



(51) International Patent Classification:
F16C 35/04 (2006.01)

(21) International Application Number:
PCT/BE2013/000056

(22) International Filing Date:
24 October 2013 (24.10.2013)

(25) Filing Language: Dutch

(26) Publication Language: English

(30) Priority Data:
61/718,837 26 October 2012 (26.10.2012) US
2013/0714 22 October 2013 (22.10.2013) BE

(71) Applicant: **ATLAS COPCO AIRPOWER** [BE/BE];
Naamioze Vennootschap, Boomssesteenweg 957, B-2610
Wilrijk (BE).

(72) Inventors: **ZWYSEN, Peter Karel Anna-Maria**; c/o AT-
LAS COPCO AIRPOWER, nv, Boomssesteenweg 957, B-
2610 WILRIJK (BE). **MARCELIS, Kristof Pieter Frans**;
c/o ATLAS COPCO AIRPOWER, nv, Boomssesteenweg
957, B-2610 WILRIJK (BE).

(74) Agent: **P.VAN VARENBERG - E, DONNE**; Bureau
M.F.J. BOCKSTAEL nv, Arenbergstraat 13, B- 2000 Ant-
werpen, Belgium (BE).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: BEARING SHIELD AND METHOD FOR MANUFACTURING A BEARING SHIELD

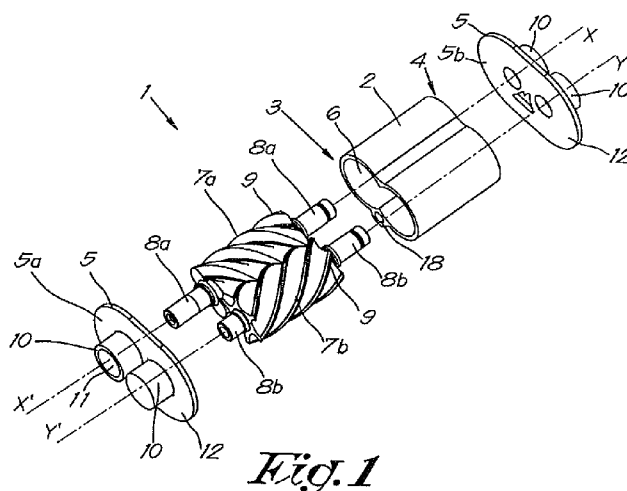


Fig. 1

(57) Abstract: Bearing shield for mounting a bearing (23) for the shaft (8a, 8b) of a rotor (7a, 7b) in the housing (2) of a compressor (1), expander, vacuum pump or the like, wherein the bearing shield (5) is made from a metal sheet (12) whereby a bearing seat (10) for the bearing (23) is formed by drawing and/or punching the metal sheet (12) and/or by welding a tube to the metal sheet (12).

Bearing shield and method for manufacturing a bearing shield.

The present invention relates to a bearing shield for mounting a bearing for the shaft of a rotor in the housing of a compressor, expander, vacuum pump or the like.

The housing of a compressor, expander or vacuum pump is usually equipped with an inlet bearing housing and an outlet bearing housing, in which the bearings are provided for bearing mounting the shaft of the rotor. Traditionally, these bearing housings are made out of cast iron or cast steel.

In most cases either the inlet bearing housing or the outlet bearing housing is integrated with the housing of the compressor, expander or vacuum pump in order to have less components that need to be cast.

Since the casting of a bearing housing is a difficult process that is not easy to adapt, a standard bearing housing is cast for several variants of a compressor instead of producing a specific and optimally adapted inlet and/or outlet bearing housing for each compressor variant.

Although this can reduce production costs and production time, this has the disadvantage that compromises need to be made and that the characteristics of the bearing housings are never optimal for the compressor or the like. This

reduces the efficiency of the compressor which deviates from the designed compromise.

It is therefore an objective of the invention to give a solution to one or more of the above-mentioned disadvantages.

Therefore the present invention has a bearing shield for mounting a bearing for the shaft of a rotor in the housing of a compressor, expander, vacuum pump or the like, whereby the bearing shield is made from a metal sheet whereby a bearing seat for the bearing is formed by drawing and/or punching the metal sheet and/or by welding a tube to the metal sheet.

An advantage is that a bearing shield according to the invention can be produced more easily and at a lower cost compared to a traditional cast iron bearing housing.

Another advantage is that the bearing shield can be easily adapted to meet the specific requirements of a compressor. Therefore each variant of a compressor can be equipped with an inlet and/or outlet bearing shield that is specifically optimized for that variant of the compressor, expander, vacuum pump or the like.

Another advantage is that such a bearing housing allows to integrate specific features of a compressor or the like.

For example, an air inlet port can be integrated into the bearing shield of a screw compressor. This will allow for

an axial air inlet instead of a radial air inlet.

This will allow for a simpler design of the housing of the screw compressor since there is no need to provide for a radial air inlet.

The present invention also relates to a bearing assembly, comprising a bearing shield according to the invention and at least one bearing mounted in the bearing seat with the same advantages as mentioned above.

The present invention further relates to a method for manufacturing a bearing shield according to the invention for mounting a bearing for the shaft of a rotor in the housing of a compressor, expander, vacuum pump or the like, whereby the method comprises the step of deforming a metal sheet into a bearing shield by means of drawing and/or punching the metal sheet and/or by welding a tube onto the metal sheet to form a bearing seat.

An advantage of such a method is that it will allow to produce a bearing shield at lower cost than the traditional bearing housings from cast iron or cast steel.

Moreover, such a method can be easily adapted to the specific characteristics or features needed for a compressor, expander, vacuum pump or the like.

The present invention further relates to a method for bearing mounting the shaft of a rotor in a housing of a compressor, expander, vacuum pump or the like with a

bearing, whereby this method comprises the following steps:

- mounting at least one bearing in a bearing shield according to the invention;
- mounting the bearing with the bearing shield on the housing;
- mounting the rotor in the housing with the shaft of the rotor supported in the bearing.

The present invention further relates to a compressor comprising a housing in which a rotor is bearing mounted, whereby the rotor is bearing mounted by means of a bearing shield according to the invention which is mounted on the housing.

Preferably, two separate bearing shields are used which are mounted on the housing.

This has the advantage that the housing of the compressor is simpler and more easy to manufacture, since there is no need to integrate a bearing housing into the housing of the compressor.

With the intention of better showing the characteristics of the invention, hereafter, as an example without any limitative character, some preferred forms of embodiments are described of a bearing shield and bearing assembly according to the invention, a method for manufacturing such a bearing shield, a method for bearing mounting the shaft of a rotor in the housing of a compressor, expander, vacuum pump or the like and a compressor comprising such a bearing shield, with reference to the accompanying drawings,

wherein:

figure 1 schematically represents an exploded view of a compressor with a compressor housing equipped with bearing shields according to the invention;

figure 2 schematically represents a top view of an embodiment of a bearing shield according to the invention;

figure 3 schematically represents a cross-sectional view of the bearing shield of figure 2;

figures 4 and 5 schematically represent a top view and a cross-sectional view of another embodiment of a bearing shield according to the invention;

figure 6 represents a variant of the bearing shield of figure 5;

figures 7 and 8 schematically represent another embodiment of a bearing shield according to the invention;

figure 9 schematically represents a variant of the bearing shield of figure 8;

figure 10 schematically represents a variant of the bearing shield of figure 4 or 7;

figures 11 and 12 schematically represent variants of a bearing shield according to the invention;

figure 13 schematically represents an embodiment of a bearing assembly according to the invention;

figure 14 schematically represents another embodiment of a bearing assembly according to the invention.

