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(54) **COMPRESSOR**

VERDICHTER

COMPRESSEUR

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(56) References cited:
EP-A- 1 408 235
GB-A- 2 103 759
US-A- 5 842 420
US-A1- 2002 050 425

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Description

TECHNICAL FIELD

[0001] The present invention relates to a compressor used for refrigerating cycle such as a fridge freezer.

BACKGROUND ART

[0002] European Patent Application Laid-open Publication Number EP 1 408 235 discloses a compressor according to the preamble of claim 1.

[0003] A further conventional example of this kind of compressor includes a mechanism for supplying oil to the cylinder thereof (see Patent Document 1 (JP6294380A), for example).

[0004] Hereinafter, the conventional compressor is described with reference to the accompanying drawings.

[0005] Fig. 6 is a longitudinal sectional view of the conventional compressor of Patent Document 1 as seen from a side thereof. Fig. 7 is a cross-sectional view of the conventional compressor. Fig. 8 is a longitudinal sectional view of the conventional compressor as seen from the front thereof. Fig. 9 is a sectional view of an essential part of a suction muffler of the conventional compressor.

[0006] With reference to Figs. 6, 7, 8, and 9, hermetic container 1 has oil 2 stored at the bottom thereof, and has refrigerant gas 3 filling the space thereof.

[0007] Electrically-driven element 4 includes stator 5 and rotor 6. Compressing element 7 includes the following components: crankshaft 10 having eccentric shaft 8 and main shaft 9; cylinder block 13 having cylinder 11 and main bearing 12; piston 14; and connecting rod 15. Rotor 6 is fitted onto crankshaft 10. Crankshaft 10 includes oil pump 17, and rotates in main bearing 12. At least the bottom end of oil plump 17 is immersed in oil 2. Oil pump 17 has opening 16 for splashing oil 2 from the top end face of eccentric shaft 8 into hermetic container 1.

[0008] Piston 14 is inserted into substantially columnar cylinder 11 so as to be reciprocatingly slidable therein. Piston 14 is coupled to eccentric shaft 8 via connecting rod 15. Valve plate 18 that seals the opening end face of cylinder 11 includes suction port 19 to be communicated to cylinder 11 by the opening/closing operation of a suction valve (not shown).

[0009] Cylinder head 21 forming communication channel 20 is fixed on the opposite side of cylinder 11 via valve plate 18.

[0010] Suction muffler 25 is made up of a channel for sucking refrigerant gas 3 opened to hermetic container 1, i.e. tail pipe 26, and sound-absorbing space 27. The suction muffler is coupled to one end of communication channel 20.

[0011] Oil reservoir 28 is provided at the opening of tail pipe 26 in hermetic container 1 in a concave shape.

[0012] Hereinafter, an operation of the compressor structured as above is described.

[0013] The rotation of crankshaft 10 caused by electrically-driven element 4 is transferred to connecting rod 15, thereby reciprocating piston 14. The reciprocating movement releases refrigerant gas 3 flowing from an external cooling circuit (not shown) once into hermetic container 1, and into sound-absorbing space 27 in suction muffler 25 via tail pipe 26. Thereafter, refrigerant gas 3 is intermittently sucked into cylinder 11 via communication channel 20, and suction port 19 of valve plate 18. Refrigerant gas 3 sucked into cylinder 11 is compressed by piston 14 and discharged to the external cooling circuit (not shown) again.

[0014] When crankshaft 10 is rotated by electrically-driven element 4, oil 2 stored at the inner bottom of hermetic container 1 is pumped up in crankshaft 10 by oil pump 17. After lubricating the sliding portions of main shaft 9 and eccentric shaft 8, oil 2 splashes from opening 16 of oil pump 17 in eccentric shaft 8 into hermetic container 1 and onto cylinder 11. A part of the oil accumulates in oil reservoir 28. The trajectory of oil 2 splashing from opening 16 of oil pump 17 into hermetic container 1 is shown by the arrows in Fig. 6.

[0015] The rotation of eccentric shaft 8 causes connecting rod 15 to reciprocate piston 14 in cylinder 11. Thereby, the suction, compression, and discharge strokes are sequentially repeated. In the suction stroke of piston 14, refrigerant gas 3 filling the space of hermetic container 1 is sucked from the tip of tail pipe 26.

[0016] At that time, oil 2 in oil reservoir 28 is sucked from the tip of tail pipe 26 together with refrigerant gas 3. The oil is supplied into cylinder 11 via suction muffler 25, communication channel 20, and suction port 19 of valve plate 18, and lubricates the sliding portions of piston 14 and cylinder 11.

[0017] However, in the conventional structure, the direction in which oil 2 discharged from opening 16 of oil pump 17 splashes is unstable because the direction varies with the rotation speed of crankshaft 10, the viscosity of oil 2 or the like. For this reason, oil 2 does not splash onto cylinder 11 and does not lubricate the sliding portions of cylinder 11 and piston 14. This phenomenon may cause metallic contact and abrasion between the portions.

[0018] Because the direction in which oil 2 from opening 16 of oil pump 17 splashes is unstable depending on the changes in operating conditions, oil 2 splashing in hermetic container 1 sometimes does not accumulate in oil reservoir 28. In such a case, oil 2 is not supplied from oil reservoir 28 into cylinder 11. This can degrade the sealability between valve plate 18 and the suction valve, thus freezing capability and efficiency may be degraded.

[Patent Document 1] Japanese Patent Unexamined Publication No. H06-294380; JP6294380A.

SUMMARY OF THE INVENTION

[0019] A compressor includes a hermetic container that stores oil therein and accommodates a compressing element for compressing a refrigerant gas. The compressing element includes the following components: a crankshaft that has an eccentric shaft and a main shaft, and an oil pump having an opening on a top end face of the eccentric shaft; a cylinder block that has a cylinder and a main bearing; a piston that reciprocates in the cylinder; and a suction muffler that forms a sound-absorbing space in communication with the cylinder. The eccentric shaft has an acutely angled edge that makes an acute angle with the top end face, along the outer periphery of the top end of the eccentric shaft.

[0020] The oil sucked by the oil pump and supplied to the opening of the eccentric shaft flows on the top end face of the eccentric shaft to the outer periphery thereof, and splashes from the edge having the acute angle at the end of the eccentric shaft in substantially a radial direction. Thus, the oil splashes linearly onto the sliding portions of the cylinder and piston, cools the cylinder and piston, and forms oil film on the sliding portions of the cylinder and piston, under hardly any influence of the operating conditions of the compressor. As a result, the oil can restrain metallic contact between the sliding portions and prevent abrasion between the sliding portions and increasing input into the compressor. Thus, a compressor having high efficiency and high reliability can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a longitudinal sectional view of a compressor in accordance with an exemplary embodiment of the present invention as seen from a side thereof.
Fig. 2 is a cross-sectional view of the compressor in accordance with the exemplary embodiment.
Fig. 3 is a sectional view of an essential part of a crankshaft in accordance with the exemplary embodiment.
Fig. 4 is a sectional view of an essential part of a suction muffler in accordance with the exemplary embodiment.
Fig. 5 is a sectional view of the suction muffler taken on line A-A of Fig. 4.
Fig. 6 is a longitudinal sectional view of a conventional compressor as seen from a side thereof.
Fig. 7 is a cross-sectional view of the conventional compressor.
Fig. 8 is a longitudinal sectional view of the conventional compressor as seen from the front thereof.
Fig. 9 is a sectional view of an essential part of a suction muffler of the conventional compressor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0022] Hereinafter, a compressor in accordance with the exemplary embodiment of the present invention is described with reference to the accompanying drawings.

