Nov. 5, 1957 R. S. WATERS 2,812,401

CENTRIFUGAL ACTUATOR AND SWITCH

Filed May 21, 1954

FIG. 1.

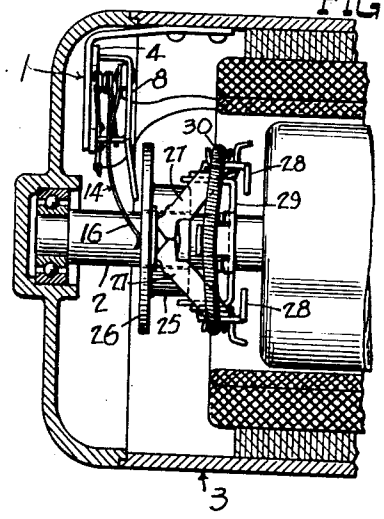


FIG. 2.

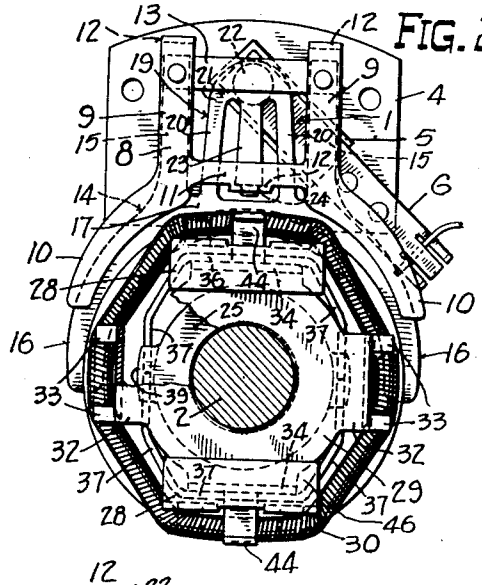


FIG. 3.

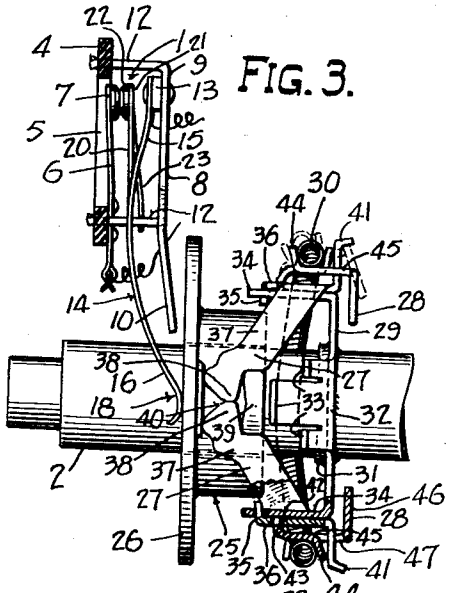


FIG. 4.

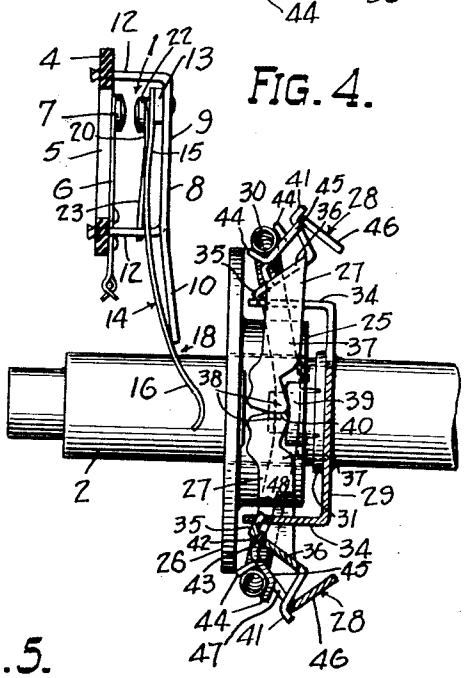
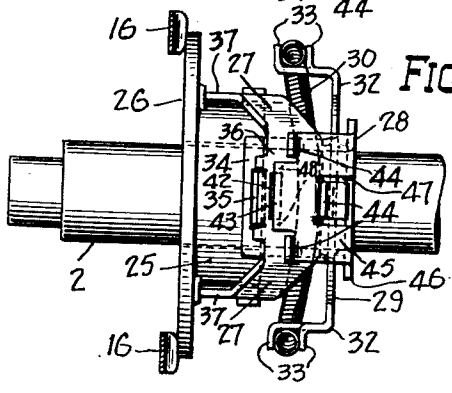


