(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 043 538**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **81105056.6**

(22) Date of filing: **30.06.81**

(51) Int. Cl.³: **A 47 L 5/22**

(30) Priority: **09.07.80 US 166810**

(43) Date of publication of application: **13.01.82**
Bulletin 82/2

(84) Designated Contracting States: **CH DE FR GB LI SE**

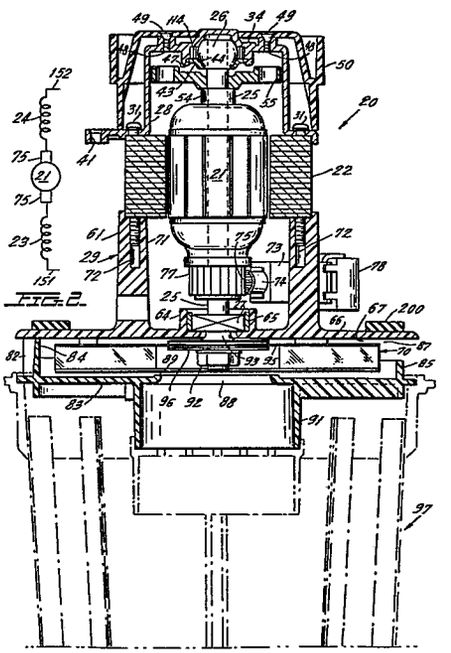
(71) Applicant: **Shop-Vac Corporation, 2323 Reach Road, Williamsport Pennsylvania (US)**

(72) Inventor: **Wacek, Rudolph W., R. D. 2 2020 Round Top Road, Montoursville, Pennsylvania (US)**
Inventor: **Miller, Jonathan, 220 Cliffside Drive, Williamsport, Pennsylvania (US)**

(74) Representative: **Weitzel, Wolfgang, Dr.-Ing., St. Pöltener Strasse 43, D-7920 Heidenheim (DE)**

(54) Fan suction for vacuum cleaner.

(57) A suction producing unit for a vacuum is constructed with a motor having an armature (21) on a vertical shaft (25) whose lower end is supported in a ball-type bearing unit 27 held in a tolerance ring 65. The upper end of the shaft is journalled in a bearing 26 that is held in a swivel support including a spring retainer ring 43. The latter is part of a subassembly which also includes the upper bearing (43) and an upper housing (28). The stator field piece (22) of the motor is clamped between the upper housing (28) and a lower housing (29) which supports the ball-type lower bearing unit (27). A pair of insulating sleeves (121, 123) on the lower end of the motor shaft (25) serve to properly space the armature (21), the lower bearing (27) and the fan blade (70). The latter (70) is mounted on the shaft (25) at its lower end by an insulating flanged cap nut (130) mounted on the lower threaded end (Figure 15) of the motor shaft (25).



EP 0 043 538 A2

SV-12

FAN SUCTION FOR VACUUM CLEANER

This invention relates to electric fans in general and more particularly relates to a suction producing unit for a vacuum cleaner.

U.S. Patent No. 2,778,563 issued January 22, 1957, to D.T. Doyle for a Vacuum and Blower Producer discloses a vertically disposed cylindrical tank having a pancake-type electric fan axially disposed at the top of the tank for producing suction within the tank. The instant invention is directed to an electric fan of this type.

More particularly, the instant invention provides a fan motor having an armature rotatable about a vertical axis defined by upper and lower bearings mounted to respective upper and lower housing sections. The lower bearing is essentially fixed while the upper bearing is mounted on a swivel support. The latter is formed by a spring retainer which is secured to the upper housing section and form parts of a subassembly. The spring retainer provides a concave seat for the upper bearing and also biases it upward against a concave seating surface of the upper housing.

The lower housing section is provided with integrally formed tubular supports for brushes engaging the commutator for the armature. The outer ends of the brush supports are covered by snap-held removable plastic caps.

In one embodiment of this invention, insulating sleeves on the fan-blade end of the motor shaft and an insulating clamping unit, electricallly insulate the motor from the fan blade and housing therefor.

Thus, the primary object of the instant invention is to provide a novel relatively inexpensive and reliable suction producing unit for a vacuum cleaner.

Another object is to provide a suction producing unit of this type so constructed that assembly thereof is facilitated.

Still another object is to provide a suction producing unit of this type constructed so as to minimize the possibility of electrical shock.

These objects as well as other objects of this invention shall become readily apparent after reading the following description of the accompanying drawings in which:

Figure 1 is a longitudinal cross-section of a suction producing unit constructed in accordance with teachings of the instant invention.

Figure 2 is an electrical schematic for the motor portion of Figure 1.

Figure 3 is a plan view of the lower housing section. A cap for a brush support part of the lower housing is also shown in Figure 3.

