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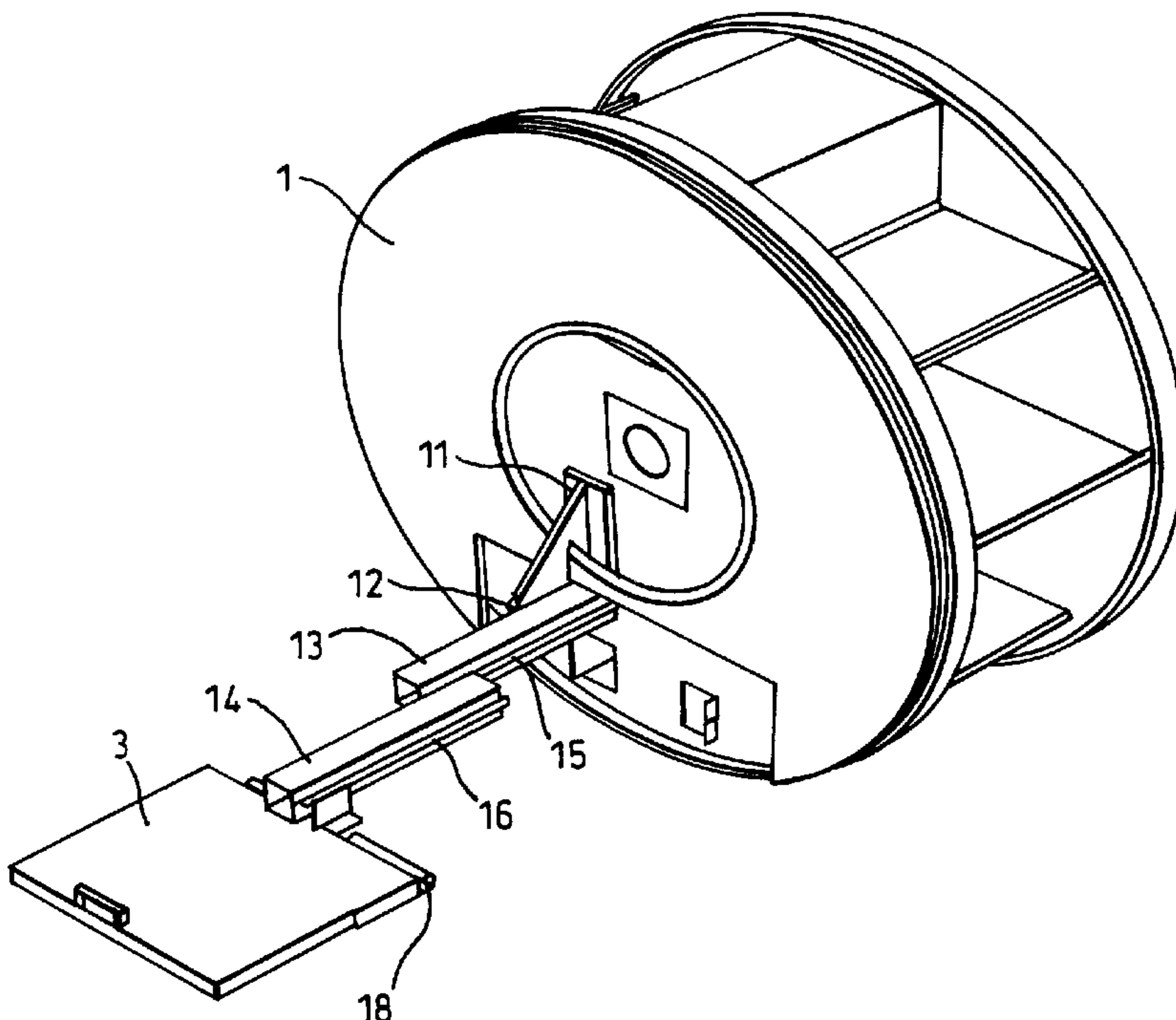
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(57) Abrégé/Abstract:

A surface mountable apparatus is provided for positioning an imaging device (3) relative to the gantry (1) of a radiation therapy apparatus. The apparatus comprises a mounting device (11) for mounting the apparatus on the gantry surface a telescopically extendable arm (13, 14) which is pivotally connected to the mounting device (11) and a holder (17) for holding an imaging device (3) the holder (17) being connected to the distal portion (14) of the telescopically extendable arm. The apparatus is mechanically simple and relatively inexpensive to manufacture. The apparatus when assembled to a radiation therapy apparatus provides an accurate and lightweight means of positioning and stowing an imaging device.