FIG. 5.



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CENTRIFUGAL ACTUATOR AND SWITCH

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8 Claims. (Cl. 200—80)

This invention relates to a centrifugal actuator and switch and more particularly to a centrifugal actuator and switch of the snap-action variety.

Centrifugal actuators for switching are normally of a snap-action variety to provide instantaneous make and break of the switch contacts.

Many present day centrifugal actuators employ a plurality of longitudinal expansive springs biasing the actuator to a non-responsive condition. The springs are generally quite sensitive to cut-out speed and require matching of the various springs. The springs tend to change with age and vary the action of the actuator, to thereby increase maintenance and replacement cost.

The majority of the actuators employ axially expansive switches and mechanism with approximately a ⅛ inch travel. Axially expansive devices have required close tolerances in the mechanism to allow for shaft end play and mounting variations.

To alleviate the above problem, centrifugal devices have been devised in the past which employ a garter-type spring. A garter-type spring makes the device very insensitive to cut-out R. P. M. as generally five or six coils can be removed from the spring without preceptibly changing the cut-out speed.

The snap-action of the switch is obtained by making the centrifugal force increase faster than the increased force of the stretched spring after the initial movement of the actuator.

The actuator of the present invention in general consists of a bracket fixed to a motor shaft and a collar encircling the shaft adjacent the bracket and movable along the shaft to make and break contact with a switch. The movement of the collar is accomplished by a snap-action through a plurality of actuating arms pivoted to the fixed bracket and engaging the collar with the movement of the arms depending upon the rotating speed of the motor shaft. A weight is pivoted to each arm and a garter spring encircles the weights and the arms and normally biases the actuator to a position in contact with the switch to be operated. However, the weights under the centrifugal force created by the speed of the motor shaft pivot the actuating arms outwardly of the motor shaft, when a predetermined speed of the shaft is reached, and move the collar to break the switch contact. An important feature of the invention is that the weights are already in action and have partially overcome the force of the spring before the actuating arms move outwardly and snap the collar along the shaft to break contact with the switch.

When the speed of the shaft is decreased the force of the garter spring on the arms of the actuator snaps the collar into engagement with the switch. The spring approaches over center position relative to the actuating arms after the speed of the shaft has actuated the collar with the result that very little force is exerted by the spring to return the collar to initial position. However, once the speed of the shaft is sufficiently decreased so that the spring overcomes the centrifugal force, the ever increasing returning force of the spring will quickly overcome the arms and weights and snap the actuating collar to switch contact position.

Therefore, the principal object of the present invention is to provide an improved snap-action centrifugal actuator impervious as to cut-out R. P. M., to shaft end play and mounting variations of both the actuator and switch.

The drawing furnished herewith illustrates the best mode presently contemplated of carrying out the invention.

In the drawing:

Figure 1 is a plan view of the actuator and switch applied to a motor;

Fig. 2 is an enlarged end view of the actuator and switch shown in Figure 1;

Fig. 3 is an enlarged view of the actuator and switch in a non-responsive position, partly in section;

Fig. 4 is a view similar to Fig. 3 with the actuator in a responsive position; and

Fig. 5 is another view of the actuator, partly in section.

