Feb. 14, 1933. C. F. THOMPSON 1,897,405

SPEED RESPONSIVE ELECTRIC SWITCH

Filed May 20, 1931

Fig. 1

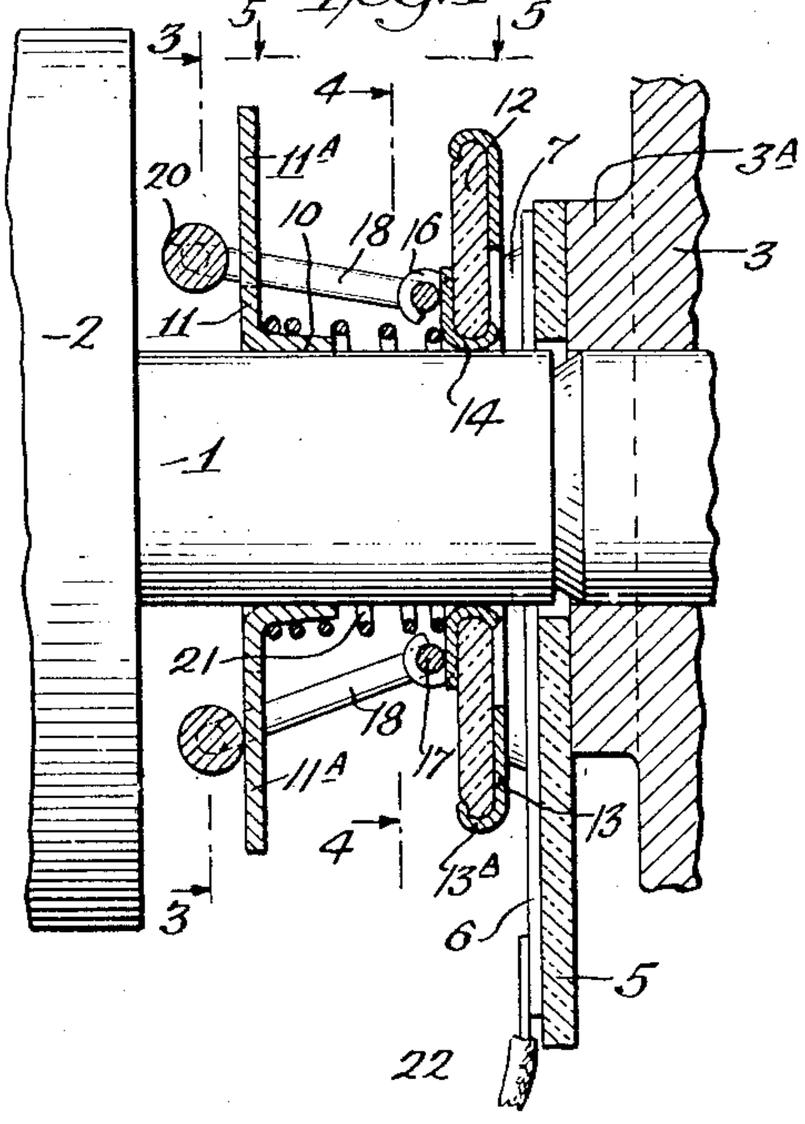


Fig. 2

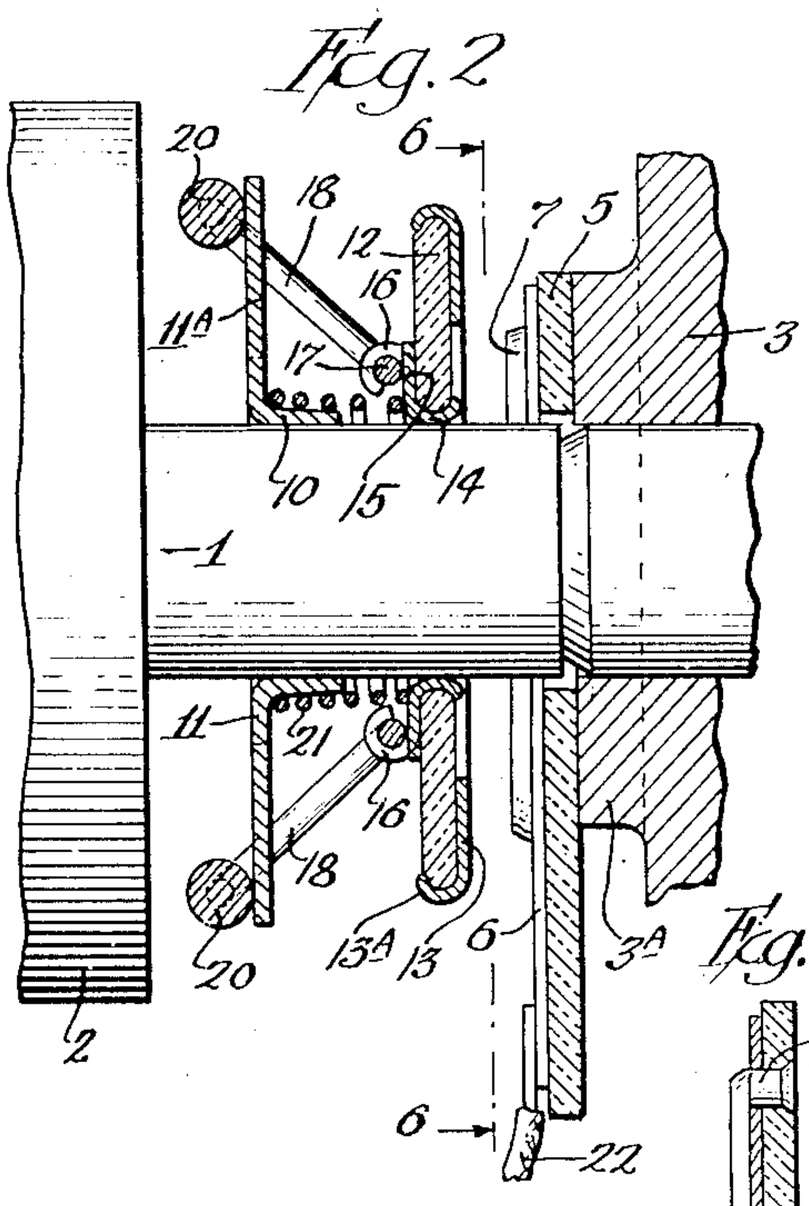


Fig. 3

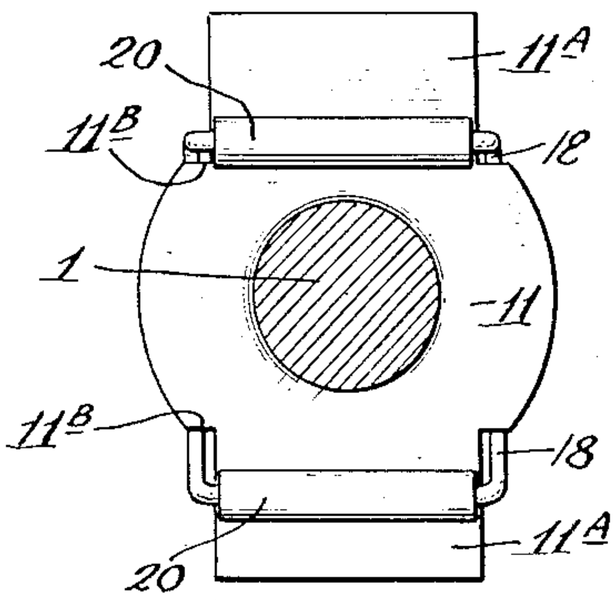


