

ELECTRIC MOTOR

The present invention relates to an electric motor in which an outer ring yoke portion and an inner ring magnetic pole portion are separately formed, a rotor is inserted into the inner ring magnetic pole portion, and coils are wound on the inner ring magnetic pole portion.

Figs. 28 and 29 of the accompanying drawings show a conventional electric motor. Fig.

28 is a plan view showing a stator of the motor, and Fig. 29 is a perspective view of the motor. In a conventional motor as shown in Fig. 28, slots 1 are formed at an inner circle of an iron plate 2. A plurality of such iron plates 2 are stacked so as to form a stator 3. Coils 4 are wound between the slots 1 of the stator 3 by the insert method. A U-shaped insulating wedge is disposed in each of the slots 1 (for example, see Unexamined Japanese Utility Model Publication (Kokai) Sho-56-141576).

As shown in Fig. 29, after leads 4a are connected to respective terminals of the coils 4 on the stator 3, the stator 3 is located in a housing (not shown), and the leads 4a are connected to a power supply cord (not shown) (for example, see Examined Japanese Patent Publication (Kokoku) Sho-59-32980).

Figs. 30 and 31 show another conventional electric motor. Fig. 30 is a perspective view showing an outer ring yoke portion of the motor, and Fig. 31 is a perspective view showing a terminal cover of the motor of Fig. 30. In a conventional motor as shown in Fig. 30, a terminal holder 67 is mounted on an outer ring yoke portion 5. Terminals of coils 26 are connected to terminals 68 on the terminal holder 67. Thereafter, a terminal cover 69 on which leads 47 are mounted is attached to the terminal holder 67, so that the terminals 68 and the leads 47 are connected to each other (for example, see Unexamined Japanese Utility Model Publication Sho-57-115545).

In the above-mentioned conventional motor shown in Figs. 28 and 29, the coils 4 are inserted into the slots 1 by the insert method. Therefore, it is necessary to provide the coils 4 with an extra length (slackening) in addition to the length needed for winding the coils 4 between the slots 1. As a result, the necessary length of the coils 4 should be made larger, and hence the amount of conductors for the coils becomes large, which deteriorates the characteristics. In some cases, the coils 4 may bulge out of the slots 1, or ends of the coils 4 may be unbraided. In such cases, it takes a longer time to perform working processes such as shaping, coil binding, and varnishing. Moreover, such working processes are difficult to mechanize.

Moreover, the connections between the coils 4 and the leads 4a, and thermal fuses (not shown) and the coils 4 are manually

performed by soldering or the like which requires skills. Therefore, there exists another problem in that the connecting work requires man power and takes a long time.

When the U-shaped insulating wedges are to be inserted into the slots 1, the shape of the wedges makes the insertion difficult. Because of this poor workability, it is difficult to automatically perform the insertion. Moreover, in some cases, the coils 4 may bulge out from the gap formed between the wedge and the stator 3. Since it is difficult to automatically detect this failure, there arises a problem in that it is necessary to perform the detection by visual observation.

In another conventional motor shown in Figs. 30 and 31, the terminal holder 67 and the terminal cover 69 are separately formed, thereby causing a poor working efficiency in assembling the motor. Therefore, there is a problem in that the motor cannot be automatically assembled.

The present invention has been conducted to solve the above problems.

According to the present invention, there is provided an electric motor comprising:

a rotor having a rotational shaft at a centre thereof;

5 a plurality of stator magnetic pole pieces radially arranged around said rotor;

a plurality of slots formed between said magnetic pole pieces, in which coils are positioned;

10 an outer ring yoke portion having recess portions receiving radially outer ends of said magnetic pole pieces to form the stator;

an insulating cover for covering one side of said rotor, and having a cylindrical through hole receiving said rotational shaft; and

15 a plurality of coil winding guides for receiving portions of said coils extending from said slots and supporting them over the rotor and inwardly of the inner periphery of the magnetic pole pieces.

20 With the invention, the end portions of the coils can be disposed in a space above the rotor so that the height of the coil end is reduced and required amount of conductors for coils is reduced to a minimum level. This allows a high-efficient compact electric motor with the reduced material of coils to be automatically
25 manufactured. Furthermore, the process of inserting insulating wedges in the motor can be stably performed and, therefore, this process can be automated.

