Dec. 2, 1969 C. E. DELANEY 3,481,212

RATCHET RELAY

Filed Jan. 23, 1968 2 Sheets-Sheet 1

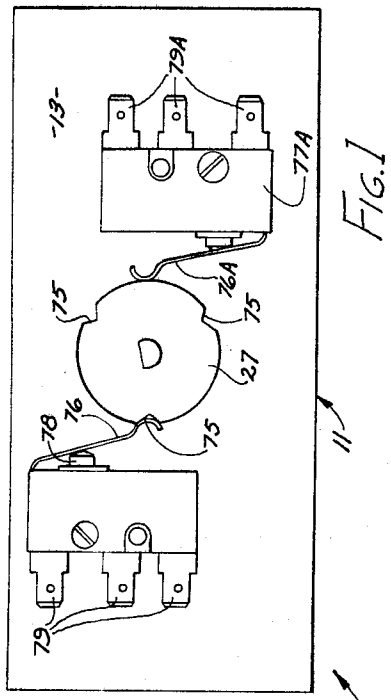


FIG. 1

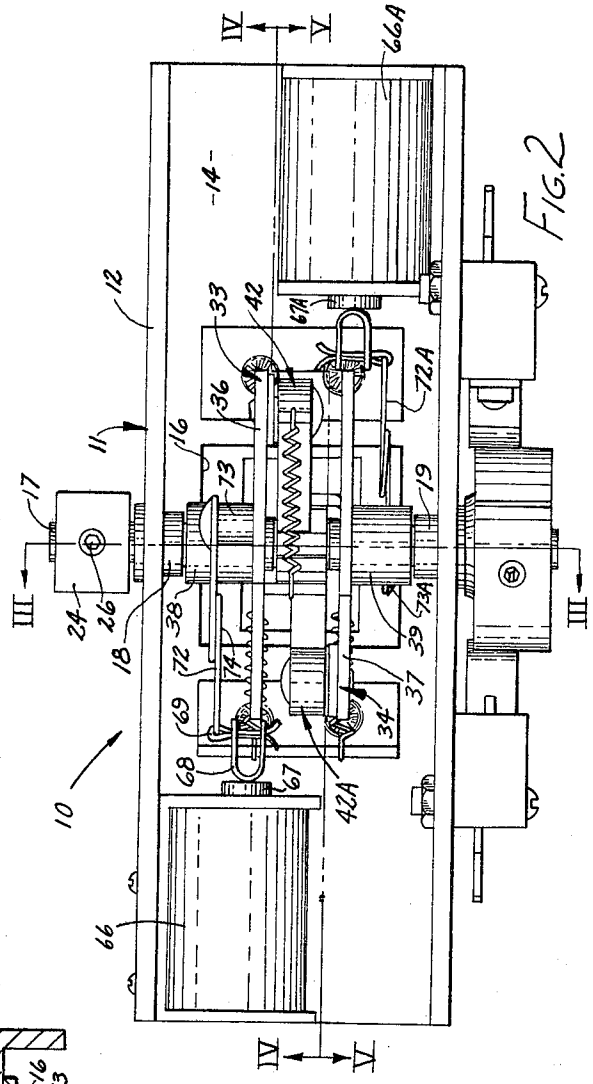


FIG. 2

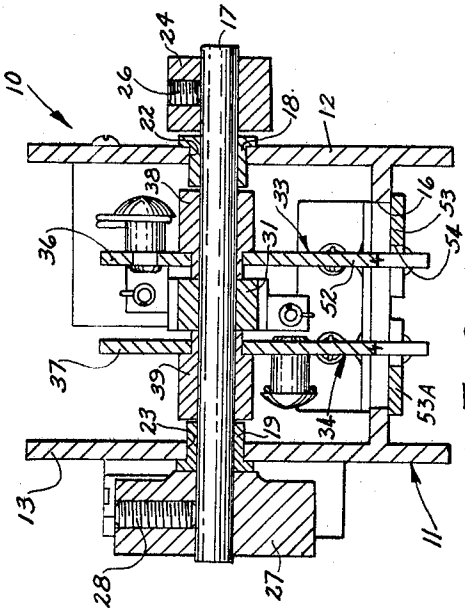


FIG. 3

