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(54) **Box assembly for a punch press**

(57) A box assembly (10) for a punch press. The box assembly (10) includes, in turn, a container (11) fixed to a base of the punch press, a die-holder box (15) adapted to accommodate an interchangeable die (16), and a device (17) for lifting/lowering the die-holder box (15) itself. The box assembly (10) is characterized in that the device (17) for lifting/lowering the die-holder box (15) includes a first cam (19) which is integral with a cam-holder bushing (18) and a second cam (25) which is integral with the die-holder box (15). The first cam (19) rests in use on the second cam (25). The invention further relates to a method for lifting, rotating and lowering the die-holder box (15) adapted to contain an interchangeable die (16).

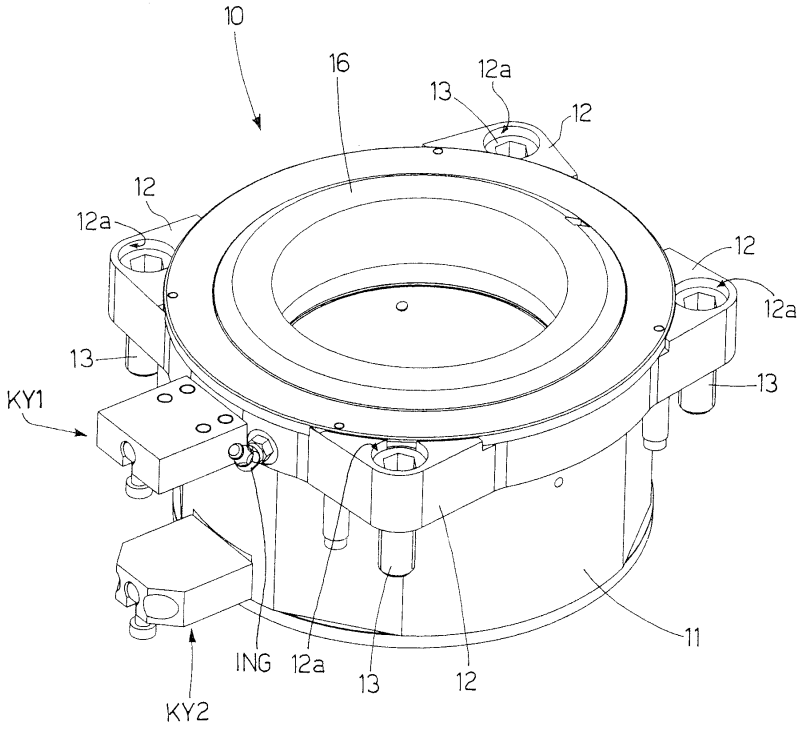

Fig.1

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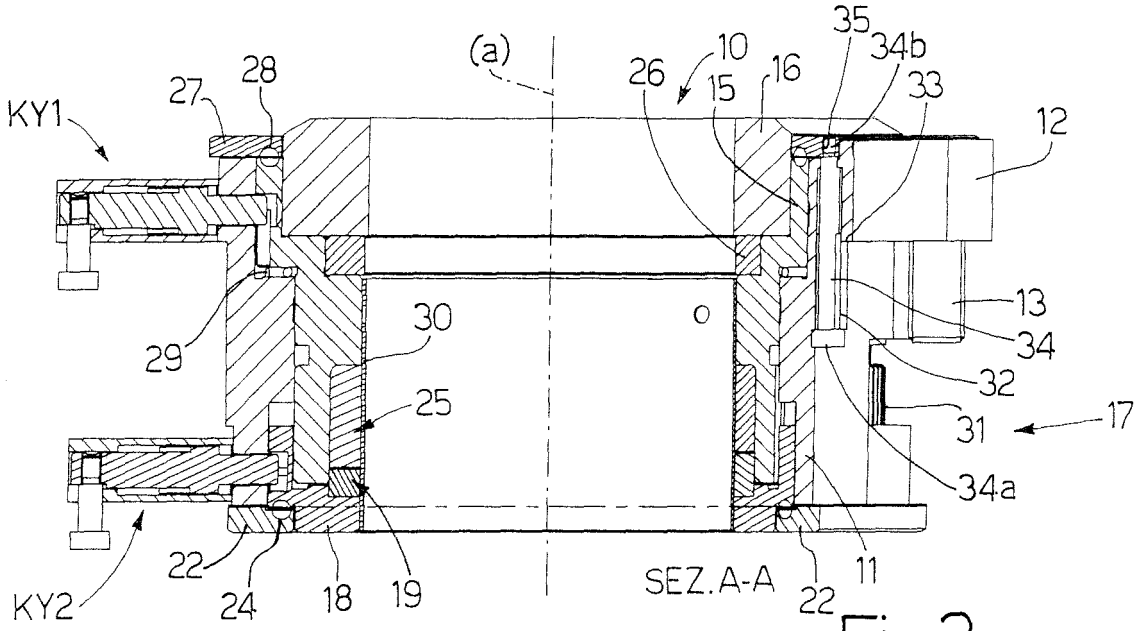
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KY2
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Fig.3

Description

[0001] The present invention relates to a box assembly for a punch press.

[0002] Incidentally, although the present description will refer to an indexing die-holder box, many of the teachings of the present invention may be applied to a simple non-indexed die-holder box.

[0003] Specifically, the present invention is advantageously, but not exclusively, applied in a plate drawing machine, to which explicit reference will be made in the following description without therefore loosing in generality.

[0004] Punch presses provided with box assemblies in which the indexing die-holder boxes can be lifted to perform various type of metal sheet machining, specifically drawing, are known.

[0005] Currently, in order to perform such a lifting of the indexing die-holder boxes, a machine of this type is equipped with complex hydraulic or electric actuators arranged in the lower part of the machine itself.

[0006] It is therefore the main object of the present invention to make a box assembly provided with a lifting/lowering device of a die-holder box which is free from the above-described drawbacks and which, at the same time, is easy and cost-effective to be made.

[0007] In the present invention, the same device for indexed rotation of the die-holder box is used, instead of employing complex electric or hydraulic apparatuses for lifting/lowering the die-holder box (with the corresponding interchangeable die).

[0008] It is a further object of the present invention to equip a punch press with a new concept box assembly.

[0009] It is a further object of the present invention to provide an innovative method for lifting, rotating and lowering a die-holder box.

[0010] According to the present invention, a die-holder box assembly, a corresponding punch press (specifically, a drawing machine) and a corresponding method are thus made according to the appended claims.

