June 25, 1957 K. C. JOHNSON 2,797,080

CENTRIFUGAL MECHANISM

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Fig. 1.

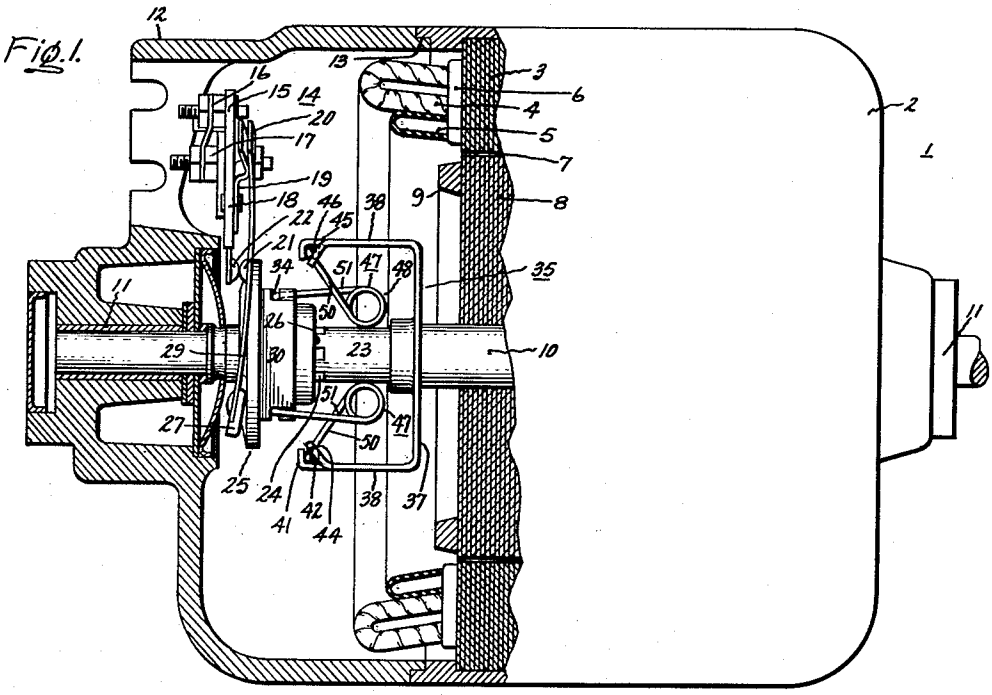


Fig. 2.

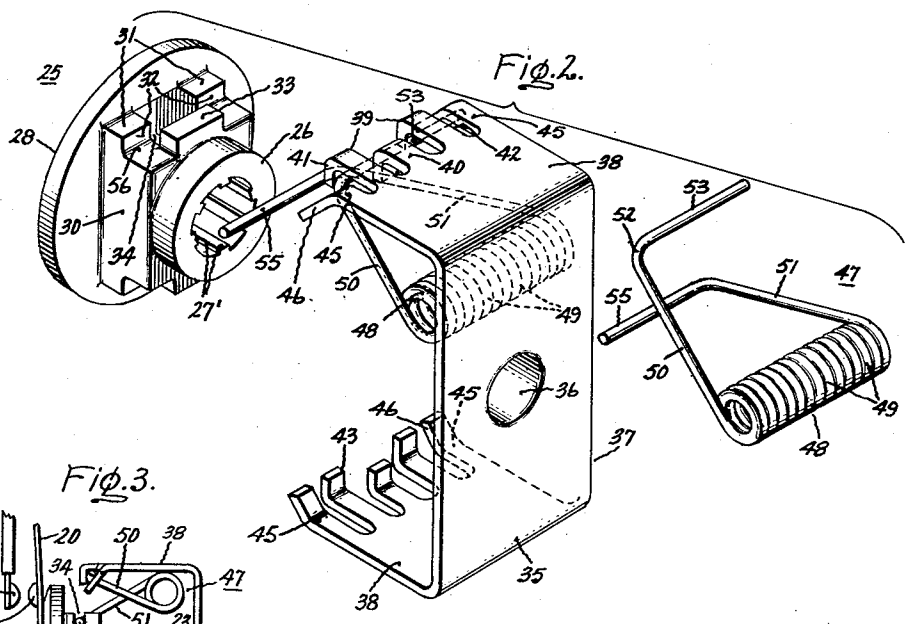
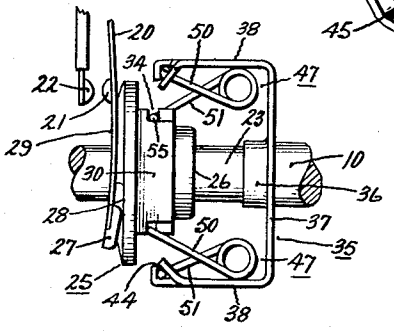