Further, as the coil winding guides are located within the inside diameter of the inner ring magnetic pole
30 portion, the inner portion of the coils can be wound within the inside the inner diameter of the stator, and does not occupy the slot space for the outer portion of the coils which is to be wound later. Accordingly, it is possible to increase the winding capacity of the outer
35 portion of the coils which is wound in a later step.

The supporting members for the rotational shaft may be disposed in the insulating resin and the insulating cover so that the length of the electric motor can be reduced.

5 Further, a common wire of coils may be connected to a plurality of pins, and a wiring board through which the pins pass be mounted on the stator core, the wiring board being provided with grooves for allowing the plural-
10 ity of pins to be connected to an identical conductor of power supply leads. Accordingly, the connection between the common wires and the pins can be done by one process, thereby facilitating the connection process.

 Also, on assembly, a covering of a power supply lead may be stripped off, and the power supply lead be
15 located in the groove while the forward end of the power supply lead remains covered. Accordingly, the positional relationship between the power supply lead and the pins can be maintained in a proper manner and, therefore, the process of electrically joining them using electric
20 resistance welding or the like can be easily performed by an automatic machine.

 A housing for accommodating the stator core may be constituted by a frame and a bracket which are joined with each other by opposite joining edge portions, the
25 joining edge portion of the bracket having a substantially U-shaped cut-out portion through which the power supply leads are inserted, the cut-out portion having a narrow entrance and a wide inner portion, and a cord bush be fitted to the cut-out portion. Accordingly, the cord bush
30 and insulating tube which are to be attached later can be easily fixed.

 The power supply leads may run through an insulating tube, the insulating tube having a curled portion at an end portion thereof, the curled portion
35 having a larger size than that of the cut-out portion. Accordingly, the insulating tube can be easily prevented

from slipping out from the bracket.

The coil guards may be formed into different shapes, grooves formed at a side wall of the coil guards, and insulating wedges inserted. Accordingly, the process of inserting insulating wedges in the electric motor can be stably performed and, therefore, this insertion process can be automated.

The coil guards may have an inclined guide for an insulating wedge and a protruding fixing portion for the insulating wedge. Accordingly, the insulating wedge can be easily attached to the electric motor, the workability is improved, and the automating is expedited.

Each of the coil winding guides on the insulating cover may be constituted by an inner pole with a plurality of pins and an outer pole with a single pin, the inner pole being located separately from each other on a circle which has the centre in the inner ring magnetic pole portion, so the coil winding guides and the pins can be disposed in the spaced formed in the coils. Even when the specification of the electric motor defines that many leads shall be connected, accordingly, the terminals of the coils can be twined without occupying the space for the coils. Furthermore, since the outer poles are located separately from each other on circles of different sizes, an automatic machine for disposing the leads so as to oppose the pins can be simplified in structure. Thus the pins can be arranged in a triangular formation.

With this arrangement, a plurality of coils which produce different phases may be connected to pins, respectively, and a wiring board through which the pins pass be mounted on the stator core, the wiring board being provided with grooves for allowing the plurality of pins to be connected to an identical conductor of power supply leads. Accordingly, the connection between a lead wire and pins can be accomplished by a single process, and a single wire is sufficient for connecting a lead wire with

a plurality of pins, whereby the connecting process can be greatly simplified.

In more detail, the wiring board may comprise:
a disk-like wiring board body; an opening formed at the
5 centre of the wiring board body; pin connecting portions
disposed around the opening and at positions quartering
the wiring board body, the pin connecting portions having
a plurality of pin hole rows; lead connecting portions
which are perpendicular to the pin connecting portions;
10 and a lead introducing port disposed between the pin
connecting portions, the wiring board further comprising a
cut-out portion formed by cutting the side wall of the
wiring board in the lead introducing portion, and a wall
portion elongating along the cut-out portion.
15 Accordingly, the power supply leads can be pressed by the
cut-out portion and the wall portion to be fixed, thereby
preventing the power supply leads from slipping off,
separating and being unbraided.

In the second embodiment, a terminal holder is
20 provided having an opening at the centre, the terminal
holder being provided with electronic devices to be
connected to the pins of the coil winding guides; guide
grooves for guiding leads to pin holes which are formed at
positions quartering the terminal holder; and deformable
25 protruding portions provided for sandwiching the guide
grooves. Accordingly, the power supply lead can be surely
sandwiched by the protruding portions to be fixed, thereby
preventing the power supply lead from lifting and slipping
off.