EXEMPLARY EMBODIMENT

[0023] Fig. 1 is a longitudinal sectional view of a compressor in accordance with the exemplary embodiment of the present invention as seen from a side thereof. Fig. 2 is a cross-sectional view of the compressor in accordance with the exemplary embodiment. Fig. 3 is a sectional view of an essential part of a crankshaft in accordance with the exemplary embodiment. Fig. 4 is a sectional view of an essential part of a suction muffler in accordance with the exemplary embodiment. Fig. 5 is a sectional view of the suction muffler taken on line A-A of Fig. 4.

[0024] With reference to Figs. 1, 2, 3, 4, and 5, hermetic container 101 has oil 102 stored therein and is filled with refrigerant gas 103.

[0025] Electrically-driven element 110 includes stator 111 and rotor 112. Compressing element 113 includes crankshaft 116 driven by electrically-driven element 110, cylinder block 119 having cylinder 117 and main bearing 118, piston 120, and connecting rod 121, to form a reciprocating compressor mechanism.

[0026] Piston 120 is inserted into cylinder 117 so as to be reciprocatingly slidable therein. Piston 120 is coupled to eccentric shaft 124 via connecting rod 121.

[0027] Crankshaft 116 includes eccentric shaft 124 and main shaft 125, and rotates in main bearing 118 with rotor 112 fitted onto the crankshaft. Oil pump 126 provided through crankshaft 116 includes oil channel 128 in main shaft 125, and rotates with at least the bottom end thereof immersed in oil 102.

[0028] Chamfer 132 is provided along opening 131 of oil pump 126 positioned at top end face 133 of eccentric shaft 124.

[0029] Eccentric shaft 124 includes edge 130 that makes an acute angle with top end face 133, along the outer periphery of the top end of the eccentric shaft. External diameter E of edge 130 is dimensioned smaller than the external diameter of eccentric shaft 124 that slides with connecting rod 121. The acute angle that edge 130 makes with top end face 133 is shown as angle α in Fig. 3.

[0030] Valve plate 135 that seals the opening end face of cylinder 117 includes suction port 136 to be communicated to cylinder 117 by the opening/closing operation of a suction valve (not shown).

[0031] Cylinder head 138 that forms communication channel 137 is fixed on the opposite side of cylinder 117 via valve plate 135.

[0032] Suction muffler 140 is integrally formed with cylinder block 119. Suction muffler 140 includes top section 142 curving outwardly of suction muffler 140 having a convex shape with a curvature exceeding 0, oil-suction hole 143 provided at top section 142, sound-absorbing space 144, and tail pipe 145. Suction muffler 140 communicates with sound-absorbing space 144 and cylinder 117 via communication channel 137 and suction port

136. Tail pipe 145 of suction muffler 140 is opened to hermetic container 101 at one end, and to sound-absorbing space 144 at the other end. Thus, the tail pipe forms a suction channel for introducing refrigerant gas 103 in hermetic container 101 into sound-absorbing space 144.

[0033] Oil-suction hole 143 is a through-hole that is provided at substantially the crest of top section 142 and allows the space in hermetic container 101 to communicate with sound-absorbing space 144 in suction muffler 140.

[0034] An operation of the compressor structured as above is described hereinafter.

[0035] The rotation of crankshaft 116 is transferred to connecting rod 121, thereby reciprocating piston 120. The reciprocating movement of piston 120 releases refrigerant gas 103 introduced from an external cooling circuit (not shown) once into hermetic container 101, and into sound-absorbing space 144 in suction muffler 140 via tail pipe 145. Thereafter, refrigerant gas 103 is intermittently sucked into cylinder 117 via communication channel 137 and suction port 136 of valve plate 135. Refrigerant gas 103 sucked into cylinder 117 is compressed by piston 120 and discharged to the external cooling circuit (not shown) again.

[0036] When crankshaft 116 is rotated by electrically-driven element 110, oil 102 stored at the inner bottom of hermetic container 101 is pumped up in crankshaft 116 by oil pump 126. Oil 102 goes through oil channel 128 and reaches opening 131 formed through top end face 133 of oil pump 126.

[0037] When oil 102 reaches opening 131, oil 102 is pushed out not directly above but in an oblique direction along chamfer 132. Substantially entire oil 102 flows to the outer periphery along top end face 133 of eccentric shaft 124 by centrifugal force. Thereafter, the oil splashes from edge 130 having the acute angle at the end in substantially a radial direction. The trajectory of oil 102 splashing from edge 130 into hermetic container 101 is shown by the arrows in Figs. 1 and 3.

[0038] As a result, substantially entire oil 102 that has reached opening 131 of oil pump 126 splashes linearly onto the sliding portions of cylinder 117 and piston 120, under hardly any influence of the operating conditions, such as the rotation speed of crankshaft 116 and the viscosity of oil 102. Thus, cylinder 117, piston 120, and other components can sufficiently be cooled, and oil film can be formed on the sliding portions of cylinder 117 and piston 120. Thus, the oil can restrain metallic contact between the sliding portions, and prevent abrasion between the sliding portions and increasing input into the compressor. Thus, a compressor having high efficiency and high reliability can be provided.

[0039] In the above structure, eccentric shaft 124 includes edge 130 that makes an acute angle with top end face 133, along the outer periphery of the eccentric shaft. If the angle that edge 130 and top end face 133 make with each other is a right angle or an obtuse angle instead of an acute angle, oil 102 introduced to edge 130 splashes not in a radial direction but obliquely downward with respect to the horizontal direction. The reason is inferred as follows. If the angle that edge 130 and top end face 133 make with each other is a right angle or an obtuse angle instead of an acute angle, the splashing force in a radial direction is inhibited by the surface tension of oil 102 or the like.

[0040] Further, when hermetic container 101 is at a low temperature and oil 102 has a high viscosity, or when the compressor is operated at a low rotation speed, e.g. 50 Hz, and oil pump 126 has a small pumping force, upward splash of oil 102 is difficult.

[0041] In contrast, when hermetic container 101 is at a high temperature and oil 102 has a low viscosity, or when the compressor is operated at a high rotation speed, e.g. 60 Hz, and oil pump 126 has a large pumping force, oil 102 tends to splash high. However, the following phenomena are confirmed in the above structure. Oil 102 splashes from edge 130 having an acute angle in substantially a radial direction linearly onto the sliding portions of cylinder 117 and piston 120, in spite of operating conditions, such as the viscosity and the rotation speed of crankshaft 116. The position onto which the oil splashes has substantially no change.

[0042] Further, chamfer 132 is provided along opening 131 of oil pump 126. In this structure, oil 102 having reached opening 131 is pushed out not directly above but in an oblique direction, as compared with the case of without chamfer 132. Thus, substantially entire oil 102 does not splash upwardly, and flows to the outer periphery along top end face 133 of eccentric shaft 124 by centrifugal force. This special advantage is also confirmed.

[0043] However, the following advantage is also confirmed. Even in the structure without chamfer 132, among oil 102 reached opening 131, oil 102 flowing to the outer periphery along top end face 133 of eccentric shaft 124 splashes from edge 130 in substantially a radial direction linearly onto the sliding portions of cylinder 117 and piston 120.

