

July 4, 1939.

J. B. SINNETT

2,164,667

MOTOR SWITCH

Filed Dec. 30, 1936

3 Sheets-Sheet 1

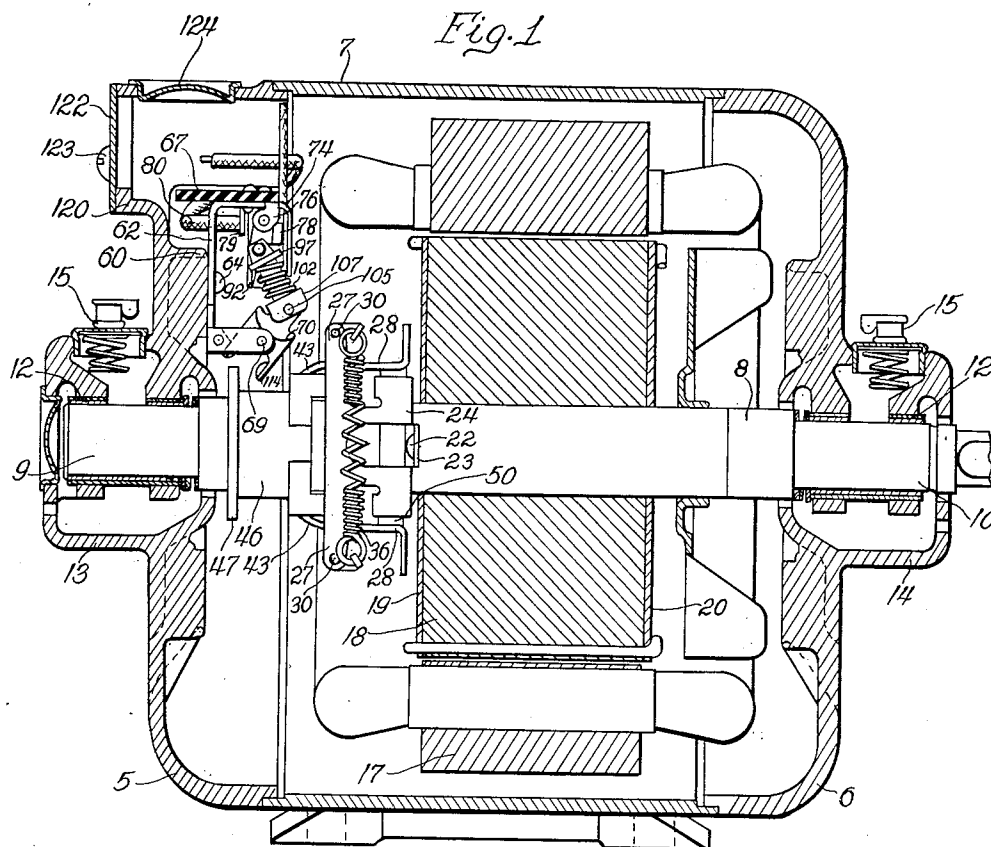
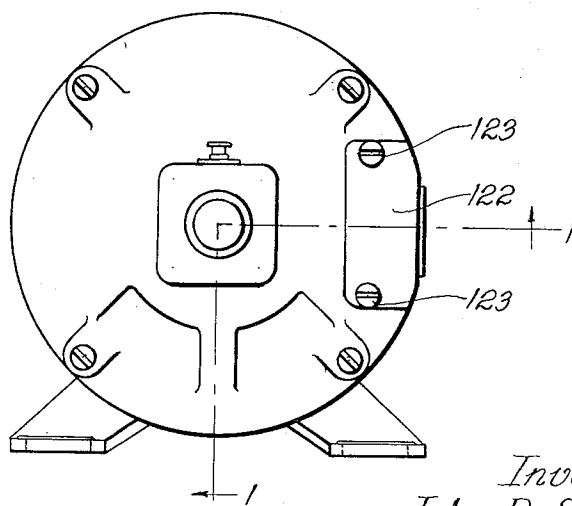


Fig. 2.



Inventor
John B. Sinnett

By *Proffessor Bruce Deane*
Attys

July 4, 1939.