Figure 4 is a cross-section taken through line 4-4 of Figure 3 looking in the direction of arrows 4-4. A retainer for electrical leads is also shown in Figure 4.

Figure 5 is a fragmentary side elevation looking in the direction of arrows 5-5 of Figure 3.

Figure 6 is a side elevation of the retainer looking in the direction of arrows 6-6 of Figure 4.

Figure 7 is a bottom view of the retainer looking in the direction of arrows 7-7 of Figure 6.

Figure 8 is a plan view of the upper housing section in Figure 1.

Figure 9 is a cross-section taken through line 9-9 of Figure 8 looking in the direction of arrows 9-9.

Figure 10 is a plan view of the top cap in the embodiment of Figure 1.

Figure 11 is a cross-section taken through line 11-11 of of Figure 10 looking in the direction of arrows 11-11.

Figure 12 is an enlarged plan view of a bearing retainer utilized in the embodiment of Figure 14.

Figure 13 is a cross-section taken through line 13-13 of Figure 12 looking in the direction of arrows 13-13.

Figure 14 is a longitudinal cross-section of another embodiment of a suction producing unit constructed in accordance with teachings of the instant invention.

Figure 15 is an enlarged cross-section of the lower bearing region for the embodiment of Figure 14.

Figure 16 is a bottom view of the flanged clamping nut looking in the direction of arrows 16-16 of Figure 15.

Now referring to the Figures. Suction producing unit 20 of Figure 1 includes an electric motor comprising rotatable armature 21 surrounded by stator field piece 22. In a manner well known to the art, although not illustrated in the drawings, stator windings 23, 24 (Figure 2) are magnetically coupled with pole piece 22. The axis of rotation for armature 21 is defined by vertical shaft 25 which extends beyond both ends of armature 21 and is rotatably supported by upper and lower bearings 26, 27 respectively. Magnetic frame or field piece 22 is sandwiched between upper and lower housing sections 28, 29 which are connected by two screws 31 which extend vertically downward through clearance apertures in frame 22..

As seen best in Figures 8 and 9, upper housing section 28 is an inverted U-shaped member having vertical legs 32, 33 which extend downward from opposite ends of web 34. The free ends of legs 32, 33 are provided with respective out-turned ears 38, 39 having the respective clearance apertures 36, 37 through which screws 31 extend. Outboard of clearance aperture 36, ear 38 is provided with another aperture 41 to receive a grounding screw (not shown). The underside of web 34 is provided with concave seating surface 42 which is engaged by upper bearing 26. The periphery of ring-like spring retainer 43 is seated on shoulder 46 at the underside of web 34 and is secured to upper housing 28 by peening over portion 47 of web 34 disposed in the vicinity of shoulder 46. Spring member 43 is provided with upwardly facing concave seating surface 44 which is in engagement with upper bearing 26. Spring 43 biases upper bearing 26 upward against seating surface 42, and seating surfaces 42, 44 permit upper bearing 26 to swivel as required. This enables bearing 26 to rotatably support the upper end of shaft 25 which extends into an axial aperture of bearing 26.

Inverted cup-like cap 50 (Figures 10 and 11) is secured to upper housing 28 by two screws 49 which are received in threaded engagement in apertures 48 in web 34 after passing through clearance apertures 51 in the disk-like upper surface 52 of cap 50. Surface 52 is also provided with a plurality of ventilating openings 53 through which air is drawn downward by fan blade 55 which is disposed within cap 50 and is secured to the upper end of shaft 25 just below upper bearing 26. Sleeve 54 on the upper end of shaft 25 operatively positions blade 55. Air moved by the latter serves to cool motor 21, 22.

As seen best with reference to Figures 3 and 4, lower housing 29 is a molded insulating member

formed having main cylindrical portion 61 concentric with motor shaft 25. Flange 62, which extends radially inward from the lower end of main section 61, is provided with central opening 63 through which the lower end of shaft 25 extends. Surrounding opening 63 is upwardly extending lip 64 which positions lower bearing 27. The latter is a ball bearing unit whose inner race is closely fitted with respect to shaft 25. Corrugated tolerance ring 65 is interposed between lip 64 and the outer race of bearing 27. Flange 62 and flange 66, extending radially outward from main section 61, form the upper boundary for shallow chamber 67 wherein suction fan blade 70 is disposed. Lower housing 29 also includes post formations 71, 71 adjacent the inner surface of main section 61. Posts 71 are provided with recesses 72 open at the their upper ends to threadably receive screws 31.

