FORM 1

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

OC 182

APPLICATION FOR A STANDARD PATENT

I\We,

SANDEN CORPORATION

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

2.10.90

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

ELECTROMAGNETIC CLUTCH WITH IMPACT ABSORBING CONNECTOR

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
U 152437/61	JP	06 OCT 86

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

DATED this 05th day of October 1987

SANDEN CORPORATION

TO: The Commissioner of Patents.

LODGED AT SUB-OFFICE
5 OCT 1987
Melbourne

PATENT OFFICE
40 CENTS
AUSTRALIA
FORTY DOLLARS
PATENT OFFICE
100
ONE HUNDRED DOLLARS

FEE STAMP TO VALUE OF
$ 140.00 ATTACHED
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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

ELECTROMAGNETIC CLUTCH WITH IMPACT ABSORBING CONNECTOR

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 6th October, 19 86
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 Hideyuki GONDA, 12-10 Ote-machi, Isesaki-shi, Gunma, 372 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, Gunma this 6th day of November, 1987

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-79352/87
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(54) Title
ELECTROMAGNETIC CLUTCH WITH IMPACT ABSORBING CONNECTOR

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(71) Applicant(s)
SANDEN CORPORATION

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(56) Prior Art Documents
AU 516262 39797/78 F16D 27/10
AU 509660 37359/78 F16D 27/10
AU 509262 32316/78 F16D 21/10

(57) Claim

1. In an electromagnetic clutch including a first rotatable member for connection to an external driving source, said first rotatable member being rotatably supported on a first bearing and having an axial magnetic end plate, a second rotatable member for connection to a driven member, an annular magnetic member connected to said second rotatable member through a plurality of leaf springs so as to be capable of axial movement and facing said axial end plate of said first rotatable member with an axial gap therebetween, a third rotatable member connected to said second rotatable member to limit the axial movement of said annular magnetic member, and electromagnetic means associated with said first rotatable member and said annular magnetic member for transmitting rotational force from said external driving source to the others of said rotatable members by attracting said annular magnetic member to said magnetic end plate, said leaf springs

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being arranged to absorb rotational force when said annular magnetic member is rotated with said first rotatable member, the improvement comprising connecting and absorbing means fixedly disposed between said annular magnetic member and said third rotatable member for connecting said annular magnetic member to said third rotatable member and for absorbing vibration and impact noise at the time of attraction in the axial direction of said annular magnetic member to the magnetic end plate of said first rotatable member.

AUSTRALIA

PATENTS ACT 1952

Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

505182

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Int. Cl:

Application Number:
Lodged:

Complete Specification-Lodged:
Accepted:
Lapsed:
Published:

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:
ELECTROMAGNETIC CLUTCH WITH IMPACT ABSORBING CONNECTOR

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

ELECTROMAGNETIC CLUTCH WITH IMPACT ABSORBING CONNECTOR

TECHNICAL FIELD

This invention relates to an electromagnetic clutch, such as for use in controlling the transmission of power from an automobile engine to a refrigerant compressor in an automotive air conditioning system, and more particularly, to an improved connecting structure between an armature plate and a stopper plate for reducing impact noise when the armature plate is attracted to a rotor.

BACKGROUND OF THE INVENTION

Generally, there are two types of well-known electromagnetic clutches with a structure to receive rotational and attractive force; one includes a plurality of leaf springs to receive the above forces and the other one includes a plurality of rubber members to receive the above forces.

