Sept. 23, 1941. C. C. PUCKETTE ET AL 2,256,869

IMPULSE REGISTERING DEVICE OF THE TYPE USED IN TELEPHONE SYSTEMS

Filed July 19, 1939 3 Sheets-Sheet 1

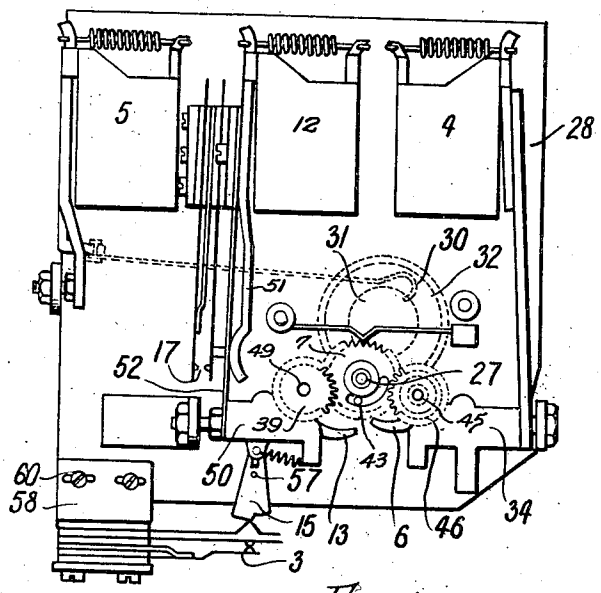

Fig. 1.

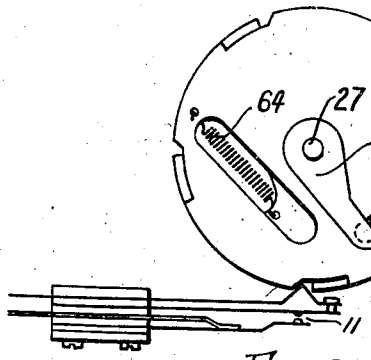

Fig. 2.

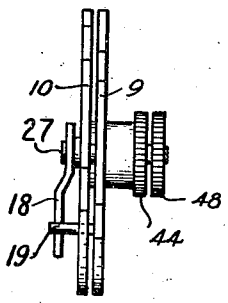

Fig. 3.

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IMPULSE REGISTERING DEVICE OF THE TYPE USED IN TELEPHONE SYSTEMS

Filed July 19, 1939 3 Sheets-Sheet 2

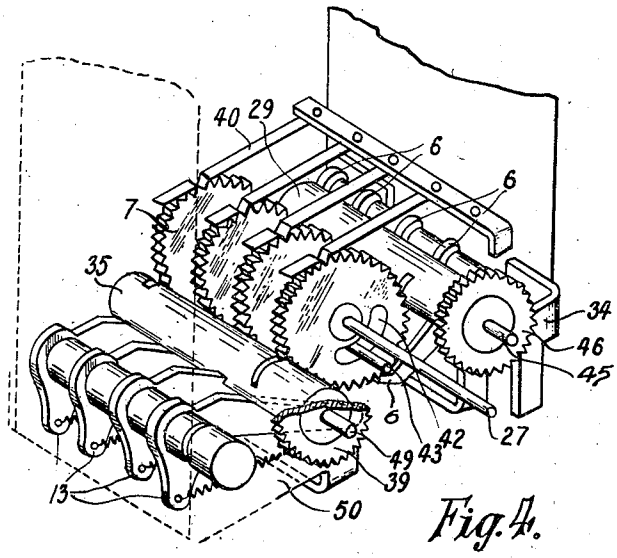

Fig. 4.

