(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 800 042 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.10.1997 Bulletin 1997/41

(51) Int. Cl.[6]: **F24C 15/32**

(21) Application number: **97103168.7**

(22) Date of filing: **27.02.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **05.04.1996 IT PN960019 U**

(71) Applicant: **IRCA S.p.A.**
I-31020 S. Vendemiano, Treviso (IT)

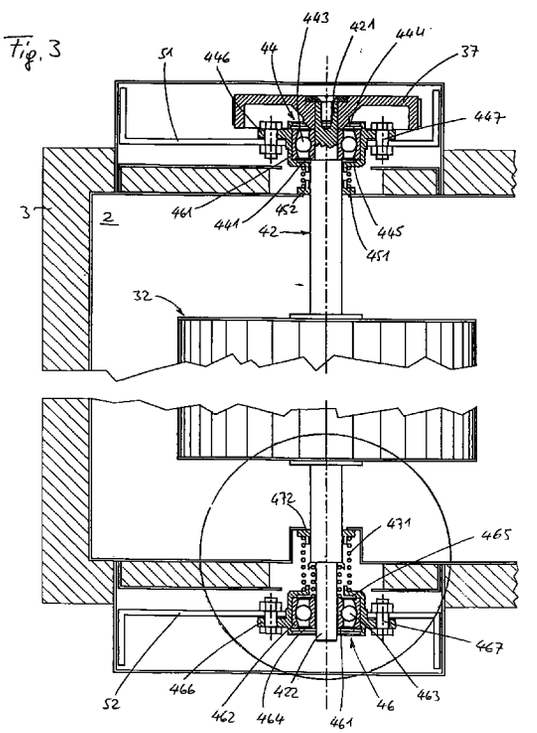
(72) Inventor: **Del Fabbro, Claudio**
33080 Porcia, Pordenone (IT)

(74) Representative: **Agostini, Agostino et al**
PROPRIA,
Protezione Proprietà Industriale srl,
Via Mazzini 13
33170 Pordenone (IT)

(54) Fan-heater unit

(57) The invention refers to a so-called fan-heater unit, adapted to be included in an apparatus such as a fan-assisted or forced-convection food cooking oven for catering or commercial applications. The unit comprises at least a tangential-type fan (32) mounted with its shaft (42) extending vertically and supported at both its ends by rolling-type journal bearings (44, 46). A main feature of the invention is that the inner ring (461) of at least a bearing (46) is mounted with a diametral clearance (480) on a corresponding end portion (422) of the shaft (42), elastic means (468) being provided which, preferably formed by at least a helical spring, are adapted to exert an axial thrust on said inner ring (461). Said axial thrust generates a friction torque capable of inducing said ring to rotate with said shaft.
Advantages: Elimination of the negative effects due to instant thermal-expansion differences between the fan and the structure on which it is mounted.

Fig. 3



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Description

The present invention refers to a fan-heater unit, adapted to be included in an apparatus such as a fan-assisted or forced-convection food cooking oven for catering or commercial applications, comprising: heating elements, at least a tangential-type fan mounted with vertically orientated axis and supported at both its end portions, which protrude from the cooking cavity of the oven, by rolling-type journal bearings, and at least an electric motor to indirectly drive said fan.

A number of patent specifications are known to disclose industrial and/or catering-type cooking ovens provided with electric heating elements and tangential fans to generate a forced circulation of hot air in a cooking cavity thereof.

Examples of ovens with a construction of the above cited kind are for instance described in US-A-3 905 760 and DE-GM-74 24 900.

To the best knowledge of the Applicant, however, no practical implementation of any such invention on an industrial scale is known up to now. The Applicant therefore believes that this may most probably be ascribed to the inability that has generally been shown up to now to solve the problems in connection with the mechanical reliability of moving parts, due to the high temperature which those parts are exposed to in the particular field of application considered.

The Italian patent application no. PN96U000013, filed by the same Applicant on March 4, 1996, describes a general solution to the problem of ensuring adequate cooling of the rolling bearings and the other moving parts.