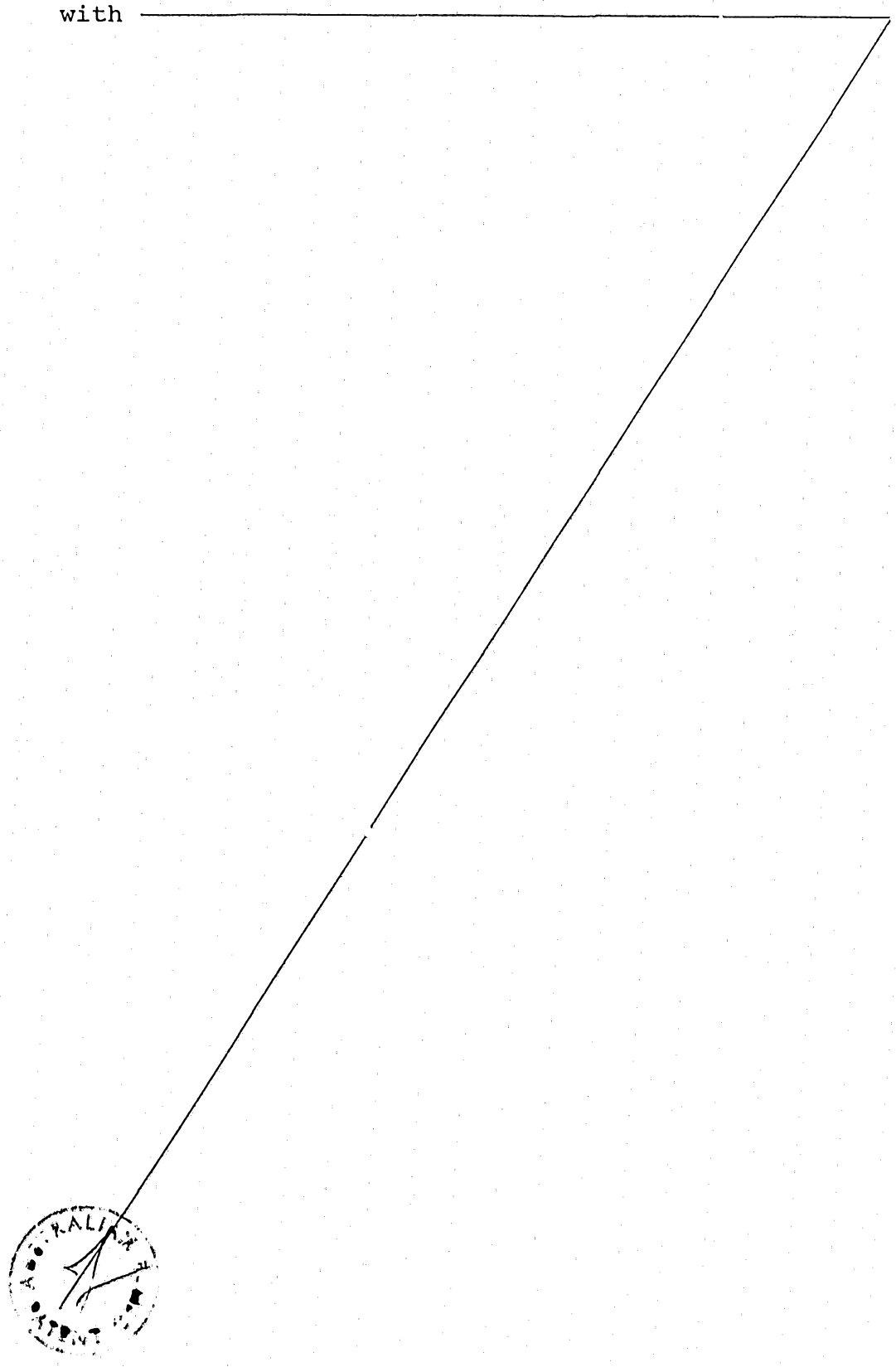
In one of the above electromagnetic clutches including the leaf springs, when the electromagnetic clutch is energized, an armature plate is attracted to one end surface of a rotor against recoil strength of the leaf springs. The smaller an axial air gap between the armature plate and the rotor is made, the higher an attractive force is required for attracting the armature plate to the rotor. Therefore, the attractive velocity of the armature plate to the rotor also increases as the distance between the armature plate and the rotor is reduced. That is, although the attractive velocity of the armature plate to the rotor is low at the early stage of attracting motion, as the axial air gap becomes smaller, the attractive force becomes more. The attractive velocity of the armature plate to the rotor is increased with increase of speed. Therefore, when the armature plate is attracted to the rotor, large impact noise and vibration is produced between the armature plate and the rotor.

On the other hand, in an electromagnetic clutch which uses rubber members, durability of the rubber members and keeping the rubber members attached becomes a problem because when the armature plate is attracted to the rotor, great impact force in rotational direction is applied to the rubber members.

STATEMENT OF INVENTION

According to the present invention there is provided in an electromagnetic clutch including a first rotatable member for connection to an external driving source, said first rotatable member being rotatably supported on a first bearing and having an axial magnetic end plate, a second rotatable member for connection to a driven member, an annular magnetic member connected to said second rotatable member through a plurality of leaf springs so as to be capable of axial movement and facing said axial end plate of said first rotatable member with an axial gap therebetween, a third rotatable member connected to said second rotatable member to limit the axial movement of said annular magnetic member, and electromagnetic means associated with said first rotatable member and said annular magnetic member for transmitting rotational force from said external driving source to the others of said rotatable members by attracting said annular magnetic member to said magnetic end plate, said leaf springs being arranged to absorb rotational force when said annular magnetic member is rotated with said first rotatable member, the improvement comprising connecting and absorbing means fixedly disposed between said annular magnetic member and said third rotatable member for connecting said annular magnetic member to said third rotatable member and for absorbing vibration and impact noise at the time of attraction in the axial direction of said annular magnetic member to the magnetic end plate of said first rotatable member.