[0011] The present invention will now be described with reference to the accompanying drawings, which show a non-limitative embodiment thereof, in which:

- figure 1 shows a three-dimensional view of a box assembly according to the present invention;
- figure 2 shows a plan view of the box assembly in figure 1;
- figure 3 shows a section A-A on the plan in figure 2;
- figure 4 shows an exploded view of the box assembly in figures 1, 2, 3;
- figure 5 shows the box assembly according to figures 1, 2, 3, 4 in a first home configuration (bottom dead centre);
- figure 6 shows the box assembly according to figures 1, 2, 3, 4 in a second configuration in which the rotation and lifting of the box starts;
- figure 7 shows the box assembly according to figures 1, 2, 3, 4 in a third fixed working configuration with the box being in its upper lifting position (top dead centre); and
- figure 8 shows the box assembly according to figures 1, 2, 3, 4 in a fourth working configuration with the box being again in its upper lifted position (top dead centre).

[0012] It is worth noting that in order to facilitate the reading of the drawings, the die and the protective liner of the cams have been removed in figures 5, 6, 7, 8.

[0013] In figure 1, numeral 10 indicates, as a whole, an indexing box assembly which is the object of the present invention.

[0014] The indexed box assembly 10 includes a container 11 provided with four ears 12, each of which includes a corresponding through hole 12a crossed, in use, by a corresponding fastening bolt 13 of the entire indexing box assembly 10 to a base (not shown) of a punch press (not shown), specifically of a drawing machine.

[0015] Furthermore, the container 11 includes a window (14) (figure 4) for purposes which will be better specified below.

[0016] The indexed box assembly 10 further includes an indexing die-holder box 15 adapted to receive a general die 16 (a tool which is changed by the operator according to the type of machining to be performed) and a device 17 (figures 3, 4) for lifting/lowering the indexing die-holder box 15 and thus the general die 16 associated thereto.

[0017] With specific reference to figures 3 and 4, the device 17 includes, in turn, a cam-holder bushing 18 to which a lower cam 19 is integrally fixed by means of a plurality of pins 20 (figure 4) inserted into the corresponding holes 21.

[0018] In the embodiment shown in figure 4, the lower cam 19 includes three cam sectors 19a.

[0019] The cam-holder bushing 18 rests on a lower closing thrust block 22, in turn fixed to the container 11 by means of a plurality of screws 23.

[0020] A plurality of metal balls (not shown) contained in a track 24 (figure 3) are provided to facilitate the sliding between the lowering closing thrust block 22 and the cam-holder bushing 18.

[0021] In other words, a rolling bearing to allow, when required, an optimal rotation between these two elements about an essential symmetry axis (a) of the entire indexing box assembly 10 is provided between the lower closing thrust block 22 and the cam-holder bushing 18.

[0022] As shown in figures 3, 4 a corresponding upper cam 25 including three cam sectors 25a is fixed by known means (not shown) to the indexing die-holder box 15.

[0023] In use, the upper cam 25 is integral with the indexing die-holder box 15, rests on the lower cam 19 and is fixed to the cam-holder bushing 18.

[0024] The die 16 is integral with the indexing die-holder box 15 while resting on an upper spacing element 26 (figures 4-8).

[0025] All the aforesaid elements which are included in the device 17 for lifting/lowering the indexing die-holder box 15 are sandwiched between the aforesaid lower thrust block 22 and an upper thrust block 27 also fixed by known means (not shown) to the casing 11 (figures 3, 4).

[0026] A track 28 containing a plurality of metal balls (not shown) so as to form a bearing adapted to facilitate the rotation of the indexing die-holder box 15 about the aforesaid axis (a) is also made between the upper thrust block 27 and the indexing die-holder box 15.

[0027] The insertion of an O-ring 29 for containing lubrication grease from a lubricator ING (specifically, figure 1, 2) is provided between the casing 11 and the indexing die-holder box.

[0028] Furthermore, in order to protect the cams 19 and 25 from the chips which are formed during the sheet drawing operations, a cylindrical liner 30 is provided, which is fixed by known means (not shown) to the internal surface of the indexing die-holder box 15 (figures 1, 4).

[0029] As specifically shown in figure 4, the indexing die-holder box 15 is provided, on its lower portion, with a toothed wheel 31 (integrally obtained with the indexing die-holder box 15 itself), which in use meshes with a toothed pinion (not shown) which belongs to a device for the indexed rotation of the indexing die-holder box 15 about the axis (a).

[0030] Incidentally, since the toothed pinion is integral with the base of the punch press, while the toothed wheel 31 is integral with the indexing die-holder box 15 (which is lifted and lowered in use), a creep is generated between the teeth of the toothed pinion and those of the toothed wheel 31. For this purpose, teeth of the toothed pinion are considerably shorter than the teeth of the toothed wheel 31. Furthermore, it is worth noting that in order to allow to lift/lower the toothed wheel 31 with the indexing die-holder box 15, the window 14 on the casing 11 is higher than the teeth of the toothed wheel 31 itself.

[0031] A series of springs 32 is used in order to allow an easy return of the indexing die-holder box 15 to its lowest position, i.e. to bottom dead centre.

[0032] Each spring 32 is pressed between a shoulder 33 specifically provided inside the casing 11 and the head 43a of a corresponding screw 34, the free end 34b of which is screwed into a seat 35 provided on the upper thrust block 27.

[0033] Therefore, in use, the spring 32 is compressed between the head 34a of the screw 34 and the shoulder 33 when by effect of its rotation about the axis (a) the indexing die-holder box 15 rises, bringing the die 16 and the upper thrust block 27 along.

[0034] A certain elastic energy will thus be stored and will be returned to the system when, by effect of the indexed rotation device, the indexing die-holder box 15 will start to lower. Such an elastic energy will be used to overcome the creeping friction which is generated between the teeth of the toothed wheel 31 and the teeth of the drive pinion, friction which will create a stall torque in the step of returning to the bottom dead centre.

[0035] Furthermore, in the embodiment shown in the accompanying figures, a first key device KY1, adapted to insert/release the indexing die-holder box 15, and a second key device KY2, employed for inserting/releasing the cam-holder bushing 18, are provided.

[0036] The key devices KY1, KY2 are actuated by pneumatic means (not shown) to perform a program which will be described hereinafter.

[0037] By summarizing, the first cam 19 is integral with the cam-holder bushing 18, and the second cam 25 is integral with the indexing die-holder box 15.