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FIG. 4

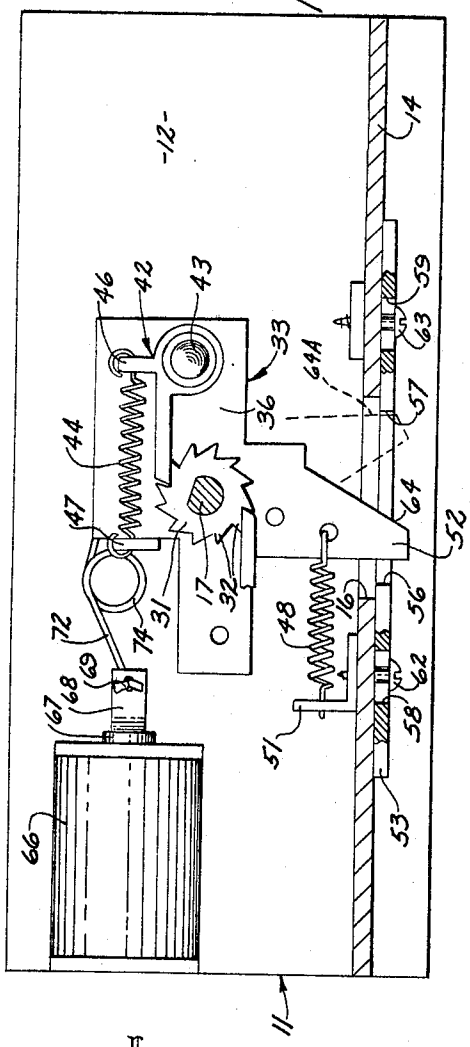


FIG. 5

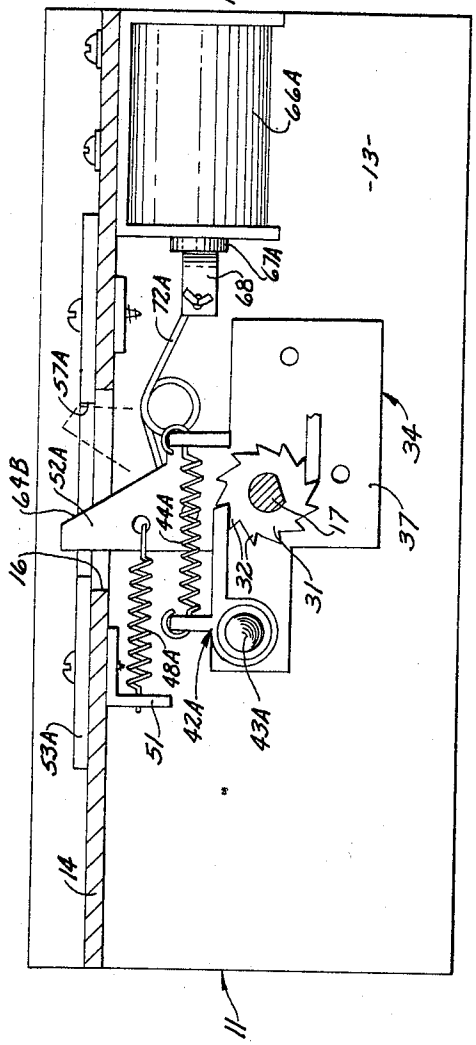


FIG. 6

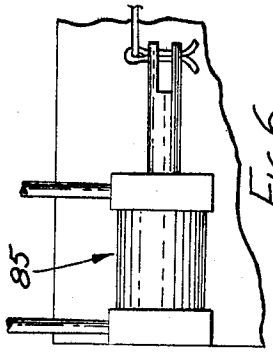
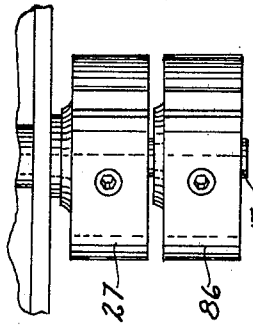