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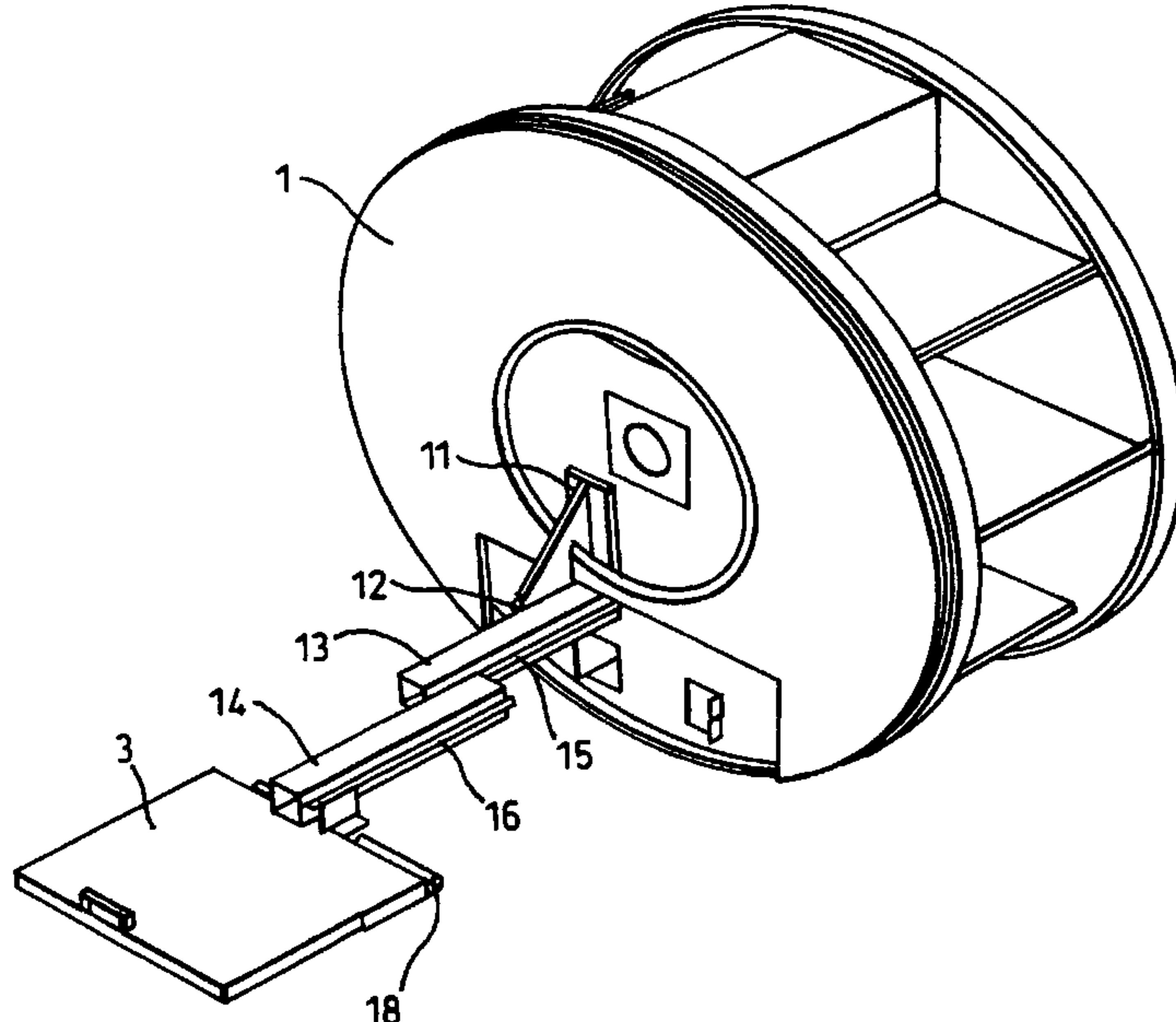
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(54) Title: PORTAL IMAGING DEVICE