The compressor represented in figure 1 is a screw compressor 1 comprising a housing 2 with an inlet side 3

and an outlet side 4 and two bearings shields 5 namely a bearing shield 5a and a bearing shield 5b. The two bearing shields 5a, 5b define, together with the housing 2 a compressor chamber 6 in which two screw rotors 7a, 7b are bearing mounted with their shafts 8a, 8b.

The rotors 7a, 7b have helical lobes 9 that cooperatively engage in one another and define with the housing 2 and the two bearing shields 5 a gas chamber that will move from the inlet side 3 to the outlet side 4 when the rotors 7a, 7b rotate around an axis X-X', Y-Y' respectively parallel to their shaft 8a, 8b, thereby reducing in size and compressing the gas trapped in it.

One of the two bearings shields 5, the inlet bearing shield 5a, is provided on the inlet side 3 of the housing 2, the other, outlet bearings shield 5b is provided on the outlet side 4 of the housing 2.

Each bearing shield 5 comprises a bearing seat 10 which is intended to mount a bearing in. In this case, two such bearing seats 10 are provided in each bearing shield 5 and in each bearing seat 10 a bearing is mounted which are not visible in figure 1.

The inlet bearing shield 5a is provided with a bearing seat 10 with an open bottom 11.

The shafts 8a, 8b of the rotors 7a, 7b are mounted in the bearings and the bearing shields 5 are attached to the housing 2 of the compressor 1.

The shaft 8a of the male rotor 7a on the inlet side 3 is provided in the bearing seat 10 with the open bottom 11 to allow for the shaft 8a to be connected to a motor or the like for driving the rotors 7a, 7b.

The bearing shield 5 according to the invention is made from a metal sheet 12, with a thickness of for example three or four millimeters.

This has the advantage that a metal sheet 12 can be easily processed to manufacture a bearing shield 5.

According to the invention a metal sheet 12 is deformed by drawing and/or punching the metal sheet 12 to form the bearing seats 10.

According to the invention, it is also possible to make a bearing seat 10 by attaching one or more standard tubes to a metal sheet 12 or plate by welding. Preferably by laser welding which has the advantage that it requires a lower heat input which would result in a better control of the desired shape. Laser cutting can be used to provide the necessary openings for the bearing seats 10 in the metal sheet 12.

Besides the bearing seat 10, the bearing shield 5 can be provided with other features depending on the application.

In the following, some possible features will be discussed in more detail and some possible other embodiments of the

bearings shield 5 represented in figure 1 will be discussed.

The bearings shield 5 shown in figures 2 and 3 is similar to the bearing shield 5 of figure 1, but it is further provided with centering means 13.

In this case these centering means 13 are in the form of two dowel holes 14. It is clear that any number of dowel holes 14 are possible.

By providing these dowel holes 14 on the appropriate locations they will allow to perfectly align the bearing shield 5 with respect to the housing 2 by using dowel pins.

Instead of dowel holes 14, it is also possible to provide a centering edge.

The centering means 13 can be provided during the manufacturing of the bearing shield 5; for example the dowel holes 14 can be provided by punching and/or laser cutting.

In figures 4, 5 and 6 other preferred embodiments are shown which will allow the bearing shield 5 to be aligned with the housing 2 if the housing 2 by its construction does not allow to use dowel pins.

In these embodiments the metal sheet 12 of plate is bend into a shape 15 that fits the inner or outer contour of the housing 2, more specifically the inner or outer contour on

the inlet side 3 or outlet side 4 of the housing 2 where the bearing shield 5 will be mounted on.

Bending the metal sheet 12 into a shape 15 that fits the outer contour, as shown in figures 4 and 5, has the advantage that the shape 15 is easier.

However, in the case of machined rotor bores, the inner contour has the advantage that the rotor bores are already machined and thus very accurate, allowing for a very accurate alignment of the bearings shield 5 with respect to the housing 2. Figure 6 shows a bearing shield 5 which is formed into a shape 15 that fits the inner contour.

Figure 7 shows a bearing shield 5 which is provided with a specific compressor feature, in this case a horizontal oil channel 16a which is oriented in the plane of the metal sheet 12.

The oil channel 16 can be realized for example by an elongated indentation 16 which will form the oil channel 16 with an adjacent piece 17 or element of the compressor 1.

This is shown in figure 8, where the adjacent piece 17 is an extra metal sheet 12 which can in this case be placed between the housing 2 and the bearing shield 5.

The elongated indentation 16 can be formed by drawing and/or punching during the manufacturing of the bearing shield 5.

The oil channel 16 can be used to connect two oil channels which arrive at the bearing shield 5.

It is also possible to provide an oil channel which is perpendicular to the plane of the metal sheet 12, for example by welding a tube to the metal sheet 12. It is also possible to integrate this tube 18 in the housing 2, as shown in figure 9.

In this figure, a bearing shield is shown which is provided with a vertical oil channel 16b which is oriented in the plane of the metal sheet 12.

By combining this vertical oil channel 16b which is realized by an elongated indentation 16b and the tube 18 perpendicular to the plane of the metal sheet 12, a cornered oil channel 16b, 18 can be realized.

In this case, two metal sheets 12 are combined. This second metal sheet 12 can be used as the adjacent piece 17 to form a vertical oil channel 16 in combination with the elongated indentation 16.

Besides one or more oil channels 16, it is also possible to provide further specific compressor functions, as shown in figures 10 to 12.

Figure 10 shows a bearing shield 5, more specifically an inlet bearing shield 5a, provided with several openings 19 around both bearings seats 10, which together form an air inlet port 20.

The air inlet port 20 is in this case a sickle shape. This has the advantage that an axial air inlet can be provided instead of a radial air inlet.

The openings 19 can be realized by for example punching and/or laser cutting.

Figures 11 and 12 both show a bearing shield 5, more specifically an outlet bearing shield 5b, provided with an air outlet port 21, which can be realized by punching and/or laser cutting during the manufacturing of the bearing shield 5.

The shape of the air outlet port 21 will determine at which stage or position of the rotors 7a, 7b the air in the gas chamber can leave the compression chamber 6 at the outlet side 4.

By punching or laser cutting the air outlet port 21, the possibility arises to use different shapes for different outlet bearing shields 5b in order to get different internal pressure ratios for different compressor variants.

It is also possible to provide for one or more reinforcement ribs, which can be provided for, for example by drawing and/or punching local indentations, during the manufacturing of the bearing shield 5.

In figure 13, a bearing assembly 22 according to the invention is shown, where this bearing assembly 22

comprises a bearing shield 5 according to the inlet bearing shield 5a of figure 1.

According to the invention, bearings 23 are mounted in the bearing seats 10 of the bearing shield 5.

Preferably the bearings 23 are press-fitted into the bearing seats 10.

In this case, a lip seal 24 is provided in the bearing seat 10 with the open bottom 11. For this reason, this bearing seat 10 is made deeper in order to accommodate the lip seal 24.

This lip seal 24 will seal off the shaft 8a of the male rotor 7a which extends through the open bottom 11 of the respective bearing seat 10 in order to prevent gas or lubricant from escaping through the open bottom 11.

In figure 14, another bearing assembly 22 is shown, comprising the outlet bearing shield 5b of figure 1. In this case, there is no lip seal 24, but the bearing assembly 22 is provided with blocking means 25 to prevent the bearings 23 from loosening from the bearing seats 10.

The blocking means 25 are in this case in the form of two clamping bushes 25 which are provided after the bearings 23 are mounted.

