 7. When the sender has taken the two steps, impulsing is resumed, and additional impulses comprising the second digit, in this case a 7, are transmitted. The switch 171 will again be stepped, but since it is not set to respond to the 7 it will again restore to normal at the end of the impulsing. If the switch W was not set to respond to a 7, when the first 7

was transmitted, the wipers of that switch would come to rest upon such contacts that wiper 140 would pick up direct positive potential, and the relay 107 would be energized to open the circuit of the motor magnet of switch W, to prevent its responding to any more digits. Thus it will be seen that responsive to the transmission of a 7, all of the switches of the type shown in the Field patent will be stepped, and all of the switches similar to W will be set. At the end of the transmission of the digit 7, the Field switches will return to normal, and the switches W which are not set to the digit 7 will be locked out and made unresponsive to further impulses of the present signal.

When the second 7 has been transmitted and the impulsing ceases momentarily, the selecting switch W is standing on its 14th bank contact to close a circuit to the relay 111, which relay energizes and prepares a point in the circuit of device 169. The sender takes two more steps without transmitting any further impulses to the line, at the end of which time the last series of impulses in the signal is transmitted. In this case the last series comprises 13 impulses. When the 13 impulses have been delivered, wiper 139 engages the contact to which the relay 108 is connected, energizing that relay to close the last point in the circuit of device 169. The device operates over this circuit. In the sending station the completion of the sending of the 13 impulses brought the wiper 53 into engagement with its eighteenth bank contact, thereby completing the circuit for the relay 6 which energizes to maintain the impulsing relay 1 energized to prevent transmission of further impulses. The sender switch S continues to step, taking 6 steps to bring its wipers into engagement with the normal position contacts, at which time the relay 1 is deenergized to transmit a single impulse of current over the trunk line. This single impulse serves as a clearing out impulse, operating the switch W to restore it to normal under the control of the local circuit completed to wiper 138, and operating the Field type of selectors which restore to normal under the control of a restoring spring. With the sender and selecting switches in their normal positions, the system is at normal in readiness for the transmission of the next signal.

If the key K3 is operated to select the station, the operation of the selector switch W and of the way station selector 171 is the same as before, the sender S is not operated. The key K sends out a code of 27 impulses, which operates the relay 1 to transmit impulses to the trunk conductors. This code of 27 impulses is split into three groups by a mechanical arrangement in the key which can be best understood from the foregoing patent.

Having thus described my invention in general, I will now proceed with a detailed description of its operation.

Sending code 7-7-13

5 Assume now that the despatcher desires to operate the device whose code is 7-7-13. To do this he operates the key K2, thereby closing a circuit from positive battery through springs 37, conductors 67, to the upper pair of contacts of the key K2, conductor 68, normal position and wiper 55, through the winding of relay 8 to negative battery. Relay 8 energizes over this circuit and at springs 35 opens the normally closed circuit extending from negative battery through resistance 56 and conductor 81, through the winding of the impulse generator 13 to positive and closes a substitute circuit therefor from negative battery through spring 35 and its make contact, through the winding of the motor magnet 12, the conductor 81, and the winding of impulse generator 13 to positive. It will be well to note that the impulse generator is operating constantly, through the circuit including the resistance 56 whenever the sender is normal. When the impulse generator energizes, springs 44 close and the circuit of the magnet 13 is shunted out. The magnets deenergize and the pendulum on the armature springs back to open the springs 44. This operation is continuous, at a uniform rate of speed under the control of the pendulum on the armature, and in the present instance the speed of swinging is about three cycles per second, that is springs 44 are closed three times a second.