[0038] The indexing cam-holder box 15 receives a torque by means of gears from an indexed rotation device (not shown). The second cam 25 creeps on the first cam 19 (blocked) and reacts on the latter, which is practically a reaction cam. The indexing die-holder box 15 is taken to the working position (i.e. to the top dead centre).

[0039] Once the indexing die-holder box 15 reaches the top dead centre, it can be used in this arrival configuration for machining (thus the indexing die-holder box 15 is used as fixed station), or it may be indexed and thus used in different angular positions. In this case, the cam 19 is made integral with the cam 25 and thus also the cam-holder bushing 18 may rotate by exploiting the same torque which is given to the indexing die-holder box 15 by the indexed rotation device (not shown).

[0040] The rotating elements consisting of the indexing die-holder box 15 and the cam-holder bushing 18 are blocked in the reference positions by means of mentioned key devices KY1, KY2 actuated and released by a pneumatically controlled lever system. It is worth noting that when the indexing die-holder box 15 is lifted, the cam 19 must react and thus the key device KY2 is inserted and blocks the cam-holder bushing 18, and thus also blocks the cam 19.

[0041] The key devices KY1, KY2 may be manually actuated by an operator or, in accordance with the device for the indexed rotation of the die-holder box 15, may perform proper cycles controlled by an electronic control unit (not shown), which performs methods for lifting, rotating and lowering the die-holder box 15 (see below).

[0042] Indeed, the following steps of a method for lifting, rotating and lowering said die-holder box 15, adapted to contain an interchangeable die 16, are actuated by means of the device 17 and with the aid of the key devices KY1, KY2.

STEP 1: (Home position: i.e. indexing die-holder box in its bottom dead centre position)

[0043]

KY1 key device: inserted
KY2 key device: inserted

STEP 2: (Indexing die-holder box lifting)

[0044]

KY1 key device: released
KY2 key device: inserted

[0045] The indexed rotation device (not shown), by means of known means (not shown), meshes with the indexing die-holder box 15 using the toothed wheel 31, and then it immediately releases the key device KY1; the indexing die-holder box 15 is rotated by approximately 54° anticlockwise; however, the key device KY2 is kept inserted.

STEP 3: (Placing the indexing die-holder box in the top dead centre working position)

[0046]

KY1 key device: released
KY2 key device: released

[0047] Releasing the key device KY2 until the cam 25 comes in contact with a stroke end for reaching the top dead centre of the indexing die-holder box 15 and thus also of the die 16.

STEP 4: (Indexed rotation of the indexing die-holder box to its top dead centre position)

[0048]

KY1 key device: released
KY2 key device: released

[0049] The indexed rotation device (not shown) rotates the indexing die-holder box 15 (to its top dead centre) by an angle α required by the machining to place the indexing box 16 in the desired position.

STEP 5: (Return path of the indexing die-holder box to its bottom dead centre position)

[0050]

KY1 key device: released
KY2 key device: inserted

[0051] Rotating the indexing die-holder box 15 in the opposite sense (clockwise) by approximately 55° and returning it to its bottom dead centre position.

STEP 6: (Fixing the system when the indexing die-holder box has reached its bottom dead centre position)

[0052] When the indexing die-holder box 15 has reached the bottom dead centre:

KY1 key device: inserted
KY2 key device: inserted

End of the cycle

[0053] In such a method, the key devices KY1, KY2 may be actuated by means of pneumatic means.

[0054] Furthermore, in this method the key devices KY1, KY2 may be actuated either manually or by means of a program controlled by an electronic control unit (not shown).

[0055] It is apparent for a person skilled in the art that the teachings of the present invention may be at least partially applied to a non-indexed die-holder box, in other words which is lifted to the dead top centre and is not indexed.

[0056] The advantages of the box assembly for punch press which is the object of the present invention are the following:

- a considerable saving due to the fact that no complex electric or hydraulic devices are to be provided, but instead a toothed wheel device is exploited, which is used for the indexed rotation of the die-holder box and which is already present on the indexed punch press;
- a consequent general simplification of the indexed punch press;
- less complexity and lighter weight (which corresponds to a lower cost) with respect to the box assemblies currently marketed.

Claims

1. A box assembly (10) for a punch press;
the box assembly (10) including:

   - a container (11) fixed to a base of the punch press;
   - a die-holder box (15) adapted to accommodate an interchangeable die (16);
   - a device (17) for lifting/lowering said die-holder box (15);

   the box assembly (10) is **characterized in that** said device (17) for lifting/lowering said die-holder box (15) includes cam means (19, 25).

2. A box assembly (10), as claimed in claim 1, **characterized in that** said cam means (19, 25) include a first cam (19) which is integral with a cam-holder bushing (18), said first cam (19) resting in use on a second cam (25) which is integral with said die-holder box (15).

3. A box assembly (10), as claimed in claim 2, **characterized in that** said first cam (19) includes a plurality of cam sectors (19a), each cam sector (19a) resting in use on a corresponding cam sector (25a) belonging to said second cam (25).

4. A box assembly (10), as claimed in any one of the preceding claims, **characterized in that** said device (17) for lifting/lowering said die-holder box (15) is actuated by a device for the rotation of the die-holder box (15) itself.

5. A box assembly (10), as claimed in claim 4, **characterized in that** said casing (11) displays a window (14) adapted to accommodate at least one portion of toothed wheel (31) integrally obtained with said die-holder box (15), said at least one portion of said toothed wheel (31) meshing, in use, with a toothed pinion of said rotation device.

6. A box assembly (10), as claimed in any one of the preceding claims, **characterized in that** all the elements included in said device (17) for lifting/lowering of said die-holder box (15) are sandwiched between a lower thrust block (22) and an upper thrust block (27).

7. A box assembly (10), as claimed in claim 6, **characterized in that** a first track (24) is made at said lower thrust block (22), and a second track (28) is made at said upper thrust block (27), and a corresponding plurality of metal balls for making a corresponding rolling bearing is accommodated in each of said first and second tracks (24, 28).

8. A box assembly (10), as claimed in any one of the preceding claims, **characterized in that** springs (32) are used to facilitate the return of the die-holder box (15) to a bottom dead centre position.

9. A box assembly (10), as claimed in claim 8, **characterized in that** each spring (32) is pressed between a shoulder (33) provided in said casing (11) and the head (34a) of a corresponding screw (34) the free end (34b) of which is screwed into a seat (35) made in an upper element (27).