Referring to the drawing, a switch 1 with which the actuator is illustrated is secured above a motor shaft 2 to the housing of motor 3. Switch 1 comprises a support plate 4 of plastic or other electrically non-conducting material having an oblique opening 5 accommodating a contact strip 6. The contact strip 6 is formed from electrically conducting material and is secured at one end portion to the plate 4 in alignment with the opening 5 so as to provide a resilient support for a contact 7. The contact 7 is secured on the free end of the strip 6 within the opening 5.

A generally H-shaped contact bracket 8 comprises a pair of upper legs 9 and lower legs 10 joined by a bridging truss 11 and is secured in spaced relation to the plate 4 over the opening 5. Three flanges 12 secure the bracket 8 to the plate 4. The flanges 12 are disposed one on each of the ends of the upper legs 10 and one centrally on the bridging truss 11. The lower legs 10 of the bracket 8 are curved outwardly to form an arc with the bridging truss 11, and centrally overlies the motor shaft 2. A cross beam 13 is riveted to the upper legs 9 in an upwardly spaced position from the truss 11 and in alignment with contact 7.

A generally H-shaped leaf-type spring 14 having upper and lower legs 15 and 16, respectively, and a bridging truss 17 is secured between the support plate 4 and bracket 8. The upper legs 15 of the spring 14 are riveted to the upper legs 9 of the bracket 8 by the rivets securing the cross beam 13 to legs 9. The bridging truss 17 of spring 14 is disposed below the level of the bridging truss 11 with the flange 12 on truss 11 passing above the truss 11. The lower legs 16 are curved outwardly to form an arc with the bridging truss 17 disposed centrally over the motor shaft 2. To prevent the legs 16 from passing through legs 10, the lower legs 16 have an outer surface aligned with an inner surface of lower legs 10 of bracket 8. The ends of the lower legs 16 extend below the legs 10 and are turned forwardly of the ends of legs 10 as at 18.

A three-pronged contact carrier 19 extends upwardly from the bridging truss 17 with the two outermost prongs 20 formed integrally with the truss 17. A base 21 of the carrier 19 is in alignment with contact 7 and carries a contact 22. A central prong 23 extends downwardly from base 21 and is secured within an opening 24 in the flange 12. The end of the prong 23 in the opening 24 is forwardly of the bridging truss 17 when the contacts are disengaged. The carrier 19 is bent with respect to truss 17 such that the base 21 of the carrier 19 is biased against the cross beam 13 of bracket 8 and holds the contact 22 disengaged from contact 7.

Switch 1 which is shown for purposes of illustration only is of a snap-action variety. As the upper legs of the spring 14 move toward the plate 4 the outer prongs 20

of carrier 19 move toward the plate 4 and past the end of the center prong 23. Upon passing the center prong 23, the contact carrier snaps toward the plate 4 and the contacts 22 and 7 are moved into engagement.

Since switch 1 is of a snap-action variety, the pressure required to operate the switch is about the same regardless of the relative position of the switch and an actuator to operate the switch. Further, both contacts are mounted on resilient members, giving a wiping action to the contacts each time they are made or broken.

Referring now to the actuator of the invention, movement of the legs 16 of the spring 14 to make or break switch contacts 7 and 22 is accomplished by the sliding actuator collar 25 which encircles motor shaft 2 and is free to move axially of the motor shaft. Collar 25 is provided with a flange 26 which is of a diameter to engage ends 18 of the legs 16 of the leaf spring 14 and the collar is normally in engagement with spring 14 to maintain contacts 7 and 22 closed.

Collar 25 is moved from spring 14 within predetermined limits along the motor shaft 2 by a centrifugal link mechanism comprising a pair of actuating arms 27 and a pair of weights 28 biased toward a fixed rotating bracket 29 by a garter-type spring 30.

The rotating bracket 29 is a generally irregularly shaped disc with a central aperture from which extends a flange 31 that overlies shaft 2. Bracket 29 is pressed onto shaft 2 and rotates therewith.