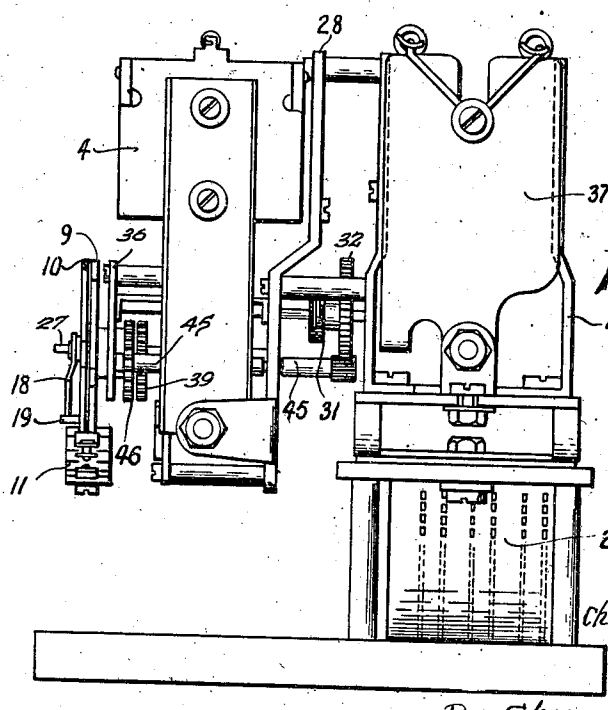

Fig. 5.

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IMPULSE REGISTERING DEVICE OF THE TYPE USED IN TELEPHONE SYSTEMS

Filed July 19, 1939 3 Sheets-Sheet 3

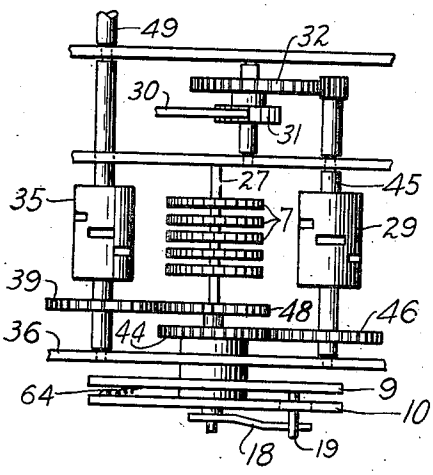

Fig. 6

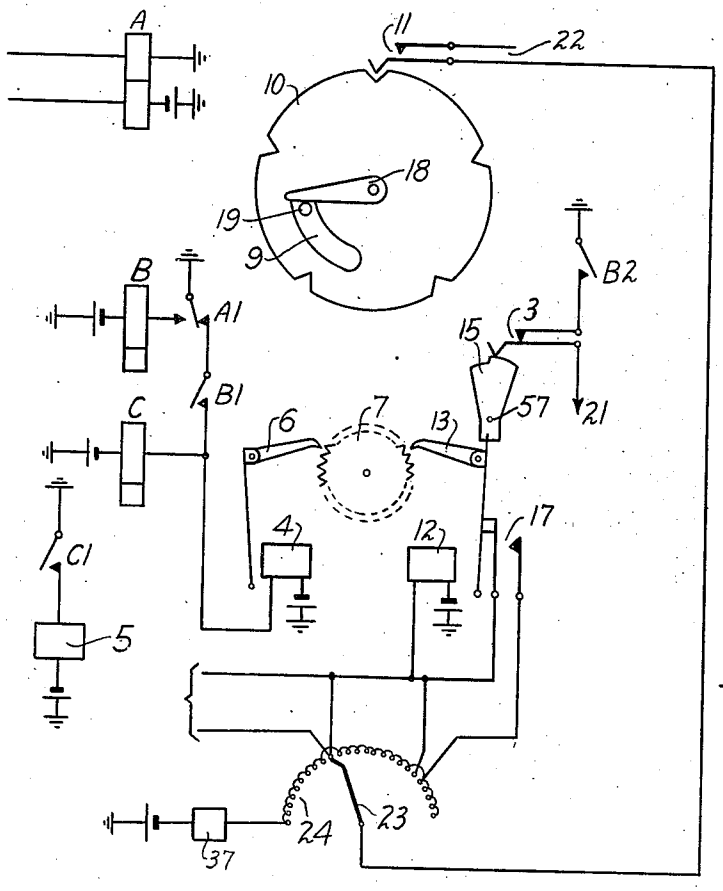

Fig. 7

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2,256,869

IMPULSE REGISTERING DEVICE OF THE TYPE USED IN TELEPHONE SYSTEMS

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Application July 19, 1939, Serial No. 285,392
In Great Britain July 20, 1938

