March 30, 1954 R. M. PURDY 2,673,907

CONTROL APPARATUS

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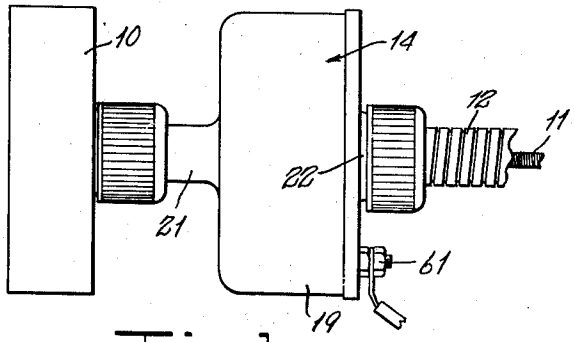


Fig. 1.

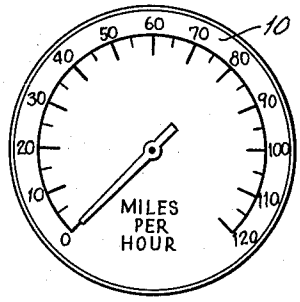


Fig. 2.

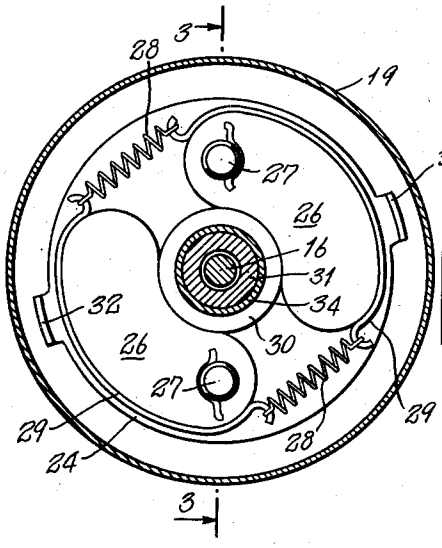


Fig. 4.

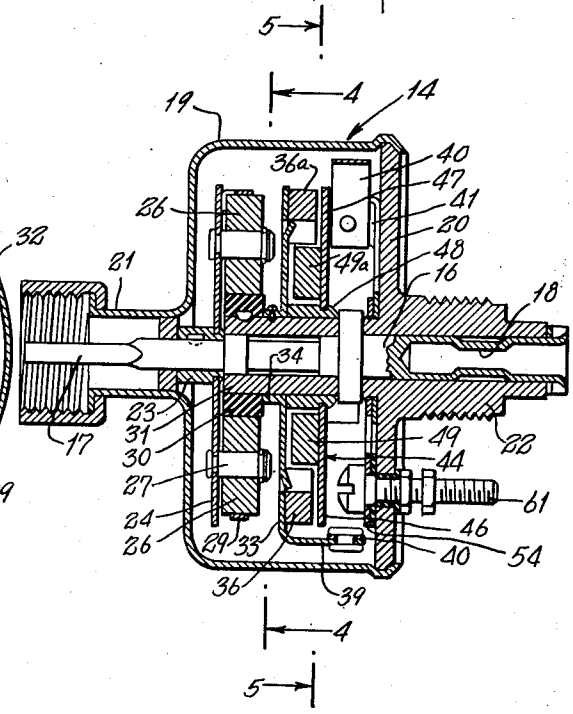


Fig. 3.

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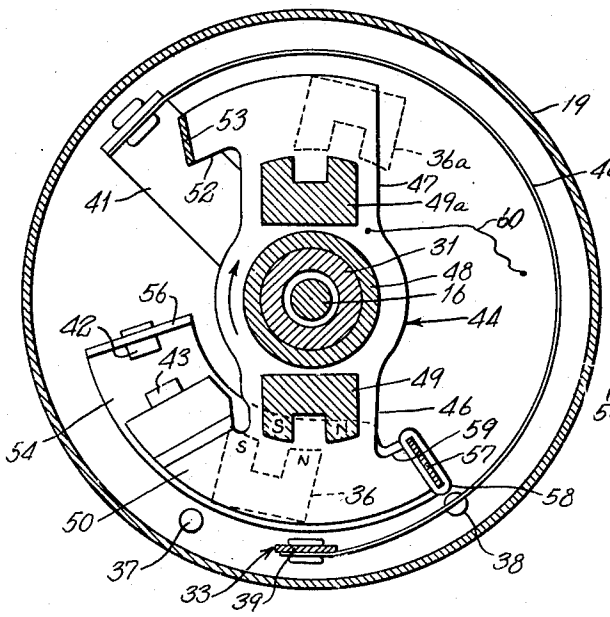


Fig. 5.

