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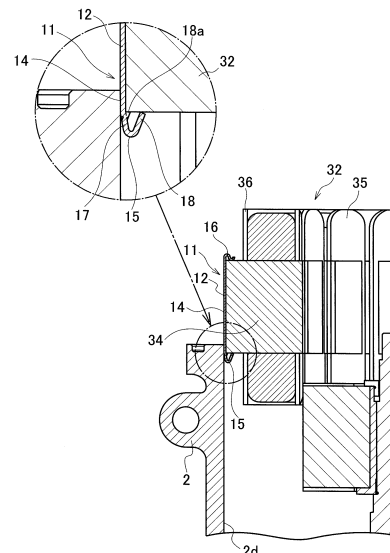
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(54) **ELECTRIC COMPRESSOR AND METHOD FOR ASSEMBLING ELECTRIC COMPRESSOR**

(57) An electric compressor (1, 101) and a method for assembling the same include: an electric motor unit (3, 104) including a stator (32, 113) fixed to a housing (2, 102) by a press-fitting to an inner peripheral wall (2d, 102d) of the housing (2, 102) and a rotor (33, 115) rotatably arranged inside the stator; a compression unit (4, 103) configured to be driven by a rotational drive force of the electric motor unit (3, 104) and compress a coolant; and a guide member (11, 119) attached to an outer periphery of the stator (32, 113) and having a guiding curved surface portion (15, 139) configured to guide the press-fitting of the stator (32, 113) to the inner peripheral wall (2d, 102d) of the housing (2, 102).

FIG. 5



Description

Technical Field

[0001] The present invention relates to an electric compressor in which a compression unit compresses coolant by being driven by an electric motor unit.

Background Art

[0002] A general electric compressor includes an electric motor unit and a compression unit in a cylindrical housing. In the electric compressor, the electric motor unit controls the compression unit and the compression unit is driven by the electric motor to operate to compress coolant. The housing is made of aluminum for sake of weight reduction. The electric motor unit includes a stator in which coils are wound around a stator core and a rotor which is arranged inside the stator and which is rotated by magnetic force generated by electric current flowing through the stator.

[0003] The stator is fixed to the inner peripheral wall of the housing and is fixed to the cylindrical housing by shrink-fitting as described in Patent Literature 1. This is because the stator and the housing have different coefficients of linear expansion and accordingly need to have a large amount of interference therebetween in view of a temperature increase in usage of the electric compressor. Such shrink-fitting is performed as follows. The housing is heated in advance and the stator core is inserted and positioned inside the heated housing. Then, the heated housing is cooled to shrink and the stator is thereby fixed to the housing.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2009-228546

Summary of Invention

[0005] Since the housing needs to be heated when the stator is to be fixed to the housing by shrink fitting as in Patent Literature 1, the number of steps and the cost increase. Moreover, in the shrink-fitting, the temperature of resin parts such as an insulating plate included in the stator and an O-ring included in a rotating body needs to be adjusted to be kept at or below a heat-resistant temperature, and work is cumbersome. Furthermore, securing a sufficient amount of interference is difficult.

[0006] An object of the present invention is to provide an electric compressor and a method for assembling an electric compressor wherein a stator can be fixed to a housing without using a shrink-fitting step, the stator can be surely press-fitted into the housing with the formation of burrs (chips) being suppressed, and a sufficient

amount of interference can be secured.

[0007] An electric compressor in accordance with some embodiments includes: a cylindrical housing; an electric motor unit fixed inside the housing and including a stator and a rotor, the stator being fixed to the housing by a press-fitting of the stator to an inner peripheral wall of the housing and configured to generate a magnetic force upon energization of the stator, the rotor being rotatably arranged inside the stator and configured to be rotated by the magnetic force generated by the stator; a compression unit arranged in the housing and configured to be driven by a rotational drive force of the electric motor unit and compress a coolant; and a guide member attached to an outer periphery of the stator and made of a thin plate material having a guiding curved surface portion configured to guide the press-fitting of the stator to the inner peripheral wall of the housing.

[0008] According to the configuration described above, the guide member provided with the guiding curved surface portion is attached to the outer periphery of the stator, and the stator is press-fitted into the housing in this attachment state. A corner portion of the stator thus does not come into contact with the inner peripheral wall of the housing and formation of burrs (chips) which causes failures can be prevented. Moreover, since fixation by press-fitting is possible, a complex shrink-fitting step can be eliminated. Furthermore, since the guide member is made of thin plate material, it is possible to reduce an increase in weight due to attachment of the guide member and suppress an increase in cost.

[0009] The guiding curved surface portion may be a curved surface extending in a direction toward a center of the stator from an end portion of the stator from which the stator is inserted into the housing.

[0010] According to the configuration described above, the guiding curved surface portion is a curved surface extending toward the center side of the stator. Hence, the stator can be surely guided in the press-fitting of the stator into the housing.

[0011] The guide member may include a displacement preventing portion extending from the guiding curved surface portion and configured to prevent a displacement of the guide member in an axial direction of the guide member in the press-fitting of the stator to the inner peripheral wall of the housing.

[0012] According to the configuration described above, the displacement preventing portion of the guide member is provided. Hence, the stator can be surely press-fitted without the guide member being displaced in the press-fitting of the stator into the housing.

[0013] The guide member may include: an interference portion formed in a shape elongated in an axial direction of the stator and press-fitted to the inner peripheral wall of the housing, the interference portion being connected to the guiding curved surface portion at an insertion-side end portion of the interference portion; and a locking-holding portion provided in an end portion of the interference portion on an opposite side to the insertion-side end

portion and configured to hold the stator.

[0014] According to the configuration described above, the guide member is formed of the interference portion, the guiding curved surface portion, and the locking-holding portion, and the interference portion secures a sufficient amount of interference in the press-fitting of the stator while the locking-holding portion secures the attachment state to the stator. Hence, it is possible to stably press-fit the stator into the housing and to also stably attach the guide member to the stator.

[0015] A plurality of the guide members may be provided, and the guide members may be attached at equal intervals along a circumferential direction of the stator.

[0016] According to the configuration described above, the guide members are attached at equal intervals in the circumferential direction of the stator. Hence, the stator can be prevented from being press-fitted in a manner inclined with respect to the housing.

[0017] A section of the inner peripheral wall of the housing facing a non-attachment section of the outer periphery of the stator where no guide member is attached may be offset toward an outer peripheral side of the housing with a gap from the non-attachment section of the stator.

[0018] According configuration described above, a gap is formed between the housing and the section of the stator where no guide member is attached. Hence, the section where no guide member is attached does not come into contact with the housing, and chips (burrs) of housing due to contact are not formed also in the section where no guide member is attached.

[0019] The guide member may include: a plurality of guide pieces each having the guiding curved surface portion, and a connection piece connecting the guide pieces to each other in the guiding curved surface portions.

[0020] According to the configuration described above, the guide member is formed of the plurality of guide pieces each having the guiding curved surface portion and of a connection piece connecting the guide pieces to each other, and the connecting piece connects the guide pieces in the guiding curved surface portions. Hence, it is possible to surely press-fit the stator into the housing with formation of burrs (chips) being suppressed and secure a sufficient amount of interference.

[0021] The guide member may have a curved surface shape along a circumferential direction of the stator and include a slit formed in an axial direction of the guide member.

[0022] According to the configuration described above, the guide member has the curved surface shape along the circumferential direction of the stator, and a slit-shaped cut is formed in the axial direction of the guide member. Hence, the stator can be surely guided when the stator is press-fitted into the housing.

[0023] A method for assembling an electric compressor in accordance with some embodiments is a method for the electric compressor including: a cylindrical housing; an electric motor unit fixed inside the housing and including a stator and a rotor, the stator being fixed to

the housing by a press-fitting of the stator to an inner peripheral wall of the housing and configured to generate a magnetic force upon energization of the stator, the rotor being rotatably arranged inside the stator and configured to be rotated by the magnetic force generated by the stator; and a compression unit arranged in the housing and configured to be activated by a rotational drive force of the electric motor unit and compress a coolant. The method includes: attaching guide members made of a thin plate material to at least three positions of an outer periphery of the stator; and guiding a press-fitting of the stator to the inner peripheral wall of the housing by using guiding curved surface portions of the guide members as attached.

[0024] According to the configuration described above, the guide member is attached to the outer periphery of the stator and the guiding curved surface portion of the guide member guides the press-fitting of the stator into the housing. Hence, it is possible to smoothly press-fit the stator into the housing and eliminate a cumbersome shrink-fitting step.

Brief Description of Drawings

[0025]

Fig. 1 is a partially cutaway perspective view showing an electric compressor in a first embodiment of the present invention.

Fig. 2 is a cross-sectional view showing a state where a stator is press-fitted into a housing.

Fig. 3 is a perspective view showing a stator.

Fig. 4 is a perspective view showing a guide member.

Fig. 5 is a cross-sectional view and a partially-enlarged cross-sectional view showing an initial state of the press-fitting of the stator into the housing.

Fig. 6 is a cross-sectional view showing a state where the press-fitting of the stator into the housing is completed.

Fig. 7 is an enlarged cross-sectional view showing the state where the stator is press-fitted into the housing.

Fig. 8 shows a modified example of the first embodiment and is a cross-sectional view showing a state where the stator is press-fitted into the housing with six guide members being attached to an outer periphery of the stator.

Fig. 9 is a cross-sectional view showing a modified example of the guide member in the first embodiment.

Fig. 10 is a cross-sectional view showing another modified example of the guide member of the first embodiment.

Fig. 11 is a partially cutaway perspective view showing an electric compressor in a second embodiment of the present invention.

Fig. 12 is a cross-sectional view showing a state where a stator is press-fitted into the housing.

Fig. 13 is a perspective view showing the stator.

Fig. 14 is a perspective view showing a guide member.

Fig. 15 is a cross-sectional view and a partially-enlarged cross-sectional view showing a state where the press-fitting of the stator into the housing is started.

Fig. 16 is a cross-sectional view showing a state where the press-fitting of the stator into the housing is completed.

Fig. 17 is an enlarged cross-sectional view showing the state where the press-fitting of the stator into the housing is completed.

Fig. 18 shows a modified example of the second embodiment and is a cross-sectional view showing a state where the stator is press-fitted into the housing with six guide members being attached to an outer periphery of the stator.

Fig. 19 is a cross-sectional view showing a modified example of the guide member in the second embodiment.

Fig. 20 is a cross-sectional view showing another modified example of guide member in the second embodiment.

Fig. 21 is a side view of the guide member which shows another modified example of the second embodiment.

Fig. 22A shows the other modified example of the second embodiment and is a cross-sectional view taken along the A-A line of Fig. 21 and showing a state before attachment of the guide member to the stator.

Fig. 22B shows the other modified example of the second embodiment and is a cross-sectional view taken along the A-A line of Fig. 21 and showing a state where attachment of the guide member to the stator is completed.

Description of Embodiments

[0026] A first embodiment of the present invention is described below in detail by using Figs. 1 to 10.

[0027] Figs. 1 to 7 are views for explaining an electric compressor 1 in a first embodiment of the present invention. Fig. 1 is a partially cutaway perspective view of the entire electric compressor 1. As shown in Fig. 1, the electric compressor 1 includes a housing 2, an electric motor unit 3, a compression unit 4, and a drive circuit unit 5.

[0028] The housing 2 includes a front housing 2a, a middle housing 2b, and a rear housing 2c and is formed entirely of aluminum in a substantially-cylindrical shape. The housings 2a, 2b, and 2c are connected to each other by bolts and the housing 2 is thereby formed to be hollow as a whole. The electric motor unit 3, the compression unit 4, and the drive circuit unit 5 are housed inside the housing 2.

[0029] The drive circuit unit 5 controls the number of revolutions of the electric motor unit 3 depending on

change of a thermal load of the compression unit 4 and is housed in the front housing 2a. The electric motor unit 3 drives the compression unit 4 and is housed in the middle housing 2b and the rear housing 2c. The compression unit 4 compresses coolant by being driven by rotational drive force of the electric motor unit 3 and is housed in the rear housing 2c.

[0030] The compression unit 4 includes a cylinder block 42, a front side block 43, a rear side block 44, and a rotor 45. A cylinder chamber 41 having an elliptical inner wall surface is formed in the cylinder block 42. The front side block 43 and the rear side block 44 holds the cylinder block 42 in a sandwiched state. The rotor 45 is attached to a rotary drive shaft 31 extending from the electric motor unit 3 and is rotatably housed in a center portion of the cylinder chamber 41. The rotary drive shaft 31 extends in a left-right direction in the housing 2 and is rotatable in the housing 2 by being supported at both ends portions by the middle housing 2b and the rear side block 44.

[0031] Multiple vane grooves 47 are formed in an outer periphery of the rotor 45 at equal intervals in a circumferential direction, and a vane 46 is housed in each of the vane grooves 47 to be capable of advancing and retreating. Each of the vanes 46 advances and retreats from and to the corresponding vane groove 47 by receiving a centrifugal force and an oil back pressure supplied to a bottom portion of the vane groove 47 which are generated by the rotation of the rotor 45. Advancing of the vanes 46 causes top portions of the vanes 46 to slide along the inner wall surface of the cylinder chamber 41. The vanes 46 divide the cylinder chamber 41 into multiple compression chambers. The volume of each of the compression chambers increases and decreases with the rotation of the rotor 45 and the advancing and retreating of the vanes 46. An intake stroke, a compression stroke, and a discharge stroke of the coolant are repeated by the increase and decrease of the volume. In the intake stroke, the coolant is sucked in from an intake port. In the discharge stroke, the coolant compressed in the compression stroke is discharged from a discharge port.

[0032] The electric motor unit 3 includes a stator 32 fixed to the rear housing 2c (hereafter referred to as housing 2) by being press-fitted into the housing 2 and a rotor 33 rotatably arranged inside the stator 32.

[0033] As shown in Figs. 1 to 3, in the stator 32, multiple coils 35 are wound around a stator core 34 having a cylindrical exterior. The coils 35 are wound around the stator core 34 via a thin insulator 36 made of insulating material. Magnetic force is generated upon energization of the coils 35 by supplying electricity from the drive circuit unit 5 to the coils 35.

[0034] A rotor 33 is attached to the rotary drive shaft 31. Multiple permanent magnets corresponding to the coils 35 of the stator 32 are provided on an outer peripheral side of the rotor 33, and the rotor 33 rotates by receiving magnetic force from the stator 32. This rotation causes the rotary drive shaft 31 to rotate and the rotor

45 of the compression unit 4 is rotated by the rotation of the rotary drive shaft 31.