30 Further, detachable putty blocking pins may be
disposed in the guide grooves and so the terminal holder
can be commonly used and manufactured at a lower cost.

Cylindrical guards may be disposed on the back
face of the pin holes so that putty is prevented from
35 leaking from the pin holes, with the result of the
improved quality.

A protruding piece which opposes the insulating cover may be disposed around the opening so that the coils can be easily insulated.

5 A lead introducing port may be formed in the periphery of the terminal holder and a downward skirt portion be continuously formed from the lead introducing port. Accordingly, the leads are prevented from contacting with the coils, so that the coils are insulated.

10 Thus after the lead is inserted into the guide groove, the protruding portions can be bent toward the guide groove, so that the lead can be held and fixed, and the flow of the insulating resin can be blocked by the putty blocking pins or by the cylindrical guards. The
15 protruding piece and the insulating cover can constitute a wall and the leads can be insulated by the skirt portion.

Thus with the invention the coil length can be reduced and hence the required amount of conductors for coils can also be reduced, whereby the motor has improved
20 characteristics. Moreover, in the motor, coils do not bulge out of slots, and the coil ends will not be unbraided, whereby the succeeding working processes can be readily and mechanically performed. Furthermore, the processes of connecting the coils with the leads, and the
25 coils with a thermal fuse can be mechanized. Insulating wedges can easily be inserted into the slots and the insertion process can be automatically performed and also the processes of connecting the coils with the leads, and the coils with a thermal fuse can be mechanized. Further,
30 a terminal holder and a terminal cover can be integrally formed which therefore can be automatically assembled with improved work efficiency.

The invention will be further described by way of non-limitative example with reference to the
35 accompanying drawings, in which:-

Fig. 1 is a perspective view showing the assembly of an embodiment of the invention.

Fig. 2 is a perspective view showing the assembly of the electric motor of Fig. 1 to which a housing is additionally provided.

Fig. 3 is a sectional view of the stator core shown in Fig. 1.

Fig. 4 is a bottom view of the stator core shown in Fig. 1.

Fig. 5 is a perspective view of the insulating cover shown in Fig. 1.

Fig. 6 is a plan view of the stator in which the inner coils shown in Fig. 1 are wound.

Fig. 7 is a plan view of the wiring board to which the power supply lead shown in Fig. 2 is connected.

Fig. 8 is a partial perspective view of the bracket shown in Fig. 2.

5 Fig. 9 is a circuit diagram of the motor of Fig. 1.

Fig. 10 is a plan view showing the power supply lead and the pin body shown in Fig. 2.

Fig. 11 is a sectional view showing a portion of Fig. 2.

10 Fig. 12 is a plan view and partial sectional view of the stator core shown in Fig. 1.

Fig. 13 a partial plan view of the stator core shown in Fig. 1 which corresponds to Fig. 12 and shows the state of inserting insulating wedges.

15 Fig. 14A is a plan view of the insulating cover shown in Fig. 1, and Fig. 14B is a plan view of a bobbin column.

Fig. 15 is a partial plan view showing the connection between the power supply lead and a pin in the wiring board shown in Fig. 2.

20 Fig. 16 is a partial sectional view showing the connection between the power supply lead and the pin in Fig. 15.

Fig. 17 is an enlarged perspective view of the wiring board shown in Fig. 2.

Figs. 18A and 18B are enlarged views showing the main portion of the wiring board shown in Fig. 17; Fig. 18A is a

plan view of a lead introducing port, and Fig. 18B is a sectional view of the lead introducing port.

5 Figs. 19A and 19B show a terminal holder of the electric motor of the another embodiment of the invention, and Fig. 19A is a plan view and Fig. 19B is a side elevation view.

Figs. 20A and 20B show an insulating cover of the motor of Fig. 19, and Fig. 20A is a plan view and Fig. 20B is a side elevation view.

10 Fig. 21 is a partial plan view showing mainly a guide groove of the terminal holder of Fig. 19.

Fig. 22 is a side elevation view of the main portion of Fig. 21.