10. A box assembly (10), as claimed in any one of the preceding claims, **characterized in that** it includes at least two key devices (KY1, KY2).

11. A box assembly (10), as claimed in claim 10, **characterized in that** a first key device (KY1) is adapted to insert/release said punch-holder box (15), and **in that** a second key device (KY2) is adapted to insert/release said cam-holder bushing (18).

12. A box assembly (10), as claimed in any one of the claims 10, 11, **characterized in that** said key devices (KY1, KY2) are actuated by pneumatic means.

13. A box assembly (10), as claimed in any one of the claims 10, 11, 12, **characterized in that** said key devices (KY1, KY2) are actuated either manually or by means of a program controlled by an electronic control unit so as to implement a method of lifting, rotating and lowering said die-holder box (15).

14. A box assembly (10), as claimed in any one of the preceding claims, **characterized in that** it is an indexing box assembly (10).

15. A punch press for machining metal sheets, specifically a drawing machine, **characterized in that** it includes at least one box assembly (10) as claimed in any one of the preceding claims 1-14.

16. A method for lifting, rotating and lowering a die-holder box (15) adapted to contain an interchangeable die (16); the method including the following steps:

STEP 1: (Home position: i.e. die-holder box in its bottom dead centre position)

Key device (KY1): inserted
Key device (KY2): inserted

STEP 2: (Die-holder box lifting)

Key device (KY1): released
Key device (KY2): insert

The rotation device meshes with the die-holder box (15) using a toothed wheel (31); then it immediately releases the key device (KY1); the die-holder box (15) is rotated by approximately 54° anticlockwise; however, the key device (KY2) is kept inserted.

STEP 3: (Placing the die-holder box in the top dead centre working position)

Key device (KY1): released
Key device (KY2): released

Releasing the key device (KY2) until a cam (25) which is integral with said die-holder box (15) comes in contact with a stroke end for reaching the top dead centre of the die-holder box (15) and thus also of the die (16).

STEP 5: (Return path of the die-holder box to its bottom dead centre position)

Key device (KY1): released
Key device (KY2): inserted

Rotating the die-holder box (15) in the opposite

sense (clockwise) by approximately 55° and returning it to its bottom dead centre position.

STEP 6: (Fixing the system when the die-holder box has reached its bottom dead centre position)

When the die-holder box (15) has reached its bottom dead centre:

Key device (KY1): inserted
Key device (KY2): inserted

End of the cycle

17. A method as claimed in claim 16, **characterized in that** said die-holder box (15) is an indexing die-holder box (15), and **in that** it includes a further STEP 4 inserted between said STEP 3 and said STEP 5, wherein the following operations are performed:

STEP 4: (Indexed rotation of the indexing die-holder box to its top dead centre position)

Key device (KY1): released
Key device (KY2): released

The indexed rotation device rotates the indexing die-holder box (15) (to its top dead centre) by an angle (α) required by the machining to place the indexing die-holder box (15) into the desired position.

18. A method as claimed in any one of the claims 16, 17, **characterized in that** it is manually performed by an operator.

19. A method as claimed in any one of the claims 16, 17, **characterized in that** it is performed by means of an electronic control unit.

20. A punch press for machining metal sheets, specifically a drawing machine, **characterized in that** it is adapted to perform the method claimed in any one of the claims 16, 17, 18, 19.