[0035] The stator core 34 of the stator 32 is formed of laminated steel plates formed by laminating thin annular steel plates. Press-fitting the stator core 34 to an inner peripheral wall 2d of the housing 2 made of aluminum fixes the stator 32 to the housing 2. Guide members 11 are attached to the stator 32 for the press-fitting of the stator 32 to the inner peripheral wall 2d of the housing 2.

[0036] As shown in Figs. 2 and 3, the guide members 11 are attached to multiple positions (three positions in the embodiment) of the outer periphery of the stator 32 (stator core 34) at equal intervals in the circumferential direction. The guide members 11 guide the press-fitting of the stator 32 into the housing 2.

[0037] As shown in Fig. 4, each of the guide members 11 is formed of multiple (four) guide pieces 12 extending along a press-fitting direction (up-down direction in Fig. 4) and connection pieces 13 provided integrally with the guide pieces 12. The connection pieces 13 are provided at multiple positions (two positions) along a longitudinal direction of the guide pieces 12 and connect the adjacent guide pieces 12 to each other at multiple positions in the longitudinal direction. The guide member 11 as a whole is formed to have a raft shape by connecting the multiple guide pieces 12 with the connection pieces 13 as described above. Since such a guide member 11 can have an arc shape along an arc-shaped outer peripheral wall of the stator 32, attachment along an outer surface of the stator 32 is made possible.

[0038] The guide members 11 are formed by pressing thin steel plates. This can reduce an increase in weight due to provision of the guide members 11 and also suppress an increase in cost.

[0039] As shown in Figs. 4 to 7, the guide pieces 12 of the guide members 11 are formed to have substantially the same length as the length, in the axial direction, of the stator 32 (stator core 34) made of laminated steel plates. Each of the guide pieces 12 is formed of an interference portion 14 formed to have a shape elongated in the axial direction of the stator 32, a guiding curved surface portion 15 extending from an insertion-side end portion (lower end portion located on the lower side in Figs. 4 to 7) of the interference portion 14, and a locking-holding portion 16 provided in an end portion (upper end portion located on the upper side in Figs. 4 to 7) of the interference portion 14 on the opposite side to the guiding curved surface portion 15.

[0040] The interference portion 14 has a flat plate shape and is press-fitted to the inner peripheral wall 2d of the housing 2 when the stator 32 is press-fitted into the housing 2. Hence, the stator 32 can be press-fitted to the inner peripheral wall 2d of the housing 2 without the outer peripheral wall of the stator 32 coming into contact with the inner peripheral wall 2d of the housing 2.

[0041] The guiding curved surface portion 15 is formed of a curved surface extending to curve from the lower end portion of the interference portion 14 toward a center

side of the stator 32. A taper portion 17 is formed in the curved surface portion of the guiding curved surface portion 15. The taper portion 17 is inclined to extend linearly from the inner peripheral wall 2d of the housing 2 along the axial direction of the stator 32, and acts as a guide when the stator 32 is press-fitted into the housing 2. Providing such a guiding curved surface portion 15 prevents a corner portion of the stator 32 from coming into direct contact with the inner peripheral wall 2d of the housing 2 when the stator 32 is press-fitted to the inner peripheral wall 2d of the housing 2. Accordingly, no chips are formed from the housing 2. Failure due to formation of chips can be thereby prevented.

[0042] An extended end portion of this guiding curved surface portion 15 serves as a displacement preventing portion 18 which comes into contact with and is locked to an insertion-side end portion (lower end portion) of the stator 32. The displacement preventing portion 18 prevents the guide member 11 from being displaced in the axial direction in the press-fitting to the inner peripheral wall 2d of the housing 2 by coming into contact with the insertion-side end portion of the stator 32.

[0043] The locking-holding portion 16 is formed integrally with the interference portion 14 in the end portion on the opposite side to the guiding curved surface portion 15 to extend toward the center side of the stator 32. The locking-holding portion 16 is curved in a U-shape from the end portion of the interference portion 14. The locking-holding portion 16 thus has a spring characteristic and is locked to an end portion (upper end portion) of the stator 32 on the opposite side to the insertion-side end portion by spring force. This can achieve a state where the guide member 11 is attached to the stator 32 with detachment of the guide member 11 from the stator 32 being prevented.

[0044] As shown in Fig. 2, sections of the inner peripheral wall 2d of the housing 2 facing the outer peripheral portion (non-attachment section) of the stator 32 where no guide members 11 are attached are formed to be offset toward the outer peripheral side (outward) of the housing 2. Forming offset portions 2f which are offset outward in the inner peripheral wall 2d of the housing 2 and which correspond to the sections where no guide members 11 are attached can form gaps between the stator 32 and the inner peripheral wall 2d of the housing 2 in the offset portions 2f. Accordingly, the sections of the stator 32 where no guide members 11 are attached do not come into contact with the inner peripheral wall 2d of the housing 2, and no chips of housing 2 are formed in the sections where no guide members 11 are attached.

[0045] Figs. 5 and 6 show operations of press-fitting the stator 32 to the inner peripheral wall 2d of the housing 2.

[0046] Before the press-fitting, the guide members 11 are attached to the three positions of the outer periphery of the stator 32 at equal intervals. Attaching the guide members 11 to at least three positions allows the stator 32 to be press-fitted without being inclined. The attach-

ment of each of the guide members 11 is performed by locking the locking-holding portion 16 to the upper end portion of the stator 32. As shown in Fig. 5, in this attachment state, the guiding curved surface portion 15 of the guide member 11 extends toward the center side in the insertion-side end portion of the stator 32 and thereby covers the insertion-side end portion.

[0047] The stator 32 is press-fitted to the inner peripheral wall 2d of the housing 2 with the guide members 11 attached as described above. In the press-fitting, since the taper portions 17 formed in the guiding curved surface portion 15 guide the press-fitting to the inner peripheral wall 2d of the housing 2, the press-fitting can be performed smoothly. Moreover, since the guiding curved surface portions 15 prevent the corner portion of the stator 32 from coming into direct contact with the inner peripheral wall 2d of the housing 2, formation of chips from the housing 2 can be prevented. In the press-fitting, since the displacement preventing portions 18 prevent displacement of the guide members 11 in the axial direction, the guide members 11 are not displaced from the stator 32.

[0048] Moreover, as shown in Fig. 5, a boss portion for increasing the strength of the guiding curved surface portion 15 is formed on the outer peripheral surface side of the guiding curved surface portion 15, and a portion protruding toward the inner peripheral surface side of the guiding curved surface portion 15 is formed. This protrusion serves as a displacement preventing portion 18a which engages with the lower end portion of the stator 32 and prevents the guide member 11 from being displaced from the stator 32.

[0049] Fig. 7 shows a state where the press-fitting of the stator 32 is completed. A tapered step portion 2e is formed in the inner peripheral wall 2d of the housing 2, and the guiding curved surface portion 15 of each guide member 11 comes into contact with the step portion 2e. The press-fitting of the stator 32 is stopped by this contact, and the stator 32 is fixed to a predetermined position in the inner peripheral wall 2d of the housing 2. In this fixation state, the elongated interference portion 14 of the guide member 11 is press-fitted to the inner peripheral wall 2d of the housing 2, a sufficient amount of interference can be secured and the stator 32 can be stably fixed to the housing 2.

[0050] In the embodiment described above, since the stator 32 is press-fitted to the inner peripheral wall 2d of the housing 2 with the guide members 11 being attached to the three positions of the outer periphery of the stator 32, the corner portion of the stator 32 does not come into contact with the inner peripheral wall 2d of the housing 2 and formation of chips causing failures can be prevented. Moreover, since fixation by press-fitting is possible, a complex shrink-fitting step can be eliminated.

[0051] Note that, although the guide members 11 have the raft shape in which the multiple guide pieces are connected to each other by the connection pieces 13 in the embodiment, the guide members 11 are not limited to

this configuration. For example, the guide pieces 12 alone may be used as the guide members 11, and the guide members 11 may have a curved plate shape curved along the outer periphery of the stator 32.

[0052] Fig. 8 shows a modified example in which raft-shaped guide members 11 shown in Fig. 4 are attached to six positions of the outer peripheral surface of the stator 32. The six guide members 11 are attached to the outer periphery of the stator 32 at equal intervals. In this case, the stator 32 can be press-fitted with the inclination of the stator 32 with respect to the housing 2 being more surely prevented.

[0053] Figs. 9 and 10 each show a modified example of the guide member 11 in the first embodiment.

[0054] In the guide member 11 of Fig. 9, the guiding curved surface portion 15 is folded back in an arch shape, and the displacement preventing portion 18 is formed integrally with this folded-back end portion. The displacement preventing portion 18 extends in a flat surface shape from the folded back end portion of the guiding curved surface portion 15 toward the center of the stator 32. Since the displacement preventing portion 18 having such a flat surface shape has a large contact area with the insertion-side end portion of the stator 32, displacement of the guide member 11 in the axial direction in the press-fitting can be more surely prevented.

[0055] In the guide member 11 of Fig. 9, no locking-holding portion 16 is formed in the end portion of the interference portion 14 on the opposite side to the guiding curved surface portion 15. Even in this case, the guide member 11 can surely guide the stator 32 when the stator 32 is press-fitted to the inner peripheral wall 2d of the housing 2.

[0056] In the guide member 11 of Fig. 10, the displacement preventing portion 18 is provided continuously with an end portion of the guiding curved surface portion 15 in an inclined manner. A corner portion of the displacement preventing portion 18 comes into contact with the insertion-side end portion (lower end portion) of the stator 32 and prevents displacement of the guide member 11 in the axial direction in the press-fitting of the stator 32. Moreover, application of press-fitting force allows the displacement preventing portion 18 to deform in such a way as to be pressed and expanded toward the center side of the stator 32. Displacement of the guide member 11 can be thereby surely prevented.

[0057] Moreover, as shown in Fig. 10, a boss portion for increasing the strength of the guiding curved surface portion 15 is formed on the outer peripheral surface side of the guiding curved surface portion 15, and a portion protruding toward the inner peripheral surface side of the guiding curved surface portion 15 is formed. This protrusion serves as the displacement preventing portion 18a which engages with the lower end portion of the stator 32 and prevents the guide member 11 from being displaced from the stator 32.

[0058] Note that no locking-holding portion 16 is formed in the end portion of the interference portion 14

on the opposite side to the guiding curved surface portion 15 also in the guide member 11 of Fig. 10. Even in this case, the guide member 11 can surely guide the stator 32 when the stator 32 is press-fitted to the inner peripheral wall 2d of the housing 2.

[0059] Moreover, although the embodiment described above shows examples in which the guide members 11 are provided on the outer periphery of the stator 32 at three portions and six portions, the guide members 11 may be formed to be provided over the entire periphery of the stator 32.

[0060] Next, a second embodiment of the present invention is described in detail by using Figs. 11 to 22B.

[0061] As shown in Fig. 11, an electric compressor 101 in the second embodiment includes a substantially-cylindrical housing 102, a compression unit 103 housed in the housing 102 and configured to compress coolant, an electric motor unit 104 housed in the housing 102 to be adjacent to the compression unit 103, and a drive circuit unit 105 configured to control drive of the electric motor unit 104.

[0062] The housing 102 includes a front housing 102a, a middle housing 102b, and a rear housing 102c. As shown in Fig. 11, the front housing 102a is connected to the middle housing 102b, and the middle housing 102b is connected to the rear housing 102c, thereby forming the substantially-cylindrical housing 102. The compression unit 103, the electric motor unit 104, and the drive circuit unit 105 are housed in the housing 102.

[0063] The drive circuit unit 105 configured to control the drive of the compression unit 103 is housed in the front housing 102a. The electric motor unit 104 and the compression unit 103 are housed in the middle housing 102b and the rear housing 102c. Bulging portions 102f are formed in an inner peripheral wall 102d of the rear housing 102c to protrude from the inner peripheral wall 102d.

[0064] The compression unit 103 includes a cylinder block 107 having a cylinder chamber 121 inside an inner periphery, a pair of side blocks 109 arranged respectively on both end portions of the cylinder block 107, and a rotor 111 rotatably arranged in the cylinder chamber 121.

[0065] The cylinder block 107 is formed in an O-shape. The both end portions of the cylinder block 107 are held by and between a front side block 109a and a rear side block 109b which are the pair of side blocks 109, and this forms the cylinder chamber 121 inside the inner periphery of the cylinder block 107.

[0066] A columnar rotor 111 is rotatably arranged in the cylinder chamber 121. Vanes 123 protrude from vane grooves 125 formed in the rotor 111, and the coolant is compressed by an inner wall of the cylinder chamber 121 and front ends of the vanes 123. Note that multiple vane grooves 125 are formed on an outer periphery of the rotor 111 at equal intervals in a circumferential direction. The plate-shaped vanes 123 are housed in the vane grooves 125 to be capable of advancing and retreating.

[0067] The rotor 111 is press-fitted and fixed to a later-

described drive shaft 117 of the electric motor unit 104 and can rotate with rotation of the drive shaft 117.

[0068] The electric motor unit 104 includes a stator 113, a rotor 115, the drive shaft 117, and guide members 119. The stator 113 is press-fitted to the inner peripheral wall 102d of the rear housing 102c. The rotor 115 is rotatably arranged inside the inner periphery of the stator 113. The drive shaft 117 is press-fitted and fixed to the rotor 115. The guide member 119 guides the press-fitting of the stator 113 into the rear housing 102c.

[0069] The stator 113 includes a stator core 127 made of laminated steel plates, an insulator 131 made of insulating material and arranged in the stator core 127, and coils 129 wound around the stator core 127 via the insulator 131.

[0070] The rotor 115 is formed in a columnar shape. The rotor 115 is rotated by magnetic force generated by flow of electric current through the stator 113. Moreover, the drive shaft 117 is press-fitted and fixed at the center of the rotor 115, and the rotor 115 transmits rotational drive force to the drive shaft 117.

[0071] One end portion of the drive shaft 117 is rotatably supported by the middle housing 102b while the other end portion is supported by the pair of side blocks 109 of the compression unit 103. The rotor 111 is press-fitted and fixed to the drive shaft 117 near the other end portion of the drive shaft 117, and the rotational drive force transmitted from the electric motor unit 104 is transmitted to the rotor 111 via the drive shaft 117.

[0072] As shown in Figs. 12 and 13, regarding the guide members 119, three guide members 119 are arranged on an outer periphery of the stator 113 at equal intervals in the circumferential direction.

