July 21, 1970 E. J. SCHAEFER 3,521,496

CENTRIFUGAL MECHANISM AND SWITCH ASSEMBLY

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Fig. 1.

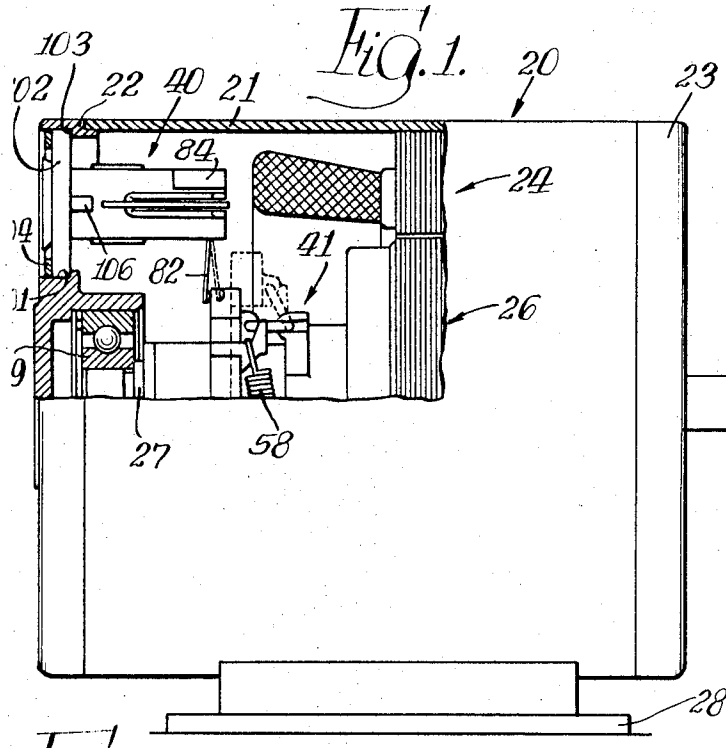


Fig. 2.

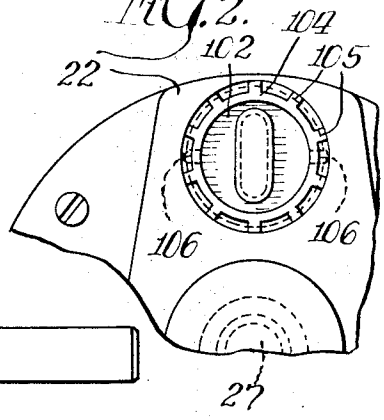


Fig. 3.

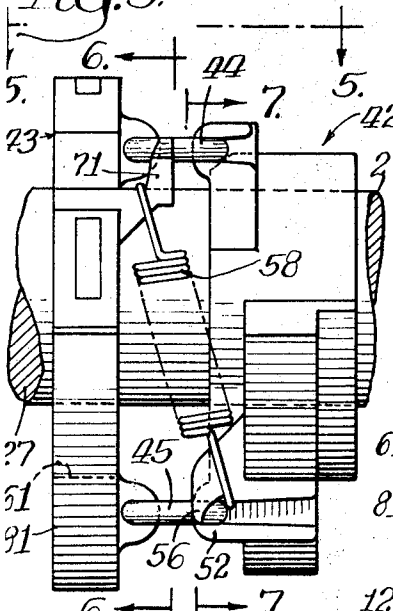


Fig. 4.

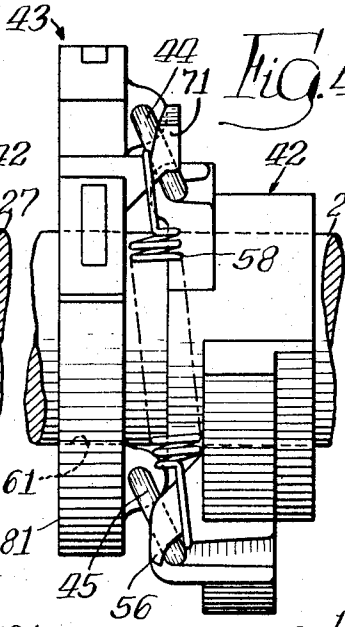


Fig. 5.

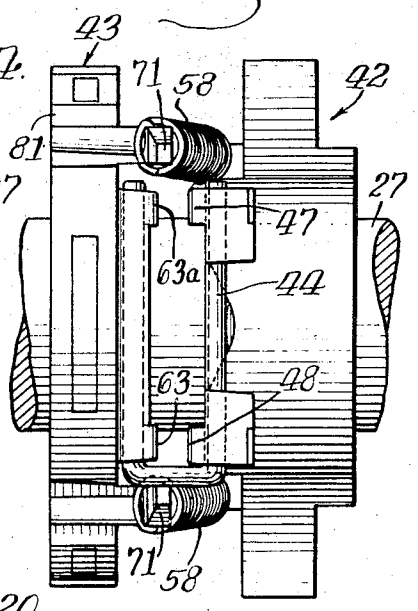


Fig. 15.