Brush supports 73, 73 are formed integrally with and extend radially through main section 61. Each support 73 is of generally rectangular cross-section having a through passage 76 which receives brass holder 74 for carbon brush 75. The latter is biased into engagement with commutator 77 mounted on shaft 25 and electrically connected to the windings of armature 21. Brass holders 74 are electrically connected to field windings 23, 24. A coiled compression spring (not shown) disposed within holder 74 biases brush 75 radially inward into good electrical contact with commutator 77. The outer end of passage 76 is closed by inwardly bending tabs (not shown) on opposite sides of brass holder 74. Plastic cap 78 covers the outer end of support 73, being removably held in operative position by four snap-fitted fingers 79. Below each of the brush supports 73, main cylindrical section 61 is provided with apertures 81 which provide outlets for air moved radially by lower fan blade 55 to cool motor 21, 22.

The end of field winding 23 remote from brush 75 is connected to electrical lead 151 and the end of field winding 24 remote from the other brush 75 is connected to electrical lead 152. Leads 151, 152 extend radially outward of lower housing 29 through notch 153 (Figure 4) in main section 61. Leads 151, 152 are maintained at the bottom of notch 153 by generally H-shaped molded plastic clamping member 155 (Figs. 4, 6 and 7) which is locked in position from above by field piece 22. Sponge-like ring 200 cemented to the upper surface of 66 provides a gasket for a cover (not shown) placed over motor 21, 22.

Extending downward from flange 66 are three posts 82 which rest against the upper surface of motor support 83. The latter provides the lower boundary for chamber 67 and is provided with upwardly extending spacer projections 84 in the vicinity of each of the posts 82. Screws (not shown) extend upward through clearance apertures in support 83 and are received in apertures 86 of post 82 to mechanically secure lower housing 29 to support 83. Support 83 is also provided with upwardly extending annular lip 85 which forms the side boundary for chamber 67. However, there is a gap 87 between the upper end of lip 85 and lower housing 29, with this gap 87 providing a narrow exhaust opening for radially moving air generated by rotating fan 70. Support 83 is provided with central opening 88 surrounded by upwardly extending shallow lip 89 and downwardly extending cylindrical section 91. Cylinder 91 and lip 89 serve to axially direct air being drawn into fan 70. The latter is secured to shaft 25 by flanged nut 92 whose threads are engaged with the threads at the lower end of shaft 25. Flanged spacer 93 on shaft 25 is interposed between fan wall 95 and the inner race of bearing 27 on shaft 25. Wall section 95 of fan 70 is clamped between flanged spacer 93 and lower washer 96 as nut 92 is tightened against the

latter. In a manner well known to the art, motor support 83 is mounted to the top of the vacuum tank 97 shown in phantom in Figure 1.

Now referring more particularly to Figure 14 which illustrates another embodiment of the instant invention which is similar to the embodiment of Figure 1 but differs therefrom by having a different upper housing construction and a lower shaft connection which provides superior insulation. More particularly, in the embodiment of Figure 14, upper housing 105 is a molded plastic member which combines the functions of metal upper housing 28 and cap 50. Upper housing 105 provides the cylindrical upper seat 106 for upper bearings 26. Spring retainer 107 is secured in operative position by ring 108 having outwardly extending ears 109 each of which is provided with a clearance aperture 111 through which a screw 112 extends. The latter is received in threaded engagement in a recess of upper housing 105.

As seen best in Figure 15, the lower end of shaft 25 extends through insulating sleeve 121 having outer shoulder 122 which abuts the top of bearing 27. Sleeve 121 extends below bearing 27 into insulating spacer sleeve 123. The latter extends through central aperture 63 at the bottom of lower housing 29 and through the central aperture in fan blade wall 95. The central portion of sleeve 123 is provided with radially outward circular flange 124 positioned below lower housing inward flange 62 and adjacent the upper surface of fan wall 95. Rubber-like washer 127 surrounds sleeve 123 and abuts the lower surface of wall 95. Insulating flanged cap nut 130 having threaded insert 131 is mounted on the threaded lower end of shaft 25 and is provided with a recess wherein washer 127 is disposed. Tightening of cap nut 130 clamps fan wall 95 between washer 127 and flange 124. At the same

time sleeve 123 is forced upward into abutment with the tapered diameter of sleeve 121 and the lower surface of bearing unit 27.

Although preferred embodiments of this invention have been described, many variations and modifications will now be apparent to those skilled in the art, and it is therefore preferred that the instant invention be limited not by the specific disclosure herein, but only by the appending claims.

WHAT IS CLAIMED IS:

1. A suction producing unit for a yacuum cleaner, said unit including a motor comprising a rotatable armature and a stator outside of said armature positioned for magnetic coupling thereto; first and second axially aligned shaft sections rotatably connected with said armature and defining a rotational axis therefor; first and second housing sections at opposite ends of said stator; first and second bearing means rotatably supporting the respective first and second shaft sections; said first and second housing sections having respective first and second means operatively positioning the respective first and second bearing means; suction fan blade means mounted on said first shaft section; and said second means providing a swivel support for said second bearing means.