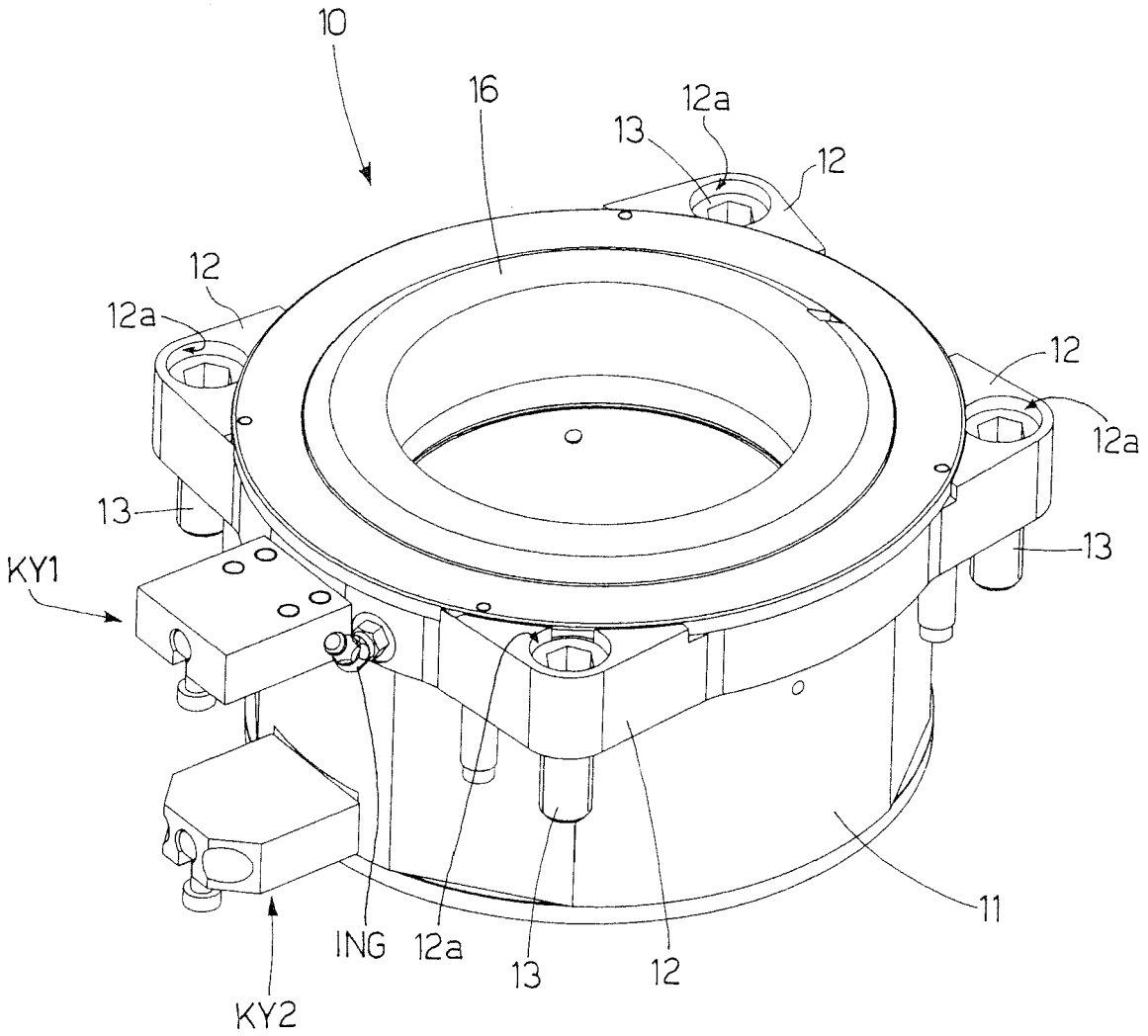

Fig.1

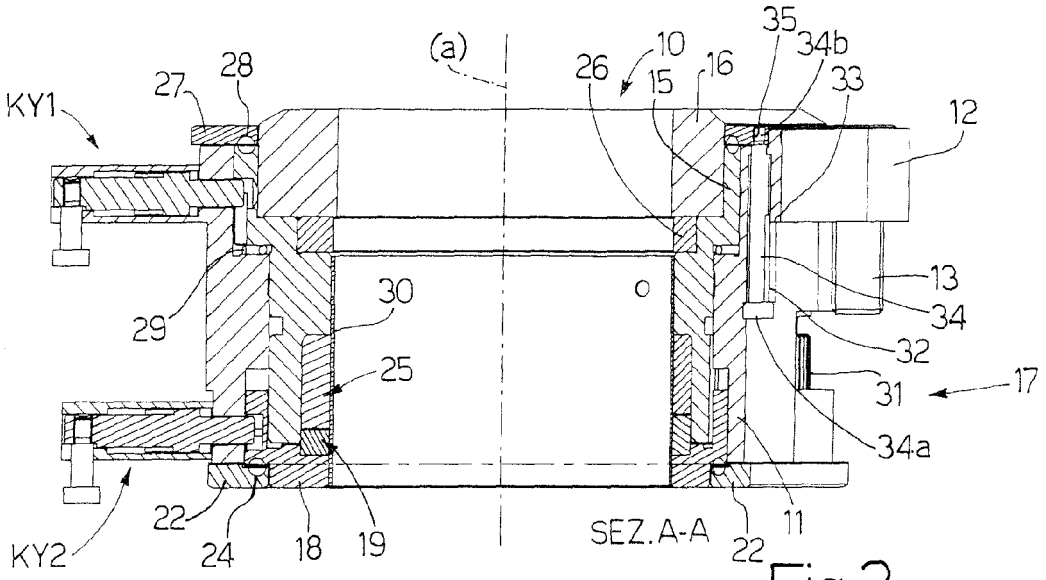
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Fig.3

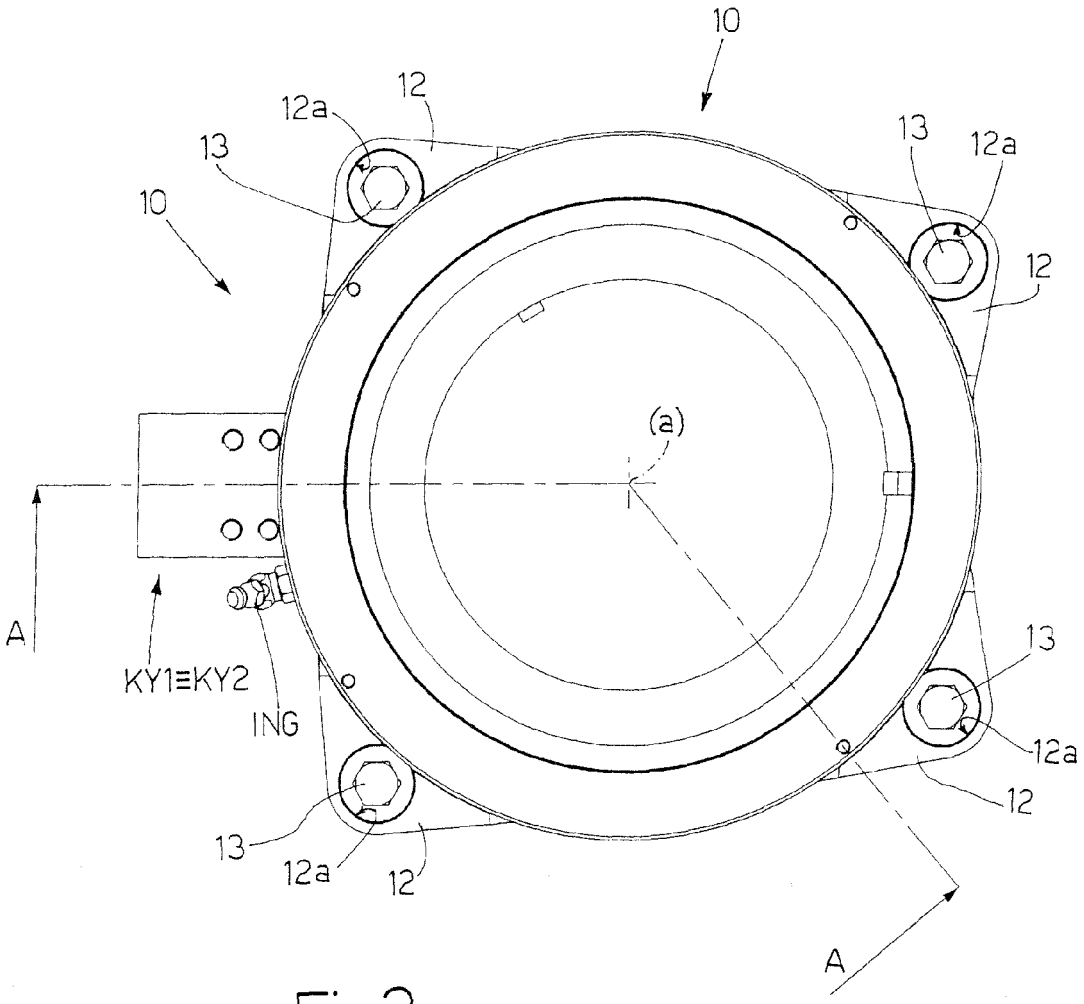
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Fig.2