13 Claims. (Cl. 179—18)

The present invention relates to impulse regenerators, by which is meant devices of the type used in telephone systems for registering impulses during the setting up of a connection and re-emitting impulses corresponding in number to those registered. The chief object of the invention is to provide a device of this character which is reliable in operation and of relatively simple construction.

Regenerators as such are known, and it is possible to provide such a device which is almost entirely electrically controlled and operated, though the present invention aims at the employment of mechanical means as far as possible.

In such a regenerating device the desired functions are firstly to receive on a succession of registers the impulse trains emitted by a caller, a sequence switch or cam being provided so as to receive each impulse train on a separate register. An impulse producing machine is now necessary, capable of generating standard impulses, i. e. those having a frequency of ten per second and a break-make ratio of 2–1. Secondly, when one or more impulse trains are stored they must be counted out again, the outgoing impulses corresponding in number and sequence to those received. Thirdly, when no further impulse trains remain stored, the action of the device must cease. Fourthly, a standard interdigital pause must be provided, this pause being given by the device as the minimum time between successive impulse trains.

The invention fulfils the foregoing desiderata, by providing five small toothed wheels each of which acts as a register, though a greater or lesser number can be used if desired. Each of the wheels is acted upon by a pawl, all the pawls being mounted on a main armature operated by a magnet. A sequence cam enables only one pawl to be operated at any one time, this sequence cam being operated step-by-step at the end of each impulse train. Thus successive impulse trains register in sequence on the small toothed wheels.

After one impulse train has been stored, release of the relay operated during the reception of each impulse train produces a disagreement between the position of two cams. This closes contacts which bring a step-by-step switch device into operation, the said switch operating a second sequence cam to select one of a further series of pawls, only one of which is operable at a time.

Standard impulses are then emitted to the magnet operating the selected pawl, which is impulsed and the register wheel restored step-by-step to a normal position. This counts out the number of impulses originally stored, further incoming trains of impulses being meanwhile registered on other and similar register wheels.

When a register wheel has been restored to normal, impulse emission ceases and the step-by-step switch is further impulsed for a predetermined number of steps, this forming the interdigital pause. At the end of this time, if further impulses have been stored on other register wheels, further impulsing of a similar character takes place until all of the off-normal register wheels are restored to their original positions. Agreement is then once more reached between the positions of the two previously mentioned cams, the associated contact springs are opened and operation of the device ceases.

In order that the nature of the invention may be properly understood, reference should be made to the accompanying drawings in which Figure 1 is a side view of the digit storing mechanism, Figures 2 and 3 are front and side views of the device used to start and terminate impulse sending, Figure 4 is a perspective view of the register wheels and pawls, Figure 5 is an end view of the device as a whole, Figure 6 is a schematic plan view showing only the arrangement of cams and gearing, and Figure 7 is the circuit diagram.

It is intended to describe the general principles of the device by outlining the method of operation with reference to Figure 7; a detailed description of the mechanism will then be given. Referring to the said figure, it will be seen that an impulse receiving relay A is assumed to be connected by wires to exchange switches which have access to the impulse generating device in known manner by means of multiple wiring on the switch banks. Suitable guard arrangements of known type are provided to prevent the regenerating device from being seized by two or more switches simultaneously. This relay A, when operated to receive impulses, changes over its contact A1 and operates relay B. Contact B1 prepares to operate relay C later and contact B2 engages a selector in a rank of switches to which impulses are to be transmitted by applying earth potential via contact 3 and lead 21. No further operation takes place until the commencement of the first impulse received on relay A, at which time contact A1 releases and operates relay C and also the magnet 4. During the whole of the time of engagement of the impulse regenerator relay B remains operated, and relay C is op-

erated during every impulse train, though this relay releases between trains.