Fig. 3.



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CENTRIFUGAL MECHANISM

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4 Claims. (Cl. 264—15)

This invention relates to circuit breaking devices and more particularly to a centrifugal mechanism for actuating a switch.

There are many instances in which operation of a device is made dependent upon the speed of a rotating part. One such typical application is the deenergization of the starting winding of a single phase alternating current induction motor after the motor comes up to speed. In these instances it then becomes necessary to provide a mechanism sensitive to rotational speed to effect the operation desired. Such mechanisms generally rotate with the rotating part and are so constructed as to move, preferably with a snap action, under the influence of centrifugal force when a certain speed is attained. In view of the wide spread application of such mechanisms, it becomes essential that a high degree of economy be achieved in their manufacture without sacrifice of their reliability. It is selfevident that both economy and reliability must, by the very nature of things, increase as the number of component parts of the mechanism decreases. Other factors being equal, the fewer the number of component parts the less chance there is for any one of them to fail. Also, the fewer the number of operations needed to produce the various components of the mechanism, the greater the economy achieved in its manufacture.

It is, therefore, an object of this invention to provide an improved centrifugally actuated mechanism which will incorporate the desirable features set forth above.

Further objects and advantages of this invention will become apparent and the invention will be better understood by reference to the following description and the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

This invention, in its broadest aspects, provides a centrifugally actuated mechanism wherein a mounting member is securely fastened to a rotatable element. A mouse trap type spring, having a body part with closely wound coils, has a resilient end portion extending from each end of the coiled body part. There is provided a collar which is adapted to slide axially along the rotatable member and one of the extending portions of the spring is attached to the collar while the other extending portion is secured to the mounting means. The spring portion secured to the collar is maintained in position by pressing downwardly against the collar while the portion secured to the mounting means is held in position by its tendency to push upwardly into the mounting means. By securing the end portions of the spring in this manner, the coiled body portion is flexibly maintained adjacent the rotatable part when it is at rest. As the rotatable part is actuated, the collar, the mounting means, and consequently the spring, will all rotate with it. As speed builds up, the body portion of the spring will tend to pull away from the rotating part under the influence of the centrifugal force. Since the mounting means is immovable, the part secured thereto will have no influence thereon despite the

above mentioned tendency. However, as has been stated, the collar member is free to slide along the rotating part as the coiled body portion of the spring tends to pull away from the rotating part it will, consequently, pull the collar along the shaft. Depending upon the operation to be effected, various means may be secured to the collar so that upon movement thereof the operation will be performed; thus, if an electrical contact is secured to the collar, the movement of the collar may be made to either open or close a circuit through the electrical contact.

In the drawing, Figure 1 is a top view, partly cut away and partly in cross-section, of an electric motor in which the improved centrifugally operated means of this invention is utilized;

Figure 2 is an exploded view in perspective of the component parts of the improved centrifugal mechanism; and

Figure 3 is a top view of the improved mechanism of this invention when under the influence of centrifugal force.