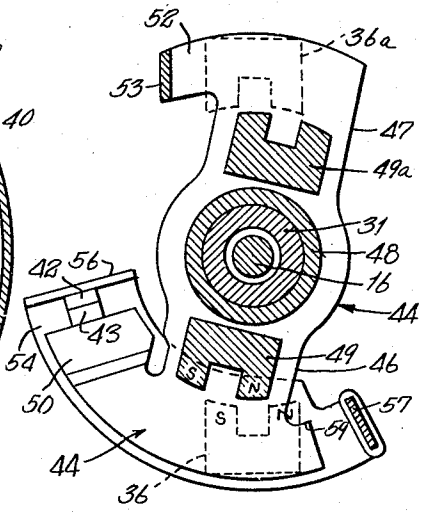


Fig. 6.

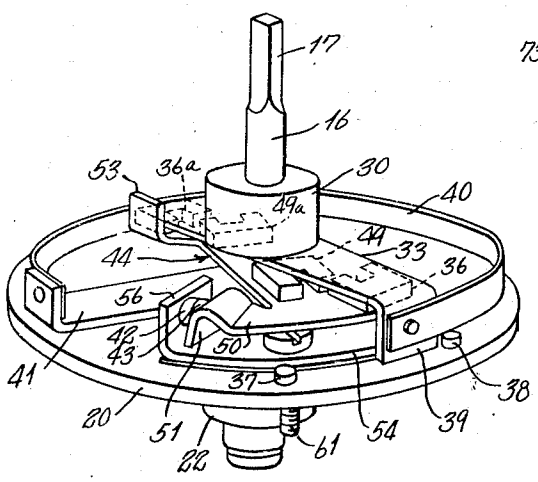


Fig. 7.

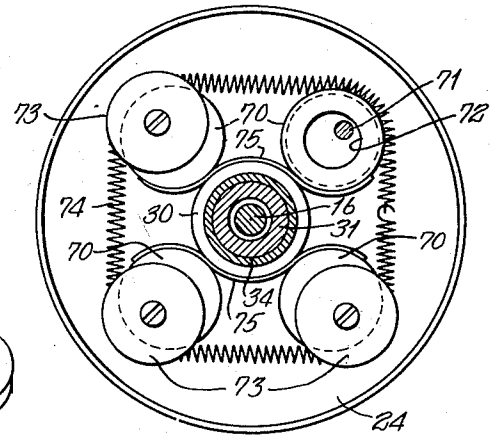


Fig. 8.

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CONTROL APPARATUS

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This invention relates to control apparatus and more particularly to devices embodying means responsive to variations in the speed of a rotating part for controlling and operating other devices.

One of the objects of the present invention is to provide novel apparatus combined in a new and advantageous manner with the speedometer of a motor vehicle for controlling a selected means on the vehicle in accordance with the speed of the latter.

Another object of the invention is to provide apparatus of the above character wherein a novelly constructed circuit breaker unit having a through shaft is operatively interposed between the speedometer and the usual drive shaft for the latter and is responsive to the speed of said shaft.

Still another object is to provide novel apparatus responsive to changes in speed for controlling the operation of an electrical switch or circuit breaker.

Still another object is to provide apparatus of the above character embodying novel speed responsive means of the centrifugal type.

A further object is to provide a novel toggle or snap-action device which is readily adapted for use as an electrical switch or circuit breaker.

Another object is to provide a novel speed responsive circuit breaker or the like which is adapted to be actuated to one position at a predetermined speed and remain in said position until the speed is decreased a predetermined amount below said first-mentioned speed.