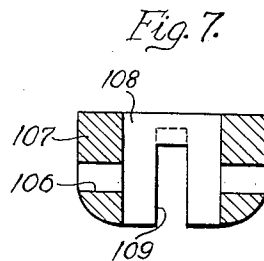
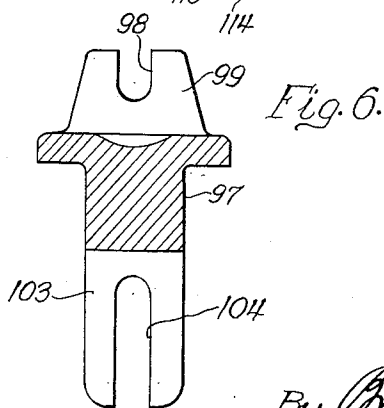
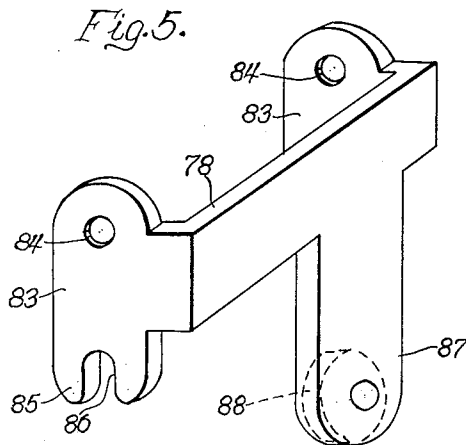
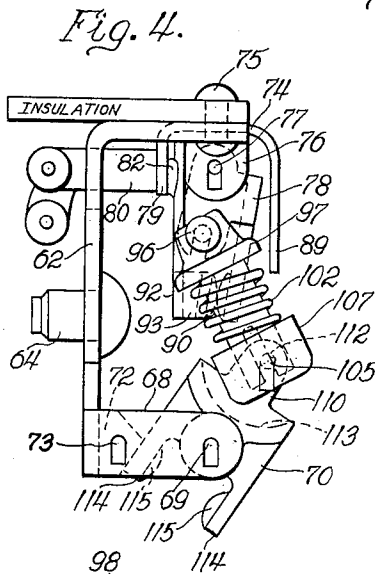
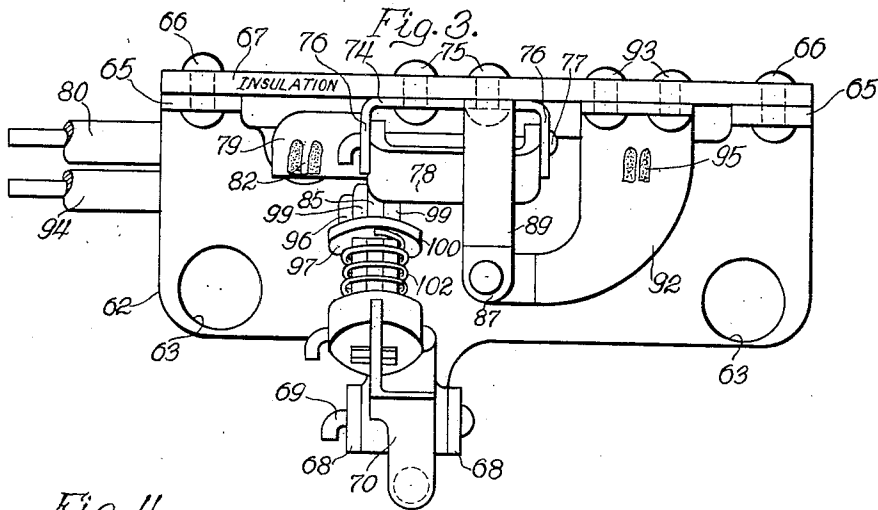
J. B. SINNETT

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MOTOR SWITCH

Filed Dec. 30, 1936

3 Sheets-Sheet 2



Inventor
John B. Sinnett
By *Maurice S. Souther*
Attys

July 4, 1939.

J. B. SINNETT

2,164,667

MOTOR SWITCH

Filed Dec. 30, 1936

3 Sheets-Sheet 3

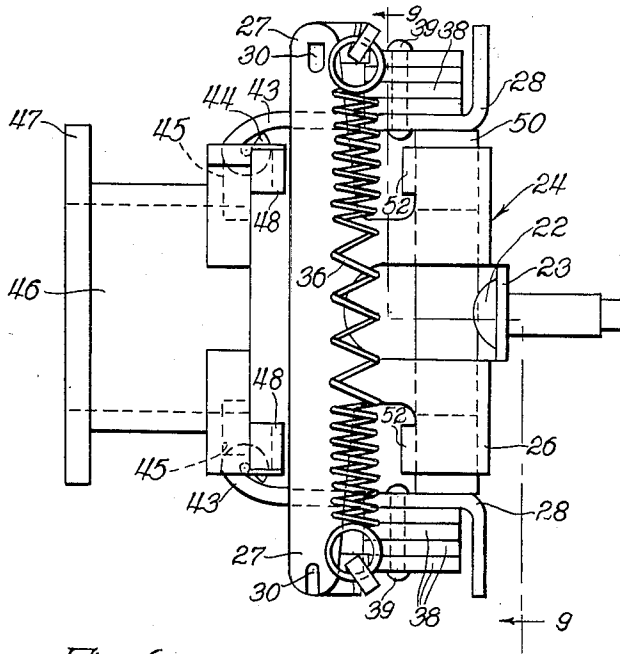


Fig. 8.

