

Jan. 8, 1946.

L. HEGY

2,392,320

REMOTE CONTROL ACTUATOR

Filed Oct. 4, 1944

2 Sheets-Sheet 1

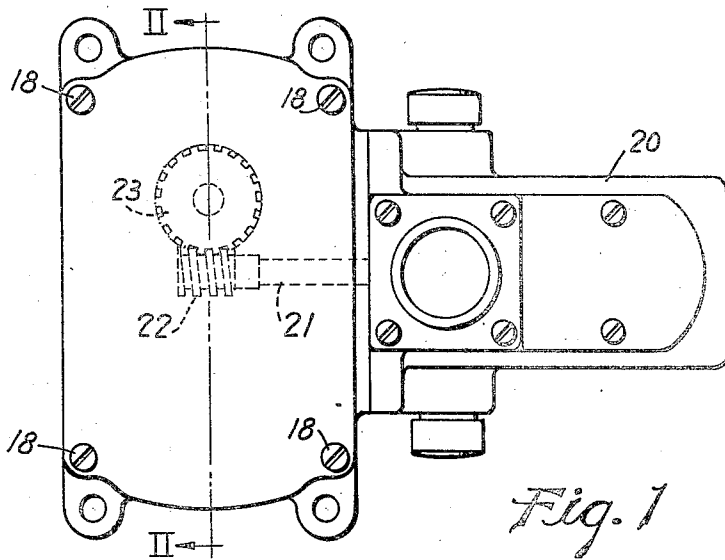


Fig. 1

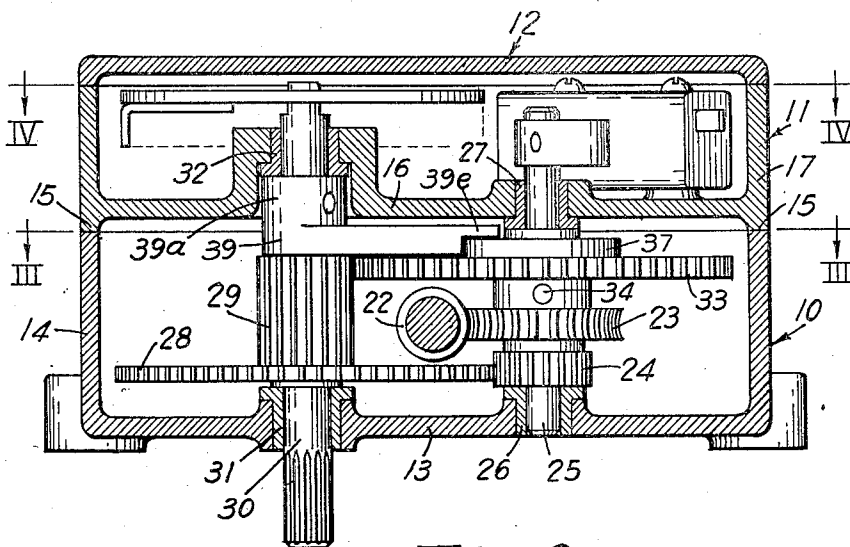


Fig. 2

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2 Sheets-Sheet 2

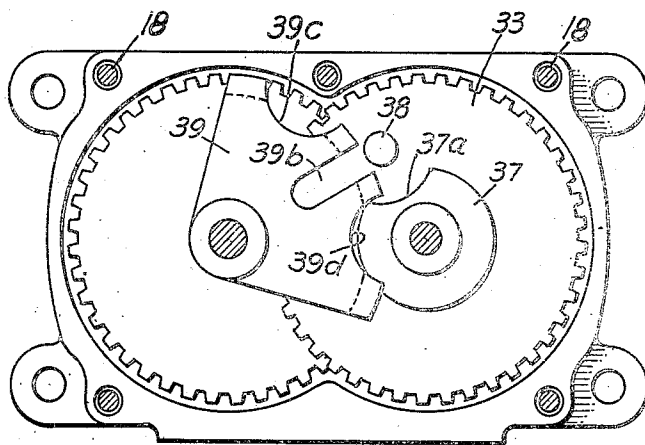


Fig. 3

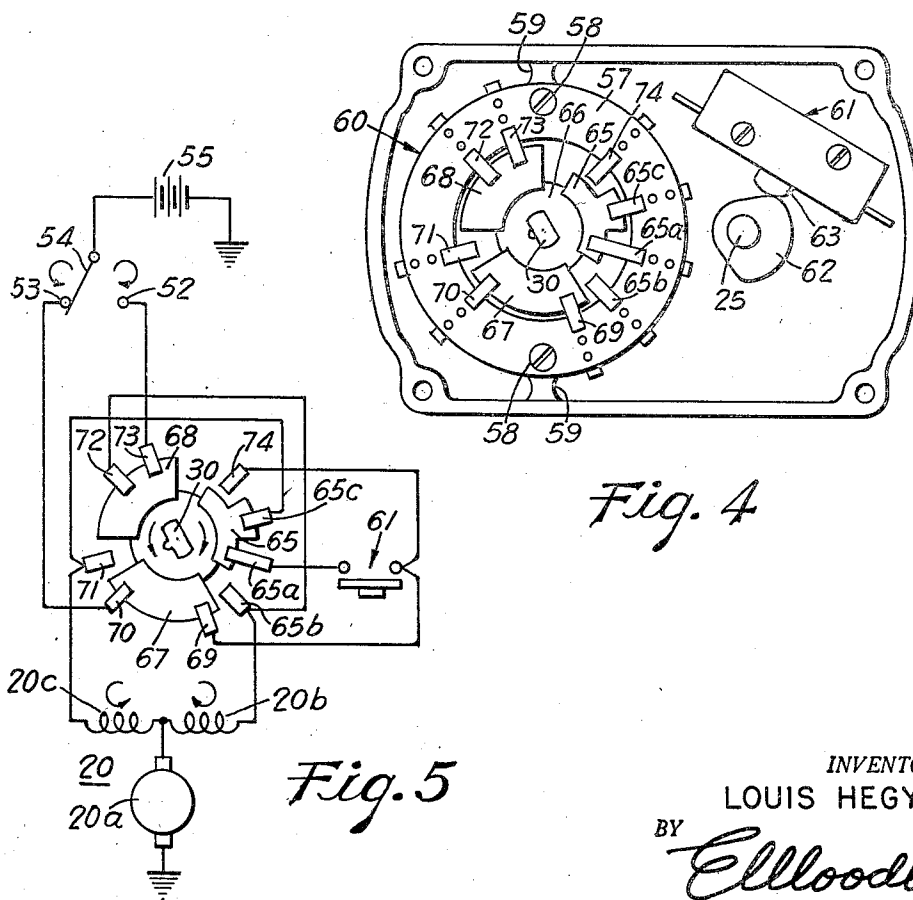


Fig. 4

Fig. 5

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REMOTE CONTROL ACTUATOR

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9 Claims. (Cl. 172-239)

This invention relates to remote control actuators for positively moving a mechanism into and holding it in desired positions, and relates more particularly to electrically actuated devices of this type although it is not necessarily limited thereto.

An object of the invention is to provide a compact, simple and reliable actuator.

Another object is to provide a compact simple and reliable reversible actuator capable of moving in either direction into desired positions but which is positively locked against movement by extraneous forces out of either extreme position.

Another object is to provide an electric actuator mechanism in which the driving motor has no load thereon at the time of starting so that a motor having low starting torque can be employed without the use of a clutch.

Another object is to provide an electric actuator in which the load on the motor becomes practically nil at the completion of a movement so that the shutoff switch for stopping the motor does not have to break a heavy current.

Another object is to provide an electric actuator having a particularly durable and reliable switch mechanism for controlling the motor.

Other more specific objects and features of the invention will become apparent from the detailed description to follow of a specific embodiment thereof.

Briefly, my actuator comprises a compact casing containing two parallel shafts, one of which actuates the driving element of a novel Geneva movement, and the other of which is actuated by the driven element of the Geneva movement. The driving element of the Geneva movement is connected through a speed reducing gear train to an electric motor mounted on the casing, and the gear train comprises a plurality of gears rotatably mounted on the two shafts within the casing. To automatically stop the motor after completion of each cycle of the Geneva movement a selector switch is mounted in a separate chamber in the housing opposite one end of the driven shaft, the movable member of the switch being connected to the driven shaft, and a snap action switch is mounted in the separate chamber and operated by a cam on the driving shaft. The connections are such that the motor is always stopped by opening of the cam-actuated snap switch, thereby eliminating arcing at the selector switch and prolonging its life. It also insures movement of the driving member of the Geneva mechanism into full locking position.