Because of the high resistance of the winding 13, magnet 12 does not energize when the magnet 13 is in series with it, but when the armature 44 shorts out the magnet 13, magnet 12 energizes. The switch of this sender is of the type of the well known rotary line-switch whose wipers are advanced when the magnet deenergizes rather than when it energizes. The energization of magnet 12 opens at springs 34 a point in the circuit of impulsing relay 1, without particular effect at this time since that circuit is held open at wiper 52. Magnet 12 also closes springs 31, which closure is likewise without effect at this time. When the impulse generator 13 opens the springs 44 and cuts the resistance of its magnet back in series with the magnet 12, the latter magnet deenergizes, advancing the wipers 52 to 55, inclusive, one step into engagement with their first working bank contacts. Returning now to the operation of key K2, it closes the obvious circuit from the positive potential on conductor 67 through the lower key springs through the winding of relay 11 to negative battery, energizing that relay. When the wiper 55 is moved out of its normal posi-

tion and into engagement with the first working contact of its banks, as explained above, it closes a circuit from positive battery through relay 9, through the multiple contacts engaged by wiper 55, and thence over two paths in parallel, the one through springs 39, and the relay 11 to negative battery, and the other through the relay 8 to negative battery. Relay 9 energizes over this circuit, and relay 8 and 11 are maintained energized. The energization of relay 9, at springs 37, opens the positive potential from the conductor 67 to render the pressing of any other keys ineffective. At springs 36 relay 9 prepares a point in the control circuit, for a purpose which will be apparent hereinafter.

The energization of relay 11 at springs 42 closes a circuit from positive battery over conductor 70 through the cross connecting blocks and jumper 77 to the tenth bank contact engaged by the wiper 54, thereby preparing a control circuit which will be completed when the wiper 54 engages its tenth bank contact. Similarly at spring 43, relay 11 places positive potential on conductor 71, to prepare a circuit through the jumper 78 and the terminal block pins, conductor 74 thence to the fourth working bank contact over which wiper 53 rotates, to prepare a control circuit which will be completed when wiper 52 engages that contact.

Impulsing

As soon as the switch is moved into engagement with its first working contact, as the magnet 12 restores, a circuit is completed from positive battery through the multiple contacts engaged by the wiper 52, through springs 34, springs 30, conductor 62, through the winding of the relay 1 to negative battery, energizing that relay. The energization of relay 1 operates springs 20 and 21 to reverse the polarity of battery placed on conductors 60 and 61, thereby transmitting the first impulse to the switches at the substation. Magnet 12 soon energizes, responsive to the operation of springs 44, and at springs 34 opens a point in the circuit of relay 1, permitting that relay to deenergize and again reverse the polarity of the battery on trunk conductors 60 and 61, to transmit the second impulse. When the springs 44 again open and the magnet 12 deenergizes, the wipers 52 to 55 are advanced one step into engagement with their second working bank contact, and the circuit of relay 1 is again closed at springs 34 to energize that relay to transmit the third impulse to the trunk conductors. This process continues until wiper 53 enters into engagement with its fourth bank contact to which 74 is connected. When the wiper moves into engagement with that contact, magnet 12 is deenergized and springs 34 closed to reenergize

the relay 1 to transmit the 7th impulse to the line conductors. Simultaneously with the energization of relay 1, relay 6 is energized over a circuit traceable from positive battery through springs 43 and the conductor 71, jumper 78, conductor 74, wiper 53, conductor 66, through the winding of relay 6 to negative battery. Relay 6 upon energizing at springs 26 closes a circuit from positive battery through conductor 62 and the winding of relay 1 to negative battery, to maintain the relay 1 energized independent of the springs 34. Relay 6 at springs 28 locks itself through springs 29 and springs 36 to positive battery over a circuit independent of the wiper 53. At springs 27, relay 6 prepares a point in the digit absorbing circuit.

The first pause period

After the energization of relay 6 at the end of the transmission of seven impulses to the trunk conductors 60 and 61, the motor magnet 12 again energizes, closing at springs 31 a circuit traceable from positive battery through springs 27, conductor 65, springs 31, conductor 64, spring 23 and its break contact, through the winding of relay 2 to negative battery. Relay 2 energizes over this circuit, and at springs 22 prepares a point in the circuit of relay 3. Relay 3 at this present moment is short circuited, having positive potential put on its upper terminal through springs 22, and having positive potential put upon its lower terminal through springs 36, and 29. When the springs 44 of the impulse generator open and permit the magnet 12 to deenergize springs 31 are opened and positive battery is removed from springs 22 of the relay 2, thereby permitting the relay 3 to energize over a circuit traceable from the positive battery previously traced to the lower terminal relay 3, through the winding relay 3, springs 22, through the winding of relay 2 to negative battery. The relay 2 is maintained energized over this circuit. The deenergization of magnet 12 advances the wipers 52 to 55 inclusive into engagement with the fifth working contact of their banks. The energization of relay 3 prepares at springs 23 a point in the circuit of the relay 4, that circuit being completed when the magnet 12 again energizes preparatory to taking another step. The circuit for the relay 4 is the same as for the circuit for the relay 2, up to the spring 23 which is now against its make contact, the circuit extending through spring 25 and the winding of the relay 4 to negative battery. Relay 4 energizes and at springs 24 prepares a point in the circuit of relay 5, which relay is at the moment short circuited by having positive potential put on its upper terminal through the springs 24 and positive potential put on its lower terminals through the springs 27. When the