2. A suction producing unit as set forth in Claim 1 in which the second housing section is a part of a subassembly which also includes the second bearing means and a retainer means securing said second bearing means to said second housing section.

3. A suction producing unit as set forth in Claim 2 in which the retainer means includes a spring element formed with a concave seat engaged with said second bearing means.

4. A suction producing unit as set forth in Claim 2 in which the second housing section includes a molded U-shaped element haying a web and arms extending in the same direction from opposite ends of said web; said second bearing means comprising a concave seating surface engaged with said second bearing means; said concave seating surface being formed integrally with said U-shaped element and being disposed at a central region of said web.

5. A suction producing unit as set forth in Claim 1 in which the first housing section includes a tubular main portion having a tubular axis parallel to said rotation axis; at the end thereof remote from said stator, said first housing section including flange means partially defining a narrow chamber wherein the fan-blade means is disposed; said flange means having a first portion extending radially inward from said main portion; said first bearing means being disposed at a central region of said first portion in general alignment with an aperture through said first portion located along the rotational axis.

6. A suction producing unit as set forth in Claim 5 also including an insulating sleeve on said first shaft section extending through said first bearing means and into a recess in an insulating spacer through which said first shaft section extends; said sleeve being interposed between said spacer and said armature; an insulating nut and washer disposed at the free end of the first shaft section and securing said blade means thereto; said spacer having a radially outward flange clamped against said blade means.

7. A suction producing unit as set forth in Claim 5 in which the armature includes armature winding means and the stator includes field winding means; said first housing section having integrally formed therewith first and second supports for brushes which electrically connect said armature winding means and said field winding means.

8. A suction producing unit as set forth in Claim 7 in which the first and second supports are tubular and extend transversely through the main portion of the first housing section; snap-on caps removably mounted at the ends of the first and second supports outside of the main portion of the first housing.

9. A suction producing unit as set forth in Claim 4 also including a cup-like ventilating cap removably mounted to said U-shaped element; said U-shaped element being cast of metal and said cap being molded of plastic material.

10. A suction producing unit as set forth in Claim 2 in which the second housing section is a cup-like ventilating cap molded of plastic material and having a concave seating surface engaged with the second bearing means; said second retainer means including a spring element and a retaining ring securing the spring element to the cap; said spring element being formed with a concave seat facing said seating surface and engaged with said second bearing means.

