A starting switch for a single-phase induction motor has an armature rotatable by an electromagnet to close two pairs of electrical contacts connectable to the starting winding of the motor. The armature is balanced about its axis of rotation.
3,593,233

ELECTROMAGNETIC STARTING SWITCH

THIS INVENTION relates to an electromagnetic starting switch for single-phase induction motors.

The invention particularly relates to an electromagnetic starting switch for single-phase induction motors of the type which has a rotatable magnet armature on which there is disposed a movable contact and an electromagnet which is connected in series with the main motor winding when the coil of the electromagnet is excited by the high starting current, the contact is caused by movement of the magnet armature to bear against a corresponding contact connected to the starting winding. When the motor has started the current in the coil is reduced and the contact is opened by a return spring. Such a starting switch is described in U.S. Pat. No. 3,192,340. In this case both the magnet armature and the magnetic core of the electromagnet are disposed in the lower part of a two-part housing. The magnetic core consists of two L-shaped parts, of which the arms extending out of the coil former are of unequal length. Because of these features the manufacture and assembly of the known starting switch are difficult and costly.

According to the present invention there is provided an electrical starting switch for single phase induction motors having a main motor winding and a starting winding, said switch including a rotatable magnet armature with two movable contacts disposed thereon, fixed countermagnets corresponding to said movable contacts and connectable to said starting winding, an electromagnet connectable in series with said main winding to rotate said armature against a return spring to close said said contacts when a starting current flows in said main winding.

In the switch of the invention therefore, the switching capacity is divided between two contact pairs, so that the contacts take less load and have a longer useful life. A high switching capacity is obtained even with high inductance. The two movable contacts are disposed on contact springs of like construction which are secured to the two longitudinal sides of the magnet armature, and they lie on a straight line extending through the axis of rotation of the armature. Consequently, there is a symmetrical arrangement of the contact springs which is simple to manufacture. A further advantage is that the magnet armature with the contact springs secured thereto is insensitive to vibration and shock, because the center of gravity of the magnet armature lies on its axis of rotation.

For a further simplification of the manufacturing process, the magnet armature is constructed as a stamping, and has on both longitudinal sides integral pins on to which the two contact springs, which are formed with appropriate apertures, are pushed and riveted. In addition, one pin can serve to hold one end of one of the contact springs which tends to rotate the magnet armature into the circuit breaking position, and bearing at its other end on an adjusting screw disposed on a part fast with the housing. The response of the starting switch is adjusted by means of the adjusting screw, which varies the return spring force.

The magnet armature can be made U-shaped, and the magnetic core disposed between its U-arms be made straight. The end faces of the magnetic core can be sectors of cylinders having axes parallel to the axis of rotation of the armature, and forming a single plane therewith, and being at equal distances therefrom. This arrangement causes the magnetic core to have a strong attraction for the magnet armature, and the latter is firmly held in the attracted position.

As in the known starting switch, the housing of the starting switch according to this invention may consist of a lower part and an upper part. Particular advantages are obtained if the magnetic core provided within the magnet coil is disposed in the lower part of the housing and the magnet armature is rotatably disposed in the upper part of the housing. In this case, the magnetic core may be pressed into the former of the magnet coil, and the said former may be inserted in self-locking manner in a corresponding recess in the lower part of the housing. The magnet armature may include a pin directed away from its U-arms, which is rotatably mounted in a corresponding aperture in the upper part of the housing. Both the magnet armature and the magnetic core, with the magnet coil disposed thereon, are thus so placed in the two housing parts as to be readily observable and accessible, which facilitates assembly. In addition, the possibility exists of employing the starting switch as a control relay.

In order that the invention may more clearly be understood, the following description is given, merely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a section of one embodiment of switch according to the invention, and is also a section along the line I-I of FIG. 2.

FIG. 2 is a section along the line II-II of FIG. 1.

FIG. 3 is the same section as that of FIG. 2, showing the starting switch in the closed position; and

FIG. 4 illustrates the starting switch according to FIGS. 1 to 3, connected into the circuit of a single-phase induction motor.

The illustrated starting switch comprises a housing which consists of a lower part 1 and an upper part 2, these two parts being connected together by two hollow rivets 3. A coil former 5 provided with a magnet coil 4 is disposed in self-locking manner in the lower part 1 of the housing. A magnetic core 6 is pressed into the coil former 5.

The upper part 2 of the housing comprises an extension 7 formed with a bore 8 in which there is pivotally mounted a cylindrical pin 9 of a magnet armature 10. The magnet armature 10 is stamped from a sheet metal section and is bent in U-form. The U-arms 11 of the magnet armature 10 surround the magnetic core 6.