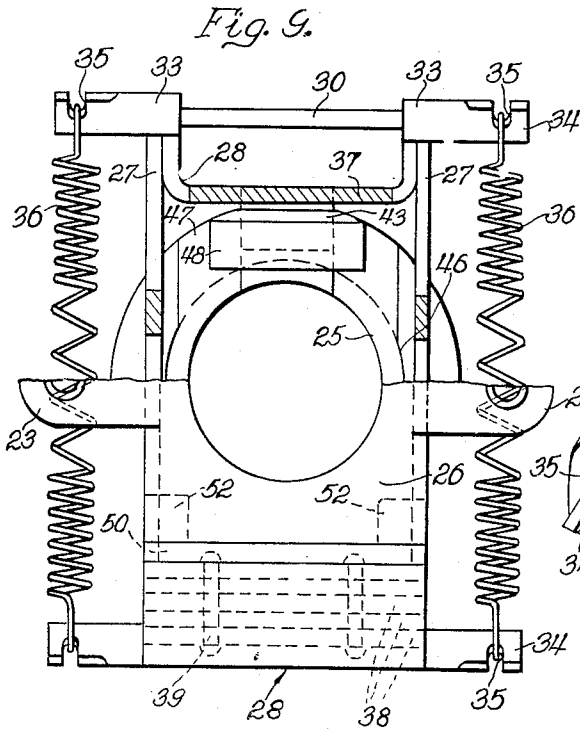
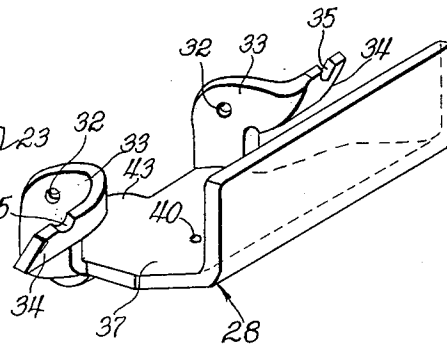


Fig. 9.

Fig. 10.



Inventor
John B. Sinnett
By *Manufacturers Bureau, Inc.*
Attys

UNITED STATES PATENT OFFICE

2,164,667

MOTOR SWITCH

John B. Sinnett, Howell, Mich., assignor to Howell
Electric Motors Company, Howell, Mich., a cor-
poration of Michigan

Application December 30, 1936, Serial No. 118,301

20 Claims. (Cl. 200—80)

This invention relates to motor switches, and more particularly is directed to motor switches for electric motors of the small capacitor or split phase, single phase types, in which centrifugal action at predetermined motor speeds opens and closes the starting switch.

As is well known, induction motors require a larger current for starting than is required for normal operation, and it has been customary to provide an automatically controlled switch which, when the motor is idle or running at slow speeds, will close the starting circuit, and when the motor has attained normal speeds, will open the starting circuit.

The present invention contemplates an improved type of switch and an improved type of centrifugally actuated mechanism for controlling the switch, and afford a combination of switch and control mechanism possessing distinct advantages as far as operation, cost, assembly and maintenance are concerned.

One of the primary objects of the present invention is the provision of a switch having a double toggle action, so constructed that slow or fast acceleration of the motor will always result in a quick break of the contacts, thus reducing burning or wearing of the contact surfaces.

Another important advantage gained by the present invention is the provision of a centrifugal operator consisting of movable weights which, as they fly out radially due to centrifugal force, move a spool axially along the rotor shaft, which in turn operates the toggle mechanism. Since the spool does not engage the operating arm of the toggle mechanism until the predetermined speeds have been attained, no loss of torque is produced, and noise and undue wear are thereby eliminated.

Another feature of the present invention resides in the design of the switch structure, so that the majority of the parts can be made from sheet metal stampings and the like.

Still another feature of the present invention resides in its compact mounting on one side of the rotor, wholly enclosed within the end plates of the motor, and easily accessible and removable for inspection, repair and replacement. Other objects and advantages of the present invention will appear more fully from the following detailed description which, taken in conjunction with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.