magnet 12 again deenergizes, to advance the wipers 52 to 55 into engagement with their sixth working contacts, springs 31 are operated to remove the positive potential from springs 24, thereby permitting relay 5 to energize in a circuit in series with the relay 4, which circuit maintains the relay 4 in its energized position. The energization of relay 5, opens at springs 29 the locking circuit of the relay 6, permitting that relay to fall back and at springs 27 open the circuit over which relays 4 and 5 were energized and held. The opening of springs 29 opens the locking circuit of relays 2 and 3. Thus the relays 2 to 5, inclusive, are permitted to restore to their normal positions. Relay 6 in restoring to its normal position, also opens the locking circuit of relay 1 at springs 26. However, since the magnet 12 is in its normal position when the relay 6 restores, relay 1 does not immediately fall back, being maintained over the circuit through springs 34 and the wiper 52.

Sending the second digit

Magnet 12 again energizes, and at springs 34 opens the circuit of relay 1 permitting that relay to fall back to transmit the first impulse of the second series. When the magnet 12 deenergizes, to advance the wipers 52 to 55 into engagement with their respective seventh working contacts, springs 34 are again closed and relay 1 energized to transmit the second impulse of the second series. This operation continues, until the wipers are brought into engagement with their tenth working contacts, at which time the second pause period is started. In stepping from its seventh to its tenth bank contacts, the sender switch takes three steps, so that the relay 1 is energized and deenergized three times to transmit six impulses to the line. Since the relay 1 was energized during the previous pause period and deenergized when the magnet 12 was energized, the relay transmitted an extra impulse, making 7 in all, so that when the wipers are resting upon the tenth contact, 7 impulses will have been transmitted over the trunk. At this time a circuit may be traced from positive battery to springs 42, conductor 70, the jumper 77, to the tenth bank contact engaged by wiper 54, through the winding of relay 7 to negative battery, energizing the relay 7. Relay 7 at springs 30, opens a point in the circuit of relay 1, to prevent that relay energizing at this time. At springs 32, relay 7 places positive battery on conductor 65 to prepare the circuit for relays 2 to 5, inclusive. At springs 33, relay 7 locks itself to positive independent of wiper 74. Motor magnet 12 is again energized, and the springs 31 close a circuit for the relay 2 as before, energizing that relay which prepares a circuit for the relay 3. When the magnet deenergizes and advances the wipers into engagement with the

eleventh bank contact, relays 2 and 3 are energized and maintained through the springs 36 and 29 as before. The magnet 12 reenergizes preparatory to advancing wipers into engagement with the twelfth bank contact. 5 The reenergization of magnet 12 prepares a circuit for the relay 4 as before and when the magnet deenergizes relay 5 energizes to unlock relays 2 and 3 and 7, which fall back immediately. The restoration of relay 7 un- 10 locks relays 4 and 5, and at springs 30 closes circuit of relay 1 which immediately energizes to transmit an impulse over the trunk conductors.