Fig. 4

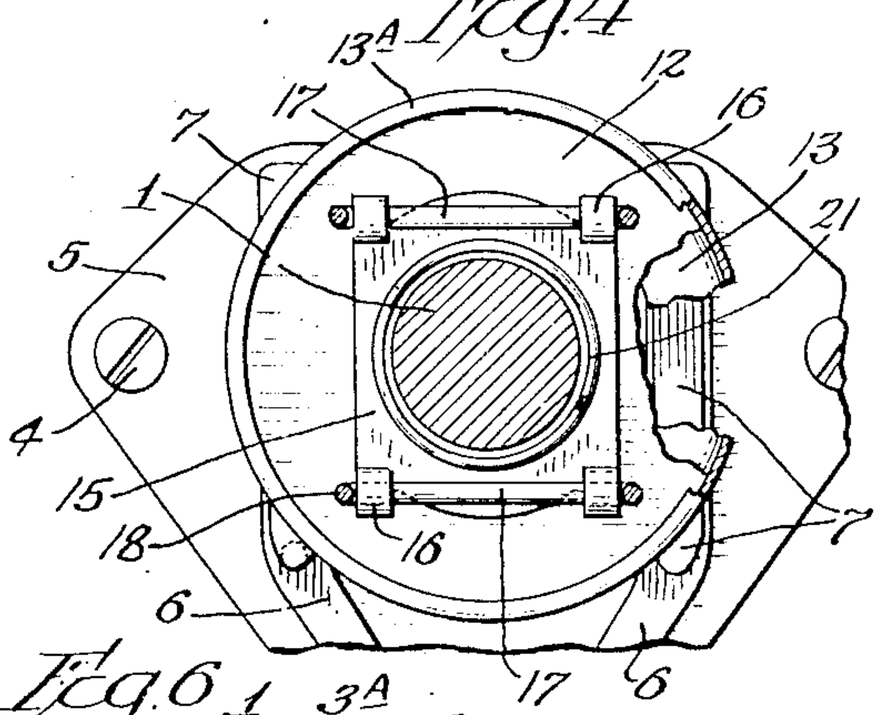


Fig. 5

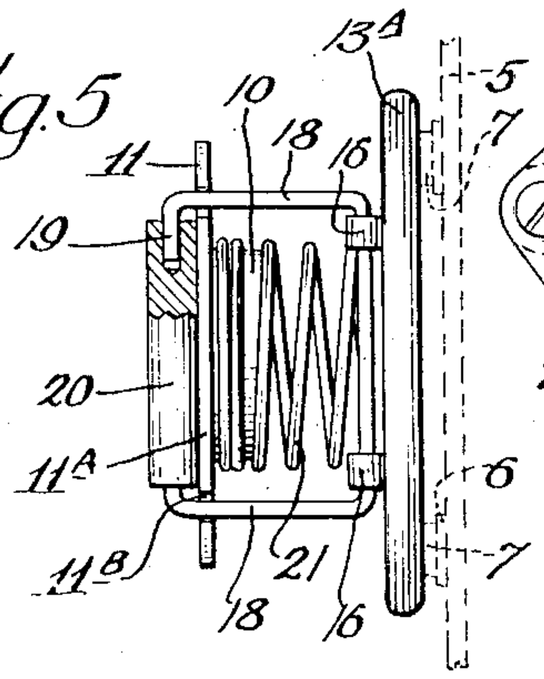


Fig. 6

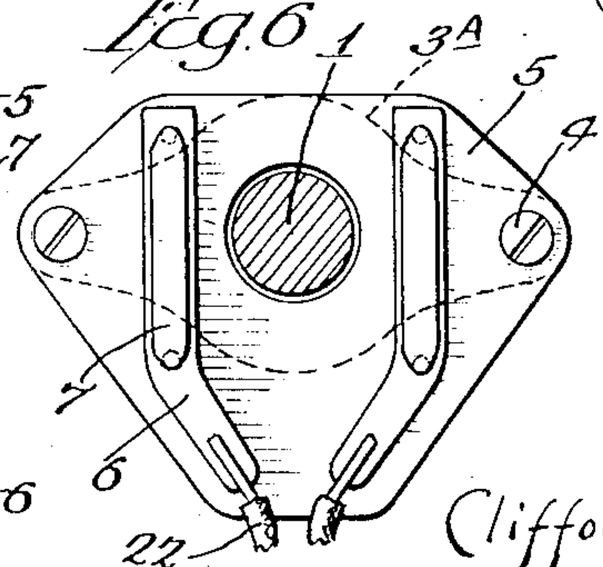
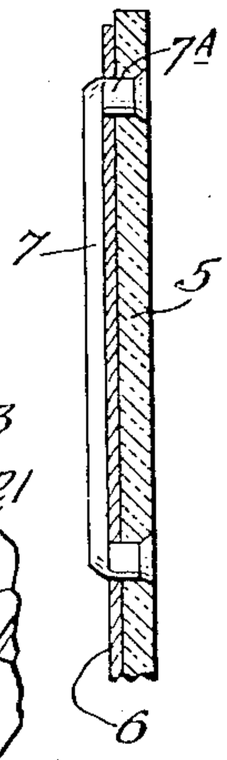


Fig. 7



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UNITED STATES PATENT OFFICE

CLIFFORD F. THOMPSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO BODINE ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

SPEED RESPONSIVE ELECTRIC SWITCH

Application filed May 20, 1931. Serial No. 538,777.

