Sept. 23, 1952 W. A. ROSEBRAUGH 2,611,602

CENTRIFUGAL OPERATING DEVICE

Filed April 16, 1948 2 SHEETS—SHEET 1

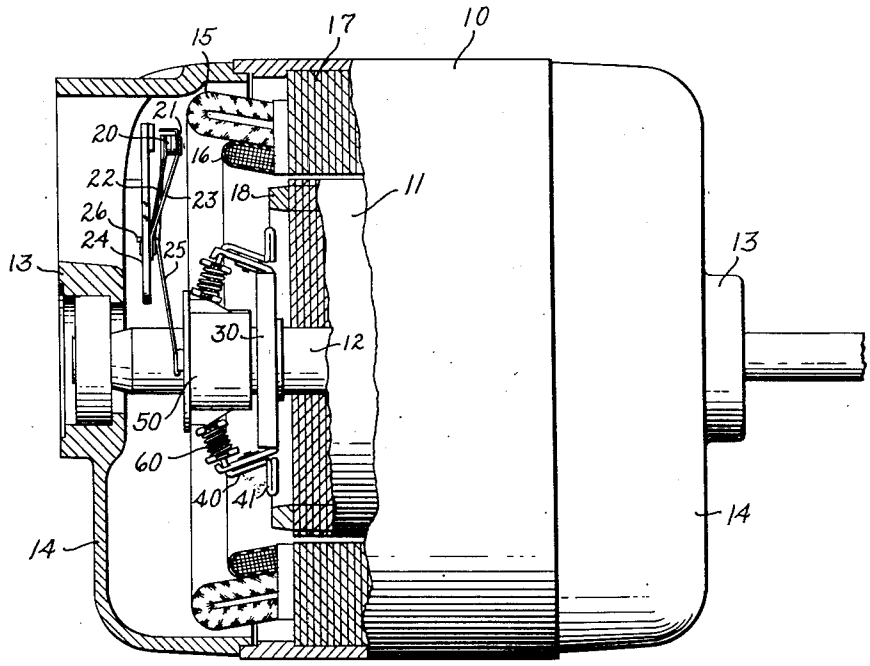



Fig. 1.

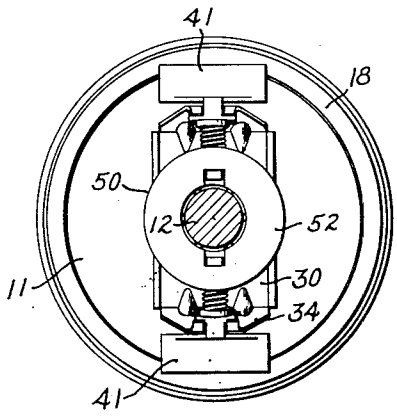



Fig. 3.

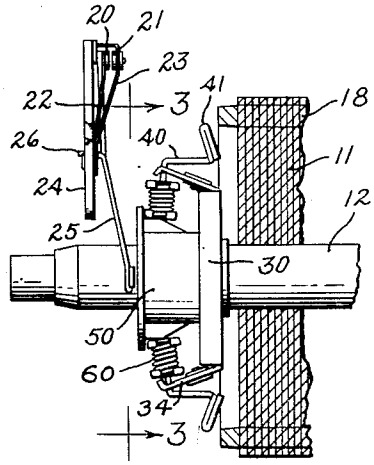



Fig. 2.

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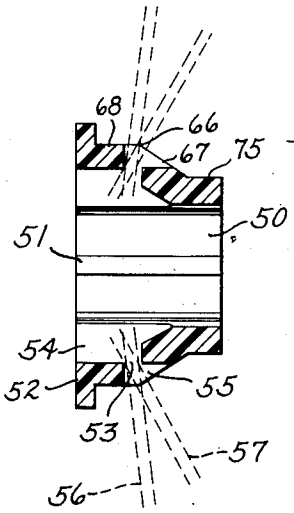



Fig. 7.

