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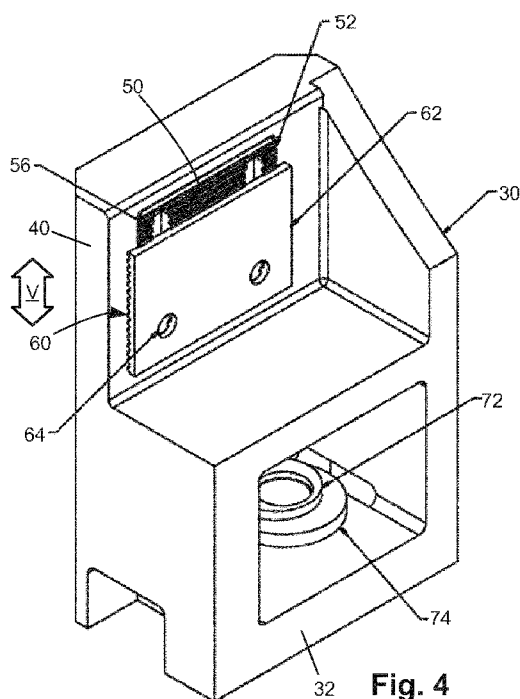
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(54) Title: BRACKET WITH VERTICAL AND HORIZONTAL ADJUSTABILITY



(57) Abstract: A superconducting magnet (10) has magnet mountings (22), each including a locking surface (60, 60a). A seismic mounting bracket (30) is secured to each magnet mounting by one or more bolts (46) passing through vertical through-slots (42) of the seismic mounting bracket and through-holes (44) of the magnet mounting. Each seismic mounting bracket has a locking surface (50, 50a) that is locked with the locking surface of the magnet mounting by mating surface features, e.g. horizontal teeth, of the respective locking surfaces. The surface features of each locking surface are periodic with a pitch P in the vertical direction to allow for a vertical positioning range. The bracket further has a horizontal mounting plate (32) with a through-hole (34) receiving a threaded rod floor anchor (20). An eccentric bushing assembly (70) including nested inner and outer eccentrics (72, 74) to allow for horizontal positioning tolerance is disposed in the through-hole (34).

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BRACKET WITH VERTICAL AND HORIZONTAL ADJUSTABILITY

FIELD

The following relates generally to the seismic mounting arts, magnetic resonance (MR) imaging device arts, and the like.

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BACKGROUND

Mounting a magnet of a magnetic resonance (MR) imaging device is challenging. The magnet is a heavy component that requires vibrational and electrical isolation. The magnet should also be mounted level to a tight tolerance.

10 A known approach for providing vertical adjustment is to employ a bracket with a vertical slot. The mounted component (e.g. the MR magnet) has a bolt hole, and a bolt passes through the vertical slot and is secured at its distal end by a nut. In this design, vertical adjustment over a distance equal to the height of the slot length is achievable. The resistance to vertical movement under a seismic force is provided by preload of the tightened fastener, which in turn is determined by its tightening torque and the coefficient of friction (COF). For
15 a bracket with N such bolt/nut fasteners, the vertical resisting force is therefore given by the product of the number of bolts (N), the preload (P) of each bolt, and the COF, i.e.:

$$F = N \times P \times COF$$

In practice, this vertical resisting force may not meet the minimum vertical resisting force required by governmental and/or other applicable regulations.

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A higher vertical resisting force can be achieved by using more bolts, but this requires a larger bracket. Higher vertical resisting force can also be achieved by using a structural adhesive, but this complicates subsequent vertical bracket position adjustments that may be needed due to settling of vibration dampers or other reasons.

25 In the case of an MR magnet mounting bracket, the aforementioned structural characteristics, including seismic compliance, should be achieved while maintaining vibrational and electrical isolation of the magnet. Moreover, a design-basis horizontal and vertical positioning tolerance should also be met by the mounting bracket.

The following discloses a new and improved systems and methods that address the above referenced issues, and others.

30

SUMMARY

In one disclosed aspect, a seismic mounting bracket assembly includes a bracket configured to be secured to a floor anchor. The bracket includes one or more through-slots oriented in a vertical direction when the bracket is secured to the floor anchor. The bracket
5 further includes a flat bracket-side locking surface having surface features that are periodic with a pitch P in the vertical direction. A flat component-side locking surface is configured to lock to the flat bracket-side locking surface with one or more through-holes of the flat component-side locking surface aligned with the one or more through-slots of the bracket. The flat component-side locking surface has surface features that are periodic with the pitch P
10 oriented in the vertical direction when the flat component-side locking surface is locked with the flat bracket-side locking surface.

In another disclosed aspect, a superconducting magnet assembly is disclosed. A superconducting magnet has a plurality of magnet mountings. Each magnet mounting includes a locking surface. A seismic mounting bracket is secured to each magnet mounting by one or
15 more bolts passing through vertical through-slots of the seismic mounting bracket and through-holes of the magnet mounting. Each seismic mounting bracket has a locking surface that is locked with the locking surface of the magnet mounting by mating surface features of the respective locking surfaces of the magnet mounting and the seismic mounting bracket. The surface features of each respective locking surface of the magnet mounting and the seismic
20 mounting bracket is periodic with a pitch P in the vertical direction.

In another disclosed aspect, a seismic mounting bracket assembly includes a bracket having a vertical plate with one or more vertical through-slots, and a horizontal plate with a through-hole sized to receive a threaded rod floor anchor. Nested outer and inner eccentric bushings are disposed in the through-hole of the horizontal plate.

25 One advantage resides in providing a seismic bracket having adjustable vertical position and improved resisting force against vertical seismic forces.

Another advantage resides in providing a seismic bracket having adjustable vertical position and improved resisting force against vertical seismic forces without the use of adhesive between the bracket and the component mounting.

30 Another advantage resides in providing a seismic bracket with large horizontal locational tolerance between the bracket and the floor anchor.

Another advantage resides in providing one or more of the foregoing advantages while maintaining vibrational isolation of the mounted component.

Another advantage resides in providing one or more of the foregoing advantages while maintaining electrical isolation of the mounted component.

Another advantage resides in providing a seismic bracket for mounting the superconducting magnet of a magnetic resonance (MR) imaging device in which the seismic
5 bracket has one or more of the foregoing advantages.

Another advantage resides in facilitating an open bracket design to allow access for tooling.

A given embodiment may provide none, one, two, more, or all of the foregoing advantages, and/or may provide other advantages as will become apparent to one of ordinary
10 skill in the art upon reading and understanding the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for
15 purposes of illustrating the preferred embodiments and are not to be construed as limiting the invention. Unless otherwise noted, the drawings are diagrammatic and are not to be construed as being to scale or to illustrate relative dimensions of different components.

FIGURE 1 diagrammatically shows a perspective view of a superconducting magnet **10** of a magnetic resonance (MR) imaging device secured to a structural floor.

20 FIGURE 2 diagrammatically shows a side view of the lower portion of the magnet of FIGURE 1 and of the supporting floor.

FIGURE 3 diagrammatically shows a perspective view of Detail D indicated in FIGURE 1 including one of the seismic mounting brackets.

25 FIGURE 4 diagrammatically shows a perspective view of one of the seismic mounting brackets of FIGURES 1-3 in isolation.