15 *Transmitting the last digit*

The magnet 12 and the relay 1 are alternately energized and deenergized as before until the wiper 53 engages its eighteenth 20 bank contact, at which time twelve impulses will have been transmitted over the trunk by the relay 1. When the wiper 53 moves into engagement with the eighteenth bank contact, the previously traced circuit for 25 relay 6 is closed, energizing that relay. At springs 26 relay 6 closes a circuit for relay 1 to energize that relay if it has not yet energized or to maintain it energized if it is already in its energized position. Relay 1 30 energizes to transmit the thirteenth or last impulse of the code. The next impulse delivered by the impulse generator 13 to the motor magnet 12 operates that magnet and the relay 2 as before, the magnet falling back 35 to advance the wipers at the end of the step and the relay 2 completing the circuit of the relay 3 which energizes when the magnet deenergizes as before. The next step energizes the magnets 4 and 5 as before, however, 40 the circuit of relay 6 is not opened as before because the wiper 53 still engages positive potential. The magnet is energized six times to advance wipers 52 and 53 into their home position, thereby opening the circuit of relay 45 6 which falls back and opens the circuit of relay 1 which falls back to transmit a single or clearing out pulse over the lines 60 and 61. With the wipers of the switches in their home position, the circuits of relays 9, 8, 50 and 11 are opened, those relays restoring to restore the mechanism to its normal position. The restoration of relay 8 removes the magnet 12 from the circuit of the impulse generator 13 and substitutes therefor the resistance 56, so that further operation of the im- 55 pulse generator is without effect at this time. Thus all of the relays of the sender S are brought back to their normal positions, in readiness for the next call.

60 *Operation of the selector W*

Returning now to the initiation of the operation of the sender S to transmit the code 7-7-13, the first impulse of reversed current sent over the trunk connector 60 and 61

by the relay 1 operates the motor magnet of the station 171, and the polarized relay 113 of the selector W. The operation of the motor magnet of station 171 advances the disc of that station one step in the manner best 70 understood from a reading of the above referred to Field patent. The operation of relay 113 closes a circuit from positive battery through the winding of relay 101 to negative battery, energizing the relay 101. 75 The energization of relay 101 at springs 122 closes a circuit for the relay 102, energizing that relay. At springs 121, relay 101 closes a circuit from positive through springs 135, conductor 162, springs 121, conductor 161, 80 through the winding of motor magnet 115 to negative battery, energizing the motor magnet preparatory to advancing the wipers 138 to 140, inclusive. At springs 123, 85 relay 101 closes the obvious circuit of relay 105 which energizes and at its armature 130 prepares a locking circuit for itself which includes the winding of relay 104. The energization of relay 102, at springs 125, 90 closes a point in the circuit of relays 104 and 106. The closure of this circuit short circuits the relay 104, while relay 101 is in its energized position. The energization of relay 102 opens at springs 124, a point in the 95 circuit of relay 107 to render that relay inoperative at the present time. When the reversal of current in the line 60, 61, is completed, and relay 113 restores, the circuit of relay 101 is opened, and that relay falls back. 100 The restoration of springs 123 removes the short circuit from around the relay 104, permitting that relay to energize over a circuit traceable from positive through springs 125, through the winding of relay 104, through 105 springs 130, through the winding of relay 105 to negative battery. Relay 105 is maintained energized in series with relay 104. The energization of relay 104 at spring 129, 110 prepares a point in the circuit of relay 103, which circuit is opened at springs 123 at the moment. At spring 128, relay 104 prepares a point in the circuit traceable from positive from springs 125, springs 126, springs 128, through the winding of relay 106 to negative 115 battery. Relay 106 is equipped with a copper slug on the armature end of this core, indicated in the drawings by shaded portion at the upper end of the core, and is therefore slow to pull up and will not immediately energize. The restoration of springs 121 by 120 the deenergization of relay 101 opens a point in the circuit of the motor magnet 115, permitting that magnet to fall back and advance the wipers 138 to 140 of the switch W one step. The next reversal of the current in the conductor 60 and 61 occurs before relay 106 has 125 had time to energize, and relay 113 is again energized to close the circuit of relay 101. The energization of relay 101 recloses circuit of the motor magnet 115 at springs 121 and 130