15 Fig. 23 is a side elevation view of the main portion of Fig. 21 and shows a deformed state of projections of the guiding groove of Fig. 21.

Fig. 24 is a partial plan view showing the assembly of the terminal holder and a bobbin column.

Fig. 25 is a side elevation view of the main portion of Fig. 24.

20 Fig. 26 is a bottom view of the main portion of Fig. 24.

Fig. 27 is a sectional view showing the vicinity of the terminal holder.

Fig. 28 is a plan view showing a stator of a conventional motor.

25 Fig. 29 is a perspective view of the stator of Fig. 28.

Figure 30 is a perspective view showing an outer ring yoke portion of another conventional motor.

Figure 31 is a perspective view showing a terminal cover of the motor of Figure 30.

5 Figures 1 to 18 show an embodiment of the invention. In the Figures, 5 designates an outer ring yoke portion which constitutes the outer ring portion of a stator core 6. The outer ring yoke portion 5 is formed as follows: an electric steel sheet wound in a hoop is
10 punched by a high speed automatic press (not shown) in the shapes of a stator and a rotor core which will be described later, and then stacked in a predetermined thickness to be caulked. Fitting recesses 6a are formed on the inner wall of the outer ring yoke portion 5, and a
15 plurality of magnetic pole pieces 7 form in the assembled motor slots 8 directed from the inner periphery of the outer ring yoke portion 5 toward the centre. The outer ends 7a of the magnetic pole pieces are respectively fitted in the fitting recesses 6a of the outer ring yoke
20 portion 5. The magnetic pole pieces 7 are formed by stacking core plates of the thickness of, for example, 0.35 mm to 0.5 mm and are arranged at equal intervals to constitute an inner ring magnetic pole portion 10.

 An insulating portion 11 which is produced by,
25 for example, injection moulding covers the inner ring magnetic pole portion 10. The insulating portion 11 is formed on and fixed to the slots 8 and the end face 12 of the inner ring magnetic pole portion 10. In production, the magnetic pole pieces 7 which have been formed by the
30 stacking are respectively held by provisional insertion tools that are arranged at the same pitch as injection moulds, and then transferred to the injection moulds to be subjected therein to the one-piece moulding. Since the magnetic pole pieces are separated from each other, the
35 characteristics of the motor are improved.

 The insulating resin is also formed on and fixed

to one end face 14 of the inner ring magnetic pole portion 10. This part 13 is formed integrally with the insulating portion 11 into a funnel shape, as shown in Figure 3, and integrally includes a first circular through hole 15 for a rotational shaft and coil guards 16 which protrude from the peripheral edge of the inner ring magnetic pole portion 10 towards the inside of the assembled stator. The coil guards 16 are located at the outer periphery of the magnetic pole pieces 7, and function as winding guides. The coil guards 16 have different shapes, and there are two types as shown in Figure 12: first coil guards 16a having a larger width; and second coil guards 16b having a smaller width. Grooves 16c are formed on the side walls of the coil guards 16 for receiving insulating wedges (described later). Insulating wedge-insertion guides 16d are formed integrally with the grooves 16c and have a slope that descends to an introducing port 16e. Insulating wedge-fixing portions 16f protrude from the rear end of the insulating wedge-insertion guides 16d, and cooperate with the outer ring yoke portion 5 to press and fix the insulating wedges when the inner ring magnetic pole portion 10 is assembled with the outer ring yoke portion 5 by pressingly inserting it thereinto (see Figure 13). In this embodiment, coils are wound so as to extend from one of the second narrow coil guards 16b to another one of the second narrow coil guards 16b, and prevented by the first wide coil guards 16a from being unbraided.

A rotor 17 is disposed in the inner ring magnetic pole portion 10 and has a rotational shaft 18 passing through its centre portion. Over the rotor 17 extends an insulating cover 19 which has a funnel-like shape. A plurality of coil winding guides 20 which independently function as coil winding guides and are hereinafter referred to as bobbin columns 20 are formed in the periphery of the insulating cover and it also has a second circular through hole 21 for the rotational shaft which hole communicates with the inner ring magnetic pole

portion 10 and the first through hole 15 for the rotational shaft. The insulating cover 19 is detachably attached to the end face of the inner ring magnetic pole portion 10 so that an end ring 22 which is a conductor of the rotor 17 is insulated from the exterior.

