June 15, 1954 W. J. SPENGLER 2,680,969

GOVERNOR WITH OVER-CENTER SPRING SNAP-ACTION OUTPUT

Filed May 26, 1950

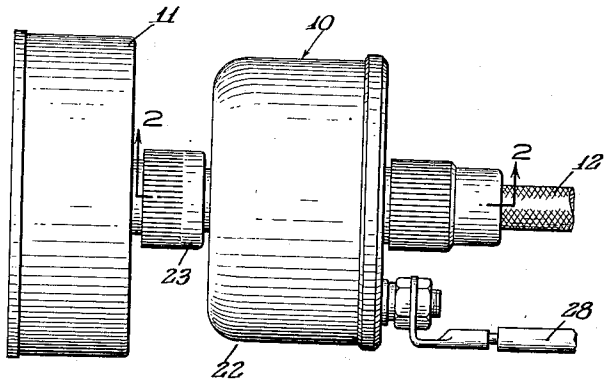


FIG. 1.

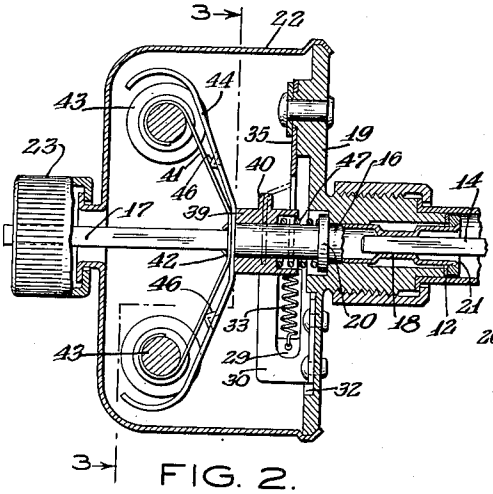


FIG. 2.

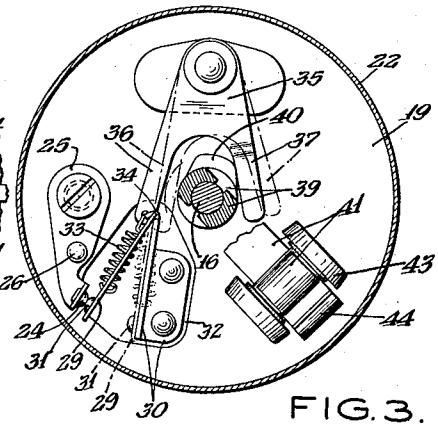


FIG. 3.

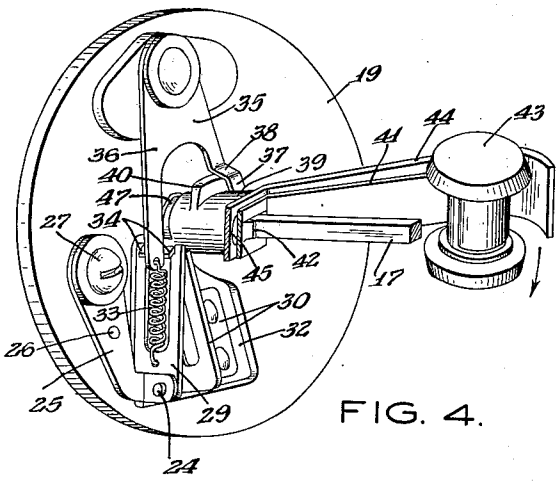


FIG. 4.

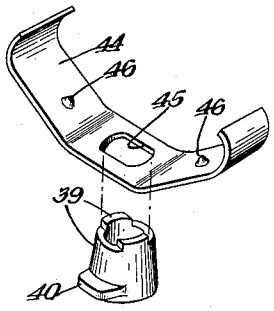


FIG. 5.

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Patented June 15, 1954

2,680,969

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2,680,969

GOVERNOR WITH OVER-CENTER SPRING SNAP-ACTION OUTPUT

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Application May 26, 1950, Serial No. 164,553

2 Claims. (Cl. 74—54)

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This invention relates to speed responsive control apparatus and more particularly to centrifugally controlled toggle or snap-action devices such as electrical switches or the like.

One of the objects of the present invention is to provide apparatus embodying novel means for controlling the operation of a toggle or snap-action device in accordance with the angular speed of a rotating part.

Another object of the invention is to provide novel means for actuating and centrifugally controlling an electrical circuit making and breaking device.

A further object is to provide novel means and apparatus of the above character which comprises only a small number of light and simply constructed parts adapted to be assembled in a relatively small space.

Still another object is to provide a novel speed responsive device which may be combined in a novel manner with a rotating shaft whereby the latter extends through the device for the transmission of power.

