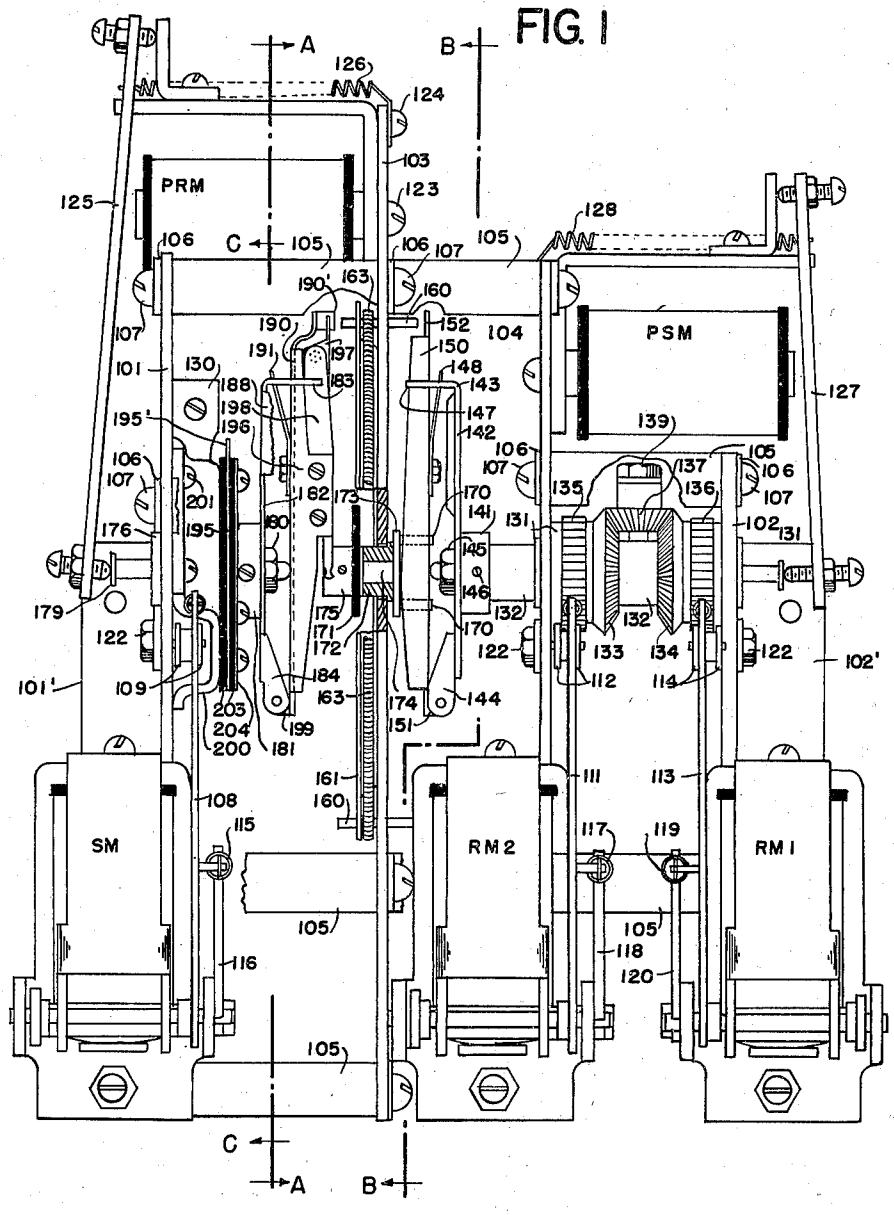
July 27, 1948. O. W. HENRIKSON ET AL 2,445,829

MECHANICAL IMPULSE REGENERATOR

Filed Sept. 20, 1944 3 Sheets-Sheet 1

FIG. 1



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Filed Sept. 20, 1944 3 Sheets-Sheet 2