The magnet 4 carries a pawl 6 which engages with the teeth of a storage wheel 7 and when the magnet is energised the pawl pushes the wheel one tooth in a forward direction. At the end of the impulse the magnet releases and the pawl prepares to act on the next tooth at the commencement of the second impulse. In the meantime, contact C1 has operated the magnet 5, which on release at the end of the impulse train moves the cams 9 and 10 one fifth of a revolution in the direction of rotation of the main shaft. The result of this operation is that the contacts 11 close, owing to an overlapping action of the cams to be described later, and impulses generated by an impulse machine connected to lead 22 pass through contacts 11, the wiper 23 in the position shown, to the magnet 12, this magnet and its associated pawl 13 being provided for the purpose of counting out the impulses stored on the register wheel 7.

This counting out process takes place at a standard rate determined by the impulse machine, the wheel 7 being turned in a backward direction to the extent of one tooth for each impulse counted out. Each time the pawl 13 is pushed forward by the magnet 12 a cam 15 is tilted about a pivot 57 so as to open and close the contacts 3, each such opening and closure providing an impulse of suitable length and ratio to the selector connected to lead 21. When a number of impulses equal to those put into the register wheel have been counted out, the wheel reaches a stop with the result that the next impulse given to the magnet 12 fails to turn the wheel. By means of a mechanical device to be explained later, contact 17 is now closed, with the result that the standard impulses from the impulse machine pass over contact 11, wiper 23 in the position shown, multiple contacts in the switch bank 24, to the switch magnet 37, with the result that the switch wiper 23 steps through a space of ten bank contacts under the influence of the impulse machine, this wiper movement being also geared to the arm 18. At the end of this period of stepping, the wiper 23 once more reaches an isolated contact, and impulses are again imparted to the magnet 12 instead of to the magnet 37 provided that any further digits have been stored in the meantime. If, however, only one such digit has been transmitted to the storage wheels the arm 18 moves the cam 9, by acting on the pin 19, so that the pawl slots in the two cams coincide. This once more opens the contact 11 with the result that the action of the device ceases. Release of relay A by the switches preceding the regenerating device causes release of relay B, and the device is available for use by some other switch if required.

Although one bank of 25 contacts only is shown, two such banks each subtending an arc of 180° at the wiper spindle are employed. Five positions of rest for the wiper 23 are provided, and movement of the wiper from one such position to the next is adapted by means of gearing to move arm 18 through one-fifth of a revolution. The time elapsing between movement of the wiper 23 from one position of rest to the next is adapted to be of sufficient length to ensure adequate switching time in the succeeding switch stages. This interdigital pause is of course always constant, the other bank (not shown) being connected so that similar pauses are given to those shown in Figure 7.

Referring now to the remaining figures it will be seen from Figure 5 that the impulse regenerator consists of a uniselector 25 of known type and a storing device mounted on the side of the uniselector. This storing device comprises the base plate 28, magnets 4, 5 and 12 mounted thereon in the positions shown in Figure 1, digit storing wheels 7 (Figs. 1, 4 and 6) and pawls 6 and 13 acting on the wheels. The wheels 7 are free to rotate independently of one another and of the spindle 27 upon which they are mounted.