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(57) **Abstract:** A surface mountable apparatus is provided for positioning an imaging device (3) relative to the gantry (1) of a radiation therapy apparatus. The apparatus comprises a mounting device (11) for mounting the apparatus on the gantry surface a telescopically extendable arm (13, 14) which is pivotally connected to the mounting device (11) and a holder (17) for holding an imaging device (3) the holder (17) being connected to the distal portion (14) of the telescopically extendable arm. The apparatus is mechanically simple and relatively inexpensive to manufacture. The apparatus when assembled to a radiation therapy apparatus provides an accurate and lightweight means of positioning and stowing an imaging device.

## PORTAL IMAGING DEVICE

This invention relates to radiation treatment apparatus, in particular portal imaging systems comprising a rotatable gantry, supported by a stand, a radiation emitting head coupled to the gantry and an imaging device for providing, in visual form, a representation of the radiation beam emitted from the head after it has passed through the object under treatment. In particular the invention relates to apparatus for mounting the imaging device on the gantry of the radiation treatment apparatus.

European Patent No. EP 0541717 identifies a problem with portal imaging devices, that being that in order for the lightweight boxes to cover a reasonable radiation field size, the construction of the detector enclosure has to be very bulky, this poses an inconvenience during patient set up and occupies space in the treatment room when not being used. Practical use of such devices has thus, historically been quite limited. That Patent goes on to describe an apparatus for mounting the imaging device to the gantry of a radiation treatment apparatus in which the imaging device is fixed to the end of a telescopically extendable holding means the holding means being arranged such that when not in use the majority of the holding apparatus and imaging device is retracted into the body of the gantry.

Whilst this arrangement provides a convenient means of storing the imaging device and associated mounting apparatus, the mounting apparatus is integral with the gantry of the radiation treatment apparatus and must therefore be built into the apparatus during manufacture. Additional disadvantages of this arrangement arise where parts of the mounting apparatus require repair maintenance or replacement. The arrangement also requires that space be found in the body of an already cumbersome piece of equipment to locate the collapsed mounting means.

Alternative mounting apparatus have been proposed which are surface mountable on the gantry of the radiation treatment apparatus. These arrangements

comprise an arm for holding the imaging device which is collapsible about one or more pivots. The arm itself is pivotally mounted on the surface of the gantry of the treatment apparatus and the imaging device is pivotally connected to the distal end of the arm the arrangement being such that the entire assembly can be folded flat to sit flush against the surface of the gantry.

In order to produce an accurate visual representation of the image it is essential that the imaging device is positioned and maintained in position accurately at a predetermined distance from the radiation emitting head. Thus, foldable mounting apparatus such as that described, is extremely difficult and expensive to engineer in practice and not always as accurate as may be desired.

It is therefore an object of the present invention to provide a mounting apparatus for mounting the imaging device on the gantry which alleviates some or all of the aforementioned disadvantages associated with the previously described mounting apparatus.

In accordance with the present invention there is provided apparatus for positioning an imaging device relative to the gantry of a radiation therapy apparatus comprising:

a mounting device for mounting the apparatus onto the gantry surface, a telescopically extendable arm pivotally connected to the mounting device, and a holder for holding an imaging device, the holder being connected to the telescopically extendable arm.

Conveniently, the arm may comprise two or more elongate elements arranged in slidable communication with each other. Optionally, the slidable communication is provided by means of one or more linear bearings located between the elongate elements. The elongate elements may optionally be arranged to slide one inside another or alternatively side by side. To provide optimum stability, the arm is preferably pivotally mounted substantially about its centre of mass. Most preferably the arm is

pivottally mounted substantially about the centre of mass of the arm and imaging device assembly.