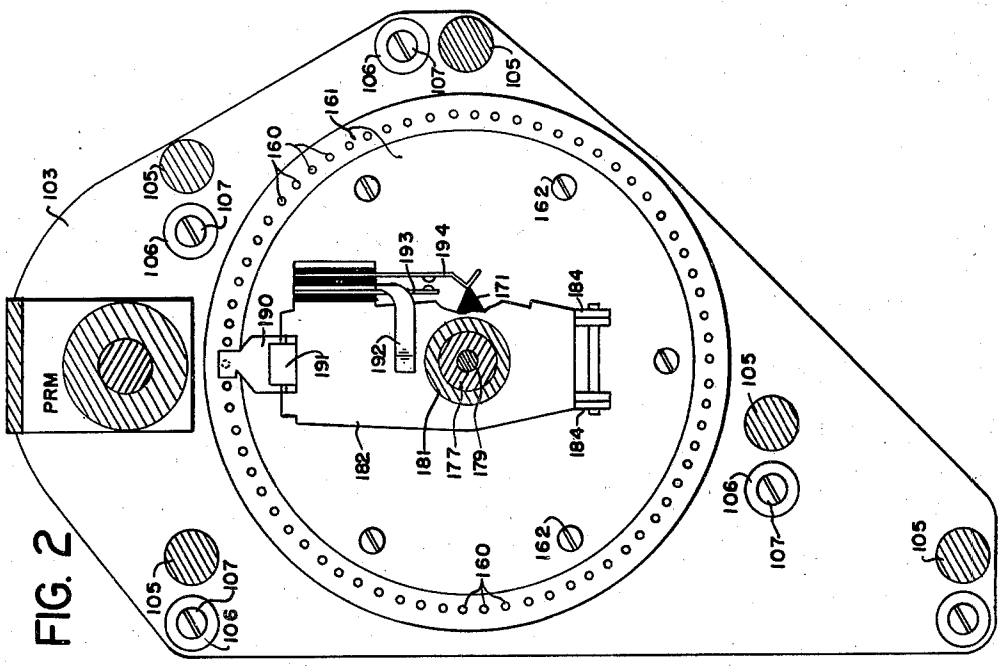

FIG. 2

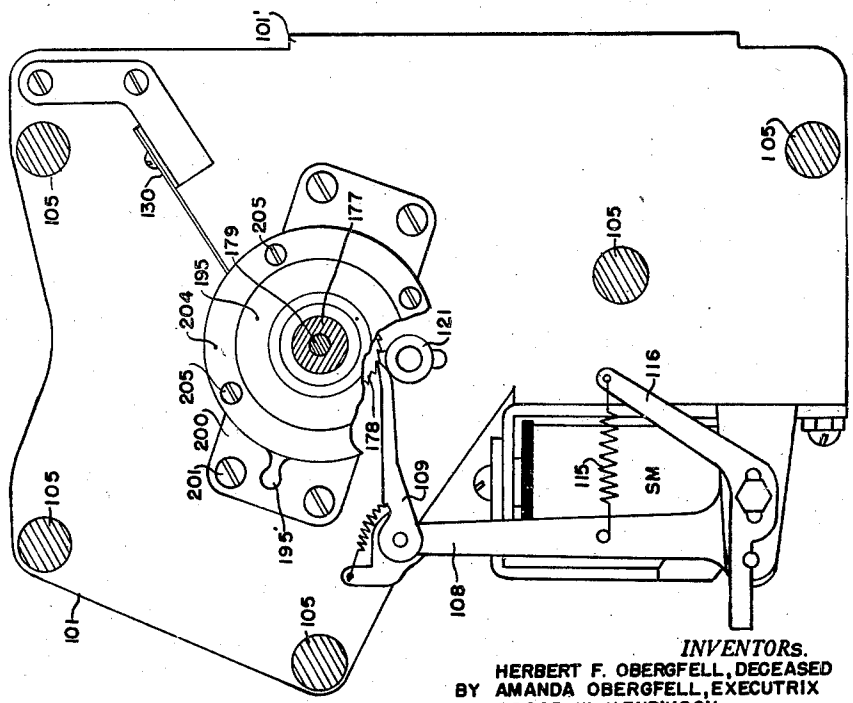

FIG. 4

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MECHANICAL IMPULSE REGENERATOR