Both the impulse storing magnet 4 and the impulse repeating magnet 12 carry five pawls, four only of these pawls being shown in Figure 4. The pawls 6, operated by magnet 4, normally rest against a barrel cam 29, this cam having a series of slots around its periphery. The slots are displaced one-fifth of 360° apart in a circumferential direction, and are spaced longitudinally so as to co-operate each one with a separate pawl. The barrel cam 29 is rotated from the back of the base plate by means of the magnet 5 and its pawl 30, the latter engaging with a ratchet wheel 31 driving a gear train 32, the ratio of the gearing being such that every energisation of the magnet 5 rotates the cam 29 through one-fifth of a revolution. Thus it will be seen that after an impulse train the cam 29, by revolving, brings one of its slots opposite a fresh pawl.

During the reception of an impulse train the framework 34 carried by the armature of the magnet 4 moves the whole of the pawl assembly forward and backward. Only one pawl, however, i. e. the one which can fall into the corresponding slot in cam 29, can engage with teeth of a storage wheel 7, this wheel alone, therefore, being rotated a number of steps equal to the number of impulses in the train. Revolution of the cam 29 at the end of the impulse train causes transfer of storage to another pawl and storage wheel.

The armature of the counting-out magnet 12 has a framework 50 carrying a similar pawl assembly in which the pawls are numbered 13, these pawls being brought into action successively by the barrel cam 35. This cam and the wipers of switch 25 are mounted on a common spindle 49, and rotated as previously described by the magnet 37 of the switch. All the storage wheels 7 are provided with centering and retaining springs 40, these acting to retain the wheels in a normal or stored position, though of course the said springs do not prevent the wheels from being moved by their associated pawls.

Each of the storage wheels 7 has a normal position from which it is adapted to be moved step by step by its associated pawl 6 during the reception of an impulse train and toward which normal position it is thereafter returned by its associated pawl 13 when the impulse train is repeated by the regenerator. In each wheel a slot 42 is provided through which passes a fixed pin 43. This pin and slot are so dimensioned that the wheel can be moved no more than ten steps from its normal position by the receiving magnet and pawl 6, and the slot also serves to prevent the wheel from being returned past its zero position by the impulsing-out magnet and pawl 13.

It is now proposed to describe the method whereby the device is kept in operation so long as any digits are stored in the storage wheels. This device is shown in Figures 2 and 3, and comprises two cams 9 and 10, mounted on concentric bearings on the end of spindle 27 as shown in Figures 5 and 6. The cam 10 is driven by a gear

wheel 44 which in turn is driven by the shaft 45 and gear wheel 46 (Figure 6), this drive being initiated by the magnet 5 through the pawl 30 and wheels 31 and 32. These two cams 9 and 10 are held together by a spring 64 in such a position that slots 33 on the two cams do not agree, so that contacts 11 would normally be held closed. The cam 9, however, carries a pin 19, which is acted upon by an arm 18, this arm being rotated by the wheel 48 which is driven by wheel 39. This latter wheel is itself rotated with the cam 35 by the spindle 49 of the switch 25. The position of the cams 9 and 10 and the arm 18 is such that the slots 33 coincide in a position beneath the contacts 11 only when all the impulse storage wheels 7 are in a normal position i. e. when the cams 29 and 35 have been rotated by their associated drives to such positions that no stored digits remain in the storage wheels. This may occur five times during one revolution of the cams 9 and 10, though if one or more digits remain stored, the spring 64 pulls the cam 9 into such a position that its slots do not agree with the slots in cam 10, so that contacts 11 remain closed.

When a pawl 13 carried by the member 50 engages with a storage wheel to remove the digit stored by it, the member 50 is moved backwards and forwards by means of the armature 51 of the magnet 12. The armature 51 is connected to the member 50 by means of the flexible spring 52, this spring being tensioned so as to rest against the armature. At the end of digit sending, i. e. when a number of impulses have been counted out in a particular train equal to the number of impulses counted in, the storage wheel being acted upon is stopped by engagement of the pin 43 with the end of the slot 42. The next energization of the magnet 12, therefore, causes the armature 51 to move to the full extent of its travel, though the member 50 is stopped by engagement of pawl 13 with the storage wheel a short distance after the forward travel of the member 50 commences. This causes bending of the spring 52, with consequent closure of the contacts 17, this closure being employed as previously described to step the magnet of the switch 25, this causing termination of impulsing and preparing the inter-digital pause.