In the drawings:

Figure 1 is a sectional view through the motor along the line 1—1 of Figure 2;

Figure 2 is an end elevational view of the motor shown in Figure 1;

Figure 3 is a side elevational view of the switch mechanism;

Figure 4 is an end elevational view of the same;

Figure 5 is an enlarged perspective view of the contact carrying arm of the switch mechanism;

Figure 6 is a detail view, partly in section, of another portion of the switch mechanism;

Figure 7 is a detail view of still another portion of the switch mechanism;

Figure 8 is a side elevational view of the switch operator carried by the rotor;

Figure 9 is a sectional view taken substantially on the line 9—9 of Figure 8; and

Figure 10 is a perspective view of the actuating arm for the operating mechanism.

Referring now in detail to the drawings, the switch comprises generally the two end plate members 5 and 6, between which is supported the annular cylindrical member 7 forming the enclosure for the motor and having shouldered engagement with the defining edges of the cup-shaped end plates 5 and 6.

Mounted within the motor housing formed by the members 5, 6 and 7 is the rotor shaft 8, which shaft has reduced end portions 9 and 10 mounted in suitable bearing members 12 carried by the enlarged boss portions 13 and 14 of the end plates 5 and 6 respectively. Suitable lubricating ports 15 are provided at each of the bosses, and provide communication with the bearing surfaces of the shaft for allowing admission of lubricant thereto through the interior of the enlarged boss portions 13 and 14.

The motor is provided with the stator 17, which may be of usual construction, and which is cylindrical in form and surrounds the rotor indicated generally at 18. The rotor 18 is fixed to the shaft 8, and is conjointly rotatable therewith. The rotor preferably is provided with radially extending side plates 19 and 20, the plate 19 being adapted to receive the screw members 22 by which the operating mechanism is secured for fixed rotation with the rotor 18.

The screws 22 extend through oppositely projecting arms 23 formed on the actuating arm support indicated generally at 24. This support, as shown more in detail in Figures 8 and 9, is provided with the arm portions 23 struck out from the sides thereof, and is also provided with the opening 25 in the rear face thereof which fits about the rotor shaft 8. Extending forwardly

from the rear surface 26 of the support are the vertically extending arm members 27, which have suitable openings formed adjacent the extremities thereof for pivotally mounting the actuating arms 28 therein for centrifugal movement.

The actuating arms are mounted on transversely extending pivot pins 30 extending between the opposite extremities of the arms 27, and extending through the pivot openings 32 formed in the projecting portions 33 of the actuator arms, as shown in Figure 10. The arms 33 extend outwardly as indicated at 34, and terminate in notched portions 35 adapted to receive the upper ends of the spring members 36 supported therebetween. The notched arms 33 are disposed in spaced relation to the pivot 30, so that at no time will they pass over center position with respect to the pivots.

Between the arm portions 33 of the member 28 is a substantially flat portion 37, which is adapted to receive a plurality of flat plate members 38 forming weights for controlling the pivotal action of the arm under rotation of the rotor, these plates being secured to the arm by means of the rivets 39 which extend through suitable openings 40 formed in the portion 37 of the arm. The rear portion of the arm is extended upwardly at right angles to the portion 37, as indicated at 42, and forms a rear stop for the plates 38.

The above described arrangement enables the mechanism to be readily adapted to motors having different normal operating speeds, by merely adding or subtracting the weights 38. For example, the present switch mechanism can be used on motors having normal operating speeds of 900, 1200, 1800 or 3600 revolutions per minute.

Each of the arms 28 is provided at its forward portion with a forwardly and downwardly extending tongue 43, which is rolled as indicated at 44 in Figure 8 to be received within recesses 45 formed in a shaft sleeve or spool 46 which has sliding movement upon the rotor shaft 8. The shaft sleeve 46 has the radially extending actuating flange 47 adapted for engagement with the switch toggle mechanism, and is provided with the oppositely extending portions 48 suitably folded to form recesses 45 in which the forward ends of the tongue 43 are adapted to extend to control sliding movement of the sleeve 46 upon pivotal movement of the arms 28 about the pivots 30.

A suitable actuator stop 50 is provided, which is retained in position within the actuator support 24 by means of the forwardly and inwardly bent tongues 52 formed integral with the support and retaining the block shaped member 50 in fixed nonrotative position within the support 24. The lower or inner surfaces of the actuator arm 28 are adapted to rest upon the defining edges of the block member 50 when the motor is idle or running at low speeds, thereby forming a support for limiting the axial movement of the sleeve 46 with respect to the switch mechanism.