FIG. 7



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RATCHET RELAY

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Filed Jan. 23, 1968, Ser. No. 699,815
Int. Cl. F16s 27/02
U.S. Cl. 74—142 10 Claims

ABSTRACT OF THE DISCLOSURE

A shaft has cam means and a ratchet wheel secured thereon and rotatable therewith. A pair of pawl supports are rotatably mounted on the shaft on opposite sides of the ratchet wheel and pivotally support pawls which are resiliently held in engagement with teeth on the ratchet wheel. The pawl supports are connected to a pair of independent actuators which are capable of rotating the pawl supports whereby the ratchet wheel, shaft and cam are rotated in one rotational direction. Switch or valve means are engaged by the cam to effect preselected operation thereof.

BACKGROUND OF THE INVENTION

This invention relates in general to a ratchet-type relay device for converting one type of impulse into another and, more particularly, to a relay device capable of receiving a plurality of similar electrical impulses and converting them into a plurality of switch operations in a selected sequence.

There are many circumstances where it becomes desirable to produce or repeat a series of similar or sequential operations or movements in response to the sensing of one or several signals, whereby the operation of one type of mechanism controls the performance of another mechanism. Such a need exists, for example, in the operation of an electrically and remotely controlled garage door having a main circuit for effecting the normal opening and closing of the door, and a separate, safety circuit for effecting the emergency opening and/or closing the door. It is at least advantageous that the signals from these two sources of control should actuate the same control mechanism, and that the two actuations should be capable of performance without interference.

That is, it is important that the control mechanism can receive signals from at least two different sources at the same time or substantially the same time without jamming the control or damaging the door operator.

While detailed reference is made herein to a relay device particularly adapted for receiving a plurality of electrical impulses and converting them into sequential control of an electrically energized door operator, because it was from this environment that the invention developed, it will be apparent that the relay device of the invention can be used for a variety of different purposes and that it can be readily adapted for response to fluid actuated impulses, purely mechanical impulses, or various combinations of impulses. It will also be apparent that the output of the relay device can be electrically hydraulically or mechanically coupled to the apparatus which it controls.

Existing devices for receiving impulses and discharging actuations in response thereto of the character described above have not been satisfactory for applicant's purposes because of their complicated and expensive structures, because of the sensitivity of their adjustment, because of their inability to receive or coordinate overlapping input impulses from two or more sources and/or because of their inability to compensate for overtravel

during normal operation, minor discrepancies in manufacturing tolerances or installation and/or lack of adaptability to various types of impulse media and use requirements.

By way of example, it sometimes becomes desirable to have a single sequencing output responsive to many similar, completely independent input signals which are completely unrelated to each other. Moreover, it may be desirable to have a relay device in which relatively few input signals are converted into a plurality of output sequences. By way of example, it may be desirable to have the opening and closing of the doors controlled by a number of switches having independent actuating devices associated with the relay device. Moreover, it may be desirable to have the output of said relay operating several cams which in turn control the energization of the door actuator, the control of light switches, and the operation of a signalling device, each of which may be connected in an independent circuit and certain of which may have timing devices so that they are not always operative.

Accordingly, a primary object of this invention is the provision of a relay device which is capable of receiving independent and uncoordinated impulses and converting said impulses into one or more output operations capable of actuating one or more mechanisms in a predetermined manner or sequence without becoming jammed if two or more inpulses are received in a nonspecific and overlapping relationship.

A further object of this invention is the provision of a relay device, as aforsaid, which is completely mechaical in its operation, which is adapted for response to electrical, pressure fluid or purely mechanical impulses or combinations of such impulses and which is capable of converting same into operations for controlling switches, valves or purely mechanical movements.