[0073] The guide members 119 are formed of thin plate material. As shown in Fig. 14, each of the guide members 119 includes multiple guide pieces 133 extending in a press-fitting direction and connection pieces 135 configured to connect the multiple guide pieces 133 to each other, and is formed in a raft shape. Since the guide member 119 is formed in a raft shape, the guide member 119 can be formed in a curved surface shape along the outer periphery of the stator 113 and be attached along the outer periphery of the stator 113.

[0074] Each of the guide pieces 133 having the curved shape along the outer periphery of the stator 113 includes an interference portion 137, a guiding curved surface portion 139, and a locking-holding portion 141. The interference portion 137 comes into contact with a corresponding one of the bulging portions 102f formed on the inner peripheral wall 102d of the rear housing 102c. The guiding curved surface portion 139 is formed in an end portion (lower end portion) of the guide piece 133 on one end side and guides the press-fitting of the stator 113 into the housing 102. The locking-holding portion 141 is formed on an end portion (upper end portion) of the guide piece 133 on the other end side which is opposite to the guiding curved surface portion 139.

[0075] The interference portion 137 is press-fitted to

the inner peripheral wall 102d of the rear housing 102 when the stator 113 is press-fitted to the bulging portions 102f of the rear housing 102c. Specifically, the stator 113 can be press-fitted to the bulging portions 102f of the rear housing 102c without the outer periphery of the stator 113 coming into contact with the inner peripheral wall 102d of the rear housing 102c.

[0076] Slit portions 140 are formed adjacent to the interference portions 137. Providing the slit portions 140 can reduce resistance due to friction in the press-fitting of the stator 113 to the rear housing 102c and facilitates the press-fitting. In addition, it is possible to reduce the weight of the guide member 119 and achieve weight reduction.

[0077] The guiding curved surface portion 139 includes a taper portion 142 configured to guide the press-fitting of the stator 113 into the rear housing 102c and a displacement preventing portion 143 coming into contact with and locked to the end portion (lower end portion) of the stator 113 on a side from which the stator 113 is press-fitted into the rear housing 102c.

[0078] The taper portion 142 is formed continuously with the interference portion 137 and is inclined to extend linearly from the inner peripheral wall 102d of the housing 102 along the axial direction of the stator 113. The taper portion 142 acts as a guide when the stator 113 is press-fitted into the rear housing 102c.

[0079] In a portion of the taper portion 142 on the interference portion 137 side, the adjacent guide pieces 133 are connected to each other together with one of the connection pieces 135 to be described later.

[0080] The displacement preventing portion 143 formed continuously with the taper portion 142 is formed by being folded from an end of the taper portion 142 on the opposite side to the interference portion 137 to come into contact with the stator 113. The displacement preventing portion 143 prevents the guide member 119 from being displaced in the axial direction when the stator 113 is press-fitted to the inner peripheral wall 102d of the rear housing 102c, by coming into contact with a front end portion of the stator 113 in the press-fitting direction.

[0081] On an inner peripheral surface side of the guiding curved surface portion 139 where the guiding curved surface portion 139 and the stator 113 come into contact with each other, there is formed a protrusion 143a protruding from the inner peripheral surface. The front end portion of the stator 113 in the press-fitting direction comes into contact with the protrusion 143a and displacement between the guide member 119 and the stator 113 is thereby prevented. A boss portion for securing the strength of the guiding curved surface portion 139 is formed on an outer peripheral surface side of the guiding curved surface portion 139.

[0082] The locking-holding portion 141 is formed continuously with the interference portion 137 and is formed to extend toward the center of the stator 113 in an end portion of the interference portion 137 on the opposite side to the guiding curved surface portion 139. The lock-

ing-holding portion 141 is curved in a U-shape from the end portion of the interference portion 137. The locking-holding portion 141 thus has a spring characteristic and holds the stator 113 on a rear end side of the stator 113 in the press-fitting direction by spring force.

[0083] As described above, each of the guide members 119 supports the front end side and the rear end side of the stator 113 in the press-fitting direction by using the locking-holding portions 141 and the displacement preventing portions 143 of the guiding curved surface portions 139.

[0084] The connection pieces 135 connecting the guide pieces 133 to each other connect the adjacent guide pieces 133 in a raft shape. The positions where the connection pieces 135 are provided can be set near the end portions of the guide pieces 133.

[0085] The connection piece 135 provided near the front ends of the guide pieces 133 in the press-fitting direction connects the guide pieces 133 to each other in the taper portions 142 of the guiding curved surface portions 139 and in the interference portions 137 with which the inner peripheral wall 102d of the housing 102 comes into contact. The connection piece 135 provided near the rear ends of the guide pieces 133 in the press-fitting direction connects the guide pieces 133 to each other in the interference portions 137.

[0086] An end portion of the connection piece 135 on the front end side in the press-fitting direction is also inclined to extend linearly from the inner peripheral wall 102d of the housing 102 along the axial direction of the stator 113 like the taper portion 142.

[0087] Although the two connection pieces 135 are connected to the guide pieces 133 as shown in Fig. 14 in the embodiment, two or more connection pieces 135 may be provided. Even in this case, at least one of the connection pieces 135 connects the guide pieces 133 to each other in the guiding curved surface portions 139.

[0088] The drive circuit unit 105 is housed in the front housing 102a. The drive circuit unit 105 controls the number of revolutions of the electric motor unit 104 depending on a thermal load of the compression unit 103.

[0089] Next, description is given of an operation of press-fitting the stator 113 into the housing 102.

[0090] First, as shown in Figs. 12 and 13, the three guide members 119 are attached to the outer periphery of the stator 113 at equal intervals in the circumferential direction. In the attachment of the guide members 119, the displacement preventing portions 143 and the protrusions 143a formed in the guiding curved surface portions 139 are brought into contact with the front end portion of the stator 113 in the press-fitting direction, and the locking-holding portions 141 are then attached to the rear end portion of the stator 113 in the press-fitting direction by using the spring characteristic of the locking-holding portions 141.

[0091] After the guide members 119 are attached to the stator 113, as shown in Fig. 15, the guiding curved surface portions 139 of the guide members 119 are

press-fitted from an opening portion of the housing 102.

[0092] When the stator 113 is press-fitted into the housing 102, the press-fitting is performed such that the guiding curved surface portions 139 of the guide members 119 first come into sliding contact with the bulging portions 102f formed on the inner peripheral wall 102d of the rear housing 102c. The taper portions 142 of the guiding curved surface portions 139 thus guide the press-fitting. Accordingly, the press-fitting of the stator 113 into the housing 102 can be facilitated.

[0093] Moreover, since the guiding curved surface portions 139 are press-fitted to the bulging portions 102f formed on the inner peripheral wall 102d of the housing 102, it is possible to prevent the front end portion of the stator 113 in the press-fitting direction from coming into contact with the opening portion of the housing 102. Accordingly, formation of chips (burrs) from the inner peripheral wall 102d of the housing 102 can be prevented.

[0094] As described above, by press-fitting the guiding curved surface portions 139 in the press-fitting direction to the bulging portions 102f formed on the inner peripheral wall 102d of the housing 102, the interference portions 137 are press-fitted to the bulging portions 102f. The press-fitting is completed as shown in Figs. 16 and 17 by further performing the press-fitting.

[0095] In the electric compressor 101 of the embodiment, the guide members 119 having the guiding curved surface portions 139 configured to guide the press-fitting of the stator 131 into the housing 102 are arranged on the outer peripheral surface of the stator 113. Accordingly, the stator 113 can be fixed to the housing 102 without using a shrink-fitting step.

[0096] Each of the guide members 119 are formed of the multiple guide pieces 133 having the guiding curved surface portions 139 and of the connection pieces 135 connecting the guide pieces 133 to each other, and one of the connection pieces 135 is connecting the guide pieces 133 to each other in the guiding curved surface portions 139. This enables the stator 113 to be surely fitted into the housing 102 with the formation of burrs (chips) suppressed and can secure a sufficient amount of interference. Moreover, one of the connection pieces 135 is connected to the guide pieces 133 in the guiding curved surface portions 139. Accordingly, each of the guiding curved surface portions 139 can have a large cross-sectional area, and the strength of the guide member 119 can be improved.

[0097] Each of the guide members 119 has the curved surface shape along the outer periphery of the stator 113, and the slit-shaped cuts (slit portions 140) are formed in the axial direction of the guide member 119. Guiding in the press-fitting of the stator 113 into the housing 102 can be thereby surely performed.

[0098] The guide members 119 are made of thin plate material. Accordingly, it is possible to prevent an increase in weight due to the attachment of the guide members 119 and also suppress an increase in cost.

[0099] The guide members 119 are attached at equal

intervals in the circumferential direction of the stator 113. Accordingly, it is possible to prevent the stator 113 from being press-fitted in a manner inclined with respect to the housing 102.

[0100] A gap is formed between the housing 102 and sections of the stator 113 where no guide members 119 are attached. Since the sections where no guide members 119 are attached do not come into contact with the housing 102, it is possible to prevent formation of chips (burrs) due to contact of the stator 113 with the housing 102, in the sections where no guide members 119 are attached.

[0101] Next, modified examples of the second embodiment are described by using Figs. 18 to 22B.

[0102] Fig. 18 shows a modified example in which the raft-shaped guide members 119 shown in Fig. 14 are attached to six positions of the outer periphery of the stator 113.

[0103] The six guide members 119 attached to the outer periphery of the stator 113 are attached at equal intervals in the circumferential direction also in this modified example.

[0104] In this modified example, the press-fitting of the stator 113 can be performed in a state where the inclination of the stator 113 with respect to the housing 102 is more surely prevented than in the aforementioned case where the three guide members 119 are attached to the outer periphery of the stator 113.

[0105] Figs. 19 and 20 each show a modified example of the guide member 119 of the second embodiment.

[0106] In the guide member 119 shown in Fig. 19, the guiding curved surface portion 139 is folded in a U-shape. Furthermore, the flat-surface-shaped displacement preventing portion 143 extends in such a way that the inner peripheral surface side of the guiding curved surface portion 139 extends toward the center of the stator 113 along the front end portion of the stator 113 in the press-fitting direction to form.

[0107] As in the second embodiment described above, the guiding curved surface portions 139 formed in the guide pieces 133 are connected to each other near the end portions thereof by the connection piece 135 also in this guide member 119.

[0108] Since the displacement preventing portion 143 having such a flat surface shape has a large contact area with the front end portion of the stator 113 in the press-fitting direction, it is possible to more surely prevent the displacement of the guide member 119 in the press-fitting direction in the press-fitting.

[0109] Moreover, in the guide member 119 shown in Fig. 20, the protrusion 143a is formed on the inner peripheral surface of the guide member 119, and the protrusion 143a is formed along an outer peripheral end of the front end of the stator 113 in the press-fitting direction. Note that the boss portion is formed on the outer peripheral surface of the guide member 119 also in the guide member 119 shown in Fig. 20.

[0110] As in the second embodiment and the modified

example described above, the guiding curved surface portions 139 formed in the guide pieces 133 are connected to each other near the end portions thereof by the connection piece 135 also in this guide member 119.

[0111] Since the protrusion 143a is provided along the outer peripheral end of the stator 113, in addition to the displacement preventing portion 143, the protrusion 143a also comes into contact with the front end portion of the stator 113 in the press-fitting direction. Accordingly, it is possible to more surely prevent the displacement of the guide member 119 in the press-fitting direction in the press-fitting.

[0112] Moreover, in each of the guide members 119 shown in Figs. 19 and 20, no locking-holding portion 141 is formed in the end portion on the opposite side to the guiding curved surface portion 139. Even in this case, the guiding by the guide member 119 can be surely performed when the stator 113 is press-fitted to the inner peripheral wall 102d of the housing 102.

[0113] In the guide member 119 shown in Figs. 21, 22A, and 22B, a protrusion forming hole 144 is provided in each of the guiding curved surface portions 139. Note that description of configurations same as those in the second embodiment and the modified examples described above is omitted.

[0114] The protrusion forming hole 144 is formed by shearing the thin plate material forming the guide member 119. A portion sheared to form the protrusion forming hole 144 is pressed by a not-illustrated tool or the like in such a way that the protrusion 143a is inclined in a direction coming close to the displacement preventing portion 143.

[0115] Fig. 22A is a cross-sectional view of the guide member 119 shows a state before the guide member 119 is attached to the stator 113. Fig. 22B is a cross-sectional view of the guide member 119 showing a state where the attachment of the guide member 119 to the outer periphery of the stator 113 is completed.

[0116] In this modified example, the stator 113 is brought into contact with the displacement preventing portion 143 formed in the guiding curved surface portion 139 when the guide member 119 is attached to the stator 113. Then, by further pressing the stator 113 in the press-fitting direction from the state where the displacement preventing portion 143 and the stator 113 are in contact with each other, the displacement preventing portion 143 is displaced in a direction moving away from the protrusion 143a from the state of the guide member 119 shown in Fig. 22A, and the guide member 119 is set to an attachment completed state shown in Fig. 22B. At this time, the front ends of the protrusion 143a and the displacement preventing portion 143 come into contact with the stator 113 and support the front end portion of the stator 113 in the press-fitting direction.

[0117] As described above, the protrusion 143a is formed by providing the protrusion forming hole 144 in each of the interference portions 137 of the guide member 119 and inclining the portion sheared to form the pro-

trusion forming hole 144 in the direction coming close to the displacement preventing portion 143. Accordingly, the protrusion 143a can be formed by simply punching the thin plate material and pressing the protrusion forming hole 144. The protrusion 143a can be thus easily formed.

[0118] Moreover, the protrusion 143a and the displacement preventing portion 143 are in contact with the stator 113 as in the modified examples described above. Accordingly, the displacement of the stator 113 in the press-fitting direction can be prevented.

[0119] In each of the embodiment and the modified examples, the guide members 119 are arranged at three positions of the outer periphery of the stator 113 at equal intervals, or at six positions at equal intervals as shown in Fig. 18. However, the number of positions where the guide members 119 are arranged may be a number other than three and six. Specifically, any number of guide members 119 may be provided as long as the stator 113 can be inserted without being inclined in the press-fitting of the stator 113 into the housing 102.

[0120] Furthermore, a single guide member 119 having a C-shape covering the outer periphery of the stator 113 may be provided.

[0121] Moreover, although the protrusion forming hole 144 is provided in each of the interference portions 137 in the modified example shown in Figs. 21, 22A, and 22B, a configuration may be such that the protrusion forming hole 144 is provided in each of the taper portions 142 and the protrusion 143a is inclined in a direction coming close to the displacement preventing portion 143.