For convenience, five storage wheels have been provided, though less or more than this number may be used if required. Even in a multi-exchange area, it is not thought likely that more than three digits will be stored and awaiting sending at any one time, so that the device has a safety margin of two digits. If the incoming impulse trains are received quicker than those which are being sent, storage takes place faster than sending, a standard inter-digital pause being always provided. If, however, the incoming trains are received slower than the maximum speed at which the digits can be sent, the impulses are sent out at correct speed and impulse ratio, though the inter-digital pause is longer than that previously produced.

The impulses sent out by the device are obtained not from an impulse producing machine directly, but via the cam 15 which is rocked by the magnet 12 during the restoration of a storage wheel to normal. This cam 15 is pivoted on a pin 57, which is fixed to the frame 28 of the device, and carries a slot at its upper end engaging with another pin fixed to the member 50 and moving with it. The cam 15 therefore rocks each time the member 50 moves a pawl 13 to rotate a storage wheel step-by-step toward its zero position. This rocking motion opens and closes the contacts 3 as already described, these contacts being carried by a bracket 58 fixed to the framework 28 of the device. This bracket 58 is fixed by means of screws 60, which pass through elongated holes in the bracket. The bracket can, therefore, be moved in a direction transverse to the length of the cam 15. The position of the contacts 3 relative to the cam is adjusted until the ratio of the impulses sent by the device is of a particular value. Thus a 1/1 ratio may be required for acting upon a particular type of succeeding selector, or a 1/2 ratio may be required for a different type of selector. Either of these ratios, or any other ratio, may be obtained by suitable positioning of the contacts 3 relative to the cam 15. Should this facility not be required, the contact B2 (Figure 7) may be connected to impulse springs carried by an impulse generating machine, the contacts 3 being then adapted to act as masking means only i. e. the contacts 3 then open slightly before and close slightly after the actual impulse producing springs on the machine. Closure of contact 3 then prevents impulses from being sent, since it would then be connected, via contact B2, in parallel with the actual impulse producing contacts.

The device as a whole is adapted to be mounted on a normal type of mounting plate of the kind used in telephone systems, the said plate carrying the associated controlling relays A, B and C, and also spark quenching condensers and the like when necessary. If required, the impulse regenerating device may be, as stated above, available in common to a number of selectors, or alternatively it may be associated with a particular selector or junction, all impulses received through the said selector or junction being regenerated by the device.

We claim:

1. An impulse regenerating device of the type used in telephone systems comprising a plurality of storage wheels each adapted to store the impulses of one impulse train, means for rotating each of the wheels in one direction, further means for rotating the wheels in the other direction during sending out of impulses, and means for continuing impulsing out until all impulses counted in have been sent out.

2. An impulse regenerating device according to claim 1 in which each storage wheel is toothed, each impulse received by the device being adapted to act on a magnet so as to move a storage wheel one tooth forward, the said wheel being rotated backwards one tooth at a time by a further magnet during impulse sending.

3. An impulse repeater comprising a plurality of rotary storage members each adapted to store the impulses of one impulse train, means operated by the received impulses for rotating each of the members in one direction, further means for rotating the members in the other direction during the sending out of impulses, a cam operated in accordance with the number of trains of impulses received by the repeater, a second cam operated in accordance with the number of trains of impulses sent out by the repeater, and means including an electrical contact set controlled by said two cams for maintaining the sending out operation until all received impulse trains have been sent out.

4. An impulse repeater comprising a plurality of rotary storage members each having a normal position, means operated by received trains of

impulses for rotating the members successively step-by-step in one direction from normal to store each impulse train as it is received upon a different member, means for rotating the members successively step-by-step in the other direction to restore them to normal and, during said rotation of each member to normal, transmitting a train of impulses corresponding to the train stored upon that member, and means operated during transmission of said impulse trains to provide a pause of predetermined minimum length between successive trains.