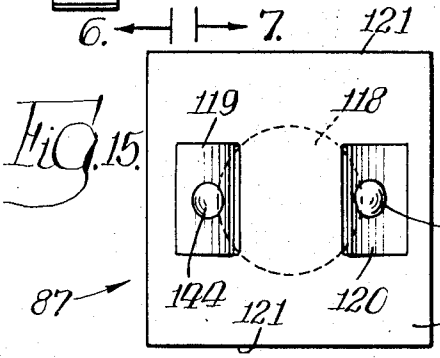
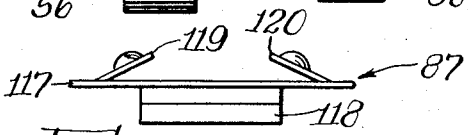


Fig. 14.



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CENTRIFUGAL MECHANISM AND SWITCH ASSEMBLY

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Fig. 6.

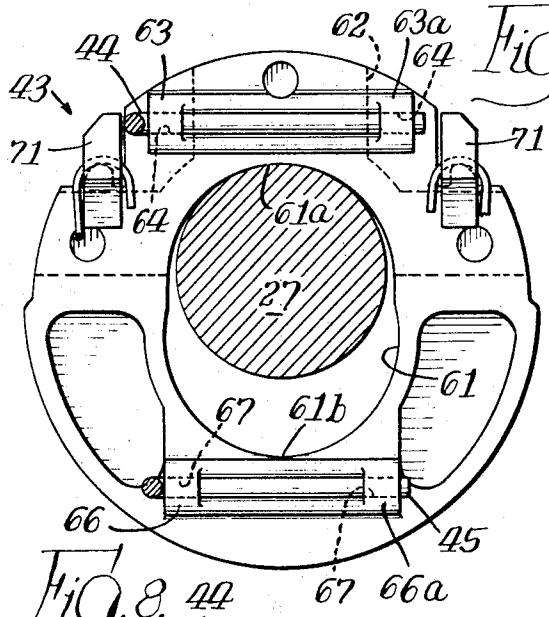


Fig. 7.

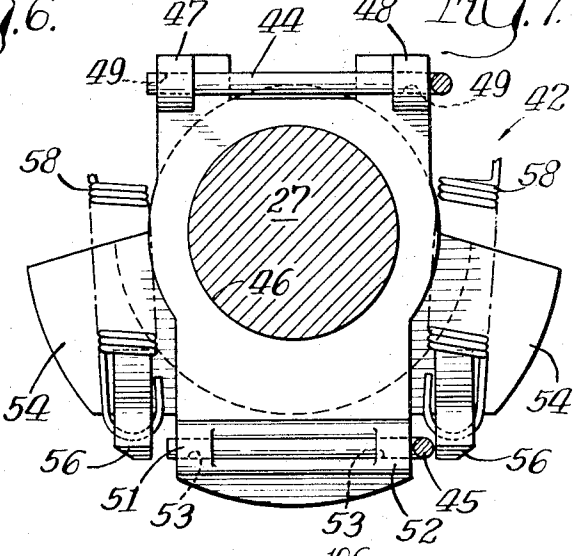


Fig. 8.

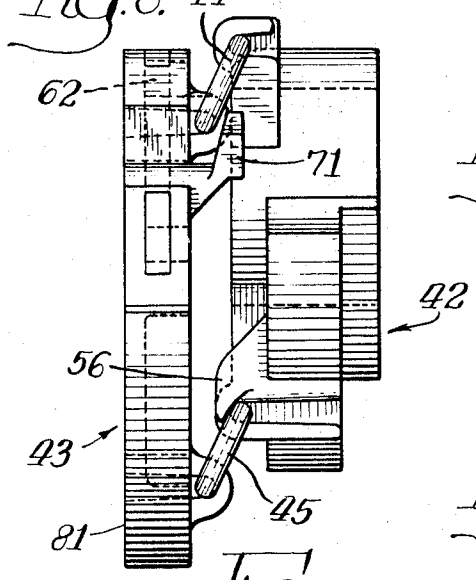


Fig. 9.

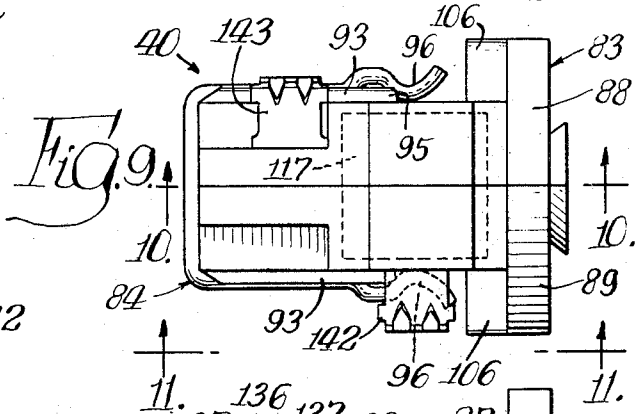


Fig. 10.