[0122] As described above, the present invention includes various embodiments which are not described herein as a matter of course. Accordingly, the technical scope of the present invention is determined only by the matters to define the invention in the scope of claims regarded as appropriate from the aforementioned description.

[0123] The entire contents of Japanese Patent Application No. 2012-157415 (filed July 13, 2012) and Japanese Patent Application No. 2013-025180 (filed February 13, 2013) are incorporated herein by reference.

Claims

1. An electric compressor comprising:

a cylindrical housing;
an electric motor unit fixed inside the housing and including a stator and a rotor, the stator being fixed to the housing by a press-fitting of the stator to an inner peripheral wall of the housing and configured to generate a magnetic force upon energization of the stator, the rotor being rotatably arranged inside the stator and configured to be rotated by the magnetic force generated by the stator;

- a compression unit arranged in the housing and configured to be driven by a rotational drive force of the electric motor unit and compress a coolant; and
 a guide member attached to an outer periphery of the stator and made of a thin plate material having a guiding curved surface portion configured to guide the press-fitting of the stator to the inner peripheral wall of the housing.
2. The electric compressor according to claim 1, wherein the guiding curved surface portion is a curved surface extending in a direction toward a center of the stator from an end portion of the stator from which the stator is inserted into the housing.
3. The electric compressor according to claim 1 or 2, wherein the guide member includes a displacement preventing portion extending from the guiding curved surface portion and configured to prevent a displacement of the guide member in an axial direction of the guide member in the press-fitting of the stator to the inner peripheral wall of the housing.
4. The electric compressor according to any one of claims 1 to 3, wherein the guide member includes:
- an interference portion formed in a shape elongated in an axial direction of the stator and press-fitted to the inner peripheral wall of the housing, the interference portion being connected to the guiding curved surface portion at an insertion-side end portion of the interference portion; and
 a locking-holding portion provided in an end portion of the interference portion on an opposite side to the insertion-side end portion and configured to hold the stator.
5. The electric compressor according to any one of claims 1 to 4, wherein
 a plurality of the guide members are provided, and the guide members are attached at equal intervals along a circumferential direction of the stator.
6. The electric compressor according to any one of claims 1 to 5, wherein a section of the inner peripheral wall of the housing facing a non-attachment section of the outer periphery of the stator where no guide member is attached is offset toward an outer peripheral side of the housing with a gap from the non-attachment section of the stator.
7. The electric compressor according to claim 1, wherein the guide member includes:
- a plurality of guide pieces each having the guiding curved surface portion, and
 a connection piece connecting the guide pieces

to each other in the guiding curved surface portions.

8. The electric compressor according to claim 7, wherein the guide member has a curved surface shape along a circumferential direction of the stator and includes a slit formed in an axial direction of the guide member.
9. A method for assembling an electric compressor, the electric compressor including: a cylindrical housing; an electric motor unit fixed inside the housing and including a stator and a rotor, the stator being fixed to the housing by a press-fitting of the stator to an inner peripheral wall of the housing and configured to generate a magnetic force upon energization of the stator, the rotor being rotatably arranged inside the stator and configured to be rotated by the magnetic force generated by the stator; and a compression unit arranged in the housing and configured to be activated by a rotational drive force of the electric motor unit and compress a coolant, the method comprising:

attaching guide members made of a thin plate material to at least three positions of an outer periphery of the stator; and
 guiding a press-fitting of the stator to the inner peripheral wall of the housing by using guiding curved surface portions of the guide members as attached.