Referring now to the drawings:

Fig. 1 is a plan view of one embodiment of the invention;

Fig. 2 is a section taken along the line II—II of Fig. 1;

Fig. 3 is a section taken along the line III—III of Fig. 2;

Fig. 4 is a section taken along the line IV—IV of Fig. 2; and

Fig. 5 is a schematic diagram of the electrical circuit of the device.

Referring to Figs. 1 and 2, the device comprises a casing containing all the working elements with the exception of the electric motor. The casing is made in three sections 10, 11, and 12. Section 10 consists of an end wall 13 and a peripheral wall 14 having a flat upper edge against which a flange 15, projecting from the bottom wall 16 of the section 11, seats. The section 11, in addition to the bottom wall 16, includes a peripheral wall 17 having a flat upper edge against which the cover plate (section 12) fits. Screws 18 extend through the cover plate 12 and the peripheral wall of section 11 into the lower section 14, to detachably connect the different parts of the casing together. An electric motor 20 is attached as by screws to a face provided therefor on the exterior surface of the peripheral wall 10 of the lower section of the case. The shaft 21 of the motor projects through the wall of the casing and has a worm 22 on its end which meshes with and drives a worm wheel 23.

Referring particularly to Fig. 2, the worm wheel 23 is formed integrally with a pinion 24, and the assembly is rotatably supported on a shaft 25 journaled in bearings 26 and 27 in the casing walls 13 and 16 respectively. The pinion 24 meshes with and drives a spur gear 28 which is formed integrally with or is rigidly secured to a pinion 29, the assembly being rotatably supported by a shaft 30 which is journaled in bearings 31 and 32 in the casing walls 13 and 16. The pinion 29 meshes with a spur gear 33 which is fixed to the shaft 25 as by a pin 34, although it is not essential to the operation of the device that the shaft 25 rotate with the gear 33. However, the pin 34 serves to fix the gear 33 to the shaft 25 and to prevent its escape therefrom during handling and assembly. The desired longitudinal, or axial, positions of the gears on shaft 25 are determined by the fact that the assembly of elements fills the space between the bearings 26 and 27.

The driving mechanism of the Geneva movement is mounted on the gear 33 and it cooperates with a driven element keyed or locked to

the shaft 39, which is the driven shaft and is extended through the wall 13 of the casing and splined or otherwise shaped for connection to a suitable driven element.

Referring now to Figs. 2 and 3, the driving elements of the Geneva movement comprise a disk 37, formed integrally with or secured to the upper face of gear 33 and a crank pin 38 projecting upwardly from the gear at a point spaced radially outwardly from the disk 37. The disk is provided with an arcuate recess 37a adjacent the crank pin. The driven element of the Geneva movement comprises a sector 39 having a hub 39a pinned to the shaft 30. The sector 39 has a central radial slot 39b dimensioned to slidably receive the crank pin 38 and has a pair of arcuate recesses 39c and 39d in its rim on each side of the slot. The sector 39 (Fig. 2) is thicker than the disk 37 and has a projecting flange 39e which overlaps the disk for the purpose of extending the length of the slot 39b. The recesses 39c and 39d may extend through the flange 39e as shown in Fig. 3, but this is not essential.

Fig. 3 shows the Geneva mechanism in one extreme position, in which the disk 37 has entered the recess 39d in the sector and is contacting both ends of the sector to thereby prevent angular movement of the sector in either direction. However, when it is desired to rock the sector 39 clockwise into its other extreme position, the gear 33 is rotated in counterclockwise direction by suitably energizing the motor 30. Initial movement of the gear causes the crank pin 38 to enter the slot 39b. At first, the motion of the crank pin is parallel to the slot, so that there is substantially no load on the motor other than that necessary to overcome the friction of the gear train. As the pin 38 revolves, its direction changes and it bears against the lower edge of the slot 39b to shift the sector clockwise. This movement is permitted by the fact that counterclockwise rotation of the disk 37 carries the leading end of the recess 37a into the recess 39d. The movement continues until the pin 38 has been carried into and then out of the slot 39b, at which time the disk 37 will have engaged the recess 39c to lock the sector against movement by extraneous forces.