A spring support extension 32 extends axially from diametrically opposite edges of the rotating bracket 29. Each extension 32 comprises three generally L-shaped fingers 33 disposed to form a channel, opening outwardly, to receive and support garter spring 30, as will be described hereinafter.

Two pivot supports 34 extend axially from bracket 29 at positions diametrically opposite each other and 90° from each of the extensions 32. A slot is provided in the surface of each support 34 forwardly of the actuator relative to the extension 32 and accommodates a stem 35 of an actuating arm 27.

The actuating arms 27 are generally channel-shaped having a base portion 36 adjacent the pivot supports 34 and sides 37 extending forwardly toward the sliding collar 25. The sides 37 are of such length as to provide substantial axial movement of the collar when the arms pivot in response to centrifugal force. In the drawing the travel is shown as approximately 3/8 of an inch. The stem 35 protrudes from a forward edge of the base portion 36 into the slot in the support 34 to permit pivoting of the arms.

The sides 37 of arms 27 are bent outwardly to dispose the ends thereof adjacent the radially outer surface of collar 25. The ends of each of the actuating arms 27 are recessed to provide a lip 38 that extends into the oppositely disposed channel shaped abutments 39 on the periphery of the collar 25. The ends of the arms 27 are curved as at 40 opposite the recessed portion, to allow the ends of arms to pivot on each other within the channel shaped abutments 39 when the arms are actuated to axially move the collar 25 by engagement with abutments 39.

The rearward edge of the base 36 of each arm 27 is provided with an L-shaped lug 41 for engagement by weights 28. A slot 42 in general alignment with the slot in extension 32 to receive the stem 35 of the arm is provided in each arm 27 to receive a pivot stem 43 extending inwardly of the respective weight 28.

The weights 28 are formed with three tabs 44 struck outwardly from a base portion 45 and spaced to form a spring receiving channel and a flange 46 struck inwardly of base 45 and an opening 47 therein and opposite to the location of pivot stem 43. The portion of the weights 28 between the tabs 44 which extends toward the shaft 2 and from which stem 43 projects is undercut to provide shoulders 48 that engage the respective arm 27 when stem 43 is located in the slot in the arm. The opening 47 permits the weight to be located over the lug 41 of arms

27 when stem 43 is inserted into a respective slot to dispose the center tab 44 into engagement with the lug 41 of a respective arm.

As the weights pivot outwardly under ceutrifugal force the back of flange 46 at opening 47 engages the lug 41 and tends to pivot the actuating arm 27 outwardly.

At all times the spring 30 biases the weights to an initial position disengaged from lugs 41. However, due to the construction under centrifugal force exerted by the speed of the shaft the weights initially pivot freely of the arms until they engage lugs 41.

As previously noted the garter spring 30 is disposed within the channels formed by the fingers 33 and tabs 44 on the rotating bracket 29 and weights 28, respectively. The spring 30 normally biases the weights 28 and the actuating arms 27 radially inwardly and the collar 25 axially outwardly of the rotating bracket 29.

When the actuator is in completely retracted position with the weights 28 engaging the lugs and the arms 27 at their outermost position, the spring 30 has passed the point of exerting the greatest tension to collapse the arms. This is due to the fact, as can be observed in Fig. 5, that those portions of the spring engaging weights 28 are withdrawn from the expanded position that they were in when the weights were on the same circumferential line as the channel formed by fingers 33 on extensions 32. Less force is required to hold the collar 25 in retracted position once the final position is obtained. When the speed of the actuator decreases to a predetermined amount, those positions of the spring engaging fingers 33 on extension 32 exert a force greater than the centrifugal force that collapses the arms 27 and closes the switch with a snap action.

The operation of the embodiment of the invention illustrated in the drawing and described above is as follows:

Assume the motor 3 is started and increasing in speed. The switch 1 is closed by the extended collar 25 forcing the lower legs 16 of lead spring 14 forwardly and the contacts 7 and 22 in engagement.