The clamping bushes 25 also provide for a sealing function, because they will prevent that compressed gas can escape

via the bearing seats 10 and the rotor shafts 8a, 8b at the outlet side 4 of the housing 2.

Bearing mounting a shaft 8a, 8b of a rotor 7a, 7b or the like in a housing 2 of a compressor 1 or the like by using an inlet bearing shield 5a and outlet bearing shield 5b according to the invention is easy and as follows.

In a first step, the bearings 23 are mounted in the bearing seats 10 of a bearing shield 5. The number of bearing seats 10 and the number of bearings 23 depends on the application.

Preferably, during this step, the bearings 23 are press-fitted into the bearing seats 10.

If required, before the step of mounting the bearing 23 in the bearing seat 10, one or more lip seals 24 can be provided in the bearing seat 10.

In a next step, in the case of the outlet bearing shield 5b, one or more clamping bushes 25 or other blocking means 25 to prevent the bearings 23 from loosening from the bearing seats 10 can be provided.

As explained above, it is possible that these clamping bushes 25 have a sealing function.

Then both bearing assemblies 22, consisting of the bearing shield 5, the bearings 23, the lip seals 24 and/or the clamping bushes 25 can be mounted on the housing 2 in the known way.

For example, the outlet bearing assembly 22 can be mounted first on the outlet side 4 of the housing 2.

In order to align the bearing assembly 22 with respect to the housing 2, use can be made of the dowel holes 14 and/or a centering edge when they are provided for in the bearing shield 5.

The rotor 7a, 7b can be mounted into the housing 2, and one of its shafts 8a, 8b can be supported in the bearings 23. The clamping bushes 25 will allow for a sealing function to seal off around the shaft 8a, 8b meaning that they will function as a shaft sealing device.

Subsequently, the inlet bearing shield 5a can be mounted such that the other rotor shaft 8a, 8b is also mounted in the bearings 23 of the inlet bearing shield 5a. In this case the lip seals 24 will provide the necessary sealing around the shaft 8a, 8b.

Although in all the embodiments discussed above, the bearing shields 5 are provided with two bearing seats 10, it is clear that only one bearing seat 10 or more than two bearing seats 10 are within the scope of the invention.

It is clear that the invention is not limited to screw compressors 1, but also other types of compressors, expanders or vacuum pump are within the scope of the invention.

The present invention is in no way limited to the form of embodiment described by way of an example and represented in the figures, however, such a bearing shield 5 and bearing assembly 22 according to the invention, a method for manufacturing such a bearing shield 5, a method for bearing mounting the shaft 8a, 8b of a rotor 7a, 7b in the housing 2 of a compressor 1, expander, vacuum pump or the like and a compressor 1 comprising such a bearing shield 5 can be realized in various variants without leaving the scope of the invention.

Claims.

1.- Bearing shield for mounting a bearing (23) for the shaft (8a, 8b) of a rotor (7a, 7b) in the housing (2) of a compressor (1), expander, vacuum pump or the like, characterized in that the bearing shield (5) is made from a metal sheet (12) whereby a bearing seat (10) for the bearing (23) is formed by drawing and/or punching the metal sheet (12) and/or by welding a tube to the metal sheet (12).

2.- Bearing shield according to any one of the preceding claims, characterized in that it is provided with centering means (13).

3.- Bearing shield according to claim 2, characterized in that the centering means (13) comprise one or more dowel holes (14) and/or one or more centering edges.

4.- Bearing shield according to any one of the preceding claims, characterized in that the metal sheet (12) is bended in a shape (15) that fits an inner and/or outer contour of the housing (2).

5.- Bearing shield according to any one of the preceding claims, characterized in that it is provided with one or more air inlet ports (20) and/or one or more air outlet ports (21).

6.- Bearing shield according to any one of the preceding

claims, characterized in that it is provided with one or more oil channels (16a, 16b).

7.- Bearing shield according to claim 5 or 6, characterized in that the air inlet port (20) and/or the air outlet port (21) and/or the oil channel (16a, 16b) are realized by means of drawing and/or punching and/or laser cutting.

8.- Bearing shield according to any one of the previous claims characterized in that it is provided with one or more reinforcement ribs.

9.- Bearing assembly, comprising a bearing shield according to any one of the preceding claims and at least one bearing (23) mounted in the bearing seat (10).

10.- Bearing assembly according to claim 9, characterized in that the bearing (23) is press-fitted into the bearing shield (5).

11.- Bearing assembly according to claim 9 or 10, characterized in that it comprises at least one lip seal (24) for sealing of the shaft (8a, 8b).

12.- Bearing assembly according to any one of the preceding claims 9 to 11, characterized in that it is provided with blocking means (25) to prevent the bearing (23) from loosening from the bearing seat (10).

13.- Bearing assembly according to claim 12, characterized in that the blocking means (25) comprise at least one

clamping bush (25).

14.- Bearing assembly according to claim 13, characterized in that this clamping bush (25) also provides a sealing function.

15.- Method for manufacturing a bearing shield (5) for mounting a bearing (23) for the shaft (8a, 8b) of a rotor (7a, 7b) in the housing (2) of a compressor (1), expander, vacuum pump or the like, characterized in that it comprises the step of deforming a metal sheet (12) into a bearing shield (5) by means of drawing and/or punching the metal sheet and/or by welding a tube onto the metal sheet to form a bearing seat (10).

16.- Method according to claim 14, characterized in that it comprises the step of providing centering means (13) on the bearing shield.

17.- Method according to claim 15 or 16, characterized in that it comprises the step of bending the metal sheet (12) in a shape (15) that fits an inner or outer contour of the housing (2).

18.- Method according to any one of the preceding claims 15 to 17, characterized in that it comprises the step of realizing openings (19) or indentations in the metal sheet (12) for realizing one or more air inlet ports (20) and/or one or more air outlet ports (21) and/or one or more oil channels (16a, 16b) by drawing and/or punching and/or laser cutting the metal sheet (12).

19.- Method according to any one of the previous claims 15 to 18, characterized in that it comprises the step of providing one or more reinforcement ribs on the metal sheet (12) by local indentations formed by drawing and/or punching.

20.- Method for bearing mounting a shaft (8a, 8b) of a rotor (7a, 7b) in a housing (2) of a compressor (1), expander, vacuum pump or the like by means of a bearing (23), characterized in that it comprises the following steps:

- mounting at least one bearing (23) in a bearing shield (5) according to any one of the preceding claims 1 to 8;
- mounting the bearing (23) with the bearing shield (5) on the housing (1);
- mounting the rotor (7a, 7b) in the housing (1) with the shaft (8a, 8b) of the rotor (7a, 7b) supported in the bearing (23).

21.- Method according to claim 20, characterized in that during the step of mounting the bearing (23) in the bearing shield (5), the bearing (23) is press-fitted into a bearing seat (10) of the bearing shield (5).

22.- Method according to claim 20 or 21, characterized in that, before mounting the bearing (23) in the bearing shield (5), it comprises the step of providing at least one lip seal (24) in the bearing seat (10) for sealing the shaft (8a, 8b).