This, however, leaves out the problem brought about by the sudden, quite remarkable differences in thermal expansion that occur between the vertical shaft of the tangential fan and the cooking cavity, which the bearing supports are mounted integrally with, due to the quick temperature variations. In an oven of the type used in commercial catering or professional kitchen applications, the cooking cavity may reach a height of up to 1500 mm, so that even the vertical shaft of the fan will necessarily have a comparable length. With a temperature of the hot air used for cooking of 300°C, the shaft of the fan undergoes, in just a few minutes, an elongation by approx. 5 mm. In a similar way, when the door of the oven is opened to rapidly cool down the interior of the cooking cavity with the tangential fan kept operating, the large volume of air at room temperature (ie. 20 to 25°C) that flows into the cooking cavity causes the fan shaft to undergo an almost instantaneous shortening by an equal amount as indicated above. Owing to their greater thermic inertia, the cooking cavity itself and the journal bearing supports heat up and cool down at a slower rate than the tangential fan and this instant expansion difference is more than sufficient to give rise to a jamming situation between the balls and the rings of the journal bearings and, as a result, a breakdown of the bearings themselves in a very short time.

It therefore is a purpose of the present invention to provide a construction thanks to which, notwithstanding the fact that the cooking air circulated by the tangential fan has a temperature difference of up to approx. 300°C with respect to the surrounding ambient, the reliability of the rolling-type journal bearings is not affected by the above mentioned differences in thermal expansion.

According to the present invention, this and other aims are reached in the arrangement of the heating elements and the motor-driven fan in a so-called "fan-heater unit" according to the characteristics recited in the appended claim 1.

Further characteristics are the subject of the subsequent claims.

A preferred, although non-exclusive embodiment of the fan-heater unit according to the present invention will be illustrated in the description given below by way of non-limiting example. For reasons of greater clarity, in the given example such a fan-heater unit is illustrated as associated to a catering-type or professional-kitchen cooking oven, with reference to the accompanying drawings in which:

- Figure 1 is a schematical, prespective view of the oven, as seen from behind;
- Figure 2 is a view of the oven as sectioned horizontally along the II-II plane of Figure 1;
- Figure 3 is a view of the oven as sectioned along the III-III line of Figure 2;
- Figure 4 is an enlarged view of the circled detail appearing in Figure 3.

As illustrated in Figures 1 and 2, a fan-assisted, forced-convection cooking oven for catering applications comprises an outer casing, which is generally referred to at 1 and encloses a substantially parallelepiped cooking cavity 2. The food items to be cooked are filled, in a traditional manner which is generally known to those skilled in the art, into said cooking cavity 2, which is surrounded by thermally insulating material 3 and is provided on the front side with a door 4. On the side of said cooking cavity 2, and duly separated therefrom by the provision of a vertical partition wall 5 therebetween, the oven further comprises a so-called control cavity 6, which is arranged to accomodate all of the control and auxiliary devices (not shown) of the oven and carries on its front side a control panel 7 with the various actuation members 8 of the control devices 9.

On the bottom plate 10 of the outer casing of the oven, in correspondence of said control cavity 6, there is provided an opening 11 through which the air needed for cooling down the control devices and the moving parts is taken in from the surrounding ambient by an electric fan 12. Such an air, after it has covered a definite inner flowpath so as to be able perform its above cited cooling duty, is exhausted from the rear side 13 of

the outer casing of the oven through appropriate upper and lower exhaust apertures 14, 15 and 16, 17, respectively, as this is described and claimed in the afore cited Italian patent application no. PN96U000013.

As this has already been mentioned above, the forced circulation of the hot air for food cooking purposes is generated by a so-called fan-heater unit which is incorporated in the oven. Such a unit is appropriately arranged behind a vertical wall 20 which, in a manner that is generally well-known to those skilled in the art, defines the hot-air suction section 21, 22 and the hot-air delivery section 23, 24 (Figure 2) inside the cooking cavity 2.

The fan-heater unit therefore comprises a pair of counterrotating tangential fans 31 and 32, as well as electric heating elements 33 and 34. Said tangential fans 31 and 32, arranged with their axes extending vertically, are driven through a driving belt (not shown) by a single electric motor 38 (not shown, either). For reasons of greater simplicity, the description given below is not only referred to the fan 32, which is shown in Figures 3 and 4, but similarly applies to the other fan 31 as well.