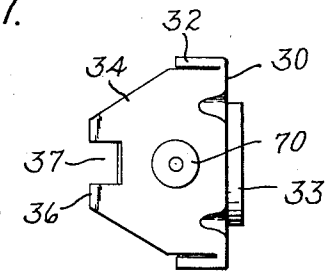



Fig. 5.

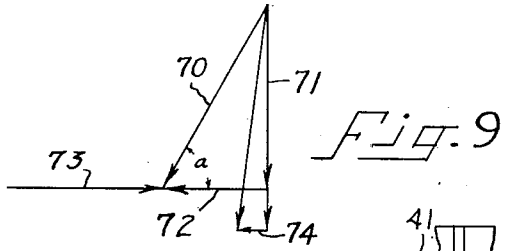



Fig. 9

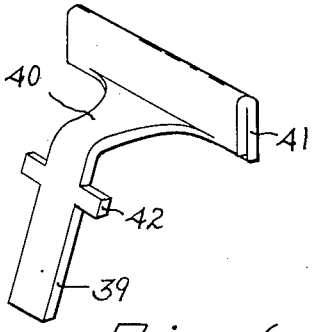



Fig. 6.

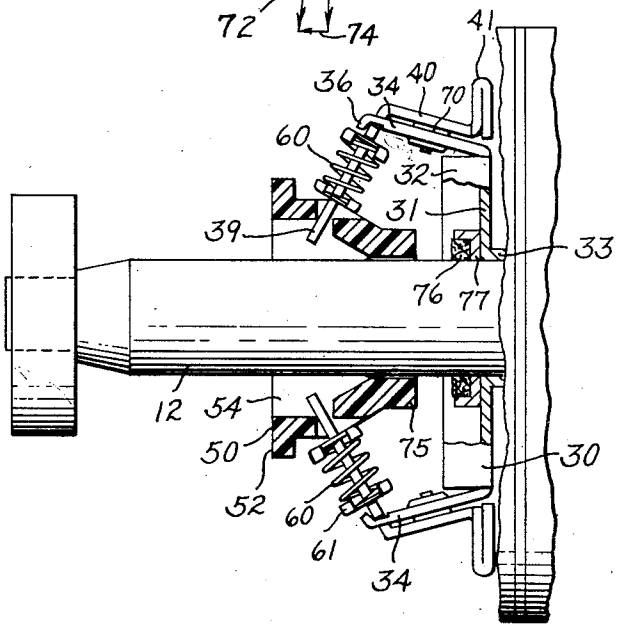



Fig. 4.

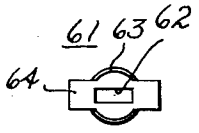



Fig. 8.

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# UNITED STATES PATENT OFFICE

2,611,602

## CENTRIFUGAL OPERATING DEVICE

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Application April 16, 1948, Serial No. 21,482

12 Claims. (Cl. 264—15)

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My present invention relates to centrifugal operating devices and, while not necessarily limited thereto, the devices are particularly suitable for use in connection with centrifugal starting switch mechanisms for controlling the circuits of starting windings for dynamo-electric machines.

It is a principal object of the present invention to provide an improved centrifugal device which is simple, inexpensive to manufacture and reliable in operation.

A further object of the invention is to provide a centrifugal switch operating device having a new and improved snap action spring arrangement.

The still further specific object of the invention is to provide a new and improved flyweight mounting arrangement for centrifugal devices.

In accordance with the illustrated embodiment, the invention comprises a bracket adapted to be fixedly mounted upon a rotatable member or shaft for pivotally supporting a pair of flyweight elements of novel construction on opposite sides of the axis of rotation. An axially movable collar adapted to be mounted upon the shaft is arranged adjacent the support and is operatively engaged by the ends of a pair of operating arms extending theretoward from the flyweights. The collar is biased to a limit position away from the support by means of a compression spring mounted upon each of the operating arms of the flyweight units and which springs also serve to retain the flyweights in the assembled position upon the support. The particular arrangement of the compression springs further provides a new and improved snap action for the device for both directions of operation.