[0044] Top section 142 of suction muffler 140 is disposed at a position where oil 102 splashing from edge 130 in substantially a radial direction hits directly. The top section also includes oil-suction hole 143. With this structure, oil 102 continuously splashes onto top section 142 and forms oil film on the surface of top section 142, during the operation of the compressor.

[0045] Further, top section 142 of suction muffler 140 forms a convex shape having a curvature exceeding 0. With this structure, oil 102 splashing onto and adhering to the surface of top section 142 does not remain on the surface of top section 142. The oil is spread thin on top section 142 by the surface tension of the oil and can form oil film. Then, oil-suction hole 143 can suck a fixed amount of oil 102 according to the inner peripheral length of the hole from the oil film spread thin at substantially a fixed thickness, using the negative pressure inside of suction muffler 140.

[0046] The suction of oil 102 in the oil film near oil-suction hole 143 into suction muffler 140 through oil-suction hole 143 allows stable lubrication to the inside of cylinder 117 via sound-absorbing space 144, communication channel 137, and suction port 136 through valve plate 135.

[0047] As a result, entry of a large amount of oil 102 into cylinder 117 can be prevented, and thus piston 120 does not compress refrigerant gas 103 containing a large amount of oil 102. This structure can prevent unnecessary increase in the load imposed on piston 120 and increasing input into the compressor and improve the sealability between valve plate 135 and the suction valve. Thus, efficiency can be improved.

[0048] Further, edge 130 is smaller than the external diameter of eccentric shaft 124 that slides with connecting rod 121. For this reason, when connecting rod 121 is inserted into eccentric shaft 124 during assembly of the compressor, contact of the sliding surface of the inner periphery of connecting rod 121 with edge 130 of eccentric shaft 124 can be prevented. This structure can prevent the sliding surface of connecting rod 121 from being damaged by edge 130 of eccentric shaft 124, thereby improving the quality and reliability.

[0049] For these reasons, a compressor having high reliability, efficiency, and quality can be provided.

[0050] In the description of the exemplary embodiment of the present invention, edge 130 is integrally formed with crankshaft 116. However, an edge and a crankshaft separately formed into the same shape as the integrally-formed component can also give the same advantage as the exemplary embodiment of the present invention.

[0051] Further, a slight chamfer can be provided along edge 130 to prevent the damage to the sliding surface of connecting rod 121 in case that edge 130 makes contact with connecting rod 121 during assembly thereof. Also with this structure, the oil splashing effect can be maintained.

INDUSTRIAL APPLICABILITY

[0052] As described above, a compressor of the present invention has high reliability and efficiency, and thus can be used in any application using a refrigerating cycle, such as a domestic refrigerator, a dehumidifier, a showcase, and an automatic vending machine.

REFERENCE MARKS IN THE DRAWINGS

[0053]

101	Hermetic container
102	Oil
103	Refrigerant gas
113	Compressing element
116	Crankshaft
117	Cylinder
118	Main bearing
119	Cylinder block
120	Piston
121	Connecting rod
124	Eccentric shaft
125	Main shaft
126	Oil pump
130	Edge
131	Opening
132	Chamfer
133	Top end face
140	Suction muffler
142	Top section
143	Oil-suction hole
144	Sound-absorbing space

Claims

1. A compressor comprising:

a hermetic container (101) that stores oil (102) therein and accommodates a compressing element (113) for compressing a refrigerant gas (103), the compressing element (113) including:
a crankshaft (116) including an eccentric shaft (124) and a main shaft (125), and including an oil pump (126) having an opening (131) on a top end face (133) of the eccentric shaft (124);
a cylinder block (119) including a cylinder (117) and a main bearing (118);
a piston (120) inserted into the cylinder (117) and reciprocating; and
a suction muffler (140) having a sound-absorbing space (144) formed therein, the sound-absorbing space (144) being in communication with the cylinder (117);
characterized in that
the eccentric shaft (124) has an acutely angled edge (130) making an acute angle with the top end face (133), along an outer periphery of a top face of the eccentric shaft (124).

2. The compressor of claim 1, **characterized in that** a chamfer (132) is provided along the opening (131) of the top end face (133) of the oil pump (126) on.

3. The compressor of claim 1, **characterized in that** it further includes a connecting rod (121) for coupling the eccentric shaft (124) to the piston (120), wherein an external diameter of the edge (130) is dimensioned smaller than that of the eccentric shaft (124) that slides with the connecting rod (121).

4. The compressor of claim 1, **characterized in that** the suction muffler (140) includes an oil-suction hole (143) at a position where the oil (102) splashing from the edge (130) hits directly.

5. The compressor of claim 4, **characterized in that**

a top section (142) of the suction muffler (140) forms a convex having a curvature exceeding 0 and includes the oil-suction hole (143) near a crest of the top section (142).

Patentansprüche

1. Kompressor, der umfasst:

   einen hermetischen Behälter (101), in dem Öl (102) aufbewahrt wird und der ein Kompressionselement (113) zum Komprimieren eines Kühlgases (103) aufnimmt, wobei das Kompressionselement (113) enthält:
   eine Kurbelwelle (116), die eine Exzenterwelle (124) und eine Hauptwelle (125) enthält, und eine Ölpumpe (126) enthält, die eine Öffnung (131) an einer oberen Abschlussfläche (133) der Exzenterwelle (124) aufweist;
   einen Zylinderblock (119), der einen Zylinder (117) und ein Hauptlager (118) enthält;
   einen Kolben (120), der in den Zylinder (117) eingeführt ist und sich hin und her bewegt; und
   einen Ansaugschalldämpfer (140), in dem ein schallabsorbierender Raum (144) ausgebildet ist, wobei der schallabsorbierende Raum (144) in Verbindung mit dem Zylinder (117) steht;
   dadurch gekennzeichnet, dass
   die Exzenterwelle (124) eine spitz angewinkelte Kante (130), die einen spitzen Winkel zu der oberen Endfläche (133) bildet, entlang eines Außenumfangs einer oberen Fläche der Exzenterwelle (124) aufweist.

2. Kompressor nach Anspruch 1, **dadurch gekennzeichnet, dass** eine Fase (132) entlang der Öffnung (131) der oberen Endfläche (133) der Ölpumpe (126) vorhanden ist.

3. Kompressor nach Anspruch 1, **dadurch gekennzeichnet, dass** er des Weiteren eine Pleuelstange (121) enthält, die die Exzenterwelle (124) mit dem Kolben (120) koppelt, wobei ein Außendurchmesser der Kante (130) kleiner bemessen ist als der der Exzenterwelle (124), die mit der Pleuelstange (121) gleitet.

4. Kompressor nach Anspruch 1, **dadurch gekennzeichnet, dass** der Ansaugschalldämpfer (140) ein Ölansaugloch (143) an einer Position enthält, an der das Öl (102), das von der Kante (130) spritzt, direkt auftrifft.

5. Kompressor nach Anspruch 4, **dadurch gekennzeichnet, dass** ein oberer Abschnitt (142) des Ansaugschalldämpfers (140) eine Außenwölbung bildet, die eine Krümmung hat, die 0 übersteigt und die das Ölansaugloch (143) in der Nähe des Scheitels des oberen Abschnitts (142) einschließt.