The shaft 42 of the fan 32 carries the driven pulley 37 and is supported, at both its end portions 421 and 422 protruding from the cooking cavity 2 of the oven, by rolling-type journal bearings 44 and 46. These bearings comprise an inner ring 441 and 461, an outer ring 442 and 462, at least a loop of balls 443 and 463, as well as sealing and/or guarding screens 444, 445 and 464, 465. The outer rings 442 and 462 are attached to their respective support plates 51 and 52 by means of flanged bushes 446 and 466 and loops of bolts 447 and 467 (see Figure 3).

According to the main feature of the present invention, the inner ring 461 of the lower bearing 46 is mounted with a diametral clearance or play 480 (which persists under both hot and cold conditions) on the end portion 422 of the shaft 42, ie. the end portion which is opposite to the end portion 421 to which the driven pulley 37 is attached (see Figure 4). In this manner, the shaft 42 is at any time free to elongate or shorten without this implying a risk for its end portion 422 to get stuck against the inner ring 461 of the bearing 46 and, therefore, without this implying the risk for the balls 463 of the bearing 46 to seize and thereby affect the functionality of the same bearing assembly.

A first end portion of a helical spring 468, which extends along the above cited end portion 422 of the shaft 42, presses against the inner ring 461 of the bearing 45. In a preferred embodiment of the invention, the second end portion of the spring 468 presses against an auxiliary ring 469 which abuts against a shoulder 423 of the shaft 42, but is itself mounted with a diametral play or clearance 481 with respect to the same end portion 422 (see Figure 4).

In this manner, the spring 468 produces a direct thrust along the axis of the shaft 42 to generate a friction torque. The torque generated by the spring 468 rotatably drives the inner ring 461, and therefore also the circle of balls 463, since it is greater than the rolling friction torque of the bearing 46. This practically prevents the inner ring 461 from harmfully or even destructively scoring or similarly damaging the end portion 422 of the shaft 42 owing to the afore cited instant differences in thermal expansion. At the same time, this also prevents the balls 463 from scoring or similarly damaging the inner ring 461 owing to gripping due to inadequancy or even absence of the preload needed for the bearing to operate. The axial thrust produced by the spring 468 remains substantially constant both when the fan-heater unit is not operating (ie. under cold conditions) and when the same unit is operating (ie. under hot conditions) and therefore prevents the balls 463 from coming off the inner ring 461.

According to a further feature of the present invention, close to both end portions 421 and 422 of the shaft 42 there are arranged further helical springs 451 and 471, respectively, to retain corresponding sealing rings 452 and 472 on the ceiling 200 and the bottom 201 of the cooking cavity 2 (see Figure 3).

The end portions of the spring 471 press in fact against the flanged bush 466 supporting the bearing 46, as well as against the sealing ring 472 that is mounted with a diametral play or clearance 482 on the shaft 42 and therefore is stationary (see Figure 4).

In turn, the end portions of the spring 451 press against the flanged bush 446 supporting the bearing 44, as well as against the sealing ring 452 which is in turn mounted with a diametral clearance (not visible in Figure 3 owing to the small scale of the drawing) on the shaft 42 and therefore is stationary. In this manner, the risk of hot air leaking from the interior of the cooking cavity 2 in correspondence of the shaft 42 towards the bearings 44 and 46 is minimized. In any case, the afore cited auxiliary ring 469, which is appropriately given a cup-like shape (see Figure 4) and is pushed against the shoulder 423 by the spring 468, performs also the duty, owing to the centrifugal force, of casting possible water drippings, which may fall from the interior of the cooking cavity 2, away from the bearing 46.

Even if the above described one has to be intended to represent a preferred embodiment of the present invention, it will be appreciated that it is within the capabilities of those skilled in the art to use such teachings to derive further variants of the same innovative concept, and that all such variants will therefore fall within the scope of the present invention.

Claims

1. Fan-heater unit, adapted to be included in an apparatus such as a fan-assisted or forced-convection food cooking oven for catering or commercial applications, comprising: heating elements (33, 34), at least a tangential-type fan (32) mounted with its shaft (42) extending vertically and supported at both its end portions (421, 422), which protrude from the cooking cavity (2) of the oven, by rolling-

type journal bearings (44, 46), and at least an electric motor (38) to indirectly drive said fan (32), **characterized in that** the inner ring (461) of at least a bearing (46) is mounted with a diametral clearance (480) on a corresponding end portion (422) of the shaft (42), and that elastic means (468) are provided which are adapted to perform an axial thrust against said inner ring (461) and the shaft (42), so as to generate a friction torque capable of inducing said ring (461) to rotate with said shaft.

