Sept. 15, 1936. J. S. HODDY 2,054,479

CLUTCH AND SWITCH FOR ELECTRIC MOTORS

Filed April 15, 1935

FIG 1

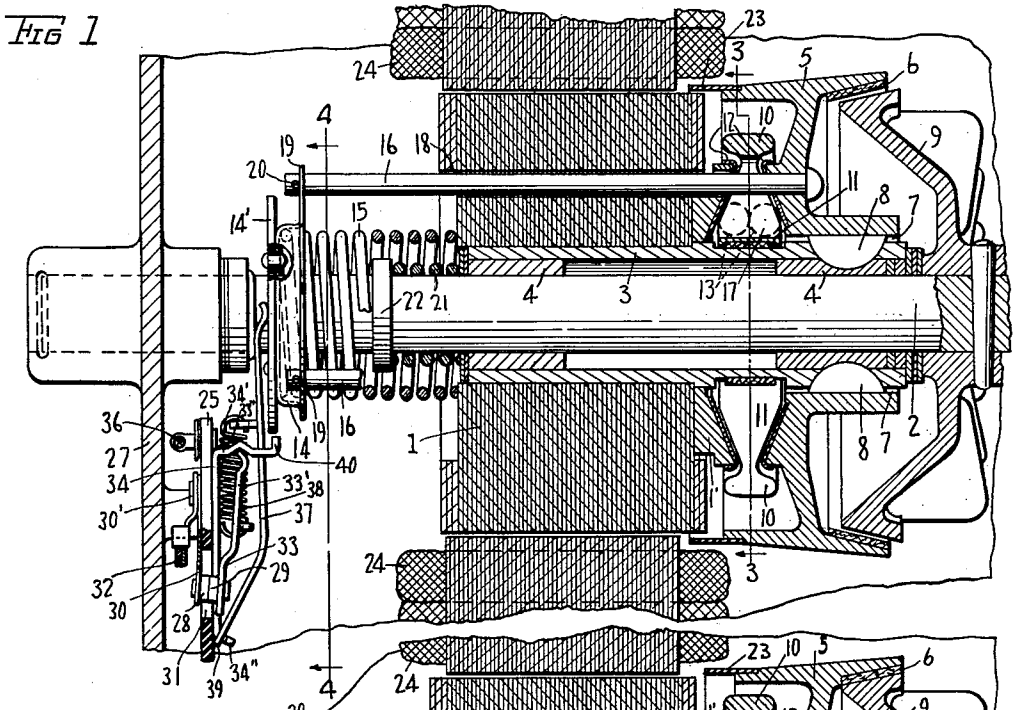


FIG 2

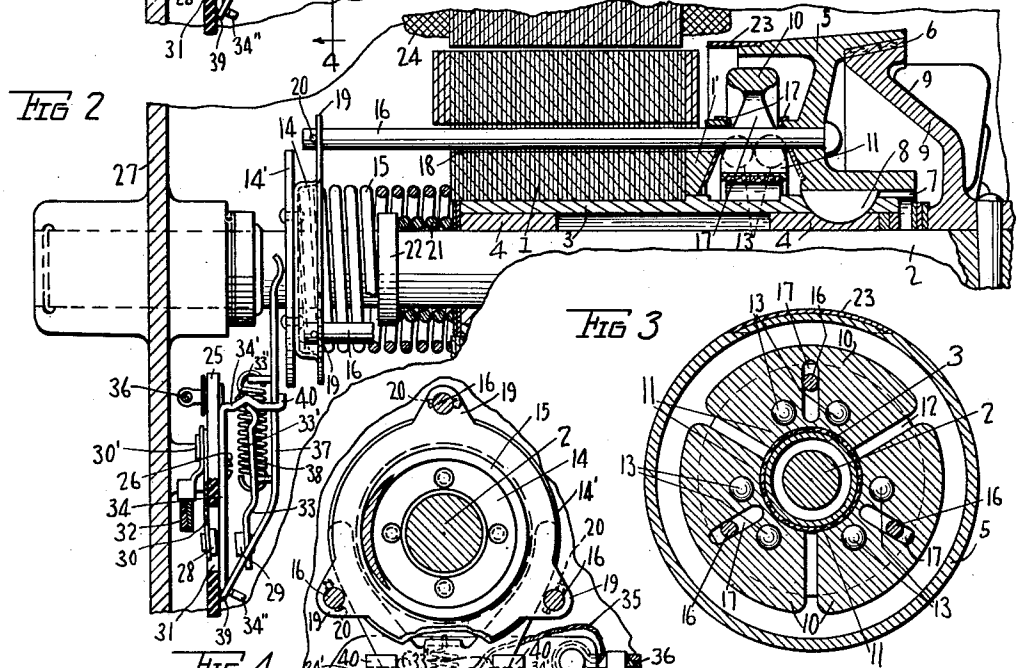
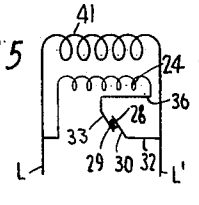