Revendications

1. Compresseur comprenant:

   un conteneur hermétique (101) dans lequel on stocke de l'huile (102) et recevant un élément de compression (113) pour comprimer un gaz frigorigène (103), l'élément de compression (113) incluant:
   un vilebrequin (116) incluant un arbre excentrique (124) et un arbre principal (125), et incluant une pompe à huile (126) ayant une ouverture (131) sur une face d'extrémité supérieure (133) de l'arbre excentrique (124);
   un bloc-cylindre (119) incluant un cylindre (117) et un palier principal (118);
   un piston (120) inséré dans le cylindre (117) et animé d'un mouvement de va et vient; et
   un silencieux d'aspiration (140) ayant un espace d'absorption acoustique (144) qui y est formé, l'espace d'absorption acoustique (144) étant en communication avec le cylindre (117);
   caractérisé en ce que
   l'arbre excentrique (124) a un bord à angle aigu (130) faisant angle aigu avec la face d'extrémité supérieure (133), le long d'une périphérie externe sur une face supérieure de l'arbre excentrique (124).

2. Compresseur de la revendication 1, **caractérisé en ce qu'**un chanfrein (132) est pourvu le long de l'ouverture (131) de la face d'extrémité supérieure (133) de la pompe à huile (126).

3. Compresseur de la revendication 1, **caractérisé en ce qu'**il inclut en plus une biellette de liaison (121) pour accoupler l'arbre excentrique (124) au piston (120), où un diamètre externe du bord (130) est dimensionné de manière à être plus petit que celui de l'arbre excentrique (124) qui coulisse avec la biellette de liaison (121).

4. Compresseur de la revendication 1, **caractérisé en ce que** le silencieux d'aspiration (140) inclut un trou d'aspiration d'huile (143) à une position que l'huile (102) giclant à partir du bord (130) heurte directement.

5. Compresseur de la revendication 4, **caractérisé en ce qu'**une section supérieure (142) du silencieux d'aspiration (140) forme un convexe ayant une courbure dépassant 0 et inclut le trou d'aspiration d'huile (143) près d'une crête de la section supérieure (142).

FIG. 1

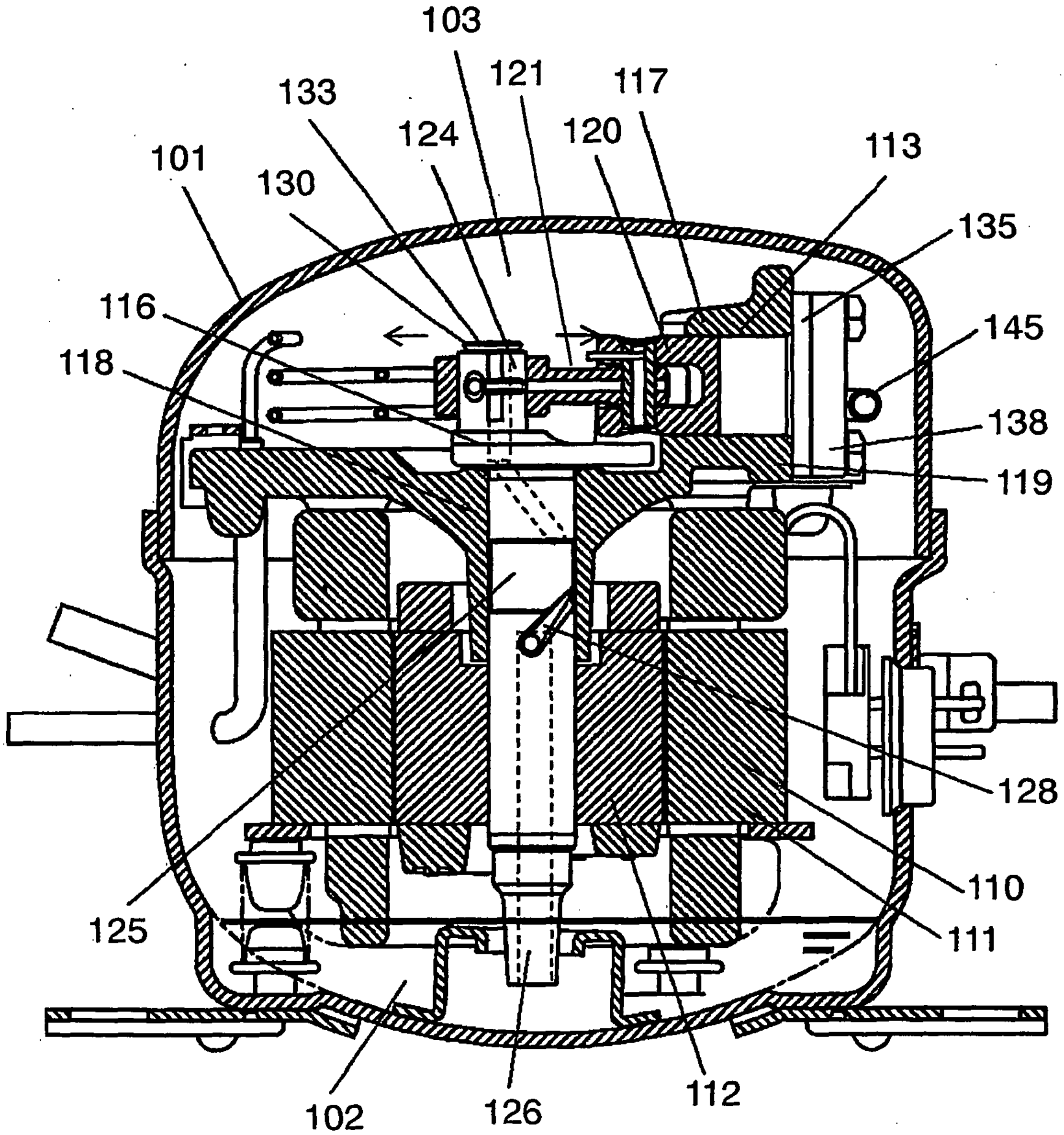

103
121
117
133
124
120
113
101
130
135
116
145
118
138
119
128
110
125
111
102
126
112