Optionally, the holder is slidably mounted to slide along the extendable arm. This arrangement provides for more compact retraction of the arm and image device assembly as well as more freedom in positioning the image device relative to the radiation head. The holder may further comprise means for permitting linear motion of the imager device along an axis perpendicular to the longitudinal axis of the extendable arm. This arrangement provides a further degree of freedom in positioning the imaging device with respect to the radiation emitting head and when provided along with a slidably mounted holder provides for the imaging device to be easily locatable about a relatively large area.

As a further option, the apparatus may be provided with means for moving the image device radially along the surface of the gantry, toward and away from its centre point. Such means may comprise, for example, a slider on the surface of the gantry or a pivot and linkage system connecting the components of the apparatus.

Preferably the holder is detachable from the imaging device, permitting the imaging device to be removed for storage or replacement. Preferably, the holder has means for locking the position of the imaging device when the device is located within the holder.

In order to permit a further degree of freedom in positioning the imaging device, the holder may optionally comprise a rotating means for rotating the imaging device about an axis parallel to the longitudinal axis of the extending arm.

Preferably the apparatus is provided with counterbalancing means such that the arm and/or the arm and image device assembly can be held under gravity in any given angular position relative to the surface of the gantry.

Optionally, the apparatus may be activated by mechanical means, in particular,

where the apparatus is provided with counterbalancing means, the sliding and rotational movements may be actuated by a simple lower power means.

Thus it can be seen that the invention provides a mechanically simple and inexpensive means of positioning an imaging device relative to the gantry of a radiation therapy apparatus. As the arrangement is surface mountable it can be fixed to existing equipment and can easily be maintained repaired or replaced. Apparatus according to the invention will operate at any given positional rotation of the gantry. Thus, two or more apparatus according to the present invention may be provided on any single given gantry of the radiation therapy apparatus. For example, two such apparatus may be disposed at two positions about the gantry of a radiation therapy apparatus a first position being commensurate with a megavolt measurement of the radiation image and the second position being commensurate with a kilovolt measurement of the radiation image. In this arrangement where the holder of the apparatus is provided to be detachable from the imaging device, a single imaging device may be transferred between the two apparatus according to the present invention to obtain both megavolt and kilovolt measurements.

A particular advantage of this arrangement is provided where the pivot about which the arm is mounted is offset from the end of the arm, this enables the arrangement to be self counter balancing when retracted and minimises any movement about the arm when extended. The inherent stability of this arrangement means that the forces to be overcome on extension and retraction are primarily frictional or inertial and can easily be overcome either manually or with simple electro-mechanical actuation devices.

It is also to be appreciated that the small framed lightweight arrangement is easy to manoeuvre around even when partially stowed.

The invention will now be further described by way of example with reference to the Figures, in which:-

Figure 1 shows an apparatus for positioning an imaging device relative to the gantry of radiation therapy apparatus substantially as described in European Patent EP 0541717;

Figure 2 shows a schematic of the surface mountable folding apparatus also described above;

Figure 3 shows an embodiment of the present invention in its fully extended position in both a perspective and side view;

Figure 4 shows the embodiment of Figure 3 in a partially retracted position;

Figure 5 shows the embodiment of Figure 3 with the arms and imaging device fully retracted;

Figure 6 shows how the fully retracted arm and imaging device rotate about a centre of mass to be stowed flat against the gantry surface;

Figure 7 illustrates the embodiment of Figure 3 in a fully stowed and retracted position in both a perspective and side view;

Figure 8 shows how the embodiment can operate at an alternative gantry rotation.

