FORM 1

SPRUSON & FERGUSON

604186

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

Sanden Corporation, of 20 Kotobuki-cho, Isesaki-shi, Gunma, 372, JAPAN, hereby apply for the grant of a standard patent for an invention entitled:

Slant Plate Type Compressor

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
37,069/63	JP	23 March 1988

The address for service is:-

Spruson & Ferguson
Patent Attorneys
Level 33 St Martins Tower
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Sydney New South Wales Australia

DATED this TWENTY SECOND day of MARCH 1989

Sanden Corporation

By: M.J. Anderson

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 90206
S&F CODE: 61189

ACCEPTED AND AMENDMENTS
5-9-90

REPRINT OF RECEIPT
S006350 23/03/89

5845/4

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

"Slant Plate Type Compressor"

I/~~We,~~ Masayoshi Ushikubo
[full name of declarant(s)]

~~of~~ c/o Sanden Corporation, 20 Kotobuki-cho, Isesaki-shi, Gunma, 372 Japan
[full address of declarant(s) - not post office box]

do solemnly and sincerely declare as follows:-

1. I am/~~We are~~ authorised by Sanden Corporation, the applicant for the patent to make this declaration on its behalf.

2. The basic application~~s~~ as defined by Section 141 of the Act ~~were~~ was made in Japan on 23rd March, 1988 by Sanden Corporation

3. Shigemi Shimizu, of 425 Higashi-Arai, Sakai-machi, Sawa-gun, Gunma, 370-01 Japan

~~[respectively]~~, ~~are~~ is the actual inventor~~s~~ of the invention and the facts upon which the applicant is entitled to make the application are as follows:

The said applicant is the assignee of the actual inventor(~~s~~).

4. The basic application~~s~~ referred to in paragraph 2 of this Declaration was ~~were~~ the first application~~s~~ made in a Convention country in respect of the invention~~s~~ the subject of the application.

DECLARED at Tokyo Japan this 2nd day of May 1989

M. Ushikubo
Signature of Declarant

Masayoshi Ushikubo,
Executive Vice President of
Sanden Corporation

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA

(12) PATENT ABRIDGMENT (11) Document No. AU-B-31713/89
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 604186

(54) Title
SLANT PLATE TYPE COMPRESSOR

International Patent Classification(s)
(51)[4] F04B 025/04

(21) Application No. : 31713/89 (22) Application Date : 23.03.89

(30) Priority Data

(31) Number	(32) Date	(33) Country
63-37069	23.03.88	JP JAPAN

(43) Publication Date : 28.09.89

(44) Publication Date of Accepted Application : 06.12.90

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(56) Prior Art Documents
AU 52679/86 F04B 25/04
GB 2153922
US 4586874

(57) Claim

1. A slant plate type compressor for use in a refrigeration circuit, said compressor including a compressor housing having a cylinder block provided with a centrally formed bore and a plurality of cylinders, a front end plate disposed on one end of said cylinder block and enclosing a crank chamber within said cylinder block, a piston slidably fitted within each of said cylinders, a drive mechanism coupled to said pistons to reciprocate said pistons within said cylinders, said drive mechanism including a drive shaft rotatably supported in said housing, a rotor coupled to said drive shaft and rotatable therewith, and coupling means for drivingly coupling said rotor to said pistons, such that the rotary motion of said rotor is converted into reciprocating motion of said pistons, one end of said drive shaft rotatably supported in said bore, a screw member into said bore to adjust an axial location of said drive shaft, a screwed spacing member disposed between an inner axial end surface of said drive shaft and said screw member, said coupling means including a plate having a surface disposed at a slant angle relative to said drive shaft, a rear end plate disposed on the opposite end of said cylinder block from said front

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end plate and defining a suction chamber and a discharge chamber therein, and means for preventing rotation of said screw member during an operation of said compressor, said rotation preventing means comprising at least one radial projection formed on a peripheral surface of said spacing member and at least one corresponding depression formed at an inner surface of said bore.

S & F Ref: 90206

FORM 1 604196

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name and Address of Applicant: Sanden Corporation
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Complete Specification for the invention entitled:

Slant Plate Type Compressor

The following statement is a full description of this invention, including the best method of performing it known to me/us

5845/5

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to a refrigerant compressor and, more particularly, to a slant plate type compressor, such a wobble plate type compressor, suitable for use in an automotive air conditioning system.

