FORM 1

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

607149

I\We,
SANDEN CORPORATION

of 20 KOTOBUKI-CHO
ISESAKI-SHI
GUNMA-KEN
JAPAN

hereby apply for the grant of a standard patent for an invention entitled:

WOBBLE PLATE TYPE COMPRESSOR WITH IMPROVED ROTATION-PREVENTING MECHANISM.

which is described in the accompanying complete specification

Details of basic application(s):

Number of basic application	Name of Convention country in which basic application was filed	Date of basic application
U107984/61	JP	16 JUL 86

My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 14th day of July 1987

SANDEN CORPORATION

CLEMENT HACK & CO.

TO: The Commissioner of Patents.

FEE STAMP TO VALUE OF $...160..... ATTACHED
MAIL OFFICER.....

LODGED AT SUB-OFFICE
14 JUL 1987
Melbourne

PATENT OFFICE 50 FIFTY DOLLARS AUSTRALIA
PATENT OFFICE 100 ONE HUNDRED DOLLARS AUSTRALIA
PATENT OFFICE 10 TEN DOLLARS AUSTRALIA

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 27.11.90

CLEMENT HACK & CO. Australia Patent Declaration Form

Forms 7 and 8

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of Applicant(s)

In support of the application made by Sanden Corporation

for a patent for an invention entitled

Title

Wobble Plate Type Compressor With Improved Rotation-Preventing Mechanism

Name(s) and address(es) of person(s) making declaration

I/We, Masayoshi Ushikubo
c/o Sanden Corporation
20 Kotobuki-cho, Isesaki-shi, Gunma, 372 Japan

do solemnly and sincerely declare as follows:-

1. I am/we are the applicant(s) for the patent, or am/are authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant(s) for the or each basic application

in Japan on 16th July, 1986
by Sanden Corporation
in on 19
by

3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Name(s) and address(es) of the or each actual inventor

4. The actual inventor(s) of the said invention is/are

Yoshiyuki Saito
1-3-4-506 Kashiwa Honjo-shi,
Saitama, 367 Japan

See reverse side of this form for guidance in completing this part

5. The facts upon which the applicant(s) is/are entitled to make this application are as follows:-

The applicant is the assignee of the actual inventor.

DECLARED at Isesaki this 28th day of August, 19 87

M. Ushikubo

Masayoshi Ushikubo, Vice-President

This form may be completed and filed after the filing of a patent

(12) PATENT ABRIDGMENT (11) Document No. AU-B-75629/87
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 607149

(54) Title
WOBBLE PLATE COMPRESSOR

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(56) Prior Art Documents
US 4594055
US 4301716

(57) Claim

1. A refrigerant compressor including a compressor housing having a cylinder block provided with a plurality of cylinders and a crank chamber adjacent said cylinder block; reciprocative pistons slidably fitted within each of said cylinders; a drive shaft supported within a front end plate which is mounted on one end portion of said compressor housing; a cam rotor mounted on an inner end of said drive shaft and having an inclined end surface; a wobble plate disposed in proximity with said inclined end surface and having a first bevel gear; a second bevel gear supported on said cylinder block and coupled with said first bevel gear so as to nutatably support said wobble plate; and rods connecting respective pistons to said wobble plate, said first bevel gear being permanently located with respect to said wobble plate so that said connecting rods are inclined relative to the axis of said cylinders to provide a torque transmitted to said wobble plate in a direction opposite to a rotational drag created in said wobble plate by said cam rotor,

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PATENTS ACT 1952

Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

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Short Title:

Int. Cl:

Application Number:
Lodged:

Complete Specification-Lodged:
Accepted:
Lapsed:
Published:

This document contains the amendments made under Section 49 and is correct for printing.

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant:
SANDEN CORPORATION

Address of Applicant: 20 KOTOBUKI-CHO
ISESAKI-SHI
GUNMA-KEN
JAPAN

Actual Inventor:

Address for Service: CLEMENT HACK & CO.,
601 St. Kilda Road,
Melbourne, Victoria 3004,
Australia.

Complete Specification for the invention entitled:
WOBBLE PLATE TYPE COMPRESSOR WITH IMPROVED ROTATION-PREVENTING MECHANISM.