0043538

FIG. 1

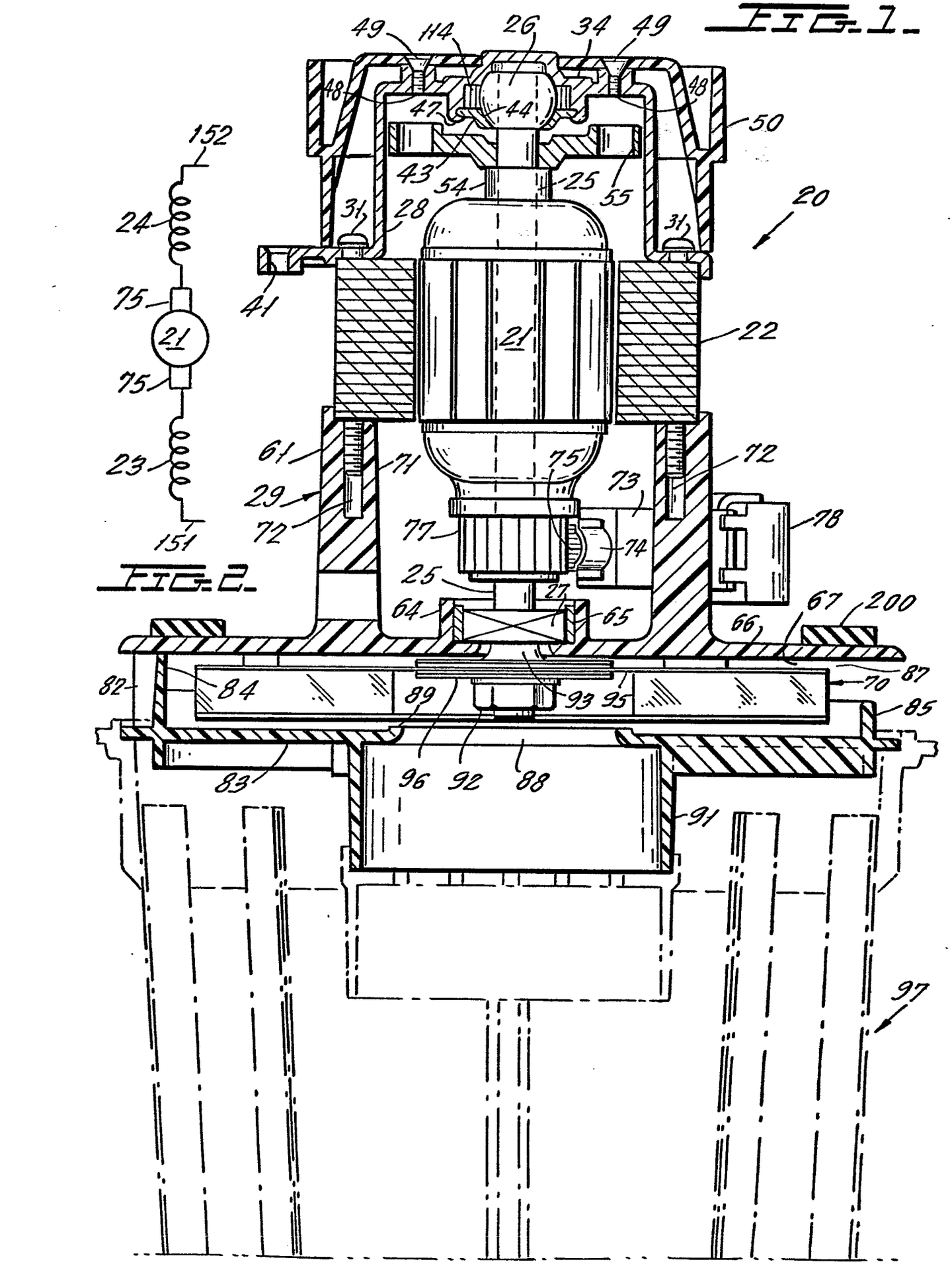


FIG. 2

0043538

FIG. 3.

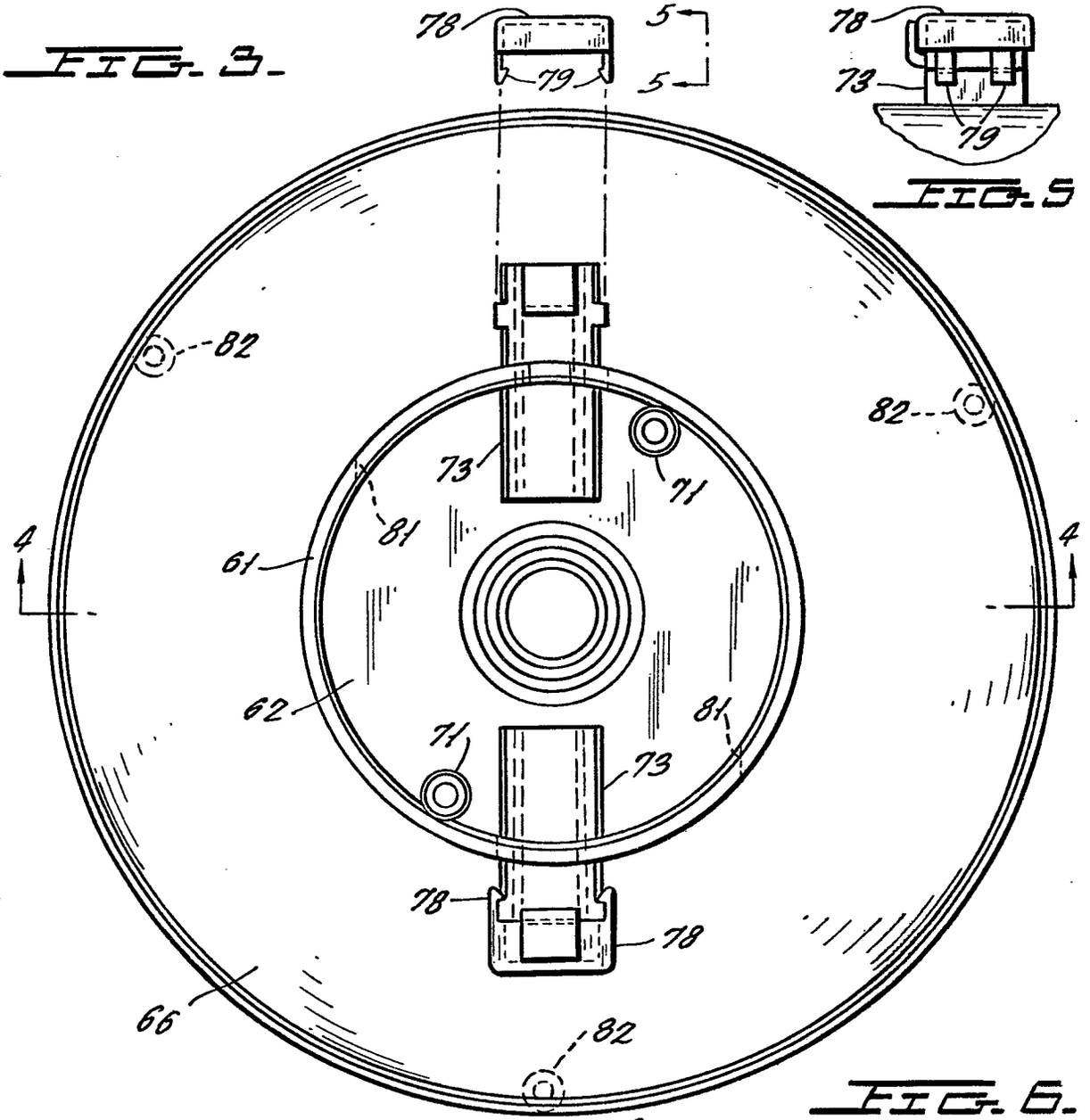


FIG. 5

FIG. 6.