It is important to note that it is not at all necessary to accurately time the stopping of the motor 30 and the gear 33 driven thereby. The gear 33 could rotate clockwise through nearly 240° after the pin 38 leaves the slot 39b without changing the position of the sector 39. This eliminates the necessity of employing any brake or special mechanism for quickly stopping the motor, because, with the gear reduction shown, it would be quite impossible for the mechanism to coast far enough to carry the gear 33 beyond its limit of free travel. Regardless of how far the crank pin 38 travels after leaving the slot 39b, it will always re-enter the slot when the movement of the gear 33 is reversed, because the sector 39 will be retained in proper position for re-entry of the pin 38 into the slot 39b by the disk 37.

An important feature of the invention is the making of the recesses 39c and 39d of a smaller radius of curvature than the radius of curvature of the disk 37, so that the latter contacts only the ends of the recess in locking position. This makes it possible for the disk to engage with both ends of the recess just as the pin 38 leaves the slot 39b.

In a conventional Geneva mechanism the re-

cess 39c and 39d would have the same radius as the disk 37. With the conventional construction the parts must be so spaced and positioned that when the pin 38 leaves the slot 39b the end of the recess 37a is at the mid-point of the recess 39d. With such an arrangement, reverse movement of the sector 39 can be controlled only with considerable difficulty, because the mid-portion of the recess 39d is moving substantially parallel to the adjacent portion of the disk 38 (the adjacent portion being the lower end of the recess 37a) and unless all clearance is eliminated between the recess 39d and the disk 37, back lash is inevitable. Furthermore, a powerful wedging force is exerted, tending to bind the shafts of the sector 39 and the disk 37 in their bearings and jamming the mechanism.

In contrast to the conventional mechanism, in the present mechanism, in which the recesses 39c and 39d have a substantially smaller radius of curvature than the disk 37, the parts can be so proportioned that the disk 37 contacts both ends of the recess 39b or 39c at the time the pin 38 leaves the slot 39b. This makes it possible to reduce the back lash between the sector 39 and the disk 37 to a small value without employing tolerances that are difficult to meet in manufacture, and prevents the development of powerful wedging forces that would tend to bind the members in their bearings and thereby jam the device.

Various control circuits may be employed with the mechanism described, but a particularly desirable one is shown in the drawings and will be described with particular reference to Figs. 2, 3, 4, and 5.

Referring first to Fig. 5, the motor is illustrated as having an armature 20a and a pair of field windings 20b and 20c, which field windings are oppositely poled so that when current is supplied through one, the motor runs in one direction, and vice versa. As indicated by the arrows, when current is supplied through field winding 20b, the motor runs in such direction as to cause the shaft 30 to be rotated clockwise, and when the current is supplied through the field winding 20c, the motor runs in the opposite direction, which results in movement of the shaft 30 counterclockwise, the direction being with reference to the views of the apparatus in Figs. 3, 4, and 5. Circuits to the motor through one or the other of the field windings 20b and 20c are completed from a battery 55 through a manual control switch 54 and switches automatically controlled by the shafts 30 and 25. The arrangement is such that when the manual switch 54 is thrown to the left on to a contact 53, a circuit is completed to rotate the shaft 30 counterclockwise, and when the switch 54 is thrown to the right onto a contact 52, a circuit is completed to rotate the shaft 30 clockwise.

Referring to Figs. 2 and 4, the automatically controlled switches comprise a selector switch 60 actuated by the shaft 30, and a snap action switch 61 actuated by a cam 62 on the shaft 25. The switch 61 is closed when its plunger 63 is depressed by the cam 62 and opens when the cam releases the plunger.

The selector switch 60 comprises a ring 57 of insulating material supported by a pair of screws 58 and brackets 59 in concentric relations with the shaft 30. This insulating ring supports three contacts 65a, 65b and 65c which cooperate with a contact segment 65 attached to an insulating disc 66 on the shaft 30. The member 66 also carries a pair of conductive segments 67 and 68

adapted to contact other contacts supported on the insulating ring. The segment 65 always contacts the contact 65a, and contacts contact 65c in one extreme position of shaft 30 and contacts contact 65b in the other extreme position. The conductive segment 67 always contacts contact 70 and contacts contact 69 in one extreme position and contacts contact 71 in all positions except said one extreme position. Segment 68 likewise always contacts contact 73, but contacts contact 74 only in extreme clockwise position and contacts contact 72 in all positions except the extreme clockwise position.