FIG 3

FIG 4

FIG 5



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CLUTCH AND SWITCH FOR ELECTRIC MOTORS

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4 Claims. (Cl. 192—.02)

This invention relates to a clutch and switch for use in connection with single phase alternating current induction motors, although not necessarily confined to that particular use.

In motors of the type referred to a start winding is employed which is usually controlled by a centrifugally operated circuit breaking mechanism whereby the start winding is cut out after the start is made. When a clutch is employed in connection with such a motor of the centrifugally operated type such as shown, it is the essential mode of operation that the start winding be cut out before the clutch members become engaged and that it be cut in after the clutch members become disengaged. When the clutch members are operated by one set of centrifugally operated devices and the switch member by another set of centrifugally operated devices it often happens that such a mode of operation is not efficiently performed due to the difficulty of properly timing the operation of the two sets of centrifugally operated devices.

It is an object of my invention to devise an arrangement whereby the engagement and disengagement of the clutch members and the operation of the switch which controls the start winding may be accurately timed so that the start winding will be cut out or in at the proper moment with relation to the engagement and disengagement of the clutch members.

A further and more specific object of the invention is to provide means controlled by the movable clutch member for making and breaking the contacts of the switch which controls the start winding.

A further object of the invention is to interlock the start winding switch devices with the movable clutch member in such a manner that it will be impossible for the start winding to be energized when the clutch members are engaged and further that the start winding will be energized when the clutch members are disengaged.

A further object of the invention is to eliminate the necessity of providing a separate centrifugally operated mechanism for operating the start winding switch, thus effecting a material saving in cost of construction.

It is desirable that before the clutch members are engaged that the speed of the rotor approach approximately the maximum speed at which it is designed to run under normal load. In the present case, it is possible to obtain a much higher speed when both start and main windings remain in circuit because they act together to increase the rotor current volume which in turn increases the magnetic force on a magnetizable element and delays the clutch members from engaging until a higher speed is obtained than would be possible if the main winding acted alone. With independent centrifugally operated devices for the clutch and switch this result is very difficult if not impossible to attain due to the nice timing which must be made for the two centrifugally operated mechanisms. Another object of my invention, therefore, is to so connect the switch and clutch with one centrifugally operated mechanism that perfect timing may be attained in the engagement of the clutch and the opening of the circuit of the start winding.

A further object of my invention is to provide an arrangement whereby a magnetizable band, which is employed to retard the action of the centrifugal devices which operate the clutch and switch may be so positioned with relation to the rotor as to furnish the minimum reluctance path for the magnetic leakage flux and consequently the greatest magnetic pull, by causing the band, when the clutch is disengaged and the switch closed, to overlie not only the rotor end ring but also a portion of the rotor iron.

A further object of my invention is to provide, in a centrifugal operating mechanism employing weights, means for causing the weights to move outwardly and inwardly in a true radial direction and thus maintain the weights at uniform and equal distance apart.

In the accompanying drawing:

Fig. 1 is a longitudinal section of the motor, clutch device and switch device showing the clutch members in disengaged position and the switch closed.

Fig. 2 is a longitudinal section similar to Fig. 1 but showing the clutch members engaged and the switch contacts open.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 1.

Fig. 5 is a view showing a simple circuit, such as is used in connection with the device.

Referring to the drawing, 1 represents the rotor of an electric motor and 2 a shaft to be driven thereby. The rotor is secured to a sleeve 3 which has bearings 4 rotatably mounted on the shaft. A shiftable clutch member is indicated at 5, this member having an internal cone-shaped clutch face which is preferably lined with cork 6. The clutch member 5 has keyways 7 to receive keys 8 which are connected with the sleeve 3. There is shown at 9 a companion clutch member which is pinned to the shaft 2 and has an exterior cone-

shaped clutch face to cooperate with the clutch face of the member 5.