The following statement is a full description of this invention including the best method of performing it known to me:-

WOBBLE PLATE TYPE COMPRESSOR WITH IMPROVED ROTATION-PREVENTING MECHANISM

Technical Field

The present invention relates to a wobble plate type compressor for use in an automotive air conditioning system, and more particularly, to a rotation-preventing mechanism for a wobble plate type compressor.

Background of the Invention

A wobble plate type compressor is disclosed in U.S. Patent No. Re. 29,844. In the compressor rotation of the drive shaft is converted into reciprocal motion through a cam rotor having a sloping surface mounted on an end of the drive

shaft and a wobble plate disposed on the sloping surface through a needle bearing therebetween. The wobble plate is supported on a fixed member in such manner that the wobble plate is prevented from rotating but is mutatable or able to wobble. Thus, the wobble plate wobbles due to the rotation of the cam motor, and the piston rods connected to the wobble plate reciprocate to compress fluid within the cylinders.

Referring to Figure 1, which is a cross-sectional view of a conventional wobble plate type compressor, the general structure of a wobble plate type compressor will be explained. Compressor housing 1 defines a crank chamber 11 and a cylinder block 12 formed with a plurality of cylinders 121 on the axial circumference. One open end of housing 1 is closed by a front end plate 2. A cylinder head 3 is mounted on the end surface of cylinder block 12 through a valve plate 4 and affixed thereon by bolts 30.

A cylinder cavity 122 is formed at the center of cylinder block 12. Supporting axis 5, which includes an annular rod portion 51 with a hollow portion 51a for receiving a coil spring (not shown) and a bevel gear 52 formed on one terminal end of rod portion 51, is disposed within cylindrical cavity 122. Supporting axis 5 is prevented from rotation by positioning a key 123 in a groove which is defined on rod portion 51 of supporting axis 5 and cylinder block 12. The center portion of bevel gear 52 is formed with a seat portion 53.

A drive shaft 6 is rotatably supported on front end plate 2 through a bearing 7 and is coupled with a cam rotor at the inner end thereof which is disposed in crank chamber 11. Rotor 8 is axially and rotatably supported on the inner surface of front end plate 2 through a bearing 9. An inclined surface 81 of rotor 8 is placed in close proximity to one end surface 101 of a wobble plate 10 and engaged by a bearing 13 positioned between cam rotor 8 and wobble plate 10. A bevel gear 14 is fitted on the central portion of wobble plate 10 by caulking and is provided with a receiving seat 141 at the center thereof. The bevel gear 14 interfits with the bevel

gear 53 through a steel ball 15 for preventing rotation of wobble plate 10. Accordingly, wobble plate 10 wobbles without rotation in accordance with operation of cam rotor 8. A plurality of pistons 16 are reciprocatably fitted within cylinders 121 and are connected to wobble plate 10 through connecting rods 17. Therefore, pistons 16 reciprocate in accordance with operation of wobble plate 10. Cylinder head 3 defines a suction chamber 31 and a discharge chamber 32. Discharge chamber 32 is located at the center of cylinder head 3 and suction chamber 31 is located about discharge chamber 32. An inlet port 311 is formed on the outer end surface of cylinder head 3 for introducing refrigerant from a refrigerant circuit, and an outlet port 321 is formed on the outer end surface of cylinder head 3 for discharging compressed refrigerant gas into the refrigerant circuit.

With reference to Fig. 2, a front view of wobble plate 10 and bevel gear 14 is shown. A plurality of receiving portions 102 for receiving one end of each of the connecting rods 17 are spaced at regular intervals around the circumference of wobble plate 10. Bevel gear 14 is fixed on the inner surface of wobble plate 10 by caulking portions 103. Wobble plate 10 is located to bevel gear 14 so that point H of a central position between two teeth of bevel gear 14 is on the line which extends between central point C of bevel gear 14 and point P of a central position between two receiving portions 102. When the bevel gear 52 and the bevel gear 14 are interfitted, as mentioned above, the center line of each connecting rod 17 is arranged parallel to the center line of cylinders 121, as shown in Fig. 3.

When the above-mentioned compressor is operated by rotating drive shaft 6, axial force P1 of piston 16 is operated parallel to cylinders 121 in the direction of an arrow of a dotted line as shown in Fig. 4. Drag F1 on inclined surface 31 of cam rotor 3 is operated in the direction of an arrow of a dotted line. Thus, rotational force F2 to rotate wobble plate 10 is added against the contact point of both bevel gears 14,52 in the direction of an

arrow of a dotted line. In the relation of the above forces, when large rotational force F2 is added to bevel gears 14, 52 in large, a rotation-preventing mechanism including bevel gears 14, 52 may be broken down by rotational force F2. Further, vibration and noise may be produced on bevel gears 14, 52.