The two end faces 12 of the straight magnetic core 6 are in the form of sectors of a cylinder, the axes of the cylinders being at equal distances from and opposite sides of the axis of rotation 13 of the magnet armature 10, and being in one plane with that axis. The magnet armature 10 includes, on the two longitudinal sides of the part connecting the two U-arms 11, rectangular pins 14, on to which two contact springs 15 formed with appropriate apertures are pushed and riveted. The contact springs 15 are similar and are provided at their free ends with contacts 16 which cooperate with fixed countermagnets 17 on connecting lugs 18. The center of gravity of the whole magnet armature 10 lies on the axis of rotation 13, so that shocks and vibrations cannot cause it to unwind.

One pin 14 serves to hold one end of a return spring 19, which bears at its other end against an unthreaded sink 20 on an adjusting screw 21. The screw 21 is screwed into a nut 22 fixed in a recess in the upper part 2 of the housing. Adjustment of the screw 21 varies the compression of return spring 19, so that the response of the armature to current in the coil 6 may be adjusted.

One end of the magnet coil 4 is connected to the connecting lug 18 and the other end to a connecting lug 23. In FIGS. 2 and 3, there is shown a fourth connecting lug 24, but this lug may be omitted. All the connecting lugs 18, 23, 24 are disposed in self-locking manner in corresponding recesses in the upper part 1 of the housing. When the upper part of the housing has been mounted on the lower part 1 of the housing, these connecting lugs 18, 23, 24 project outside the upper part 2 of the housing, as shown in FIG. 1. The connecting lugs 18, 23, 24 are formed as plug in contacts at the ends projecting out of the upper part 2 of the housing.

In FIG. 4, the starting switch illustrated in FIGS. 1 to 3 is denoted by 25 and is connected in the circuit of a single-phase induction motor. One end of the magnet coil 4 is connected to the connecting lug 24 and to the connecting lug 18, which is connected to the phase source 26. The neutral conductor 27 is connected both to the main winding 26 and to the starting winding 27 of a single-phase induction motor 28.

The illustrated starting switch operates as follows: Before the circuit of the main winding 26 of the electric motor 28 is closed by a main switch, the starting switch is in the noncontacting position illustrated in FIG. 2. When the
main switch is closed, a large starting current flows through the main winding 26 of the motor and through the magnet coil 4. This produces an intense magnetic field in the magnetic core 6, which causes the magnet armature 10 to rotate so that the contacts are closed, that is the position of FIG. 3. Current is thus supplied to the starting winding 27. The motor starts and as its speed increases, a back EMF is built up in the main winding 26, and the current in the magnet coil 4 decreases. When a rated speed is reached, the magnetic field in the magnetic core 6 can no longer hold the magnet armature 10 in the position illustrated in FIG. 3, and this magnet armature 10 therefore returns, under the action of the return spring 19, to the position illustrated in FIG. 2, in which the circuit of the starting winding 27 is broken.

If the end faces 12 of the magnetic core 6 have the shape described above, a relatively small airgap exists between the arms 11 of the magnet armature 10 and the end faces even before the magnet armature 10 is rotated. This causes strong attraction of the magnet armature on energization of the magnetic core 6 so that the starting circuit is certain to be closed in opposition to the return spring 19, to the position shown in FIG. 3 in which the airgap 29 at its narrowest point 30 is small, and the attraction is correspondingly large.

If the load on the motor is so high that the speed of rotation falls to a certain extent, the current in the magnet coil 4 is increased to such an extent that the starting switch 25 is again closed, and the starting winding 27 is energized to increase the motor torque.

I claim:

1. An electromagnetic starting switch for a single phase induction motor having a main winding, said switch comprising a housing having a lower part and a separate upper part, a straight magnetic core, a coil former, said core being fixed in said coil former, a magnetic coil carried by said coil former, said coil being connected in series with said main winding, said lower part of the housing having a recess receiving said coil former, a U-shaped magnetic armature having two arms and a transverse portion and rotatably mounted in said upper part of the housing, the two arms of the magnetic armature extending out of the upper part of the housing and into the lower part of the housing, whereby when the magnetic armature is energized the ends of said arms cover the two ends of said core with a small airgap, a pin fixed to said armature in the middle thereof and extending away from its arms, said pin being rotatably mounted in a bore of the upper part of the housing, two similar contact springs, separate means fixing one end of each of said contact springs to the transverse portion of the armature, said contact springs further having a free end, a separate movable contact carried by each free end, said free ends extending beyond said arms, and two counter contacts, the movable contact of such contact spring being adapted to engage a separate countercontact, the contact springs being bent during this engagement.

2. A switch in accordance with claim 1, wherein said means consist of pins holding said contact springs, said switch further comprising a return spring engaging said armature and urging it to carry out a return movement, one of said pins engaging one end of said return spring, and an adjustable screw carried by said housing and engaging the other end of said return spring.

3. A switch in accordance with claim 2, wherein said magnetic core has two opposed end faces, said end faces having the shape of sectors of cylinders the axes of which extend parallel to the axis of rotation of the armature and are in the same plane, said axes being equidistant from said axis of rotation and being located on opposite sides thereof.