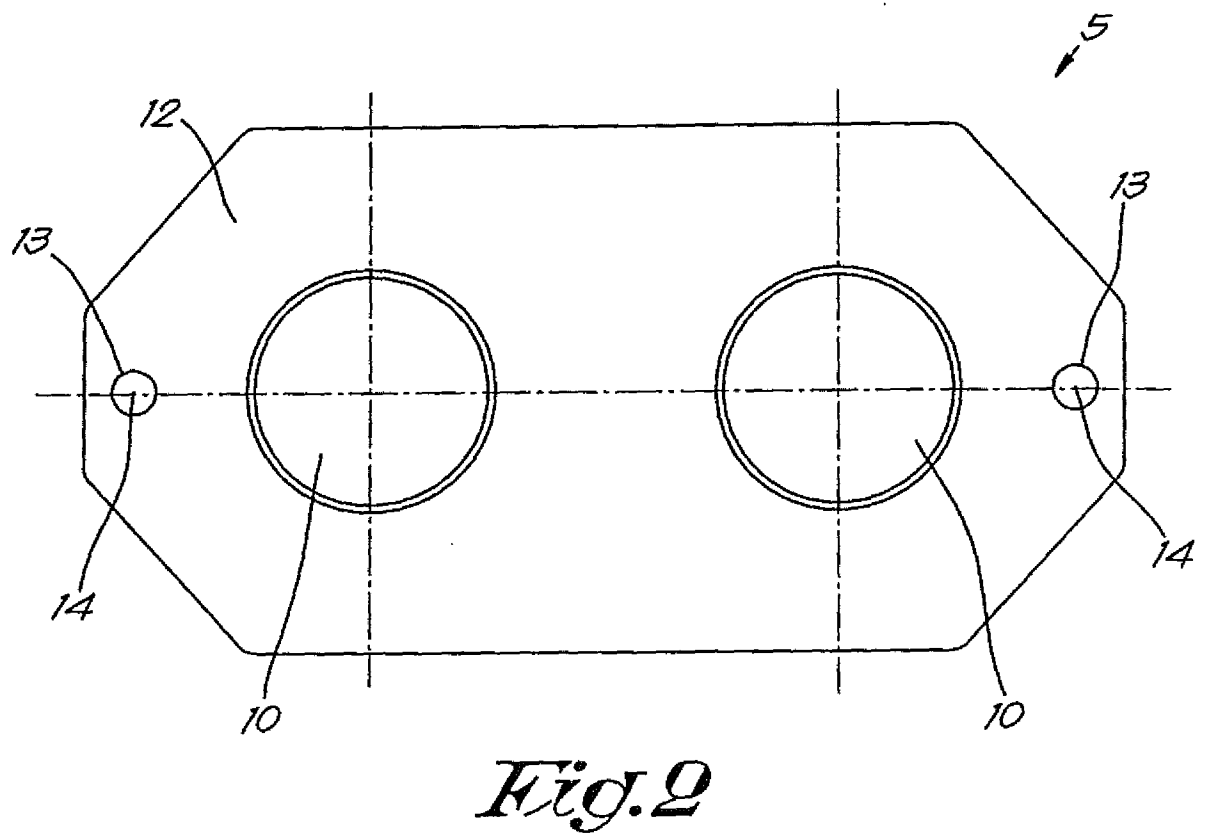
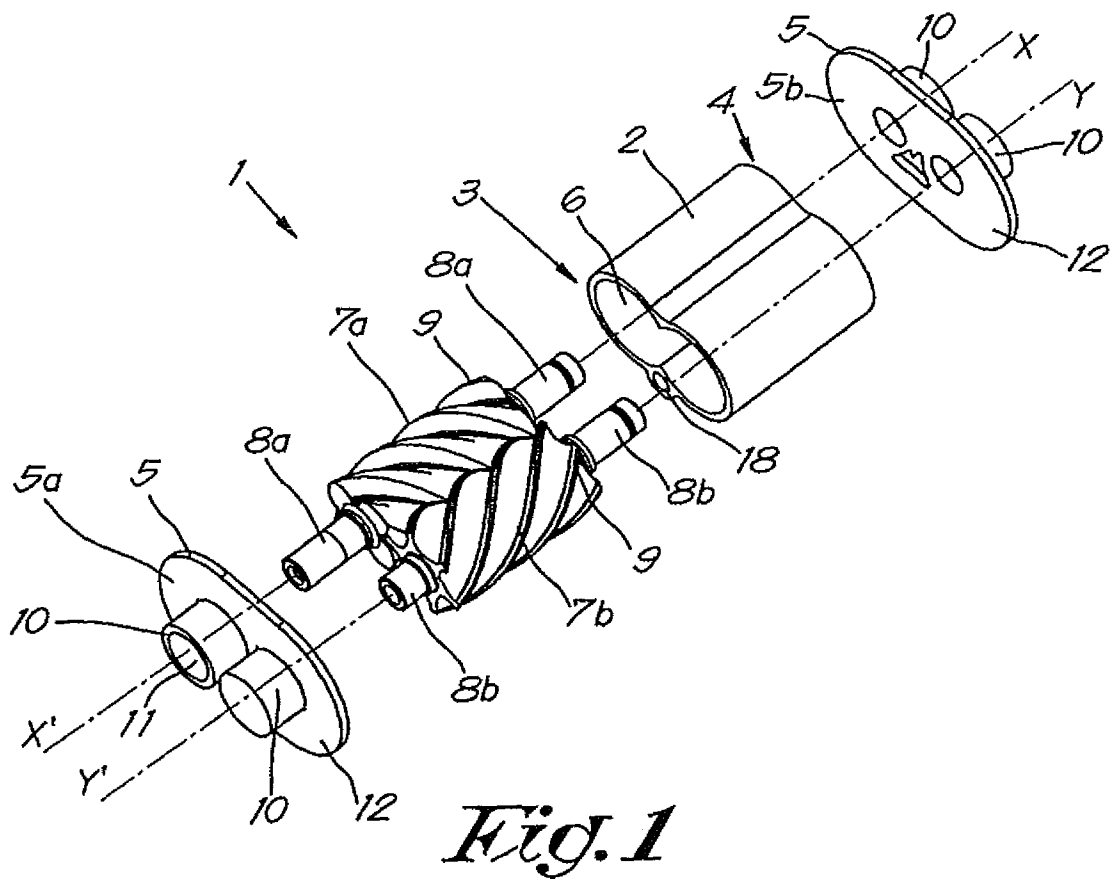
23.- Method according to any one of the preceding claims 20 to 22, characterized in that, after mounting the bearing (23) in a bearing shield (5), it comprises the step of providing blocking means (25) which prevent the bearing (23) from loosening from the bearing seat (10).

24.- Method according to any of the preceding claims 20 to 23, characterized in that it further comprises the step of bearing mounting the other shaft (8a, 8b) of the rotor (7a, 7b) by mounting a second bearing shield (5) according to claims 1 to 10 on the housing (2) whereby this other shaft (8a, 8b) is placed in the bearing (23) of the second bearing shield (5).

25.- Device comprising a housing (2) in which a rotor (7a, 7b) is bearing mounted, characterized in that the rotor (7a, 7b) is bearing mounted by means of a bearing shield (5) according to any of the previous claims 1 to 8 which is mounted in the housing (2).

26.- Device according to claim 25, characterized in that the rotor (7a, 7b) is bearing mounted by means of two separate bearing shields (5a, 5b) which are mounted on the housing (2).

27.- Device according to claim 25 or 26, characterized in that the device comprises a compressor, an expander and/or a vacuum pump.