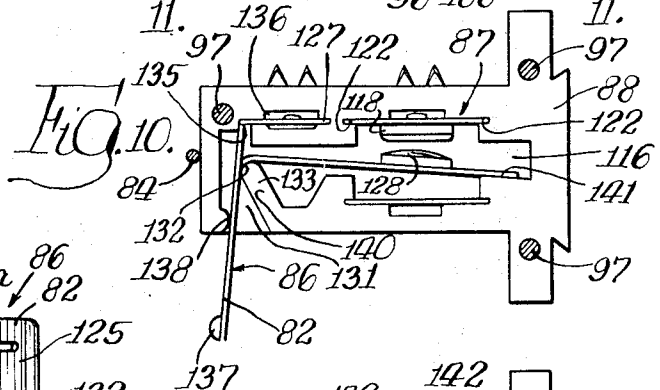


Fig. 13.

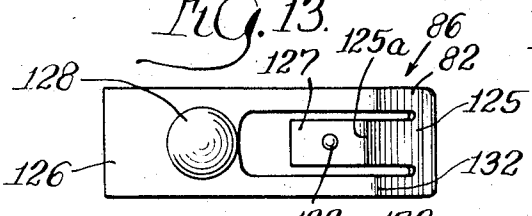


Fig. 12.

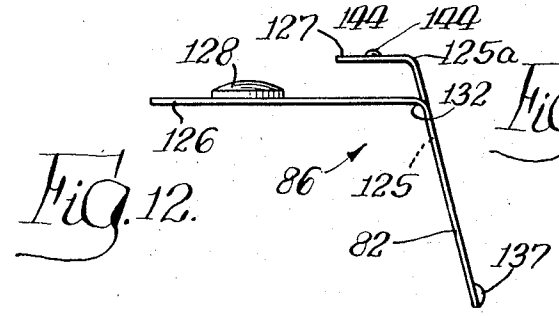
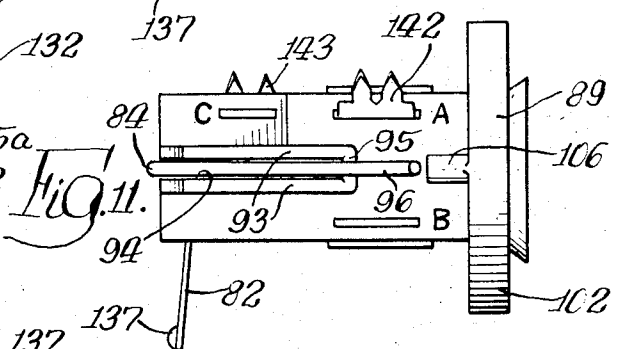


Fig. 11.



United States Patent Office 3,521,496 Patented July 21, 1970

3,521,496

CENTRIFUGAL MECHANISM AND SWITCH ASSEMBLY

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Filed May 29, 1967, Ser. No. 641,787
Int. Cl. G01p 3/18
U.S. Cl. 73—538 4 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure deals with an assembly of a centrifugal mechanism and an electric switch for use with an electric motor, the mechanism being rotated by the motor and the switch being electrically connected to cut out a start winding of the motor at a predetermined motor speed. The centrifugal mechanism includes two inexpensively molded parts, one of the parts being secured to the motor shaft and the other part being hinged to the first mentioned part. Hinge pins and springs connect the two parts. The parts are assembled off the motor shaft, and once the assembly is fastened to the motor shaft, an interlocking relation between the two parts and the hinge pins prevents disassembly. The switch includes a molded case and two contact carrying members, one of the two members, in addition to carrying a contact, including a portion which serves as a spring and another portion which engages the centrifugal mechanism.

Certain types of electric motors have a running winding, a starting winding, and a motor speed responsive apparatus including a switch designed to connect the starting winding to a power supply only at motor speeds below a predetermined speed. Usually, the switch is closed at standstill and open when the motor is operating above the predetermined speed, and the switch automatically recloses when the motor speed falls to the predetermined speed.

An electric motor including an assembly of this character is disclosed in E. J. Schaefer Pat. No. 3,244,832 issued Apr. 5, 1966. The centrifugal mechanism includes a first part secured to the motor shaft and a second part pivotally connected to the first part by parallel links. A pair of springs hold the second part in an "at rest" position when the motor is deenergized but the second part swings radially and axially, due to the centrifugal force, relative to the first part to a "running position" when the motor is energized and reaches running speed. The switch is mounted adjacent the centrifugal mechanism, and the axial movement of the second part, as it shifts between the at rest and running positions, actuates the switch.

The assembly disclosed in the foregoing Schaefer Pat. No. 3,244,832 works very well but it is especially suited for use with relatively large size motors. This is true because the assembly is relatively large and expensive and has a relatively large current rupturing capacity. For smaller motors, a smaller and less expensive construction is desirable. In addition, the switch of an assembly for a small size motor may need only a relatively small force to actuate it.

In accordance with the present invention, a centrifugal mechanism and switch assembly is provided, the mechanism comprising primarily two molded parts. One part is secured to the motor shaft and the other part is swingably connected to the first part by a pair of double hinge pins or links and by a pair of springs. No machining or drilling of the two molded parts is required and the two molded parts are held together in interlocking assembled relation with the pins when installed on a motor shaft.

The switch of the assembly comprises a molded case which encloses a stationary member and a movable member, each of the members carrying a contact. In addition to carrying a contact, the movable member includes an actuating arm portion and a spring portion. Due to the novel arrangement of the switch elements, the switch may be easily assembled and permits a relatively long overtravel of the actuating arm portion, and the switch may be actuated without excessive actuating force. Further, the switch is mounted in the motor such that it may be easily removed for servicing or replacement after failure, without disassembly of the motor.

Objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying figures of the drawings, in which:

FIG. 1 is a view partially in section of a motor including a centrifugal mechanism and switch assembly embodying the invention;

FIG. 2 is a fragmentary end elevational view of the motor;

FIG. 3 is an enlarged fragmentary view showing the centrifugal mechanism of the assembly when in an "at rest" position;

FIG. 4 is a view similar to FIG. 3 but showing the mechanism in a "running" position;

FIG. 5 is a view taken on the line **5—5** of FIG. 3;

FIG. 6 is a sectional view taken on the line **6—6** of FIG. 3;

FIG. 7 is a sectional view taken on the line **7—7** of FIG. 3;

FIG. 8 is a view of the mechanism during the assembly thereof;

FIG. 9 is an enlarged elevational view of the switch of the assembly;

FIG. 10 is a sectional view taken on the line **10—10** of FIG. 9;

FIG. 11 is an elevational view taken on the line **11—11** of FIG. 9;

FIG. 12 is an enlarged side elevational view of a part of the switch;

FIG. 13 is a plan view of the part shown in FIG. 12;

FIG. 14 is a side elevational view of another part of the switch; and

FIG. 15 is a plan view of the part shown in FIG. 14.

In greater detail, FIGS. 1 and 2 illustrate an electric motor **20** including a cylindrical stator shell **21** and two end bells **22** and **23** which are secured to and close the ends of the shell. A stator assembly **24** is secured to the inner periphery of the shell **21**, and a rotor **26** including a shaft **27** is positioned within the stator and rotatably mounted on the end bells **22** and **23**. A foot or mounting bracket **28** is secured to the lower side of the shell **21** for securing the motor in a fixed position. The right hand end, as seen in FIG. 1, of the shaft **27** is supported by a bearing assembly (not shown) in the end bell **23**, and the left hand end of the shaft **27** is rotatably mounted in the end bell **22** by means of a bearing assembly **29**.

The motor **20** further includes an assembly of a centrifugal mechanism **41** mounted on the rotor shaft **27** between the rotor **26** and the ball bearing **29**, and a switch **40** mounted on the end bell **22** in position where it may be actuated by the centrifugal mechanism **41**. With reference to FIGS. 3 to 8, the centrifugal mechanism **41** comprises a hub part **42** and a track part **43**, the two parts **42** and **43** being swingably connected together by a pair of U-shaped hinge pins **44** and **45**.

With reference to FIG. 7, the hub part **42** is a one piece molded plastic member having an opening **46** formed therein, the rotor shaft **27** extending through the opening **46** and being secured to the part **42** as by a press fit. On

one side of the shaft **27**, a pair of laterally spaced hinge lugs **47** and **48** are formed on the part **42**, and aligned holes **49** are formed through the lugs **47** and **48**, the holes receiving one arm of the U-shaped hinge pin **44**. On the opposite side of the shaft from the lugs **47** and **48** is provided another pair of hinge lugs **51** and **52**, the lugs **51** and **52** having aligned holes **53** formed therethrough which receive an arm of the U-shaped hinge pin **45**. As shown in FIG. 7, approximately one-half the hub part **42** on the side adjacent the lugs **51** and **52** is enlarged as compared to the other side, for the purpose of proper balancing of the entire centrifugal mechanism. Such enlargement is achieved by forming relatively thick radially extending wing portions **54** on this side of the hub part **42**.

In addition to the hinge pin lugs and the wings, a pair of laterally spaced hook-shaped ears **56** are formed on the hub part **42**, spaced laterally outwardly from the lugs **51** and **52**. As shown in FIG. 3, the ears **56** extend longitudinally toward the track part **43** and then curve radially outwardly from the shaft **27** to form a hook and the laterally inner sides of the ears are spaced from the lugs **51** and **52** a distance which is slightly greater than the thickness of the hinge pins, as shown in FIG. 7. These ears **56** perform the dual function of hook supports for an end of a pair of tension springs **58** and abutments which hold the parts **42** and **43** and the pins **44** and **45** in assembled relation while on the shaft **27**, as will be explained hereafter. The track part **53** also comprises a molded plastic member (FIG. 6) having an elongated opening **61** formed therethrough through which the shaft **27** extends. The elongation of the opening **61** is in the direction of the desired swinging movement permitted by the pins **44** and **45**. While the track part **43** may be a one piece molded plastic member, a weight **62** (FIG. 6) may be provided within the member, the part **43** being molded around the weight. On the side of the track part **43** facing the hub part **42**, there is provided a pair of laterally spaced hinge pin lugs **63** and **63***a* which have holes **64** formed therethrough, the holes **64** receiving one arm of the hinge pin **44**. A second pair of hinge pin lugs **66** and **66***a* having a hole **67** formed therethrough is also provided for one arm of the other hinge pin **45**. The two pairs of lugs on the part **43** are laterally spaced on opposite sides of the shaft **27** (FIG. 8) and are spaced in the direction of elongation of the opening **61**.