A still further object is to provide novel circuit breaker mechanism which is so constructed as to automatically open or close an electrical circuit at a predetermined speed on acceleration and to close or open said circuit at a different or lesser speed on deceleration.

Another object is to provide a centrifugally operated electrical circuit make and break device which takes full advantage of the small amount of centrifugal force required to thereby reduce the size and weight of the device without sacrificing essential strength, efficiency or dependability.

Another object is to provide novel electrical circuit breaker mechanism which lends itself readily to actuation by centrifugally responsive means and is so constructed that no brushes or the like are required for making necessary electrical connections.

Another object of the invention is to provide novel apparatus which may be combined with the speedometer of a motor vehicle for controlling a selected means on the vehicle in accordance with the speed of the latter.

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 drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and is not intended as a definition of the limits of the invention.

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In the drawing, 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 a sectional side elevation view of one type of centrifugally controlled circuit breaker unit, adapted for use in the structure shown in Fig. 1, the section being taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view with parts broken away, the section being taken substantially on line 3—3 of Fig. 2;

Fig. 4 is an isometric view, partly in section and with parts broken away, the view being taken from the left in Fig. 2 with the casing cover removed; and

Fig. 5 is a detail exploded isometric view of some of the parts of said unit.

The single embodiment of the invention illustrated in the drawing, by way of example, is in the form of a control unit adapted for use in conjunction with the speedometer of a motor vehicle or the like to control the operation of an electrical switch in accordance with the speed of the vehicle. The switch may, for example, control a circuit to an electrically operated means for controlling the transmission or other functional apparatus on the vehicle (not shown) in a desired manner and in accordance with variations in vehicle speed. 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 overdrive in modern automobiles at one vehicle speed and a shift back to regular drive at a lower predetermined vehicle speed. The unit may, of course, be operatively associated with any other rotating part to effect control in accordance with the speed of rotation of the part.

As shown in Fig. 1 the novel control unit 10 is operatively associated with a speedometer 11 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 14 housed in a flexible armor 12 and through the novel control

unit. The latter is provided with a through shaft 16 which is operatively connected at one end to the flexible driving shaft 14 in the same manner that the latter is usually connected with the speedometer itself. For example, the square end of the driving shaft extends into a squared recess 18 in shaft 16 and the square end 17 of shaft 16 extends into a squared recess in a rotating part of a speedometer in the usual manner.

As shown in Figs. 1 to 3, the control unit 10 comprises the rotating shaft 16—18 which is journalled in a flanged stationary supporting member 19. Axial movement of the shaft relative to the support may be prevented by providing a collar 20 on the shaft and flaring the hollow end thereof as shown at 21. The operating parts may be enclosed by a cup-shaped cover or casing member 22 which may be removably secured to flanged support 19 and to the speedometer casing by a nut 23 surrounding shaft 17.

The snap-action device or switch embodied in the present invention consists wholly of non-rotatable parts and in the specific form shown, by way of example, comprises a stationary contact 24 on a bracket 25 of electrically conductive material. The latter is mounted on and suitably insulated from support member 19 by means including a rivet 26 and a terminal screw 27 which extends through the support for connection with a lead 28 externally of casing 19, 22. The lead may be part of a circuit including an electrical device such as a solenoid, for example, and a source of electrical energy, such as a battery or other source. A movable contact carrying member 29 carries a contact 31 and is mounted for substantially frictionless pivotal movement relative to the supporting member 19.

For mounting member 29 and for limiting movement thereof in one direction, a bracket 30 is secured to support 19 in some suitable manner, such as by rivets. The supporting member may have a recess 32 therein for this purpose. The end of the upstanding portion of bracket 30 nearest shaft 16 and the corresponding end of contact carrying member 29 are centrally slotted or bifurcated to straddle a spring 33, the function and operation of which will be hereinafter fully described. Any suitable known method of pivotally mounting member 29 on bracket 30 may be used, and as shown the ends 34 of the arms or bifurcations of the bracket are of reduced width and bent to form bites or notches in which the bifurcations or arms of member 29 are loosely received. Lateral movement of said member in the direction of the axis of shaft 16 is prevented by extensions on member 29 which straddle the bent ends 34 in the manner best illustrated in Fig. 4.

Movement of the contact carrying member 29 between its limiting positions against brackets 25 and 30 is effected by spring 33 and a pivoted actuating member 35. The latter is journalled for free pivotal movement about a boss on support 19 and is secured in position by a screw or rivet. The pivotal axes of members 29 and 35 are located on a line which extends between brackets 25 and 30 and hence, between the extreme or stop positions of contact member 29. Member 35 is formed with two arms or bifurcations 36 and 37 that straddle shaft 16, the arm 36 extending into the vicinity of the pivotal axis of member 29 and being connected to the inner end of spring 33. Since the arm 37 is cut off by the section in Fig. 2, the same is illustrated in phantom or dotted lines in said figure in the interest of clarity.