In Figure 1 a gantry 1 of a radiation therapy apparatus is provided with a radiation head 2 and diametrically opposed to the radiation head is an imaging device 3 connected to a telescopic arm 4, 5 which is retractable into a cavity 6 within the gantry 1. The arm comprises two concentrically aligned tubes 4, 5 slidable one within the other along an axis A. Imaging device 3 is pivotally mounted about a point 7 to the distal end of tube 4. The arrangement is shown in fully extended position, but it can be seen that retraction of tube 4 along tube 5 into cavity 6 and pivoting of imaging device 3 about pivot 7 allows the assembly to be retracted and stowed in a position

flush with the surface of the gantry 1 of the radiation therapy apparatus.

In Figure 2 the gantry 1 of a radiation therapy apparatus has pivotally connected thereto a jointed arm 8, 9 which is further connected to an imaging device 3 about a pivotal joint 10. Figure 2a shows the arrangement partially extended and Figure 2b shows the arrangement fully retracted.

In Figure 3, a gantry 1 of a radiation therapy apparatus has fixed thereto a mounting plate 11 to which, by means of pivot 12, telescopically extending arm 13, 14 is attached. The telescopically extending arm comprises two tubes, 13 and 14, which in this embodiment are of substantially rectangular cross-section but may be of any other suitable cross-section arranged to slide side by side by means of linear bearing 15. Slidably connected to the distal portion 14 of the slidable arm is an imaging device holder 17 which is slidable along linear bearing 16. Mounted on the holder 17 is an imaging device 3. Imaging device 3 is slidable with respect to holder 17 by means of linear bearing 18.

As can be seen from the Figure the imaging device 3 is free to move along two perpendicular axes defined by linear bearings 16 and 18.

In Figure 4, the distal portion 14 of the extendable arm 13, 14 has been moved towards the surface of gantry 1 by means of linear bearing 15. Movement of the slidable arm 14 in linear bearing 15 together with movement of linear bearing 18 of holder 17 allows the imaging device 3 to be locatable about a relatively large viewing area.

In Figure 5 holder 17 has been moved from a relatively distal to a relatively proximal position on the extendable arm 13, 14 drawing the imaging device 3 closer to the surface of the gantry 1. This partially retracted position provides more convenient access to the patient during treatment.

Figure 6 illustrates how the apparatus, fully retracted as shown in Figure 5, can

be pivoted about pivot 12 towards a stowing position substantially flush with the surface of gantry 1.

Finally, Figure 7 illustrates the apparatus in fully stowed position.

The foregoing describes only one embodiment of the invention to aid understanding and is not intended to be in any way limiting from the true scope of the invention as defined in the appended claims.