A further object of this invention is the provision of a relay device, as aforesaid, which is readily adapted to receive multiple input impulses and perform multiple output operations, which is easily adjusted to compensate for relatively wide variations in manufacturing tolerances, which automatically compensates for overtravel, which is positive in its operation, which requires an absolute mininum of parts and maintenance and which can be easily installed, adjusted and/or repaired by any person capable of installing an overhead door operator, for example.

Other objects and purposes of the invention will become apparent to persons familiar with relay devices upon reading the following descriptive material and examining the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a relay device embodying the invention.

FIGURE 2 is a top plan view of said relay device.

FIGURE 3 is a sectional view taken along the line III—III in FIGURE 2.

FIGURE 4 is a sectional view taken along the line IV—IV in FIGURE 2.

FIGURE 5 is a sectional view taken along the line V—V in FIGURE 2.

FIGURE 6 is a fragment of FIGURE 2 showing a modified construction.

FIGURE 7 is a fragment of FIGURE 2 showing a further modification of said relay device.

For convenience in description, the terms "upper," "lower" and words of similar import will have reference to the relay device as appearing in FIGURES 1, 3 and 4. The words "front" and "rear" have reference to the left and right sides, respectively, of the relay device as appearing in FIGURE 3. The words "inner," "outer" and derivatives thereof will have reference to the geo-

metric center and particularly the shaft axis of said relay device.

SUMMARY OF THE INVENTION

The objects and purposes of the invention, including those set forth above, have been met by providing a ratchet relay device having a frame rotatably supporting a shaft having a cam and ratchet wheel secured thereto for rotation therewith. A pair of pawl supports are rotatably supported upon the shaft adjacent the ratchet wheel and a pawl is pivotally mounted upon each pawl support and resiliently urged into engagement with said ratchet wheel. Both pawls are arranged for effecting unidirectional rotation of the ratchet wheel in the same direction and the two pawl supports are connected by resilient linkage to a pair of solenoids for effecting said unidirectional rotation of said pawl supports. The cam is engaged by one or more switch operators for opening and closing associated switches in a predetermined sequence.

DETAILED DESCRIPTION

The relay device **10**, a preferred embodiment of which is disclosed in FIGURES 1 and 2, is comprised of a rigid frame **11** having a pair of sidewalls **12** and **13** and a bottom wall **14** with a central opening **16** therethrough.

A shaft **17** (FIGURE 3) is rotatably supported within bearings **18** and **19** which extend through aligned openings **22** and **23** in the sidewalls **12** and **13**, respectively. A locking collar **24** is firmly secured to the rear end of the shaft **17** by a set screw **26**, and a substantially circular cam **27** is firmly secured to the front end of the shaft **17** by a set screw **28**. A ratchet wheel **31** is rigidly mounted upon the shaft **17**, preferably midway between the sidewalls **12** and **13**. The ratchet wheel **31** has a plurality of substantially conventional teeth **32**, one corresponding side of each tooth being approximately radially disposed.

A pair of pawl supports **33** and **34** (FIGURE 2) are comprised of substantially identical, rigid plates **36** and **37**, respectively, secured to and supported by hubs **38** and **39**, respectively, which are rotatably supported upon the shaft **17** on opposite sides of the ratchet wheel **31**.

A pawl **42** (FIGURE 4) is pivotally supported by the pin **43** on the inner side of the plate **36** for engagement with the teeth of the ratchet wheel **31** near the upper side thereof. The pawl **42** is resiliently urged into an engaged position with the ratchet wheel **31** by a spiral spring **44** which is held under tension between an ear **46** on the pawl **42** and an ear **47** on the pawl support **33**.

The teeth **32** on the ratchet wheel **31** are arranged so that rotation of the pawl support **33** (FIGURE 4) in a counterclockwise direction operates through the pawl **42** mounted thereon to effect a counterclockwise rotation of the ratchet wheel **31**, hence, the shaft **17** secured thereto. A spiral spring **48** is connected to and held under tension between a bracket **51**, secured to the bottom wall **14**, and an integral, downwardly projecting arm **52** on the pawl support **33**, whereby said pawl support is urged to rotate in a clockwise direction as appearing in FIGURE 4.