2. Fan-heater unit according to claim 1, **characterized in that** said elastic means (468) comprise at least a helical spring that extends along said end portion (422) of the shaft (42), a first end portion of said spring pressing against said inner ring (461) of the bearing (46) and the second end portion of said spring pressing against an auxiliary centrifugally slinging ring (469) which abuts against a shoulder (423) of the shaft (42) and is also mounted with a diametral clearance (481) on said end portion (422).

3. Fan-heater unit according to claim 1 or 2, **characterized in that** said elastic means (468) is situated in correspondence of that end portion (422) of the shaft (42) which is opposite with respect to that end portion (421) of the same shaft to which the driven pulley (37) of the tangential fan (32) is attached.

4. Fan-heater unit according to any of the preceding claims, **characterized in that** the sections provided in the ceiling (200) and the bottom (201) of the cooking cavity (2) for the passage of the shaft (42) of the tangential fan (32) are sealed by sealing rings (452, 472), further elastic means (451, 471) being provided which are integral with the bushes (446, 466) used to support said bearings (44, 46) and are adapted to exert an axial thrust on said sealing rings (452, 472) so as to keep them stationary.

5. Fan-heater unit according to claim 4, **characterized in that** said further elastic means (451, 471) provided to keep said stationary sealing rings (452, 472) firmly in position are in turn formed by helical springs extending along corresponding portions of the shaft (42).