Referring now to the figures of the drawing, the component parts of the improved centrifugal mechanism of this invention will be described. A single phase alternating current electric motor **1** is provided having a housing **2** in which there is mounted a stator **3** made of laminated punchings. The slots (not shown) in stator **3** have a conventional main winding **4** and a starting winding **5** wound therein. Insulation **6** is provided in the slots to prevent short circuits between the coil windings **4** and **5** and the laminated punchings of stator **3**. Within the bore of stator **3** and separated therefrom by an air gap **7** is a laminated rotor **8** having a squirrel cage winding **9**. Rotor **8** is mounted on a shaft **10** which is rotatably supported in bearings **11** at each end of the motor. The end of housing **2** is closed by an end flange **12** which has a rabbet fit **13** with the housing. Secured to end flange **12** in any suitable manner is a switch **14** having a terminal board **15** with a pair of terminals **16** and **17** secured thereto which are adapted to receive appropriate leads (not shown) from the motor windings. A movable contact **21** is secured to terminal **16** by conductors **18** and **19** and by spring arm **20**, and a stationary contact **22** is connected to terminal **17**. Such a switch is shown in Patent 2,149,096 issued to Morrill et al. and assigned to the assignee of the present application. It will be understood that the apparatus described thus far is not an essential part of the invention, insofar as its precise structure is concerned. Any one of an infinite variety of motor structures would be equally applicable; in fact, apparatus other than motors may also be used with the invention. However, as an example of a highly advantageous setting for the invention, the inclusion of the various details of motor **1** will serve to clarify the invention as it is explained below.

Shaft **10** of motor **1** has a portion **23** of lesser diameter than the main portion of the shaft and is provided with a plurality of keyways **24**. It will, of course, be understood that a single keyway may be used equally advantageously or, depending on the type and strength of the spring members (described below), the keyway may be omitted entirely. Mounted to slide along portion **23** of shaft **10**, but prevented from turning thereon by keyways **24**, is a collar **25**. Collar **25** has a hub portion **26** whose bore is formed with keys **27'** which coact with keyways **24** in shaft **10** to prevent rotation of collar **25** thereon. Spring arm **20** carrying contact **21** is adapted to bear against portion **28** of collar **25** by means of an extension **29** which has at the end thereof a wear pad **27**. Wear pad **27** is biased against flange **28** of collar **25**, and if collar **25** slides to the right, as shown in Figure 1, wear pad **27** of spring arm **20** will follow it and contact **21** will thereby be separated from contact **22**. While it has not been so shown, starting winding **5** of motor **1** is con-

nected through terminals 16 and 17; the leads extending from the winding to the terminals have been omitted from the drawing so as not to interfere with the clarity thereof. It will be clearly understood that in a motor of this type, starting is achieved by means of the two windings 4 and 5 both being energized and that when motor 1 comes up to speed, it is desirable to disconnect winding 5 so that the motor may run on winding 4 alone. Since it has been stated that winding 5 is connected through terminals 16 and 17, winding 5 will be deenergized when contacts 21 and 22 are separated.

Between circular flange 28 and hub 26, collar 25 is formed with a projecting portion 30. At opposite sides of this projecting portion are a pair of extensions 31 having surfaces 32. A third extension 33 is slightly spaced from the other two so as to form therewith a passageway 34.

A member 35 has a hub portion 36, by means of which it is adapted to be mounted on shaft 10, as shown, in a position which is axially displaced from collar 25. Hub portion 36 is tightly secured to shaft portion 23 so as to be stationary therewith. This may be effected by any desired method, such as press fitting, shrink fitting, etc. The main body portion 37 of member 35 extends in a plane vertical to the axis of shaft 10, and at each end thereof is a flange 38 which is at right angles to the main portion 37 and parallel with the axis of shaft 10. Each of the flanges 38 terminates in a plurality of fingers 39 and 40, fingers 39 being made slightly longer than finger 40. All of the fingers have their outer ends bent downwardly as shown at 41. By means of this arrangement a passageway is formed between the inner surface 43 of the longer fingers 39 and the outer surface (not shown) of the shorter finger 40. This passageway is denoted by the numeral 44 in Figures 1 and 3. Each flange 38 has, in addition, a third type of finger 45 at each end which extends in the plane of flange 38 for a short distance and is then bent downwardly at an angle, as shown at 46.