As shown in Figs. 14A and 14B, the bobbin columns 20 are arranged at positions quartering the inner ring magnetic pole portion 10, and disposed on the circumferences of two different circles with respect to the center of the inner ring magnetic pole portion 10. The bobbin columns 20 consist of inner poles 23 which are located in the center side of the inner ring magnetic pole portion 10, and outer poles 24 which are located outside the inner ring magnetic pole portion 10 so as to respectively oppose the inner poles. The bobbin columns 20 are arranged within the diameter of the inner ring magnetic pole portion 10 in such a manner that they are closer to the center of the inner ring magnetic pole portion 10 than the coil guards 16 (see Fig. 6). The inner poles 23 are disposed so as to be closer to the center of the inner ring magnetic pole portion 10 than the coil guards 16 which are formed integrally with the inner ring magnetic pole portion 10, and to be on a substantially straight line which

extends along the axial direction and passes inner walls 16a formed in the stator core 13. The inner poles may be arranged in a slightly mis-aligned manner.

The outer end of the bobbin column 20 include
5 pin bodies 25 inserted therein. More specifically, two spaced pin bodies are attached to each of the inner poles 23, and one pin body is attached to each of the outer poles. To the pin bodies, are connected end portions of coils 26 and power supply leads which will be described
10 later. The coils consist of, for example, a magnet wire which is coated with an autohesion material.

Figure 9 shows the connection of the coils and there is a main coil 27, an auxiliary coil 28; and a connection portion 29 at which the common wires of the
15 main coil 27 and the auxiliary coil 28 are connected to each other. A capacitor 30 is connected to the main coil 27 and the auxiliary coil 28.

In Figure 1, an E-type locking ring 33 is fitted to the rotational shaft 18 with a washer 34 and the motor
20 is enclosed in a housing 35 consisting of a frame 36 provided with a shaft hole (not shown) at the centre and a joining edge portion 37 at the periphery edge. As shown in Figure 2, a bracket 38 constitutes the other member of the housing 35, and is provided with a joining edge
25 portion 37 at the periphery edge. As shown in Figure 8, a substantially U-shape cut-out portion 41 is formed at a location inwardly of the joining edge portion 37. The cut-out portion 41 has a narrow entrance 39 and a wide inner portion 40. A cord bush 42 made of, for example, a
30 synthetic resin and having the same shape as the cut-out portion 41 is fitted therein and fixed at the entrance 39.

As shown in Figures 2, 7, 15 and 16, a disc-like wiring board 43 made of, for example, an injection-moulded insulating resin is mounted on the insulating cover 19.
35 An opening 60 through which the rotational shaft 18 can pass is formed at the centre of the body 43b of the wiring

board 43. A recess is formed between the opening 60 and a side wall 43a of the wiring board 43. A pin hole 61 through which the pin body 25 can pass is formed in this recess. In this embodiment, the size of the pin hole 6 is selected so that also the forward end portions of the inner poles 23 and the outer poles 24 can pass through the pin hole 61. A pin connecting portion 62 is formed in the vicinity of the pin hole 61.

As shown in Figures 18a and 18b, a cut-out portion 63 which functions as a lead introducing port 44 is formed in the side wall 43a of the wiring board 43. A groove 46 for guiding a power supply lead 47 is vertically formed between the pin connecting portion 62 and the lead introducing port 44. A wall portion 65 for guiding the power supply lead 47 is formed at a portion which opposes the lead introducing port 44, and a projection 64 is formed on its wall so that the inserted power supply leads 47 contact with it, thereby enabling the leads to be easily separated.

The wiring board 43 is fixed by inserting the inner poles 23 and outer poles 24 disposed on the insulating cover 19 into the pin hole 61. As a result, the grooves 46 and the pin body 25 have a mutual positional relationship that they are substantially parallel to each other. The power supply leads 47 have a forward end which is to be connected with the pin body 25 and in which the covering is partially stripped off as shown in Figure 10 or which consists of a covering-stripped portion 48 and a cover-remaining portion 49. An insulating tube 50 made of a flexible insulating material and through which the power supply leads 47 pass has (as shown in Figure 8) an end 50 which is to be located inside the bracket 38 formed as a curled portion 51 which is greater than the cut-out portion 41, so as to consist a mechanism for preventing the tube from slipping from the bracket 38.