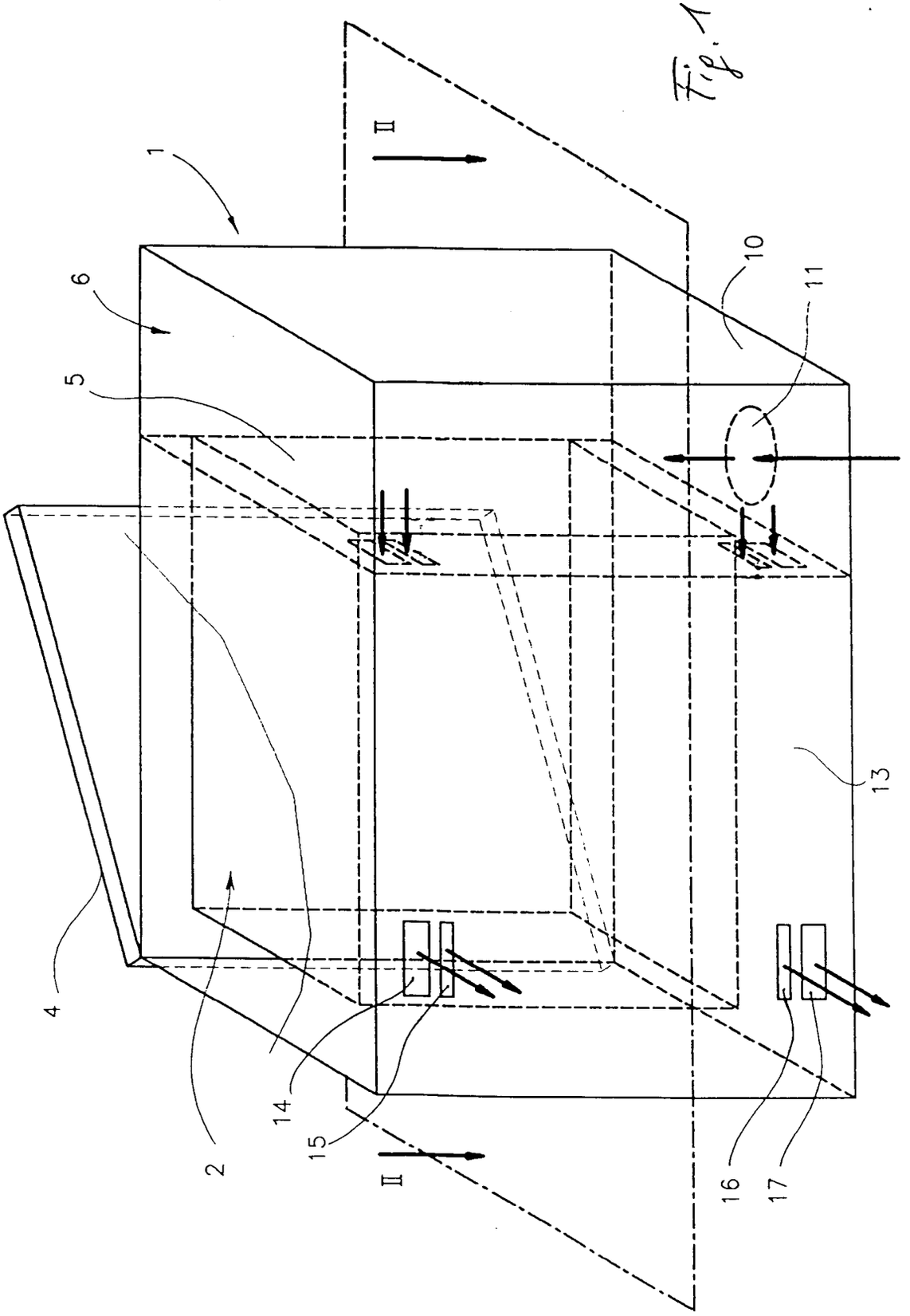


Fig. 1

Fig. 2