The clutch member 5 is adapted to be shifted by a series of centrifugally operated segmental weights 10, each of which has a wedge-shaped portion 11 positioned in a wedge-shaped annular pocket formed by outwardly converged walls, one of which is on a ring 1' secured to the rotor and the other on the shiftable clutch member 5. These faces are preferably lined with wear resisting material 12 and each of the weights preferably have pockets in which are located antifriction balls 13. Interposed between a collar 14 slidably mounted on the shaft and the rotor is a coil spring 15, the purpose of which is to disengage the clutch members when the speed of the motor has decreased to a predetermined degree by acting to shift the clutch member 5 away from the clutch member 9 and causing the weights to be returned to their innermost position. This spring is weaker than springs usually employed as clutch disengagers so that the spring will offer less resistance to the action of the weights in moving the shiftable clutch member into engagement and holding it there so that a greater amount of the full force of the centrifugal action of the weights may be employed to hold the clutch members in engagement. The collar 14 is on the opposite side of the rotor from the clutch member for a purpose later to be explained and is connected to the movable clutch member through a series of rods 16, three in number in the present case, which pass through slotted openings 17 in the centrifugal weights and through openings 18 in the rotor and through openings in the arms 19, being provided with cotter pins 20 whereby the movement of the rods when the movable clutch member is moved to engaging position is transferred to the collar 14 against the tension of the spring 15. A coil spring 21 is preferably interposed between a collar 22 on the shaft and the rotor and its sleeve and bearings, the purpose of which will be explained later.

The spring 15 has been referred to as a spring weaker than springs ordinarily employed. As it is necessary to prevent the operation of the weights until after the motor has reached a predetermined speed means other than the spring is employed in the present case to prevent the shifting of the shiftable clutch member until after that predetermined speed has been reached. This additional means is primarily the magnetic force exerted by the leakage flux of the motor, and to that end there is secured to the shiftable clutch member 5 a magnetizable band 23 which projects into the effective field of the motor leakage flux when the shiftable clutch member is in disengaged position and acts in the manner described in my Patent No. 2,012,509 dated August 27th, 1935, it being sufficient to state here that when the motor starts a comparatively large magnetic pull is on the shiftable clutch member which decreases as the motor gains speed until the centrifugal force of the weights will become greater than the combined forces of the magnet and spring 15 and the weights become effective to shift the movable clutch member into engagement with its companion clutch member, at which time the magnetic pull becomes negligible with the result that the release spring forms the only opposition to the centrifugal force of the weights in holding the clutch members engaged.

The switch for controlling the start winding 24 which is here shown is preferably the one which is described in my pending application Serial No. 747,708, filed October 10th, 1934, and may be described as follows: The switch is one which gives a quick break of the contacts to avoid injury thereto. A flat supporting base member is shown at 25, this base being of any suitable dielectric material such as hard rubber, Bakelite or composition and on it the circuit breaker parts are assembled and through it are passed screws 26 to attach it to bosses on the inner surface of one of the motor heads such as the one indicated at 27.

Contact points are supplied in the circuit breaker, one of which, 28, is the fixed point (although this point does have a slight movement as will be explained), the other, 29, a movable point. The fixed point is secured to the lower end of a flat metallic strip 30 for a certain degree of natural resiliency such as is obtained in spring steel or spring brass, and the strip itself is secured by a rivet 30' at its upper end to the rear side of the base with its contact point projecting forwardly or to the right through an opening 31 in the base. Under the rivet which secures the strip to the base there is also secured the terminal clip of a conductor 32 whereby current is conducted to the point 28.

The movable point 29 is secured to the lower end of an element known as the movable contact arm 33. The movement of the arm is a swinging one, its contact moving toward and making contact with the point 28 and normally swinging away from that point. This swinging movement is possible by providing that the upper end of the arm is fulcrumed at a suitable location. The arm 33 consists of the portion at the lower end to which the point 29 is secured and a pair of diverging legs 33' whereby a two-point bearing at the upper end of the arm is obtained. To provde the fulcrums, a pair of strips 34 is provided which is secured to the base. These strips extend upwardly along the base and are bent over substantially at right angles at their upper ends as indicated at 34' forming horizontal portions in which inverted V-bends are made. The vertical strips are spaced apart a suitable distance and the upper ends of the legs 33' are given the bends shown so that the upper edge of each leg will come to rest in one of the V-bends. To guard against lateral displacement each of the legs 33' is provided with a small projecting tab shown in dotted lines at 33'' in Fig. 4 which when assembled rest against the inner edges of the adjacent strips 34. To carry current to the point 29 a flexible lead 35 is attached to one of the tabs 33'' and from there taken to a terminal clip riveted to the base, a conductor 36 being attached to the terminal clip to convey current to the point.

