Sept. 12, 1939. N. H. SAUNDERS ET AL 2,172,596

IMPULSE SENDER

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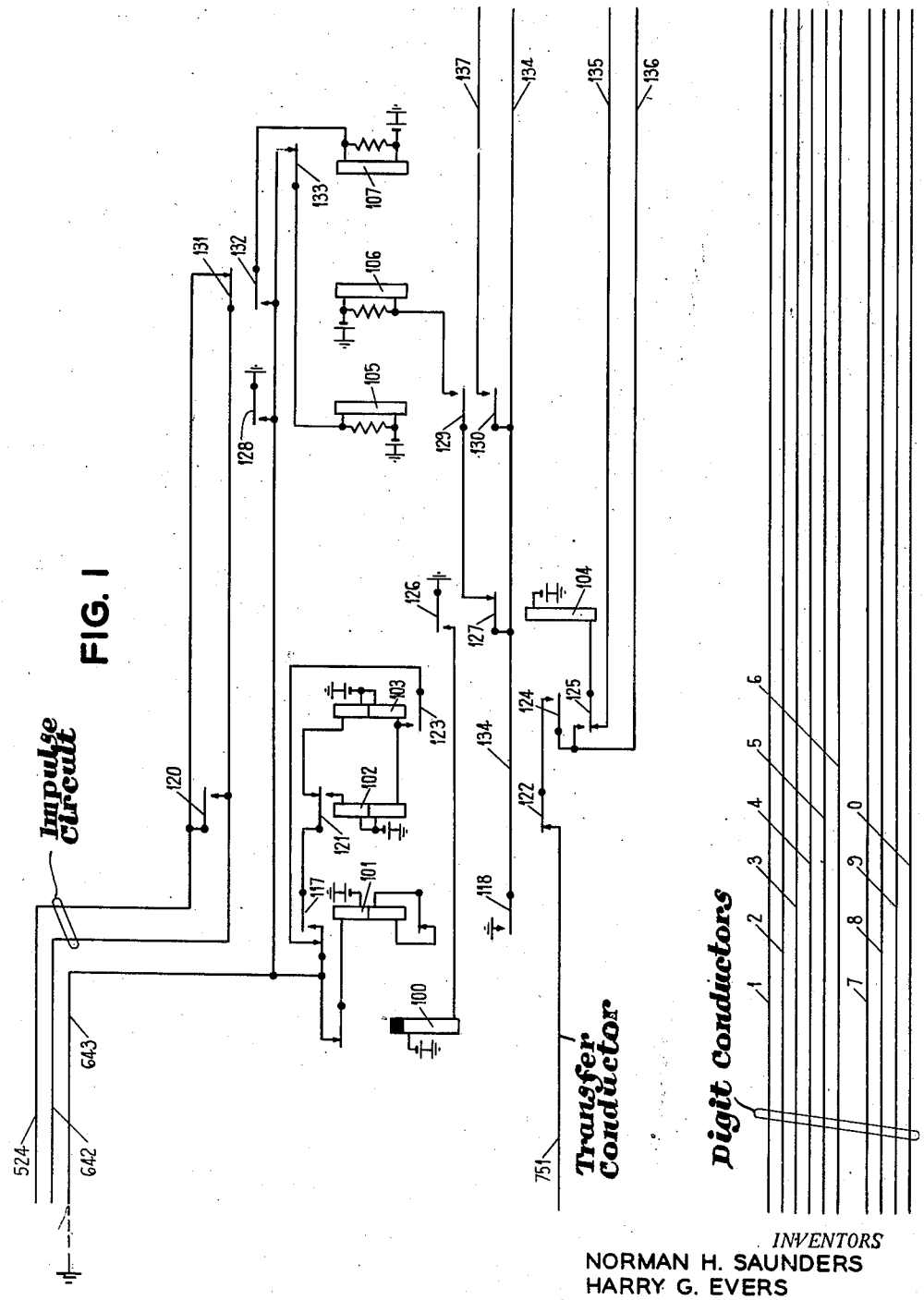