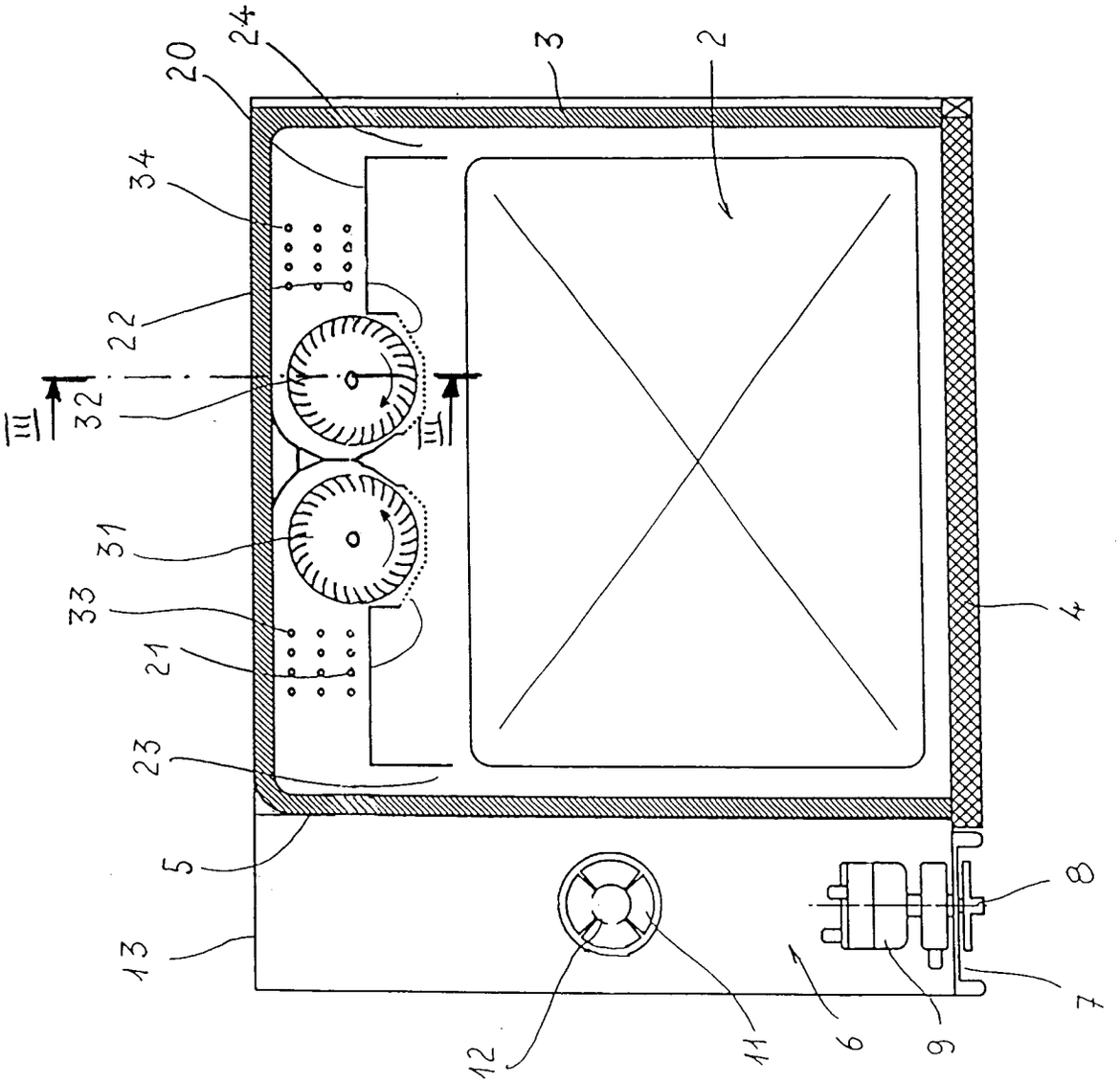
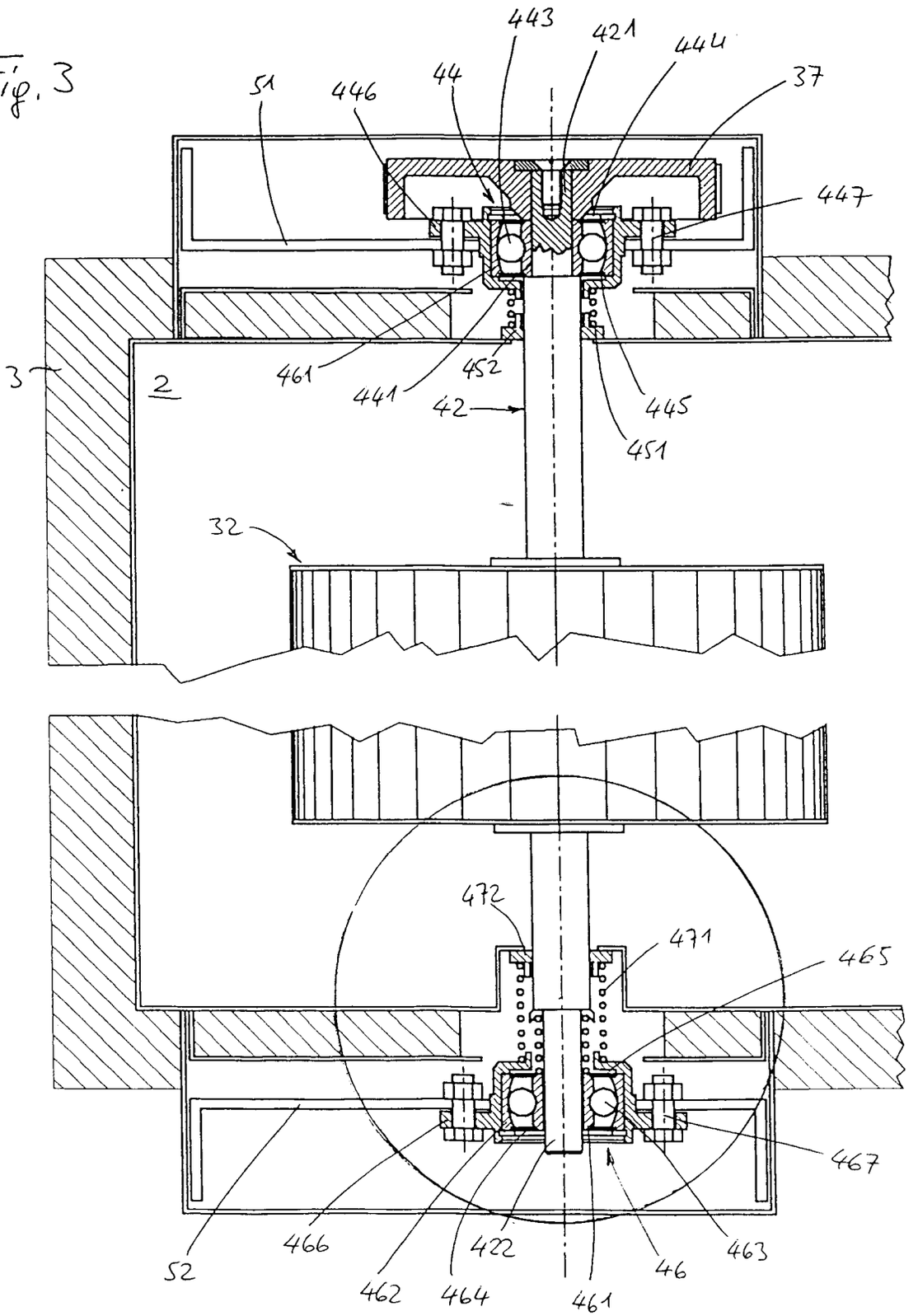