FIGURE 5 diagrammatically shows a side sectional view of one of the seismic mounting brackets of FIGURES 1-3 in isolation. Detail B is also shown in enlarged view.

30 FIGURE 6 diagrammatically shows the side sectional view of one of the seismic mounting brackets of FIGURE 5 with the bracket-side locking plate moved away to reveal the receiving recess, and also showing the magnet mounting with the magnet-side locking plate secured to the magnet mounting.

FIGURES 7 and 8 diagrammatically show front views of an alternative embodiment of the mating locking plates including bracket-side locking plate (FIGURE 7) and magnet mounting-side locking plate (FIGURE 8).

FIGURE 9 diagrammatically shows the horizontal mounting plate of the bracket of FIGURES 4-6 with an exploded view of the eccentric bushing assembly including nested outer and inner eccentric bushings, with the exploded view further revealing the anchor-mount through-hole sized to receive the floor anchor comprising a threaded rod.

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DETAILED DESCRIPTION

With reference to FIGURE 1, a superconducting magnet **10** of a magnetic resonance (MR) imaging device is shown in diagrammatic perspective view. The magnet **10** includes a cryostat, such as a vacuum-jacketed liquid helium dewar, containing superconducting windings or coils. In FIGURE 1, only the magnet cryostat is visible since the windings are internal components. The cryostat includes various ports **12** for adding liquid helium, making external contact to the superconducting windings to ramp current up or down, and so forth. The illustrative magnet **10** is a horizontal bore cylindrical magnet in which the windings encircle a central bore **14** within which a patient or other imaging subject is loaded for imaging. The skilled artisan recognizes the MR imaging device includes numerous additional components not illustrated in FIGURE 1, such as magnetic field gradient coils typically having a cylindrical form-factor and disposed coaxially inside the central bore **14**, radio frequency (RF) coils such as (for example) a whole-body birdcage or other whole-body coil having a cylindrical form-factor and disposed coaxially inside the central bore **14** (and usually inside the gradient coils) and/or one or more local coils or coil arrays, e.g. disposed on or near a portion of the imaging subject to be imaged. The MR imaging device also includes various electronics such as power supplies, gradient coil amplifiers, RF amplifiers, RF receiver electronics, and so forth, as well as an optional cosmetic housing or enclosure that may be disposed around the magnet **10**; these features are again not illustrated in diagrammatic FIGURE 1. In general, the MR imaging device of FIGURE 1 may be any cylindrical bore superconducting-magnet MR imaging device, such as the Philips Ingenuia 3.0T or 1.5T MR system. It is also to be appreciated that the cylindrical-bore magnet **10** of FIGURE 1 is merely an illustrative mounted component, and the disclosed seismic mounting brackets may be used for mounting other types of MR magnets (e.g. vertical bore magnets, open magnets, or so forth) or for mounting large magnets for other types of devices or more generally any heavy component whose mounting should be seismically resistant and may optionally also preferably provide vibrational and/or electrical isolation (e.g. industrial robots for automotive assembly lines or the like; assembly line conveyor belts; and so forth).

With continuing reference to FIGURE 1 and with further reference to FIGURES 2 and 3, the magnet **10** is disposed on, and supported by, a structural floor such as an illustrative concrete floor **16**. Optionally, a finished floor **18** may be disposed on top of the concrete floor **16**; however, the weight of the magnet **10** calls for it to be supported by the structural floor **16** which is designed to support its weight. FIGURE 2 diagrammatically shows a side view of the lower portion of the magnet **10** and of the supporting structural floor **16** and optional finished floor **18**. As best seen in the “Detail D” view of FIGURE 3 (showing the “Detail D” indicated in FIGURE 1), floor anchors **20** are secured into the structural floor **16** and extend upward to provide anchor points for the magnet **10**. The illustrative floor anchors **20** are threaded rods having their lower ends embedded into the structural floor **16** and extending vertically upward through the (optional) finished floor **18** to be accessible as floor anchors for mounting the magnet **10**.

With continuing reference to FIGURES 1-3 and with further reference to FIGURES 4-6, the magnet **10** further includes magnet mountings **22** providing attachment points for connecting seismic mounting brackets **30** that secure the magnet **10** to the floor anchors **20**. The “Detail D” view of FIGURE 3 shows a perspective view of one seismic bracket **30** positioned *in situ* supporting the magnet **10**. FIGURE 4 diagrammatically shows a perspective view of the seismic mounting bracket **30** in isolation. FIGURE 5 diagrammatically shows a side sectional view of the seismic mounting bracket **30** in isolation. In FIGURE 5, the indicated “Detail B” is also shown in enlarged view in the upper left of FIGURE 5. FIGURE 6 diagrammatically shows the side sectional view of the seismic mounting bracket **30** as in FIGURE 5, in partly exploded view also showing the magnet mounting **22**. The bracket **30** is configured to be secured to the floor anchor **20**. In the illustrative embodiment, this is by way of the bracket **30** including a horizontal mounting plate **32** which has an anchor-mount through-hole **34** that is sized to receive the floor anchor **20** (i.e. the threaded rod **20** in the illustrative case). The sizing may provide some extra gap to accommodate vibrations if vibration isolation is desired. An anti-loosening nut (or two nuts locking each other) **36** (shown only in FIGURE 3) tightens onto the floor anchor threaded rod **20** to secure the bracket **30**, and more particularly the horizontal mounting plate **32** of the bracket **30**, to the floor anchor **20**.

The bracket **30** further includes a vertical plate **40** that is connected with the horizontal mounting plate **32** to form a single rigid bracket. For example, the vertical plate **40** and the horizontal mounting plate **32** may be manufactured as a single forged piece, or may be cast as a single cast piece. Alternatively, the vertical plate **40** and the horizontal mounting plate **32** may be manufactured as separate pieces that are welded together. The vertical plate **40** has

one or more (illustrative two) through-slots **42** oriented in a vertical direction (indicated by a double-arrow labeled **V** in the drawings) when the bracket **30** is secured to the floor anchor **20**. The magnet mounting **22** has matching through-hole(s) **44** (see FIGURE 6) that align with respective through-slots **42** of the bracket **30**, so that fastener(s) can secure the magnet mounting **22** to the vertical plate **40** of the bracket. In the illustrative example, each fastener includes a bolt **46** (see FIGURES 3 and 6) that passes through the through-slot **42** and through-hole **44** and is secured at its opposite end by a nut **48** (see FIGURE 6). The through-slots **42** enable the height of the bracket **30** in the vertical direction **V** to be adjusted. For example, FIGURE 2 illustrates the magnet is at a level **L** at which the bolts **46** are located. The left bracket shown in FIGURE 2 is positioned at the lowest achievable bracket height **z_L** by having the bolts **46** at the tops of the through-slots **42**; whereas, the right bracket shown in FIGURE 2 is positioned at the highest achievable bracket height **z_H** by having the bolts **46** at the bottoms of the through-slots **42**. Such height adjustment capability enables the brackets **30** to accommodate the possibility that the structural floor **16** is not perfectly level.