FIG. 1

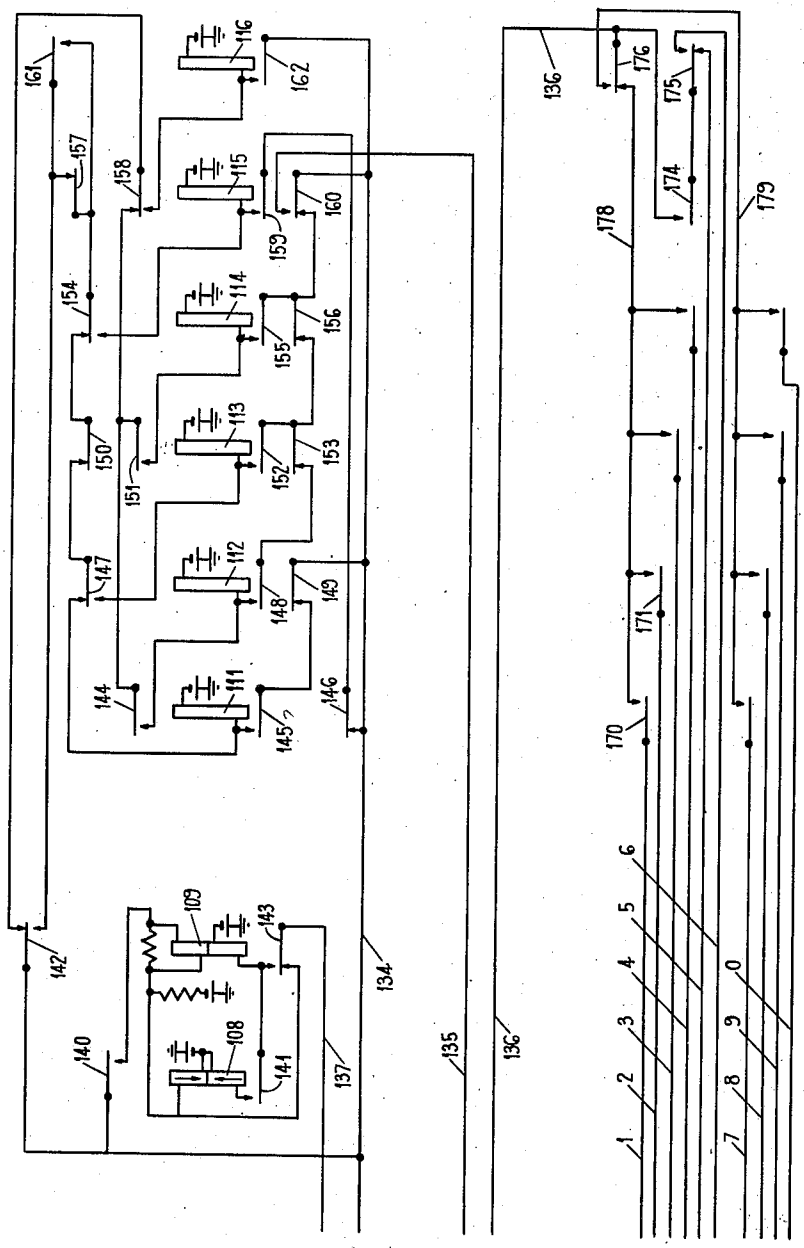
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FIG. 2



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IMPULSE SENDER

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Application November 4, 1935, Serial No. 48,159

8 Claims. (Cl. 177—380)

The present invention relates in general to impulse senders and more in particular to impulse senders for use by operators, such as toll operators or operators in semi-automatic exchanges, in controlling the setting of automatic switches. The object of the invention is to produce a reliable and economical impulse sender of this character.

The impulse sender which is the subject matter of the present invention may be considered as an improvement on the impulse sender shown in the Nelson Patent No. 1,614,678, granted January 18, 1927, and particularly as an improvement on the impulse sender shown in Figs. 6, 7, and 8 of Peterson Patent No. 1,914,383, granted June 20, 1933.

The invention will be described hereinafter with reference to the accompanying drawings, which show by means of the usual circuit diagrams sufficient of the equipment involved to enable the invention to be explained and understood.

An operator's impulse sender of the type with which this invention is concerned comprises a set of digit keys, a plurality of storage devices, means for automatically generating impulses, and means for counting impulses under control of successive storage devices, together with certain controlling relays. The storage devices may be of the permutational relay type. The impulse generator and the counting means may also consist of relays, as disclosed particularly in the Peterson patent.