FIG. 2

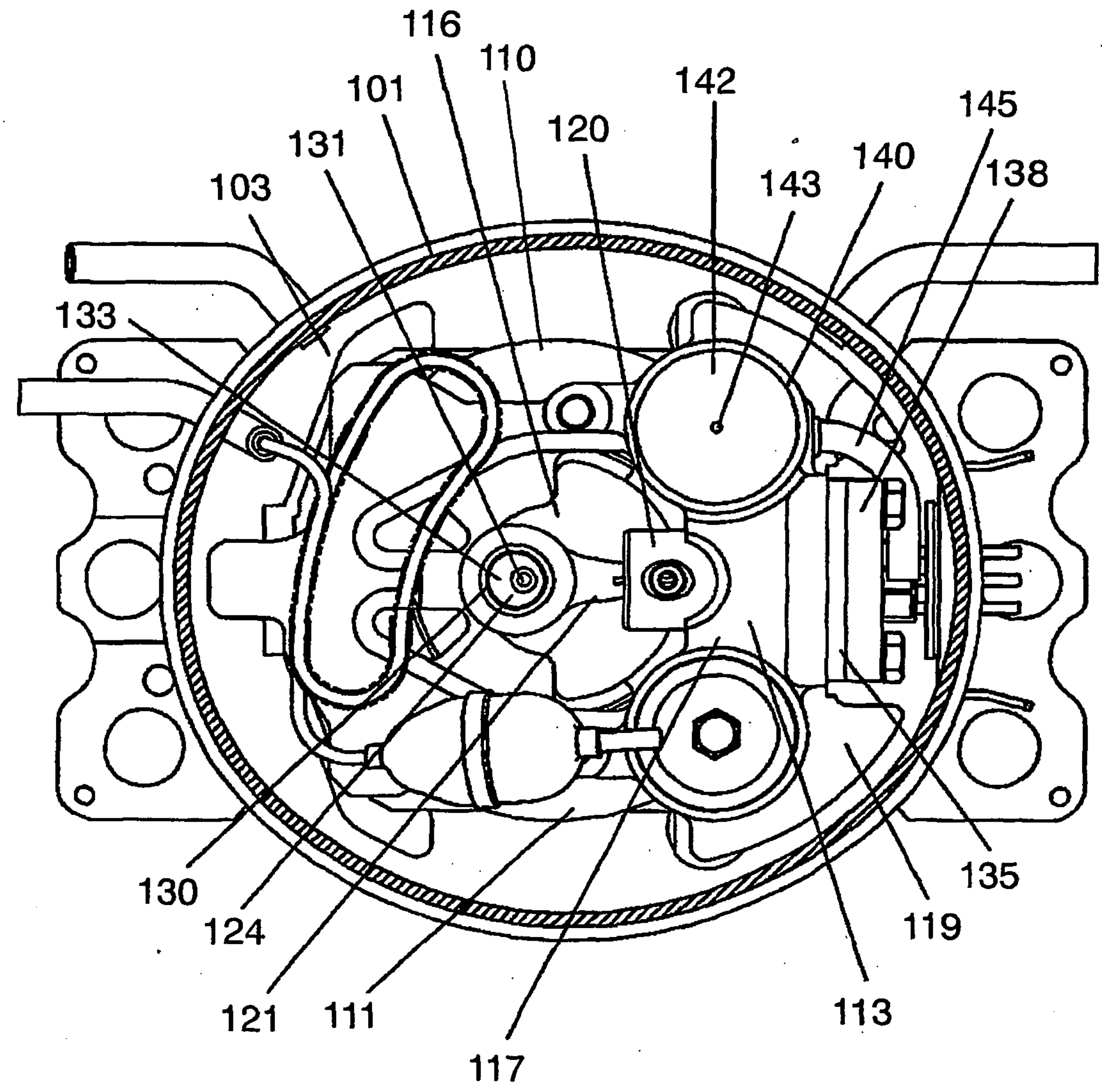

116
110
101
142
145
120
131
140
143
138
103
133
130
124
121
111
117
113
119
135

FIG. 3

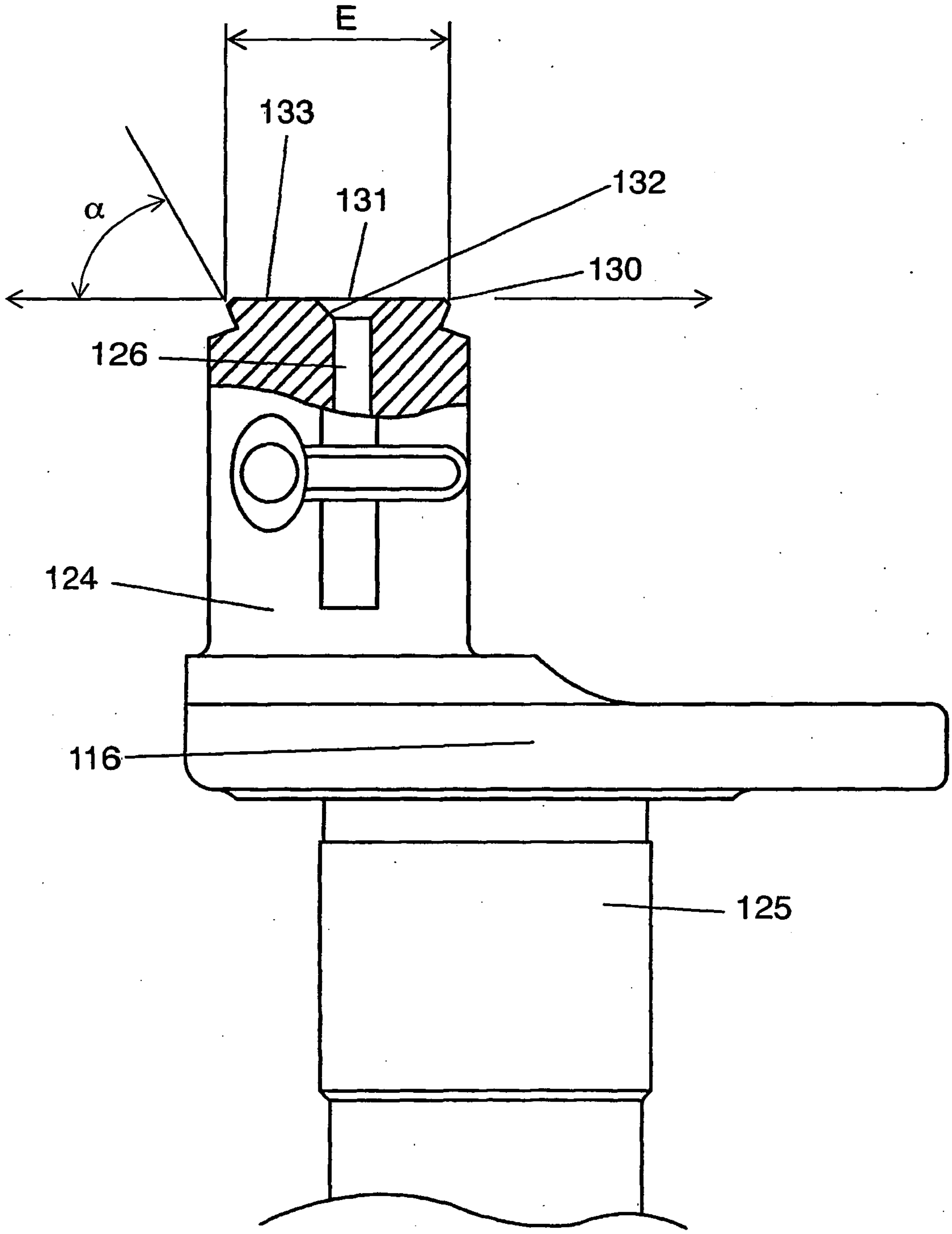