As the motor 3 accelerates, the centrifugal actuator responds to a predetermined speed. As the speed is reached the centrifugal force on the weights overcomes the force of the spring and the weights 28 snap outwardly striking the lugs 41.

The snap action of the weights is obtained as the centrifugal force increases faster than the force of the spring.

At the predetermined speed, the centrifugal force acting on the weights 28 and the arms 27 overcomes the force of the spring 30 and the collar 25 is retracted with a snap action. As the arms pivot within the support 34 the ends of the arms move toward the bracket 29 until they are generally aligned transversely to the shaft 2. The spring 30 in the meantime has expanded partially as the weights 28 engage the lugs 41, and then continues to increase, expanding at a gradually reduced rate, to the fully expanded position as the channels of the weights in which the spring is lodged move forwardly of the spring channel in extensions 32.

As the motor decelerates, the actuator is held in a retracted position until the centrifugal force is sufficiently reduced to allow the spring 30 to pivot the weights 28 from lugs 41 and then the arms 27 to initial position. The centrifugal force acting against the force of the spring at this time is relatively small and the arms snap back to their original position.

Thus under the invention, the weights 28 shift position and are in motion immediately before the cut-out or cut-in speed is attained to provide an improved snap action. Further, the mechanism employed decreases the force of the spring on the arms 27 when the latter are in their outermost position and thereby reduces the centrifugal force required to hold the collar 25 in a retracted position.

Other types of switches than switch 1 may be employed with the actuator of the invention.

Various modes of carrying out the invention are contemplated as within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a centrifugal actuator responding to a predetermined speed of a rotating shaft to actuate a switch, a support bracket fixed to said shaft, actuating means pivotally attached to said support bracket, a weight pivotally secured to said means, said weight being adapted to rotate radially outwardly from said shaft in response to rotation of the shaft and after a predetermined radially outward movement being disposed to engage said means in spaced relation to the pivotal securement of the weight to said means and effect pivotal movement of the means at a predetermined speed of rotation, and a garter spring encircling said weight and shaft and biasing the weight to an initial non-responsive position.

2. A centrifugal actuator responding to the speed of a rotating shaft, which comprises a support plate fixed to said rotating shaft and rotating therewith, a switch actuating member encircling said shaft and free to move axially thereof, actuating arms pivotally mounted on said support plate and connected to said switch actuating member, a weight pivotally secured to each of said actuating arms, said weight being adapted to move radially outwardly as said shaft rotates and after a predetermined radially outward movement being disposed to engage said means in spaced relation to the pivotal securement of the weight to said means to pivot said arms radially outwardly and thereby axially move said switch actuating member, and a garter spring biasing said weights and arms radially inwardly.

3. In a centrifugal actuator, a support secured to a rotatable shaft, a pair of actuating arms pivotally secured to said support on diametrically opposite sides of said shaft, said arms extending axially of the shaft and being adapted to actuate a switch in response to pivotable movement of the arms, weights pivotally secured to said arms, said weights engaging the arms to effect pivotal movement of the arms in response to rotation of said shaft, a garter spring encircling said weights and biasing the weights to an initial position, said spring being radially expanded and axially moved by the operation of said weights, and means adjacent said support to prevent axial movement of generally diametrically opposite portions of said spring disposed between said weights.

4. In a centrifugal actuator, a support bracket secured on a shaft and having a plurality of generally axially diametrically opposite extensions, a pair of actuating arms, one of said arms being pivotally secured to one of said extensions and extending axially and circumferentially therefrom to dispose the end of the arm in alignment with said shaft, the second of said arms being pivotally secured to one of said extensions diametrically opposite to said first arm and extending axially and circumferentially therefrom to dispose the end of the arm in alignment with said shaft, the ends of said arms being adjacent and being formed to permit simultaneous axial movement and each of the arms carrying a lug intermediate the ends thereof, a pair of weights, one of said weights being pivotally secured to said first arm and moving axially outwardly a predetermined distance and engaging the lug extending from said first arm to effect pivoting of said arm, the second of said weights being pivotally secured to said second arm and moving radially outwardly a predetermined distance and engaging the lug extending from said second arm to effect pivoting of said second arm, and a garter spring encircling said weights and secured to said weights and to said extensions with said spring biasing the weights to an initial position disengaged from said lugs.