In the operation of an impulse sender such as is described above the operator first sets up the desired number, which may have four digits, for example, by means of her set of digit keys. As each key is depressed the corresponding digit is registered on a relay storage device, the connections from the keys being transferred automatically from one storage device to the next, so that successive digits are registered on successive storage devices. The operator then depresses a start key, and from this point on the operation is entirely automatic. The impulse generating relays are started sending a train of impulses and when the number transmitted corresponds to the setting of the first storage device, as determined by the counting means, the sending is stopped, and the control of the counting means is shifted over to the next storage device. After an interval the sending is resumed and the second digit is transmitted the same as the first, the value of the digit being, of course, determined by the setting of the second storage device. The remaining digits are transmitted the same way and when all are sent the sending is stopped and the storage devices are restored to normal.

The present invention is concerned only with the impulse generating and counting relays and certain controlling relays directly associated therewith, and consequently a complete operator's sender has not been shown in the drawings. There is shown in Fig. 1 the impulse generating relays 105—107, and certain controlling relays 100—104, and in Fig. 2 the counting relays 111—116, and control relays 108 and 109. For a disclosure of the complete sender reliance is had on the Peterson patent hereinbefore referred to. More specifically, the complete sender is disclosed in Figs. 6 and 7 of Peterson and in the drawings of the instant case, Figs. 1 and 2 of the latter being substituted for Fig. 8 of Peterson.

The operation of the invention will now be described, it being assumed that the operator has set up a number and depressed the start key. The depression of the start key results in certain relay operations which bring about the grounding of start conductor 643, Fig. 1, and the closure of the control circuit over which the impulses are to be transmitted. This control circuit includes the conductors 524 and 642, Fig. 1, and extends to the line relay of the switch (first selector) which responds to the first digit of the number. These details are fully disclosed in the Peterson patent hereinbefore referred to.

The grounding of the start wire 643 closes a circuit for relay 105, which energizes and prepares a circuit for relay 106 at 129. Relays 105, 106, and 107 are the impulse generating relays. The grounding of the start wire also completes a circuit for relay 101, which energizes after a slight delay, due to the effect of its short circuited lower winding. This relay is made slow to energize in order to provide time for the selector line relay to become energized. On energizing, relay 101 closes a circuit at 117 for the upper winding of relay 103, which energizes also.

As a further result of the energization of relay 101 the conductor 134 is grounded at 118. This completes the circuit of relay 106, which energizes and closes a circuit for relay 107 at 132. Relay 107 accordingly energizes and breaks the circuit of relay 105 at 133. Relay 105 now falls back and breaks the circuit of relay 106 at 129, whereupon relay 106 falls back and breaks the circuit of relay 107 at 132. Relay 107 falling back closes the circuit of relay 105 and this

relay again energizes. It will be seen that these three relays will continue operating in this manner automatically. The relays each have a shunt resistance so that they will not operate too fast. The resistances have the proper value to cause the relays to go through a complete cycle of operations about ten times per second, which is the normal rate of impulsing to automatic switches.

The effect of the operation of the impulse generating relays 105—107 is to transmit loop impulses over the outgoing control circuit, which is opened at 131 every time relay 106 pulls up, and to transmit ground impulses over conductor 137 to the odd and even relays 108 and 109, conductor 137 being grounded at 130 every time relay 105 pulls up. The operation of relays 108 and 109 will now be explained.

The first impulse traverses the circuit from ground at 118 by way of 134, 130, 137, 143, and upper winding of relay 108 to battery. Relay 108 energizes and prepares a locking circuit for itself at 140. This locking circuit includes the grounded conductor 134 and the upper winding of relay 109, which is short-circuited as long as conductor 137 is grounded. At the end of the first impulse (ground removed from 137) relay 109 energizes in series with relay 108 over the latter's locking circuit and at 143 shifts the impulse conductor 137 into connection with the lower windings of both relays, which are now both energized. When the second impulse comes in now the lower windings of relays 108 and 109 are energized in parallel. Relay 108 is differentially wound and deenergizes, but relay 109 is cumulatively wound and is held up by both windings until relay 108 falls back and thereafter by its lower winding alone so long as conductor 137 remains grounded. This condition endures of course until the end of the second impulse, whereupon relay 109 falls back. Both relays 108 and 109 are now in normal deenergized condition, and are ready to repeat their operations responsive to the third and fourth impulses, and again responsive to the fifth and sixth impulses, etc.