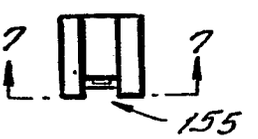


FIG. 4.

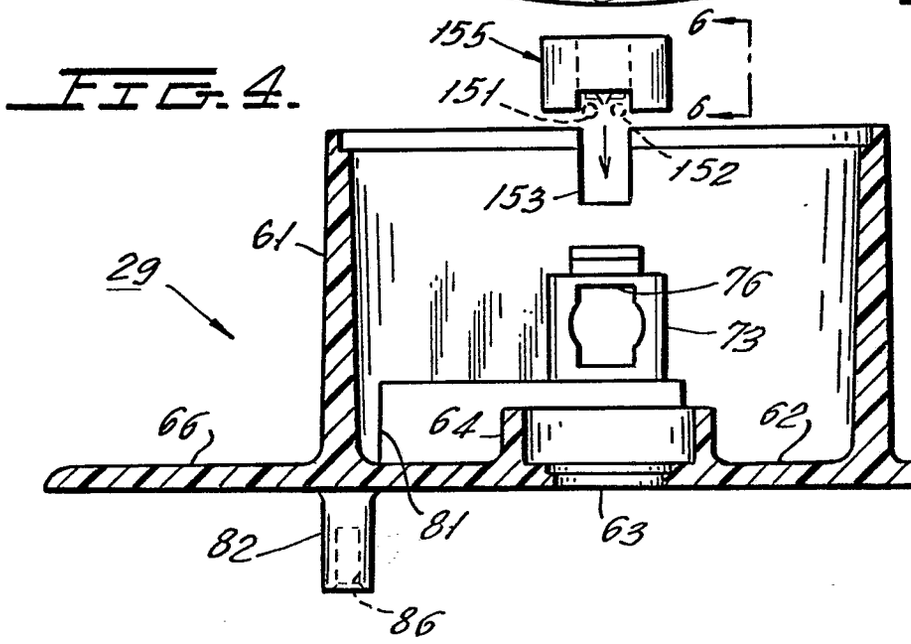
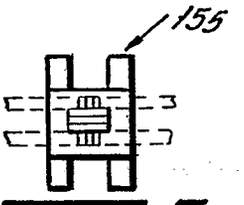


FIG. 7.



0043538

FIG. 10.

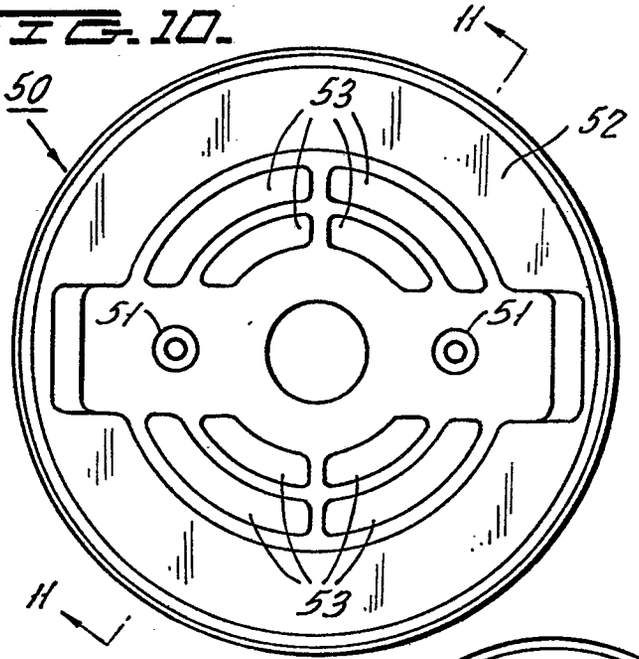


FIG. 11.