The track part **43** also has a pair of hook-shaped ears **71** formed thereon laterally spaced from the hinge pin lugs **63** and **63***a* for the same purpose as the ears **56**. As shown in FIGS. 3 and 5, the two tension springs **58** are connected between the ears **56** and **71**, one of the springs **58** being on each side of the shaft **27**.

The hinge pins **44** and **45** are made of metal wire and are bent into the shape of a U (FIG. 5). The arms of the pin **44** are positioned in the holes **49** and **64** of the associated hinge pin lugs, and the arms of the pin **45** are positioned in the holes **53** and **67** of the associated hinge pin lugs. The axes of the holes **49**, **64**, **53** and **67** and the arms of the pins are normal to the direction of elongation of the opening **61**, so that the track part **43** may swing relative to the hub part **42** in the direction of elongation of the opening **61**. When the mechanism is in the at rest position shown in FIG. 3, the lugs **47** and **48** are longitudinally aligned with the lugs **63** and **63***a*, and the lugs **51** and **52** are longitudinally aligned with the lugs **66** and **66***a*. The center portions of the pins **44** and **45** also extend longitudinally. The tension springs **58** connected at their ends to the ears **56** and **71**, extend in the direction of elongation of the opening **61** and tend to hold the track part in the position shiwn in FIGS. 3 and 6 where the side **61***a* of the opening **61** bears against the shaft **27**. The location of the hinge pin lugs on the two parts relative to the side **61***a* is such that the lugs are longitudinally aligned, as previously explained.

The weight distribution in the radial direction, of the track part **43** is such that the part **43** tends to move radially due to centrifugal force when the mechanism **41** is rotated, the direction of such radial movement being in the direction of elongation of the opening **61** and against the force of the tension springs **58**. The two hinge pins **44** and **45** cause the part **43** to swing radially and also axially toward the hub part **42** when the shaft **27** and the mechanism are rotated at above a predetermined speed, the part **43** being held in planes parallel to the part **42** and normal to the shaft **27**. The extent of such swinging movement is determined by the location of the side **61***b* of the opening **61**, and FIG. 4 shows the relative positions of the parts **42** and **43** when the side **61***b* engages the shaft **27**, referred to herein as the running position.

To assemble the members of centrifugal mechanism and then to mount the mechanism on the shaft **27**, the two parts **42** and **43** are first positioned as shown in FIG. 8, with the hinge pin lugs of the two parts facing each other and the track part **43** offset relative to the track part **43** in the direction which is opposite the direction of movement due to centrifugal force. It will be noted in FIGS. 3 and 4 that, when the mechanism is in the at rest and running positions, one of the ears **71** of the part **43** overlies the center portion of the hinge pin **44** and one of the ears **56** of the part **42** overlies the center portion of the hinge pin **45**, the ears thus preventing the pins from being withdrawn from the respective holes **64** and **67**. However, before the parts **42** and **43** are on the shaft **27**, the part **43** is shifted relative to the part **42** to the positions shown in FIG. 8, and the ears no longer overlie the center portions of the hinge pins and the hinge pins may be freely inserted into or removed from the holes in the hinge pin lugs. This can happen only when parts **42** and **43** are off the shaft **27**. Therefore, when assembling the mechanism the parts **42** and **43** are first moved to the position shown in FIG. 8 and while in this position, the arms of the pin **44** are inserted into the holes **49** and **64** and the arms of the other hinge pin **45** are inserted into the holes **53** and **67**. Due to the offset of the two parts **42** and **43**, the hinge pins may be inserted into the holes and the center portions of the hinge pins may be moved past the adjacent ears until the center portions are within the spaces between the adjacent ear and the hinge pin lug. The track part **43** is then swung in the clockwise direction as seen in FIG. 8 relative to the hub part **42** to bring the hinge pin lugs substantially into longitudinal alignments. As previously stated, in this position the ears **56** nad **71** overlie the center portions of the pins and prevent the pins from being withdrawn laterally out of the holes. While the two parts **42** and **43** are being held in this position, the two parts **42** and **43** are positioned on the shaft **27** and the part **42** is secured to the shaft **27**. The two springs **58** may be connected to the ears **56** and **71** either before or after mechanism is positioned on the shaft. Once the mechanism has been mounted on the shaft **27**, the part **43** cannot be swung to the position shown in FIG. 8 due to engagement of the side **61***a* with the shaft **27**, and consequently the parts of the mechanism are interlockingly held in assembled relation while on the shaft **27**.

The face **81** of the track part **43**, which is away from the hub part **42** is substantially flat and smooth and is adapted to engage an actuating arm portion **82** of the switch **40** when the centrifugal mechanism is in the at rest position, as shown in full lines in FIG. 1. With reference to FIGS. 9 to 15, the switch **40** comprises a case **83**, a generally U-shaped spring clip **84**, a movable member **86**, and a stationary member **87**. The case **83** includes two molded plastic halves **88** and **89** (FIG. 9) which are normally held together in assembled relation by the spring clip **84** which extends over three sides of the assembled halves **88** and **89**. As shown in FIGS. 9 and 11, ridges **93** are provided on the outside of the two halves, the ridges forming channels **94** therebetween, which receive the arms of the spring clip **84**, and which are closed at their inner ends by portions **95**. The outer ends of the

spring clip **84** are provided with curved clip portions **96** which snap over the portions **95** to releasably hold the clip on the halves **88** and **89** and the two halves together. Further, small rounded protrusions **97** (FIG. 10) are formed on the side of the half **89**, which engages the half **88**, the protrusions **97** extending into mating depressions in the half **88** and thereby preventing the two halves from slipping relative to each other.