SUMMARY OF THIS INVENTION

It is a primary object of this invention to provide a wobble plate type compressor wherein durability of the rotation-preventing mechanism is improved.

It is another object of this invention to provide a wobble plate type compressor wherein vibration and noise are eliminated.

According to the present invention there is provided a refrigerant compressor including a compressor housing having a cylinder block provided with a plurality of cylinders and a crank chamber adjacent said cylinder block; reciprocative pistons slidably fitted within each of said cylinders; a drive shaft supported within a front end plate which is mounted on one end portion of said compressor housing; a cam rotor mounted on an inner end of said drive shaft and having an inclined end surface; a wobble plate disposed in proximity with said inclined end surface and having a first bevel gear; a second bevel gear supported on said cylinder block and coupled with said first bevel gear so as to nutatably support said wobble plate; and rods connecting respective pistons to said wobble plate, said first bevel gear being permanently located with respect to said wobble plate so that said connecting rods are inclined relative to the axis of said cylinders to provide a torque transmitted to said wobble plate in a direction opposite to a rotational drag created in said wobble plate by said cam rotor.

Further objects, features and other aspects of this invention will be understood from the following detailed description of the preferred embodiments of this invention with reference to the annexed drawings.

Brief Description of the Drawings

Fig. 1 is a cross-sectional view of a conventional wobble plate type compressor.

Fig. 2 is a front view of a wobble plate with a bevel gear used in wobble plate type compressor of Figure 1.

Fig. 3 is a cross-sectional view of a conventional wobble plate type compressor illustrating the orientation of the connecting rods.

Fig. 4 is an explanatory view which shows a force diagram for the rotation-preventing mechanism.

Fig. 5 is a front view of a wobble plate and a bevel gear in a wobble plate type compressor in accordance with one embodiment of this invention.

Fig. 6 is a cross-sectional view of a wobble plate type compressor in accordance with one embodiment of this invention illustrating the orientation of connecting rod.

Fig. 7 is a graph illustrating the relationship between rotational angle of a cam rotor and torque added to a conventional rotation-preventing mechanism.

Fig. 8 is a graph illustrating the relationship between rotational angle of a cam rotor and torque added to a rotation-preventing mechanism in accordance with one embodiment of this invention.

Detailed Description of the Preferred Embodiments

Since the construction of a wobble plate type compressor in accordance with one embodiment of this invention is the same as that shown in Fig. 1 except for the construction of the wobble plate and a bevel gear, detailed description of such a compressor is omitted. Furthermore, since there are no new parts and construction in the compressor of one embodiment of this invention, the same reference numbers as for the conventional compressor are used.

Referring to Fig. 5, the connection of the wobble plate 10 and bevel gear 14 in accordance with one embodiment of this invention is shown. Bevel gear 14 is fixed on the center portion of wobble plate 10 by caulking. The wobble

plate 10 is located to bevel gear 14 so that point of a central position between two teeth of bevel gear 14 is on the line which extends between central point C of bevel gear 14 and point P' which is at an angle of five degrees toward the rotational direction from point P. When the bevel gear 14 is interfitted with the bevel gear 52, connecting rods 17 are inclined toward the rotational direction of driving shaft 6, as shown in Fig. 6.

When the above compressor is operated by rotation of drive shaft 6, pistons 16 are reciprocated and, as a result, axial force P2 of piston 16 is operated in the direction of an arrow of a solid line as shown in Fig. 4. Since drag F'1 is not changed even though the orientation between wobble plate 10 and bevel gear 14 is changed, drag F'1 is the same as drag F1. Also, the direction of rotational force F3 is the same as rotational force F2 even though the orientation between wobble plate 10 and bevel gear 14 is changed. However, since the direction of axial force of piston P2 is changed, the quantity of rotational force F3 is reduced as shown by an arrow of a solid line. Therefore, the rotational force which is added to bevel gears 14, 52 of the rotation-preventing mechanism is reduced.