The arm **52** (FIGURE 3) extends downwardly through the opening **16** in the bottom wall **14**. A U-shaped adjustment plate **53** has a substantially rectangular recess **54** which is defined by end edges **56** and **57** (FIGURE 4). The adjustment plate **53** has a pair of lengthwise slots **58** and **59** through which the screws **62** and **63** are slideably received for engagement with the bottom wall **14** whereby the position of the edge **57** of the plate **53** can be adjusted lengthwise of the bottom wall **14** so that it will engage the edge **64** of the arm **52** when it is in its broken line position **64A** of FIGURE 4. The angular distance between the edges **64** and **64A** is preferably slightly more than the angular pitch of the teeth **32**. Thus, after a full rotational movement of the wheel **31** by the pawl support **33** the pawl **42** can drop behind the next tooth at the end of its return movement.

A solenoid **66** is mounted upon the rear wall **12** (FIGURE 4) at the left end thereof so that the movable core **67** is substantially horizontal and approximately aligned with a pin **73** extending from the pawl support **33** above the shaft **17**. The core **67** has a yoke **68** secured to its outer end and connected by a cotter key **69** to one end of a spring element **72** having a tension-absorbing loop **74** between the ends thereof. The other end of the element **72** is mounted upon the pin **73** which extends rearwardly from the support **33**. Acocrdingly, if the core **67** overtravels during normal operation of the solenoid **66** beyond the point where it causes the edge **64** of arm **52** to engage the plate **53**, such overtravel will be resiliently absorbed by the loop **74** in the spring element **72**.

The pawl support **34** (FIGURE 5) has a pawl **42A** pivotally supported thereon by the pin **43A** which is held against the ratchet wheel **31** by a spring **44A**. A spring **48A** extends between the arm **52A** and the bracket **51** to oppose clockwise rotation of the pawl support **34** into the broken line position thereof shown in FIGURE 5, wherein the edge **64B** of the arm **52A** engages the edge **57A** of the adjustment plate **53A**. The core **67A** of the solenoid **66A**, which is mounted upon the right end of the bottom wall **14**, is connected by a spring element **72A** to a pin **73A** on the arm **52A** below the shaft **17**. Accordingly, operation of the solenoid **66A** effects a rightward movement of the core **67A** whereby the shaft **17** is rotated in the same direction as it is rotated by a corresponding leftward operation of the solenoid **66**. While the shaft **17**, hence the ratchet wheel **31**, is being rotated by one of the pawls **42** or **42A**, the other of said pawls will ride up over the tooth engaged thereby and thereafter be urged back into engagement with the next tooth by the corresponding spring **44** or **44A**.

By increasing the distance tbetween the sidewalls **12** and **13**, additional solenoids, additional pawl supports and their related parts can be mounted within the frame **11** for actuation of additional ratchet wheels mounted upon the shaft **17**, if desired.

The cam **27** (FIGURE 1) has one or more recesses **75** in its circumferential surface into which one end of the switch actuator **76** is received. The switch actuator **76** is mounted upon the switch **77** so that it extends across and normally holds the switch button **78** in the depressed position, wherein the switch **77** may be held open. Thus, when the free end of the actuator **76** drops into a recess **75**, the switch **77** is closed. Clearly, the recesses **75** could be replaced by small projections and the closed position of the switch **77** could be achieved by the resultant pressing of the button **78** into the switch. Also, the switch could be normally closed.

A second switch **77A** may be mounted upon the front wall **13** so that its actuator **76A** is engaged with the cam **27**. The terminals **79** and **79A** on the switches **77** and **77A**, respectively, are electrically connected to conductors in a conventional manner for conventional purposes.

OPERATION

Persons skilled in the art will be able to determine the operation of the invention from the foregoing description and the drawings. However, for convenience, the operation will be summarized.