The switch **40** is secured to the end bell **22** of the motor by positioning the switch in an opening **101** (FIG. 1) formed in the outer radially extending face of the end bell **22**. The end of the case opposite from the spring clip **84** has a radially extending flange **102** formed thereon, and the switch **40** is moved into the opening **101** until the flange **102** is tightly seated against an annular shoulder **103** formed on the end bell **22** within the opening **101**. In this position, the outer face of the switch case is substantially flush with the outer radial face of the end bell **22**. To hold the switch in place in the end bell, a fastening ring **104** (FIGS. 1 and 2) is pressed into the opening **101** over the flange **102**. The fastening ring **104** includes a plurality of radially outwardly extending fingers **105** which tightly engage the inner periphery of the opening **101** when the ring **104** has been pressed into the opening to prevent the switch from accidentally falling out. The diameter of the outer edges of the fingers **105** is normally slightly greater than the inner diameter of the opening **101**, so that the fingers **105** are bowed outwardly slightly as the fastening ring is pressed into the hole, and thus prevent the ring from falling out. To properly orient the switch **40** within the end bell, a pair of radially extending aligning lugs **106** (FIGS. 1, 2 and 9) are formed on the halves **88** and **89**, the end bell **22** having slots which receive the lugs **106**, thereby ensuring proper positioning of the switch.

By this construction, the switch **40** may be easily taken out of the motor for servicing and then reinstalled in the motor, or the switch **40** may be easily replaced by a new switch, without disassembly of the motor. To remove the switch **40**, the ring **104** is first pried out of the opening **101** and then the switch **40** is pulled out through the opening **101**. The switch case **83** may be tilted slightly as the switch is being removed so that the actuating arm portion **82** of the switch will clear the lower side of the opening **101**. After repair or replacement of the switch, it is reinstalled in the motor by inserting it through the opening **101** until the flange **102** is seated on the shoulder **103**, and then a new ring **104** is pressed into the opening **101** to hold the switch in place. The length of the switch from the shoulder **103** to the actuating arm portion **82** is of course such that the arm portion **82** is properly located to be engaged by the part **43** of the centrifugal mechanism.

The stationary member **87** and the movable member **86** are positioned within an opening **116** formed within the two halves, the movable member **86** including the actuating arm portion **82** which extends out of the case. The stationary member **87** comprises a square contact clip **117** (FIGS. 14 and 15) and a contact **118** which is secured to the clip **117** as by welding. The clip **117** has two spring portions **119** and **120** which are punched out of the interior portions of the square contact member **117** and are bent upwardly therefrom. Two edges **121** (FIG. 15) of the contact member **117** are positioned in the grooves **122** (FIG. 10) formed in the two halves at one side of the opening **116** with the contact **118** facing toward the interior of the opening **116**. As shown in FIG. 9, the contact clip **117** extends between the two halves **88** and **89** with one half of the contact member within each half.

The movable contact member **86** comprises the actuating arm portion **82** (FIGS. 1 and 10 to 12), a contact carrying arm portion **126**, and a spring portion **127**, the portions **82**, **126** and **127** being formed from a single piece of metal. The member **86** is bent at **132** to form the arm portions **82** and **126**, these two portions **82** and **126** making an angle of approximately 110° (FIG. 12) and the contact carrying arm portion **126** having a contact **128** secured thereto as by welding. In the present instance, the distance of the contact **128** from the bend **132** is approximately equal to the length of arm portion **82**, but it should be understood that any desired ratio of these two distances may be provided.

The spring portion **127** is formed in the center area of the movable member as by a punching operation and extends from a point **125** in the arm portion **82** upwardly (FIG. 12) in the plane of the arm portion, past the bend **132** and is bent at **125***a* to extend parallel to the arm portion **126**. The distance from the bend **132** to the point **125** is approximately equal to the distance from the bend **132** to the bend **125***a*.

With reference to FIG. 10, when the switch is assembled, the actuating arm portion **82** extends out of the case through an opening **131** formed in the case, the opening **131** communicating with the interior opening **116**. Adjacent the lower end of the actuating arm portion **82** there is provided a rounded offset **137** (FIGS. 10 to 12) which is engageable by the face **81** of the track part **43** of the centrifugal mechanism. From the upper end of the bend **132** the arm portion **82** extends generally downwardly through the opening **131** and the contact carrying arm portion **126** extends toward the right as seen in FIG. 10 within the opening **116**. The contact **128** is located opposite the contact **118** of the stationary member **87**. The spring portion **127** of the movable member extends upwardly from the bend **132** and horizontally into a narrow opening or slot **136** formed within the case above the main opening **116**. When the two case halves are assembled with the movable member therein, the spring portion **127** is held relatively tightly within the slot **136**, whereas the arm portions **82** and **126** are permitted limited movement. The bend **125***a* in the spring portion **127** is received in a corner **135** formed in the main case opening **116**.