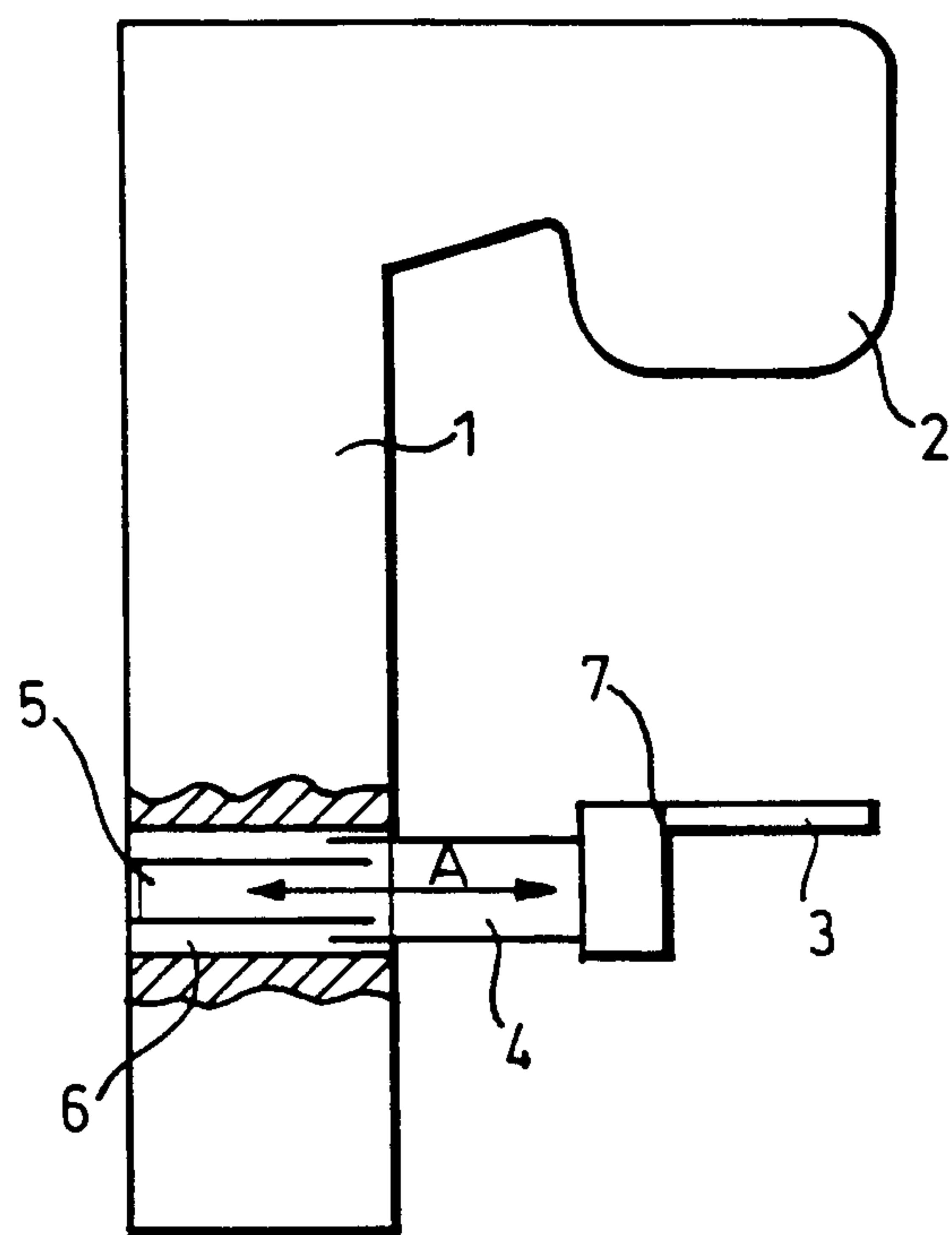
CLAIMS

1. Apparatus for positioning an imaging device relative to the gantry of a radiation therapy apparatus comprises a mounting device for mounting the apparatus on the gantry surface, a telescopically extendable arm pivotally connected to the mounting device and a holder for holding an imaging device, the holder being connected to the distal portion of the telescopically extendable arm.
2. Apparatus as claimed in claim 1 wherein the arm comprises two or more elongate elements in slidable communication with each other.
3. Apparatus as claimed in claim 2 wherein the slidable communication is provided by one or more linear bearings between the elongate elements.
4. Apparatus as claimed in claim 2 or claim 3 wherein the elongate elements do not share a common central axis.
5. Apparatus as claimed in any preceding claim wherein the arm is pivotally mounted substantially about its centre of mass.
6. Apparatus as claimed in any one of claims 1 to 4 wherein the arm is pivotally mounted substantially about the centre of mass of the arm and imaging device assembly.
7. Apparatus as claimed in any preceding claim wherein the holder is slidably mounted to slide along the extendable arm.
8. Apparatus as claimed in any preceding claim wherein the holder comprises means for sliding the image device along an axis perpendicular to the longitudinal axis of the extendable arm.
9. Apparatus as claimed in any preceding claim wherein the holder is detachable