My invention relates to the class of electric switches in which the effect of centrifugal action on certain switch parts automatically moves a switching member out of its circuit-closing position when the movable parts of the switch are rotating at a speed above a predetermined minimum, and in which spring means yieldingly hold the switching member in its circuit-closing position when these movable switch parts are rotating at a speed below the said minimum.

With centrifugal switches of this class as heretofore employed for controlling the auxiliary starting circuit of induction motors, one or more of the following objections have commonly been encountered:

With some types, the mechanism for moving the switching member has included lever systems involving an undesirable number of parts; with others, the actuating mechanism has included sliding parts or cam parts which would affect the operating speed when these parts become worn; and with still others, a part of the switch would have to be fastened to the core of the armature, thereby increasing the cost of the armature. Moreover, with many of the heretofore employed types, sparking will occur unless the contacting circuit-controlling members are constructed and mounted with an accuracy which involves a considerable increase in the cost of manufacture.

My present invention aims to overcome all of these objections, its general objects being that of providing an exceedingly simple, compact and rugged switch of this general class which can easily be assembled and installed, which can be applied to an electric motor without attaching any part to the armature core, which will automatically compensate for any lack of exact alinement between the interengaging contact faces, and which will be quite low in cost.

Still further and more detailed objects of my invention will appear from the following specification and from the accompanying drawing, in which

Fig. 1 is a fragmentary vertical section taken along the axis of the armature shaft through an electric motor equipped with a switch embodying my invention, the shaft and armature portions being shown in elevation, and the section being taken with the armature at rest and the switch closed.

Fig. 2 is a similar section, showing the switch in the circuit-opening position effected by a rotation of the armature at its normal speed.

Figs. 3 and 4 are sections taken at right angles to the axis of the shaft, respectively along the lines 3—3 and 4—4 of Fig. 1 but drawn on a smaller scale.

Fig. 5 is a view looking downward from the line 5—5 of Fig. 1, but drawn on the same scale as Fig. 3.

Fig. 6 is a vertical section taken along the line 6—6 of Fig. 2, drawn on a smaller scale than Figs. 3 to 5 inclusive, with portions of the movable switching member broken away.

Fig. 7 is an enlarged section through the stationary member of the switch, taken along the line 7—7 of Fig. 6.

In the motor portions shown in the drawing, the shaft 1 of the armature 2 is journaled in an inwardly thickened portion 3A of a frame end 3, which thickened portion has the contour shown in dotted lines in Fig. 6. Attached to this thickened portion of the frame by screws 4 is a perforated insulating plate 5 which carries two wire terminals 6 respectively clamped to the insulating plate by two contact bars 7. Each of these contact bars 7 is constituted by the flattened medial portion of a copper or bronze rod which has each end portion 7A extending through alined perforation in the adjacent terminal 6 and the insulating plate 5, and which end portion 7A is enlarged behind this plate to afford a head, as shown in Fig. 7. With the inward frame end 3 faced off at right angles to the

axis of the bearing for the shaft, the inwardly directed contact faces of the contact bars 7 are also disposed in a plane at right angles to the shaft axis.

Tightly driven upon the armature shaft 1 at a suitable distance from the frame end of the motor is a sleeve 10 having integral with it a plate 11 disposed in a plane at right angles of the axis of the sleeve, so that these parts 10 and 11 form a thrust member rigidly mounted upon and rotating with the shaft. The plate 11 of this thrust member has diametrically opposite wing portions 11A, with shoulders 11B at the inner ends of these wing portions, as shown in Fig. 3.