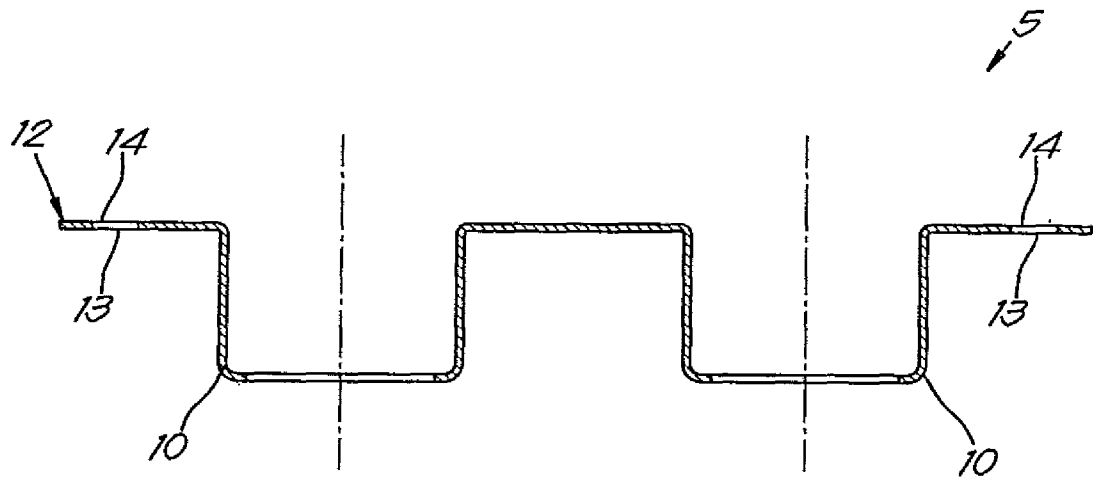


Fig. 3

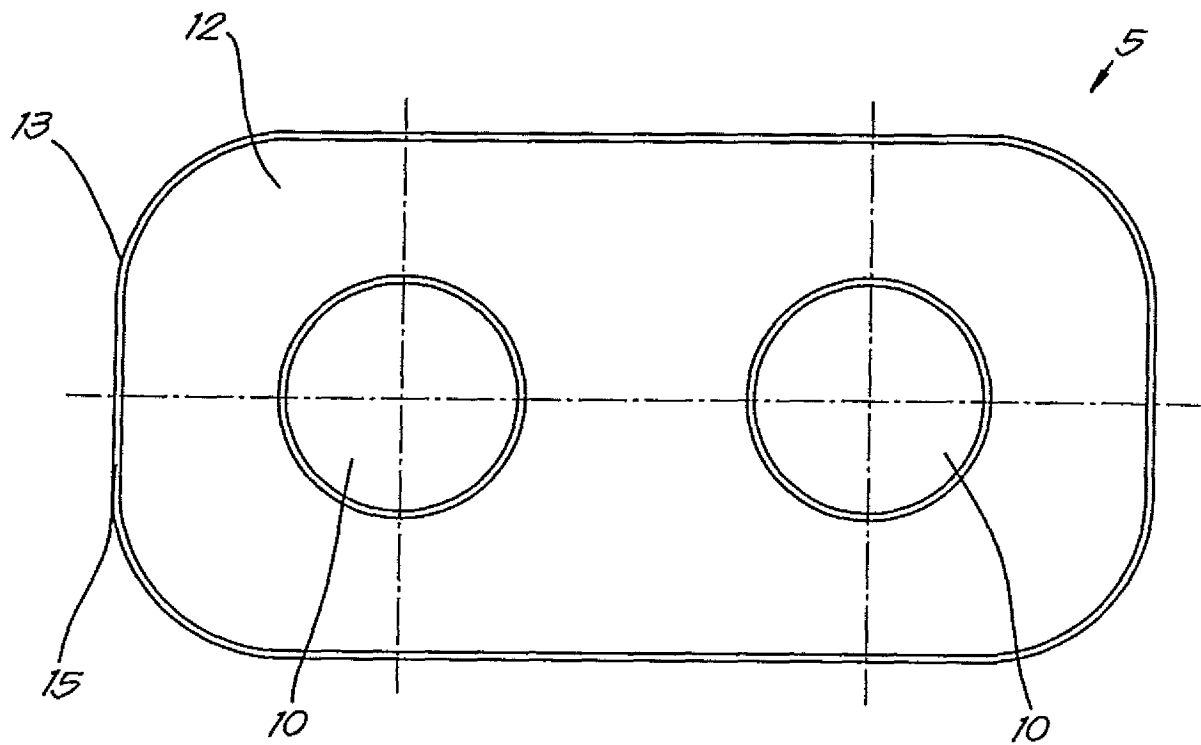


Fig. 4

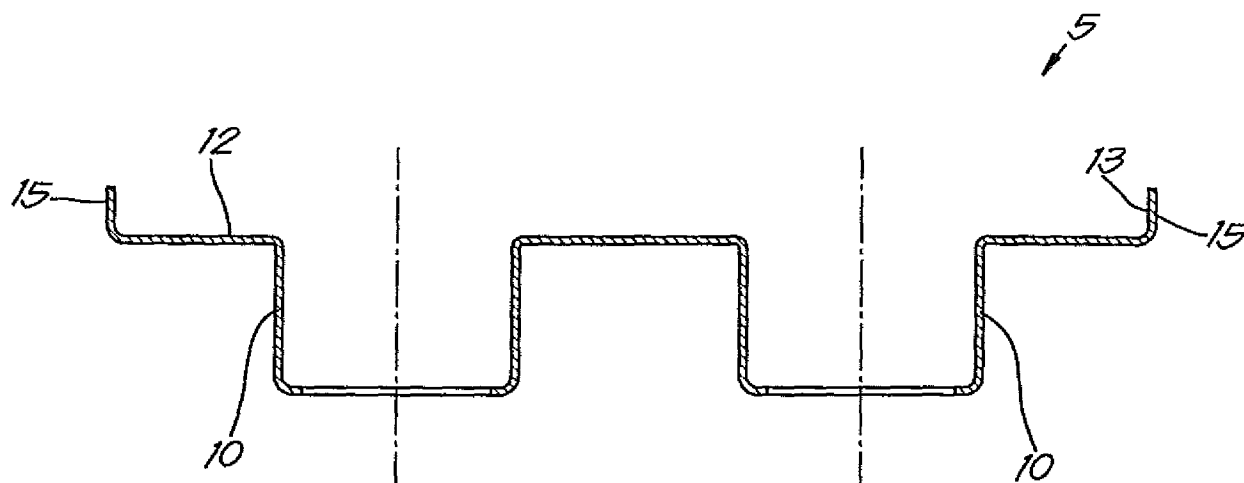


Fig.5

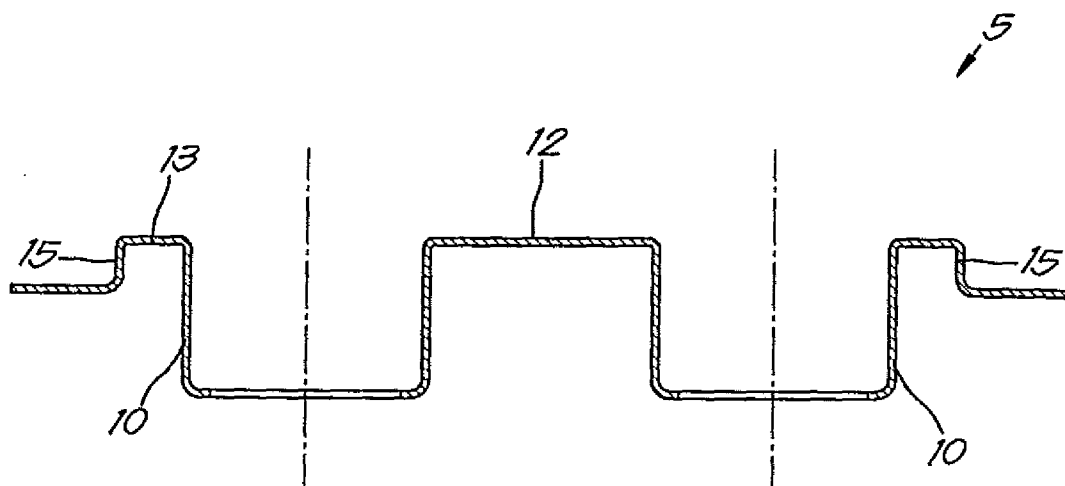