of the relay 102 at springs 122 as before. Since the relay 102 is equipped with a copper slug on the heel end of its core, indicated on the drawings by the cross section area at the lower end of the core, it is slow to release and has remained in its energized position during the time that relay 101 was deenergized. The operation of springs 123 closes the circuit from positive, through spring 129 and its make contact, through the winding of relay 103 to negative battery, energizing the relay 103. Relay 103 at springs 127 locks itself to the positive battery through springs 125 of the relay 102, thereby insuring that it will remain in its energized position as long as relay 102 is energized. At springs 126, relay 103 opens a point in the circuit of relay 106, to prevent that relay energizing at that time. The motor magnet being energized by the closing of relay 101 is in readiness to advance the wipers another step when the relay 101 deenergizes. In this manner the relay 101 motor magnet and the relay 113 will energize, and deenergize responsive to the impulses received over the trunk conductors 60 and 61. When the first digit of the code has been transmitted, in this case a 7, relay 113 comes to rest deenergized, relay 101 is consequently deenergized for a sufficiently long period of time to permit relay 102 to deenergize. The deenergization of relay 102 opens the locking circuit of relays 103, 104, and 105, permitting those relays to deenergize. With the reception of the present signal, wiper 140 will be resting upon its seventh bank contact when the switch comes to rest at the end of the first digit, and a circuit will be closed from negative battery through resistance 114, springs 134, conductor 160, springs 124, through the lower winding of relay 107, through springs 137, through the wiper 140, seventh bank contact engaged by the wiper 140, through the winding of 109 to positive. Relay 109 has a high resistance winding, and energizes over this circuit. Because of the resistance of relay 109, relay 107 does not energize. Relay 109 upon energizing, at springs 143 locks itself independent of the wiper 140 to the conductor 160 which is maintained at negative battery potential through resistance 114 and the springs 134. The energization of relay 109 at springs 142 closes a circuit from positive through the conductor 167, for a purpose which will be best understood from the details which follow.

At the end of the pause period, impulsing is resumed, and the switch W stepped in accordance with the second digit of the code, in this case another 7. The details of this stepping are the same as before, and need not be repeated at this time. When the wiper 140 is brought to rest the second time, it completes the circuit for the relay 111, traceable from negative battery through the resistance

114 and the previously traced circuit to the wiper 140, which is now resting upon its 14th bank contact, to the terminal block and jumper associated with that contact, through the winding of the relay 111 to negative battery. Relay 111 energizes over the circuit, locking itself through springs 149 to the positive battery on conductor 160. At springs 148, relay 111 closes a point in the circuit of device 169, connecting one terminal of that device to the conductor 167. At the end of the second pause period, the relays 102 to 105, inclusive, are restored as before, and when impulsing is resumed, the switch is again stepped in accordance with the last digit of the code, in this case a 13. There are 25 bank contacts in the switch W, the 25th step will therefore bring the wipers into engagement with their normal contacts and the 26th into engagement with the first contact and the 27th into engagement with their second contacts. When the wipers come to rest at the end of the thirteen impulses comprising the last digit of the code, a total of 27 steps will have been taken by the switch, the wipers will come to rest upon their second bank contacts. A circuit may now be traced from positive through the wiper 139 and its second bank contact through the winding of the relay 108 negative battery energizing that relay. The energization of relay 108 closes a circuit from negative battery through springs 141 to the common conductor 166, thereby completing the circuit through the selected device 169, springs 148, conductor 167 to positive at springs 142. The selected device 169 is operated by this impulse. The circuit of the device 169 remains closed as long as the wipers remain upon their second bank contacts until the sender S sends out a clearing-out code.

Clearing out pulse

In the foregoing description of the operation of the sender it was pointed out that when the wiper 53 moved out of engagement with its 24th bank contact and into engagement with its normal contact, the circuit of relay 1 was opened and that relay fell back to transmit a single impulse over the trunk conductor. Responsive to the receipt of this impulse, relay 113 is operated to close a circuit of relay 101 which energizes, and causes the circuit of relay 102 and of the motor magnet 115 and of the relay 105 as before. When the relay 101 restores at the end of the impulse, relay 104 pulls up as before and completes the circuit of the relay 106, that circuit being traceable through springs 125, 126, 128, to the winding of the relay 106. No further impulses are to be received, and the relay 101 remains in its deenergized position long enough to permit relay 106 to energize. The relay 106 although it is slow to pull up, will pull up before the relay 102 deenergizes. When