Thus it will be seen that relay 109 energizes at the end of the first impulse and deenergizes at the end of the second impulse, energizes again at the end of the third impulse and deenergizes again at the end of the fourth impulse, and so on. That is, relay 109 energizes at the end of every odd impulse and deenergizes at the end of every even impulse. Relay 109 controls the counting relays 111—116 at 142.

Considering the operation of the counting relays, it will be assumed that a full train of ten impulses are delivered over conductor 137 and the operation will be described.

At the end of the first impulse relay 109 energizes and closes a circuit for relay 111 which extends from grounded conductor 134 by way of 142, 157, 154, 150, 147, and winding of 111 to battery. Relay 111 energizes and locks itself to grounded conductor 134 at 145, also preparing a circuit for relay 112 at 144. At the end of the second impulse relay 109 deenergizes and closes a circuit for relay 112 by way of 118, 134, 142, 158, and 144. Relay 112 energizes, locks itself to grounded conductor 134 by way of 160, 156, 153, and 148, unlocks 111 at 149, and prepares a circuit for relay 113 at 147.

At the end of the third impulse relay 109 energizes and closes a circuit for relay 113. This relay locks itself at 152, breaks the circuit of relay 112 at 153, and prepares a circuit for relay 114 at 151. At the end of the fourth impulse relay 109 deenergizes and closes a circuit for relay 114. Relay 114 energizes, locks itself at 155, breaks the locking circuit of relay 113 at 156, and prepares a circuit for relay 115 at 154.

At the end of the fifth impulse relay 109 energizes and closes a circuit for relay 115, which energizes and locks at 159. Contacts such as 159 on all relays 111—116 close first so relay 115 energizes all right, although it breaks its initial circuit at 157. Relay 115 also unlocks relay 114 at 160 and prepares a circuit for relay 116 at 158. At the end of the sixth impulse relay 109 deenergizes and closes a circuit for relay 116, which energizes and locks itself at 162. Relay 116 prepares a circuit for relay 111 at 161 but does not unlock relay 115.

At the end of the seventh impulse relay 109 energizes and closes a circuit for relay 111, the circuit being the same as previously traced except that it includes contact 161 instead of 157. Relay 111 locks itself at 145, prepares a circuit for relay 112 at 144, and unlocks relay 115 at 146. Relay 115 falls back and closes another point in the circuit of relay 112 at 158. The remaining operations are the same as already described, relay 112 operating at the end of the eighth impulse, relay 113 at the end of the ninth, and relay 114 at the end of the tenth.

The primary function of the counting relays is to selectively connect the stop conductor 136 to the digit conductors 1, 2, 3, etc., coming from the relay registers. This is done at contacts 170, 171, etc. It is obvious from the drawings that relays 111 to 114 connect conductor 136 with digit conductors 1 to 4, respectively, considering the counting operation from the start. Relay 115 connects up digit conductor 5 at 174, and relays 115 and 116 (both energized at the end of the sixth impulse) jointly connect up digit conductor 6 at 174 and 175. As the counting proceeds relay 116 remains up and relay 115 falls back and the operation of relays 111 to 114 connects up digit conductors 7 to 0, respectively, since 136 has been switched at 176 from conductor 178 to conductor 179.

Since the counting relays are controlled from the same impulse generating relays that produce the impulses or interruptions in the outgoing control circuit, the connecting up of the digit conductors is definitely timed with respect to the transmission of impulses over such control circuit. Consider the first interruption at 131, for instance, and the manner of connecting up digit conductor 1. Relay 105 falls back to terminate the first impulse to the odd and even relays and simultaneously breaks the circuit of relay 106, which falls back to terminate the interruption by closing 131. While relay 106 is deenergizing, relay 109 is energizing. The energization of relay 109 is followed by the energization of counting relay 111, and it will be seen, therefore, that promptly at the termination of the first interruption the digit conductor 1 is connected up. It will be obvious that the connection of digit conductors 2 and 3 takes place concurrently with the termination of the second and third interruptions, and so on.

Returning now to the beginning of the operation of the sender, where the operator depresses the start key, the transmission of several impulse trains corresponding to specific digits will be considered for the purpose of explaining how the digits are terminated and how the necessary

time interval between successive impulse trains is produced.