Further objects and advantages of the invention will become apparent from the following description referring to the accompanying drawings, while the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawings, Fig. 1 is a side elevational view of a dynamo-electric machine partially broken away to illustrate a centrifugal device embodying my invention in accordance with one form thereof; Fig. 2 is a fragmentary side elevational view illustrating the centrifugal device in a different position from that shown in Fig. 1; Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2; Fig. 4 is an enlarged longitudinal sectional view illustrating the centrifugal device and showing the parts in the same limit position as in Fig. 1; Fig. 5 is an end view of support bracket incorporated in the device; Fig. 6 is an enlarged view, in perspective, illustrating one of the flyweight members incorporated in the device; Fig. 7 is a longitudinal sectional view of the sliding collar incorporated in the device; Fig. 8 is a plan view showing one of the spring bearing cups incorporated in the device; and Fig. 9 is a vector diagram illustrating a principle of operation of the device.

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Referring now to the drawings, I have shown a dynamo-electric machine having a stationary unit 10 and a rotatable unit 11 including a shaft 12 which is supported in suitable bearing assemblies in the opposite end bells 14. The dynamo-electric machine illustrated is a single phase induction motor and the excitation is provided by a single phase main field exciting winding 15 and a starting field exciting winding 16, which windings are arranged in slots provided therefor in the core 17 of the stationary unit and are adapted to induce electric currents in a squirrel cage winding 18 arranged in slots in the rotatable unit 11.

In this type of induction motor, it is desirable that the starting field exciting winding should be energized during the period when the motor starts to operate, or under such operating conditions that the speed of the motor is reduced below a predetermined value and that this field exciting winding be de-energized when the speed of the motor exceeds a predetermined value. In order to accomplish this, a control switch unit is provided having electric contacts 20 and 21 connected to the energizing circuit of the starting field exciting winding 16. These contacts 20 and 21 are mounted on stationary flexible supporting elements 22 and 23, respectively, which are secured upon a mounting plate 24 of insulating material suitably mounted upon the adjacent end bell 14. A yoke member 25 having bifurcated end portions straddling the shaft 12 is fulcrumed as at 26 onto the base plate 24 and operatively connected to the contact 20 for actuation thereof between the closed and open circuit positions. The switch is shown in the closed circuit condition in Fig. 1 and in the open circuit condition in Fig. 2.

The details of the switch structure described form no part of the present invention and are disclosed and more fully described in the copending application Serial No. 21,637 filed concurrently herewith and assigned to the assignee of the instant invention. The above numbered

application has since matured into United States Letters Patent No. 2,463,020. The present invention is concerned primarily with the details of the centrifugal operating device provided for actuation of the control switch between the open and closed circuit conditions, and it will become obvious to those skilled in the art, following a perusal of the instant specification, that the operating device of the present invention may be used for operation of control switches differing from that specifically shown herein.

The centrifugal operating device of the present invention includes a support bracket 30 which may be stamped from sheet metal and comprises a plate portion 31 provided with opposite side flanges 32 and opposite end flanges 34. A central opening is provided in the plate portion 31 defined by a flanged collar portion 33 adapted to be mounted with a press fit upon the shaft 12 for fixedly securing the support 30 thereto with the plate portion 31 extending at right angles to the axis of rotation of shaft 12. The opposite end flange portions 34 extend from the same side of the support bracket toward the outer end of the shaft and spaced equal distances from the opposite sides thereof. The outer edges of the flange portions 34 are rolled or bent downwardly a slight distance as indicated at 36 toward the shaft 12.

As illustrated more clearly in the detail view of Fig. 5, the forward edge of each of the flange portions 34 is provided with a notch 37 within which the generally L-shaped flyweight members are mounted.