With reference to Fig. 7, the relationship between the rotation angle of a cam rotor and torque added to a conventional rotation-preventing mechanism is shown. The torque is maintained about 100 kg/cm at any rotation angle of the cam rotor.

With reference to Fig. 8, the relationship between the rotation angle of a cam rotor and torque added to a rotation-preventing mechanism according to one embodiment of this invention is shown. The torque is maintained about 35 kg/cm at any rotation angle of the cam rotor.

As mentioned above, due to changing the orientation of the wobble plate 10 and bevel gear 14, the torque added to bevel gears 14, 52 is reduced.

This invention has been described in detail in connection with a preferred embodiment. The embodiment, however, merely is an example only and this invention is not restricted thereto. It will be easily understood by those skilled in the art that variations and modifications can be easily made within the scope of this invention, as defined by the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1 A refrigerant compressor including a compressor housing having a cylinder block provided with a plurality of cylinders and a crank chamber adjacent said cylinder block; reciprocative pistons slidably fitted within each of said cylinders; a drive shaft supported within a front end plate which is mounted on one end portion of said compressor housing; a cam rotor mounted on an inner end of said drive shaft and having an inclined end surface; a wobble plate disposed in proximity with said inclined end surface and having a first bevel gear; a second bevel gear supported on said cylinder block and coupled with said first bevel gear so as to nutatably support said wobble plate; and rods connecting respective pistons to said wobble plate, said first bevel gear being permanently located with respect to said wobble plate so that said connecting rods are inclined relative to the axis of said cylinders to provide a torque transmitted to said wobble plate in a direction opposite to a rotational drag created in said wobble plate by said cam rotor.

2. The compressor defined in claim 1 wherein said wobble plate has an edge along which are located receiving portions for receiving one end of each of said connecting rods and said first bevel gear is located with respect to said wobble plate so that a line connecting the centre point of said first bevel gear to a point located at the centre between two teeth of said first bevel gear includes a point on said wobble plate between two said receiving portions which is shifted within a range of 5° in the rotational direction of said drive shaft from a central point between two said receiving portions.

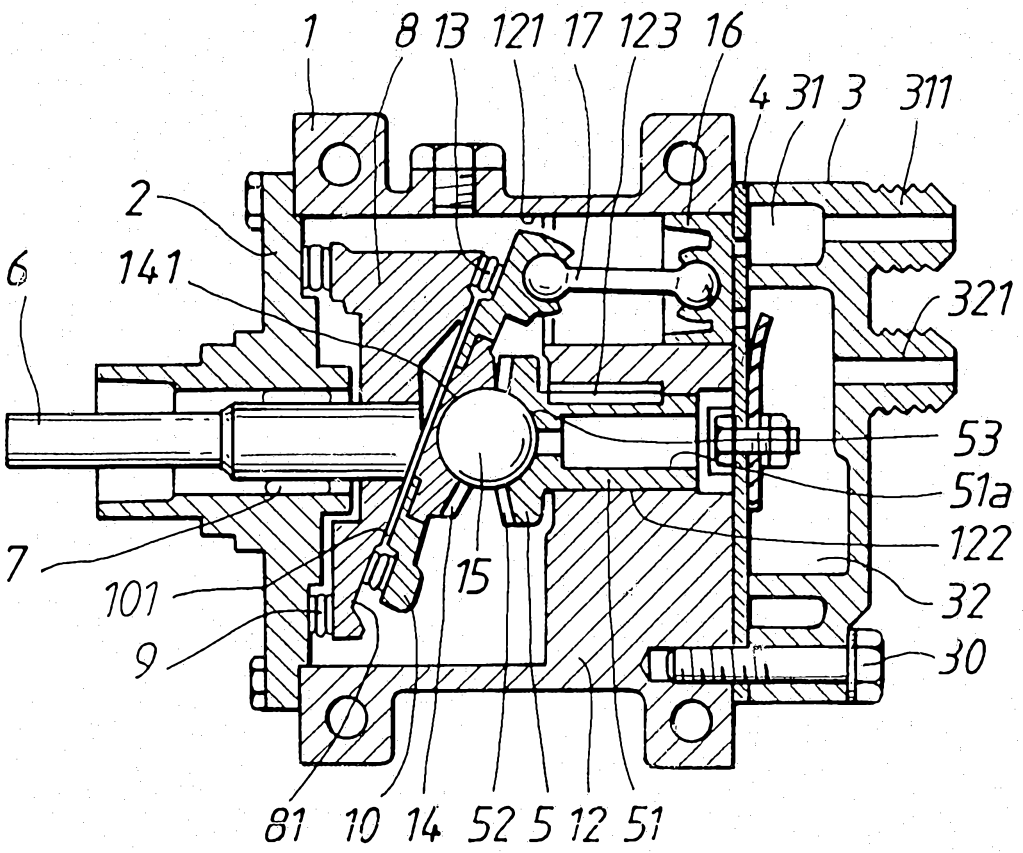
3. The compressor defined in claim 2 wherein said shift is 2½°.