The movable part **86** of the switch may either be supported entirely by the spring portion **127** being fixed in the slot **136**, or it may be supported both in this manner and also by a lug engaging the bend **132**. The latter construction is illustrated herein, wherein a rounded lug **133** (FIG. 10) is formed at the interior of the opening **116** and the bend **132** is positioned over the top of the lug. When such a lug is provided, its upper end is preferably notched down to a line **140** so that the spring portion is free of the lug **133** but the bend **132** engages the lug **133**.

To assemble the movable part **86** in one of the halves of the case such as the half **88**, the upper end of the spring portion **127** is positioned in the slot **136** with the bend **125***a* in the corner **135** and the bend **132** is positioned over the lug **133**. A rounded projection **138** is formed on the case at the margin of the opening **131** on the side of the opening opposite from the lug **133**, and the actuating arm portion **82** is positioned in the opening **131** with the actuating arm portion **82** in engagement with the projection **138** when the switch contacts are open, the projection **138** thus serving to limit the extent of movement of the arm portion **82** when the switch is opened. The stationary member **87** is positioned in the grooves **122** in the half **38**, and the other half **89** of the case is positioned against the half **88**, thus enclosing the stationary member **87** and the portions **126** and **127** of the movable member **86**.

As shown in FIG. 10, the actuating arm portion normally bears against the projection **138** and the free end of the arm portion **126** normally rests on a ledge **141** formed on the two halves within the opening **116**, the two contacts **118** and **128** being out of engagement when in this position.

When pressure is applied on the offset **137**, the actuating arm portion **82** and the arm portion **126** pivot in the counterclockwise direction as seen in FIG. 10 about the

lug **133**, the arm portion **126** swings upwardly and the contacts **118** and **128** move into engagement. After the contacts **118** and **128** have moved into engagement, continued counterclockwise movement of the actuating arm portion **82** causes the contact carrying arm portion **126** to bow upwardly slightly, such bowing causing the contact **128** to wipe and roll across the face of the contact **118**, the contact **128** having a rounded surface for this purpose. The spring portion between the point **125** and the bend **125***a* also bows, and when the pressure on the offset **137** is released the force of the spring portion **127** returns the arm portions **82** and **126** to the solid line positions.

When a switch is provided without a lug **133**, a force on the offset **137** causes the arm portions **82** and **126** to swing in the clockwise direction about the bend **125***a*, the spring portion **127** flexing below the bend **125***a*. This construction has the advantages over a switch with the lug **133** of having less frictional drag on the movable member **86** and increased wiping action between the contacts **118** and **128**.

The stationary contact clip **117** and the movable member **86** are both made of an electrically conductive metal, and electrical connections to the contacts **118** and **128** are made through bayonet type connectors **142** and **143** which respectively make electrical contact with the clip **117** and the spring portion **127** as shown in FIG. 10. Narrow openings approximately the width and thickness of the bayonet connectors are formed through the halves **88** and **89** of the case so that the connectors may be inserted through the openings. Small points **144** formed on the clip **117** and the spring portion **127** tightly engage the connectors **142** and **143** and establish firm electrical contact therebetween.

The switch may be assembled by first securing the contacts **118** and **128** to the clip **117** and movable part **86**, respectively. The movable part and the stationary part are then assembled in one of the two housing halves and the other housing half is then assembled with the first housing half thereby enclosing the two contacts. The spring clip **84** is then fastened over the case halves in order to hold the halves in assembled relation, and the two bayonet connectors are then inserted into the respective slots in order to establish electrical connection with the two contacts. When the switch is fully assembled, the motor conductors (not shown) to be connected to the switch are drawn out of the motor through the opening **101** and attached to the bayonet connectors **142** and **143**. The wires must of course be long enough for this purpose. Thereafter, the wires and the switch are inserted through the opening **101** formed in the end bell **22** and the fastening ring **104** is pressed into the opening **101** over the top of the switch to hold the switch in place in the end wall.