Filed Sept. 20, 1944 3 Sheets-Sheet 3

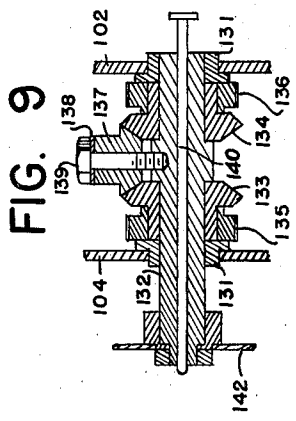

FIG. 9

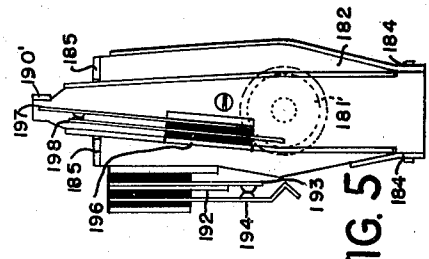

FIG. 5

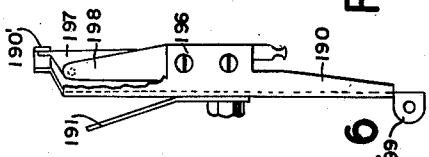

FIG. 6

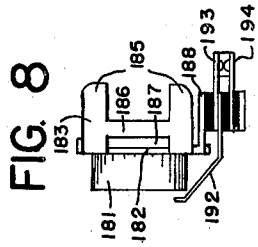

FIG. 8

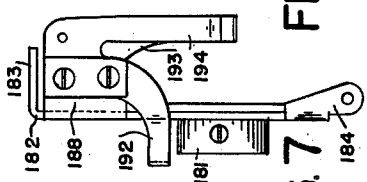

FIG. 7

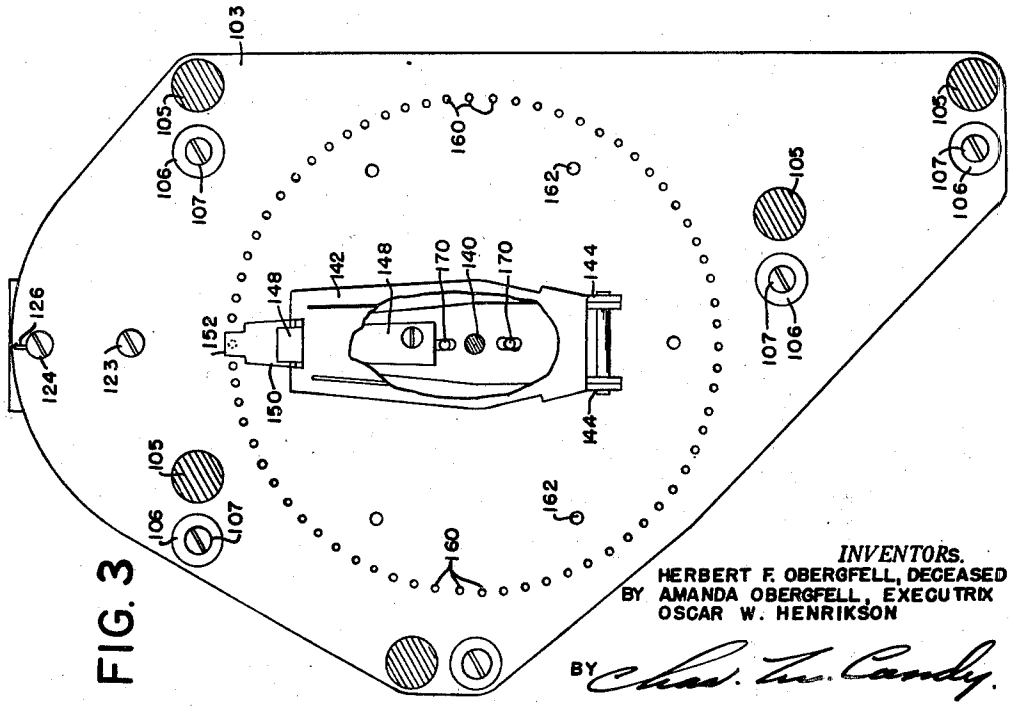

FIG. 3

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Patented July 27, 1948 2,445,829

UNITED STATES PATENT OFFICE

2,445,829

MECHANICAL IMPULSE REGENERATOR

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Application September 20, 1944, Serial No. 554,912

16 Claims. (Cl. 179—16)

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The present invention relates in general to automatic telephone systems and more particularly to improved impulse receiving and regenerating repeaters.

The main object of the present invention is the provision of an improved mechanical impulse repeater for receiving a plurality of series of incoming impulses and for retransmitting these impulses after the incoming series have been mechanically registered.

One of the features of the improved repeater relates to the provision of two separate stepping magnets which are operated simultaneously or separately in response to incoming impulses over two separate circuits for operating a differential gearing arrangement which in turn operates a selecting member one or two steps dependent upon whether only one magnet is operated or both magnets are simultaneously operated.

Another feature relates to the improved sending mechanism for controlling the retransmission of outgoing impulses.

Other features of the invention relate mainly to the detail construction and arrangements of the operating mechanisms of the mechanical repeater and will be apparent from the following description and in the claims.

This mechanical impulse repeater along with a push button calling device, being claimed in a copending application, S. N. 551,010, filed August 24, 1944, was designed primarily for use by a person who originates a large number of outgoing calls, such as a salesman, an order clerk, or a P. B. X operator who completes outgoing trunk calls from a local private exchange to automatic subscribers accessible through automatic switches in the main exchange.

A subscriber's line equipped with this push-button calling device and mechanical impulse repeater may set up, or key, the digits of the called number without waiting for the automatic switches. The mechanical impulse repeater is individual to the subscriber's line and impulsing may proceed as soon as the receiver is removed. The repeater receives and mechanically registers the called digits until such time as the automatic switches are ready to receive impulses at which time the registered digits are retransmitted by the repeater.

The push button calling device is arranged to transmit both loop and ground impulses and an intervening circuit, shown in a copending application Serial No. 559,878, filed October 23, 1944, now Patent 2,418,609, issued April 8, 1947, between the repeater and the calling device, translates the

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coded transmitted impulses from the push button calling device and operates the two impulse receiving magnets of the repeater to register successive digits. Loop impulses from the calling device cause simultaneous operation of both receiving magnets to operate the selecting member of the repeater a distance corresponding to two steps while a ground pulse from the calling device operates only one of the receiving magnets to operate the selecting member only one step. The mechanical dial repeater takes two steps for each loop pulse and only one step for each ground pulse to register the incoming digits transmitted in code from the push-button calling device. When the automatic switches are in condition to receive impulses, the sending mechanism of the repeater is operated step by step to transmit standard loop pulses in accordance with the digits registered in the mechanical repeater. The automatic switches are operated in response to these digits to complete the desired connection.