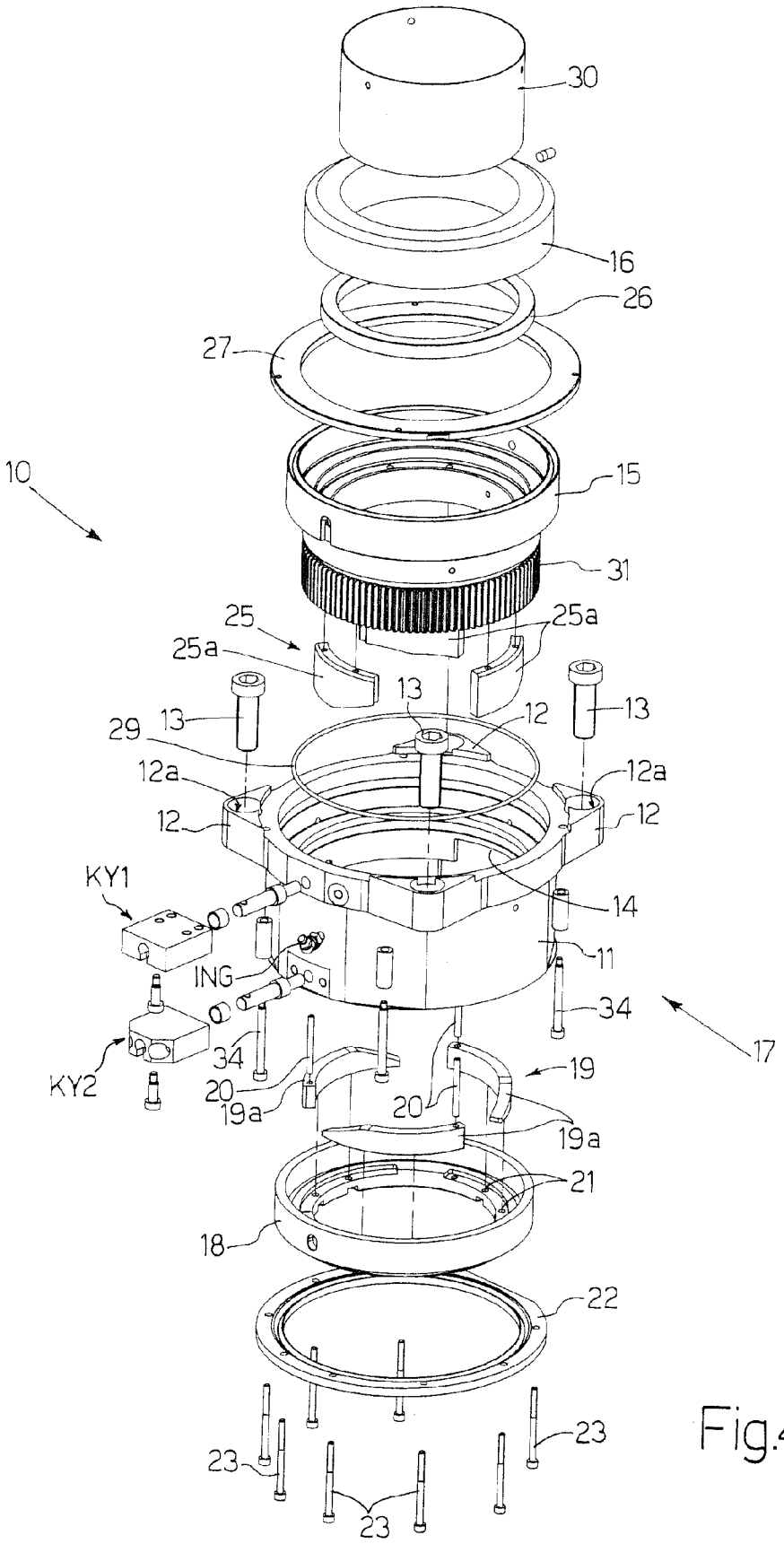
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Fig.4