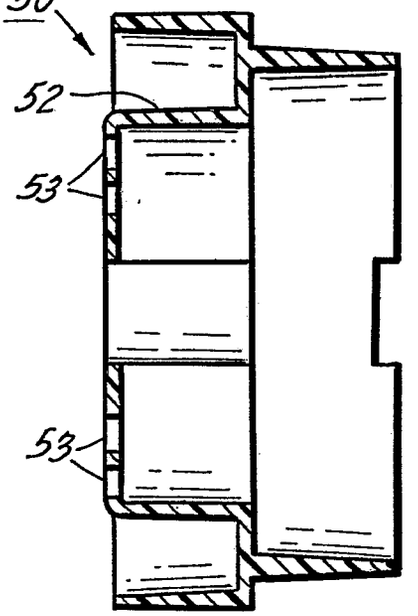


FIG. 12.

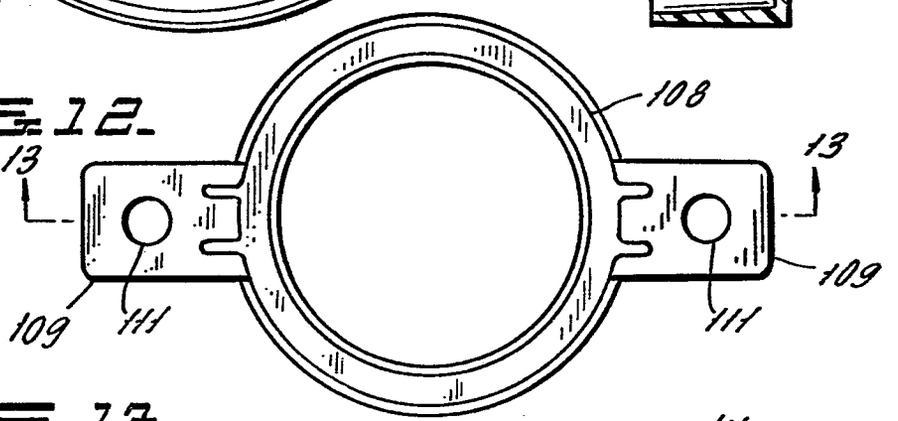


FIG. 13.

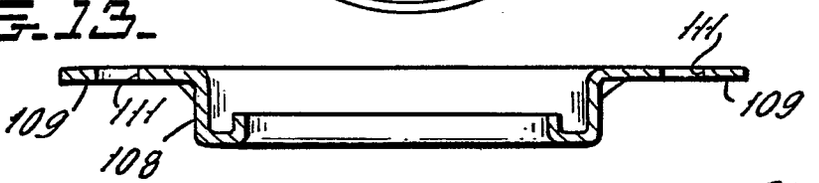


FIG. 8.

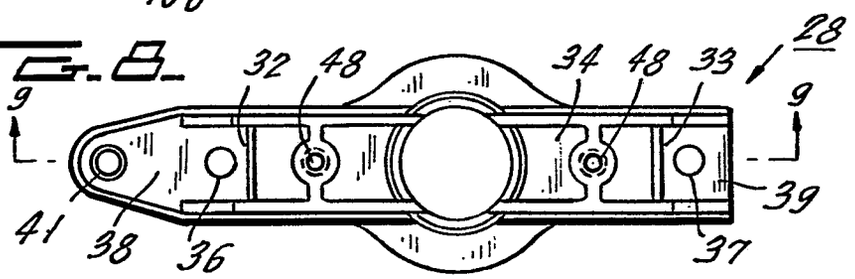
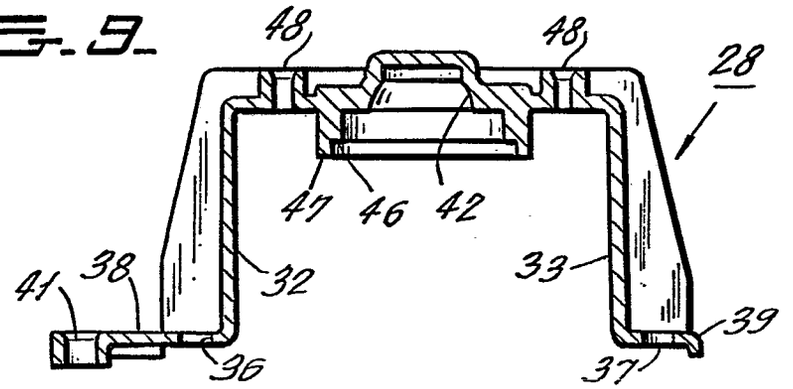


FIG. 9.



0043538

FIG. 14.