Referring now to the drawings:

Figure 1 shows a front view of the mechanical dial repeater.

Figure 2 shows a cross section of the repeater taken on the line A—A of Figure 1.

Figure 3 shows a cross section of the repeater taken on the line B—B of Figure 1.

Figure 4 shows a cross section of the repeater taken on the line C—C of Figure 1.

Figure 5 shows an assembly view of the sending member of the repeater.

Figure 6 shows a side view of the pivoted pin restoring arm of the sending member shown in Figure 5.

Figure 7 shows a side view of the base portion of the sending member shown in Figure 5.

Figure 8 shows an end view of the base portion of the sending member shown in Figure 7.

Figure 9 shows a cross section of the differential gearing arrangement on the shaft for operating the selecting member.

Referring now to the drawings showing the mechanical dial repeater, the frame comprises a plurality of vertical mounting plates **101**, **102**, **103** and **104** which are separated the required distances by means of the studs **105**. The studs **105**, as shown, are secured to the mounting plates by means of the screws **107** extending through the washers **106** and holes in the mounting plates into threaded holes in studs **105**.

Mounting plate **101** has a turned edge **101'** with holes therein for mounting the entire repeater assembly to a frame and mounting plate **102** has a similar turned edge **102'** for also mounting the

repeater to the frame. Sending magnet SM is mounted on a turned edge of plate 101 and has an operating armature arm 108 on which the stepping pawl 109 is pivotally mounted. A restoring spring 115 is secured to the armature arm 108 by means of a pin and to the adjusting member 116. The member 116 is adjustable for variably tensioning restoring spring 115. The construction of this magnet, as well as stepping magnets RM1 and RM2, is substantially the same as that shown and described in the Erickson Patent 1,794,888. Stepping magnet RM1 is mounted on a turned edge of end mounting plate 102 and has a similar armature operating arm 113, pawl 114, restoring spring 119 and adjusting member 120. Stepping magnet RM2 is mounted on a turned edge of mounting plate 104 and also has a similar armature operating arm 111, pawl 112, restoring spring 117 and adjusting member 118.

Associated with each stepping pawl is an adjustable stop 121, such as shown in Figure 4. Each such stop is adjustably mounted to its associated mounting plate by means of a slot in such plate and by means of screws, such as screws 122, to limit the operating stroke of the armature arms, such as arms 113, 111 and 108. A holding detent, such as detent 130 is also provided for engagement with the teeth of the ratchet wheels to maintain the ratchet wheels in their operated positions.

A pin restoring magnet PRM is mounted on plate 103 by means of screws 123 and 124. A pin restoring armature 125 is mounted on the heel piece of pin restoring magnet PRM, as shown, and its operating stroke is made adjustable by the adjusting nuts and screws at each end thereof. Spring 126 normally holds the armature 125 in the position shown. Pin setting magnet PSM is similarly mounted on mounting plate 104 and has a similar pin setting armature 127 and restoring spring 128.

Brass bearings 131 are ring staked in holes in mounting plates 104 and 102 to provide bearing surfaces for rotatable shaft 132. Miter gears 133 and 134 of the differential gearing arrangement are rotatably mounted on shaft 132. The ratchet wheel 135 is prong staked to miter gear 133 to make it a unitary assembly. The ratchet wheel 136 is similarly prong staked to miter gear 134. A miter pinion 137 meshes with miter gears 133 and 134 and is rotatably mounted on bolt 139 which is secured to the shaft 132 as shown in Figure 9. The ratchet wheels and their associated miter gears are rotated on the shaft 132 by stepping magnets RM1 and RM2 and each miter gear rotates the miter pinion 137 to cause rotation of shaft 132. With this type of gearing, the rotation of either miter gear 133 or 134 alone one step in turn rotates miter pinion 137 and shaft 132 one step while the simultaneous rotation of both miter gears one step causes the miter pinion 137 to rotate the shaft a distance corresponding to two steps. The shaft 132 is hollow and an operate rod 140 extends through the hollow shaft for the purpose of operating the operate arm 150 of the pin selecting member when the pin setting magnet PSM operates its armature 127.