With the solenoids **66** and **66A** electrically connected to a source of an electrical impulse, such as a source of electrical potential in series with a normally open switch, closure of the switch will effect an operation of the solenoid **66**, for example, whereby the core **67** is moved leftwardly (FIGURE 4) and, accordingly, the pawl support **33** is rotated in a counterclockwise direction around the shaft **17**. Accordingly, the pawl **42** will cause the ratchet wheel **31** to rotate a corresponding distance and, thereby, simultaneously rotate the cam **27**. Normally, the angular movement of the ratchet wheel **31** will be slightly in excess of the angular pitch of a tooth **32**. Accordingly, as the pawl **42** is turning the ratchet wheel **31** and shaft **17**, the pawl **42A** will ride up over the corresponding

tooth on the opposite side of the ratchet wheel and then drop into the detent position on the opposite side of such tooth, thereby holding the ratchet wheel **31** in its advanced position as the pawl support **33** and its attached pawl **42** are returned to their solid line positions of FIGURE 4.

After the solenoid **66** is de-energized, so that the pawl support **33** can return to its solid line position of FIGURE 4, the spring **48** will hold the pawl **42** snugly against the radial side of the next tooth thusly engaged so that the ratchet wheel and shaft will normally be rotated in equal angular increments.

In this particular embodiment, there are **12** similar teeth on the ratchet wheel **31**. Accordingly, each movement of one of the pawl supports **33** and **34** by the corresponding solenoids **66** and **66A** will effect a 30 degree rotational movement of the ratchet wheel **31**, as well as the shaft **17** and cam **27**.

If, during a rotational movement of the ratchet wheel **31**, hence the cam **27**, the end of one of the switch actuators **76** and **76A** drops into a recess **75**, its corresponding switch will be closed and thereby energize a circuit through the corresponding switch.

In one particular embodiment of the invention, this relay device **10** and its associated switches **77** and **77A** are connected to the operator of an overhead door and the circuits connected to the solenoids **66** and **66A** are in series respectively with the switch or switches which control normal operation of the door and the safety switch or switches which effect emergency operation of the door, for example.

In a manner as described above with respect to the pawl support **33** and associated elements, the pawl support **34** can also be operated to effect a similar rotation of the cam **27**. Since the pawl supports **33** and **34** are entirely independent of each other, overlapping operations of the solenoids **66** and **66A** will not adversely affect the performance of the relay device **10**.

One or both of the solenoids **66** and **66A** (FIGURE 2) can be replaced by a pressure fluid operated device **85** or a purely mechanical device (not shown), and the switches **77** and **77A** can likewise be replaced by valves or other means responsive to the rotation of the cam **27**, or some other rotating member mounted on the shaft **17**, while maintaining the essential performance of operation of the relay device. Moreover, as shown in FIGURE 7, additional cams **86** can be mounted upon the shaft **17** outboard of the cam **27**.

In another application of the invention relating to operating devices for residential garage doors, an additional ratchet wheel solenoid and the associated springs, pawl arm, pawl and the like could be arranged so that the door would be started or stopped by one coil in series with the pushbutton of the main circuit, as discussed above. The motor shut off would be effected by the door limit switches through another coil, and the third coil would be actuated by the safety switch such that the cam would not be indexed once but twice. Thus, when the safety switch was actuated, the door would not stop, as in the case discussed above, but would index two positions and cause the door to reverse to the full open position. In other applications, the third coil could be programmed by the relay itself depending upon the coils which would be required to obtain a certain safety sensing system or override control action.

By appropriate rearrangement of the solenoids and arm return springs, the relay device could be modified so that the cam would be indexed upon the release or deenergization of the solenoids, rather than by the actuation of the solenoids, as described above.

Thus, although particular preferred embodiments of the invention have been described above for illustrative purposes, it will be understood that variations or modifications of such disclosure, which come within the scope of the appended claims, are fully contemplated.