The springs 36 normally retain the actuating arms 28 in engagement with the actuator stop 50 while the motor is idle or running at slow speeds, but as the motor accelerates, the centrifugal force acting upon the actuator arms causes these arms to pivot in opposite directions about the pivots 30, moving the rear portion of the arms outwardly away from the defining edges of the stop 50. As a result, the forward ends 43 of these arms are moved downwardly and rearwardly with respect to the support 24, moving

the sleeve 46 to the right, against the tension of the spring 36. As the motor speed decreases below a predetermined minimum, the springs 36 again come into action to effect pivotal movement of the arms 28 in a direction toward the stop 50, moving the ends 43 thereof axially outwardly to move the sleeve 46 axially away from the support 24.

Considering now the switch mechanism in detail, shown in Figures 1, and 3 to 7, inclusive, the switch mechanism is preferably supported on the boss portion 60 of the end plate 5 by means of the switch supporting member 62 which is provided with suitable openings 63 adapted to receive screws 64 mounting the same upon the face of the boss 60.

The switch support 62 has a pair of forwardly extending tongues 65, which are adapted to receive suitable rivets 66 for securing an insulating block 67 thereto, the support 62 being cut away between the ears 65 to provide clearance for assembly of the switch mechanism upon the insulating block 67. Adjacent its lower edge, the member 62 is provided with an integral tongue portion having forwardly extending arms 68 spaced apart and adapted to receive adjacent their extremities the pivot pin 69 for supporting the toggle member 70 for oscillation therebetween. A suitable toggle stop 72 is also supported by these arms adjacent the inner ends thereof, as indicated clearly in Figure 4, the toggle stop being held in position by the pin 73, and limiting the swinging movement of the toggle member 70.

Mounted upon the insulating block 67 is the contact arm supporting member 74, which is secured thereto by means of the rivets 75, and which has the parallel downwardly extending arm portions 76 receiving the pin 77 for pivoting the contact arm 78 therebetween. The contact support 74 is also provided with an offset extending portion 79, shown clearly in Figures 3 and 4, which is adapted to provide a terminal connection for the conductor 80 leading thereto, the conductors 80 being soldered, as indicated at 82 for electrical contact with the contact arm supporting member 74.

The contact arm 78 carried by this support is shown more in detail in Figure 5, and comprises a pair of parallel arm portions 83 having suitable openings 84 therein adapted to receive the pin 77 for pivotally supporting the arm for oscillation between the supporting arms 76 of the contact arm support 74. One of the arm portions 83 of the member 78 is provided with a downwardly extending forked portion 85, which is provided with the recess 86 adapted to receive the actuating pin of the toggle mechanism for reciprocating the member 78 into and out of switch closed position. The contact arm 78 is also provided with a downwardly extending portion 87, which at its outer end is adapted to carry the contact 88 thereon, this contact being preferably formed of silver or the like and suitably secured to the inner face of the arm 87. A protecting tongue 89 is formed integral with the contact arm support 74, and extends over and overlies the portion 87 of the contact arm 78, protecting the same from the interior of the motor housing.

The contact 88 carried by the contact arm support 78 is adapted to have contact engagement against a second contact 90 carried by the stationary contact support 92, which is secured by means of the rivets 91 to the insulating block 67. The contact 90 is supported in an angular

position with respect to the stationary contact support 92 by means of the spacing member 93, so that the contacting surface thereof extends substantially parallel to the contact surface of the contact 88 when the arm 78 is moved into switch closed position.

A conductor 94 extends rearwardly of the switch support 62, and is provided with a terminal connection at 95 with the stationary contact support, thereby electrically connecting the stationary contact 90 with the conductor 94.

The contact arm 78 is oscillated by engagement of the spring guide pin 96 carried at the upper end of the spring guide 97 in the recess 86 formed in the portion 85 of the arm 83. This pin 96 is provided with flanges at opposite ends thereof which retain it against axial movement with respect to the spring guide 97, and has a reduced intermediate portion engaging in the notch 98 formed in the guide 97 and also in the notch 86 of the contact arm. The portion 99 of the spring guide is preferably bifurcated, and extends upon opposite sides of the portion 85 of the contact arm as clearly illustrated in Figure 3. The member 97 is also provided with the annular flange 100, which forms an upper seat for the spring member 102 which encircles the body portion of the spring guide 97. The lower end of the spring guide 97 is also bifurcated to provide two parallel arm portions 103, which are preferably longitudinally recessed as indicated at 104 to receive the pin member 105 extending through the opening 106 of the spring seat 107 shown in detail in Figure 7. This spring seat, which carries the pin 105, is provided with a central recessed portion 108 receiving the lower end forks 103 of the spring guide 97, and its upper surface is adapted to form a second seat for the spring member 102. The spring seat 107 is also provided with the recess 109 adapted to receive the upper forked end 110 of the toggle member 70. The toggle member 70 is provided with the apertured portion 112 which receives the pin 105, and which reciprocates within the spring seat 107. The upper surface of the member 70 is arcuately recessed, as shown at 113, to provide clearance for the swinging movement of the spring seat 107 as the toggle switch is snapped over center position.