The above and further objects and novel features of the invention will more fully appear from the following detail description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a side elevation view showing one embodiment of the invention adapted for use in controlling the transmission of a vehicle, for example, in accordance with the speed of the vehicle;

Fig. 2 is an end elevation view, taken from the left in Fig. 1;

Fig. 3 is a sectional side elevation view of one type of centrifugally controlled circuit breaker unit adapted for use in the structure shown in

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Fig. 1, the section being taken substantially on line 3—3 of Fig. 4;

Fig. 4 is a transverse sectional view of said unit, taken substantially on line 4—4 of Fig. 3;

Figs. 5 and 6 are transverse sectional views, with some parts omitted from Fig. 6, showing the parts in open circuit and closed circuit position, respectively, the sections being taken substantially on line 5—5 of Fig. 3, but with a pair of magnets to the left of the section line shown by dotted lines;

Fig. 7 is an isometric view of said unit with the casing body and centrifugal weights removed; and

Fig. 8 is an end elevation, with parts broken away and removed and partly in section, showing another form of centrifugal means for controlling the operation of the circuit breaker means.

In the form illustrated in the drawings, by way of example, the present invention comprises means novelly associated with the speedometer of a vehicle, such as an automobile, and adapted for controlling the operation of an electrical switch or circuit maker and breaker in accordance with vehicle speed. The switch may control a circuit to any electrically operated means for controlling the transmission or other functional apparatus on the vehicle (not shown) in a desired manner in accordance with variations in vehicle speed or the speed of some operating part. For example, the control means may be operative to effect shifting of the transmission from one gear ratio to another and back again at different predetermined vehicle speeds. As a more specific example, the present device may effect a shift into so-called over-drive in modern automobiles at one vehicle speed and a shift back to regular drive at a lower predetermined vehicle speed.

As shown in Fig. 1 the novel combination comprehended by the invention comprises a speedometer 10 which may be of the type extensively used on automobiles, trucks and like vehicles, the same being operatively driven from an engine or vehicle driven part (not shown) which rotates at a speed proportional to the speed of the vehicle. The transmission of power from the driving part may be through a flexible shaft 11 housed in a flexible armor 12 and through a novel control unit 14. The latter is provided with a through shaft 16 which is operatively connected at one end to flexible shaft 11 in the same manner that the latter is usually connected with the speedometer itself. For example, the square

end 17 of shaft 16 extends into a squared recess in a rotating part of the speedometer similar to the squared recess 18 in shaft 16 which receives a rigid squared extension on flexible shaft 11.

Control unit 19 embodies novel means which are operable in a predetermined manner in response to the speed of shaft 11, 16 and hence in accordance with the speed of the vehicle when these speeds are proportional. As shown, said unit comprises a casing consisting of a cup-like body 19 and a cover 20 having aligned hollow hub portions 21 and 22, respectively, in which opposite ends of shaft 16 are rotatably journalled. Mounted on shaft 16 inside the casing and for rotation therewith are a hub member 23 and a disk or plate 24 on which one or more (two being shown) weights 26, 26 are pivotally mounted by means of diametrically disposed pivoted pins or stub shafts 27. Centrifugal weights 26 constitute part of a friction type clutch or driving connection between shaft 16 and the novel switch or circuit breaker means to be hereinafter fully described. These weights may be kidney shaped as shown and outward movement thereof in response to contrifugal forces during rotation may be yieldably resisted by suitable resilient means, such as springs 28, 28 stretched between adjacent ends of straps 29, 29 that engage the arcuate surfaces of the weights remote from the shaft. Portions of the inner arcuate surfaces of said weights have the same radius as and are adapted to frictionally engage the periphery of a ring 30 preferably made of material having a high coefficient of friction, such as a clutch or brake lining material or others similar thereto, but metal may be satisfactorily used. It is not essential that the friction between ring 30 and weights 26 be extremely high since the force or torque required to be transmitted therethrough is relatively small, as will hereinafter appear.

Friction ring or band 30 is mounted on a sleeve 31 for angular movement therewith and said sleeve is shown as being mounted on shaft 16 for free angular movement relative thereto. Thus, when weights 26 revolve with shaft 16 while being held in frictional engagement with ring 30 by springs 28, 28, said ring and sleeve tend to rotate with the shaft. However, when said ring and sleeve are held against rotation by stop means or in a manner to be hereinafter described, slippage will occur between the weights and the ring without appreciably interfering with the rotation of shaft 16 which will continue to transmit power to the speedometer 10. When centrifugal forces acting on weights 26 overcome the pressure of springs 28, the weights are moved outwardly upon stretching of the springs at a shaft speed determined by the calibration of the springs. With the clutch thus disengaged, that is, with the weights out of frictional engagement with ring 30, the latter and parts operatively associated therewith are freed to move angularly relative to the shaft 16 in either direction independently of the rotation of the shaft. Outward pivotal movement of weights 26 in response to centrifugal forces may be limited, such as by the right angle extensions 32, 32 on disk 24.