The bracket **30** further includes a flat bracket-side locking surface **50** which is vertically oriented and disposed on the vertical plate **40**, and has surface features that are periodic with a pitch **P** in the vertical direction (see “Detail B” of FIGURE 5). The illustrative surface features of the locking surface **50** are mutually parallel horizontal grooves and/or ridges (alternatively may be referred to as “teeth”) spaced apart in the vertical direction **V** by a constant spacing (or pitch) **P**. in the illustrative example of FIGURES 4-6. For manufacturing convenience, the bracket-side locking surface **50** is disposed on a separate bracket-side locking plate **52** which fits into a recess or pocket **54** (see FIGURE 6) of the vertical plate **40** of the bracket **30** to prevent the locking plate **52** from moving. The locking plate **52** may be held in the recess or pocket **54** by adhesive or by fasteners. Clearance between the perimeter of the locking plate **52** and the perimeter of the recess **54** should be tight to prevent movement of locking plate **52** disposed in the recess **54**. The bracket-side locking plate **52** includes vertical through-slots **56** matching the vertical through-slots **42** of the vertical plate **40** of the bracket **30** so that the bracket-side locking plate **52** does not impede the bolt(s) **46**. Alternatively, the locking surface **50** could be formed integrally into the bracket **30**, i.e. integrally into the vertical plate, e.g. by machining the horizontal ridges and/or grooves (i.e. teeth) into the blank plate surface.

Furthermore, a flat component-side locking surface **60** is integral with or secured with the component that is mounted by the bracket **30**. In the instant case that component is the MR magnet **10**, and hence the component-side locking surface **60** may be

deemed a magnet-side locking surface **60**. The magnet-side locking surface **60** includes mutually parallel grooves or ridges having the (same) pitch P in the vertical direction V as the grooves or ridges of the bracket-side locking surface **50**. Again for manufacturing convenience, the component-side locking surface **60** is formed in a component-side locking plate **62** having
5 opposite first and second sides. The first side is secured to the magnet mounting **22**, for example using structural adhesive, fasteners, or the like; while, the second side is the component-side locking surface **60**. Alternatively, the component-side locking surface **60** may be formed directly into the surface of the magnet mounting **22**, e.g. by machining the grooves or ridges. The magnet-side locking plate **62** includes through-holes **64** matching the through-holes **44** of
10 the magnet mounting **22** so that the magnet-side locking plate **62** does not impede the bolt(s) **46**.

As best seen in “Detail B” of FIGURE 5, the surface features of the bracket-side locking surface **50** and the surface features of the magnet-side locking surface **60** engage or lock together so as provide resistance to vertical movement due to seismic forces. This
15 resistance is additional to the resistance to vertical movement due to seismic forces provided by the pre-load torque and friction of the bolt/nut fastener **46**, **48**. Advantageously, because the surface features of the two locking surfaces **50**, **60** are periodic in the vertical direction with pitch P , they can be locked together at different relative heights in the vertical direction V , with a “resolution” equal to the pitch P . For example, referencing “Detail B” of FIGURE 5, it will
20 be appreciated that the bracket **30** including its locking surface **50** could be disengaged from the magnet-side locking surface **60** and moved up (or down) by a vertical distance equal to any integral multiple (1, 2, 3, ...) of the pitch P , and then re-engaged with the magnet-side locking surface **60**. If the two locking surfaces **50**, **60** have sufficient vertical extent, then this allows the bracket **30** to be moved up or down over the entire height of the through-slot(s) **42** and
25 positioned at any height between the lowest achievable bracket height z_L and the highest achievable bracket height z_H (see FIGURE 2), with the positioning limited only by the “resolution” defined by the vertical pitch P . In this regard, it should be noted that only partial overlap of the two locking surfaces **50**, **60** is generally sufficient to provide the desired resisting force to counter vertical seismic forces. For example, in some embodiments as few as three
30 engaged teeth (grooves/ridges) is sufficient.

The choice of surface features (i.e. teeth) of the locking surfaces **50**, **60** for providing this vertically adjustable lock can be varied, so long as they exhibit periodicity in the vertical direction of the (same) pitch P . For example, the bracket-side locking surface **50** may have ridges that mate with grooves of the magnet-side locking surface **60**. Alternatively, the

bracket-side locking surface **50** may have grooves that receive ridges of the magnet-side locking surface **60**. In one specific illustrative embodiment, the bracket-side locking surface **50** and the magnet-side locking surface **60** have matching tapered (10° included angle) tongues and grooves that prevent vertical slippage when engaged.

5 With reference to FIGURES 7 and 8, in another illustrative embodiment a bracket-side locking surface **50a** has teeth in the form of bumps (FIGURE 7) and a magnet-side locking surface **60a** has dimples sized to receive the bumps of the locking surface **50a**. This may be reversed, e.g. the magnet-side locking surface may have the bumps and the bracket-side locking surface the dimples. In this embodiment, the locking surfaces **50a**, **60a**
10 also provide resistance to seismic forces in the horizontal direction (however, the vertical through-slots **42**, **56** also resist horizontal movement of the bracket **30** through shear against the attachment bolts **46**).

In the disclosed approach, the flat component-side locking surface **60** or **60a** is locked with the flat bracket-side locking surface **50** or **50a**. These locking surfaces provide
15 additional resistance to vertical seismic forces that enable use of the vertical through-slots **42** to provide adjustable bracket height. Advantageously, in some embodiments no adhesive is disposed between the flat component-side locking surface **60** or **60a** and the flat bracket-side locking surface **50** or **50a**. Consequently, if the bracket height is to be adjusted, there is no adhesive bond to be broken, and the adjustment merely entails loosening the fastener **46**, **48**
20 and moving the bracket vertically to its new height.

The locking surfaces **50**, **60** or **50a**, **60a** provide additional resisting force to counter vertical seismic forces so as to permit vertical bracket adjustment by way of the vertical through-slots **42**, **56**. Additionally or alternatively, in some embodiments it is advantageous to provide for large horizontal locational tolerance between the bracket **30** and the floor anchor
25 **20**.

With reference to FIGURES 3-6 and with further reference to FIGURE 9, a tolerance zone between the floor anchor **20** and the anchor-mount through-hole **34** of the horizontal mounting plate **32** is provided by an eccentric bushing assembly **70** disposed in the anchor-mount through-hole **34**. The eccentric bushing assembly **70** includes an inner eccentric
30 bushing **72** nested in an outer eccentric bushing **74**. If electrical isolation is desired, the inner and/or outer eccentric **72** is suitably made of an electrically non-conductive material. If vibrational isolation is desired, this is achieved by the eccentric **72** having an inner diameter larger than the anchor threaded rod **20**. Additionally, since vibrations could be transmitted through the junction between the nut **36** and the inner eccentric bushing **72** (see FIGURE 3),

in some embodiments a gap is provided between the nut **36** and the eccentric bushing assembly **70** (and more particularly between the nut **36** and the inner eccentric bushing **72**). The gap should be chosen to be large enough to suppress vibrational coupling between the nut **36** and the inner eccentric bushing **72**, but small enough that the vertical movement permitted by the gap (e.g. during a seismic event) is acceptably small. In some embodiments, a gap in a range of 1.0-3.0 mm is employed, with some specific embodiments employing a 1.5 mm gap.