The switch arrangement is such that the selector switch 60, together with the manual switch 54, completes a circuit to start the motor running in direction to move the shaft 30 out of its existent position and into its other extreme position, and the snap switch 61 functions to open the circuit to the motor when the latter has moved far enough. This eliminates the interruption by the selector switch 60 of any current-carrying circuit, thereby prolonging the life of the contacts. The snap switch 61 which is of conventional design and need not be described, can be of a type adapted to give long service even though it breaks current of substantial value.

Fig. 5 shows the switch system in the condition existent when the shaft 30 has been moved into extreme counterclockwise position as shown in Figs. 3 and 4. It will be observed that the only circuit from the battery 55 extends through the manual switch 54 and fixed contact 53 to contact 70 and thence through segment 67 to contact 69. A circuit is also completed from contact 69 to one terminal of the snap switch 61 and to the contact 74. However, no current can flow, because the switch 61 has just been opened by the cam 62, and the contact 74 is out of contact with the segment 68. Hence, the motor is de-energized.

Now, assume that it is desired to shift the shaft 30 clockwise into its other extreme position. To do this, the manual switch 54 is thrown onto the contact 52, completing a circuit from the battery 55 to the contact 73 of the selector switch and through segment 68 to contact 72 and thence through the field winding 20b and the armature 20a to ground, starting the motor in such direction as to rotate the shaft 25 counterclockwise and the shaft 30 clockwise. Initial motion of the shaft 25 in counterclockwise direction causes the cam 62 to depress the plunger 63 and close the switch 61. However, this produces no new path for current flow immediately. After clockwise motion of the shaft 30 has continued for some time, however, the segment 68 closes with the contact 74, completing a path for current flow from the contact 73 through segment 68, contact 74, and through the now closed switch 61 to contact 65a and segment 65. By this time, the segment 65 has moved out of contact with contact 65c and into contact with contact 65b completing a new path for current flow to the field winding 20b. Shortly thereafter, the original path for current flow through contact 72 is broken by the movement of segment 68 clear of contact 72. Because of the fact that a parallel circuit is completed through the switch 61 at the time segment 68 leaves contact 72, there is no arcing at the latter contact. The movement continues with current being supplied through contact 73, segment 68, contact 74, switch 61, contact 65a, segment 65, and contact 65b until switch 61 is again opened by the cam 62.

The motor will then be de-energized and will remain de-energized until the manual switch 54 is again thrown to the left into engagement with contact 53. Thereupon a circuit will be completed from contact 53 through contact 70, segment 67 and contact 71 through the motor field 20c and armature 20a, to start the motor in the reverse direction, which motion will continue until the parts again reach the position shown in Figs. 4 and 5.

An additional advantage of employing the cam-actuated switch 61 in conjunction with the selector switch 60 is that the energization of the motor can be maintained until after the pin 38 has left the slot 39b, thereby positively assuring full movement of the sector 39 and the shaft 30. Obviously, if switches actuated by movement of the shaft 30 alone were employed, the contacts that stop the motor would have to be opened slightly before the shaft 30 reaches its end position, and the momentum of the motor would have to be relied upon to carry the segment 39 into its final position.

It is apparent that the feature of the invention involving the deep recesses 39c and 39d, for enabling contact of the disk 37 with the shoulders at both ends of one of the recesses at the time the pin 38 leaves the slot 39b, is not limited to the two-position reversible mechanism, which is shown for purpose of illustration. This feature is equally well adapted for use in systems having more than two positions of the driven member and in systems which are not reversible. Likewise, the use of the auxiliary switch 61 actuated by the driving shaft is useful in unidirectional systems and systems having more than two positions of the driven member.

Obviously, the construction of the selector switch 60 would have to be modified in a system having more than two positions, but such modification is well within the capabilities of those still in the art.

Various other departures from the exact construction shown can be made without departing from the invention which is to be limited only to the extent set forth in the appended claims.