Operatively associated with friction ring 30 and sleeve 31 is a novel toggle or snap-action type switch means and novel actuating means therefor to effect the opening and closing of an electrical circuit. Said switch or circuit breaker means, in the form shown, are in part controlled or actuated magnetically, the actuating means therefor comprising an actuating member or element 33 having diametrically disposed radially extending arms of non-magnetic material connected by a hub portion 34 to ring 30, either directly or indirectly through sleeve 31 for angular movement therewith. Mounted on said arms near the outer ends thereof is a pair of inwardly facing horse shoe magnets 36, 36a. Angular movement of actuating means 33 about the axis of shaft 16 or other pivotal axis is limited by suitable stop means, such as spaced posts 37 and 38 on cover 20, which extend into the path of an axially extending flange or lug 39 at one end of said member. When weights 26 frictionally engage ring 30 at low speeds, thereby frictionally connecting the ring and hence actuating member 33 with the shaft, said member will be moved against one of the stops 37 or 38, depending upon the direction of rotation of the shaft. If the direction of shaft rotation is clockwise, as viewed in Fig. 5, member 33, 39 will move into engagement with stop 37. Suitable resilient means may be provided for normally urging the end 39 of member 33 in the opposite direction toward the other stop 38. Said resilient means, as shown, comprises a leaf spring 40 which is secured at one end to extension 39 and at the other end to a bracket 41 stationarily mounted on cover 20 in any suitable manner.

The switch means or circuit breaker, in the specific form shown, includes a pair of separable contact points 42 and 43, the first being fixed and the second being carried by a snap-action member 44 angularly movable relative to the shaft and comprising diametrically disposed arms 46, 47 and a hub 48 loosely mounted on sleeve 31 for angular movement relative thereto. Mounted on said arms on opposite sides of the shaft and facing outwardly therefrom in coacting relation to magnets 36, 36a are a pair of horse shoe magnets 49, 49a. Inasmuch as only one pair of coacting magnets 36, 49 or 36a, 49a is required, the description will proceed by referring to only one such pair, the other pair being merely cumulative. When the magnets 36, 49 are in radial alignment the south poles S thereof are adjacent and the north poles N are likewise adjacent so that each magnet tends to repel the other. If one magnet is moved slightly to the right or left from such aligned position, the other magnet will be snapped to the left or right, respectively, by the resultant magnetic forces of attraction and repulsion. It is this functioning of the magnets which provides the so-called toggle or snap-action movement of the movable contact carrying member 44 from its limiting position against either stop 56 or 57 to its limiting position against the other.

At the outer end of arm 46 of member 44, there is a circumferentially extending portion 50 that terminates in a bent-over end 51 (Fig. 7) on which contact 43 is mounted. For a purpose to hereinafter appear, the other arm 47 of the contact carrying or toggle member has thereon a circumferential extension 52, the end portion 53 of which is bent at right angles into the path of actuating member 33. Mounted in a fixed position on the inner face of cover 20 and insulated therefrom and from ground, is an arcuate strap 54 the end portions of which are bent inwardly from the cover to form a support 56 for fixed contact 42 and a stop 57 which limits angular movement of movable contact carrying member 44 in a counter-clockwise direction, as viewed in Fig. 5. Movement of member 44 in the other direction is limited by contact 42 and support 56. Suitable

insulating means, such as a sleeve 58, are provided for preventing electrical contact between extension 59 on member 44 and contact carrying strap 54 when the contact points 42, 43 are out of engagement. Member 44 and hence movable contact 43 are preferably connected to ground through the shaft and casing. If desired, a more positive connection to the casing may be effected by means of a light flexible conductive pigtail 60 (Fig. 5) secured to member 44 and cover 20. Contact supporting strap 54 may be electrically connected with a terminal 61 which extends through cover 20 and is suitably insulated therefrom. An electrical circuit may be completed from said terminal through a solenoid (not shown) or to another electrically operated device or prime mover which may, for example, operate or control the shifting of gears in the transmission of an automobile.