The construction is such that when arm 36 is moved to the full line position illustrated in Figs. 3 and 4, spring 33 will pivot contact member 29 in a clockwise direction, as viewed in Fig. 3, with a quick snap-action and then resiliently press contact 31 into engagement with stationary contact 24. An electrical circuit will thus be completed through said contacts, lead 28, and ground or such other return lead as may be connected to contact 31. When arm 36 is moved to the dotted line position shown in Fig. 3, thereby moving the end of spring 33 to the right and past pivot 34, the line of action of the spring becomes such that toggle member 29 will be snapped to the right in a counter-clockwise direction into engagement (dotted line position) with bracket 30, thereby breaking the circuit at contact 24.

The necessary pivoted movement of forked member 35 is effected in a novel manner in accordance with and in response to the speed of shaft 16 by means rotatable with said shaft and cooperable in a novel way with said member. In the form shown arm 37 has a bend 38 therein so that the end portion thereof adjacent shaft 16 is in a different transverse plane than the corresponding portion of arm 36, i. e., a different plane perpendicular to the axis of rotation of the shaft. Surrounding an enlarged portion of shaft 16 adjacent support member 19 is a sleeve 39 which has a cam lobe or lug 40 projecting from the outer surface thereof for cooperation with lever arms 36 and 37 in a manner to hereinafter more fully appear.

Suitable means are provided for causing sleeve 39 to rotate with shaft 16 and to move axially thereon in response to the speed of shaft 16. As illustrated said means are of the centrifugally actuated type and comprise a leaf spring 41 mounted on shaft 16 for rotation therewith. The driving connection may be effected by providing a rectangular hole in the spring to fit the squared portion 17 of the shaft. Spring 41 may be fixedly or adjustably secured against axial movement on shaft 16 in any suitable known manner, resilient lips or tongues 42 at the ends of the opening in the spring being employed for this purpose in the illustrated embodiment. The tongues resiliently engage the shaft and prevent unintentional or accidental movement of the spring axially away from the shoulder on shaft 16 formed by the enlarged cylindrical portion thereof within sleeve 39. In another suitable embodiment a washer having portions thereof staked or spread into grooves in the shaft is used to secure the spring against said shoulder.

The end portions of spring 41 are inclined away from sleeve 39, the same making an acute angle with the axis of shaft rotation. A loop or bight is formed at each end of spring 41 for resiliently gripping and supporting a flanged or spool-like weight member 43. Thus, when the shaft rotates with spring 41 and weights 43, centrifugal force which is proportional to speed tends to throw the weights away from the axis of rotation and hence, to bend the ends of the spring 41 to the right, as viewed in Fig. 2, toward a position perpendicular to said axis. Adjustments to get desired operation may be readily made by bending spring 41 to change the initial angle of the arms thereof. Similar results may be effected by increasing or decreasing the mass of weights 43.

This motion, which is thus centrifugally imparted to spring 41, and the rotary movement thereof are transmitted to cam sleeve 39 through a rigid member 44 having oppositely extending inclined arms. The latter are preferably spaced a short distance from the corresponding arms of spring 41 and extend between the flanges of weight members 43, whereby the rotary movement of the shaft is imparted to motion transmitting member 44 through spring 41 and weights 43. The central flat portion of member 44 has an oblong opening 45 (Figs. 4 and 5) and the end of sleeve 39 has portions thereof cut away (Fig. 5) to make it fit into said oblong opening and thereby effect a rotary driving connection between member 44 and sleeve 39.

The rigid arms of member 44 operatively engage the inclined ends of spring 41 so that flexing of the latter in response to centrifugal force will move member 44 and hence sleeve 39 axially along shaft 16. Such engagement or its equivalent may be effected in various ways, such as by pressing a bead 46 in each of said arms to make substantially point contact with the spring and hence minimize friction. The outer or free ends of rigid arms 44, 44 may be curved as best seen in Fig. 2 to limit the movement of weights 43, 43 radially from the shaft.

It will thus be seen that as the arms of spring 41 are flexed in response to centrifugal force, member 44 and sleeve 39 will be moved bodily to the right (Fig. 2). This axial movement of sleeve 39 is yieldably resisted by suitable resilient means such as a coil spring 47 (Fig. 2) surrounding shaft 16 between collar 20 and an internal shoulder in sleeve 39. Beads 46 may be replaced by adjustable set screws or the like in arms 44, whereby the speed at which spring 41 will engage and start to move member 44 may be readily varied or adjusted. Adjustment could also be effected by providing means to change the initial compression of spring 47.