Description of the Prior Art

A wobble plate type compressor for use in an automotive air conditioning system is disclosed in U.S. Patent No. 4,586,874 corresponding to Japanese Patent Application Publication No. 60-135680. With reference to Figure 1, the disclosed wobble plate type compressor 10 comprises closed cylindrical housing assembly 11 formed by cylinder block 111, a hollow portion such as crank chamber 12, front end plate 13 and rear end plate 14. An inner end portion of drive shaft 15 extends into central bore 112 formed in the center portion of cylinder block 111 and is rotatably supported therein by a bearing such as radial needle bearing 16. The axial location of drive shaft 15 can be adjusted by adjusting screw 17 screwed into the threaded portion of central bore 112 and spring member 18 is disposed between the axial end surface of drive shaft 15 and adjusting screw 17.

Thrust needle bearing 19 is placed between drive shaft 15 and spring member 18 to ensure smooth rotation of drive shaft 15 and to prevent transferring rotational force from drive shaft 15 to adjusting screw 17 through spring member 18. Thus, even when drive shaft 15 rotates in the direction which causes adjusting screw 17 to tighten or loosen, adjusting screw 17 can be still kept its fixed position.

However, disposing costly bearing 19 therein makes a manufacturing cost raise and an assembling process complicate.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a slant plate type compressor in which a drive shaft can be kept in its adjusted axial location during operation of the compressor.

The slant plant type compressor in accordance with the present invention includes a compressor housing having a cylinder block with a front end plate and a rear end plate attached thereto. A crank chamber is defined between the front end plate and the cylinder block and a plurality of cylinders are formed in the cylinder block. A bore is formed at a central portion of the cylinder block. A piston is slidably fitted within each of the cylinders. A drive mechanism is coupled to the pistons to

reciprocate the pistons within the cylinders. The drive mechanism includes a drive shaft rotatably supported in the compressor housing, a rotor coupled to the drive shaft and rotatable therein, and a coupling mechanism for drivingly coupling the rotor to the pistons such that the rotary motion of the rotor is coverted into reciprocating motion of the pistons. One end of the drive shaft is rotatably supported in the bore. A screw member is screwed into the bore to adjust the axial location of the drive shaft. A spacing member is disposed between one axial end surface of the drive shaft and the screw member. The coupling mechanism includes a plate having a surface disposed at a slant angle relative to the shaft. The rear end plate includes a suction chamber and a discharge chamber defined therein. A rotation preventing device includes at least one radial projection formed at a peripheral surface of the spacing member and at least one depression formed at an inner surface of the bore in order to fit through the radial projection.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a vertical sectional view of a refrigerant compressor in accordance with the prior art.

Figure 2 is a vertical sectional view of a wobble plate type compressor in accordance with one embodiment of this invention.

Figure 3 is an perspective view of the spacer shown in Figure 2.

Figure 4 is an elevation viewing from line A-A of Figure 2.

Figure 5 is an exploded perspective view of a bore portion shown in Figure 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the present invention is described below in terms of a wobble plate type compressor, it is not limited in this respect. The present invention is broadly applicable to any slant plate type compressor.

Figure 2 illustrates a wobble plate type refrigerant compressor in accordance with one embodiment of the present invention in which the same numerals are used to dencte the corresponding elements shown in Figure 1. Compressor 100 includes cylindrical housing assembly 11 including cylinder block 111, front end plate 13 disposed at one end of cylinder block 111, crank chamber 12 formed between cylinder block 111 and front end plate 13, and rear end plate 14 attached to the other end of cylinder block 111. Front end plate 13 is secured to one end of cylinder block 111 by a plurality of bolts (not shown). Rear end plate 14 is secured to the opposite end of cylinder block 111 by a plurality of bolts (not shown). Valve plate 21 is disposed between rear end plate 14 and cylinder block

111. Opening 131 is formed centrally in front end plate 13 for supporting drive shaft 15 through bearing 132 disposed therein. The inner end portion of drive shaft 15 is rotatably supported by bearing 16 disposed within central bore 112 of cylinder block 111. Bore 112 extends to a rearward (to the right in Figure 1) end surface of cylinder block 111.

Cam rotor 30 is fixed on drive shaft 15 by pin member 151 and rotates therein. Thrust needle bearing 22 is disposed between the inner end surface of front end plate 13 and the adjacent axial end surface of cam rotor 30. Cam rotor 30 includes arm 31 having slot 32. Slant plate 40 is disposed adjacent cam rotor 30 and includes opening 43 through which drive shaft 15 passes. Slant plate 40 includes arm 41 having pin member 42 extending thereon. Cam rotor 30 and slant plate 40 are coupled by pin member 42 which is inserted in slot 32 to form a hinged joint. Pin member 42 slides within slot 32 to allow adjustment of the angular position of slant plate 40 with respect to the londitudinal axis of drive shaft 15.