One of the flyweight members is more clearly illustrated in the perspective view of Fig. 6 and comprises an operating arm 39 and a lever arm 40 extending at an angle with respect to the operating arm 39, the outer end of the lever arm 40 being provided with a weighted portion 41. A pair of oppositely disposed lugs 42 are provided on the opposite edges of the operating arm 39 spaced downwardly a slight distance from the point of intersection between the operating arm 39 and the lever arm 40. The notches 37 in the forward edge portions of the support flanges 34 are of a width slightly greater than the width of the operating arm above the lugs 42. In the assembled position of the flyweight members upon the support, it will be observed that the lug portions 42 are fitted behind the downwardly bent ends 36 and form fulcrums engaging with the underneath surface of the flange portions 34 about which the flyweight members pivot or rock during operation of the device.

A collar 50 of suitable insulating material, such as molded plastic, is adapted to be mounted for sliding movement in the axial direction upon the shaft 12, the cylindrical bore through the collar 50 being provided with radially spaced apart longitudinal ribs 51 for minimizing frictional resistance to sliding movement of the collar 50 upon the shaft. The collar 50 is provided with a plane forward face 52 for cooperatively engaging the ends of the switch yoke 25 previously described. The collar is provided with a pair of diametrically opposed slots 53 in raised bosses which are adapted for cooperatively receiving the ends of the operating arms 39 of the flyweight members as shown in Fig. 4. Particular attention is directed to the fact that the collar is recessed on the inner side thereof beneath the slots 53 as indicated at 54 and on the outer side as indicated at 55 so as to permit the arms 39 to move pivotally within the slots 53 through the angle between the two limit positions illustrated by dotted lines 56 and 57 in Fig. 7.

The collar unit 50 is normally biased to a first limit, or inoperative, position, as shown in Fig. 4, by means of compression springs 60 arranged about each of the operating arms 39 of the flyweight members. The opposite ends of each of the springs 60 are enclosed within bearing cups 61, one of which is shown in greater detail in the view of Fig. 8. These cups are provided with a central elongated rectangular slot 62 for fitting cooperatively upon the arm 39 and upstanding flange portions 63 and outwardly extending tabs 64 projecting from each of the opposite sides thereof. The tabs 64 extend in longitudinal alignment with the slot 62 and form enlarged bearing surfaces, which in the case of the cups at the outer ends of the springs 60 engage against the lower surfaces of the outstanding lugs 42 on the flyweight arms 39. The tabs 64 of the cups at the inner ends of the springs 60 provide bearing surfaces which rock across the corners 66 of the outwardly extending bosses within which the slots 53 are formed in the collar 50 as the collar is moved between its opposite limits of travel.

The compression springs 60 normally bias the collar 50 to a first limit position away from the support 30 as illustrated in Figs. 1 and 4, and at the same time retain the fulcrum lugs 42 of the flyweight arms in firm seating engagement with the underneath side of the support flanges 34. In the position of rest of the device, the lever arms 40 of the flyweight members extend parallel with the support flanges 34 and rest against felt pads 70 suitably secured within cooperating recesses stamped in the upper surface of the flange portions. These felt pads serve as buffers to reduce noise which would otherwise result from direct metallic contact between the lever arms portions 40 and the support when the flyweights move inwardly upon deceleration of the machine. As illustrated in Fig. 4, the ends of the operating arms 39 extending into the slots 53 in the collar 50 positively retain the collar 50 against axial movement away from the support bracket 30 beyond the first limit position shown.

When the collar 50 of the device is in the limit position illustrated in Figs. 1 and 4, the contacts 20 and 21 of the control switch are closed connecting the starting exciting winding 16 in readiness for starting the machine. Upon application of energizing current, the rotatable unit will be driven and, upon reaching a predetermined speed, the weighted portions 41 of the flyweight members will move outwardly under centrifugal force to the position shown in Fig. 2, and the inner ends of the arms 39 will shift the collar 50 toward a second limit position adjacent the support 30. The second limit position is determined by engagement of the cylindrical portion 75 of the collar 50 with the sound deadening or felt washer 76 mounted within a retaining ring 77 held by a press fit upon the shaft 12 next adjacent the support bracket 30.