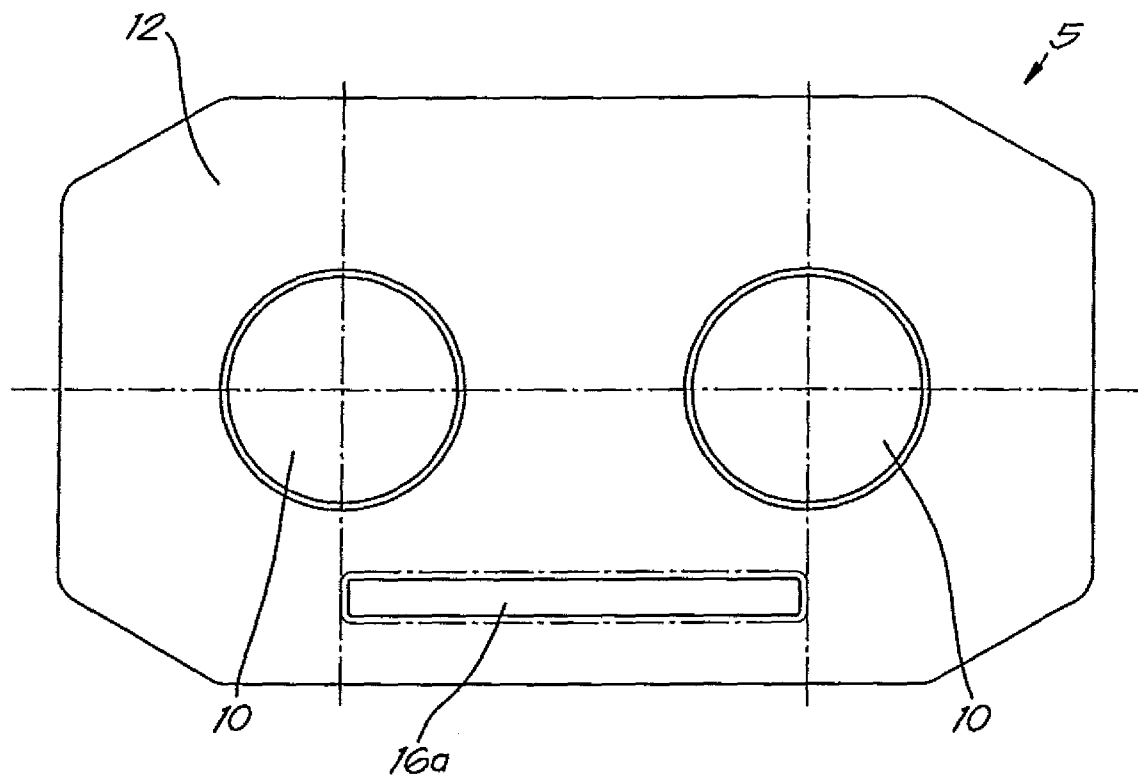
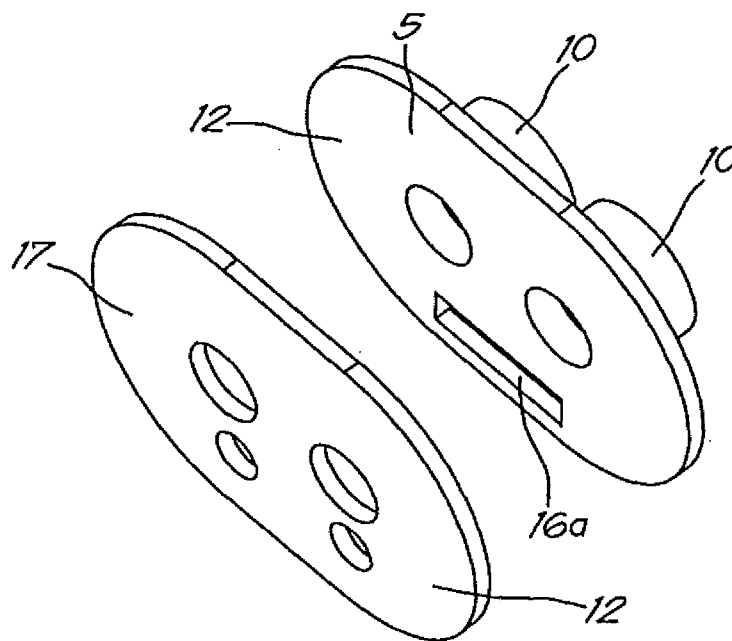
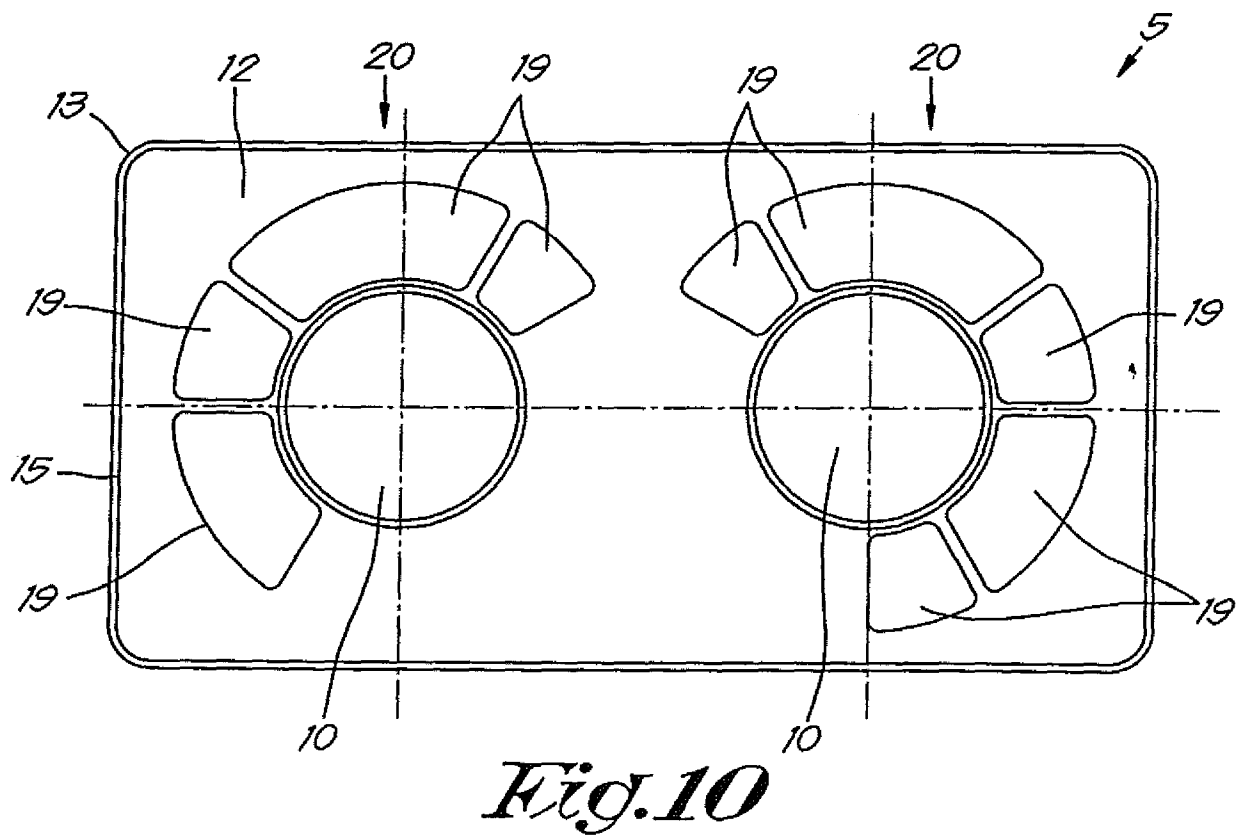
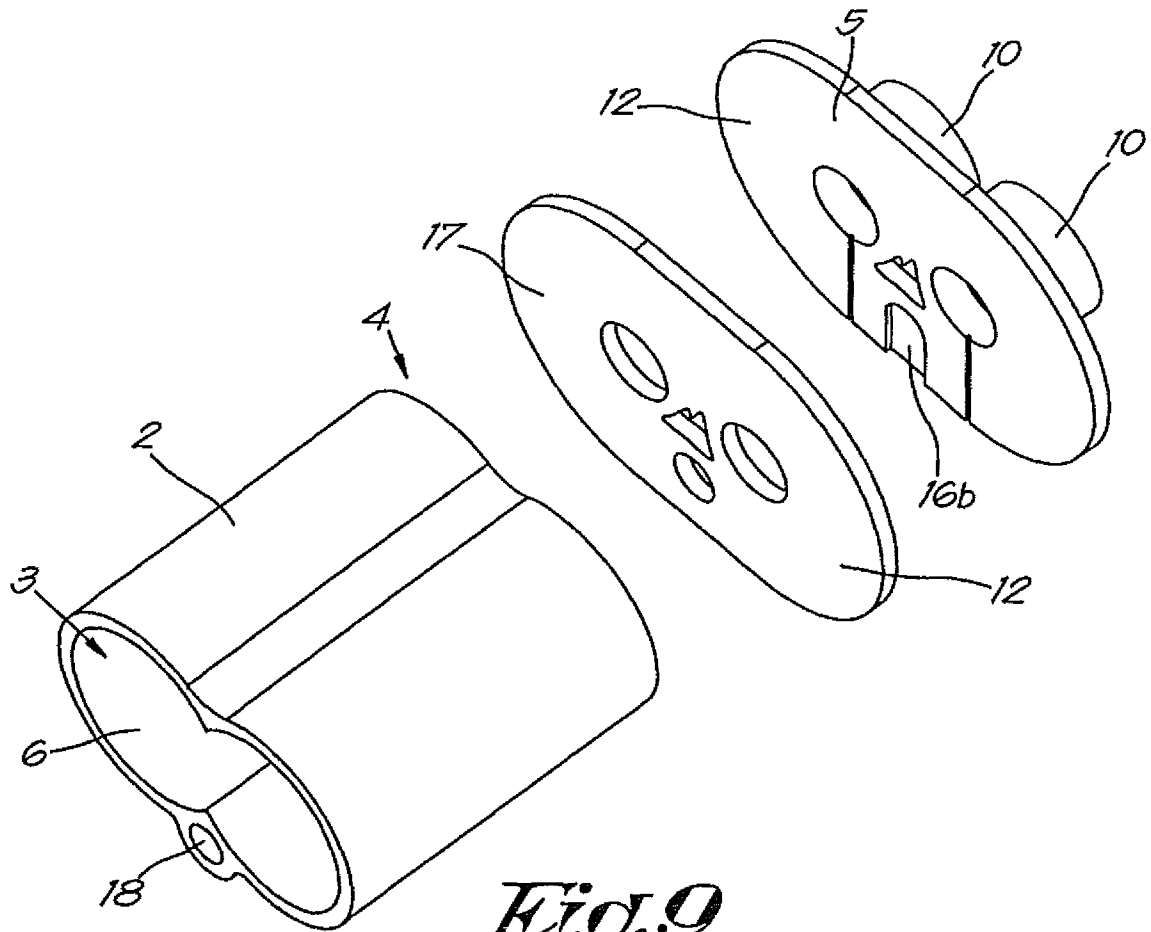