When the parts are at rest or rotating at slow speed, spring 47 urges sleeve 39 and member 44 to the illustrated position against spring 41 which acts as a stop. In this position, cam lobe 40 is in the plane of arm 37 so that upon rotation of the shaft, members 35 and 29 will assume their dotted line position (Fig. 3), that is, open circuit position. As the speed of the shaft increases, sleeve 39 is moved axially toward support 19 in response to centrifugal force, until cam lobe 40 moves into the plane of toggle arm 36 and moves the latter away from the axis of rotation to effect a snap-action of contact member 29 into circuit closing position (full line, Fig. 4) as heretofore described. The angle between arms 36 and 37 and the location of the snap-action device on support 19 is such that when the member 35 is in full line position (Fig. 3) the arm 36 will be out of reach of the rotating cam lobe 40 and arm 37 will be sufficiently close to sleeve 39 to be engageable by the lobe when it moves into the same plane therewith. Likewise, when the cam lobe has moved fork lever 35 to dotted line position (Fig. 3) the parts will be held by spring 33 so that arm 37 will be out of reach of the cam lobe and arm 36 will be close to the sleeve for engagement by the lobe when it is moved into the same plane.

As will be understood by those skilled in the art, the characteristics of the resilient means 41 and 47 which oppose the centrifugal force in this device may be such that the axial movement of sleeve 39 will be gradual as the rotary speed increases. On the other hand, said characteristics

may be such that when the initial tension or force of the springs is overcome by centrifugal force, the sleeve will move rapidly to its other extreme position without further appreciable increase in speed. In either event, the parts may be designed and adjusted so that sleeve 39 will move lobe 40 into the plane of arm 36 at a predetermined or selected speed of shaft 16 and back into the plane of arm 37 when the shaft has been slowed to a predetermined or selected lower speed. The switch 24, 31 is accordingly closed at a predetermined speed of shaft 16 and remains closed at all higher speeds and until the speed is reduced to a predetermined lower speed. It is of course clearly apparent that the switch may be opened at the higher speed and caused to close at the predetermined lower speed, either by reversing the planes of levers 36 and 37, or by changing the electrical connections.

The novel speed responsive means for imparting axial movement to sleeve 39 is claimed in application Serial No. 164,552 of Rolland M. Purdy and Harald Mainusch for "Centrifugal Speed Responsive Apparatus Having Spring Supported Weights" filed May 26, 1950.

Although only a limited number of embodiments or modifications of the invention are illustrated in the drawing and described in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. For example, various other known types of centrifugally responsive devices may be employed for actuating sleeve 39 and rotary movement may be imparted to said sleeve directly from shaft 16, such as by a key or land or in any other suitable manner. Other known means may also be provided for securing spring 41 against axial movement on shaft 17. The snap-action or over-center device may, if desired, be utilized for a purpose other than electric switch means. Various other changes may also be made, particularly in the design and arrangement of parts illustrated, without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. In apparatus of the class described, a rotatable member, cam means mounted on said member for rotation therewith and limited axial movement relative thereto, resilient means for yieldably resisting axial movement of said cam means in one direction, centrifugally responsive means on said member for imparting axial movement to said cam means against the resistance of said resilient means, a pivoted bifurcated lever astraddle of said member, the furcations being in axially spaced planes perpendicular to the axis of rotation for individual engagement by said cam means at different speeds of rotation of said member, a snap-action element pivotally mounted for limited angular movement, and a spring under tension connecting said element and the free end of one of said furcations whereby movement of the lever from one predetermined position to another by said cam means renders said spring effective to snap said element from one of its limiting positions to the other.

2. In apparatus of the class described, an over-center spring snap-action device comprising a stationary support having a V-shaped notch therein, a rigid plate-like element pivotally mounted for limited angular movement about an edge thereof engaging said notch as a pivot, normally biased resilient means under tension for yieldably holding said element in one or the other

of its limiting positions and a pivoted bifurcated lever connected to said resilient means for moving the latter to render it effective to move said element from either of said positions to the other with a snap action, the pivotal axis of said lever being spaced from the pivotal axis of said element and on the side thereof remote from the free end of said element, a rotatable shaft, and means responsive to the speed of said shaft for actuating said lever including cam means having a lobe straddled by the furcations of said lever and centrifugally responsive means for axially moving said cam means, whereby said lobe is adapted to selectively engage the furcations of said lever and pivotally move the latter in different directions at different speeds of shaft rotation to effect said movement of the resilient means.

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