In Figure 2, bolts 52 join the frame 36 to the

bracket 38 at the joining edge portion 37. In Figure 11, a rotational shaft-supporting member 53 consisting of a bearing metal 54 is disposed at the bottom of the bracket 38 and made of a sintered alloy. An oil-impregnated felt 55 is disposed around the bearing metal 54, and a bearing cover 56 which covers the bearing metal 54 and the felt 55. Thus, when the electric motor is assembled, a portion of the rotational shaft-supporting member 53 is located at a position inwardly of the bobbin column 20 so that the overall length of the electric motor can be reduced. Figure 16 shows a thermal fuse 6.

The thus configured electric motor can be assembled as follows. The rotational shaft 18 having the rotor 17 is housed in the inner ring magnetic pole portion 10 in which the insulating portion 11, the first rotational shaft through hole 15, the coil guards 16 etc are disposed. Then, the insulating cover 19 in which the bobbin columns 20 have the pin bodies 25 are disposed is attached to the inner ring magnetic pole portion 10 with the rotational shaft 18 passing through the insulating cover 19, thereby insulating the rotor end ring 22. By a multiaxis flyer-type winding machine (not shown), conductors for the coils 26 are connected to predetermined pin bodies 25, and wound between the slots 8 so as to encircle inside the inner poles 23 of the bobbin columns 20. The winding end portions of the coils are twined around other predetermined pin bodies 25, thereby automatically performing the winding and termination processes without requiring manpower.

In this case, as shown in Figure 6, since the inner portion of the coils 26 is wound inside the inner poles 23, the outer portion of the coils 26 can be wound in a similar manner without occupying up the space for accommodating coils. The soldering is conducted on the pin bodies 25 around which the terminals of the coils have been twined, so that the pin bodies

25 are electrically connected to the coils 26. Probes for electrical tests (not shown) are contacted to the pin bodies 25, and electrical tests are automatically performed.

Thereafter, the inner ring magnetic pole portion 10 is
5 pressingly inserted into a predetermined position of the outer ring yoke portion 5. Insulating wedges 31 which are formed by cutting an insulating film are inserted via the insulating wedge-insertion guides 16d into the outer ring yoke portion 5 and the grooves 16c of the coil guards 16 which are formed at
10 the forward end of the magnetic pole pieces 7, and fixed by the insulating wedge-fixing portions 16f. Then, a predetermined voltage is applied to predetermined pin bodies 25 to energize the coils 26. The heat generated in the coils 26 by this energization causes the autohesion varnish adhering to the
15 surface of the magnet wire to melt, thereby hardening the coils 26.

Then, the thus formed stator is pressingly inserted into the frame 36, and the wiring board 43 which is made of an injection-molded insulating resin is attached to a fixing
20 position of the bobbin columns 20. The power supply leads 47 which have been cut into a predetermined length and the covering of which has been stripped off are disposed in the grooves 46 of the wiring board 43 in such a manner that the covering-stripped portion 48 is located in proximity to the
25 respective pin body 25 of the inner ring magnetic pole portion 10, and they are connected to each other by electric resistance

welding or the like. In this case, when the common portions of the coils 26 are respectively twined around the opposing pin bodies 25 of each of the inner poles 23, the common portions can be electrically connected by connecting these pin bodies 25 to the same covering-stripped portion 48 of each of the power supply leads 47. Namely, the pin bodies 25 can be connected to the identical conductor of the power supply lead 47. A plurality of power supply leads 47 go out from the lead introducing port 44 of the wiring board 43, while being pressingly fixed to the wall portion 65 having the cut-out portion 63 and the projection 64.

The exposed conductor portions such as the covering-stripped portion 48 of the power supply leads 47 and the pin bodies 25 are insulated by pouring an ultraviolet-curing insulating resin (not shown) into the recess of the wiring board 43, and then illuminating the resin with ultraviolet rays to instantaneously cure the resin. At the same time, the wiring board 43 and the bobbin columns 20 are jointed and fixed. Then, the bracket 38 having the U-shape cut-out portion 41 is attached to the stator, and fixedly assembled with the frame 36 by fastening the bolts 52.