Wobble plate 50 is rotatably mounted on slant plate 40 through bearing 51. Fork shaped slider 52 is attached to the outer periphral end of wobble plate 50 and is slidably mounted on sliding rail 53 disposed between front end plate 13 and cylinder block 111. Fork shaped slider 52 prevents rotation of wobble plate 50. Wobble plate 50 nutates along rail 53 when cam rotor 30 rotates. Cylinder block 111 includes a plurality of periphrally located cylinder chambers 60 in which pistons 61 reciprocate. Each piston 61 is coupled to wobble plate 50 by corresponding connecting rod 62.

Rear end plate 14 includes peripherally positioned annular suction chamber 141 and centrally positioned discharge chamber 142. Valve plate 21 is located between cylinder block 111 and rear end plate 14 and includes a plurality of valved suction ports 141a linking suction chamber 141 with respective cylinders 60. Valve plate 21 also includes a plurality of valved discharge ports 142a linking discharge chamber 142 with respective cylinders 60. Suction ports 141a and discharge ports 142a are provided with suitable reed valves as described in U.S. Patent No. 4,011,029 to Shimize.

Suction chamber 141 includes inlet portion 141b which is connected to an evaporator of an external cooling circuit (not shown). Discharge chamber 142 is provided with outlet portion 142b connected to a condenser of the cooling circuit (not shown).

Passage 152 is bored in drive shaft 15. One end opening of passage 152 opens to crank chamber 12 and another end opening of passage 152 opens

at an inner axial end surface of drive shaft 15.

Valve element 71 including valve member 71b and bellows 71a is disposed within hollow portion 70 formed at cylinder block 111. Hole 211 linking suction chamber 141 to hollow portion 70 is formed at valve plate 21. Conduit 72 linking hollow portion 70 to a rearmost (right side in Figure 2) internal space 112a of bore 112 is radially bored at cylinder block 111.

One end surface of bellows 71a is attached to one inner end surface of hollow portion 70. Valve element 71b is fixed on the other end surface of bellows 71a and operates to open and close hole 211 in accordance with the motion of bellows 71a.

The axial location of drive shaft 15 can be adjusted by adjusting screw 17 screwed into the threaded portion of central bore and circular disk shaped spacer 81 is disposed between the inner axial end surface of drive shaft 15 and adjusting screw 17.

With reference to Figures 3-5, rotation preventing device 80 for preventing a rotation of adjusting screw 17 during an operation of compressor 100 is shown. Rotation preventing device 80 includes a pair of semicircular-shaped portions 81a radially projecting from a circumferantial surface of spacer 81 and a pair of semicylindrical-shaped depressions 82 formed at an inner periphral surface of bore 112 to fit through semicurcular-shaped portion 81a. Spacer 81 including central hole 81b is obtained by cutting out from sheet iron (not shown) by press work. Adjusting screw 17 comprises hexagonal hole 17a for fitting through an appropriate hexagonal spanner axially bored at a central portion thereof. After semicircular shaped portion 81a fitting through semicylindrical-shaped depression 82, adjusting screw 17 is tightened or loosened by using an hexagonal spanner to adjust an axial location of drive shaft 15.

Passage 152 links the rearmost internal space 112a of bore 112 through holes 81b and 17a as shown. Thus, crank chamber 12 links to suction chamber 141 via passage 152, hole 81b, hole 17a, space 112a, conduit 72, hollow portion 70 and hole 211.

During operation of compressor 100, drive shaft 15 is rotated by the engine of the vehicle (not shown) through an electromagnetic clutch (not shown). Cam rotor 30 is rotated with drive shaft 15 causing slant plate 40 to rotate. The rotation of slant plate 40 causes wobble plate 50 to nutate. The nutating motion of wobble plate 50 reciprocates pistons 61 in their respective cylinders 60. As pistons 61 are reciptocated,