relay 106 pulls up, it locks itself to positive battery on the multiplied contacts engaged by the wiper 138 over the circuit through springs 132 and 133, thereby insuring that it will remain up as long as the wiper 138 is out of its normal position. When the relay 101 fell back it opened the circuit of magnet 115 to advance the wipers one step, thereby opening the circuit of relay 108 to permit that relay to restore and open the circuit of the device 169. The energization of relay 106 also causes the circuit of the device 169 to be opened removing at springs 113, negative potential from the conductor 160 to permit the relays 109 and 111 to restore to their normal positions. The motor magnet 115 is again energized over a circuit traceable from a positive on the multiplied contacts engaged by wiper 138 and that wiper, springs 132, springs 131, through the winding of the magnet 115 to negative battery. The magnet energizes and opens its own circuit at springs 131, falling back to advance the wipers one step. The magnet 115 will operate in a buzzer-like fashion as long as the wiper 138 encounters positive potential, and the switch W will be stepped around into its normal position. When the switch reaches its normal position wiper 138 loses its positive potential, relay 106 is deenergized, and the selector and associated equipment is in its normal position in readiness for the receipt of the next call.

In the way-station 171 the field selector is operated by the single clearing out impulse, however, since that selector did not close a local circuit at this time, the operation responsive to this impulse is without particular effect and at the end of the pulse the selector returns to its normal position.

40 *Operation of selector in non-called substations*

Since the trunk conductors 60 and 61 are multiplied to a plurality of substations, and since some of those substations will not be called by the digit 7, provision must be made to prevent any of the selectors in those substations from closing a local circuit when the digit 7 is received. For this purpose all of the unused contacts in the bank over which the wiper 140 of the switch S rotates, are multiplied together and connected to positive battery. At the end of the transmission of the first digit 7, wiper 140 of all of the switches except the switch W in the substation in Fig. 2 will engage a contact to which positive potential is connected, and when the relay 102 falls back a circuit for the relay 107 will be completed from this positive potential through the springs 137 through the lower winding of the relay 107, conductor 163, springs 124, the conductor 160, through the springs 134, and the resistance 114 to negative battery. Relay 107 energizes over this circuit, springs 137 are operated to remove

the short circuit from the high resistance upper winding, and at springs 136 relay 107 completes the locking circuit for itself independent of the springs 124 of the relay 102. Relay 107 will remain locked up to the positive potential picked up by wiper 140 until the clearing out pulse is received. At springs 135, relay 107 opens a point in the circuit of motor magnet 115, to render that motor magnet unresponsive to further closures of the spring 121 by the pulsing relay 101. The second train of digits are received, the relay 113 and the relay 101 will operate as before, closing the circuits of the relays 102, 104, and 105 as before, but the motor magnet 115 will not be operated and the switch will remain set upon the contacts upon which the wipers are resting. When the clearing out pulse is received, the relays 104 and 105 are operated to close the circuit of relay 106 as before, and that relay energizes to unlock relay 107 at springs 134, and to close the restoring circuit as hereinbefore pointed out.

Other codes

As illustrated the sender S and the selector W are arranged for a 27-digit code. This showing is made by way of example only as these devices are capable of being arranged for codes of any number of impulses. In the sender S the final cut off of the code is determined by the contact upon which wiper 53 picks up positive potential, that contact can be altered to suit requirements. In the drawings this positive potential is picked up on the eighteenth bank contact and maintained until after the 24th contact has been passed. If a 17-digit code were to be sent out by the sender S, this multiple would be extended to the thirteenth bank contact, and the last digit of the code number which is correspondingly short. For example with the connections as shown and multiple extended to contact 13, the pressing of the key K2 would cause the sender to send out the digits 7-7-3, totalling 17 impulses.

Similarly in the selector W, the finishing of the code must position the wiper 139 upon the contact leading to the relay 108. Since there are 25 steps in a half revolution of the wipers 139, and since the selectors shown connected for a 27-digit code, this relay is connected to the second contact of the bank, the wiper making a complete revolution plus two steps to reach that contact. If a 17-digit code were to be received by the selector W, the relay 108 would be connected to the 17th bank contact, and the wiper 139 would be positioned thereon after the 17 steps had been taken.