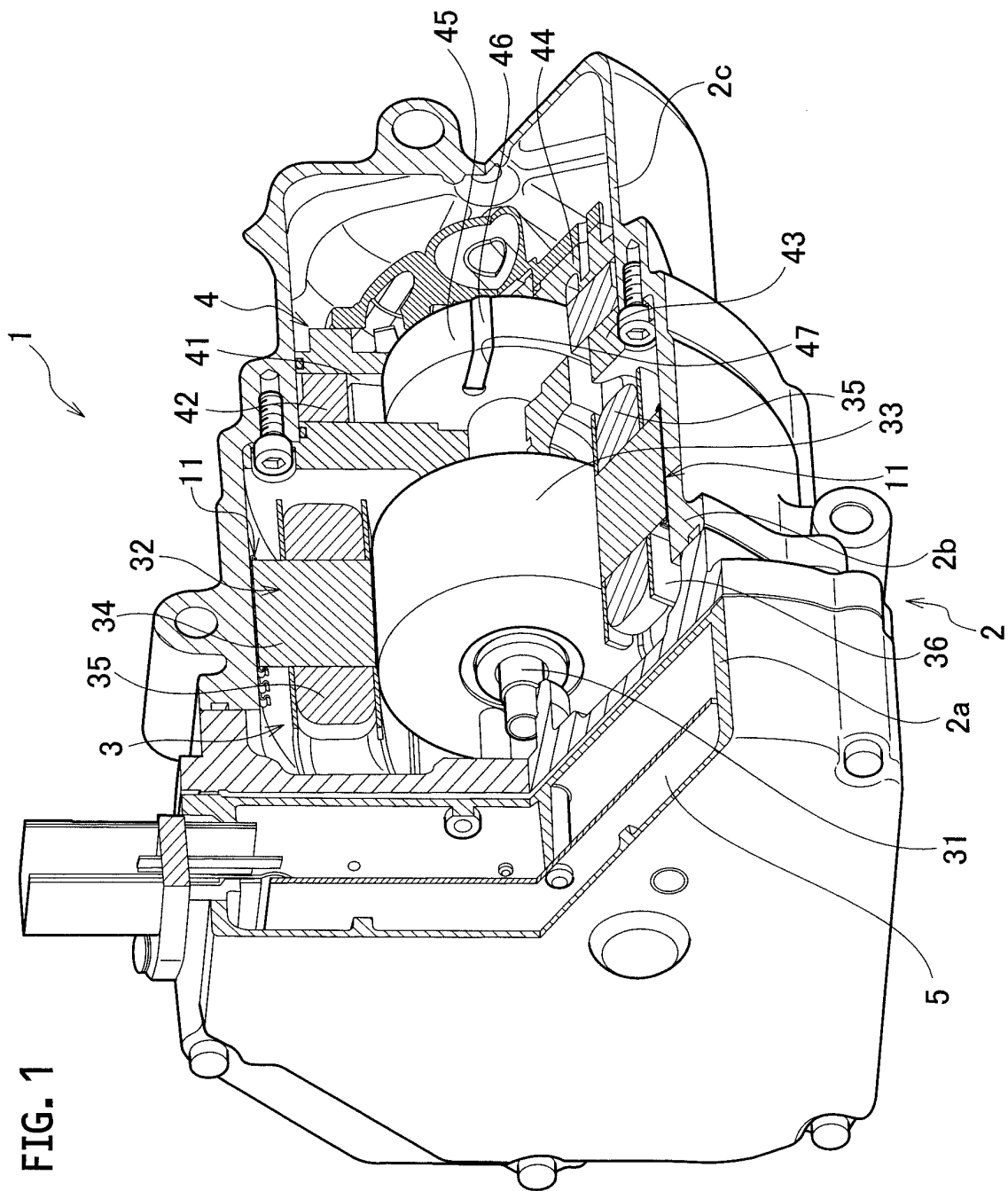


FIG. 2

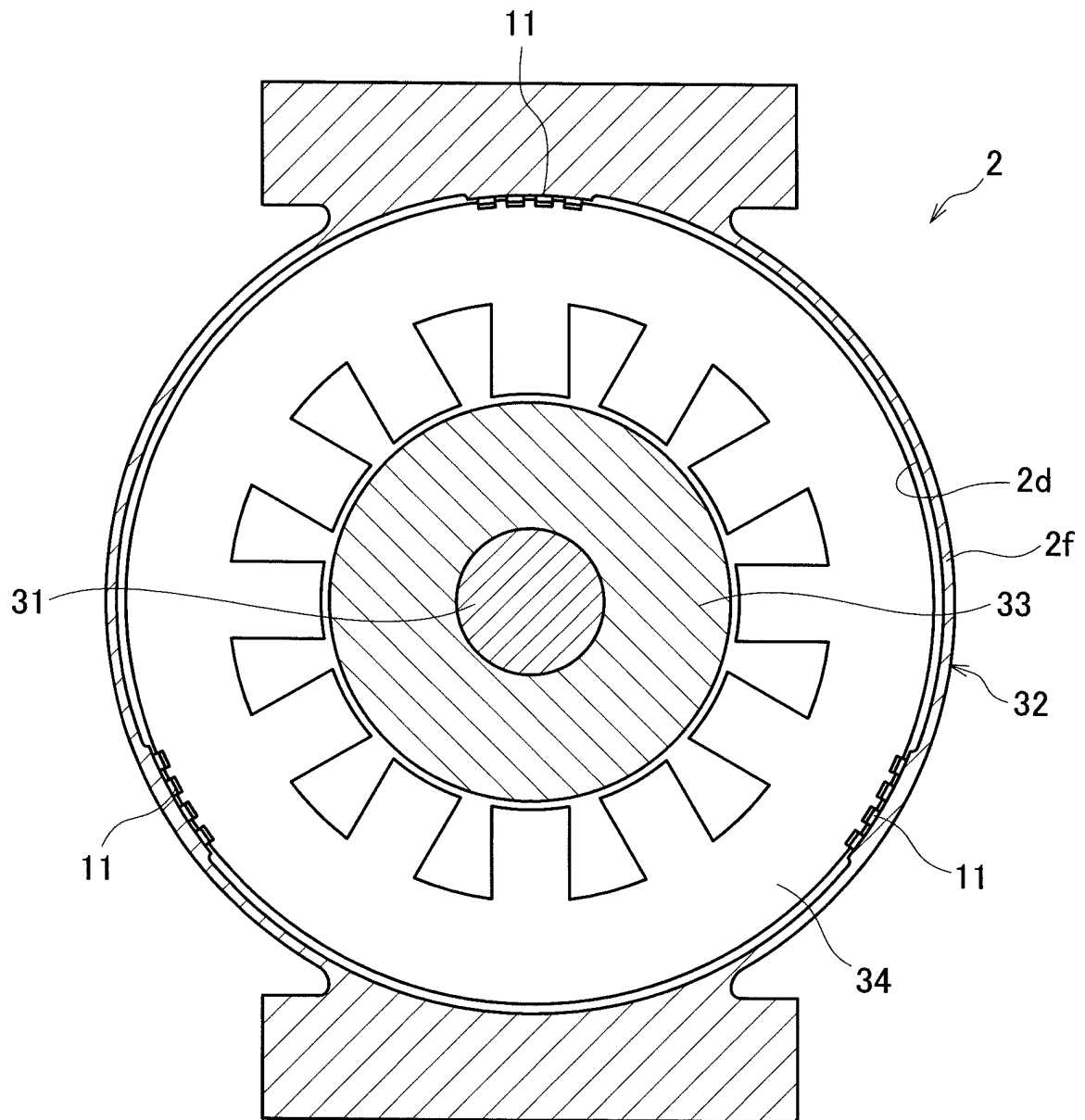


FIG. 3

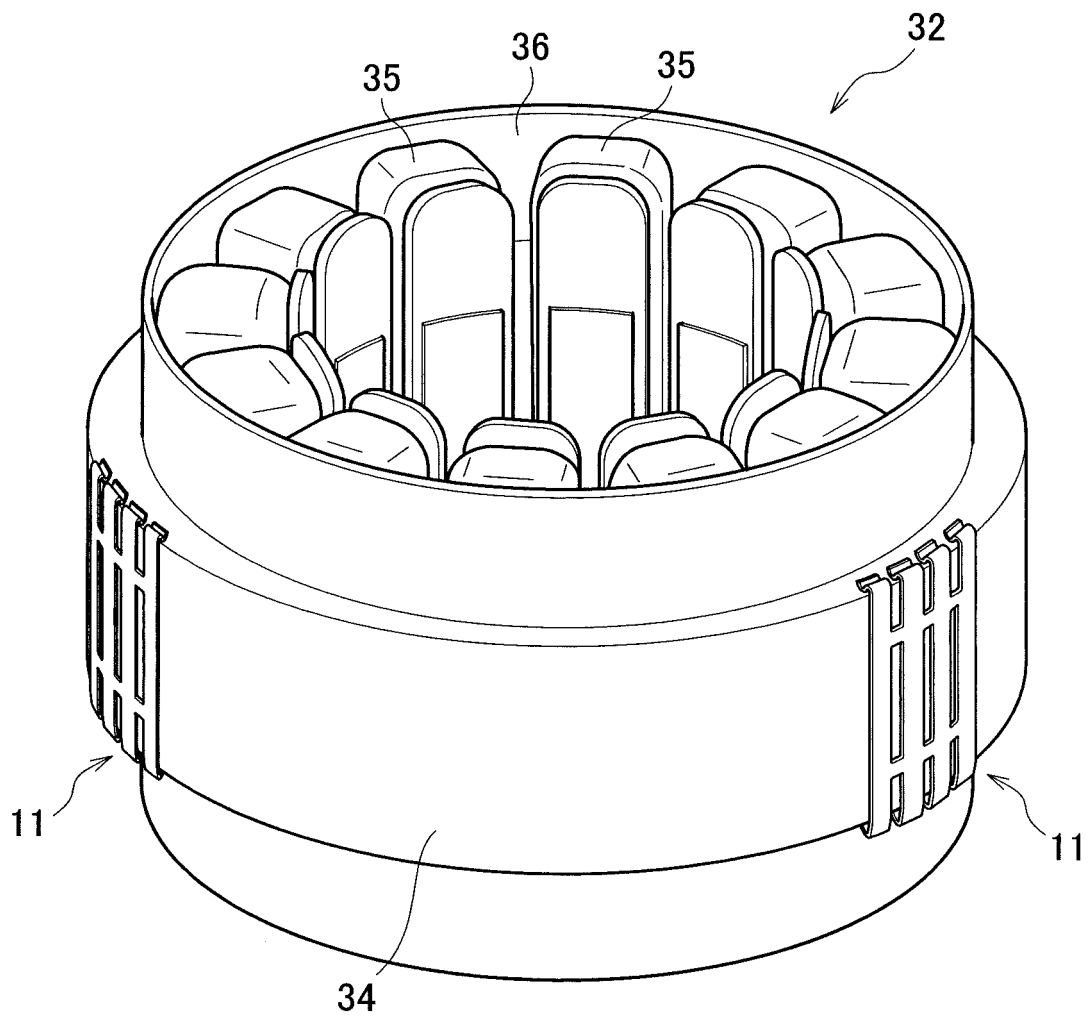


FIG. 4

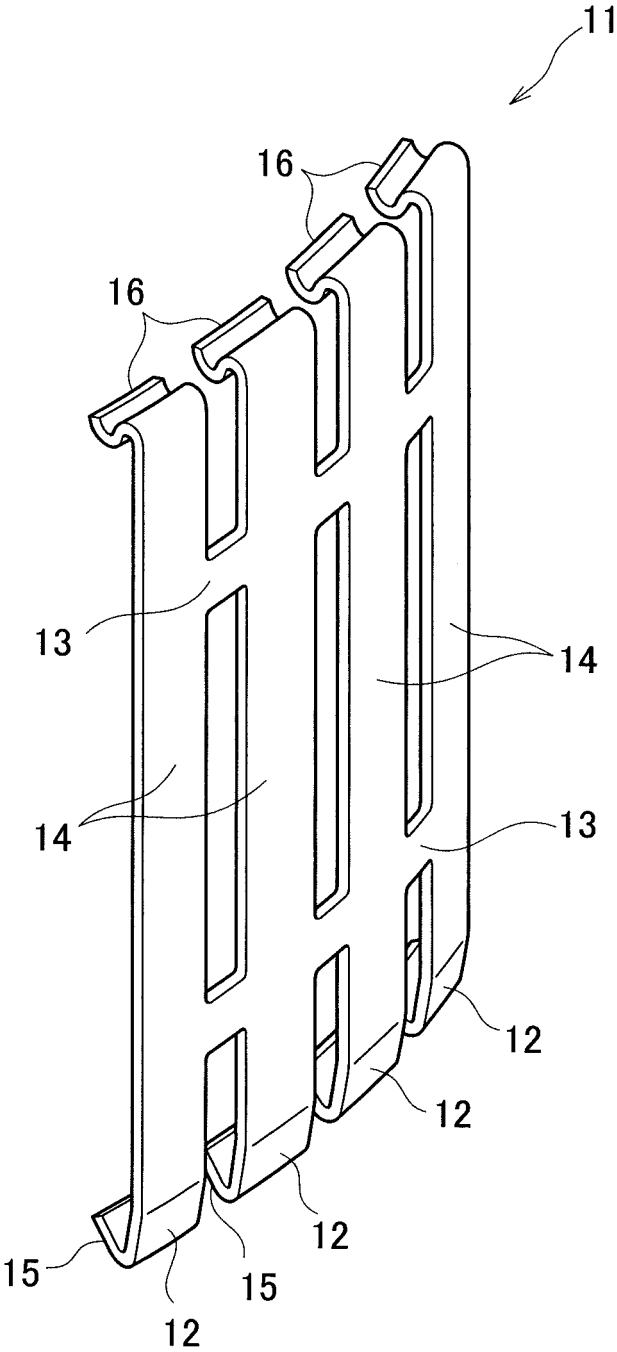


FIG. 5

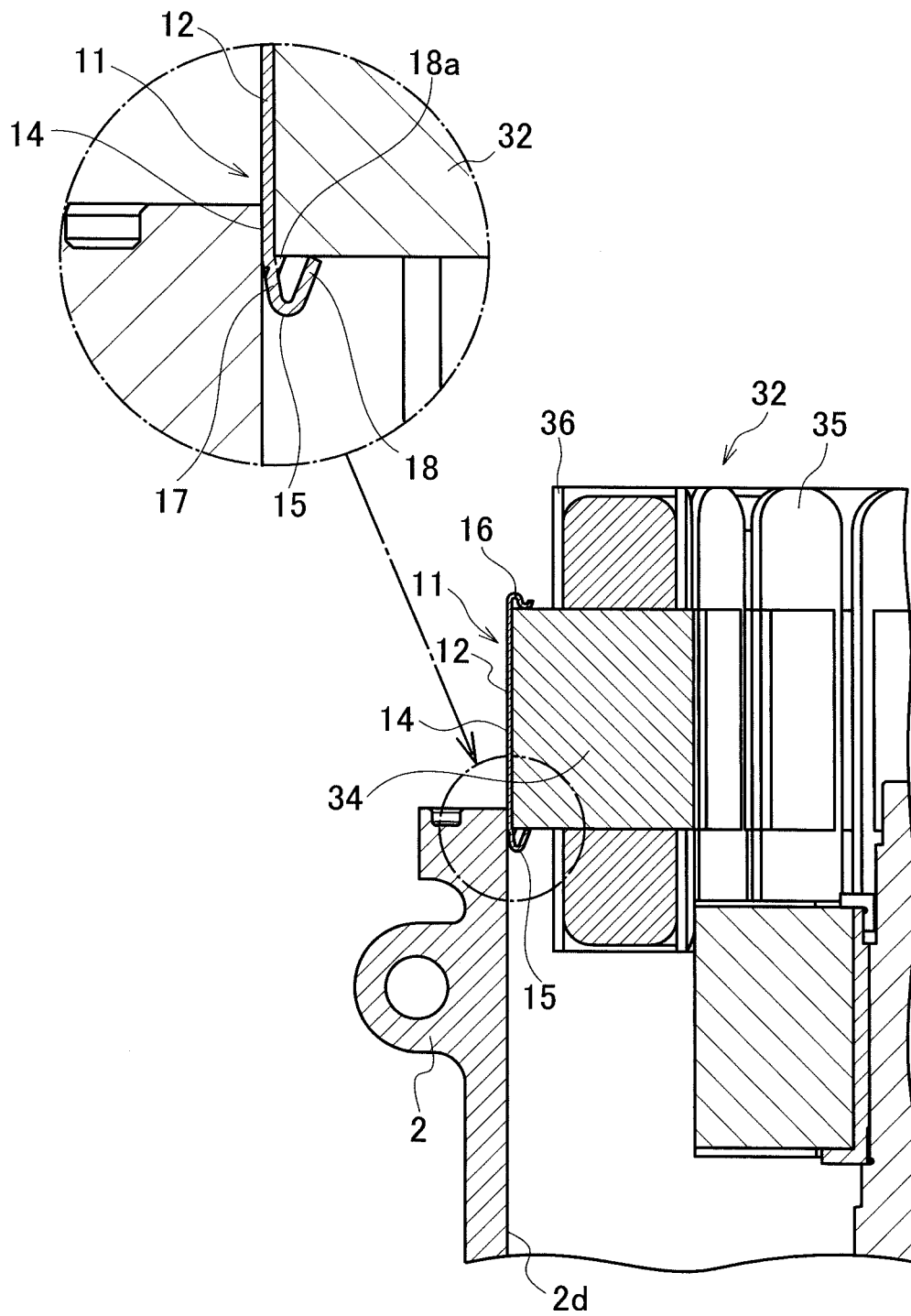