I claim:

1. A mechanism of the type described comprising: a casing having first and second opposed walls; first and second parallel shafts extending between and journaled in said walls, said second shaft extending through said first wall for connection to a device to be actuated; a gear train for rotating said first shaft comprising intermeshed gears on said shafts and including a final driven gear on said first shaft; a third wall interconnecting said first and second walls; a motor mounted against the outer surface of said third wall and having a shaft extending through said third wall into said casing, with gear means on said shaft engaging a gear of said gear train for driving it; a crank pin and a concentrically positioned disk extending axially from one face of said final gear, said disk having a recess in its rim adjacent said crank pin; a sector secured to said second shaft and having a radial slot adapted to be engaged by said crank pin and having recesses in its rim on each side of said slot adapted to receive said disk for locking said sector when said crank pin is out of engagement with said slot and cooperating with the recess in said disk to permit movement of the sector by the crank pin when the latter is positioned in said slot.

2. A mechanism of the type described com-

prising: a casing having first and second opposed walls; first and second parallel shafts extending between and journaled in said walls, said second shaft extending through said first wall for connection to a device to be actuated; a gear train for rotating said first shaft comprising intermeshed gears on said shafts and including a final driven gear on said first shaft; a third wall interconnecting said first and second walls; a motor mounted against the outer surface of said third wall and having a shaft extending through said third wall into said casing, with gear means on said shaft engaging a gear of said gear train for driving it; a crank pin and a concentrically positioned disk extending axially from one face of said final gear, said disk having a recess in its rim adjacent said crank pin; a sector secured to said second shaft and having a radial slot adapted to be engaged by said crank pin and having recesses in its rim on each side of said slot adapted to receive said disk for locking said sector when said crank pin is out of engagement with said slot and cooperating with the recess in said disk to permit movement of the sector by the crank pin when the latter is positioned in said slot; additional wall means exterior of said second wall and defining therewith an auxiliary chamber, said second shaft projecting into said auxiliary chamber, and switch means in said auxiliary chamber actuated by said second shaft for opening the circuit of said motor when said sector moves into locked position.

3. A mechanism of the type described comprising: a casing and first and second parallel shafts within said casing; a reversible electric motor; a concentrically positioned disk on said first shaft having a recess in its rim; and means coupling said disk to said motor for rotation thereby; a crank pin connected to said disk in radially outwardly spaced relation with respect to the recess in said disk; a sector secured to said second shaft in the plane of said disk and crank pin and having a radial slot adapted to be engaged by said crank pin and having recesses in its rim on opposite sides of said slot, said recesses being adapted to receive said disk for locking said sector when said crank pin is out of engagement with said slot, and cooperating with the recess in said disk to permit movement of the sector by the crank pin when the latter is positioned in said slot; switch means actuated by said second shaft comprising two pairs of contacts and means actuated by said second shaft for closing one pair of contacts in all positions of said sector save one extreme position thereof and closing the other pair of contacts in all positions of said sector save the other extreme position thereof, and means for supplying current through said first pair of contacts for driving said motor in one direction and separate means for supplying current through said second pair of contacts to drive said motor in the other direction.

4. A mechanism of the type described comprising: a casing having first and second opposed walls; first and second parallel shafts extending between and journaled in said walls, said second shaft extending through said first wall for connection to a device to be actuated; a gear train for rotating said first shaft comprising intermeshed gears on said shafts and including a final driven gear on said first shaft; a third wall interconnecting said first and second walls; a motor mounted against the outer surface of said third wall and having a shaft extending through said third wall into said casing, with gear means

on said shaft engaging a gear of said gear train for driving it; a crank pin and a concentrically positioned disk extending axially from one face of said final gear, said disk having a recess in its rim adjacent said crank pin; a sector secured to said second shaft and having a radial slot adapted to be engaged by said crank pin and having recesses in its rim on each side of said slot adapted to receive said disk for locking said sector when said crank pin is out of engagement with said slot and cooperating with the recess in said disk to permit movement of the sector by the crank pin when the latter is positioned in said slot, said sector having an edge portion of the same axial thickness as said disk cooperating with said disk, and a radially projecting flange portion adapted to overlap said disk and extend the length of said slot, and said pin being of greater axial dimension than said disk for engagement with that portion of said slot extending through said flange.