refrigerant gas which is introduced into suction chamber 141 through inlet portion 141b is drawn into cylinders 60 through suction ports 141a and subsequently compressed. The compressed refrigerant gas is discharged from cylinder 60 to discharge chamber 142 through respective discharge ports 142a and then into the cooling circuit through outlet portion 142b. Valve member 71 is responsive to the crank chamber pressure led through passage 152, hole 81b, hole 17a, space 112a and conduit 72. When the pressure in crank chamber 12 exceeds a predetermined value, hole 211 is opened by the construction of bellows 71a. The opening of hole 211 permits communication between crank chamber 12 and suction chamber 141. As a result, the slant angle of slant plate 40 is maximized to maximize the displacement of the compressor. However, when the pressure in crank chamber 12 is less than a predetermined value, hole 211 is closed by valve member 71b attached to bellows 71a. This action blocks communication between crank chamber 12 and suction chamber 141. As a result, the slant angle of slant plate 40 is controlled by changes in the pressure in crank chamber 12 to vary the displacement of the compressor.

Furthermore, transferring rotational force from drive shaft 15 to adjusting screw 17 is interrupted by rotation preventing spacer 81 which is disposed between the inner axial end surface of drive shaft 15 and adjusting screw 17. Thus, drive shaft 15 can be kept in its adjusted axial location during the operation of the compressor.

The claims defining the invention are as follows:

1. A slant plate type compressor for use in a refrigeration circuit, said compressor including a compressor housing having a cylinder block provided with a centrally formed bore and a plurality of cylinders, a front end plate disposed on one end of said cylinder block and enclosing a crank chamber within said cylinder block, a piston slidably fitted within each of said cylinders, a drive mechanism coupled to said pistons to reciprocate said pistons within said cylinders, said drive mechanism including a drive shaft rotatably supported in said housing, a rotor coupled to said drive shaft and rotatable therewith, and coupling means for drivingly coupling said rotor to said pistons, such that the rotary motion of said rotor is converted into reciprocating motion of said pistons, one end of said drive shaft rotatably supported in said bore, a screw member into said bore to adjust an axial location of said drive shaft, a screwed spacing member disposed between an inner axial end surface of said drive shaft and said screw member, said coupling means including a plate having a surface disposed at a slant angle relative to said drive shaft, a rear end plate disposed on the opposite end of said cylinder block from said front end plate and defining a suction chamber and a discharge chamber therein, and means for preventing rotation of said screw member during an operation of said compressor, said rotation preventing means comprising at least one radial projection formed on a peripheral surface of said spacing member and at least one corresponding depression formed at an inner surface of said bore.

2. The refrigerant compressor of claim 1 said spacing member is a circular disk having at least one semicircular-shaped radial projection.

3. The refrigerant compressor of claim 1 wherein said depression is semicylindrical-shaped.

4. A refrigerant compressor substantially as described herein with reference to FIGS. 2 to 4 of the accompanying drawings.