The invention has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS:

1. A seismic mounting bracket assembly comprising:
 - a bracket (30) configured to be secured to a floor anchor (20), the bracket including one or more through-slots (42) oriented in a vertical direction when the bracket is secured to the floor anchor, the bracket further including a flat bracket-side locking surface (50, 50a) having surface features that are periodic with a pitch P in the vertical direction; and
 - a flat component-side locking surface (60, 60a) configured to lock to the flat bracket-side locking surface with one or more through-holes (64) of the flat component-side locking surface aligned with the one or more through-slots of the bracket, the flat component-side locking surface having surface features that are periodic with the pitch P oriented in the vertical direction when the flat component-side locking surface is locked with the flat bracket-side locking surface.

2. The seismic mounting bracket assembly of claim 1 wherein:
 - the surface features of the flat bracket-side locking surface (50) comprise one of mutually parallel horizontal ridges spaced apart by the pitch P and mutually parallel horizontal grooves spaced apart by the pitch P; and
 - the surface features of the flat component-side locking surface (60) comprise the other of mutually parallel horizontal ridges spaced apart by the pitch P and mutually parallel horizontal grooves spaced apart by the pitch P.

3. The seismic mounting bracket assembly of any one of claims 1-2 wherein:
 - the flat component-side locking surface (60, 60a) is locked with the flat bracket-side locking surface (50, 50a); and
 - no adhesive is disposed between the flat component-side locking surface and the flat bracket-side locking surface.

4. The seismic mounting bracket assembly of any one of claims 1-3 wherein the bracket (30) further comprises:
 - a horizontal mounting plate (32) having an anchor-mount through-hole (34) sized to receive a floor anchor (20) comprising a threaded rod.

5. The seismic mounting bracket assembly of claim 4 further comprising:
an eccentric bushing assembly (70) disposed in the anchor-mount through-hole (34),
the eccentric bushing assembly comprising nested outer and inner eccentric bushings (72, 74).
6. The seismic mounting bracket assembly of any one of claims 1-5 wherein the bracket (30) includes:
a bracket-side locking plate (52) disposed in a recess (54) of the bracket, the bracket-side locking plate including the flat bracket-side locking surface (50).
7. The seismic mounting bracket assembly of any one of claims 1-6 further comprising:
a component-side locking plate (62) including the flat component-side locking surface (60, 60a).
8. The seismic mounting bracket assembly of claim 7 further comprising:
a magnet mounting (22) of a superconducting magnet (10);
wherein the component-side locking plate (62) has opposite first and second surfaces with the first surface secured to the magnet mounting and the second surface being the flat component-side locking surface (60, 60a).
9. A superconducting magnet assembly comprising:
a superconducting magnet (10) having a plurality of magnet mountings (22), each magnet mounting including a locking surface (60, 60a); and
a seismic mounting bracket (30) secured to each magnet mounting by one or more bolts (46) passing through vertical through-slots (42) of the seismic mounting bracket and through-holes (44) of the magnet mounting;
wherein each seismic mounting bracket has a locking surface (50, 50a) that is locked with the locking surface of the magnet mounting by mating surface features of the respective locking surfaces of the magnet mounting and the seismic mounting bracket;
wherein the surface features of each respective locking surface of the magnet mounting and the seismic mounting bracket is periodic with a pitch P in the vertical direction.
10. The superconducting magnet assembly of claim 9 wherein the mating surface features of the respective locking surfaces (50, 60) of the magnet mounting (22) and the seismic

mounting bracket (30) comprise mating horizontal teeth spaced apart on each respective locking surface by the pitch P in the vertical direction.

11. The superconducting magnet assembly of any one of claims 9-10 wherein no adhesive is disposed between the locking surface (60) of the magnet mounting (22) and the locking surface (50) of the seismic mounting bracket (30).

12. The superconducting magnet assembly of any one of claims 9-11 wherein the seismic mounting bracket (30) further comprises:

a horizontal mounting plate (32) having an anchor-mount through-hole (34) sized to receive a threaded rod floor anchor (20).

13. The superconducting magnet assembly of claim 12 wherein the seismic mounting bracket further comprises:

an eccentric bushing assembly (70) disposed in the anchor-mount through-hole (34), the eccentric bushing assembly comprising nested outer and inner eccentric bushings (72, 74).

14. The superconducting magnet assembly of claim 13 wherein the seismic mounting bracket (30) further comprises:

a nut (36) threaded onto the threaded rod floor anchor (20) with a gap between the nut and the eccentric bushing assembly (70).

15. The superconducting magnet assembly of any one of claims 9-14 wherein each magnet mounting (22) comprises:

a locking plate (62) having the locking surface (60) of the magnet mounting.

16. A seismic mounting bracket assembly comprising:

a bracket (30) including a vertical plate (40) having one or more vertical through-slots (42) and a horizontal plate (32) having a through-hole (34) sized to receive a threaded rod floor anchor (20); and

nested outer and inner eccentric bushings (72, 74) disposed in the through-hole of the horizontal plate.

17. The seismic mounting bracket assembly of claim 16 further comprising:

a bracket-side locking surface (50, 50a) disposed on the vertical plate (40) and having surface features which are periodic in the vertical direction with a pitch P

18. The seismic mounting bracket assembly of claim 17 further comprising:

a component-side locking plate (60, 60a) locked with the bracket-side locking surface (50, 50a) by surface features of the component-side locking plate which are periodic in the vertical direction with the pitch P.

19. The seismic mounting bracket assembly of claim 18 wherein:

the surface features of the bracket-side locking surface (50) comprise horizontal teeth spaced apart by the pitch P; and

the surface features of the component-side locking plate (60) comprise horizontal teeth spaced apart by the pitch P that are interlocked with the horizontal teeth of the bracket-side locking surface.

20. A superconducting magnet assembly comprising:

a superconducting magnet (10) having a plurality of magnet mountings (22); and

a seismic mounting bracket assembly as set forth in any one of claims 16-19 supporting each magnet mounting wherein:

the bracket (30) of each seismic mounting bracket assembly is secured to the corresponding magnet mounting by one or more bolts (46) passing through the one or more vertical through-slots (42) of the vertical plate (40) of the bracket, and

the bracket of each seismic mounting bracket assembly is secured to a threaded rod floor anchor (20) passing through the through-hole (34) of the horizontal plate (32) of the bracket by a nut (36) threaded onto the threaded rod floor anchor (20).

21. The superconducting magnet assembly of claim 20 wherein the seismic mounting bracket (30) supporting each magnet mounting (22) has a gap separating the nut (36) threaded onto the threaded rod floor anchor (20) from the inner eccentric bushing (72) disposed in the through-hole (34) of the horizontal plate (32) of the bracket.