The member 70, which is pivoted upon the pin 69 carried by the arms 68, is adapted to be engaged by the collar 47 of the sleeve 46, and the lower end of the member 70 is provided with parallel extending arms 114, spaced apart a distance such as to provide for free entrance and withdrawal of the flange 47 therebetween. Suitable bearing portions 115 are provided upon each of the arms 114, and are engaged by the radial surfaces of the flange 47 for moving the toggle member 70 in opposite directions about its pivot 69.

The switch mechanism is adapted to be mounted in position prior to assembly of the end plate to the motor housing, but the end plate 5 is provided with a laterally offset portion 120 providing for leading in the terminal conductors which carry the circuit to the switch controlled by the operating mechanism on the rotor. The opening formed by the offset 120 is closed by the closure plate 122, secured to the offset by means of the screws 123, as shown in detail in Figure 2. A press cap 124 is provided for closing the annular surface of the offset, and is readily removable for inspection of the switch mechanism.

In the operation of the mechanism thus far described, the switch as shown in Figures 1, 3

and 4 is in closed position, corresponding to the position when the rotor is idle or running at slow speeds. As the motor accelerates, the rotor increases in speed, and consequently the centrifugal force acting on the arms 28 is increased. This results in tensioning of the springs 36, and causes the forward ends of the arms 43 to move radially inwardly and rearwardly toward the rotor. This results in pulling the sleeve 46 to the right, as viewed in Figure 1, and the flange 47 thus is moved into engagement with the lowermost arm 114 of the toggle member 70. As the motor speed increases, the flange 47 moves further along the rotor shaft, forcing the toggle member 70 to rotate in a counter-clockwise direction. This results in moving the spring seat 107 axially upwardly on the spring guide 97, compressing the spring 102, and moving the spring pin or toggle pin 105 into a center position between the pivots 69 of the toggle member 70 and the pivot formed by the spring guide pin 96. As the toggle snaps over center position, the unconfined spring guide pin 97 moves to the right, causing counter-clockwise rotation of the contact arm 78, moving the contact 88 outwardly away from the contact 90. As a result, the starting circuit is broken, and remains broken as long as the motor speed exceeds that at which the actuating arms retain the sleeve 46 in the position causing this actuation of the toggle mechanism. The point at which this operation occurs can be determined by the amount of weight carried by the arms 28, and the tension of the springs 36, and for a particular motor a predetermined speed is obtained and the operating mechanism adjusted accordingly. As the motor speed decreases below the predetermined minimum, the centrifugal force acting on the arms 28 is reduced to an extent such that the springs 36 cause these arms to move inwardly toward the actuator stop 50. This results in radial outward and forward movement of the ends 43 of these arms, moving the sleeve 46 axially along the rotor shaft 3 to the left, as viewed in Figure 1. The flange 47 engages the opposite arm 114 of the toggle member 70, tending to move the toggle member 70 in a clockwise direction about its pivot 69. This results in snap actuation of the toggle mechanism into the position shown in Figure 1, and results in a snap actuation of the contact arm 78 to close the contacts 88 and 90. The abutting surfaces of the toggle stop member 72 limit the movement of the toggle member, but it is apparent that regardless of whether the motor is accelerating at a slow rate or at a fast rate, the toggle mechanism will operate with a snap action, and the contacts will thus be snapped open and closed, preventing burning or undue wear of these contacts.

It is believed apparent from the disclosure that the majority of the parts for the operating mechanism and for the switch mechanism can be made of metal stampings and castings, and require little or no machine work. This results in a very economical type of switch, which can be easily assembled and is capable of mass production. This, together with the feature of the snap actuation of the contacts, produces a switch of cheap construction which has relatively long life, and needs little or no attention. The adjustability of the mechanism by increasing or decreasing the number of weights carried by the arms, allows the use of the same mechanism for motors of various types, and for motors at which differ-

ent predetermined speeds are required for cutting in and cutting out of the starting circuit.

I am aware that various changes may be made in certain details of construction and operation of the present invention, and I therefore do not intend to be limited except as defined by the scope and spirit of the appended claims.