The pin selecting member comprises in part a flat arm 142 having a collar 141 brazed thereto and secured to the shaft 132 by means of a set screw 146. In addition a hexagonal nut 145 is screwed on threads on shaft 132 to hold the selecting member in place during its rotation with shaft 132. The lower extremity of arm 142, as seen in Figure 1, has ears 144 by means of which the operate arm 150 of the selecting member is pivotally mounted on arm 142. The upper extremity of arm 142 is turned at right angles to form extension 143 in which a rectangular hole, not shown, is provided for spring 148. At the outer left hand extremity of extension 143 two arms 147 are provided, one on each side of operate arm 150 for keeping arm 150 aligned with arm 142 during rotation of shaft 132. The operate arm 150 is a substantially channel-shaped member having ears 151 at its lower extremity for pivotally mounting arm 150 to arm 142. At its upper extremity arm 150 has a flat extension 152 which is rotated over the circular row of pins 160 by shaft 132. Arm 150 is pivoted by the operation of pin setting magnet PSM to displace one of the pins 160. The spring 148 is secured to arm 150 by means of machine screws and is tensioned so as to normally hold arm 150 against a cross member of 143 extending between the arms 147. The rod 140 normally abuts against the back of arm 150, as shown, and pivots the arm 150 on its ears 151 when armature 127 is operated.

Near the center of operate arm 150, two pins 170 extend through elongated slots in arm 150 for the purpose of rotating cam 171 in unison with arm 150. A brass bearing 172 is ring-staked to mounting plate 103 to provide a bearing hole for cam shaft 175. Circular plate 173, to which pins 170 are secured, is integral with cam shaft 174 and the collar assembly 175 including cam 171 is secured to the cam shaft 174 by means of a set screw. Due to the pins 170 extending through holes in arm 150 the cam 171 is rotated in unison with the operate arm 150 and shaft 132. Cam 171 is provided for operating a set of contacts included in a circuit which controls the transmission of outgoing impulses. This set of springs is closed as long as the selecting arm and the sending arm are in non-corresponding positions and are open when such arms are in corresponding positions.

A disk-shaped plate 161 is secured to mounting plate 103 by means of machine screws 162 and the flanged portion of disk-shaped plate 161 is drilled with a circular row of holes through which the pins 160 extend. The mounting plate 103 is also drilled with a corresponding row of holes in alignment with the holes in plate 161. A circular row of pins 160, seventy in number, extend through these aligned holes and are normally held in place by spring 163 which is located between the flange portion of disk-shaped plate 161 and mounting plate 103.

A brass bearing 176 is ring-staked into a hole in mounting plate 101 in which the sending shaft 177 rotates. Integral with this shaft is a ratchet wheel 178 having teeth for engagement by pawl 109 and holding detent 130. The shaft 177 is hollow and a rod 179 extends through the hollow shaft and bears against the pin restoring arm 190 of the sending member. The right hand end of shaft 177 is threaded and a hexagonal nut 180 is screwed thereon to hold the sending member in place.

The sending member assembly is best shown in Figures 5 to 8, inclusive, and comprises a collar 181 which is secured to shaft 177 by means of a set screw and to the base of sending arm 182 by brazing so as to rotate in unison with ratchet wheel 178 and shaft 177 when sending magnet SM operates armature arm 108 and pawl 109. Turned ears 184 are provided at one end of sending arm 182 for pivotally mounting the pin restoring arm 190 and the other end of arm 182 is bent at right angles forming an exten-

sion 183. This extension has a hole 187 through which the spring 191 extends and two arm extensions 185 and a cross member 186 in which the restoring arm 190 rests. Another right angle extension 188 is provided on arm 182 for mounting spring contacts 192, 193 and 194. Spring contact 192 is mounted in engagement with spring 193 and is provided to wipe over the conducting ring 195 mounted on plate 101. Spring contact 194 is provided for operation by cam 171 when the sending member and selecting member are in corresponding positions. The pin restoring arm 190 of the sending member is pivotally mounted on the base arm 182 by means of ears 199 and a pin at one end. At the other end an extension 190' is provided with a turned edge for engagement with a displaced pin 160. Spring contacts 197 and 198 are mounted on extension 196 as best shown in Figures 5 and 6. These contacts are normally closed and are separated in response to the rotation of arm 190 into a displaced pin 160. The arm 190 is rotated step by step with arm 182 by stepping magnet SM over the path of circular pins until such time as spring 197 engages a displaced pin to stop such operation as will be more fully described hereinafter.

A disk-shaped plate 200 is mounted on mounting plate 101 by means of screws 201 over ratchet wheel 178 and is provided with a hole near its center through which the shaft 177 extends. The conducting ring 195 separated by a pair of insulating rings 203 is mounted on to the plate 200 by means of metal ring 204 and screws 205. Spring contact 192 continually wipes over this conducting ring 195 to complete the transmission circuit which terminates on the terminal 195'.

Having given a description of the detailed construction of the various parts of the mechanical dial repeaters, a brief description will now be given of the operations which take place in response to the receipt of incoming impulses and of the operations which take place during retransmission of the outgoing impulses.