Fig. 3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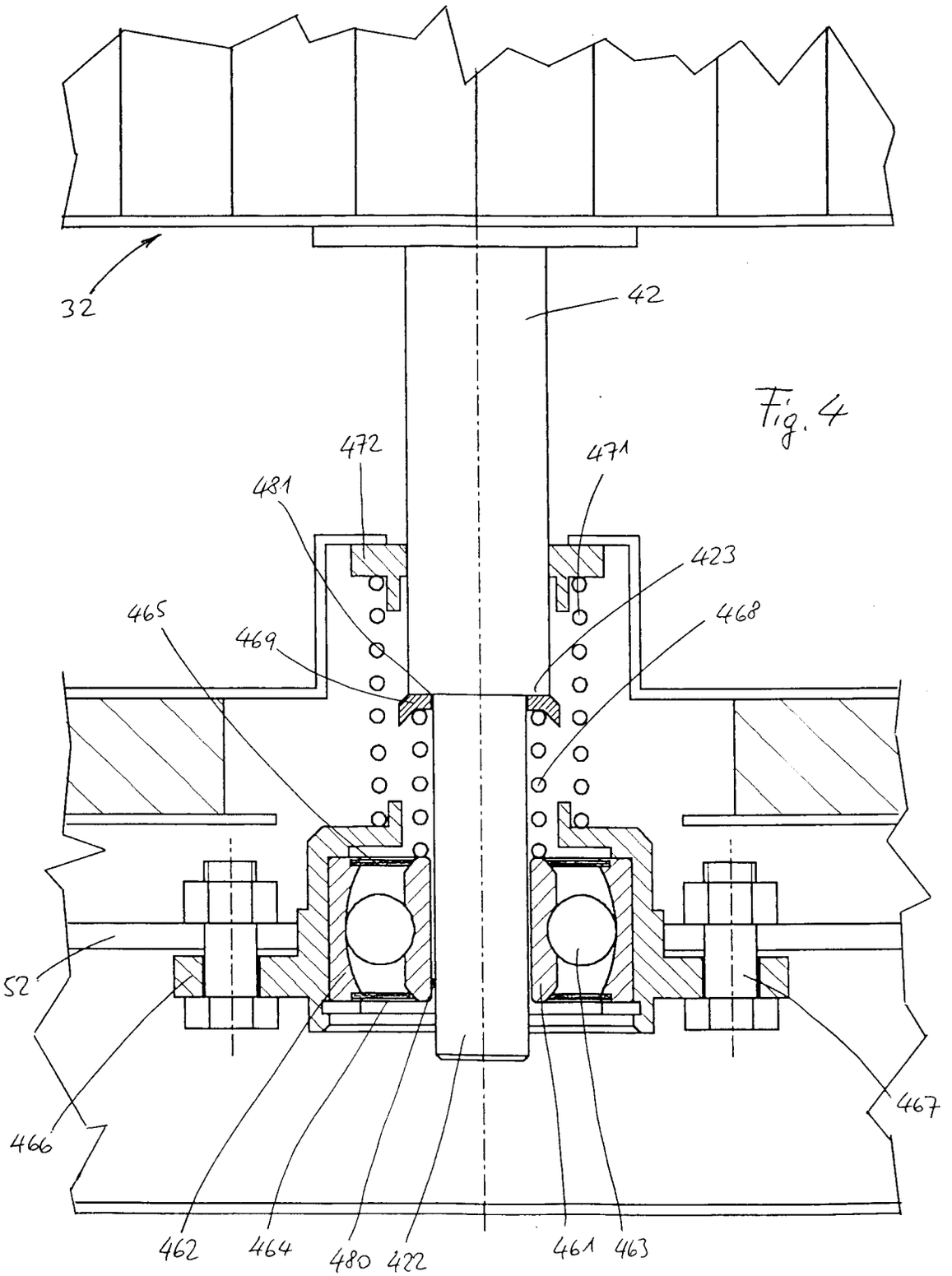
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Fig. 4