When the centrifugal mechanism has been assembled and installed on the rotor shaft **27** and the switch has been fastened in place in the end bell as previously explained, the switch contacts are normally held in electrical egnagement or contact by pressure of the track part **43** on the actuating arm portion **82** of the switch when the motor is at standstill and also when the motor is rotating at below a predetermined speed (solid line position in FIG. 1). When the motor is rotating at above the predetermined speed, the track part **43** is completely out of engagement with the arm portion **82** of the switch (dashed lines in FIG. 1), and the switch contacts are out of engagement. When in the solid line position, the springs **58** of the centrifugal mechanism exert sufficient force on the track part to hold the track part in the "at rest" position and to pivot the actuating arm portion **82** and the contact carrying arm portion **126** against the force of the spring portion **127** and hold the switch contacts closed. When the mechanism is in this position, the arms of the pivot pins are substantially in longitudinal alignment, and since the spring portion **82** exerts only a longitudinally directed force on the track part of the centrifugal mechanism, there is no tendency of the spring portion to move the track part to the running position. Thus, the force exerted by the spring portion on the centrifugal mechanism cannot affect the calibration of the centrifugal mechanism. When the motor is energized and reaches a predetermined speed, the track part **43** of the centrifugal mechanism starts to swing radially outward, and once the track part has moved a slight amount in the radial direction, the arms of the hinge pins are no longer in longitudinal alignment. Consequently the longitudinally or axially directed force exerted by the switch on the track part **43** assists in moving the track part to the "running" position (shown in dashed lines in FIG. 1) until the track part **43** moves out of engagement with the switch actuating arm portion **82**. In addition, the centrifugal force acting on the track part tending to move it radially outward gradually increase as the track part shifts radially outward due to the increased circle movement of the track part. Due to these factors, the track part of the centrifugal mechanism will remain in the at rest position until the predetermined speed is reached and then the track part will rapidly move outwardly with a "snap action." When the track part reaches the running position it is completely out of engagement with the switch actuating arm portion **82** and the spring portion **127** moves the contact carrying arm portion **126** and the actuating arm portion **82** to the normal position shown in FIG. 10 thereby breaking electrical contact through the switch. If the switch is connected to the starting winding of the motor, this winding is deenergized when the switch opens. When the main winding of the motor is subsequently deenergized, the track part of the mechanism again swings radially and axially toward the switch and moves the arm portion **82** to the left, thereby reclosing the switch contacts.

It will be apparent from the foregoing description that an improved, economical and small size, centrifugal mechanism and switch construction has been provided. The two major parts of the centrifugal mechanism are formed by a molding operation with no machining or drilling required on the parts. These two parts of the centrifugal mechanism are easily assembled by inserting two hinge pins into the openings therefor and attaching the springs to the parts. Once the centrifugal mechanism has been positioned on a rotor chaft, the two molded parts and the hinge pins are held together in interlocking relation.

The switch of the assembly may also be inexpensively manufactured by molding the two halves of the case, forming the contact clip **117** from a single piece of metal by a punching operation, and forming the movable part **86** from another single strip of metal by a punching and bending operation. The parts of the switch may be easily assembled by installing the movable and stationary parts in one half of the switch case, enclosing the parts with the other half of the case, and then fastening the two parts of the case together using the spring clip **84**. The switch is further advantageous in that relatively little actuating force is required to move the switch between its positions, the exact amount of the spring force being determined by the design of the spring portion **127**. In a construction where the distance of the contact **128** from the bend **132** is approximately equal to the distance from the bend **132** to the offset **137** which is engaged by the switch, the contact **128** will move substantially the same distance as the portion **137**. Therefore, since the contacts are relatively close together even when the switch is open, the track part of the pivotal mechanism need move only a short distance in order to actuate the switch from one of its two positions to the other position. In addition to the foregoing advantages, the switch permits a long "overtravel" of the track part of the centrifugal mechanism since such overtravel will simply flex the actuating arm portion **82** of the switch and the size of the opening **131**

is such as to permit considerable flexing of the arm portion **82**.

Since the actuating arm portion **82** moves only a short distance when the switch is actuated between its two positions, it is possible for the track part **43** to move completely out of engagement with the arm portion **82**. This is advantageous because the track part **43** and the arm portion **82** are out of engagement when maximum wear would otherwise occur, which is at running speed. Further, the switch contacts move completely to the open position and are not held intermediate the open and closed positions due to engagement of the arm portion **82** by the track part **43**. However, even if the switch should fail, such failure usually being due to contact arcing or wear at the offset **137**, the switch may be easily replaced without disassembly of the motor. Thus, the switch is mounted within the motor housing and not in a separate housing external to the motor as in some constructions. Nevertheless the switch may be easily replaced when necessary without disassembly of the motor.

I claim:

1. A centrifugal mechanism for use with a rotatable shaft, comprising a first part, a second part, hinge means, including a removable hinge part, connecting said second part to said first part for enabling swinging movement of said second part relative to said first part between first, second and third positions, said first position being obtained when said parts are mounted on the shaft and are rotating with the shaft at above a predetermined speed, said second position being obtained when said parts are mounted on said shaft and are at standstill or are rotating below said predetermined speed, and said third position being obtained only when said parts are off of said shaft, said second part including means adapted to engage the shaft to prevent said second part from moving to said third position when said parts are mounted on the shaft, and abutment means formed on said first and second parts and being in overlying relation with said removable hinge part to prevent removal of said hinge part when said second part is in said first and second positions, said abutment means being out of overlying relation with said hinge part only when said second part is in said third position.

2. Apparatus as in claim **1**, wherein said first and second parts are of molded plastic, and said molded plastic second part includes a metal weight embedded therein.

3. Apparatus as in claim **1**, and further including spring means connected between said first and second parts for urging said parts relative to each other from said first position toward said second and third positions, said spring means being connected to said abutment means on said first and second parts.

4. Apparatus as in claim **1**, wherein said removable hinge comprises a pair of U-shaped hinge pins, the center portions part of said pins extending between said first and second parts, and said abutment means overlying said center portions of said hinge means when said parts are in said first and second positions but being displaced from said center portions when said parts move to said third position.

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