Further features and other aspects of this invention will be understood from the following detailed description of preferred embodiments of this invention with



reference to the annexed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of an electromagnetic clutch with a connecting structure in accordance with one embodiment of this invention.

Fig. 2 is an enlarged cross-sectional view of a part of an electromagnetic clutch with a connecting structure shown in Fig. 1.

Fig. 3 is an enlarged cross-sectional view of a part of an electromagnetic clutch with a connecting structure modified in accordance with another embodiment of this invention.

Fig. 4 is an enlarged cross-sectional view of a part of an electromagnetic clutch with a connecting structure modified in accordance with a further embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figs. 1 and 2, the construction of an electromagnetic clutch with a connecting structure in accordance with one embodiment of this invention is shown. An electromagnetic clutch is mounted on the outer peripheral portion of annular extension 1 which projects from an end surface of compressor housing 2 and surrounds a drive shaft 3. Drive shaft 3 is rotatably supported in compressor housing 2 by a bearing (not shown). The electromagnetic clutch includes rotor 4 (a first rotatable member) which is rotatably mounted on the outer surface of annular extension 1 through a bearing 5 and driven by an automobile engine (not shown) through a belt (not shown). Rotor 4 includes an annular V-shaped groove 41 to receive the belt, a disc-shaped frictional surface 42 and a cylindrical portion 43 which is fixedly disposed on the outer surface of bearing 5.

An electromagnet 6 which includes an electromagnetic coil 61 is fixed on one end surface of

compressor housing 2 and is disposed within an annular hollow portion 44 which is surrounded by rotor 4 that defines with a surrounding air gap. A terminal end of drive shaft 3 extends from annular extension 1, and a hub 7 (second rotatable member) is fixed on the terminal end of drive shaft 3 by securing bolt 8. The axial end surface of a armature plate 9 is fixedly joined to hub 7 by a plurality of leaf springs 10, which are fixed on the outer end surface of armature plate 9 at one end by rivets 11 in such a fashion that the inner end surface of armature plate 10 faces frictional surface 42 of rotor 4 with an axial air gap therebetween. A stopper plate 12 (a third rotatable member) is coupled to hub 7 together with leaf springs 10 on the outer end surface of hub 7 so as to be able to limit the axial movement of armature plate 9 within a certain range.

A plurality of connecting devices 13 are disposed between armature plate 9 and stopper plate 12 to form a connection therebetween. Connecting device 13 includes a retaining member 131, a pin member 132 which is provided with projecting portion 132a, and a rubber member 133, which are all connected to one another, preferably by vulcanizing. Rubber member 133 is disposed between retaining member 131 and pin member 132, connecting device 13 formed by these three members is attached to stopper plate 12 by press fitting into an aperture 121, which is formed through stopper plate 12. Projecting portion 132a of pin member 132 is inserted into an aperture 91, which is formed through armature plate 9 and includes a narrow portion 91a and a wide portion 91b connected by a step portion 91c. The terminal end of projecting portion 132a is then caulked to form and enlarged tip which contacts step portion 91c to thereby secure pin 132 to armature plate 9.

When electromagnetic coil 61 is energized, magnetic flux as shown by a dotted arrow is produced around electromagnet 6. Armature plate 9, which is an annular magnetic member, is thus attracted to frictional surface 42, which is an axial magnetic end plate, of rotor 4 against the recoil strength of leaf springs 10. Rotational force from the

automobile engine is transmitted to armature plate 9 through rotor 4, and armature plate 9 is rotated with rotor 4. Rotational force between armature plate 9 and rotor 4 is absorbed by leaf springs 10.

Impact noise and vibration, which is conventionally produced at the time of attraction of armature plate 9 to frictional surface 42, is absorbed by connecting devices through their rubber members 133 and pin member 132 by deformation of rubber member 133. The absorption of the impact noise and vibration is accomplished by rubber members 133 of connecting devices 13, which deform in the axial direction only since rotation force are absorbed by the leaf springs. It has been found that this division of absorption functions enhances durability of the rubber members, while accomplishing both the function of reducing vibration and impact noise and absorbing rotational force.