FIG. 4

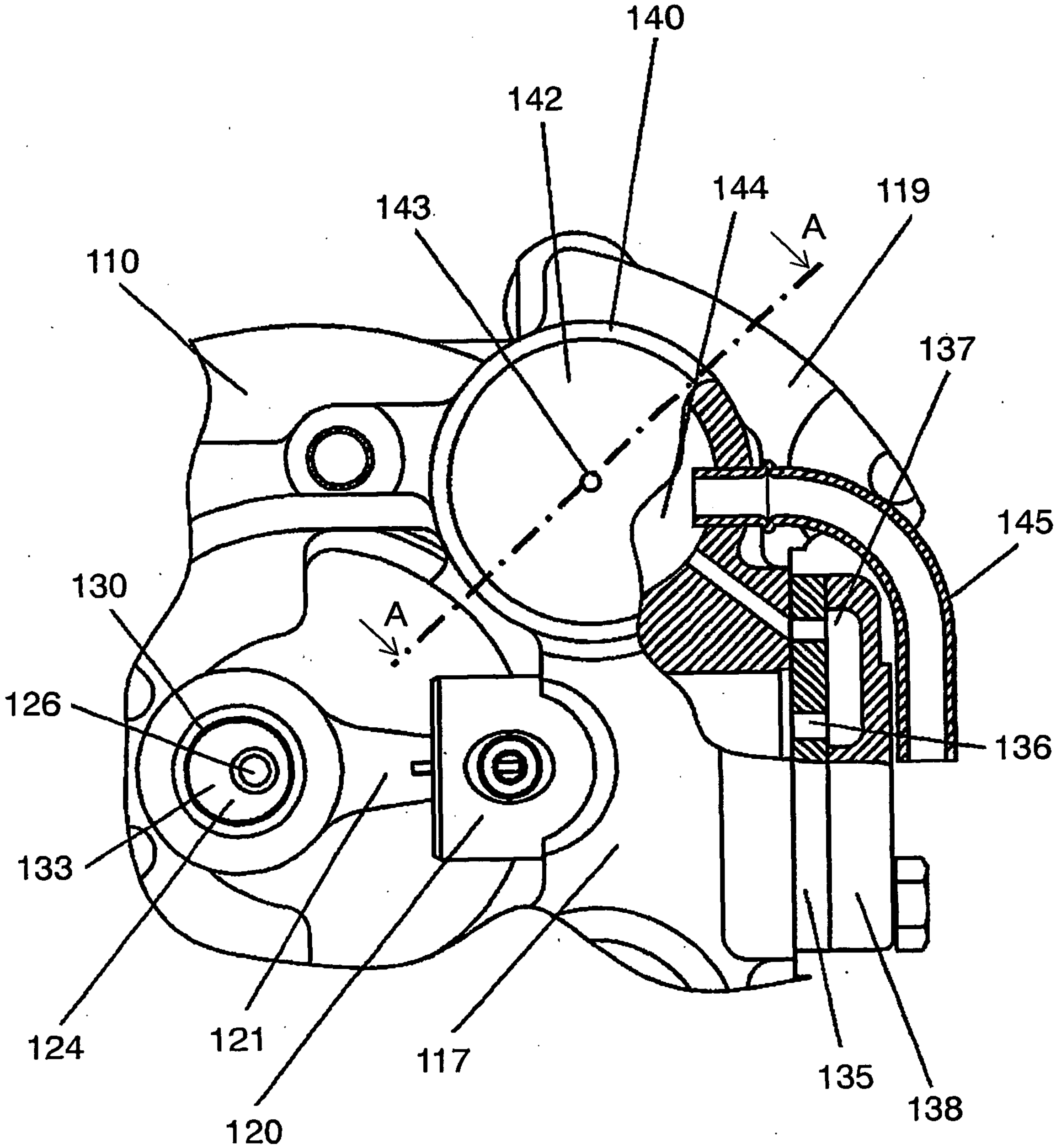

140
142
143
144
119
A
110
137
145
130
A
126
136
133
124
121
117
135
138
120

FIG. 5

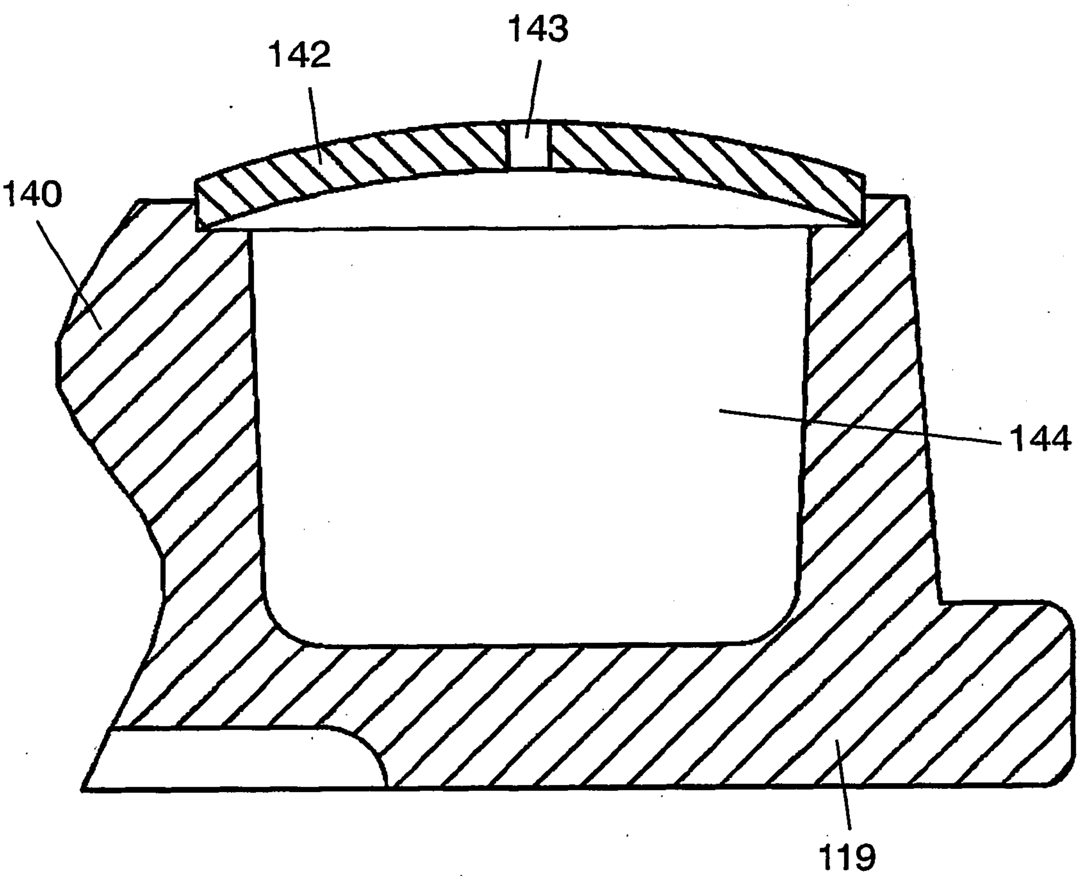


FIG. 6