Fig.6

*Fig. 7**Fig. 8*

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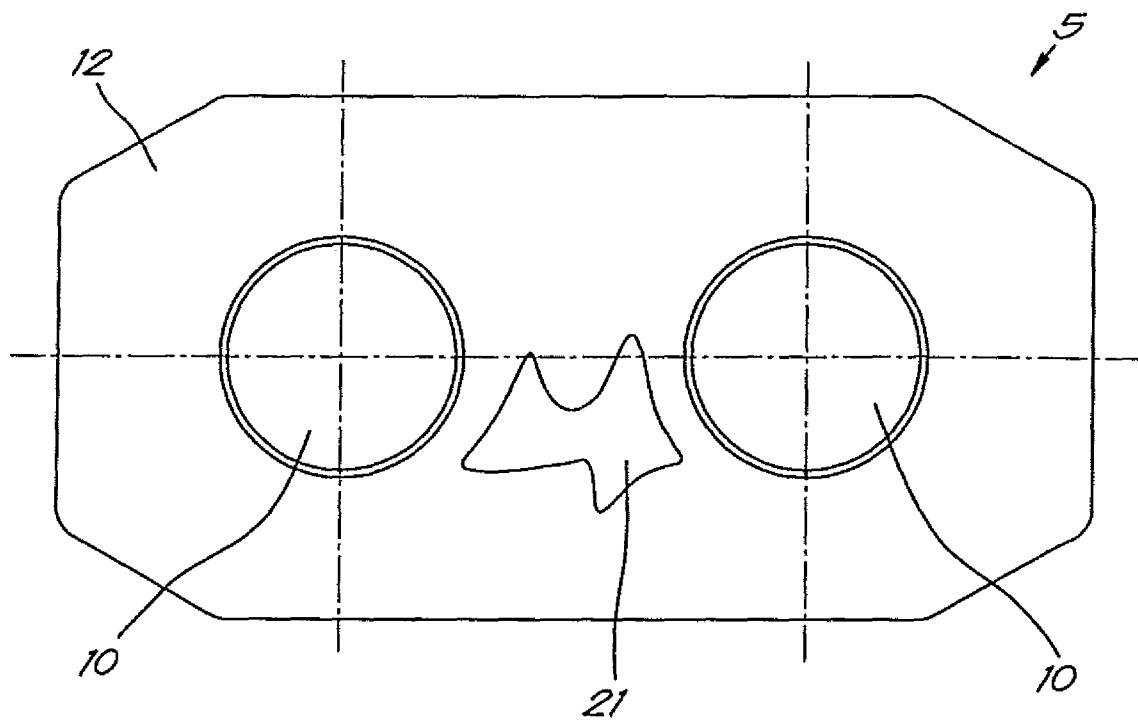