FIG. 6

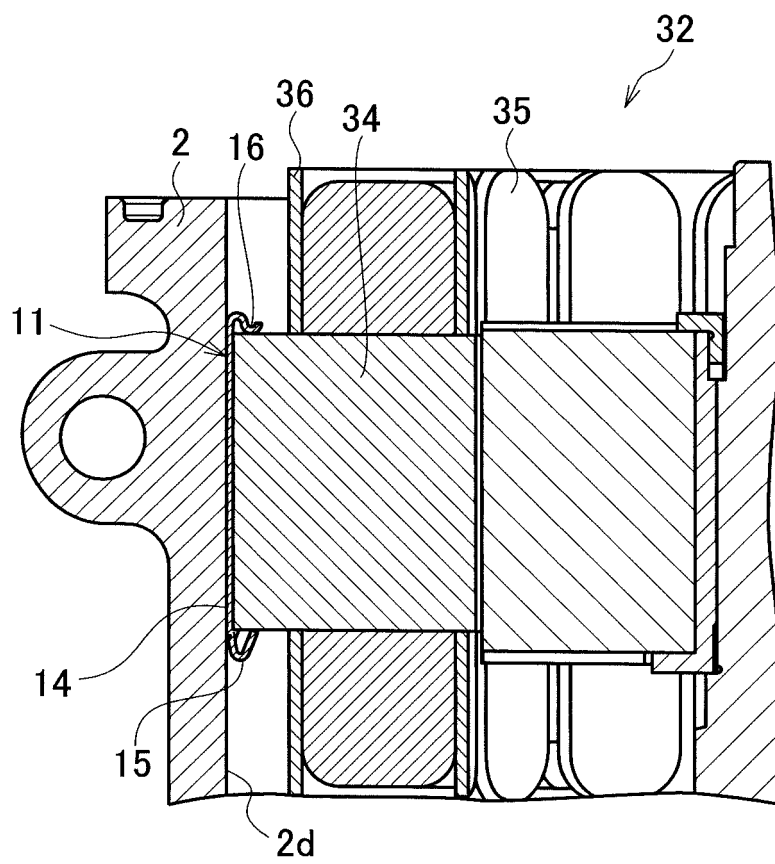


FIG. 7

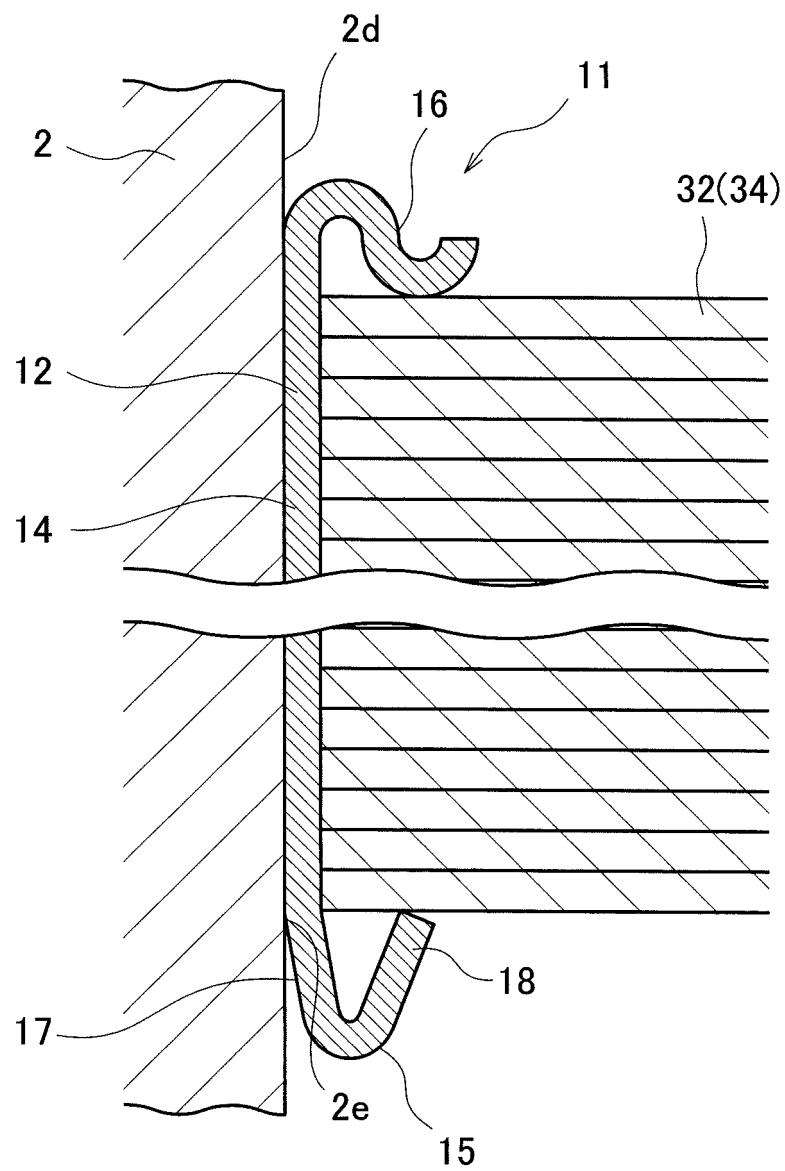


FIG. 8

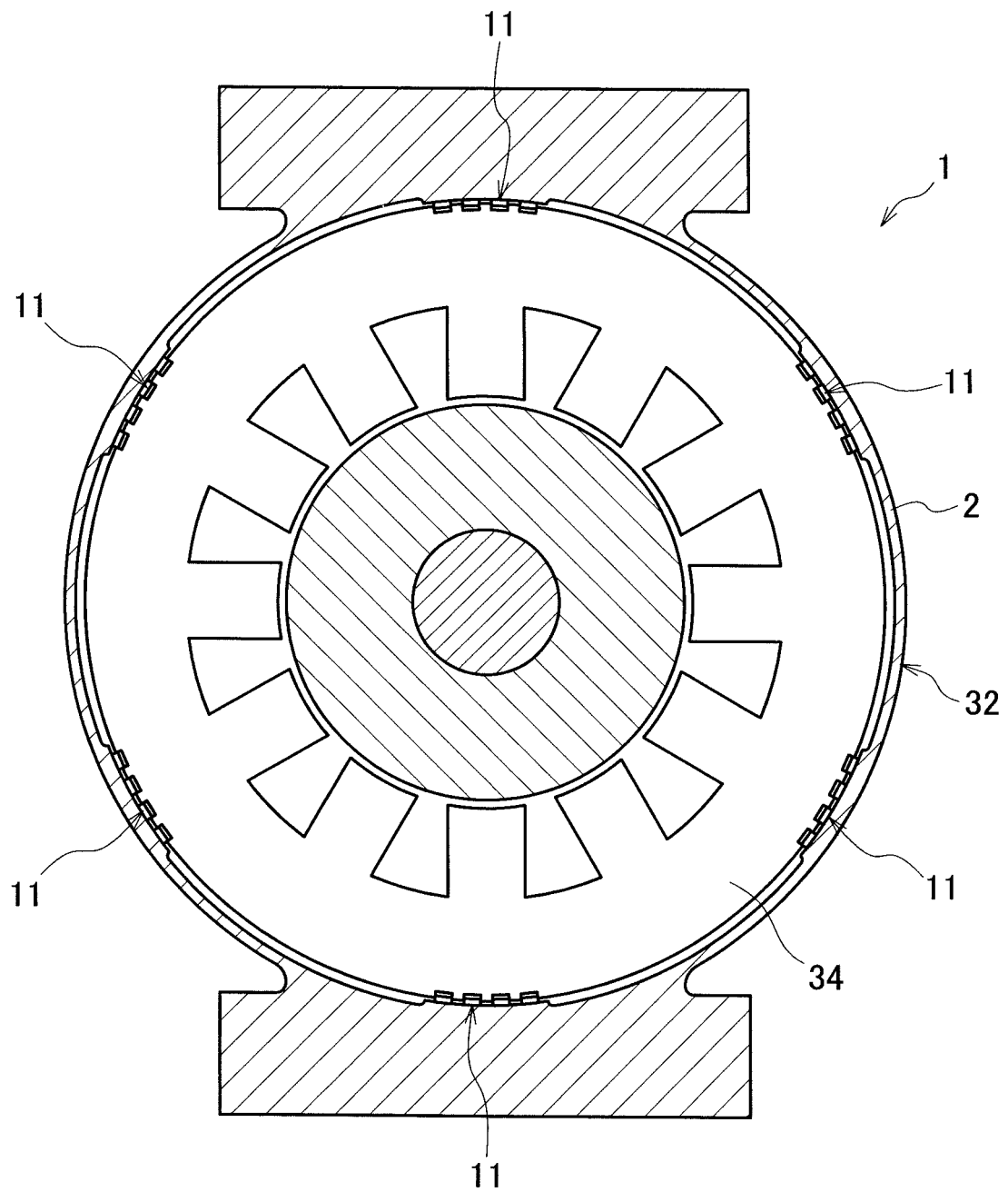


FIG. 9

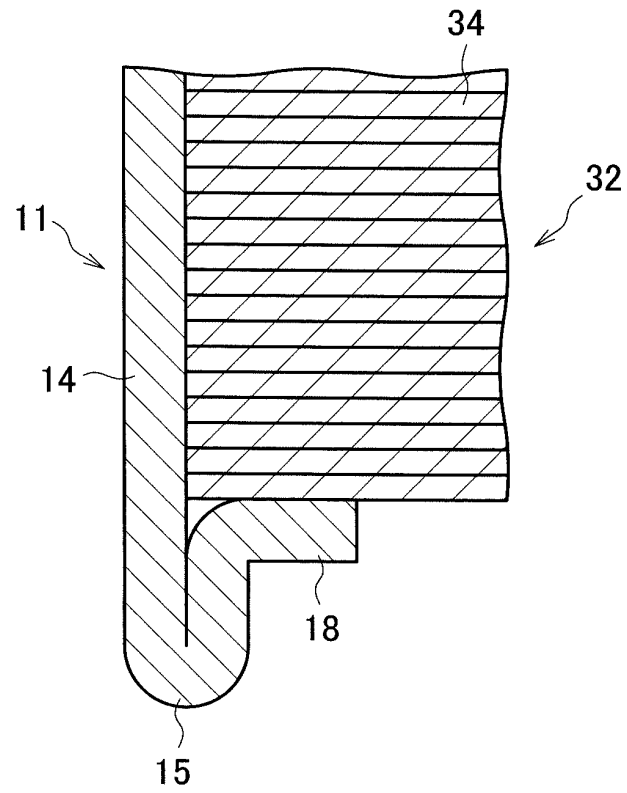
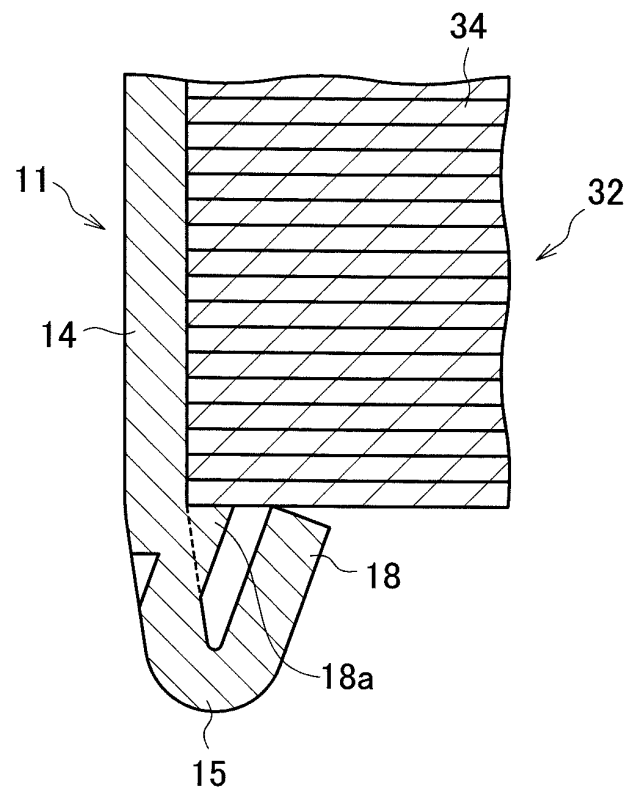