5. In a centrifugal actuator, a support bracket fixed to

a rotatable shaft having a pair of diametrically opposite pivot extensions and a pair of diametrically opposite spring support extensions, a first and second channel shaped actuating arm pivotally secured one to each of said pivot extensions and each having an L-shaped lug extending from a base portion thereof, the sides of said arms extending forwardly and circumferentially with the ends thereof meeting in a central plane between said pivot extensions, the ends of said sides moving in an axial direction as said arms pivot, an axially sliding member supported on said shaft and accommodating the ends of said arm sides, a first and second weight pivotally secured to said first and second actuating arm respectively and having a generally U-shaped extension, one side of said U-shaped extension resting against said L-shaped lug, a garter spring disposed in said spring support extension of said support bracket and said U-shaped extensions of said weights and biasing said weights to a non-responsive position, said weights pivoting radially outwardly a predetermined distance and thereafter biasing the actuating arms to an actuated position, and means to prevent said arms from extending axially rearwardly.

6. In a centrifugal actuator for a switch, a support bracket secured to a shaft through an opening in the bracket, a pair of actuating U-shaped arms with each being pivotally secured to a diametrically opposite side of the shaft, said arms extending forwardly and circumferentially of said shaft and meeting in a single plane passing through the center line of the shaft, a collar having a channel receiving the arms and axially moved as said arms pivot with ends of the arm within said channel being provided with a radius to prevent binding of the arms and carrying a lug intermediate the ends thereof, a first and second weight each pivotally secured to one of said actuating arms and having a plurality of tabs forming a spring receiving channel and having an opening to accommodate the lug extending from said arms, said weights being adapted to pivot a predetermined distance and then engage the actuating arms to axially move said collar, a garter spring disposed in said spring receiving channels and encircling said weights to bias said weights to an initial condition with a surface of said opening resting against said lug, said spring being securely connected to said support bracket to prevent axial movement of the spring, and means to prevent said actuating arms from extending rearwardly.

7. In combination, a snap-action switch mounted adjacent a rotatable motor shaft, an actuating collar slidably mounted on said motor shaft axially of said switch, a support bracket fixed on said shaft in axially spaced relation to said collar, an arm pivotaly secured to said support and engaging said collar to effect axial movement of the collar in response to a predetermined speed of rotation of said motor shaft, a weight pivotally secured to said arm and moving outwardly prior to the movement of said arm and thereafter engaging the arm to effect pivotal movement of the arm, said weights engaging the arm in spaced relation to the pivotal securement of the weights to the arm, and a garter spring encircling said weights and rotating shaft and biasing said weights and arm to a non-responsive condition with the force of the garter spring being overcome by centrifugal force developed by the speed of the motor shaft to effect snap action movement of the actuator and switch to make and break the contacts of the switch.

8. In combination, a snap action switch disposed adjacent a rotating shaft, an actuating collar slidably mounted on said shaft to actuate said switch, a bracket secured to said shaft in axially spaced relation to said collar, a pair of actuating arms pivotally secured to said bracket and extending into engagement with said collar, means securing said arms to the collar to effect substantial axial movement of the collar in response to pivotal movement of said arms, weights pivotally attached to each of said arms and moving outwardly in response to shaft rota-

tion with said weights engaging said arms in spaced relation to the pivotal attachment of the weights to said arms and after a predetermined period of movement to effect expansion of said arms and movement of the collar from contact with the switch to break the switch contacts, and a garter spring biasing said weights and said arms to a non-responsive position to normally maintain the collar in engagement with the switch and the switch contacts engaged, the centrifugal force acting on said arms and weights increasing faster than the force of the spring to effect the outward movement of the arms.

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