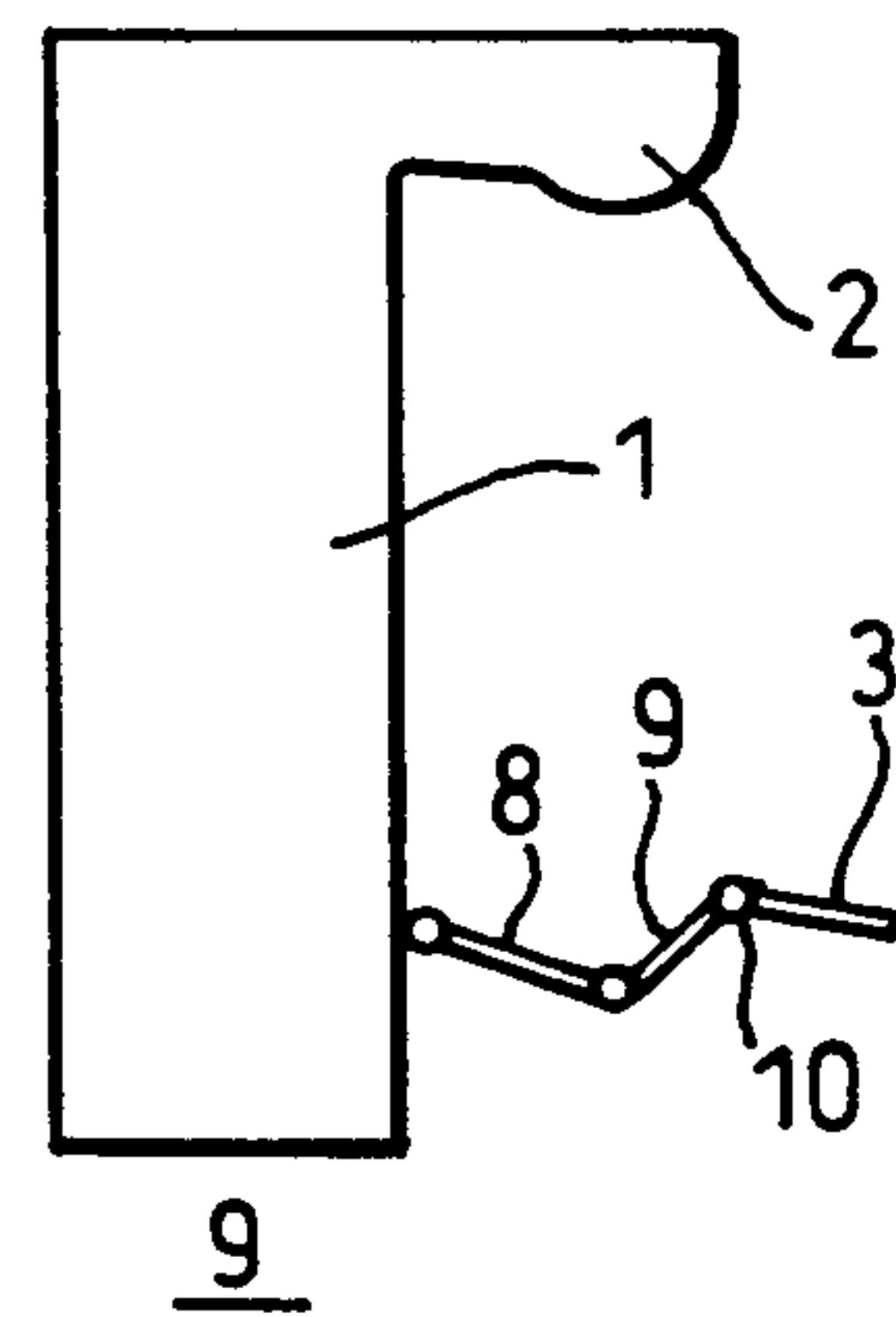
from the imaging device and/or the extendable arm.

10. Apparatus as claimed in any preceding claim wherein the holder comprises means for locking the position of the imaging device.
11. Apparatus as claimed in any preceding claim further comprising means for rotating the imaging device about an axis parallel to longitudinal axis of the extendable arm.
12. Apparatus as claimed in any preceding claim comprising a counterbalancing means for holding the extendable arm under gravity in any given angular position relative to the surface of the gantry.
13. Apparatus substantially as described herein with reference to Figures 2 to 8.
14. Apparatus as claimed in any preceding claim wherein the apparatus is actuated by mechanical or electro-mechanical means.
15. A radiation therapy apparatus comprising apparatus for positioning an imaging device substantially as described in any preceding claim.
16. A radiation therapy apparatus comprising two or more apparatus as claimed in any one of claims 1 to 13.