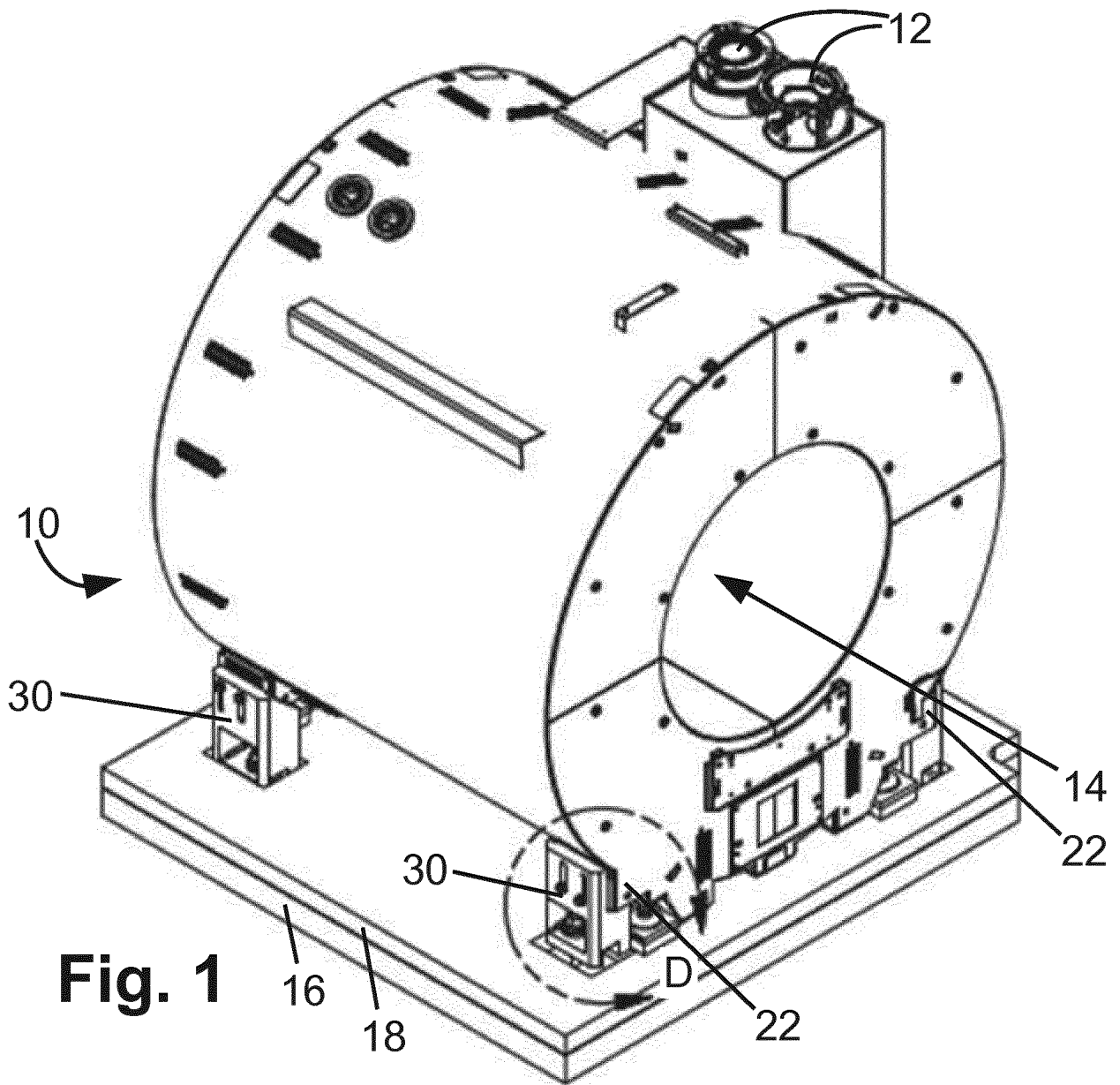


Fig. 1

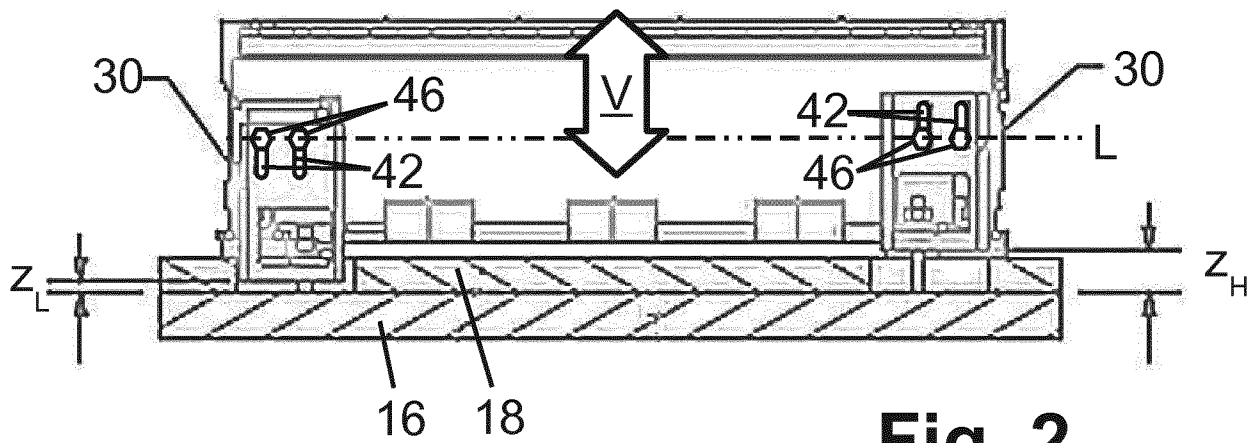