In operation, shaft 16 is driven by flexible shaft 11 which is in turn driven in any known manner, such as by a part of the vehicle, at an angular speed proportional to the linear speed of the vehicle. Shaft 16 transmits the power or torque directly to speedometer 10, which in turn operates to indicate the vehicle speed in a known manner on a calibrated dial. Disk 24 and weights 26, 26 rotate with the shaft in the direction of the arrow, clockwise as viewed in Fig. 5. At low speeds, weights 26 frictionally engage ring 30 under the pressure of springs 28 and hence switch actuating arm 33 with its magnets 36, 36a are moved clockwise into engagement with stop 37 as illustrated in Fig. 5. The actuating arm is held in that position by the torque transmitted thereto from shaft 16 through the friction clutch 26, 30. In this limiting position, the radial center line or transverse axis of magnet 36 will be coincident with or slightly nearer to fixed contact 42 than is the corresponding center line or axis of magnet 49 when the contacts are in engagement. Accordingly, contact carrying member 44 being free to move angularly relative to the shaft will move with a snap action from contact engaged position to the other limiting position thereof determined by stop 57, 58. This snap action is imparted by the reactions of the magnetic fields of magnets 36 and 49, thereby disengaging contacts 42, 43. With the parts in this position (Fig. 5), it will be seen that the north pole of magnet 36 is repelling the north pole and attracting the south pole of magnet 49 toward the right (as viewed in Fig. 5) and that the south pole of magnet 36 is repelling the south pole of magnet 49 toward the right. Thus, the overwhelming resultant magnetic force of the cooperating magnets tends to move and hold magnet 49 and hence member 49 to the right (counter-clockwise) when member 33 is held in its left-most position in engagement with stop 37 against the efforts of spring 49 which is then in tension.

At a predetermined vehicle speed, let us say at about 23 miles per hour by way of example, the centrifugal forces acting on weights 26 will overcome the pressure exerted by springs 28, as well as any friction or other forces tending to restrict outward pivotal movement of said weights on pivots 27, and said weights will pivot outwardly into engagement with stops 32 and out of engagement with ring 30 thereby disengaging the clutch. Actuating arm 33 is thus released from the shaft and is promptly moved in a counter-clockwise direction (Figs. 5 and 6) by spring 49, thereby moving magnet 36 to a position directly below or slightly to the right of the position then occupied by magnet 49. This will result in a reversal of the resultant magnetic forces and magnet 49, together with contact carrying arm 44, will be snapped back to the left (counter-clockwise) to its limiting position. This will bring the parts to the positions illustrated in Fig. 6 with contacts 42, 43 in engagement to close the control circuit.

This condition will continue to exist as long as the speed is high enough to create sufficient centrifugal force to hold weights 26 out of frictional engagement with ring 30. If the speed of the vehicle and hence shaft 16 decreases, inward movement of weights 26 will not be effected until the centrifugal forces acting thereon and the other forces, such as friction, tending to prevent such inward movement are exceeded by the force of springs 28. These springs are so regulated in the light of the other pertinent forces that such inward movement of the weights is effected at some predetermined lower vehicle speed, such as 23 miles per hour. When this condition is reached and weights 26 move inwardly to again engage ring 30, actuating member 33 will again be moved in a clockwise direction into engagement with stop 37 and contact carrying member 44 will be magnetically snapped in the opposite or counter-clockwise direction to the position shown in Fig. 5, as previously explained. This condition will persist until the speed of the vehicle is again increased to 23 miles per hour or other speed for which the device may be calibrated.

If shaft 16 is rotated slowly in the opposite direction, i. e., counter-clockwise as viewed in Fig. 5, the torque transmitted to actuating member 33, such as when a vehicle is backing at slow speed, will move the said member in the same direction, i. e., counter-clockwise, from the low speed forward position shown in Fig. 5. When the magnet 36 on member 33 reaches the position shown in Fig. 6, contact carrying member 44 will be snapped by the coacting magnetic forces of magnets 36 and 49 in a counter-clockwise direction, thereby moving contact 43 toward engagement with contact 42 in the manner heretofore explained. This may not be a desirable condition. Accordingly, upon continued movement (counter-clockwise) the upper arm of member 33 engages the inwardly bent extension 53 of contact carrying member 44. Continued counter-clockwise movement of member 33 is then transmitted to member 44 so that the latter is also moved in a counter-clockwise direction until it engages stop 57 or at least until member 33, 39 engages post 38. With the parts in that position the contacts will be disengaged.