Thus it will be seen that by suitable connection in the banks of the sender and the selector, codes of any number of digits can be transmitted by the sender and received by the selector.

In the code 7-7-13 illustrated above, the

first pause period occurs when the pulsing relay 1 is energized, the second pause period occurs with that relay deenergized and the final or operating period with the relay energized. Obviously it is not necessary that this cycle of operations be rigorously adhered to, in fact if the first digit of the code comprises an even number of impulses the first pause period will occur with the relay deenergized, if for example, the conductor 74 which controls the cut-off at the end of the first series of impulses were connected to the contacts of the banks over which wiper 51 rotates, the sender would pause when the relay 1 deenergized. The second pause period may occur with the relay 1 either deenergized or energized. To illustrate this, the key K1 when energized places positive potential on the conductors 72 and 73 which are jumpered to conductors 75 and 76. When the key K2 is pressed, the sender will send the code 13-2-12, in which case the relay 1 is energized during both of the pause periods. It is thought that this showing sufficiently describes the invention and that further addition of individual keys and the jumpers and wires through which they control the sender would be a needless complication of the drawings.

Similarly in the selector W, the local circuits may be closed by a number of combinations of energized relays two of which are shown. The relay 109 and the relay 111 close the circuit of the device 169 which extends between the bus bars 166 and 167. The closures of relays 110 and 112 will close a circuit for the device 170 which circuit includes the bus bar 166 and a second bus bar 168. As many positive bus bars may be included as are necessary, or the devices in a substation may all be controlled off one bus bar as desired. Cross-connecting blocks, one side of which contain the wires from the contacts and the bank over which wiper 140 rotates, and the other side which contains the terminals of the various relays affords a convenient means of connecting the selector to set up whatever combination of circuits is required.

While I have chosen to show my invention in connection with a particular type of apparatus, I have done so by way of example only, as there are many adaptations and modifications which can be made by one skilled in the art without departing from the scope of the invention. I have shown individual keys K1 and K2 which control the sender S, by way of example, it being obvious that the contacts could be auxiliary contacts upon a device, and which contacts are actuated when that device changes its position to transmit a signal corresponding to the device. This signal selects a particular instrument, for example 169, to make a record of the movement

of the device. This and many other adaptations will be apparent.

The selector W shown and not claimed herein, is claimed in my divisional application, Serial No. 428,663, filed February 15, 1930.

Having thus described my invention, what I consider new and desire to have protected by Letters Patent is pointed out in the appended claims.

What is claimed is:

1. In an impulse transmitter, a relay, means for generating impulses, a stepping switch, means for operating said stepping switch by said impulses and for simultaneously alternately energizing and deenergizing said relay, means controlled by said relay for transmitting an impulse when it energizes and another impulse when it deenergizes, means controlled through said switch for arranging said transmitted impulses into codes separated by pause periods, and for maintaining said relay energized or deenergized during said pause periods dependent upon the code being transmitted, and means for maintaining said last means effective while said stepping switch takes two steps.

2. In an impulse transmitter, a relay, means for generating impulses, a stepping switch, means for operating said stepping switch by said impulses and for simultaneously alternately energizing and deenergizing said relay, means controlled by said relay for transmitting an impulse when it energizes and another impulse when it deenergizes, means including a relay energized to maintain said first relay energized and a relay energized to maintain said first relay deenergized to insert pause periods in said transmitted impulses to transmit a code signal, and means for maintaining said last means effective while said stepping switch takes two steps.

3. In an impulse transmitter, a stepping switch, means for stepping said switch, a relay operated by the stepping of said switch to transmit impulses, means for arranging said impulses into groups and inserting pause periods between the groups, said means comprising relays energized in different positions of said switch to prevent the operation of said impulsing relay by said switch, and means rendered operable by the energizations of said relays and thereafter operated by said switch in its two succeeding positions to cause the deenergizations of said relays to allow said impulsing relay to again be operated by said switch.

In witness whereof, I hereunto subscribe my name this 22d day of November, A. D. 1927.

HARRY E. HERSHEY.