Interposed between this thrust member and the two contact bars 7 is a switching member which is slidable upon the shaft. This switching member includes an insulating washer 12, and a metal contact ring 13 presenting a flat annular face directed away from the thrust member, this contact ring having its edge portion 13A spun over the edge of the washer. To reduce friction and to increase the durability of the switching member, the insulating washer preferably has its bore sufficiently larger in diameter than the shaft 1 so that the bearing on the shaft can be afforded by a collar 14 extending through the bore of the washer and clinched to the washer.

This collar desirably is integral with a perforated pivoting plate 15 which bears against the inwardly directed face of the insulating washer 12, and this plate has at each end an alined pair of projections 16, which projections are recurved (as shown in Fig. 2) so that each pair of these projections forms two alined bearings, the axes of the two pairs of bearings being at opposite sides of the axis of the shaft. To prevent the collar 14 from cutting the shaft, this collar is rounded at each end, and preferably is convexed (in its radial section) toward the shaft. Moreover, the collar preferably has its minimum bore diameter slightly larger than the diameter of the shaft, so that the switching member can tilt on the shaft to insure a flat-wise contact between its contact ring and the stationary contact bars 7.

Extending through and journaled in each pair of these bearing-forming projections 16 is the back 17 of a generally U-shaped wire link which has its two arms 18 extending respectively at opposite sides of one of the thrust-plate wing portions 11A; these two arms being spaced by a distance slightly greater than the width of such a plate end portion, so that they can swing freely alongside the adjacent plate edges and are adapted to engage the plate shoulders 11B when the link is rocked about its said bearings towards the shaft. The pivoted arms 18 extend somewhat beyond the thrust plate and the free end portions 19 of these arms are bent into alinement with each other, each such arm end 19 extending into an end bore in a metal roller 20 which bears against the adjacent wing 11A of the thrust plate.

Interposed between the thrust plate 11 and the insulating washer 12 of the switching member is a compression spring 21 which preferably has one end sleeved upon the collar 10 so as to be centered by the latter.

When the shaft is stationary, this spring presses the contact ring 13 of the switching member against both of the stationary contact bars 17, so as to close the usual auxiliary starting circuit, the pivoted loop arms 18 being of such length that they can then swing freely until halted in movement toward the shaft by the engagement of the arms with the stop shoulders 11B (as shown for the upper arm in Fig. 1) or halted in movement away from the shaft by the engagement of the roller 20 with the adjacent thrust-plate wing as shown in the lower portion of the same figure.

When the armature rotates, the rollers 20 serve as weights which are moved away from the axle of the shaft by centrifugal action, thereby tending to press the thrust plate toward the switching member against the resistance of the spring 21. Since the thrust plate is fast upon the shaft, this tendency causes the arms 18 to pull the switching member toward the thrust plate as soon as the effect of the centrifugal action overcomes the resistance of the spring, and by selecting a spring of suitable strength in proportion to the other parts I can readily cause the centrifugal action to move the contact ring 13 out of engagement with the contact bars 7 at approximately a predetermined speed—as for example, two-thirds the normal running speed of the motor.

Moreover, the parts can readily be proportioned so that the switching member will be moved for a considerable distance beyond its circuit-opening position, so as to afford a wide air gap as shown in Fig. 2, the thrust-plate wings 11A being of sufficient length for still engaging the rollers 20 when the armature is rotating at its maximum speed.

Since the thrust plate, the annular contact member and the combined sliding and pivoting part (which latter includes the collar 14 and the bearings 16) are all punchings, the entire construction is unusually simple and inexpensive. Moreover, if the faces of the contact bars 7 are not exactly in a plane at right angles to the axis of the shaft, the switching member can readily tilt to compensate for this and to insure contact surfaces of ample carrying capacity. And, since no part of my switching mechanism is fastened to the armature, no changes in the latter are required.

When the motor frame is disassembled in the usual manner, the stationary contact assembly is detached with the adjacent frame

end and can easily be replaced if necessary. Then, by manually pressing the switching member toward the thrust member until the rollers snap over the ends of the wings on the thrust plate, the switching member together with the roller-carrying arms can be slid off the shaft, after which the thrust member can be forced off the shaft also if desired, thus permitting an entire removing of my switching mechanism in case any repairs are needed on the armature.