Impulses transmitted to rotary magnet RM1 causes the operation of its armature 113 and pawl 114 to rotate ratchet wheel 136 and its associated miter gear 134 one step for each impulse received. In a similar manner impulses transmitted to rotary magnet RM2 causes the operation of its armature 111 and pawl 112 to rotate ratchet wheel 135 and its associated miter gear 133 one step for each impulse received. The rotary magnets RM1 and RM2 may be independently or simultaneously operated, and, in the present example, are simultaneously operated, except for the last impulse on the odd digits, of all digits transmitted to the mechanical dial repeater. The miter pinion 137 rotates each time either miter gear 133 or 134 or both are rotated and causes the shaft 132 and pin selecting member to rotate a corresponding distance. For example, if only one rotary magnet is operated, the miter pinion 137 operates shaft 132 and pin setting arm 150 of the pin selecting member one step from one pin 160 to the next adjacent pin 160. In case both rotary magnets are simultaneously operated then the miter pinion 137 rotates the shaft 132 and pin setting arm 150 a distance equivalent to two steps from one of the pins 160 past the next adjacent pin to the next subsequent pin 160. The pin selecting member is therefore rotated one step when only one magnet alone is operated and is rotated two steps when both magnets are simultaneously operated. In response to the incoming impulses to rotary magnets RM1 and RM2, the pin selecting arm is rotated step by step in accordance with the number of incoming impulses to select one of the pins 160 in the circular row.

After receipt of the train of impulses corresponding to the transmitted digit, pin setting magnet PSM operates its armature 127 to push rod 140 and pivot pin setting arm 150 on arm 142 to displace the selected pin 160. After release of magnet PSM, the displaced pin is maintained in its displaced position by spring 163. The pin setting arm 150 restores in response to the release of armature 127.

Further incoming digits operate the rotary magnets RM1 and RM2 to select and displace corresponding pins 160 in the same manner as just described to register or store the incoming digits.

Cam 171 was also rotated in unison with pin setting arm 150 and closed contacts 193 and 194 to prepare the circuits for the transmission of outgoing impulses as soon as it moved out of the position corresponding to the occupied position of pin restoring arm 190.

Registration of the incoming digits takes place in the manner described above and the retransmission of these registered digits may take place during or after registration dependent upon whether the train of automatic switches is ready to receive the retransmitted digits.

As soon as the automatic switches are ready to receive impulses a circuit is completed through pin spring contacts 197, 198 and cam spring contacts 193 and 194 for causing the intermittent operation and release of sending magnet SM.

Sending magnet SM operates its armature 108 and pawl 109 to rotate ratchet wheel 178, shaft 177 and the sending member comprising arms 182 and 190 one step for each operation of magnet SM. Pin restoring arm 190 rotates step by step over the pins 160 until spring contacts 197 and 198 are separated by spring 197 engaging the first displaced pin. This spring contact separation stops further operation of sending magnet SM and shortly thereafter pin resetting magnet PRM is momentarily operated. Magnet PRM operates its armature 125 to push rod 179 against pin restoring arm 190 whereby arm 190 is pivoted to restore the engaged displaced pin. When armature 125 restores in response to the deenergization of magnet PRM the spring 191 restores the pin restoring arm 190 and rod 179 to normal. Spring contacts 197 and 198 again close to complete the circuit for causing the reoperation of sending magnet SM. Magnet SM is again intermittently operated to again step the pin restoring arm 190 to the next displaced pin where spring contacts 197 and 198 are again opened to stop the stepping operation of magnet SM. Magnet PRM is again operated to restore the engaged displaced pin. Sending magnet SM is operated once for each outgoing pulse transmitted and retransmits the registered digits as determined by the displaced pins. The separations of spring contacts 197 and 198 cause the transmitted impulses to be divided into groups in accordance with the registered digits. The operation continues as above described until the pin restoring arm 190 and arm 182 of the sending member catches up to and reaches a position corresponding to the now occupied position of pin setting arm 150 of the pin selecting member. When the arm 182 reaches this corresponding position the

cam springs 193 and 194 are opened by engaging the cam on cam 171 thereby opening the circuit for causing the operation of sending magnet SM. Cam springs 193 and 194 are therefore opened in response to the retransmission of the last pulse of the last registered digit. The apparatus remains in this position until a new series of digits is registered in the repeater at which time cam springs 193 and 194 are again closed by the first step of cam 171 in response to the first received impulse.

Having described the invention, what is considered new and is desired to have protected by Letters Patent will be set forth in the following claims.

What is claimed is:

1. In a repeater, the combination of a first and a second stepping magnet each operated in response to a train of incoming impulses, a plurality of marking devices, a setting device for selecting said marking devices, driving means controlled by the operation of said magnets whereby said setting device is operated one step by each magnet in case said magnets are independently operated and whereby said setting device is cumulatively operated a plurality of steps in case both said magnets are simultaneously operated, means for operating the marking device selected by said setting device in accordance with the occupied position of said setting device at the end of said train of incoming impulses to effect a marking, and means including a sending magnet operated in accordance with said operated markings.