I claim:

1. In combination, a support, a rotary shaft, a supporting bracket mounted on said support, an insulating plate carried thereby, a fixed contact supporting arm carried by said plate, a pivotally mounted contact supporting arm, terminal contacts on said arms, a toggle actuating mechanism having pin and slot connection to said last-named arm and pivoted on said bracket, a centrifugally operated mechanism adapted to be mounted on said shaft, a sleeve slidable axially of said shaft, a flange on said sleeve, means operatively connecting said sleeve to said last-named mechanism, and means on said toggle mechanism engageable by said flange upon movement of said sleeve for controlling actuation of said mechanism.

2. In combination, a rotary shaft, a starting switch comprising a fixed contact and a movable contact pivoted for swinging movement toward and away from said fixed contact, toggle means having pin and slot connection with said movable contact for snapping the same in opposite directions, an actuator sleeve adapted for sliding movement on said shaft for actuating said toggle means, and means conjointly rotatable with said shaft for moving said sleeve in accordance with the speed of rotation of said shaft.

3. In a centrifugal switch, the combination of a frame, a shaft journaled in said frame, a pair of switch contacts carried by said frame, a switch actuating device slidably mounted on said shaft, centrifugal operating means mounted for rotation with said shaft and operatively connected to said device, and toggle means supported by said frame for snapping said contacts into alternate positions upon alternate axial movement of said device.

4. In a centrifugal switch, the combination of a frame, a shaft journaled in said frame, a centrifugal operating means mounted for rotation with said shaft and including an axially movable actuator on said shaft, a stationary switch contact carried by said frame, a pivotally mounted switch contact, and toggle operating means between said last-named mechanism and said actuator.

5. In a centrifugal switch, the combination of a frame, a shaft journaled in said frame, a switch mechanism on said frame comprising a stationary contact and a pivotally mounted contact movable into and out of engagement with said stationary contact, a pair of toggle links, one of said links having pivoting engagement with said movable contact, a centrifugally controlled actuator slidably mounted on said shaft, and means carried by the other of said links and engaged by said actuator whereby movement of said actuator in opposite directions snaps said movable contact toward and away from said stationary contact.

6. In a centrifugal switch, the combination of a rotary shaft, a frame, a centrifugally controlled actuator slidably mounted on said shaft and having a radial flange, a switch supported on said frame, and toggle means supported on said frame for producing snap action operation of said switch and including spaced arms adapted to be

engaged by opposite faces of said flange upon movement of said actuator.

7. In a centrifugally operated switch of the class described, the combination of a rotary member, a centrifugally responsive member rotated by said rotary member, a movable contact adapted to be actuated by said centrifugally responsive member, and toggle means for imparting snap motion to said movable contact comprising a knuckle pivot and a biasing spring exerting pressure along a line adapted to intersect the axis of said knuckle pivot.

8. Actuating means for a centrifugal switch which is responsive to the speed of rotation of a rotary member, comprising a bracket secured to said rotary member and having parallel spaced arm portions on opposite sides of the rotary member, pivots extending between the extremities of said arm portions, actuator arms carried by said pivots and including projecting inwardly curved ends, an actuator sleeve on the rotary member having diametrically opposite pockets for receiving said ends to produce sliding movement of said sleeve upon rotation of said arms about said pivots, a stop member carried by said bracket limiting pivotal movement of said arms in one direction, and spring means between said arms normally urging said arms toward said stop member.

9. In a centrifugally operated switch of the class described, the combination of a rotary member, a centrifugally responsive member rotated by said rotary member, a movable contact adapted to be actuated by said centrifugally responsive member, and toggle means for imparting snap motion to said movable contact, said toggle means comprising a pair of toggle members connected by a knuckle pivot, and biasing spring means mounted to exert a spring pressure acting substantially longitudinally of said toggle members for imparting snap motion to said toggle members in movement of said knuckle pivot to either side of a dead-center position.

10. Actuating means for controlling a centrifugal switch of the toggle type comprising an actuator sleeve having a radially extending flange and adapted to be mounted for axial sliding movement on a shaft, a bracket adapted to be secured to said shaft and including parallel spaced arm portions, actuator arms pivotally mounted intermediate their ends on said arm portions, said arms having inwardly curved portions at one end operatively engaging said sleeve, the opposite end of said arms being adapted to receive weights controlling the centrifugal movement of said arms about their pivots upon actuation of said shaft, and toggle switch means having a forked actuating member adapted to be snapped in opposite directions by said sleeve flange.