Fig. 2

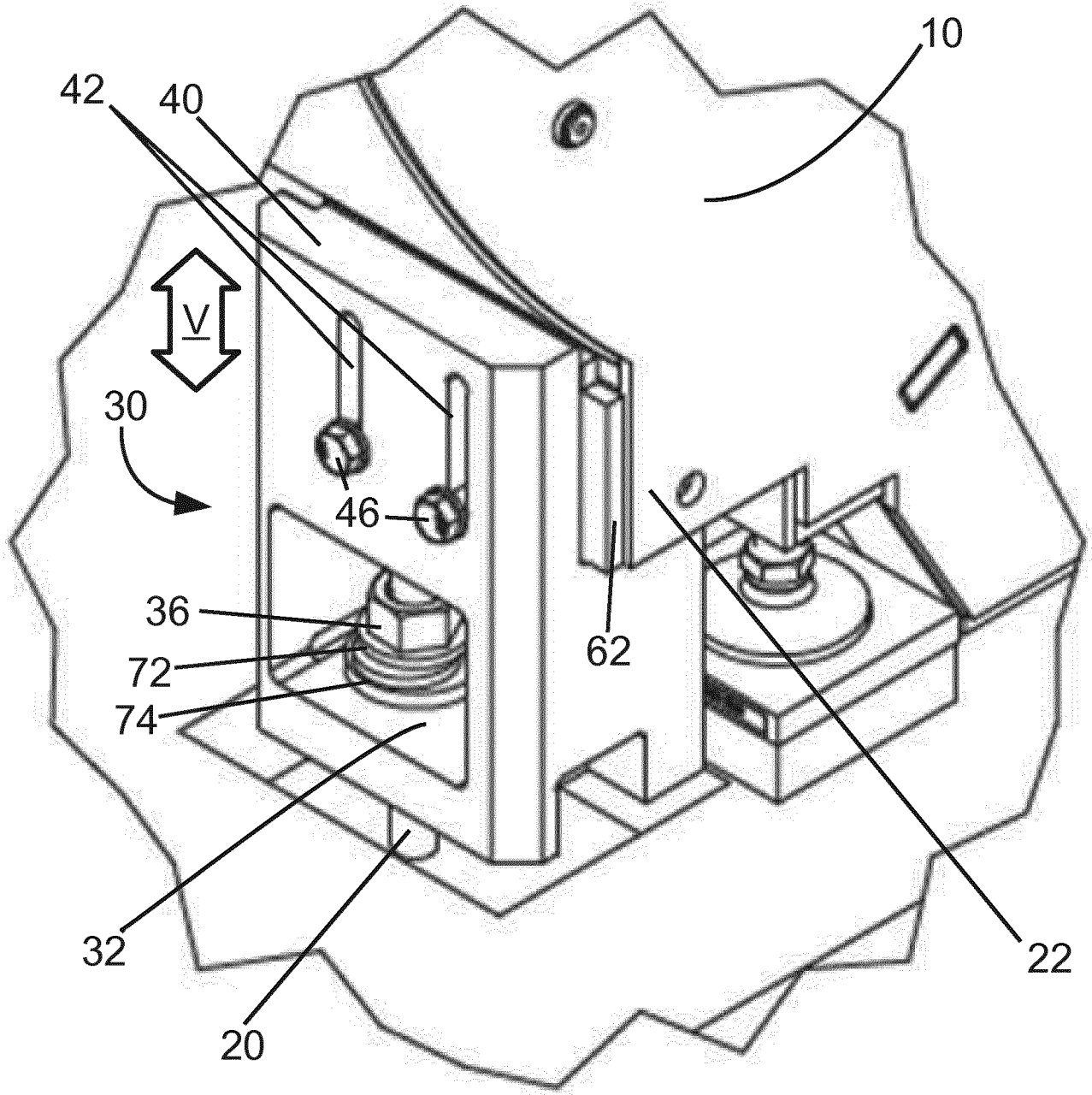


Fig. 3

DETAIL D

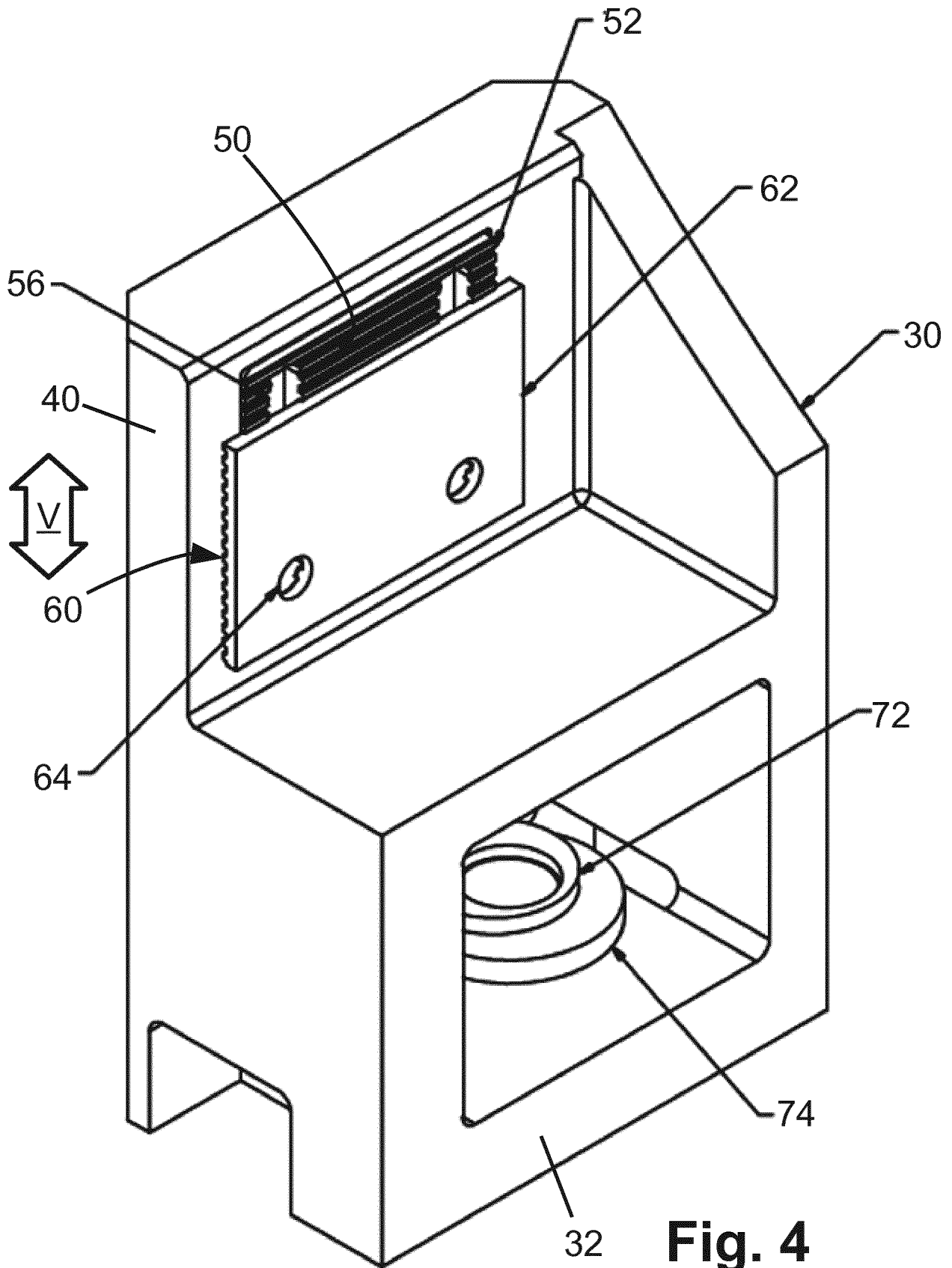