In Fig. 8 there is illustrated a modified form of centrifugal clutch which may be used in carrying out the present invention. This embodiment comprises a plurality of centrifugal weights 70 loosely mounted on pins 71 anchored in disk 24. The weights have central openings 72 somewhat larger than the diameter of pins 71 for receiving the latter and are positioned loosely on the pins by flanges or plates 73 secured to the ends of the pins. An endless coil spring 74 surrounds weights 70 and yieldably presses the same against ring 30 to effect a friction connection between shaft 16 and said ring which will serve to transmit torque to switch actuating member 33 in the same manner and for the same purpose described above. When centrifugal forces move weights 70 out of engagement with ring 30 against the pressure of spring 74 the switch parts will function in the manner hereinabove fully described. If desired, some waved

metal straps 75, 75 may be interposed between ring 30 and weights 70 so that the latter will not be caused to rotate with respect to pins 71 when revolving with shaft 16. The straps also greatly increase the area of contact with ring 30 and therefore the friction connection.

Although only a limited number of embodiments of the invention are shown in the drawings and described in detail in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. For example, the sleeve 31 may be dispensed with and member 33 may be formed integrally with or connected directly to ring 30. Additionally, the snap-action member 44 need not be supported on shaft 16 but may be mounted on a stationary part of the control unit and the pivotal mounting thereof may be either concentric with or eccentric with respect to the axis of the shaft. Likewise, the magnets may be of other than the horseshoe shape shown, such as straight bar magnets or the like, and snap-action member 44 may be used for closing different circuits when it is in its two limiting positions or the same may be used for a purpose other than controlling one or more electrical circuits. Various other changes may also be made in the design and arrangement of parts illustrated as well as in the materials suggested without departing from the spirit and scope of the invention as it will now be understood by those skilled in the art.

What is claimed is:

1. In apparatus of the class described, a casing, a rotatable shaft journalled in and extending through opposed sides of said casing, a member pivotally mounted within said casing, spaced stops on the casing for limiting angular movement of said pivoted member, means including a pivotally mounted element for yieldably holding said member against one or the other of said stops and for moving said member with a snap action from a position of engagement with either of said stops into a position of engagement with the other of said stops, said member and element being pivotally mounted for limited angular movement about the axis of said shaft, and means mounted on the shaft in said casing for controlling the movement of said element.

2. In apparatus of the class described, a rotatable shaft, means including a member pivotally supported for limited angular movement about the axis of rotation of said shaft between two extreme positions, means including an element pivotally supported for limited angular movement about the axis of said shaft for moving said member from either of said positions to the other with a snap-action, and means mounted on said shaft for actuating said element.

3. In apparatus of the class described, rotatable means, electrical circuit breaker means, means including a member having limited angular movement about the axis of said rotatable means for controlling the operation of said circuit breaker means, said member being mounted for angular movement relative to a movable part of said circuit breaker means, said movable part being angularly movable about said axis, a magnetic coupling yieldably connecting said member with said movable part, friction clutch means for drivably connecting said rotatable means and said member to effect angular movement of said member in one direction, said clutch means including speed responsive mechanism for disengaging the same, and resilient means for actuating said member in the other direction when the clutch means is disengaged.

4. In apparatus of the class described, a member mounted for limited movement between two positions, actuating means for causing said member to move with a snap-action movement from either of said positions to the other, and control means for controlling the operation of said actuating means, the latter including an element, the movement of which in one direction is controlled by said control means, resilient means for effecting movement of said element in the other direction and magnetic means for effecting said snap-action movement of said member, and said control means including friction clutch means for imparting torque to said element in opposition to said resilient means.

5. In apparatus of the class described, a support, a rotatable shaft mounted on said support, a member mounted for pivotal movement about an axis parallel to the axis of rotation of said shaft, means for restricting the pivotal movement of said member to movement between two limiting positions, means including an element mounted for limited pivotal movement about an axis parallel to the axis of rotation of said shaft and between two limiting positions, a magnetic coupling operatively connecting said member and element for yieldably holding said member in one or the other of its limiting positions and for moving said member with a snap-action from either one of its limiting positions to its other limiting position, resilient means for normally maintaining said element in one of its limiting positions, and means for yieldably coupling said element to said shaft for moving the element to its other limiting position against the force of said resilient means.

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