5. A mechanism of the type described comprising: rotary driving and driven members having spaced-apart, parallel axes of rotation, the driven member having a radial slot and the driving member having a pin element adapted to move into and out of said slot and rock said driven member through a fixed angle in response to rotation of said driving member, and means for locking said driven member against angular motion while said pin is out of said slot, said locking means comprising interengaging disk elements on said driving and driven shafts, said disk elements having peripheral recesses therein interengaging with each other to permit rotation of said driven member and said driving member when said pin is in said slot, the recess in the disk element of said driven member being relatively deep with respect to the curvature of the disk on said driving member, whereby the latter contacts the disk element on the driven member only at the ends of the recess in the latter, said disk elements being so dimensioned and positioned that the disk element on the driving member contacts the disk element on the driven member at both ends of the recess therein substantially simultaneously with departure of said pin from said slot.

6. In a mechanism of the type described, driving and driven members rotatable about spaced, parallel axes, and a Geneva mechanism intercoupling said members, said Geneva mechanism comprising: a radially slotted element on the driven member, a pin element on the driving member adapted to enter and then leave said slot in response to rotation of the driving member and rotate the driven member through a fixed angle while said pin engages said slot, a recessed disk element on the driving member and a recessed element on the driven member, the recess in said recessed element defining a pair of spaced shoulders adapted to be engaged by said disk element in response to rotation of said driven member sufficient to carry said pin out of said slot, and said recess being of such depth as to provide substantial clearance with said disk element when the latter engages said shoulders, said disk and recessed element being so proportioned and oriented with respect to said pin and slot that said disk element is in engagement with both said shoulders when said pin element is out of engagement with said slot.

7. A mechanism of the type described comprising: rotary, driving, and driven elements rotatable about spaced, parallel axes, a pin element

eccentrically disposed on said driving element, a radially slotted element on said driven member adapted to be engaged by said pin element and rotated thereby through a fixed angle in response to rotation of said driving member, said driven member having a recess in its periphery angularly spaced from said slot and defining a pair of shoulders of equal radius less than the radius of the outer end of said slot, a disk element on said driving member of radius such as to engage both said shoulders when the latter are symmetrically disposed on opposite sides of the plane of said axes, said disk having a recess for passing one of said shoulders during rotation of said driven member by said pin element and said recess that defines said shoulders being of such depth as to permit rotation of said disk element into engagement with both said shoulders during driving engagement of said pin element with said slotted member.

8. A mechanism of the type described comprising: rotatable driving and driven members, and a Geneva mechanism intercoupling them for rotating said driven member through a fixed angular distance between two predetermined positions in response to successive rotation of said driving member in opposite directions, said driving member having a range of free movement beyond said predetermined positions of said driven member, a reversible electric motor connected to said driving member for driving it, said motor having one circuit for rotating it in one direction and another circuit for rotating it in the opposite direction, a selector switch actuated by said driven member to open and close contacts according to the position of the driven member, a source of energizing current, a master switch for selectively completing either one of two energizing paths to said selector switch, an auxiliary switch, said selector switch including contact means for closing a first circuit from one of said paths directly to one motor circuit and closing a second circuit from said other path through said auxiliary switch to the other motor circuit while said driven member is in a first range of movement extending from one predetermined position, said selector switch including contact means for closing

ing a third circuit from the other of said paths directly to the other motor circuit and closing a fourth circuit from said one path through said auxiliary switch to said one motor circuit while said driven member is in a second range of movement extending from the other predetermined position and overlapping said first range, and means driven directly by said driving member for closing said auxiliary switch during movement of the driving member throughout its driving engagement with said driven member whereby said auxiliary switch always interrupts the energizing circuit of the motor at completion of movement of said driven member in either direction.

9. A mechanism of the type described comprising: rotary driving and driven members having spaced-apart parallel axes of rotation; cooperating means on said driving and driven members for rotating said driven member through a fixed angle in response to rotation of the driving member between two predetermined angular positions; and means for locking said driven member against angular motion while said driving member is beyond one of its said predetermined angular positions, said locking means comprising cooperating elements on said driving and said driven members; the element on said driven member having a pair of arcuately-spaced shoulders of the same radius and the element on the driving member having an arcuate surface concentric with respect to its axis and of radius and arcuate length such as to simultaneously engage both said shoulders during rotation of said driving member through a predetermined angle beyond said one predetermined angular position, said arcuate surface terminating abruptly at one end and said element on the driven member having a recess between said shoulders deep relative to the curvature of said arcuate surface; said elements being so oriented relative to said means for rotating said driven member, so that said arcuate surface completes contact with both said shoulders as said driving member completes its movement into its said one angular position.

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