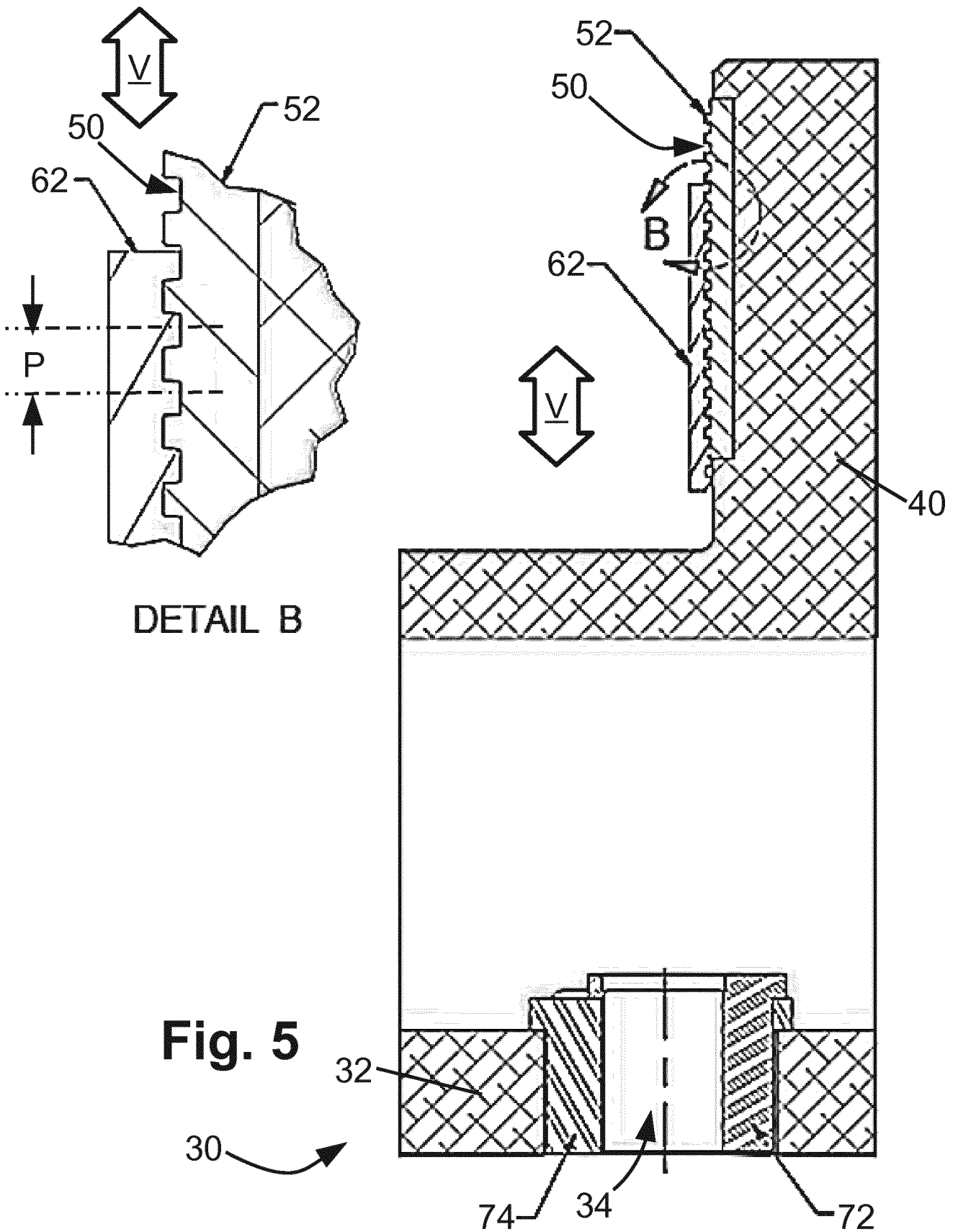
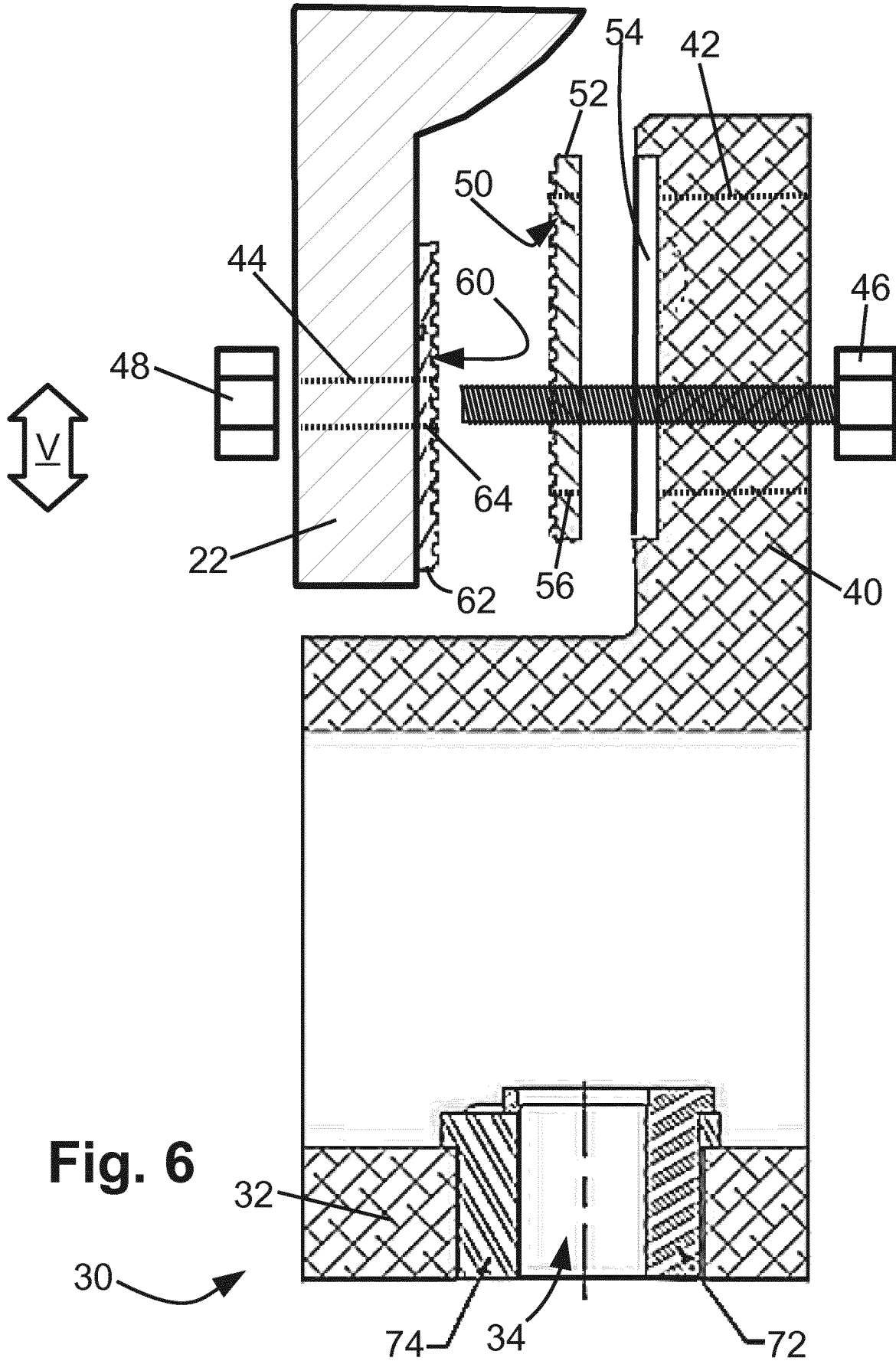