The embodiments of the invention in which an exclusive property of privilege is claimed are defined as follows:

1. A relay device for converting one mechanical movement into another, comprising:

frame means;

shaft means rotatably supported upon said frame means;

toothed wheel means secured upon and rotatable with said shaft means;

pawl support means rotatably mounted upon said shaft means near said wheel means;

pawl means pivotally mounted upon said support means and adapted to positively oppose rotation thereof in one rotational direction;

first actuating means supported upon said frame means and including a movable driving member operatively connected to said pawl support means for causing pivotal movement thereof in the other rotational direction;

resiliently yieldable linkage means drivingly connected between said pawl support means and said driving member whereby operation of said first actuating means effects pivotal movement of said pawl support means in said other rotational direction;

resilient means yieldably resisting said pivotal movement of said pawl support means; and

second actuating means responsive to rotation of said shaft means.

2. A relay device according to claim **1**, wherein said first actuating means is a fluid-actuated power cylinder and said driving member comprises the power cylinder piston rod; and

wherein said second actuating means comprises a cam and an associated valve operator.

3. A device according to claim **1**, wherein said first actuating means is a solenoid and said driving member comprises the armature of said solenoid; and

wherein said second actuating means includes a substantially circular cam means having an irregular circumferential surface, and electrical switch means operated by said cam means.

4. A device according to claim **3**, including stop means adjustably secured to said frame means for limiting said rotational movement of said pawl support means in said other direction.

5. A relay device for converting one mechanical movement into another, comprising:

frame means;

shaft means rotatably supported upon said frame means;

toothed wheel means secured upon and rotatable with said shaft means;

pawl support means rotatably mounted upon said shaft means near said wheel means;

pawl means pivotally mounted upon said support means and adapted to positively oppose rotation thereof in one rotational direction;

first actuating means supported upon said frame means;

yieldable linkage means connected between said pawl support means and said first actuating means whereby operation of said first actuating means effects pivotal movement of said pawl support means in the other rotational direction;

resilient means yieldably resisting said pivotal movement of said pawl support means;

second actuating means responsive to rotation of said shaft means;

second pawl support means rotatably supported upon said shaft means and pivotally supporting a second pawl means engaging said wheel means; and

third actuating means similar to said first actuating means and connected by yieldable means to said second pawl support means for effecting rotary

movement thereof in said other rotational direction.

6. A relay device according to claim 5, wherein said first and second pawl support means and their associated pawl means and actuating means are adapted for independent and overlapping operation.

7. A device according to claim 1, wherein said resiliently yieldable linkage means includes second resilient means operably interconnected between said movable driving member and said pawl support means for permitting movement therebetween.

8. A device according to claim 7, wherein said second resilient means comprises a spring member connected at its opposite ends to said driving member and said pawl support means, respectively, said spring member constituting the sole driving connection between said movable driving member and said pawl support means.

9. A mechanical device, comprising:

frame means;

shaft means rotatably supported upon said frame means;

a toothed ratchet wheel secured upon and rotatable with said shaft means;

a pawl support member rotatably mounted upon said shaft means and positioned adjacent said ratchet wheel;

a pawl pivotally mounted upon said support member and having a portion thereof adapted to engage the teeth of said ratchet wheel;

first resilient means coacting with said pawl for normally urging said portion thereof into engagement with the teeth of said ratchet wheel for normally positively opposing rotation of said ratchet wheel in one rotational direction;

second resilient means yieldably resisting pivotable movement of said pawl support member in said one rotational direction;

actuating means mounted on said frame means and

operably interconnected to said pawl support member for causing pivotal movement thereof in the other rotational direction which in turn causes rotational movement of said ratchet wheel in said other rotational direction, said actuating means including a reciprocable driving member and means adapted to linearly move said driving member in at least one direction;

third resilient means drivingly connected between said driving member and said pawl support member for transmitting therethrough driving force from said driving member to said pawl support member while also permitting relative movement therebetween; and

holding means coacting with said ratchet wheel for preventing rotation thereof in said one rotational direction after same has been advanced in said other rotational direction by said pawl.

10. A device according to claim 9, wherein said third resilient means comprises a spring member having one end thereof connected to said driving member and the other end thereof connected to said pawl support member, said spring member comprising the sole driving connection between said driving member and said pawl support member.

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U.S. Cl. X.R.

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