A mouse trap type spring 47 is provided with a body portion 48 which is formed of tightly wound coils 49 and constitutes a relatively heavy mass. Extending from each end of body portion 48 are, respectively, an upper (or outer) arm 50 and a lower (or inner) arm 51. Arm 50 is bent as at 52 to form a part 53 which extends parallel to the axis of body portion 48. Arm 51 has a similar bend 54 to form a similar extending part 55. As will be clear from the shape of spring 47, part 53 is biased upwardly while part 55 is biased downwardly. Spring 47 is then mounted to member 35 and to collar 25 by means of parts 53 and 55 respectively. Part 53 fits in passageway 44 between fingers 39 and 40 on each side and with portions 46 of fingers 45 positioned at each end to prevent it from sliding; part 55 fits in passageway 34 between projections 31 and 33. Since part 55 is biased downwardly it will press against bottom surface 56 of projection 30 and will be securely maintained in passageway 34 without any tendency to spring out. Since part 53 is likewise biased upwardly it will be firmly seated in passageway 44, as shown, without any tendency to pull down and out of the passage. Bent portion 46 of finger 45 is so positioned that arm 50 is prevented from sliding out of passageway 44. It will be understood that while Figure 2 shows a single spring, and only one spring has been described, the use of two oppositely disposed springs 47, as shown in Figures 1 and 3, is preferable. Also, any equivalent of the type of spring described may be substituted; thus, it will be clear that, for instance, a simple U-shaped spring with a weight instead of a coiled portion will perform the desired function.

Referring now to Figures 1 and 3 the operation of the centrifugal mechanism will be described. When windings 4 and 5 are energized through leads (not shown) from a source of alternating current (not shown), rotor 8 and shaft 10 will be caused to rotate. As the speed of rotation of the shaft increases, there will be a centrifugal force acting upon body 48 of each of springs 47 to tend to cause them to pull away from their positions adjacent shaft portion 23, as shown in Figure 1. At a predetermined speed, which depends upon the tension in arms 50 and 51 and body portion 48 of spring 47, centrifugal force will overcome the force of the spring, and body portion 48 will be pulled away from shaft 23, as shown in Figure 3. At this time the centrifugal force will be increasing very rapidly, and the horizontal component of force of the spring will be decreasing, and these factors will therefore cause the spring body portions to move with snap action. Since part 53 (Figure 2) is firmly anchored in passage 44 and member 35 is secured to the shaft so as to be stationary therewith, the movement of body portion 48 of spring 47 will cause a diminution in the horizontal component of the length of portion 51 which is anchored in passageway 34 of collar 25. Spring body portions 48 will continue to move outwardly until they abut against the inner surfaces of flanges 38 which act as stop members. Since collar 25 is free to slide on shaft portion 23, as has previously been explained, it will be pulled to the right as body portion 48 of spring 47 rises.

As was mentioned before, spring arm 20 is biased to the right with, however, a smaller force than that which is normally exerted to the left by spring 47 when shaft 10 is not rotating. As spring 47 causes collar 25 to snap to the right at a predetermined speed of shaft 10, this will free spring arm 20 to follow the collar to the right, as viewed in Figure 3, and contact 21 will pull away from contact 22. This will open the circuit which energizes starting winding 5, and motor 1 will then run on winding 4 alone. This will continue to be true so long as the rotational speed of shaft 10 exceeds the predetermined value at which body portion 48 of spring 47 succumbs to the centrifugal force to pull collar 25 to the right. As soon as the speed drops below this predetermined value, the centrifugal force will be insufficient to keep body portion 48 of spring 47 pulled away from shaft portion 23, and the body portion 47 will resume its position of Figure 1. This will force collar 25 to the left to close contacts 21 and 22 and thereby reestablish a circuit to energize starting winding 5.

It will be seen from the above description that the operation which was to be effected at a certain speed has been effected, and that this has been done by using a centrifugal mechanism which is so simple that it has only three component parts, a collar, a stationary mounting member, and a spring. The great advantage, it will be seen, is that instead of utilizing the spring only to bias the collar to its stationary position and using a separate member as a centrifugally actuated device to overcome the force of the spring, this invention provides a single, simple, economically manufactured spring which effects both purposes at once.