4. A refrigerant compressor substantially as hereinbefore described with reference to Figs. 5 to 8.

DATED THIS 21th DAY OF September 1990

SANDEN CORPORATION
By Its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.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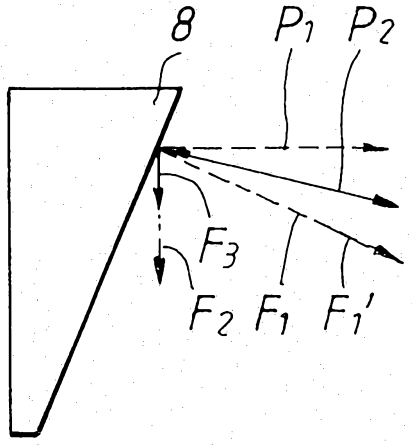
Фиг. 1.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P1
P2
F3
F2
F1
F1'

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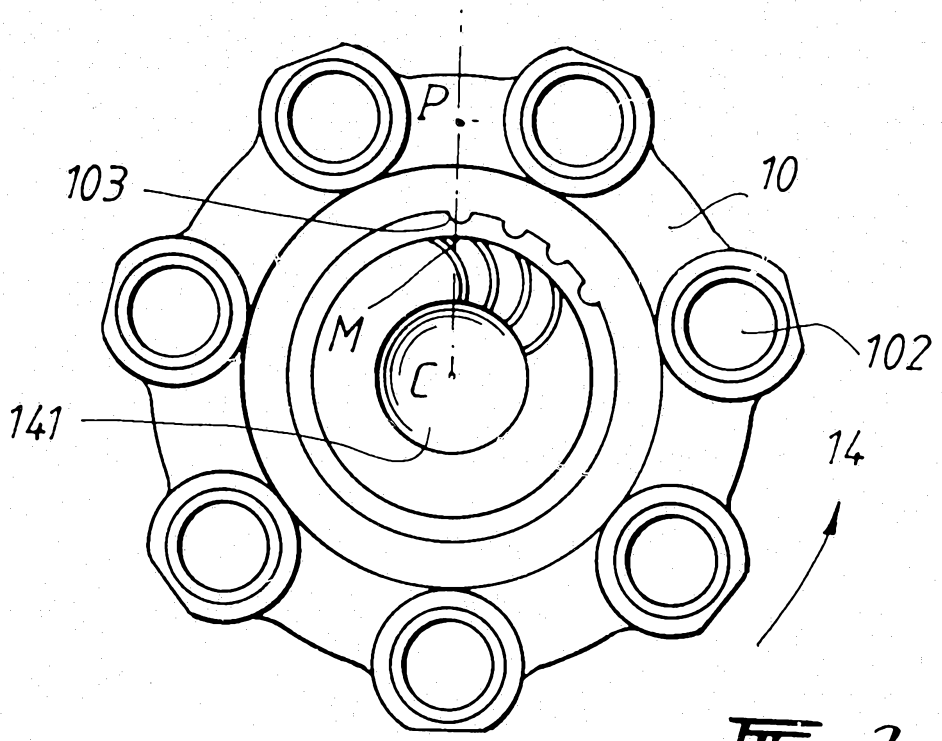