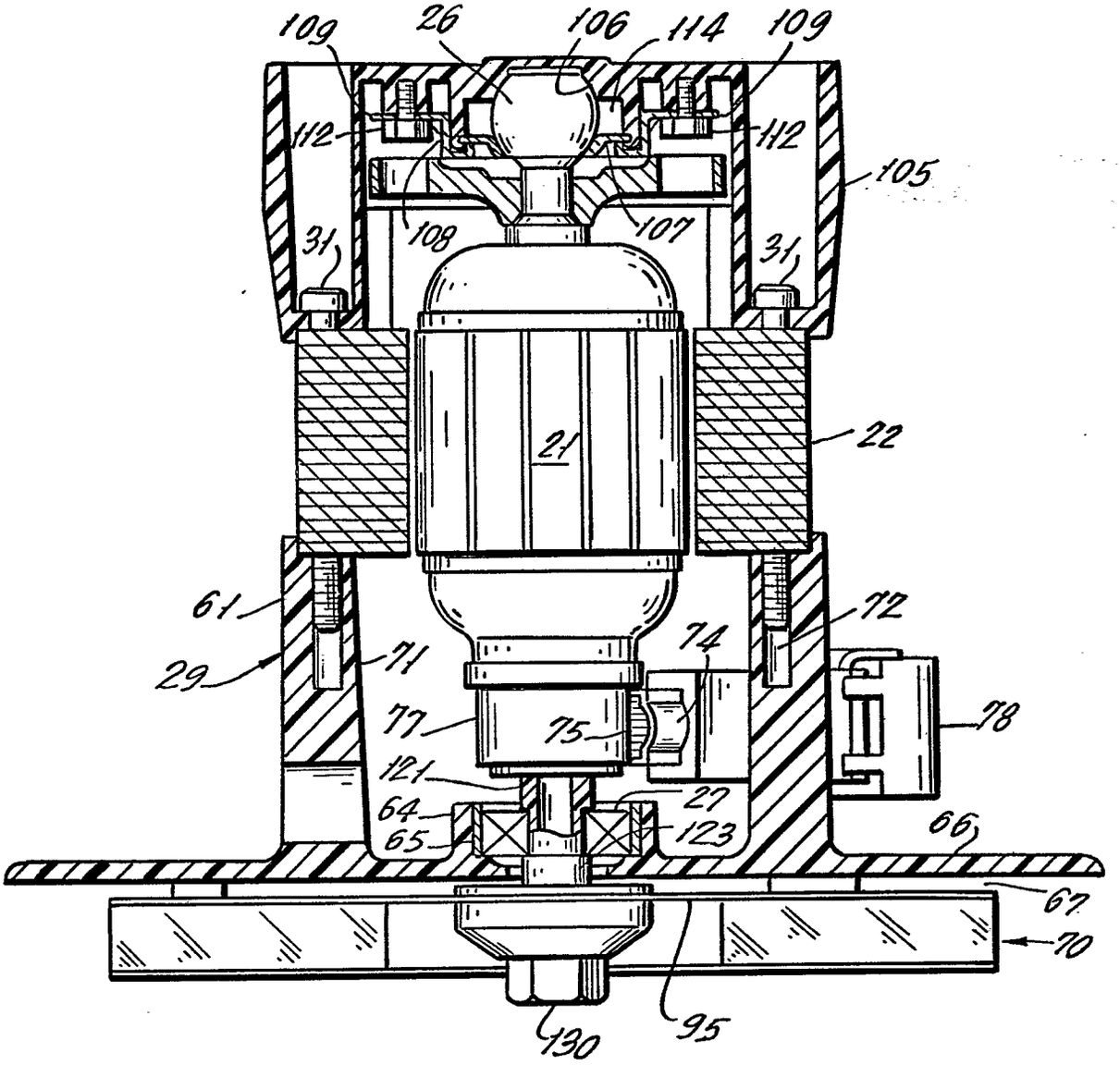


FIG. 15.

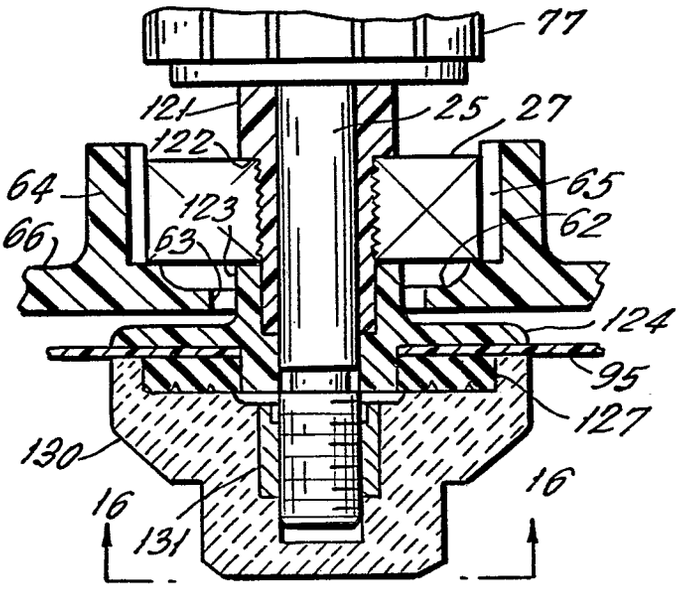


FIG. 16.