Particular attention is directed to the fact that the operating arms 39 of the flyweight members are aligned with each other in a common plane which extends through the axis of rotation of the support and are inclined at all times at an angle with respect to the perpendicular to the axis of rotation. As viewed in Fig. 4, when the flyweight members are at rest, the operating arms 39 are inclined at a relatively large

angle with respect to the perpendicular to the axis of rotation and substantially normal to the sloping shoulders 67 of the bosses on the collar 50. Upon outward movement of the weight portions 41 of the flyweight members acting under centrifugal force, the operating arms 39 pivoting about the fulcrum lugs 42 move inwardly toward the support to the second limit position shown by dotted lines 56 in Fig. 7 but in which position the arms are still inclined at an angle with respect to the perpendicular to the axis of rotation so that there is still a component of force exerted by the compression springs 60 in the axial direction of the shaft 12 toward the first limit position. The spring cups 61 in shifting from the sloping boss shoulders 67 to the outer boss shoulders 68 rock across the corners 66 therebetween.

With the spring arrangement shown, the collar 50 will be shifted with a forceful and positive snap action in either direction of movement and which is an important feature of the present invention. Referring to the force diagram of Fig. 9, the combined compressive force of the two springs 60 may be represented by the vector acting upon the collar 50 in the position of rest at an angle "a" corresponding to the angle existing between the shaft axis and the operating arms 39. This force vector consists of a component 71 normal to the shaft axis and a component 72 parallel with the shaft axis. Upon starting of the motor and as its rotation approaches normal running speed, the flyweights under centrifugal force will exert a corresponding force, which may be represented by the vector 73, upon the collar 50 in the axial direction in opposition to the force component 72. As soon as the force component 73 reaches a magnitude slightly greater than the force component 72, the collar will be shifted from its original position of rest. Immediately upon such movement of the collar the angle $a$ is increased and the axial component of force 72 exerted by the springs 60 decreases. The component 72 therefor decreases progressively until the second limit position is reached and in which position the axial component is reduced to some value such as is indicated by vector 74. It follows, therefor, that as soon as the centrifugal force vector 73 exceeds the force vector 72, the collar will be positively and forcefully snapped to its second limit position.

When power supply to the motor is cut off and the rotor decelerates, the centrifugal force vector 73 supplied by the flyweights progressively diminishes. As soon as this force 73 decreases to a value below that of the axial component 74 of springs 60 in the second limit position, the springs will shift the collar toward the first limit position. The component 74 will thereupon increase progressively in magnitude to the value indicated by vector 72 and thus forcefully and positively shift the collar with a snap action to the first limit position.

While the invention has been described with particular reference to a preferred embodiment, it is desired that, by the appended claims, all such obvious variations as may occur to one skilled in the art are to be included within the scope thereof.

I claim:

1. A centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, a weight member pivotally mounted on said support, said weight member including



an operating arm extending toward the axis of rotation of said support, an axially movable collar adapted to be mounted on said rotatable member, the inner end of said arm being operatively connected to said collar and in the position of rest of said device retaining said collar in a first limit position away from said support, said arm in said condition of rest being inclined at an angle with respect to a plane perpendicular to said axis, said arm causing movement of said collar to a second limit position toward said support upon actuation of said weight member under centrifugal force, a compression spring arranged about said arm between said support and said collar, said spring urging said collar toward said first limit position, said arm upon movement of said collar from said first limit position to said second limit position moving through an angle approaching the perpendicular to said axis, and means for stopping said collar in said second limit position in which said arm is inclined at a smaller angle with respect to said perpendicular than in said first limit position, whereby said collar will be moved with a snap action by said weight member from one of said limit positions to the other in both accelerating and decelerating conditions of said rotatable member.