To obtain a quick swinging movement of the movable contact arm 33 there is provided an actuating lever 37 which is fulcrumed at the lower ends of the vertical strips 34 and connected to the movable arm 33 by a coil spring 38. The actuating lever 37 is pivoted below the arm 33 and extends upwardly to a point in proximity to a flange 14' on the sleeve 14, the upper end of the actuating lever being preferably forked as shown so as to straddle the shaft 2. The pivotal bearing of the actuating lever 37 with the vertical strips is formed to provide a knife edge bearing to reduce friction. The extreme lower end of the strips 34 have outwardly bent portions 34'' and each of the outwardly bent portions is provided with notches one on each side thereof whereby a strip may be interchangeably used on either side of the base. The actuating lever 37 is forked at its lower end to provide downwardly extending legs

so as to furnish a two-point bearing for this lever, and the lower end of each leg has a bearing in the angle formed by its adjacent vertical strip and the outwardly bent portion thereof; the lower end of each leg of the lever having a small tab 39 to prevent lateral displacement.

The location of the spring anchorages in the arm 33 and lever 37 is such that the arm will be given a quick movement in one or the other direction depending on the movement of the lever; also, the arm and lever are retained in their respective bearings without the use of additional members; further, in connection with the location of the pivotal points of the arm and lever and stop member 40 to be explained, the arm 33 will always return to the desired normal position.

The lower end of the spring is connected to the movable contact arm 33 at a point intermediate between the lower end thereof to which the contact member is secured and the bearings of the arms at the upper ends of the legs 34. The spring extends upwardly and is hooked to an inturned tab integrally formed at the upper edge of the body portion of the actuating lever between the upwardly extending fingers thereof. From this location of the spring it will be seen that the tension tends to draw the arm upwardly whereby the same is forced into its bearings and the same tension also tends to force the lever 37 downwardly into its bearings, and, since the bearings of the lever are opposed to those of the arm each is thereby held in its respective bearings. However, without the stop members to be described the arms would not remain in position especially when the circuit breaker is being assembled or is removed from its place in the motor. To provide for this feature the horizontally bent portions at the upper ends of the strips 34 are continued to a point beyond the lever 33 and there bent upwardly to form the stops 40 so as to engage shoulders formed on the lever. It will be noticed that the actuating lever 37 has its lower legs bent toward the base whereby the pivotal points of the lever are located well to one side of the anchorages of the spring and the bearings of the actuating arm 33. The purpose of this feature of the construction is more fully explained in my pending application referred to, Serial No. 747,708, it only being necessary to explain here that as the operating lever is moved toward the base the spring after a predetermined movement of the lever acts upon the operating arm 33 to cause its point to contact with the point 28, and that when pressure is removed from the actuating lever the spring acts to return the actuating lever to its normal position against the stops 40 and to also move the actuating arm to separate the contacts; the action of the spring being to give a quick make and break. When the parts are thus restored to normal position the small ear on the actuating arm to which the lower end of the spring is connected strikes the actuating lever and acts as a stop for the arm.

As before explained, the upper forked end of the actuating lever is in close proximity to the flange on the sleeve 14 so that when the clutch members disengage the movable clutch member will move the rods 16, which have been holding the collar 14 against movement under pressure of the spring 15, and permit said spring to shift the collar 14 to the left on the shaft so as to operate the operating lever 37 to cause the spring 33 to shift the operating arm and close the contacts so as to energize the start winding 24 and speed up the motor. As the motor gains sufficient speed the movable clutch member is again moved to engaging position, drawing the rods 16 and their cotter pins to the right and thereby shifting the collar 14 to the right against the tension of the spring 15. This allows the operating lever 37 to be restored to its normal position and the spring 38 to shift the operating arm 33 to its normal position, thus breaking the contacts.

In Fig. 5 the main winding is indicated at 41 and the start winding at 24. The fixed contact is shown at 28 and the movable contact at 29. The strip carrying the fixed contact is indicated at 30 and 33 is the arm carrying the movable contact. The line wires are indicated at L and L' and 32 and 36 are the conductors.