DATED this TWENTY-FIRST day of MARCH 1989
Sanden Corporation

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

BJG/95P

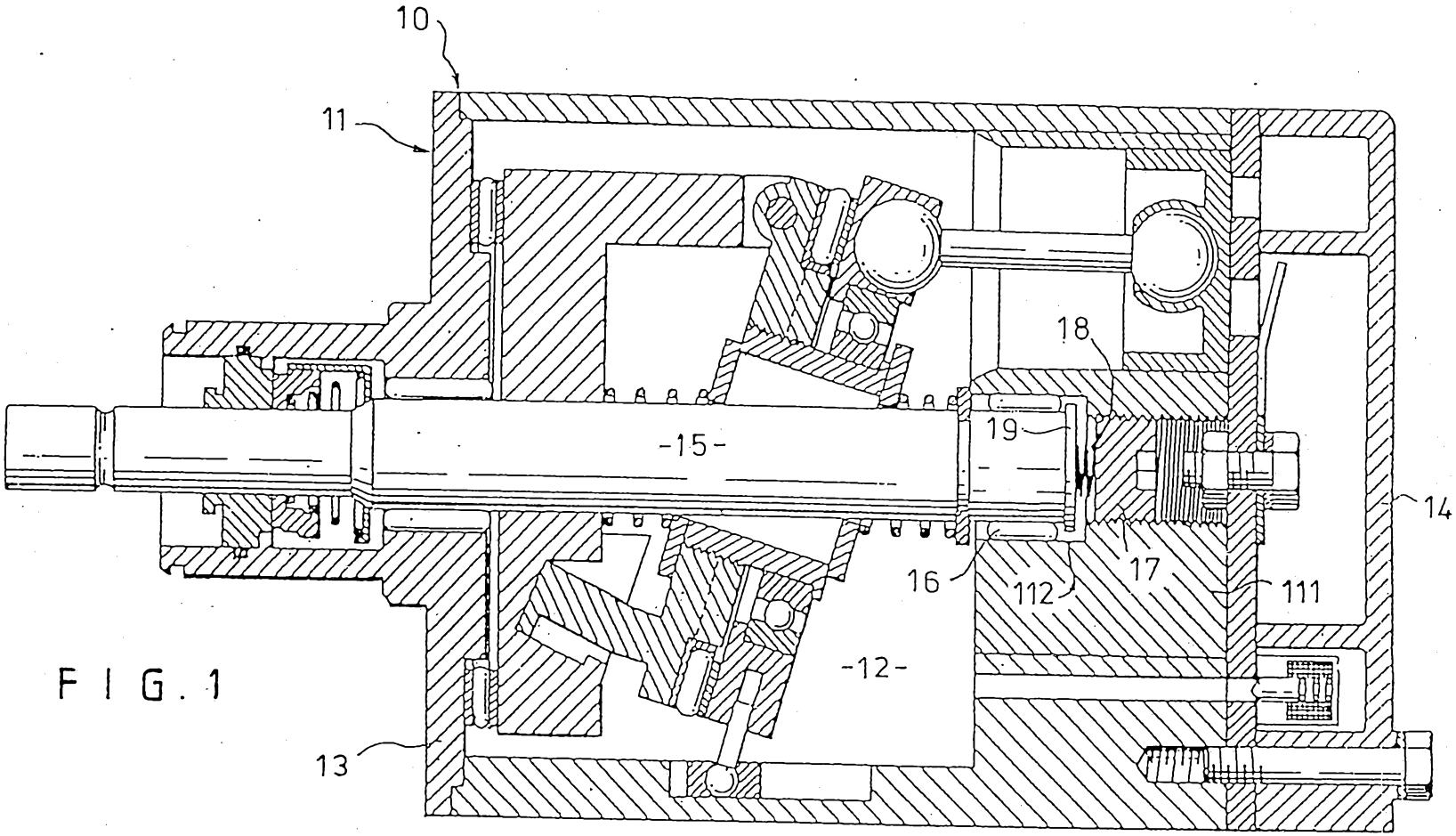
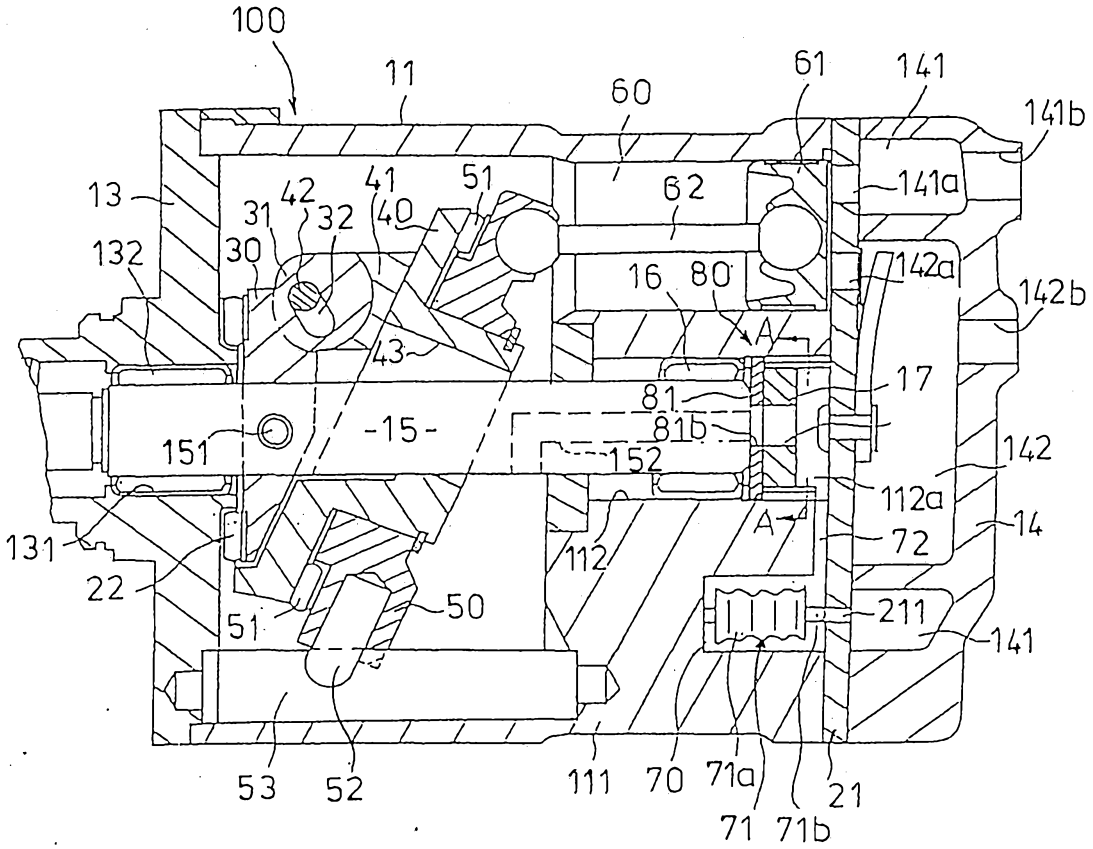
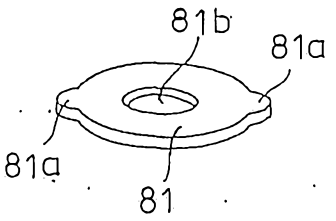