2. In a repeater, the combination of a first and a second stepping magnet each operated in response to a train of incoming impulses, a setting device cumulatively operated in response to the total number of operations of both said first and second stepping magnets, a plurality of marking devices, a particular one of said marking devices selected dependent upon the occupied position of said setting device at the end of said train of incoming impulses, means for operating the selected one of said marking devices at the end of said train of incoming impulses to effect a marking, and means including a sending magnet operated in accordance with said operated marking.

3. In a repeater, the combination of a first and a second stepping magnet each operated in response to a train of incoming impulses, a plurality of marking devices, a setting device for selecting said marking devices, differential gearing mechanism intermediate said setting device and said stepping magnets for stepping said setting device one step in response to the operation of one of said magnets and for stepping said setting device two steps in response to the operation of both said magnets, means for operating the marking device selected by said setting device in accordance with the occupied position of said setting device at the end of said train of incoming pulses, a stopping device associated with said marking devices, and a sending magnet for operating said stopping device until said operated marking device is reached.

4. In an impulse receiving device, two frame members, a bearing secured in each of said members, a shaft rotatably mounted in said bearings, a first ratchet wheel and miter gear assembly rotatably mounted on said shaft, a second ratchet wheel and miter gear assembly rotatably mounted on said shaft, means including said ratchet wheels for independently or simultaneously rotating said first and second miter gear assemblies on said shaft in response to incoming impulses, a miter

pinion meshing with said first and second miter gears and rotated in response to the rotation of either the first or second or both said miter gear assemblies, means for securing said miter pinion to said shaft to rotate said shaft in response to the rotation of said miter pinion, a selecting device secured to said shaft and rotated therewith to make a selection, a rod extending through said shaft to said selecting device, and means for operating said rod to further operate said selecting device to complete said selection.

5. In an impulse receiving device, a rotatable shaft, means including a first stepping magnet and a second stepping magnet each operated by incoming impulses to rotate said shaft one step for each magnet operation, a selecting device secured to said shaft and rotated therewith to make a selection in accordance with the total number of impulses transmitted to said stepping magnets, a rod extending through said shaft to said selecting device, and means for operating said rod to further operate said selecting device to complete said selection.

6. In a repeater, a plurality of movable marking devices each having a normal position and a marking position, a selecting device for selecting said marking devices, a first and a second stepping magnet operated in response to a train of incoming impulses, interconnecting mechanism between said selecting device and said stepping magnets for stepping said selecting device one step in response to each operation of one of said magnets or for stepping said selecting device two steps in response to each simultaneous operation of both said magnets, said selecting device thereby selecting a particular one of said marking devices in accordance with the occupied position of said selecting device at the end of said train of incoming impulses, means for operating the selected one of said marking devices from its normal position to its marking position to effect a marking, a stopping device associated with said marking devices, a sending magnet for operating said stopping device step by step until it engages said operated marking device in its marking position, and contacts carried by said stopping device operated by said engagement for stopping further operation of said sending magnet.

7. In a register sender, a movable member having a plurality of positions, movable pins arranged in the path of said member, there being a movable pin for each position of said member, a first and a second stepping magnet for moving said member two steps from one position through its next position into its next succeeding position in response to an incoming impulse to each of said magnets, a pin setting magnet operated to displace a pin corresponding to the position occupied by said member at the end of a series of incoming impulses, a sending member operable in the path of said pins, said sending member having positions corresponding to each position of said movable member, a sending magnet for operating said sending member, means controlled by said displaced pin for stopping said sending magnet and said sending member in the position corresponding to said displaced pin, and a pin restoring magnet operated in response to said sending member being stopped in said last mentioned position for restoring said displaced pin.

8. In a repeater, a movable member having a plurality of positions, movable pins arranged in the path of said member, there being a movable pin for each position of said member, electromagnetic means operated in response to a train

of incoming impulses for operating said member step-by-step through its positions, a pin setting magnet operated to displace a pin corresponding to the position occupied by said member at the end of a train of incoming impulses, a sending member operable in the path of said pins and having positions corresponding to each position of said movable member, a sending magnet for operating said sending member step-by-step, means controlled by said displaced pin for stopping the step-by-step operation of said sending member in the position corresponding to said displaced pin, and a pin restoring magnet operated as a result of said sending member being stopped in said last mentioned position for restoring said displaced pin.

9. In a repeater, a movable member having a plurality of positions, movable pins arranged in the path of said member, there being a movable pin for each position of said member, electromagnetic means operated in response to a train of incoming impulses for operating said member step by step in accordance with the number of impulses in said train from its last position to a new position, a pin setting magnet being operated to displace a pin corresponding to said new position of said member at the end of said train of incoming impulses, a sending member operable in the path of said pins and having positions corresponding to each position of said movable member, a sending magnet for operating said sending member step by step, and a pair of normally closed springs carried by said sending member and operated by the engagement of said sending member with said displaced pin for stopping the step-by-step operation of said sending member in the position corresponding to said new position.