Fig. 4





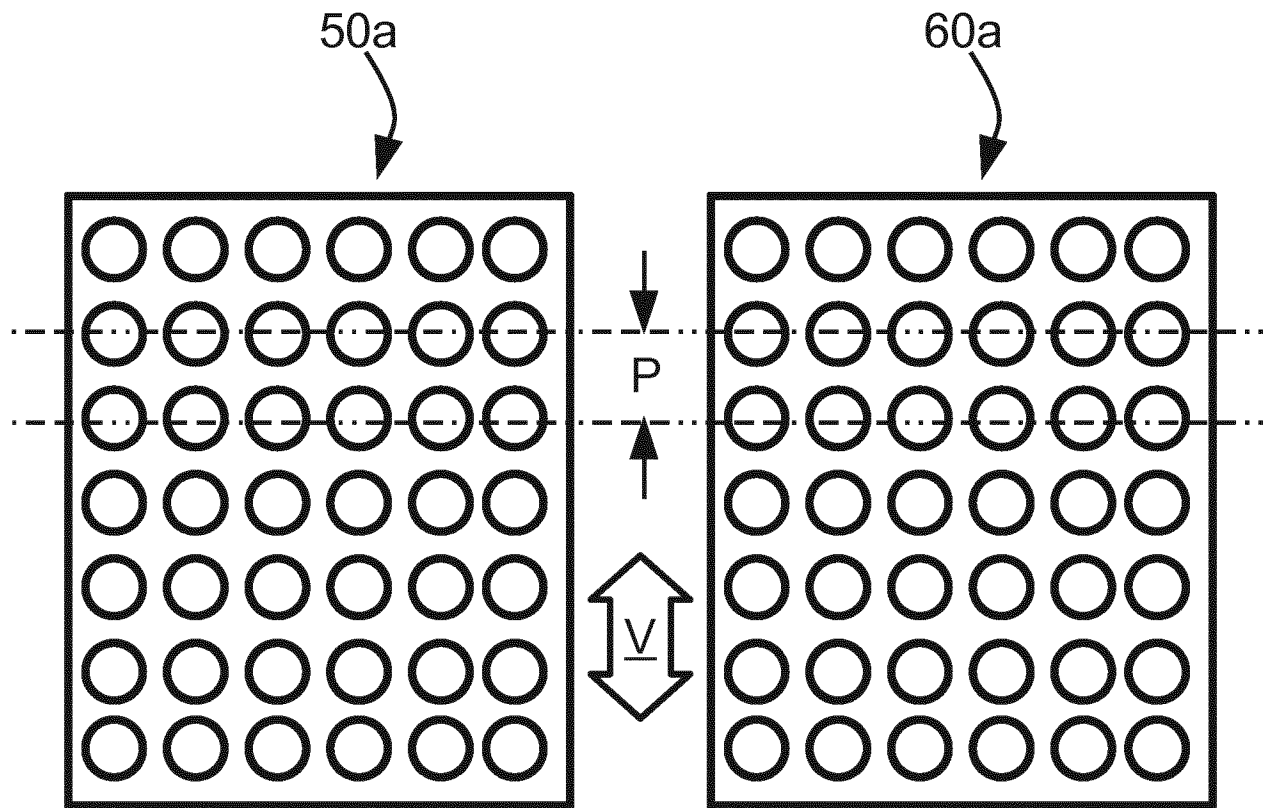


Fig. 7

Fig. 8

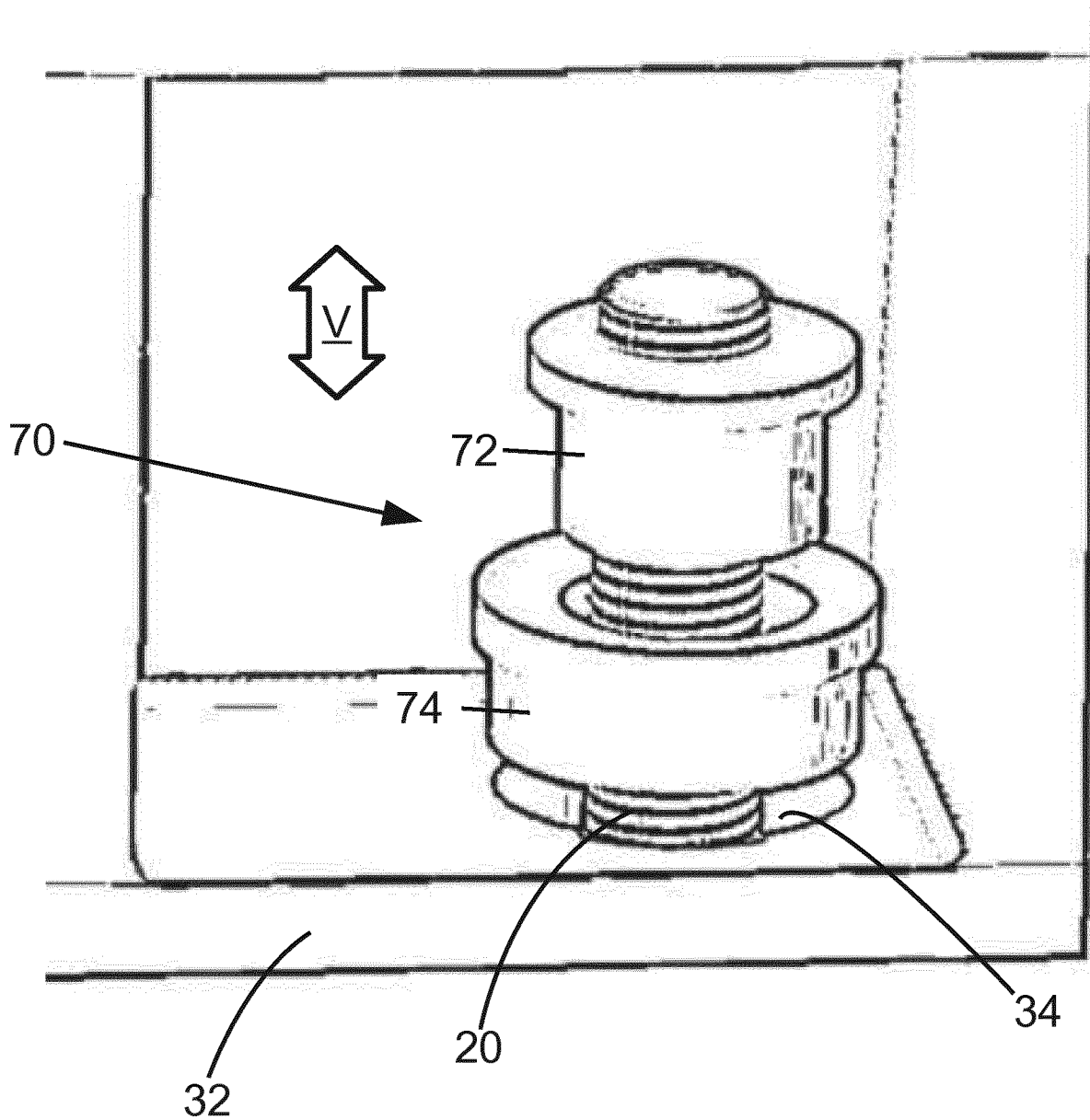


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/065669

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B1/24 A61B5/055 G01R33/38 F16B5/02 E04B1/38
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)
E04B A61B G01R F16B

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

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X	EP 1 388 620 A2 (HILTI AG [LI]) 11 February 2004 (2004-02-11)	1-4,6-8
Y	paragraph [0031] - paragraph [0045] figures	5,9-12, 15,17-19

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A	page 4, line 31 - page 8, line 17 figures	13,14

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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search 7 September 2017	Date of mailing of the international search report 15/09/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer López-García, G

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/065669

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	EP 0 457 285 A2 (TOSHIBA KK [JP]) 21 November 1991 (1991-11-21) column 4, line 14 - column 7, line 51 figures -----	1-21

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