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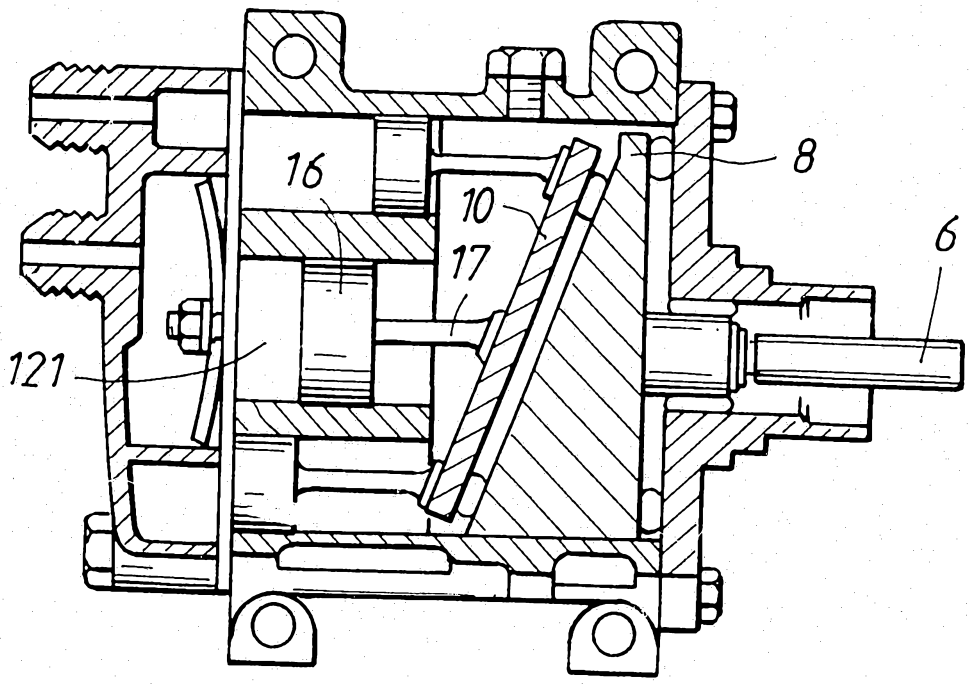

Фиг. 3.

75629/87

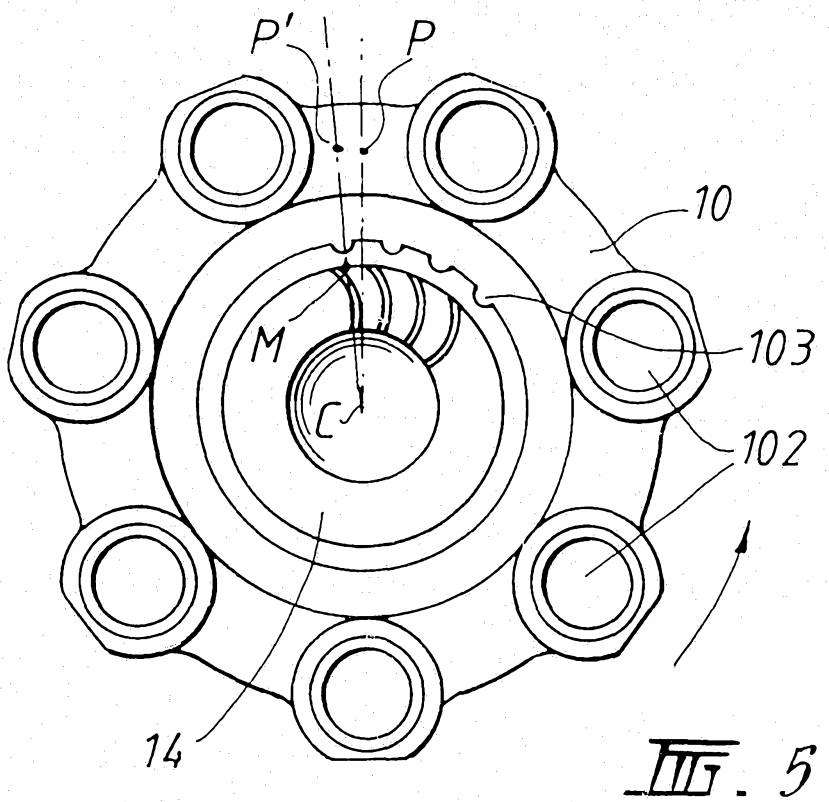

FIG. 5.