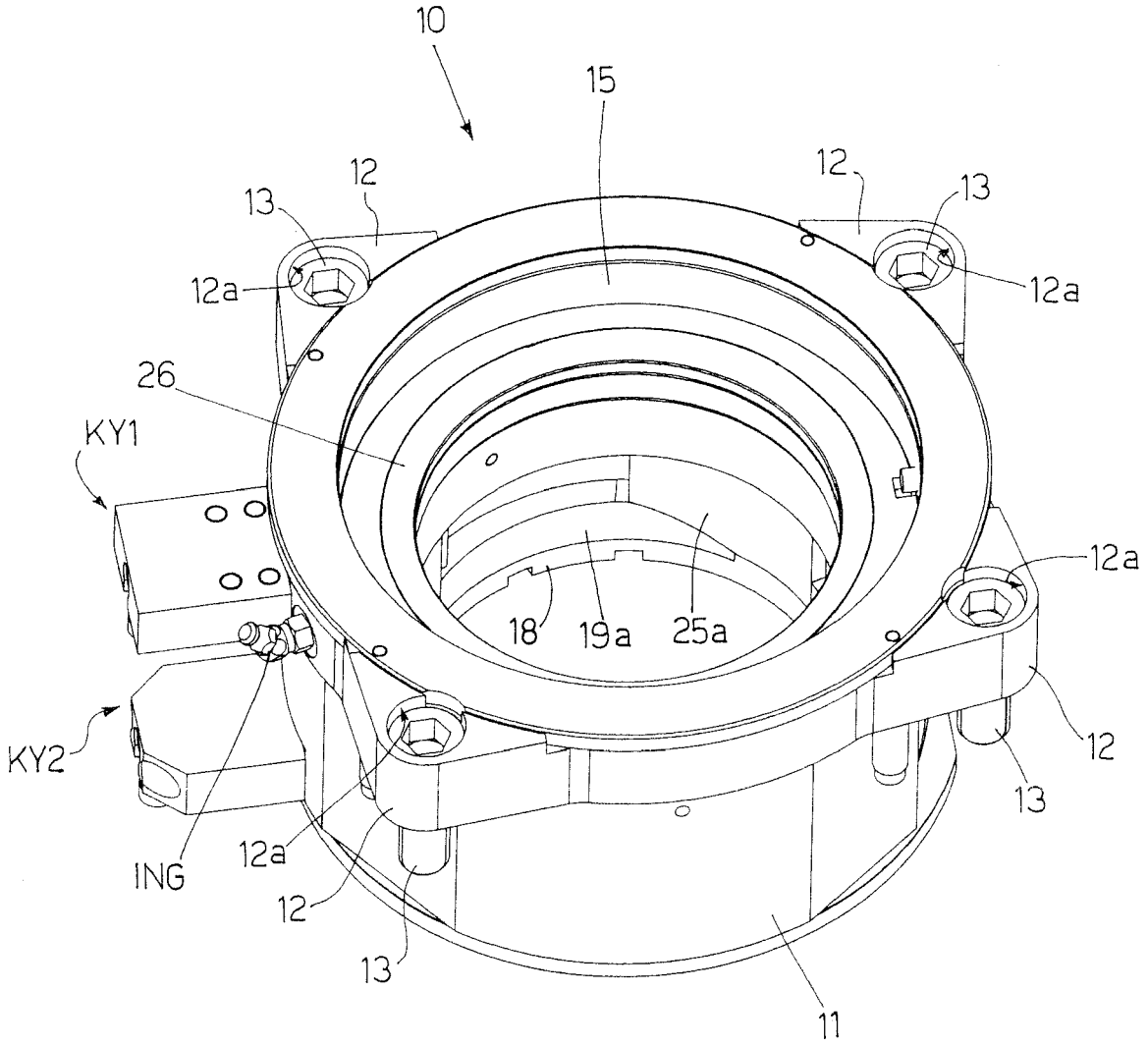

Fig.5

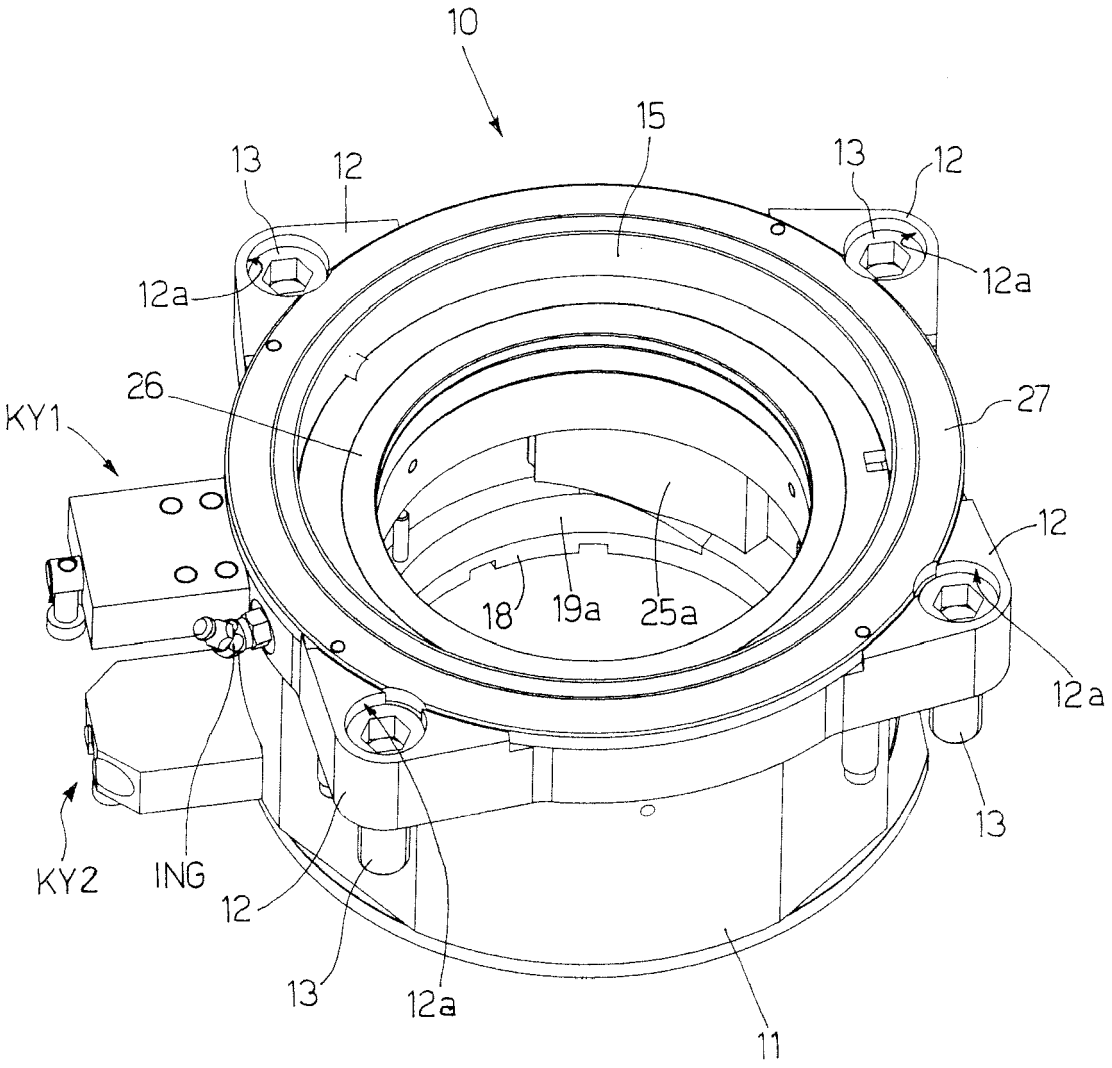
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Fig.6