FIG. 10



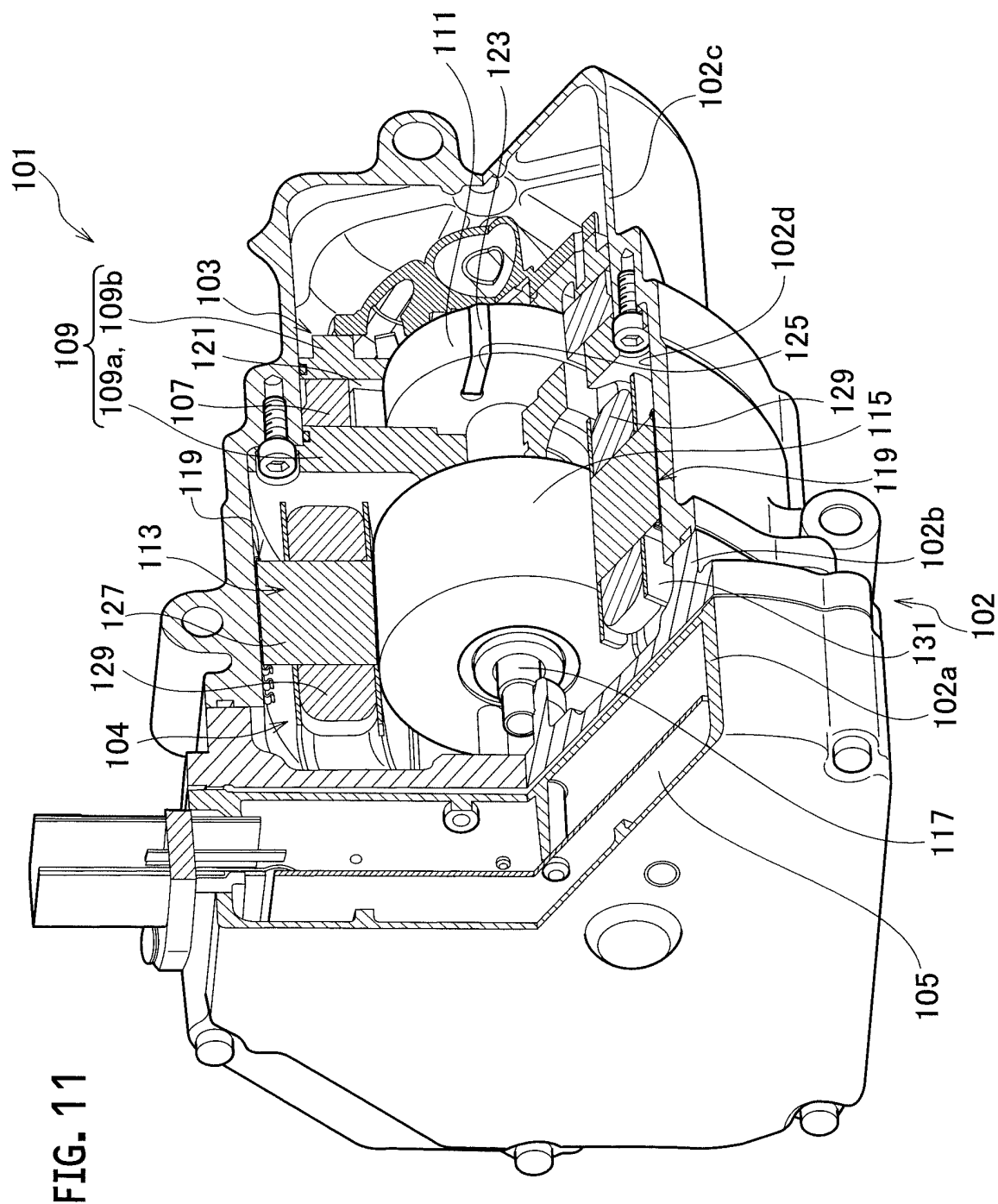


FIG. 12

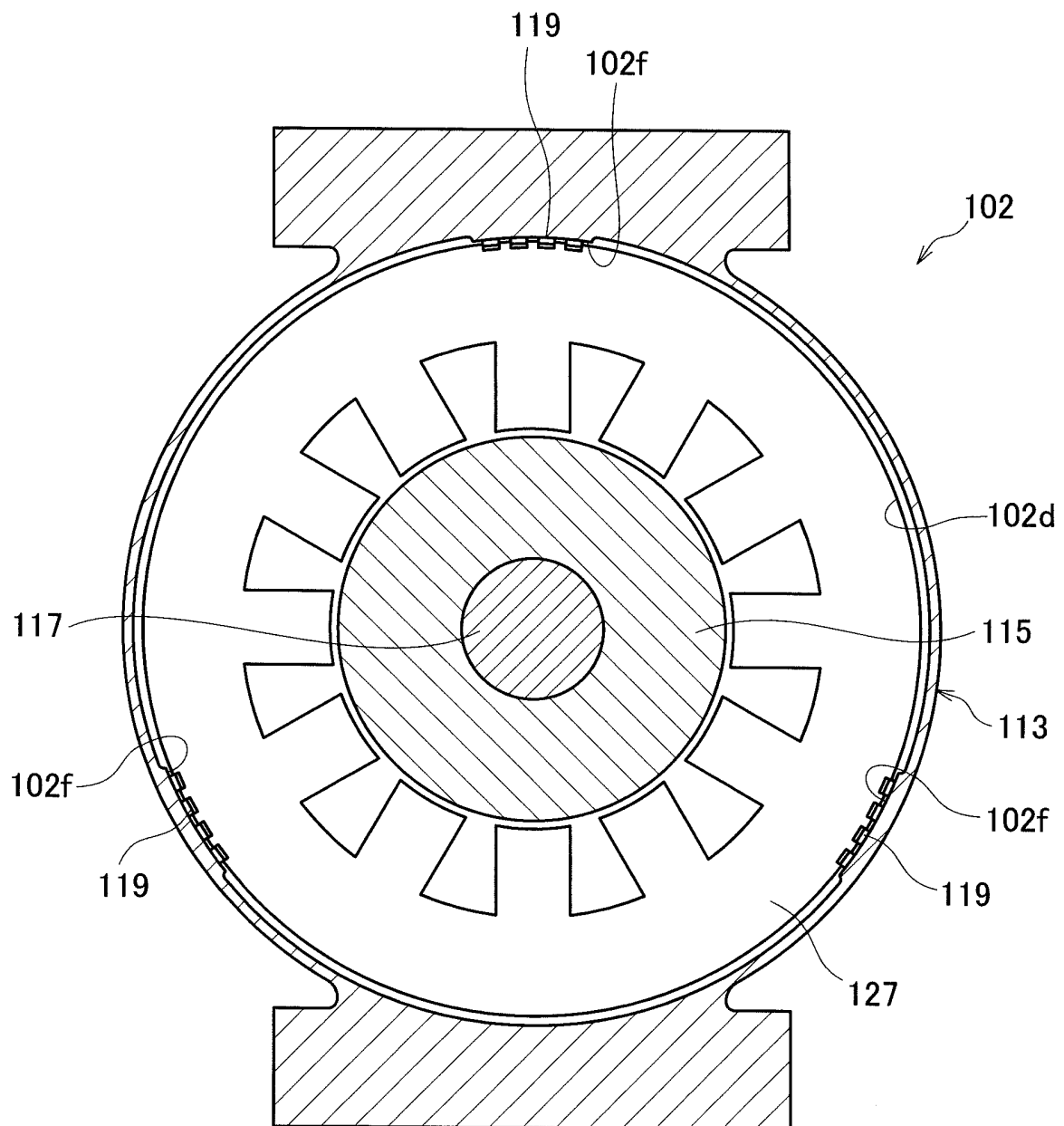


FIG. 13

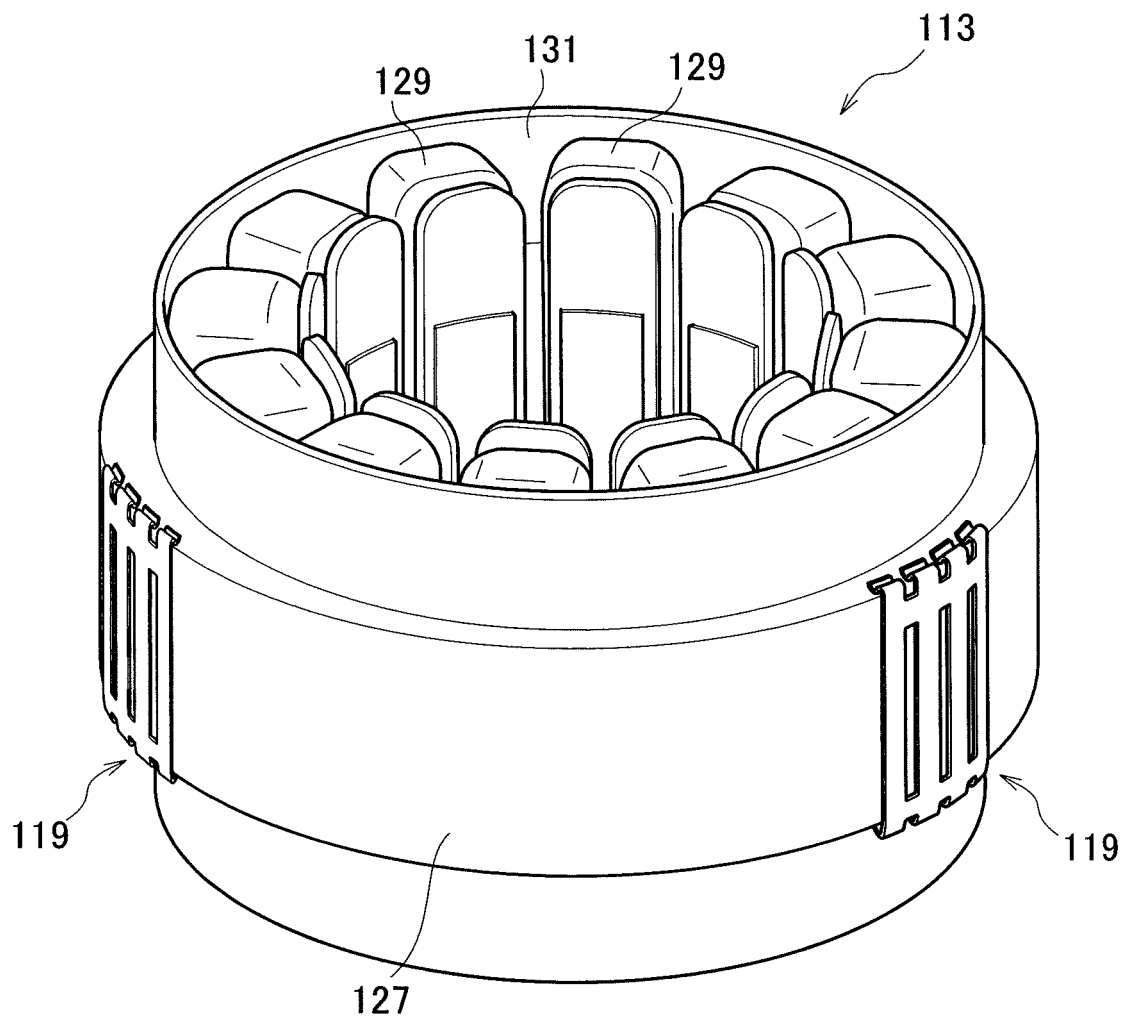


FIG. 14

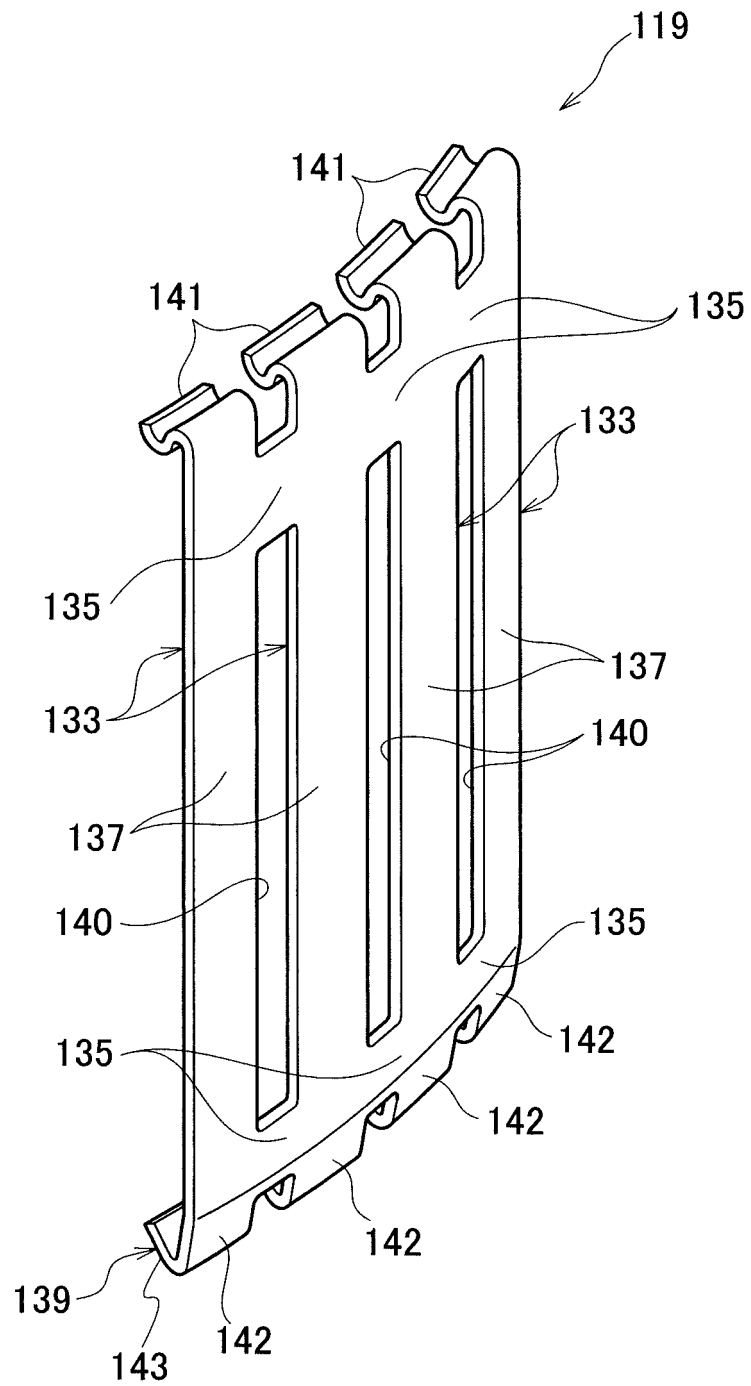


FIG. 15

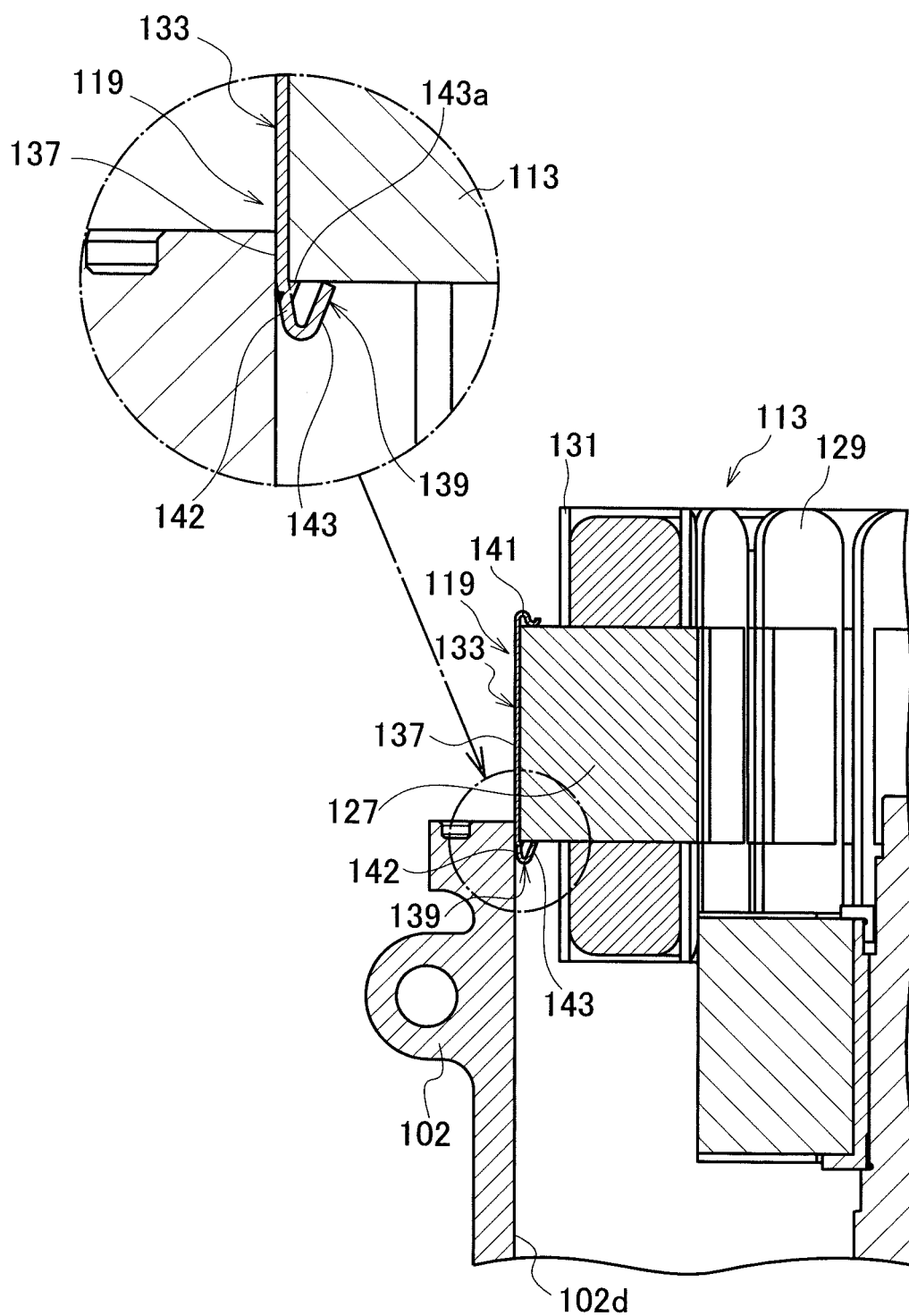


FIG. 16

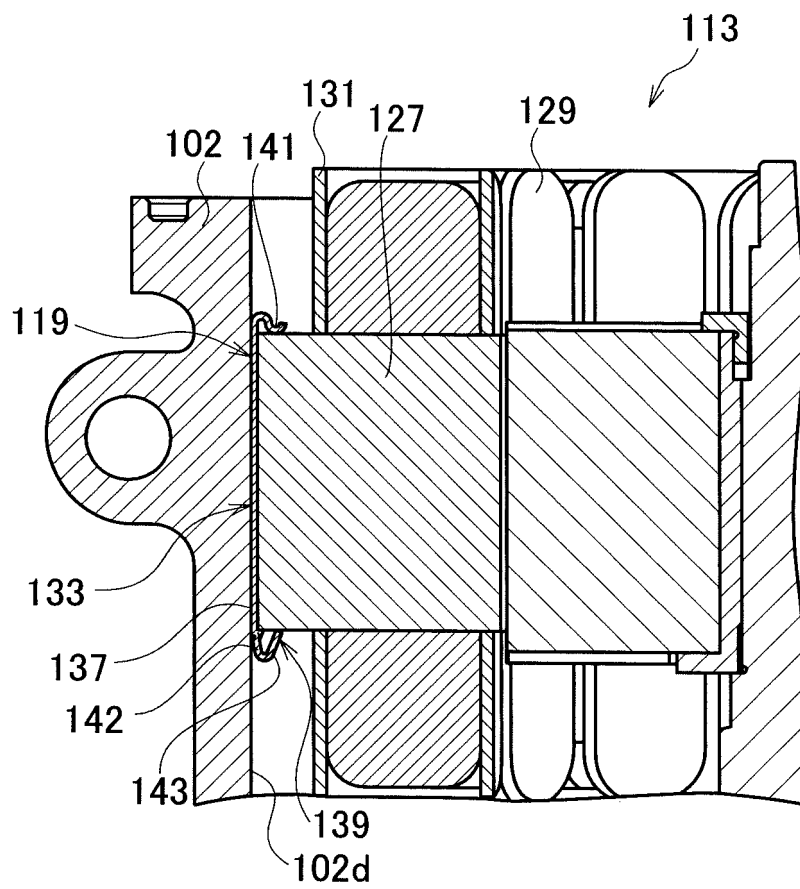


FIG. 17

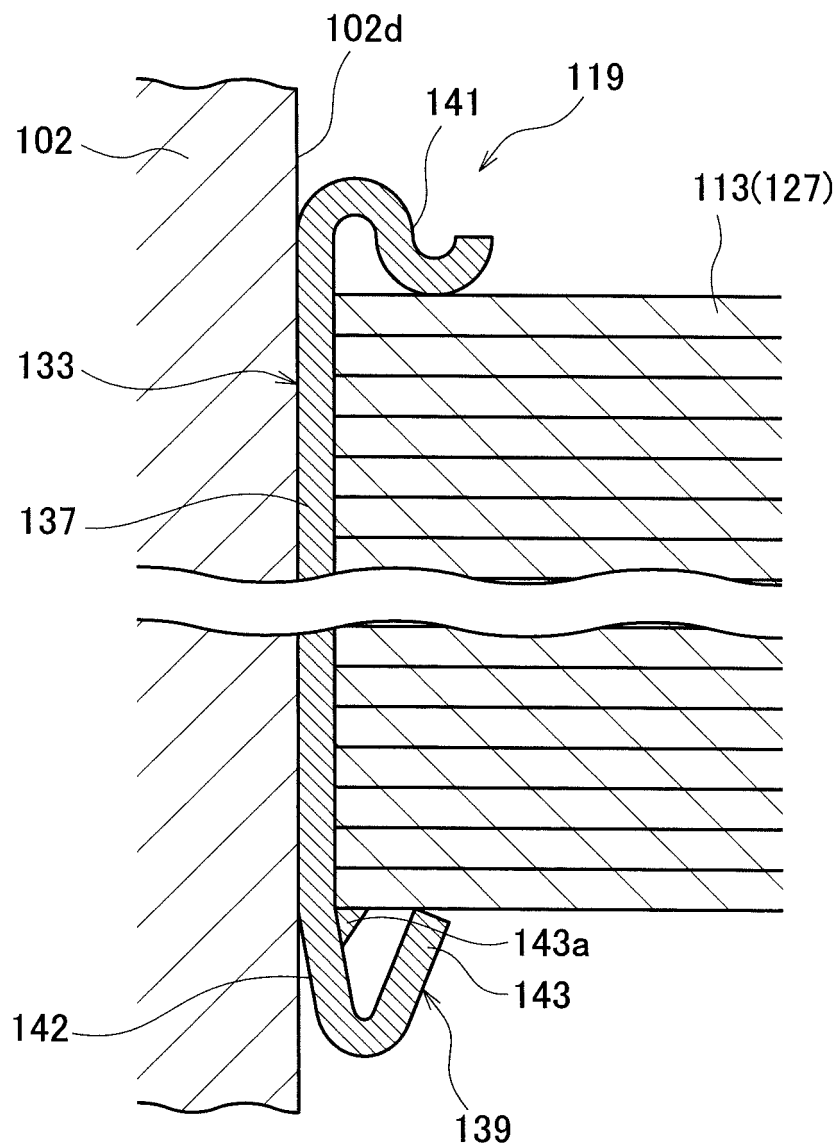


FIG. 18

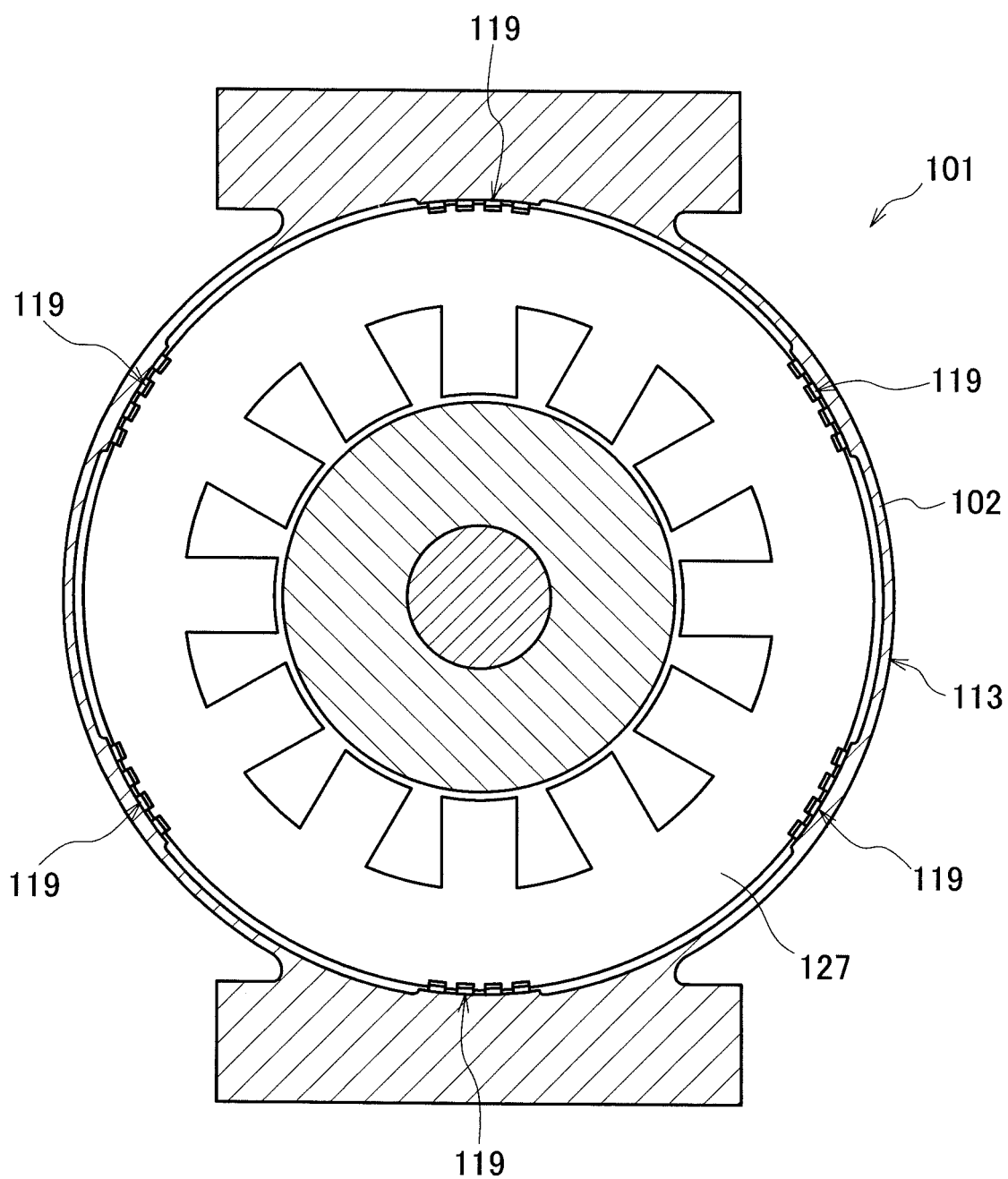


FIG. 19

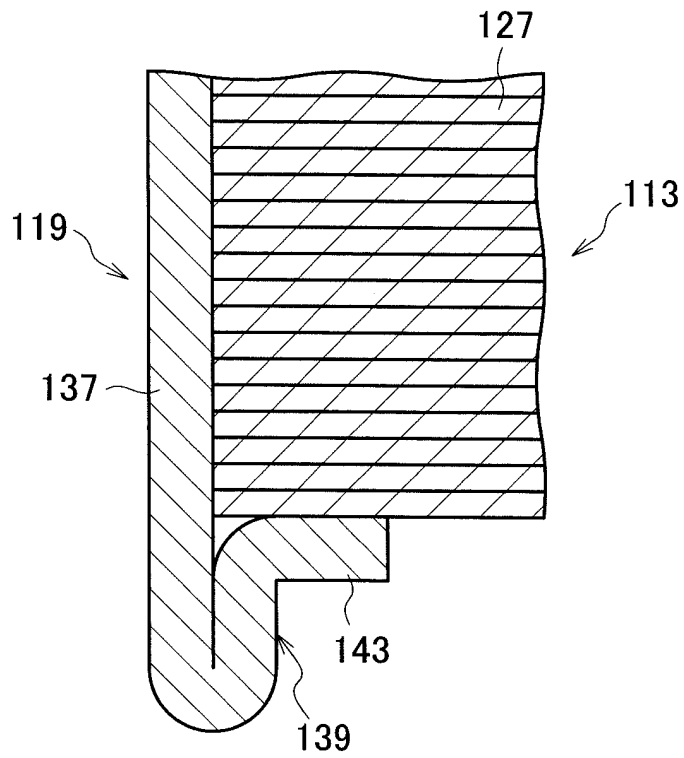


FIG. 20

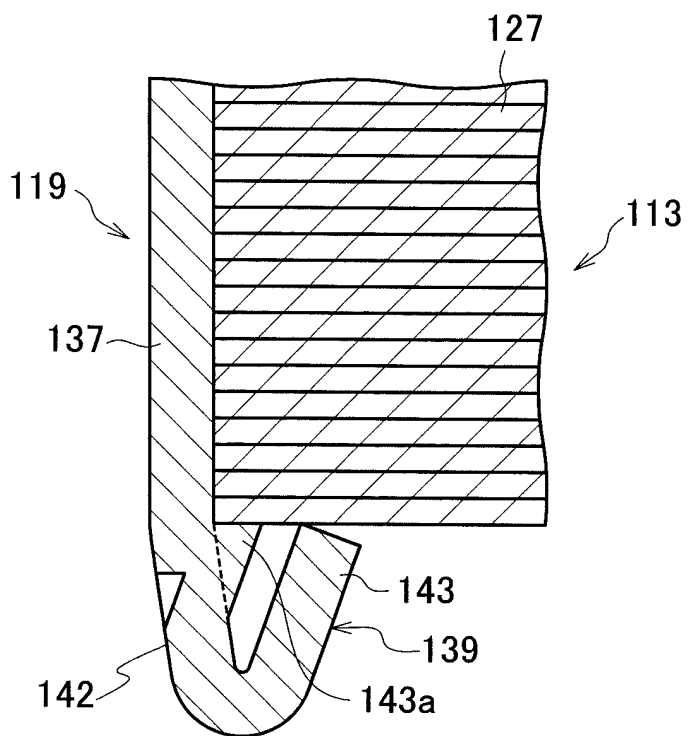


FIG. 21

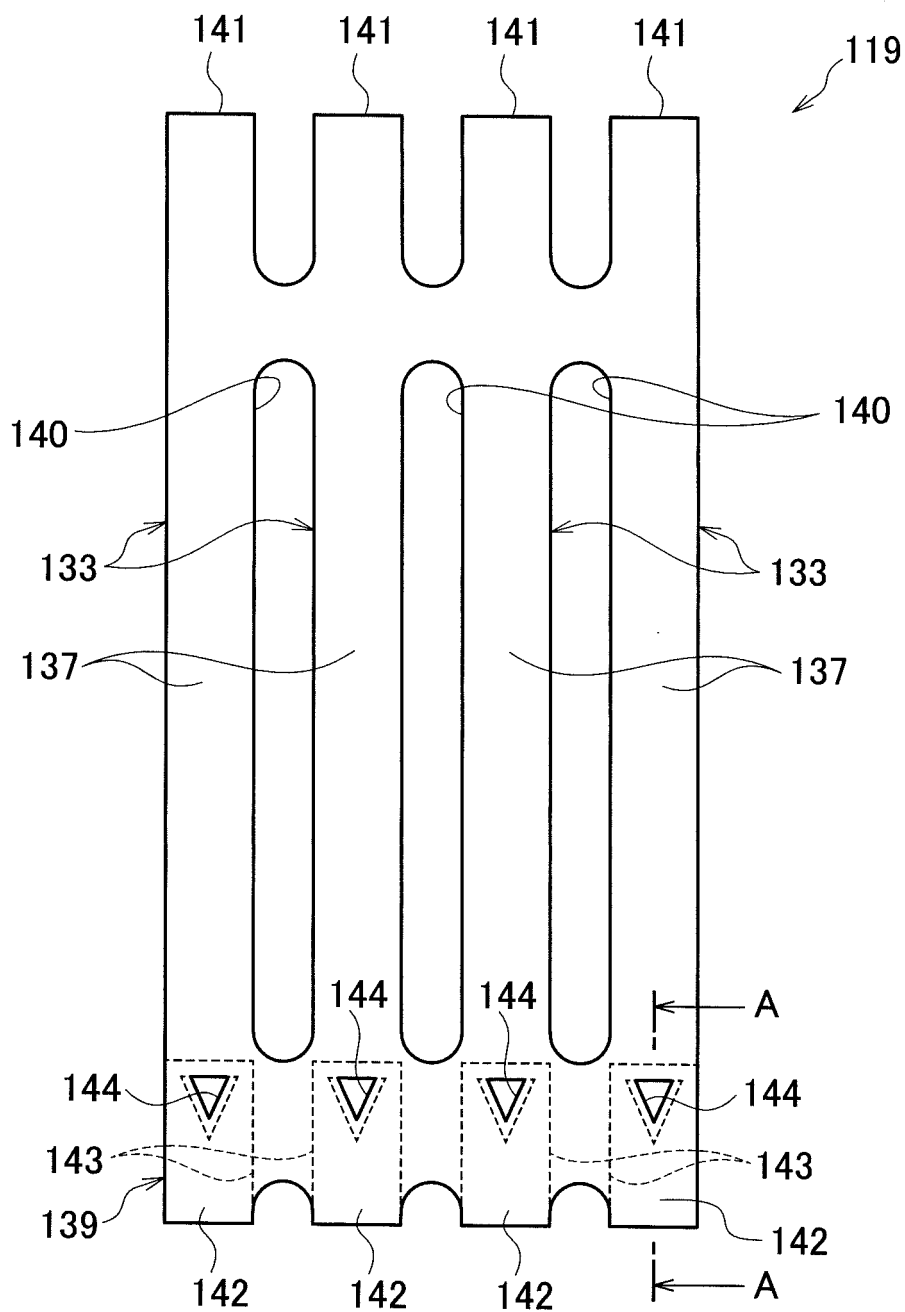


FIG. 22A

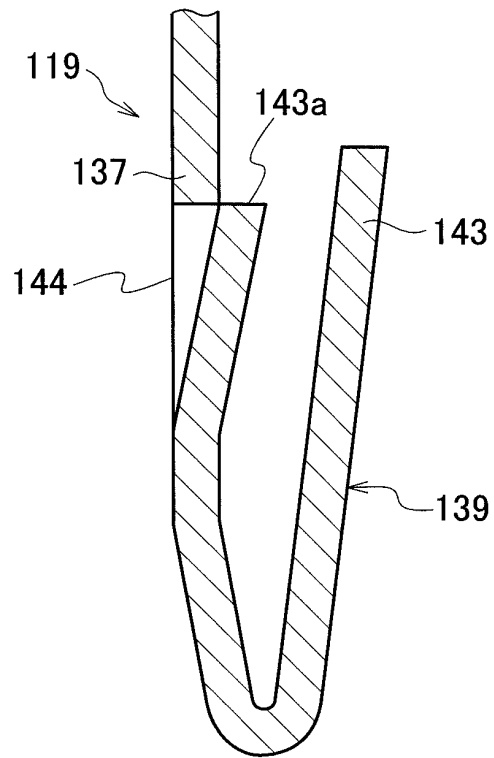
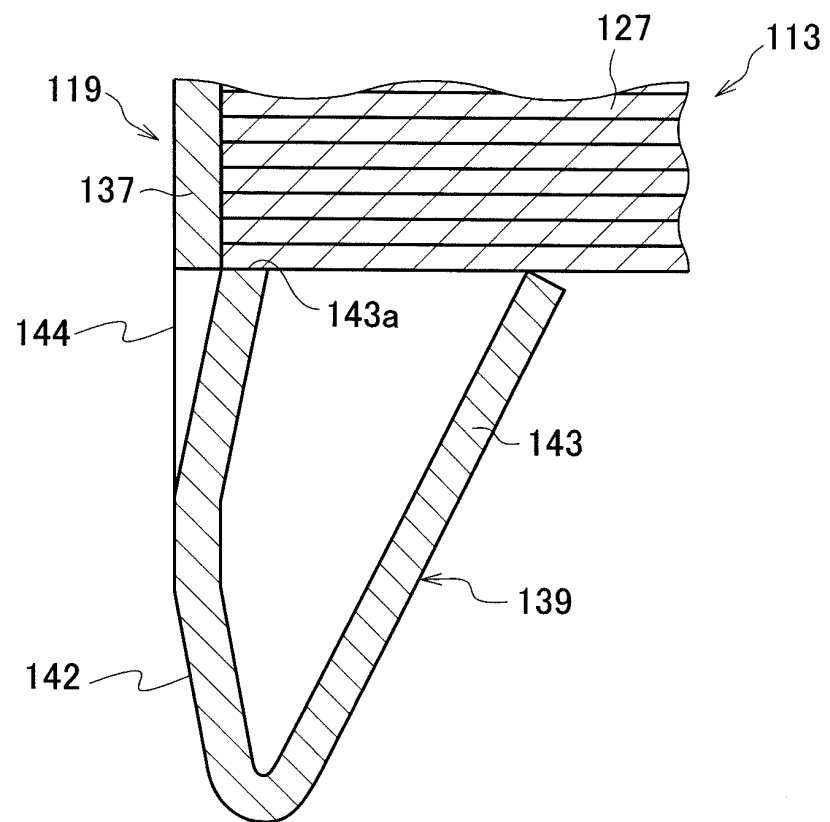


FIG. 22B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/064462

A. CLASSIFICATION OF SUBJECT MATTER F04B39/14(2006.01)i, F04B39/00(2006.01)i, F04C29/00(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) F04B39/14, F04B39/00, F04C29/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013 Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2012-13030 A (Panasonic Corp.), 19 January 2012 (19.01.2012), fig. 1, 2 (Family: none)	1-9
A	JP 2006-115581 A (Matsushita Electric Industrial Co., Ltd.), 27 April 2006 (27.04.2006), fig. 1 (Family: none)	1-9
A	JP 2009-228546 A (Calsonic Kansei Corp.), 08 October 2009 (08.10.2009), fig. 1 (Family: none)	1-9
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 06 June, 2013 (06.06.13)		Date of mailing of the international search report 18 June, 2013 (18.06.13)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2013025180 A [0123]