When the start key is operated, conductor 643 is grounded, with the result that relays 105–107 start operating automatically, and with the further result that relays 101 and 103 are energized, all as previously described. Relay 105 sends impulses to the odd and even relays at 130 and relay 106 produces impulses or interruptions in the outgoing control circuit at 131.

Assuming now that the first digit of the number being transmitted is the digit 4, the first relay register will have been set in accordance with such digit, and there will be a ground on digit conductor 4. It follows that when this digit conductor is connected up to conductor 136 by counting relay 114 at the termination of the fourth interruption produced at 131, a circuit will be closed for the stop relay 104, relay 103 being in energized condition so that the circuit is complete at 125. Relay 104, on energizing, breaks the circuit of relay 106 at 127, to prevent further operation of relay 106. This definitely terminates the first impulse train at four impulses, corresponding to the first digit 4. Relay 104 also closes a circuit for relay 100.

On energizing relay 100 breaks the circuit of relay 101, which falls back and takes ground off conductor 134 at 118. This deenergizes any relays in Fig. 2 that may be operated at this time. In the present case this will be relay 114, which falls back. Relay 101 deenergizing also closes a circuit from the grounded start conductor 643 by way of contacts controlled by 117, 123, and lower windings of relays 102 and 103 in parallel. Relay 103 therefore holds up notwithstanding the breaking of the circuit of its upper winding at 117, and relay 102 energizes. Relay 102 places a shunt around impulsing contacts 131 at 120 and opens the transfer control conductor 751 at 122.

Returning now to the point where the circuit for stop relay 104 was first closed, it will be observed that the grounding of conductor 136 to operate stop relay 104 is also effective to ground conductor 751. The ground on conductor 136 is removed when the counting relay 114 falls back following the falling back of relay 101. Removal of ground from 136 permits relay 104 to fall back and also ungrounds conductor 751. The application and removal of ground to conductor 751 brings about a transferring operation by which the control is shifted from the first relay register to the second. That is, after the transfer the second register, set in accordance with the second digit, determines which one of the conductors 1, 2, 3, etc., is grounded.

Continuing now with the operation, when stop relay 104 falls back it breaks the circuit of relay 100, which falls back and again closes the circuit of relay 101. On energizing, relay 101 closes a circuit, 117, 121, for holding relay 102 and also breaks the circuit for the lower windings of relays 102 and 103. Relay 103 accordingly falls back while 102 stays energized.

Relay 101 also again grounds conductor 134 at 118. This starts the generating relays 105—107 going again and relay 105 begins to transmit impulses over conductor 137 at 130. Relay 106, however, sends no impulses over the outgoing control circuit because relay 102 is energized and contact 120 is closed. The impulses transmitted over conductor 137 operate the odd and even relays and the counting relays respond as before described. When the fifth relay 115 pulls up a circuit is closed from the grounded conductor 134 by way of 160, 135, and 125, to stop relay 104, which energizes to terminate the spacing period. The use of relay 115 for this purpose is arbitrary and some other spacing could have been selected.

On energizing, relay 104 breaks the circuit of relay 106 at 127, and closes the circuit of relay 100 at 126. Relay 100 pulls up and breaks the circuit of relay 101, which falls back and breaks the circuit of relay 102, which falls back also. Relay 101 also removes ground from conductor 134 which permits relays 109 and 115, Fig. 2, to fall back. The deenergization of relay 115 breaks the circuit of relay 104, which falls back and breaks the circuit of relay 100. The latter relay on deenergizing closes the circuit of relay 101. Relay 101 therefore pulls up, operates relay 103, and grounds conductor 134 at 118.

The described operations start all over again now and a train of impulses corresponding to the second digit of the number is transmitted. The second digit is transmitted the same as the first, except for a possible variation in the time of the operation of the stop relay 104, depending on the value of the second digit. So also with the third digit and the fourth digit. After each digit is transmitted a transfer of control to the next register takes place as mentioned previously herein and as described in the Peterson patent hereinabove referred to. When the transfer relays associated with the last register are operated, responsive to the grounding and ungrounding of conductor 751, relay operations are initiated which disconnect the control circuit 524—642 and take ground off the start wire 643, which stops the operation of the sender.

The invention having been described that which is believed to be new and is desired to have protected by Letters Patent is set forth in the following claims.