10. In a repeater, a movable member having a plurality of positions, movable pins arranged in the path of said member, there being a movable pin for each position of said member, electromagnetic means operated in response to a train of incoming impulses for operating said member step by step in accordance with the number of impulses in said train from its last position to a new position, a pin setting magnet being operated to displace a pin corresponding to said new position of said member at the end of said train of incoming impulses, a sending member operable in the path of said pins and having positions corresponding to each position of said movable member, a sending magnet for operating said sending member step by step, a pair of normally closed contacts carried by said sending member and operated by the engagement of said sending member with said displaced pin for stopping the step by step operation of the sending member, a cam operated in unison with said movable member, and another pair of contacts carried by said sending member cooperating with said cam and connected in serial relation with said first mentioned pair of contacts for also controlling the step by step operation of said sending member, said other contacts being closed when said movable member and said sending member occupy non-corresponding positions and being opened by engagement with said cam when said movable member and said sending member reach corresponding positions.

11. In a repeater, a selecting member having a plurality of positions and normally remaining in its last occupied position, electromagnetic means operated in response to a train of incoming impulses for operating said member step by step from its last position to a new position, a sending member having positions corresponding to each position of said selecting member and also normally remaining in its last occupied position, a sending magnet for operating said sending member step by step until it reaches the position corresponding to the new position of said selecting member, a plurality of pairs of contacts carried by said sending member for controlling the operation of said sending magnet, a cam associated with said selecting member controlling the operation of one of said pairs of contacts whereby said one pair of contacts are closed as long as said selecting member and said sending member are in non-corresponding positions and are opened in response to said sending member reaching the position corresponding to the position occupied by said selecting member, and obstruction means selected and operated by said selecting member in said new position controlling the operation of the other of said pair of contacts whereby said other pair of contacts is opened in response to said sending member reaching the position corresponding to said new position regardless of whether said selecting member has been moved from said new position in response to another train of incoming impulses.

12. In a repeater, a selecting member having a plurality of positions and normally remaining in its last occupied position, electromagnetic means operated in response to a train of incoming impulses for operating said member step by step from its last position to a new position, a sending member having positions corresponding to each position of said selecting member and also normally remaining in its last occupied position, a sending magnet for operating said sending member step by step until it reaches the position corresponding to the new position of said selecting member, a plurality of pairs of contacts carried by said sending member for controlling the operation of said sending magnet, one of said pairs of contacts being closed as long as said selecting member and said sending member are in non-corresponding positions and being opened in response to said sending member reaching the position corresponding to the position occupied by said selecting member, and the other pair of contacts being opened in response to said sending member reaching the position corresponding to said new position regardless of whether said selecting member has been moved from said new position in response to another train of incoming impulses.

13. In a repeater, a selecting member having a plurality of positions and normally remaining in its last occupied position, electromagnetic means operated in response to a train of incoming impulses for operating said member step by step a number of steps corresponding to the number of impulses in said train from its last position to a new position, a sending member having positions corresponding to each position of said selecting member and also normally remaining in its last occupied position, a sending magnet for operating said sending member step by step until it reaches the position corresponding to the new position of said selecting member, and a plurality of pairs of contacts carried by said sending member for controlling the operation of said sending magnet.

14. In a repeater, a plurality of movable pins, means including a first and a second stepping magnet operated independently or simultane-

ously in response to incoming impulses to make a step-by-step selection by selecting one of said pins in accordance with the number of received impulses, a pin setting magnet energized and released after receipt of said incoming impulses for completing said selection by displacing said selected pin, a sending magnet, a sending member operated step by step by said sending magnet a plurality of steps until said displaced pin is reached and a pin restoring magnet operated after said displaced pin is reached by said sending member for restoring said displaced pin to normal.

15. In a repeater, means including a first and a second stepping magnet operated independently or simultaneously in response to incoming impulses to make a step-by-step selection in accordance with the number of received incoming impulses, an operate magnet operated after receipt of said incoming impulses for completing said selection, a sending magnet, a sending member operated step by step by said sending magnet a plurality of steps corresponding to said completed selection, and a restoring magnet operated after completion of operation of said sending member for erasing said completed selection.

16. In an impulse receiving and transmitting device, a selecting member, means for rotating said selecting member one step for each incoming impulse received and for successively rotating said member to a plurality of positions to register

a plurality of digits in response to the receipt of a plurality of incoming series of impulses, a sending member, means for stepping said sending member one step at a time for each incoming impulse of each digit received and for successively rotating said sending member in a plurality of series of stepping operations to corresponding positions, impulse transmitting means for transmitting a digit in accordance with each successive rotation of said sending member, and means whereby said selecting member may be in motion to register a subsequent digit at the same time that said sending member is in motion to transmit a prior registered digit.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,154,776	Saville et al.	Apr. 18, 1939
2,188,461	McClew et al.	Jan. 30, 1940
2,301,822	Shepherd	Nov. 10, 1942
2,303,918	Dimond	Dec. 1, 1942
2,322,848	Hibbard	June 29, 1943