5. An impulse repeater comprising a plurality of rotary storage members each having a normal position, means operated by received trains of impulses for rotating the members successively step-by-step in one direction from normal to store each impulse train as it is received upon a different member, means for rotating the members successively step-by-step in the other direction to restore them to normal and, during said rotation of each member to normal, transmitting a train of impulses corresponding to the train stored upon that member, said last means including a step-by-step switch operated after each member reaches normal to select the next member to be restored to normal.

6. In a device of the kind described, two impulse receiving circuits, a movable member having a normal position, means operated by impulses received over one of said circuits to move said member step-by-step from its normal position to another position, the distance of said other position from said normal position varying in accordance with the number of impulses received over said one circuit, and other means then operated by impulses received over the other of said circuits to return said member step-by-step to its normal position over the same path travelled in moving it to said other position.

7. In a device of the kind described, two impulse receiving circuits, a movable member having a normal position, means operated by impulses received over one of said circuits to move said member step-by-step from its normal position to another position, the distance of said other position from said normal position varying in accordance with the number of impulses received over said one circuit, other means then operated by impulses received over the other of said circuits to return said member step-by-step to its normal position over the same path travelled in moving it to said other position, and means controlled by said last means to generate a number of impulses corresponding to the number of steps required to return said member to said normal position.

8. In a device of the kind described, a movable member occupying a normal position, two motors for driving said member, means for transmitting a train of impulses to one of said motors to cause same to move said member step-by-step from its normal position to another position, the distance of said other position from said normal position varying in dependence upon the number of impulses in said train, and means effective responsive to the termination of said train of impulses to transmit a train of impulses to the other of said motors to cause same to return said member step by step to its normal position.

9. In a device of the kind described, a movable member occupying a normal position, two motors for driving said member, means for transmitting a train of impulses to one of said motors to cause same to move said member step-by-step from its normal position to another position, the distance of said other position from said normal position varying in dependence upon the number of impulses in said train, means then effective to transmit impulses to the other of said motors to cause same to return said member step-by-step to its normal position over the same path travelled by said member in moving to said other position, and means operated when said member reaches its normal position to automatically terminate the transmission of impulses to said other motor.

10. In a device of the kind described, a plurality of movable members each occupying a normal position, means operated by successive trains of impulses to move said members successively in a particular direction from their respective normal positions, each member being moved a distance corresponding to the number of impulses in a different one of said trains, and means operated by impulses to restore the moved members to their respective normal positions in the same order that they were moved therefrom by moving them successively in the opposite direction.

11. In a device of the kind described, a plurality of movable members each occupying a normal position, means operated by successive trains of impulses to move said members successively in a particular direction from their respective normal positions, each member being moved a distance corresponding to the number of impulses in a different one of said trains, means adapted to be operated by impulses to restore the moved members to their respective normal positions in the same order that they were moved therefrom by moving them successively in the opposite direction, and means for initiating the operation of said last means after certain but not all of said members have been moved from their normal positions, thereby to restore part of the moved members to normal during the same period of time that said first means is moving another part of said members from normal.

12. In a device of the kind described, a plurality of movable members, two actuators for each member, the first for moving the member in one direction and the second for moving the member in the opposite direction, an electromagnet common to all of said first actuators and operated by impulses, means operated to render said first actuators effective in succession during the receipt of said impulses by said electromagnet thereby to cause the electromagnet to move the members successively in said one direction, another electromagnet common to all of said second actuators and also operated by impulses, and means operated to render said second actuators effective in succession during the receipt of said impulses by said other electromagnet to cause said other electromagnet to move the members successively in said opposite direction.

13. A device as claimed in claim 12, wherein said first electromagnet is operated by impulses to move one of said members in said one direction at the same time said other electromagnet is operated by impulses to move another of said members in the opposite direction.

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