What is claimed is:

1. In an impulse sender, an impulse generator, a counting device, a control circuit over which said generator transmits impulses, a circuit over which said generator controls said counting device, means for starting the generator, means including said counting device for temporarily stopping the generator a plurality of times, whereby the generator goes through a plurality of successive operating cycles, and means effective during alternate cycles for preventing the transmission of impulses over said first circuit, thereby dividing the transmitted impulses into groups separated by spacing intervals.

2. In an impulse sender, a relay interrupter for transmitting control impulses, a train of counting relays, means comprising a pair of circuits for controlling said counting relays, the odd relays of said train of relays being controlled over one of said circuits and the even relays of said train of relays being controlled over the other of said circuits, means comprising a frequency changer for rendering said pair of circuits alternately active, means comprising said interrupter for controlling said frequency changer in accordance with impulses transmited by said interrupter, an outgoing control circuit over which said interrupter transmits impulses currently with the transmission of impulses to said frequency changer and during alternate impulsing cycles, means including said counting relays for determining the number of impulses transmitted over said control circuit, and means for controlling said counting relays to vary the number of

impulses transmitted over said control circuit during successive operating cycles of said counting relays.

3. In an impulse sender, an impulse generator, means for operating said generator a plurality of times, counting relays controlled by said generator, a stop relay for terminating the operation of said generator, means including a pair of conductors for controlling the operation of said stop relay in accordance with the operation of said counting relays, and means responsive to successive operations of said generator for switching said stop relay from one conductor to the other.

4. In an impulse sender, an impulse generator for transmitting a series of impulses, means including a counting device for counting impulses transmitted by said generator during each impulse series, means for starting said generator a plurality of times, means including said counting device for stopping said generator, means for restoring said counting device to normal each time said generator is stopped, and control means whereby on certain operations of said counting device the said counting device measures off intervals between successive series of impulses.

5. In an impulse sender, an impulse generator for transmitting successive cycles of impulses, counting means, means including said generator for operating, during the transmission of each cycle of impulses, said counting means to determine the number of impulses to be transmitted for each cycle, a control circuit over which said generator transmits impulses, means for temporarily preventing operation of said generator each time said counting means has determined the number of impulses to be transmitted in a cycle, and means effective during alternate impulse cycles for preventing the transmission of impulses over said circuit, thereby dividing the impulses transmitted over said circuit into groups separated by spacing intervals.

6. In an impulse sender, a generator for transmitting successive series of local impulses and spaced series of outgoing impulses, means whereby each of said series of outgoing impulses is independently variable as to the number of impulses, a counting device for cooperating with said means to determine the number of outgoing impulses comprising each series, circuits interconnecting said generator and said counting device so arranged that said generator and said counting device cooperate by means of said local impulses transmitted by said generator to limit the spacing interval between series of outgoing impulses to a predetermined constant number of local impulses and to control said counting device to determine the number of impulses in outgoing impulse series during every other series of local impulses, and means for restoring the counting device to normal at the end of each of said outgoing impulse series and at the end of each spacing interval.

7. In an impulse sender for transmitting and counting successive trains of digit pulses, a group of digit pulse counting relays, a generator for transmitting outgoing digit pulses and for sending local pulses to control the operation of said counting relays, digit conductors for registering digits in said counting relays whereby successive trains of outgoing digit pulses are each independently variable as to number of pulses, said counting relays testing said conductors to determine the registered digit, means effective when said digit counting relays have determined the registered digit for terminating the transmission of any outgoing pulses by said generator and for controlling said generator to transmit additional local pulses to said digit counting relays to determine the pause between successive trains of digit pulses and means effective responsive to the counting of a predetermined constant number of said additional local pulses by said counting relays for restarting the transmission of digit pulses.

8. An impulse generator for transmitting two spaced series of digit impulses, a local and an outgoing circuit over which said impulses are transmitted by said generator, a relay counting device controlled by impulses transmitted over said local circuit, means including said counting device whereby each transmitted series of outgoing impulses is independently variable as to the number of impulses, circuits interconnecting said generator and said counting device so arranged that said generator and said counting device cooperate by means of local impulses only to limit the number of local impulses transmitted during the spacing interval between the said two spaced series of digit impulses to a predetermined constant number, means for preventing any impulses from being transmitted over said outgoing circuit during said spacing interval, and means for restoring said counting device to normal at the end of each outgoing impulse series and at the end of said spacing interval.

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