Thereafter, the curled portion 51 is formed at the forward end of the insulating tube 50 as shown in Fig. 8, and the cord bush 42 made of an insulating resin is slidably moved from the opposite end to the forward end. The insulating tube 50 is pressingly inserted until the curled portion 51 moves to the

inside of the bracket 38, and the cord bush 42 is fittingly fixed to the cut-out portion 41 of the bracket 38. Accordingly, the power supply lead 47 is protected and the cut-out portion 41 of the bracket 38 is closed so that the electric motor is tightly sealed.

As described above, the provision of only the insulating cover 19 causes the pin bodies 25 to be inserted to the bobbin columns 20. Therefore, the insertion of pins can be easily conducted by an automatic machine, and the yield of the process of inserting pins can be improved. Even when the core thickness of the stator is changed, the components can be commonly used. Furthermore, since the covering-stripped portion of the power supply leads 47 is jointed to a plurality of pin bodies 25 around which the terminals of the coils 26 are twined, the connection of the common portions of the coils 26 can be easily achieved.

In the above described embodiment, the coil guards 16 are provided with the grooves 16c, the insulating wedge-insertion guides 16d and the like which cooperate to function as inserting portions for the insulating wedges 31. Alternatively, these inserting portions may be formed in the outer ring yoke portion 5.

Figs. 19 to 27 show another embodiment of the invention. In this embodiment, the configurations except those shown in

Figures 19 to 27 are the same as shown in Figures 1 to 3, 15, 16 and 18.

In the stator, the fitting recess 6a are formed on the inner wall of the outer ring yoke portion so that the opposing side walls in each of the recesses are on the centre line of an inner ring magnetic pole portion which will be described later.

The magnetic pole pieces 7 are arranged at equal intervals, and connected through slots 8 with an insulating portion which will be described later, thereby constituting the inner ring magnetic pole portion 10. The insulating portion 11 covers also the outer ends 7a of the magnetic pole pieces 7 which are to be fitted with the outer ring yoke portion 5 as illustrated.

In Figures 19 to 27, 67 designates a disc-like terminal holder which is made of, for example, an injection-moulded insulating resin and which has an opening 70 at the centre portion. Pin holes 71 through which the bobbin columns 20 pass are formed at positions quartering the body of the terminal holder 67 and cylindrical guards 72 protrude from the back of the pin holes 71 to prevent putty from leaking. A gap portion 73 functions, when the bobbin columns 20 are inserted into the pin holes 71, as a wiring path for guiding the terminals of the coils 26 that are the main portions of the stator 3. Lead guide grooves 74 protrude on the terminal holder 67 to oppose the pin holes 71 and into which power supply leads described later are inserted to be guided to the inner poles 23. Further, projections 75 protrude from and are formed around the guide grooves 74 so as to sandwich or form the guide grooves 74. The projections 75 are deformable as shown in Figure 23 to nippingly fix the power supply leads. Grooves 76 run in parallel with the guide grooves 74 and guide the power supply leads to the inner poles 23. Putty blocking pins 77 protrude in grooves 76 in the side of the pins 25 and

have, for example, a base portion made thin so that the pins can be easily removed.

A lead introducing port 78 is a hole formed in the surface 70 of the terminal holder 67, and a skirt portion 80 protrudes from the long side 81 of the lead introducing port 78 toward the back face. A lead guard portion 82 defines the insertion width for the power supply leads and is formed by cutting out the side wall 83 of the terminal holder 67 so as to oppose the lead introducing port 78. A projection 84 prevents the leads from slipping off and is formed at the centre of the long side 81. As shown in Figure 27, a metal vat 85 is attached to the inner wall of the bracket 38 and a protruding piece 86 surrounds the opening 70 of the terminal holder 67 so that the front end opposes the end of an insulating cover 19. The protruding piece 86 covers the coils 26 to electrically isolate them from the metal vat 85.

This electric motor can be assembled generally as before but after the thus formed stator is pressingly inserted into the frame 36, the wiring board 67 which is made of an injection-moulded insulating resin is attached to a fixing position of the bobbin columns 20. The leads of the thermal fuse are cut in a predetermined length and shape, and then placed to predetermined positions of the wiring board 67 to be connected to the pins 25 by electric resistance welding or the like. Thereafter, the putty blocking pins 77 are removed using a cutting nipper or the like. The putty blocking pins 77 prevent the insulating resin from flowing out when the power supply leads 47 are not placed.