While this invention has been explained and illustrated in a particular type of electric motor, it will be clear that use may be made of the improved centrifugal mechanism not only in other types of electric motors but also in entirely different applications. Also, while this invention has been explained by describing a particular embodiment thereof, it will be apparent that improvements and modifications may be made without departing from the scope of the invention as defined in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A centrifugal mechanism adapted to be operated at a predetermined speed of rotation of a rotatable part and comprising a collar mounted on said part so as to be slidable axially therealong, a mounting member immovably secured to said part and axially displaced from said collar, said member comprising a portion arranged substantially vertically to the axis of rotation of said part, a flange extending from and end of said vertical portion substantially parallel to the axis of rotation of said part, a spring

having a compact coiled section positioned between said part and said flange, a resilient arm extending from each end of said coiled section, one of said arms being pivotally secured to said collar and the other of said arms being pivotably secured to the end of said flange whereby said coiled section is free to move away from said part at a predetermined speed of rotation whereupon said one arm exerts pull on said collar causing the same to slide along said part.

2. A centrifugal mechanism adapted to be operated at a predetermined speed of rotation of a rotatable shaft and comprising a collar mounted on said shaft and keyed thereto so as to be axially slidable therealong, a mounting member comprising a hub portion immovably secured to said shaft by said hub portion, a portion of said member being in a plane substantially vertical to the axis of rotation of said shaft, a flange located at each end of said vertical portion in a plane substantially parallel to said axis, a plurality of bent over fingers at the outer end of each flange, said fingers being of two different lengths and being arranged alternately according to length to form a passage between the inner surfaces of the longer fingers and the outer surface of the shorter finger; a pair of springs each comprising a coiled section positioned adjacent said shaft and a resilient arm extending from each end of said coiled section, each of said springs having one of said arms pivotally secured to said collar and the other of said arms pivotably mounted in said passage whereby said coiled section is resiliently biased toward said shaft and is adapted to be moved away from said shaft by centrifugal force and thereby pull said collar toward said mounting member.

3. A centrifugal mechanism adapted to be operated at a predetermined speed of rotation of a rotatable shaft and comprising a collar mounted on said shaft and keyed thereto so as to be axially slidable therealong, said collar comprising a hub portion fitting about said shaft, an annular flange portion concentric with said hub portion and integral therewith, and a projection extending from said disc-like portion outside said hub portion and having a pair of passages formed therein; a mounting member comprising a hub portion immovably secured to said shaft by said hub portion, a portion of said member being in a

plane substantially vertical to the axis of rotation of said shaft, a flange located at each end of said vertical portion in a plane substantially parallel to said axis, a plurality of bent over fingers at the outer end of each flange, said fingers being of two different lengths and being arranged alternately according to length to form a passage between the inner surfaces of the longer fingers and the outer surface of the shorter finger, and two single fingers located at each end respectively of each of said flanges, each of said two single fingers being bent over at an angle to each of said bent-over fingers thereby to form a stop at each end of each of said passages formed by said fingers; a pair of springs each comprising a coiled section and a resilient arm extending from each end thereof substantially vertically to the axis thereof, each of said arms having an end portion bent substantially parallel to said coiled section, each of said springs having one of said arms pivotably mounted in one of said collar passages and the other of said arms being pivotably mounted in one of said mounting member passages whereby said coiled sections are resiliently biased toward said shaft and are adapted to be snapped away from said shaft by centrifugal force and thereby pull said collar toward said mounting member.

4. A centrifugal mechanism adapted to be operated at a predetermined speed of rotation of a rotatable part and comprising a collar mounted on said part so as to be slidable axially therealong, a mounting member immovably secured to said part and axially displaced from said collar, and a spring having a compact coiled section, said spring also having resilient arms extending respectively from each end of said coiled section, one of said arms being pivotably secured to said collar and the other of said arms being pivotably secured to said mounting member whereby said coiled section is free to move away from said part at a predetermined speed of rotation whereupon said one arm exerts pull on said collar causing the same to slide along said part.

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