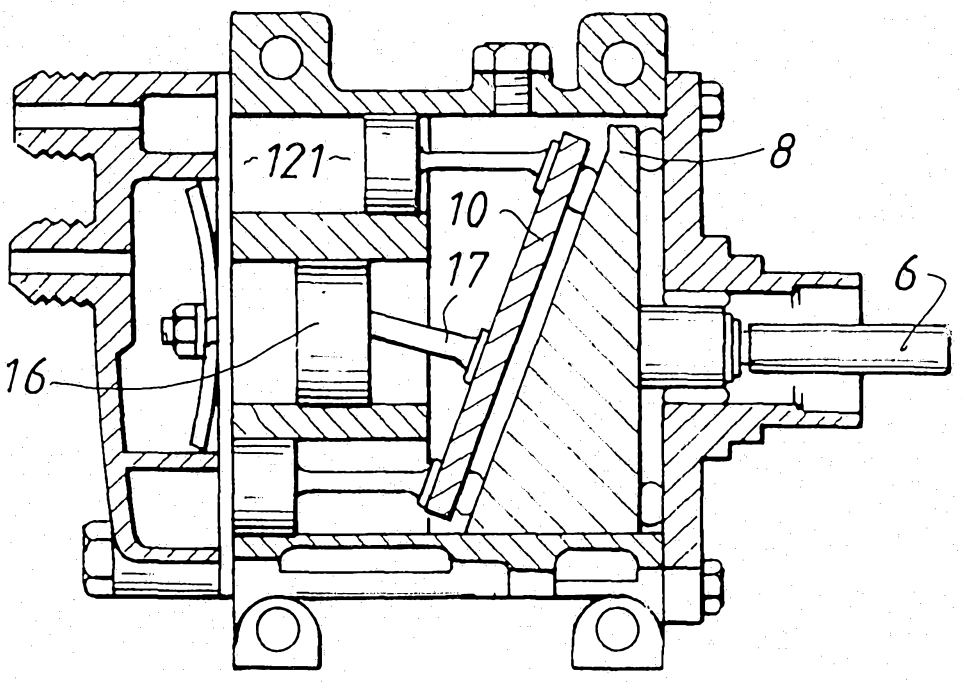

FIG. 6.

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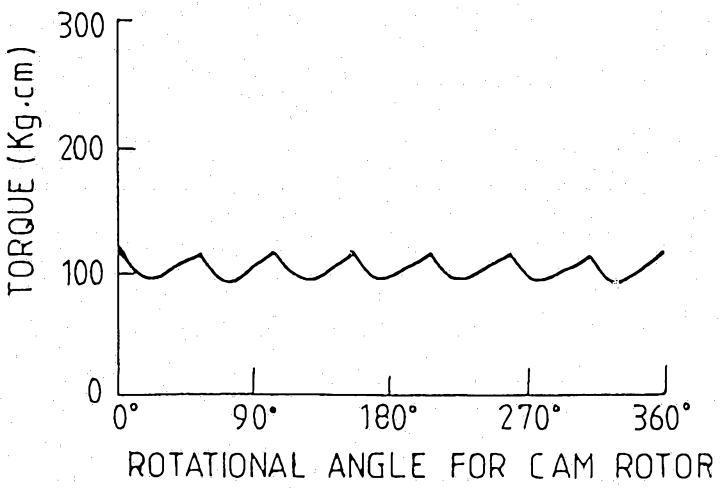

FIG. 7.

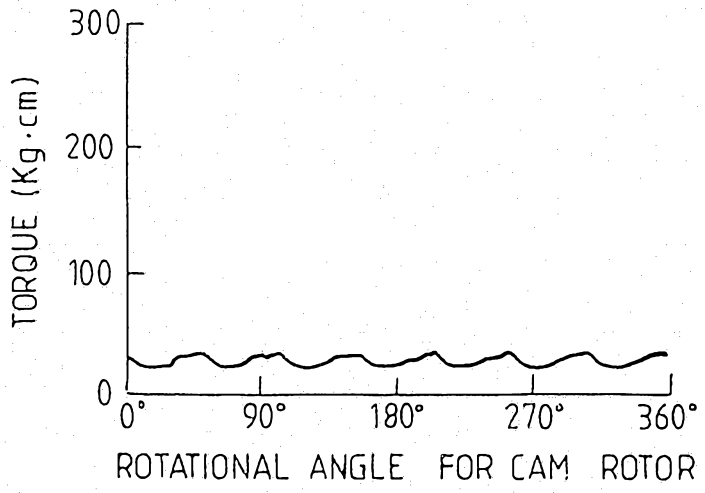

FIG. 8.