2. A centrifugal operating device including a support adapted to be mounted on a shaft, said support including a flange spaced from and extending in the direction of said shaft, a weight member including an operating arm and a lever arm extending angularly from said operating arm and having a weighted portion on the outer end of said lever arm, means pivotally mounting said weight member on the forward edge portion of said flange with said operating arm and said lever arm extending on opposite sides of said flange, an axially movable collar adapted to be mounted on said shaft beneath said flange, said collar having a recess for cooperatively receiving the end of said operating arm, and a compression spring arranged about said operating arm between said pivotal mounting means and said collar, said compression spring at all times urging said collar away from said support, whereby said collar will be moved with a snap action by said weight member from one of its limit positions to the other in both accelerating and decelerating conditions of said shaft.

3. A centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, an axially movable collar adapted to be mounted on said rotatable member, a pair of generally L-shaped weight members pivotally mounted on said support on opposite sides of the axis of rotation thereof, said weight members each including an operating arm extending from said support toward said collar, said arms being pivotally movable in a common plane extending through the axis of said collar, a pair of diametrically opposed slots in said collar for cooperatively receiving the ends of said arms, and compression springs arranged about said arms between said support and said collar at all times urging said collar away from said support, whereby said collar will be moved with a snap action by said weight members from one of its limit positions to the other in both accelerating and decelerating conditions of the rotatable member.

4. A centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, an axially movable collar adapted to be mounted on said rotatable member, a pair of centrifugal weight members pivotally

mounted on said support on opposite sides of the axis of rotation thereof, said weight members each including an operating arm extending from said flanges toward said collar, said arms being pivotally movable in a common plane extending through the axis of said collar, a pair of diametrically opposed slots in said collar for cooperatively receiving the ends of said arms, compression springs arranged about said arms, said collar including circumferential ridge portions in the same radial plane as said slots and adjacent thereto, bearing members arranged about said arms between said springs and said collar, said bearing members being adapted to rock over said ridge portions upon axial movement of said collar under action of said weight members due to centrifugal force.

5. In a centrifugal operating device including a support adapted to be fixedly mounted on a shaft, a pair of generally L-shaped weight members pivotally mounted on each of the opposite sides of the axis of rotation of said support, said weight members each including an operating arm extending from said support toward said axis and a lever arm extending angularly from said operating arm and disposed on the opposite sides of said support with respect to said axis, said lever arm having a weighted portion on the outer end thereof, an axially movable collar mounted on the inner ends of said operating arms, compression springs arranged about said operating arms between said support and said collar and bearing against said collar urging said collar at all times away from said support, the outward movement of said collar from said support during condition of rest of said device being limited by engagement of said lever arms against the outer surface portions of said support, said collar being movable with a snap action by said weight members from one of its limit positions to the other in both accelerating and decelerating conditions of said shaft.

6. In a centrifugal operating device including a support adapted to be fixedly attached to a rotatable shaft, said support including a flange extending in the direction of the axis of rotation thereof, and spaced therefrom, a notch in the edge of said flange, a generally L-shaped weight member including an operating arm and a lever arm extending angularly from said operating arm and having a weighted portion on the outer end of said lever arm, said weight member being mounted in said notch, shoulders on the opposite sides of said operating arm adjacent said lever arm pivotally engaging the lower side of said flange on opposite sides of said notch, an axially movable collar adapted to be mounted on said shaft, the end of said operating arm operatively engaging said collar, and compression spring means arranged on said operating arm between said collar and said shoulders whereby said collar will be moved with a snap action by said weight member from one of its limit positions to the other in both accelerating and decelerating conditions of said shaft.

7. In a centrifugal operating device including a support adapted to be fixedly attached to a rotatable shaft, said support including a flange extending in the direction of the axis of rotation of said support and spaced therefrom, the forward edge portion of said flange extending downwardly a short distance toward said shaft, a notch in said forward edge portion, a generally L-shaped weight member including an operating arm and an angular lever arm and a weighted



portion on the outer end of said lever arm, said member being mounted in said notch, shoulders on the opposite edges of said operating arm forming a pivotal fulcrum against the lower side of said flange, an axially movable collar adapted to be mounted on said shaft, the end of said operating arm operatively connected to said collar and a compression spring arranged between said collar and said shoulders, said spring urging said collar away from said support and retaining said member in seating engagement with said support, said collar being movable with a snap action upon operation of said weight member under centrifugal force from one of the limit positions to the other in both accelerating and decelerating conditions of said shaft.