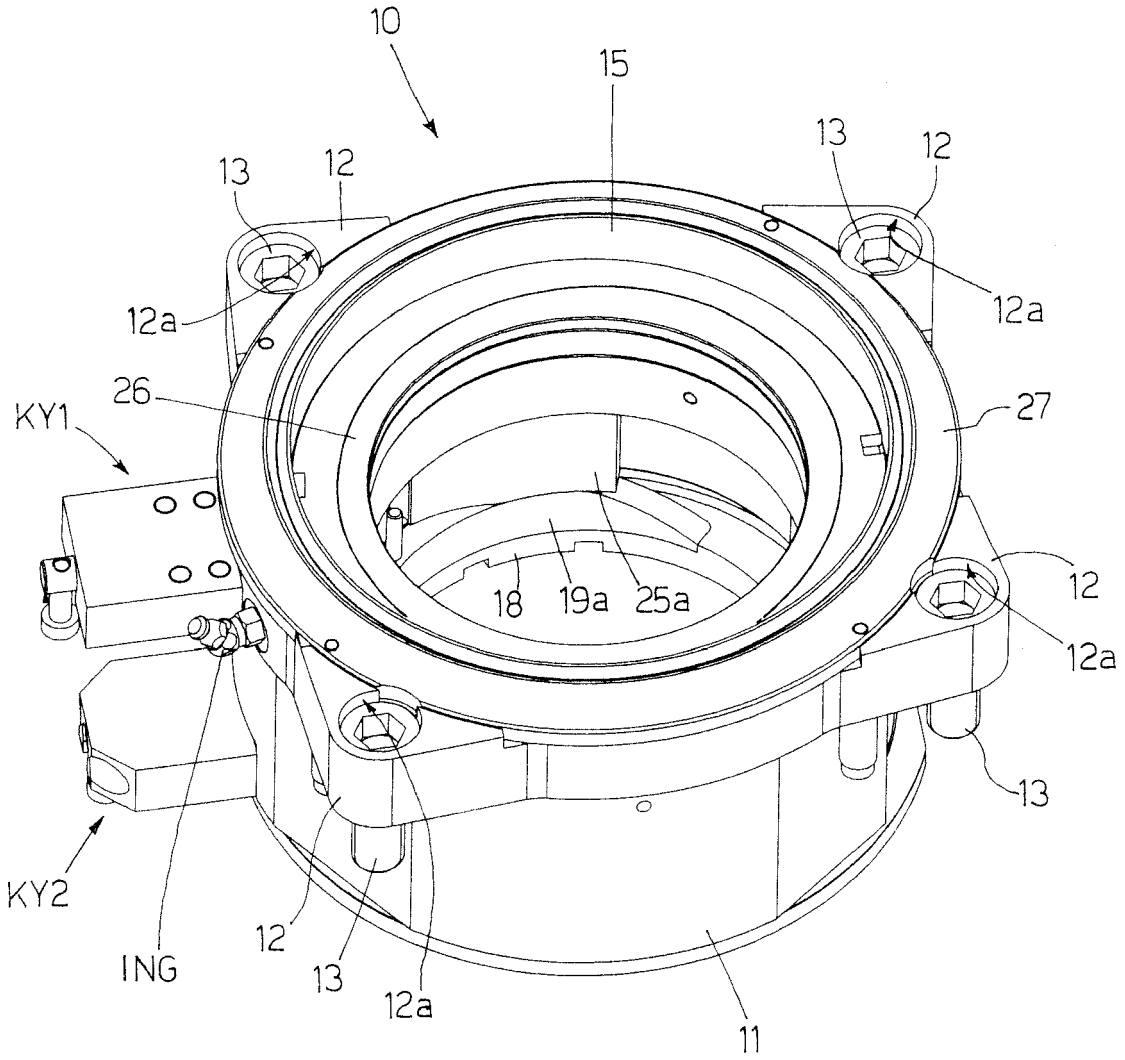
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Fig.7

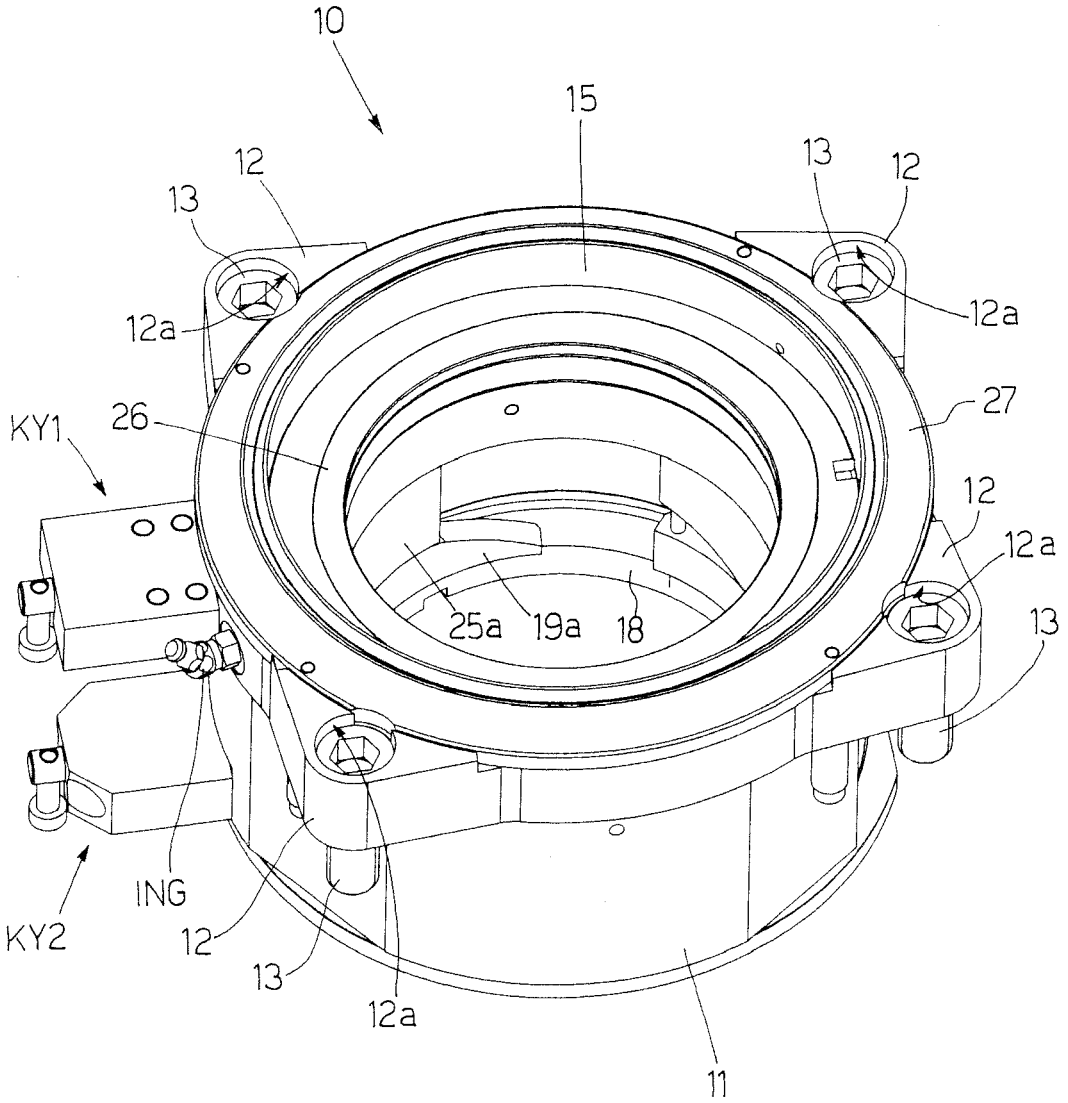
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Fig.8