With reference to Fig. 3, the construction of a part of an electromagnetic clutch with a connecting structure in accordance with another embodiment of this invention is shown. The structure of this electromagnetic clutch is the same as that shown in Fig. 1. Therefore, the same structure and the parts as that shown in Fig. 1 are accorded the same reference numerals and the description is omitted to simplify the explanation.

In this embodiment, retaining member 131 of connecting device 13 is fixed within aperture 121 of stopper plate 12 by welding or caulking at the location of reference numeral 14. Referring to Fig. 4, the construction of a part of an electromagnetic clutch with a connecting structure in accordance with a further embodiment of this invention is shown. The structure of this electromagnetic clutch is the same as that shown in Fig. 1. Therefore, the same structure and the parts as that shown in Fig. 1 are accorded the same reference numerals and the description is omitted to simplify the explanation.

In this embodiment, a screw thread 132b is formed on the outer surface of projecting portion 132a of pin member 132; and a screw thread 92a is formed on the inner surface of

aperture 92. Connecting device 13 is fixed on the outer end surface of armature plate 9 by screwing projecting portion 132a of pin member 132 into the threaded aperture 92 of armature plate 9.

This invention has been described in detail in connection with the preferred embodiment but these are examples only and the invention is not restricted thereto. It will be easily understood by those skilled in the art that other variations and modifications can be easily made within the scope of this invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. In an electromagnetic clutch including a first rotatable member for connection to an external driving source, said first rotatable member being rotatably supported on a first bearing and having an axial magnetic end plate, a second rotatable member for connection to a driven member, an annular magnetic member connected to said second rotatable member through a plurality of leaf springs so as to be capable of axial movement and facing said axial end plate of said first rotatable member with an axial gap therebetween, a third rotatable member connected to said second rotatable member to limit the axial movement of said annular magnetic member, and electromagnetic means associated with said first rotatable member and said annular magnetic member for transmitting rotational force from said external driving source to the others of said rotatable members by attracting said annular magnetic member to said magnetic end plate, said leaf springs being arranged to absorb rotational force when said annular magnetic member is rotated with said first rotatable member, the improvement comprising connecting and absorbing means fixedly disposed between said annular magnetic member and said third rotatable member for connecting said annular magnetic member to said third rotatable member and for absorbing vibration and impact noise at the time of attraction in the axial direction of said annular magnetic member to the magnetic end plate of said first rotatable member.

2. The improvement of claim 1 wherein one end of said connecting means is connected to said annular magnetic member and the other end of said connecting means is connected to said third rotatable member.

3. The improvement of claim 1 or 2 wherein said connecting means includes a deformable rubber member.

4. The improvement of claim 3 wherein said connecting means includes a pin member fixed to said annular magnetic member and said rubber member fixed to the outer surface of said pin member.

5. The improvement of claim 3 wherein said connecting means includes an annular retaining member fixed to said third rotatable member, a pin member disposed within said annular retaining member with a radial gap between said pin member and said annular magnetic member, and said rubber member having a first portion disposed in said radial gap and a second portion between an outer end surface of said annular magnetic member and an inner end surface of said third rotatable member.

6. The improvement of claim 5 wherein said annular retaining member has an annular lip overlaying the outer end surface of said third rotatable member.

7. The improvement of claim 6 wherein said annular lip is welded or caulked to said outer end surface of said third rotatable member.

8. The improvement of claim 5 wherein an aperture is formed in said annular magnetic member and said pin is fixed within said aperture.

9. The improvement of claim 8 wherein said aperture in said annular magnetic member has a narrow portion and a wide portion with a step portion therebetween, and said pin has an enlarged terminal end contacting said step portion to secure said pin in said aperture.

10. The improvement of claim 8 wherein said aperture has an internal threaded portion and said pin has an outer threaded portion for screwing into said threaded portion of said aperture.