In the assembled switching mechanism, the pivot shaft 17, the arms 18, arm ends 19 and the roller 20 at each side of the armature shaft effectively constitute a pull-effecting loop extending around one wing of the thrust member. This loop has a revolvable portion rolling upon the thrust member to reduce friction, thereby making my mechanism more sensitive and durable than mechanisms which have sliding engagements between cam parts.

However, while I have heretofore described my invention in an embodiment in which the two arms 18 of the loop member are integral, and in which the bearings for these arms are integral both with each other and with a guide sleeve (14), I do not wish to be limited in regard to these or other details of the construction and arrangement above disclosed, since many changes might be made without departing either from the spirit of my invention or from the appended claims. Nor do I wish to be limited to the use of my invention for controlling a starting circuit in an electric motor, although I have found it particularly well suited for this purpose.

I claim as my invention:

1. In combination with a rotatable shaft, of an outstanding arm mounted on the shaft, coacting contact members, one of which is axially movable along the shaft, a link yoke pivoted to the axially movable contact member and embracing the arm, and a roller journaled on the yoke and having a rolling contact with the arm on the side thereof opposite to the axially movable contact member.

2. In combination with a shaft, of oppositely outstanding arms fixed to and rotatable with the shaft, a contact member movable axially along the shaft, rollers that move along the sides of the arms which face away from the contact member, and connections between the rollers and the contact member that permit the rollers to roll and move away from the shaft under the action of centrifugal force.

3. In combination with a shaft, of a sleeve fixed to the shaft and having outstanding arms, a contact member movable axially along the shaft, a spring interposed between the sleeve and contact member, rollers that move along the sides of the arms that face away from the contact member, and links on which the rollers are journaled, said links being pivotally connected to the contact member.

4. In combination with a rotatable shaft, of a contact member movable axially along the shaft and including a collar having a transversely rounded portion that is slidable on the shaft and allows a lateral tilting of the collar, an insulating washer carried by the collar and a contact element mounted on the washer; and centrifugally operated means for shifting the contact member along the shaft and permitting its tilting thereon.

5. In combination with a shaft, of a contact member including a collar having a transversely rounded interior slidable along the shaft and capable of a tilting movement thereon, a sleeve fixed to the shaft and having outstanding arms, a spring interposed between the collar and sleeve, link yokes pivoted to the collar, and having arms extending on opposite sides of the outstanding sleeve arms, centrifugally operated rollers journaled on the link yokes and having rolling engagements with the sides of the sleeve arms that are opposite to those facing the contact member.

6. A structure as per claim 1, in which the link yoke includes side members extending alongside opposite edges of the said arm, and in which the arm is formed to afford shoulders disposed for engaging the said side members to limit the swinging of the link yoke toward the shaft.

7. A structure as per claim 1, in which the contact member comprises an insulator through which the shaft extends, a contact element and a collar both fastened to the insulator and spaced from each other by portions of the insulator; the collar being slidable directly upon the shaft and tiltable with respect to the shaft, and the collar having at the end facing the said arm a portion curved around one end of the link yoke to afford the said pivoting of that yoke to the contact member.

8. A structure as per claim 1, in which the contact member comprises an insulating washer, a contact element fastened to the radially outer portion of the washer, and a collar spun through the bore of the washer and through which the shaft extends, the collar having at the end facing the said arm a radial flange and provided with two ears curved respectively around spaced portions of one end of the link yoke to afford the said pivoting of the yoke to the contact member.

9. A centrifugal switch comprising a movable contact member slidable on a shaft and movable by centrifugal means toward a thrust member fast on the shaft, and a compression spring interposed between the said two members; the thrust member including a radial flange and an arm extending from the said flange and presenting a flat face in a plane at right angles to the axis of the

shaft, and a sleeve integral with and extending from the said arm toward the said contact member and tightly embracing the shaft; the centrifugal means comprising a roller disposed for engaging the said inner face of the said arm, and two links, each pivoted at one end to the contact member and at the other end to the roller and extending along opposite sides of the said arm; and the spring being spiral in form and having one end thereof sleeved upon the said sleeve and abutting against the said flange.

Signed at Chicago, Illinois, May 18th, 1931.

CLIFFORD F. THOMPSON.