8. A centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, said support including a pair of spaced apart flanges extending from one side thereof in the direction of the axis of rotation of said support, an axially movable collar adapted to be mounted on said rotatable member between said flanges, a notch in the edge portion of each of said flanges, a weight member mounted in each of said notches and including portions pivotally engaging the inner sides of said flanges, said weight members each including an operating arm extending toward said collar, a pair of diametrically opposed slots in said collar cooperatively receiving the ends of said operating arms, said operating arms being movable in a common plane through the axis of said collar for effecting axial movement of said collar by said weight members acting under centrifugal force, a compression spring arranged on each of said operating arms and bearing against said collar to oppose axial movement thereof by said weight members acting under centrifugal force, said collar being operable by said weight members with a snap action between its limit positions in both the accelerating and decelerating conditions of said rotatable member.

9. In a centrifugal operating device including a support adapted to be fixedly attached to a rotatable shaft, a notch in the outer edge of said support, a generally L-shaped weight member including an operating arm and a lever arm extending angularly therefrom and having a weighted portion on the outer end of said lever arm, a pair of lugs extending from the opposite edges of said operating arm adjacent the upper end thereof and spaced a short distance from said lever arm, said operating arm being mounted in said notch with said lugs positioned against the surface of said support facing said axis, an axially movable collar having a slot therein, the end of said operating arm extending into said slot, and a compression spring arranged about said operating arm between said collar and said lugs urging said lugs against said support and said collar away from said support, said collar being operable with a snap action between its limit positions by said weight member in both accelerating and decelerating conditions of said shaft.

10. A centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, an axially movable collar adapted to be mounted on said rotatable member and movable along the axis of rotation of said support, a weight member having pivot means engaging said support and including a straight operating arm extending from said pivot means toward said collar, the inner end of said arm

being operatively connected to said collar for effecting movement of said collar toward said support upon actuation of said weight member under centrifugal force, and a compression spring arranged about said arm between said pivot means and said collar for urging said collar away from said support and for retaining said pivot means in seating engagement against said support, said collar being operated with a snap action between its limit positions in both accelerating and decelerating conditions of said rotatable member.

11. In a centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, a centrifugal flyweight member pivotally engaging said support in a spaced relation from the axis of rotation thereof, said weight member including an operating arm rigidly connected thereto extending toward said axis, an axially movable collar adapted to be mounted on said rotatable member, the inner end of said arm being operatively connected to said collar, and a compression spring arranged about said arm between said collar and said support biasing said collar away from said support and retaining said member in pivotal engagement with said support, said collar being operated with a snap action by said weight member between its limit positions in both accelerating and decelerating conditions of said rotatable member.

12. In a centrifugal operating device including a support adapted to be fixedly mounted on a rotatable member, a centrifugal flyweight member pivotally mounted on said support, said weight member including an operating arm rigidly integral therewith extending toward the axis of rotation of said support, an axially movable collar adapted to be mounted on said rotatable member, the inner end of said arm being operatively connected to said collar, and a compression spring arranged about said arm between said support and said collar, said collar being operated with a snap action by said weight member from one of its limit positions to the other in both accelerating and decelerating conditions of said rotatable member.

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## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,600,788 | Beall | Sept. 21, 1926 |
| 1,840,996 | Wright | Jan. 12, 1932 |
| 1,926,339 | Kindl | Sept. 12, 1933 |
| 2,048,494 | Diehl | July 21, 1936 |
| 2,083,343 | Naul | June 8, 1937 |
| 2,095,755 | Libby | Oct. 12, 1937 |
| 2,177,063 | Gottlieb | Oct. 24, 1939 |
| 2,318,187 | Addison | May 4, 1943 |
| 2,465,332 | Witte | Mar. 22, 1949 |
| 2,544,791 | Hunt | Mar. 13, 1951 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 626,089 | Germany | Feb. 20, 1936 |