PRIOR ART

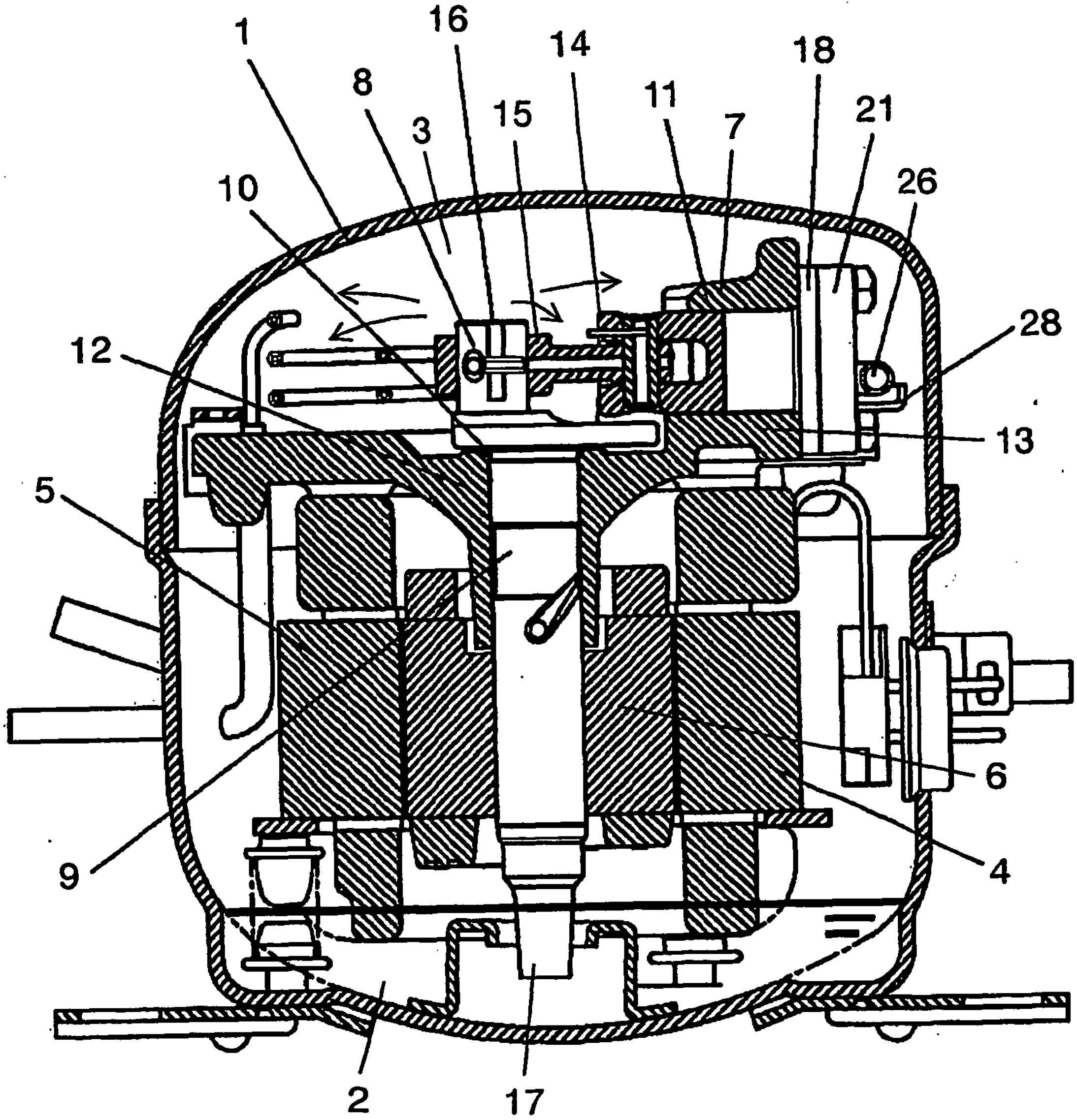


FIG. 7

PRIOR ART

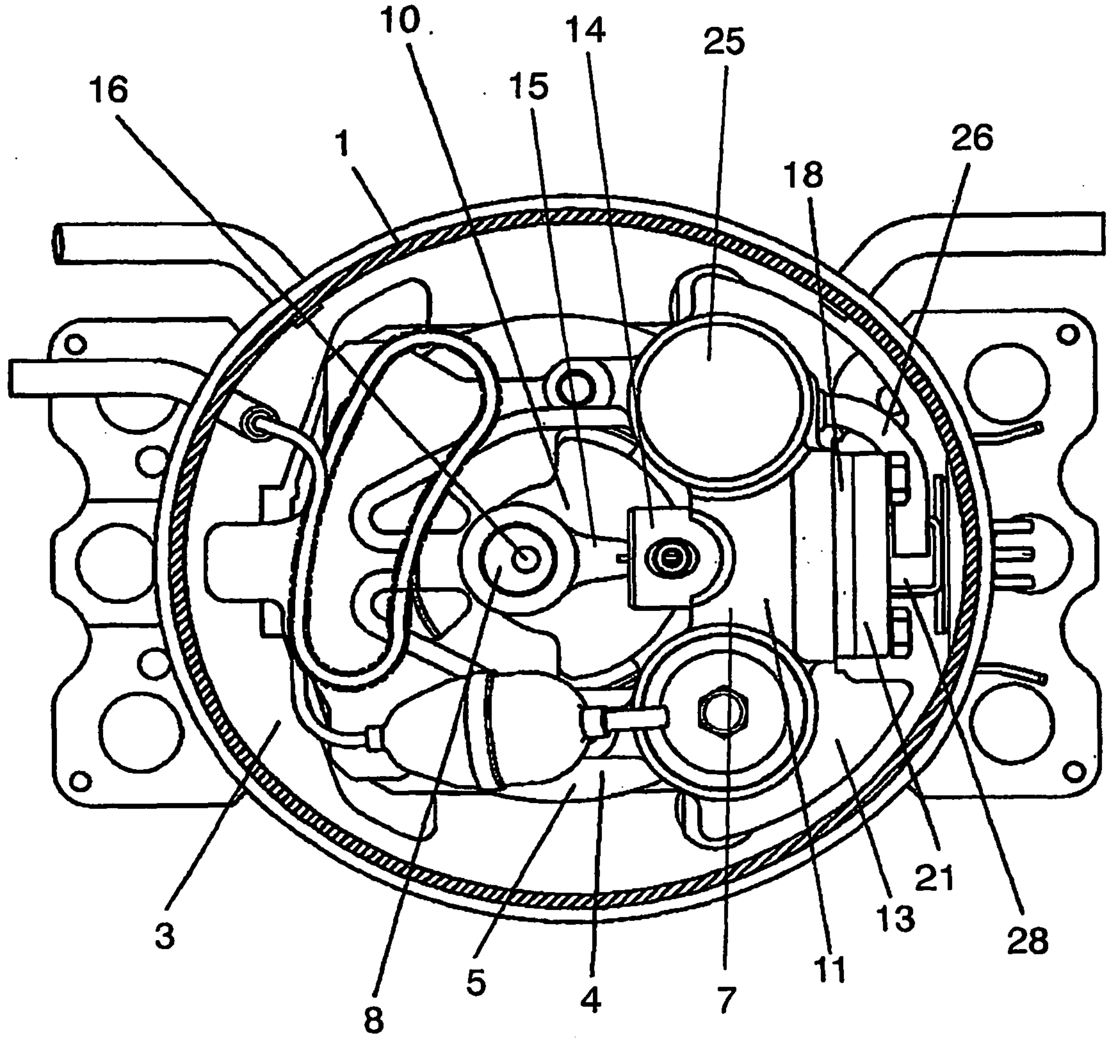


FIG. 8

PRIOR ART

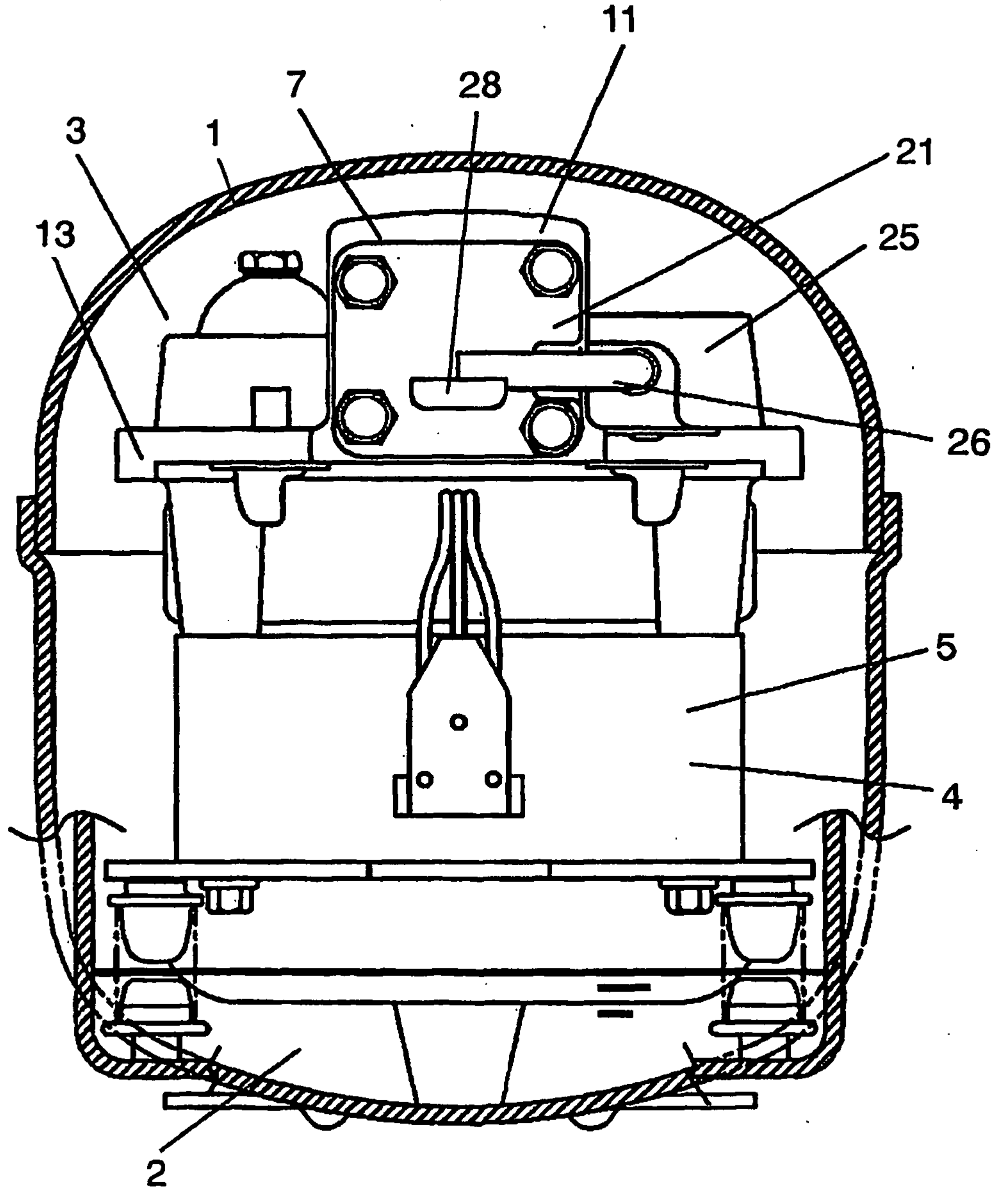