By this arrangement it will be seen that the making and breaking of the contacts may be nicely timed with the engagement and disengagement of the movable clutch member with its companion clutch member so that there will be no danger of the starting winding being left in operation too long or not long enough.

In order to provide for causing the magnetizable band 23 to furnish the minimum reluctance path for the magnetic leakage flux and therefore the greatest magnetic pull, means are provided for causing the band to be positioned, when the clutch is disengaged and the switch closed, so that the band will overlie not only the rotor end ring but a portion of the iron of the rotor. In the event that the iron in the rotor is made longer than the stator iron, so that it will project beyond the stator iron, it is obvious that this position of the band with reference to the stator iron may be readily accomplished. However, in a construction such as illustrated in the drawing where the stator iron and rotor iron are of equal length, provision is made for shifting the rotor axially to the position shown in Fig. 1 when the clutch members become disengaged. This is accomplished by the spring 15 and the spring 21 heretofore referred to which is under compression when the clutch members are engaged such as shown in Fig. 2, and acts in conjunction with the spring 15 to shift the rotor axially when the weights move inwardly and the clutch members disengage. As the rotor comes up to speed, the centrifugal weights overcome the magnetic and clutch spring forces and move the movable clutch member to the right to engage with the clutch disk. At this point, however, the centrifugal weights have moved out only part of the total movement of which they are capable and in completing their outward movement force the rotor to the left and compress the thrust spring 21 to its solid height, at which position the rotor iron is in alignment with the stator iron, the spring 21 thus acting as a resilient buffer during the early part of its compression so as to eliminate the noise which would be present if a fixed element such as the collar 22 were used as a stop. By making the distance the movable clutch member travels before engagement with the companion clutch member as short as possible, and by selecting a thrust spring of the right pressure a very quiet operating clutch is obtained. The distance the movable clutch member moves before engagement occurs, however, is limited by the amount of motion necessary to actuate the start winding switch, but little motion, however, being required for this purpose.

It has heretofore been explained that the rods 16 pass through slotted openings in the centrifugal weights, these openings being elongated

in a radial direction as shown in Fig. 3. It will also be noticed that a pair of antifriction balls are located on each side of the slotted opening in each of the weights. The rods act to keep the weights from circumferential movement in the assembly, and the arrangement of the balls acts to keep the weights from turning on the rods, since it is impossible for one pair of balls to advance ahead of the other in moving out or in radially due to the inclined surfaces upon which they run. The result of this is that the weights are caused to move outwardly or inwardly in a true radial direction and are mounted at a uniform distance apart.

Having thus described my invention, I claim:

1. In an electric motor having an axially movable rotor and an inclined face, a movable clutch member having a companion inclined face, centrifugally-operated weights between said faces, means to shift said rotor axially toward said movable clutch member when said weights are in inoperative position to expose a portion of the iron of said rotor, and a magnetizable band on said clutch member adapted to overhang a portion at least of the metal of said rotor when so shifted.

2. In an electric motor having an axially movable rotor, a clutch member connected to rotate with said rotor but axially movable with relation thereto, a magnetizable band connected with said clutch member, centrifugally-operated weights between the rotor and clutch member to shift said clutch member to engaging position, a spring to shift said clutch member to disengaging position, said spring acting to move said rotor axially in the direction of said clutch member when said weights are in their inoperative position to expose a portion of the metal of said rotor and cause said band to overhang the same, said weights when moved by centrifugal force acting to return said rotor to normal running position.

3. In an electric motor having an axially movable rotor, a clutch member connected to rotate with said rotor but axially movable with relation thereto, a magnetizable band connected with said clutch member, centrifugally operated weights between the rotor and clutch member to shift said clutch member to engaging position, a spring to shift said clutch member to disengaging position, said spring acting to move said rotor axially in the direction of said clutch member when said weights are in their inoperative position to expose a portion of the metal of said rotor and cause said band to overhang the same, said weights when moved by centrifugal force acting to return said rotor to normal running position, and a second buffer spring for said rotor at the opposite end thereof from said weights.

4. In a clutch, members having annular outwardly converged opposed inclined faces, a plurality of centrifugally-operated weights between said faces, each weight having a centrally-disposed radially extending slot, a pair of antifriction balls on each side of each slot and carried by said weights, and rods connected with one of said members and extending through said slots.

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