Fig. 11

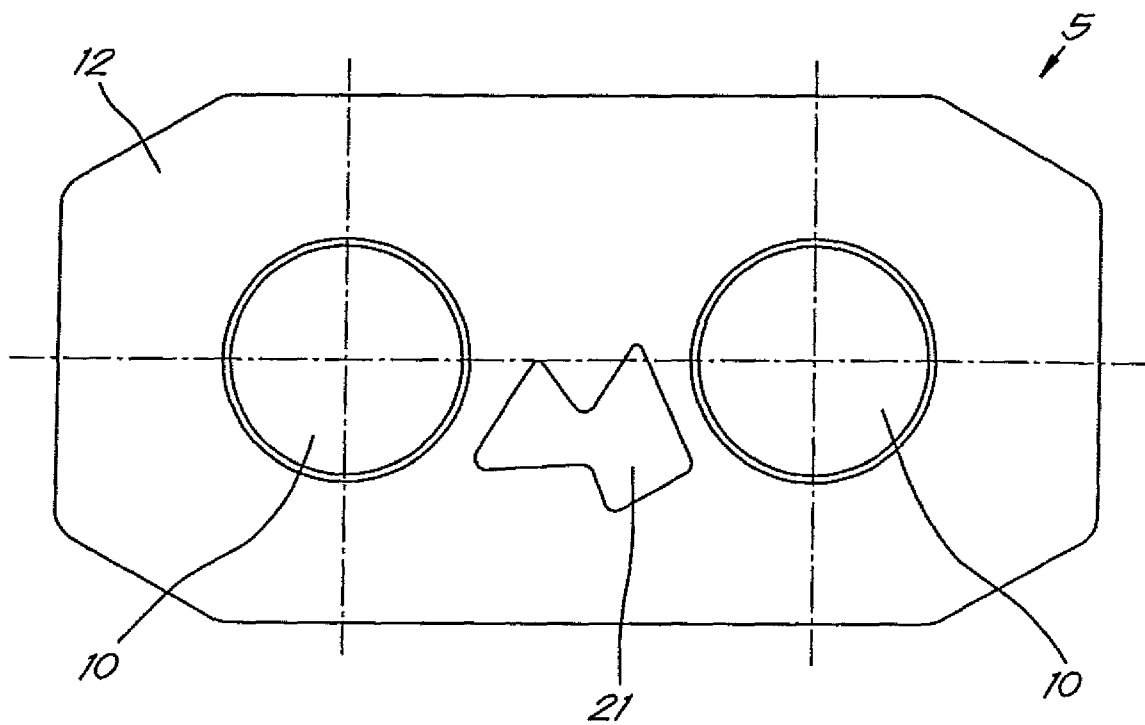
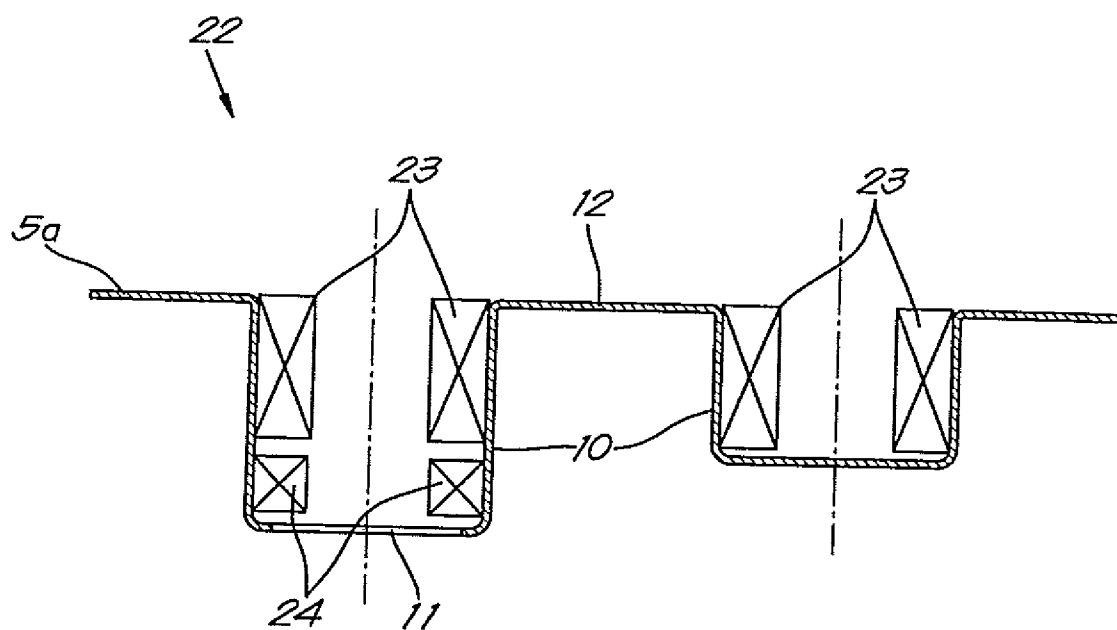
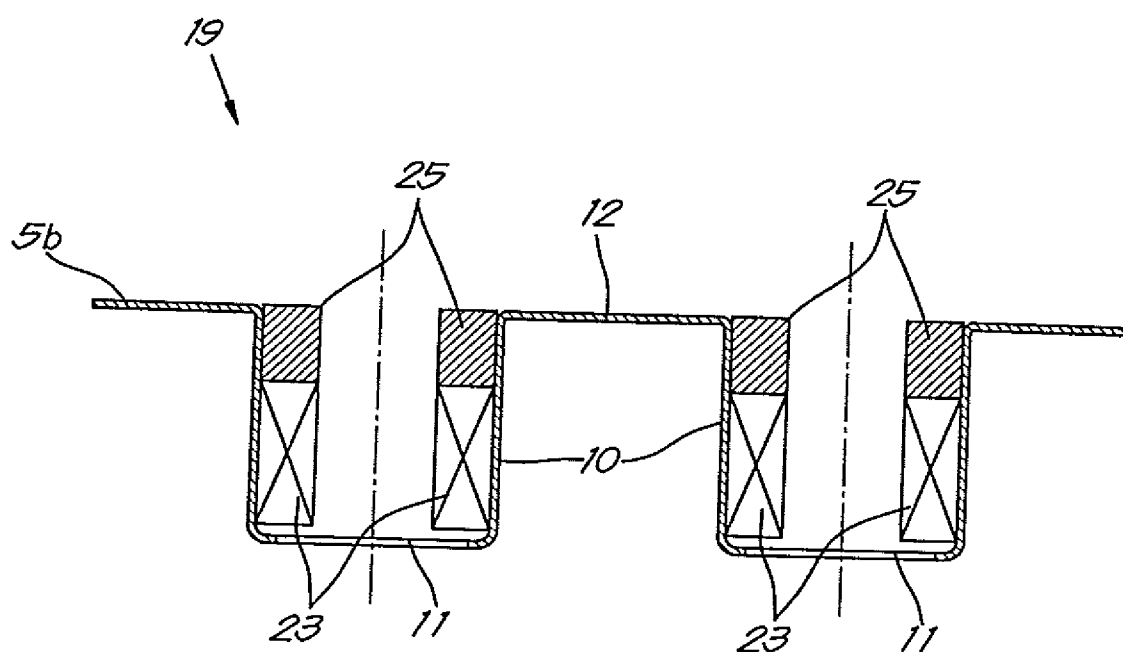


Fig. 12

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*Fig. 13**Fig. 14*

INTERNATIONAL SEARCH REPORT

International application No
PCT/BE2013/000056

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16C35/04
ADD.

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)
F16C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 106 155 A (BEYFUSS BERTHOLD [DE] ET AL) 22 August 2000 (2000-08-22) column 2, line 63 - column 4, line 26; claim 1; figures 1-3 -----	1-10, 12-21, 23-27
X	DE 10 2004 003662 B3 (SKF AB [SE]) 21 April 2005 (2005-04-21) paragraph [0023] - paragraph [0032]; claims 3-5; figures 1-3 -----	1-27
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See patent family annex.

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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