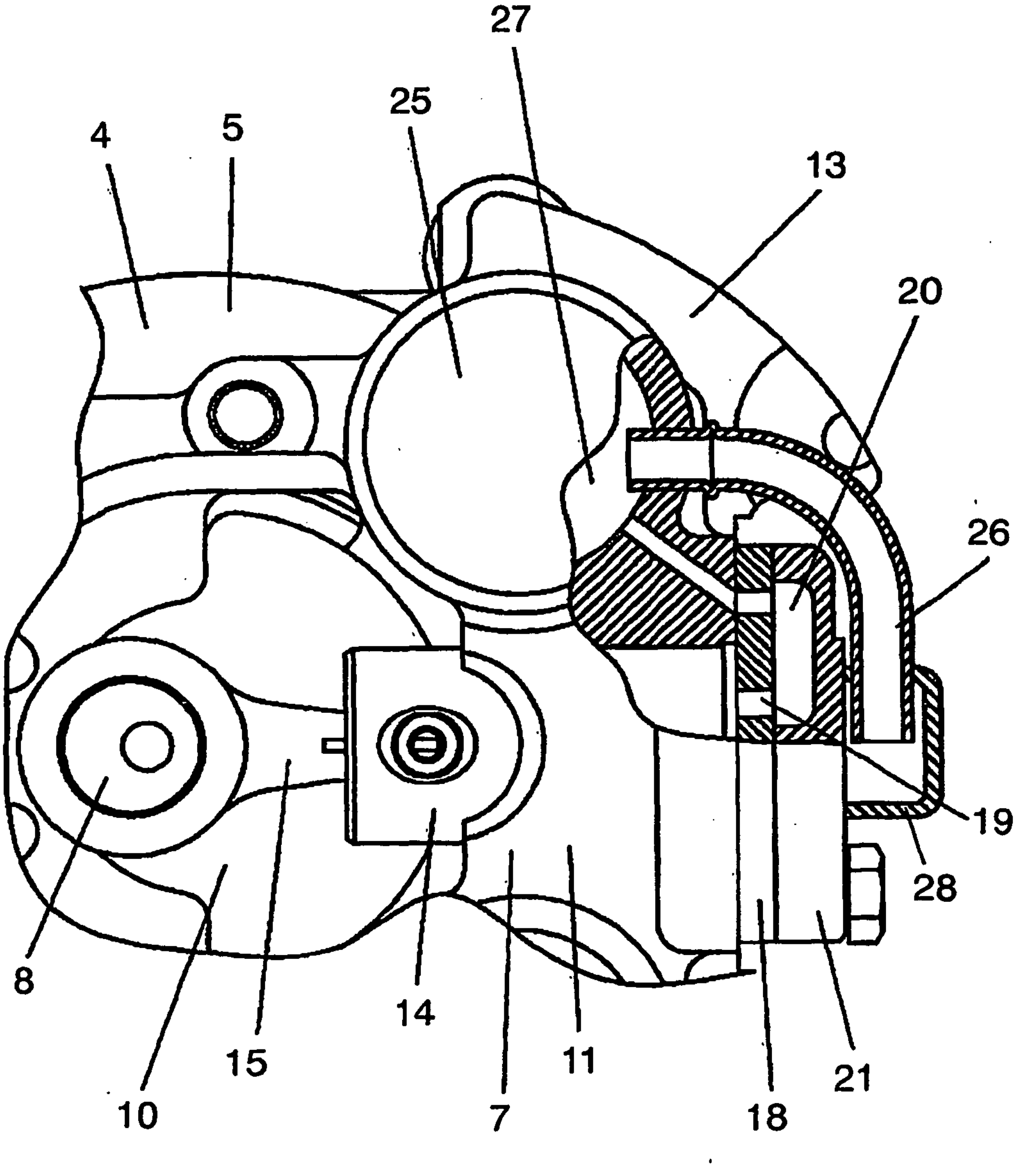


FIG. 9

PRIOR ART



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1408235 A **[0002]**
- JP 6294380 A **[0003] [0018]**
- JP H06294380 B **[0018]**