11. An electromagnetic clutch substantially as herein before described with reference to the accompanying drawings.

DATED THIS 24th DAY OF September 1990

SANDEN CORPORATION
By Its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

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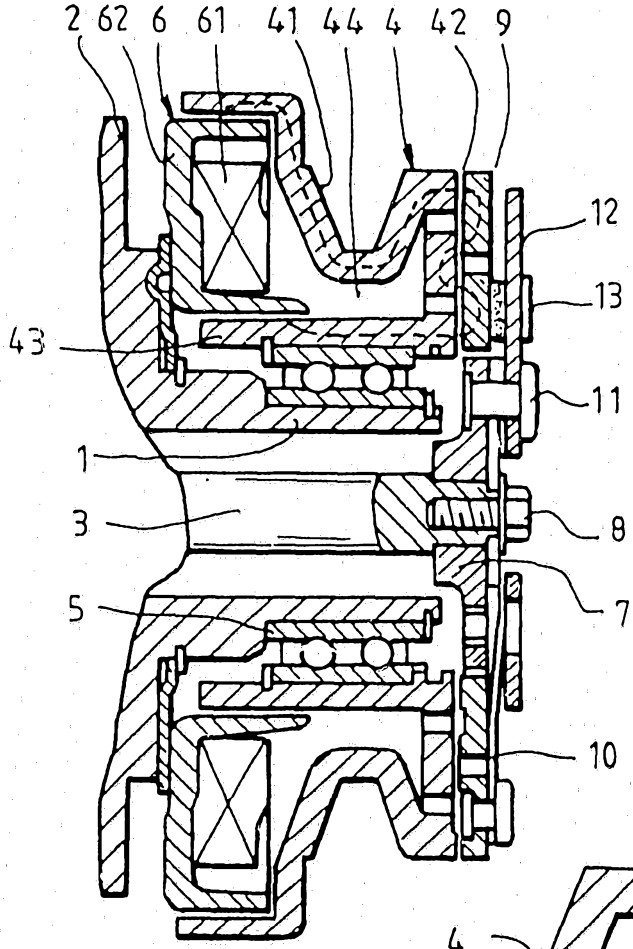
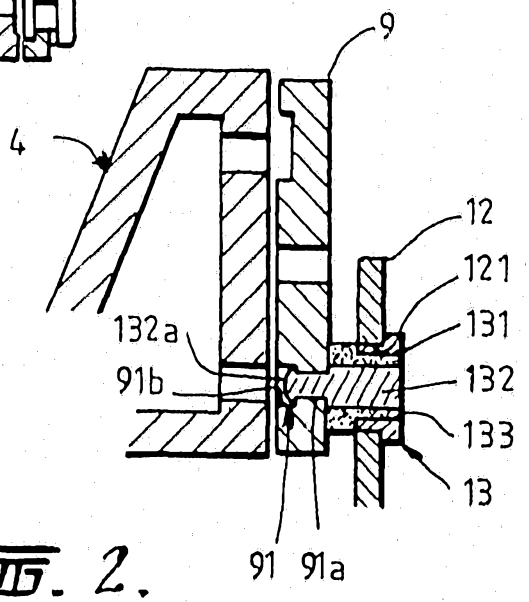


Фиг. 1.



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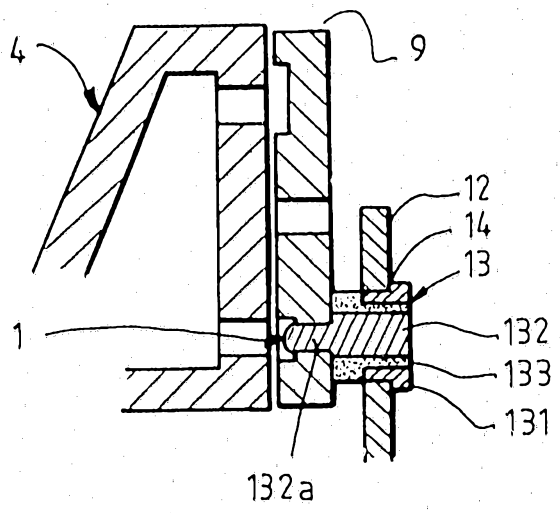
4
9
12
14
13
1
132
133
131
132a

Fig. 3.

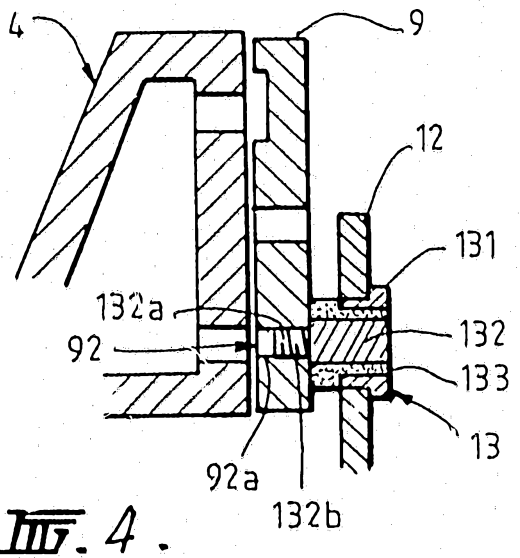
4
9
12
131
132a
92
132
133
13
92a
132b

Fig. 4.