FIG. 1

FIG. 2





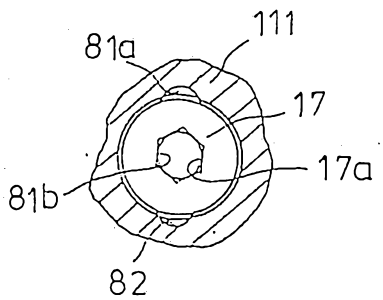


FIG. 3

FIG. 4

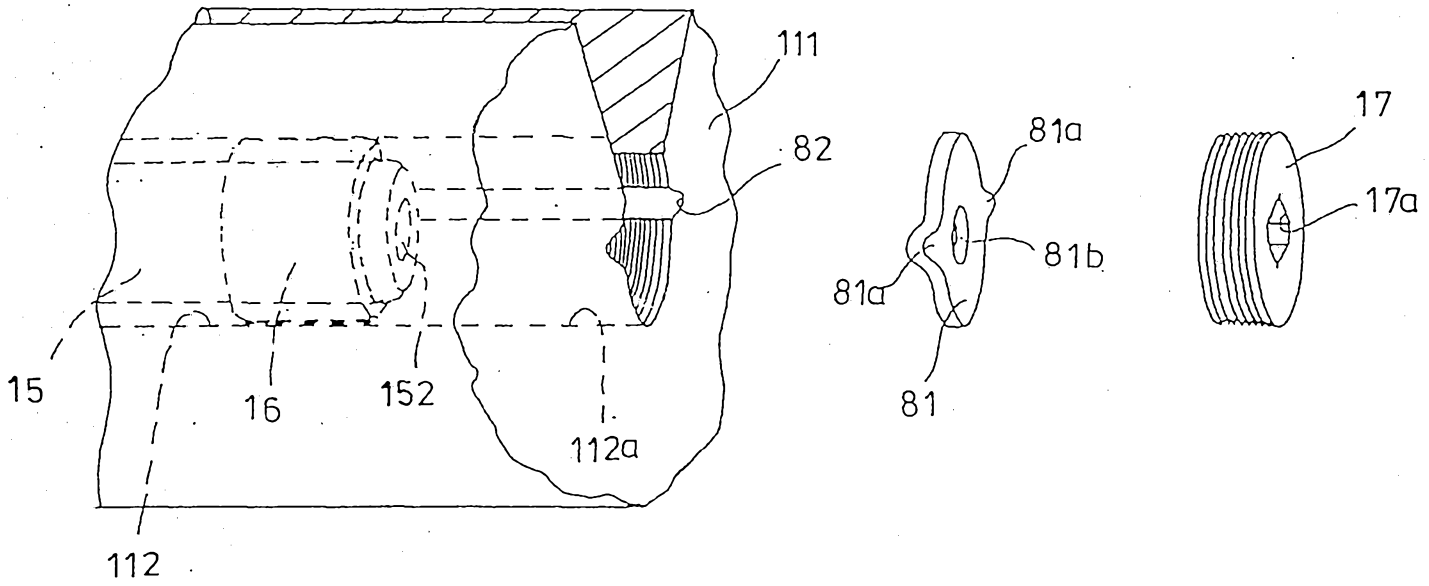


FIG. 5