When the power supply leads 47 are inserted into the lead introducing port 78, the power supply leads 47 are fixed by the combination of the lead guard portion 82 and the projection 84,

whereby the power supply leads 47 are prevented from slipping out and bundled. This facilitates the attachment to the bracket 38. Then, the power supply leads 47 are placed in the guide grooves 74, and the projections 75 are deformed using an electric iron so that the power supply leads 47 are fixed. The covering-stripped portions of the power supply lead 47 are contacted with the pins 25 as shown in Fig. 15 and connected therewith by electric resistance welding or the like. The exposed conductor portions such as the covering-stripped portions of the power supply leads 47 and the pin bodies 25 are insulated by pouring an ultraviolet-curing insulating resin (not shown) into the guide grooves 74 of the wiring board 67, and then illuminating the resin with ultraviolet rays to instantaneously cure the resin. At the same time, the wiring board 67 and the bobbin columns 20 are joined and fixed.

Then, the bracket 38 is attached to the stator, and fixedly assembled with the frame 36 by fastening the bolts 52. In this case, as shown in Fig. 27, the skirt portion 80 and the coil guards 16 prevent the power supply leads 47 from contacting with the coils 26, thereby ensuring the insulation. Moreover, the protruding piece 86 prevent the metal vat 85 and the coils 26 from contacting with each other, thereby ensuring the insulation.

In the above described embodiment, the putty blocking pins 77 are removed using a cutting nipper or the like. The putty blocking pins 77 may be removed by an ultrasonic machine. In



19. An electric motor according to any one of the preceding claims, wherein a supporting member for said rotational shaft is disposed in said insulating cover.

20. An electric motor constructed and arranged to
5 operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 27 of the accompanying drawings.



9. An electric motor according to any one of claims 3 to 8, wherein a plurality of coils which produce different phases are connected to said pins.

10. An electric motor according to any one of
5 claims 3 to 9, wherein a wiring board comprises: a disk-like wiring board body; an opening formed at the centre of said wiring board body; pin connecting portions disposed around said opening and at positions quartering said
10 wiring board body, said pin connecting portions having a plurality of pin hole rows; lead connecting portions which are perpendicular to said pin connecting portions; and a lead introducing port disposed between said pin connecting portions, said wiring board further comprising a cut-out
15 portion formed by cutting the side wall of said wiring board in said lead introducing port, and a wall portion extending along said cut-out portion.

11. An electric motor according to any one of claims 3 to 10, further comprising:

a terminal holder having an opening at the
20 centre, said terminal holder being provided with electronic devices to be connected to said pins of said coil winding guides;

guide grooves for guiding leads to pin holes which are formed at positions quartering said terminal
25 holder; and

deformable protruding portions provided for sandwiching said guide grooves.

12. An electric motor according to claim 11, wherein said detachable putty blocking pins are disposed
30 in said guide grooves.



13. An electric motor according to claim 12, wherein cylindrical guards are disposed on the back face of the pin holes.

14. An electric motor according to claim 11 or 5 12, wherein a protruding piece which opposes said insulating cover is disposed around said opening.

15. An electric motor according to claim 11, 12, 13 or 14, wherein a lead introducing port is formed in the periphery of said terminal holder, and a downward 10 skirt portion is continuously formed from said lead introducing port.

16. An electric motor according to any one of the preceding claims, wherein a housing for accommodating the motor is consisted by a frame and a bracket which are 15 joined with each other by opposite joining edge portions, said joining edge portion of said bracket having a substantially U-shaped cut-out portion through which power supply leads are inserted, said cut-out portion having a narrow entrance and a wide inner portion, and a cord brush 20 is fitted to said cut-out portion.

17. An electric motor according to claim 16, wherein said power supply lead runs through an insulating tube, said insulating tube having a curled portion at an end portion thereof, said curled portion having a larger 25 size than that of said cut-out portion.

18. An electric motor according to any one of the preceding claims, wherein said coil winding guides extend inwardly of the inward ends of the magnetic pole pieces.



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19. An electric motor according to any one of the preceding claims, wherein a supporting member for said rotational shaft is disposed in said insulating cover.

20. An electric motor constructed and arranged to
5 operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 27 of the accompanying drawings.