11. Actuating means for controlling a centrifugal switch of the toggle type comprising an actuator sleeve having a radially extending flange and adapted to be mounted for axial sliding movement on a shaft, a bracket adapted to be secured to said shaft and including parallel spaced arm portions, actuator arms pivotally mounted intermediate their ends on said arm portions, said arms having inwardly curved portions at one end operatively engaging said sleeve, the opposite end of said arms being adapted to receive weights controlling the centrifugal movement of said arms about their pivots upon actuation of said shaft, and toggle switch means having a forked actuating member adapted to be

snapped in opposite directions by said sleeve flange, said sleeve flange normally being positioned out of engagement with said member.

12. Actuating means for controlling a centrifugal switch of the toggle type comprising an actuator sleeve having a radially extending flange and adapted to be mounted for axial sliding movement on a shaft, a bracket adapted to be secured to said shaft and including parallel spaced arm portions, actuator arms pivotally mounted intermediate their ends on said arm portions, said arms having inwardly curved portions at one end operatively engaging said sleeve, the opposite end of said arms being adapted to receive weights controlling the centrifugal movement of said arms about their pivots upon actuation of said shaft, spring means interconnecting said arms at a point intermediate their pivots and said opposite ends thereof, and toggle switch means having a forked actuating member adapted to be snapped in opposite directions by said sleeve flange.

13. In a switch of the class described, the combination of a stationary support, a rotary member, a centrifugal actuating means mounted for conjoint rotation with said rotary member and including a sleeve axially slidable on said rotary member, a switch mechanism supported on said stationary support and including a stationary contact and a pivotally mounted contact and means supported on said stationary support providing a spring controlled toggle actuating means for said pivotally mounted contact and engageable by said sleeve upon predetermined speeds of rotation of said rotary member to snap said pivotally mounted contact toward and away from said stationary contact.

14. In a switch of the class described, the combination of a rotary member, a relatively stationary mounting member, a centrifugal actuating means mounted for conjoint rotation with said rotary member and including a sleeve axially slidable on said rotary member, a switch mechanism supported on said mounting member and including a stationary contact and a pivotally mounted contact and means supported on said mounting member providing a spring controlled toggle actuating means for said pivotally mounted contact and engageable by said sleeve upon predetermined speeds of rotation of said rotary member to snap said pivotally mounted contact toward and away from said stationary contact, said sleeve being out of engagement with said toggle actuating means when said rotary member is rotating at speeds other than said predetermined speeds.

15. In a switch of the class described, the combination of a rotary member, a relatively stationary mounting member, a centrifugal actuating means mounted for conjoint rotation with said rotary member and including a sleeve axially slidable on said rotary member, a switch mechanism supported on said mounting member and

including a stationary contact and a pivotally mounted contact and means supported on said mounting member providing a spring controlled toggle actuating means for said pivotally mounted contact and engageable by said sleeve upon predetermined speeds of rotation of said rotary member to snap said pivotally mounted contact toward and away from said stationary contact, said centrifugal actuating means including spring means actuating said sleeve to move said contacts into closed position when said rotary member speed drops below a predetermined point.

16. In a device of the class described, the combination of a switch, a rotary member, centrifugal operating means rotated by said rotary member and adapted to operate said switch, and toggle means comprising a toggle spring adapted to swing laterally to different over-center positions for causing snap actuation of said switch.

17. A centrifugally operated switch comprising toggle means including a laterally swinging toggle member and a laterally swinging toggle spring for causing snap actuation of said switch.

18. In a centrifugally operated switch of the class described, the combination of a pair of toggle members connected by a knuckle pivot, biasing spring means for imparting snap motion to said toggle members in movement of said knuckle pivot to either side of a dead-center position, a movable switch contact actuated by one of said toggle members, a rotary member, and centrifugally operated actuating means rotating with said rotary member and operative to impart motion to one of said toggle members.

19. In a centrifugally operated switch of the class described, the combination of a rotary member, a centrifugally responsive member rotated by said rotary member, and toggle snapped contact mechanism adapted to be operated by said centrifugally responsive member and comprising a movable contact carrying member, a first toggle member movable relatively to said movable contact carrying member and cooperating therewith, a second toggle movable relatively to said first toggle member and cooperating therewith, and spring means acting substantially along the length of one of said toggle members for causing snap actuation of said mechanism.

20. In a centrifugally operated switch of the class described, the combination of a rotary member, a centrifugally responsive member rotated by said rotary member, and toggle actuated contact mechanism adapted to be operated by said centrifugally responsive member and comprising two relatively movable toggle members cooperating with each other through a knuckle pivot, and a compression spring associated therewith acting along a line adapted to intersect the axis of said knuckle pivot for imparting an over-center snap motion to said toggle members.

JOHN B. SINNETT.