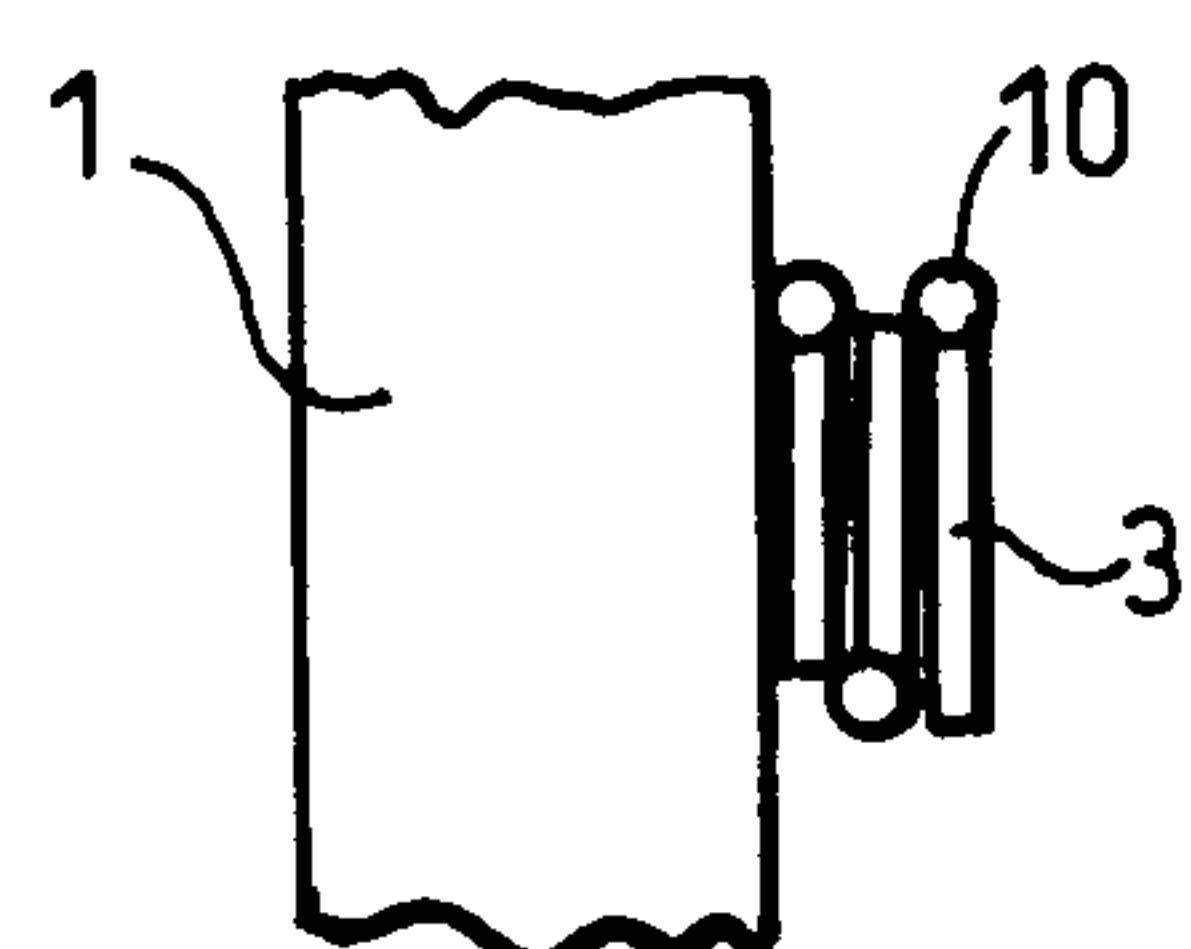
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*Fig.1.*



*Fig.2a.*



*Fig.2b.*

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*Fig. 3a.*

11

12

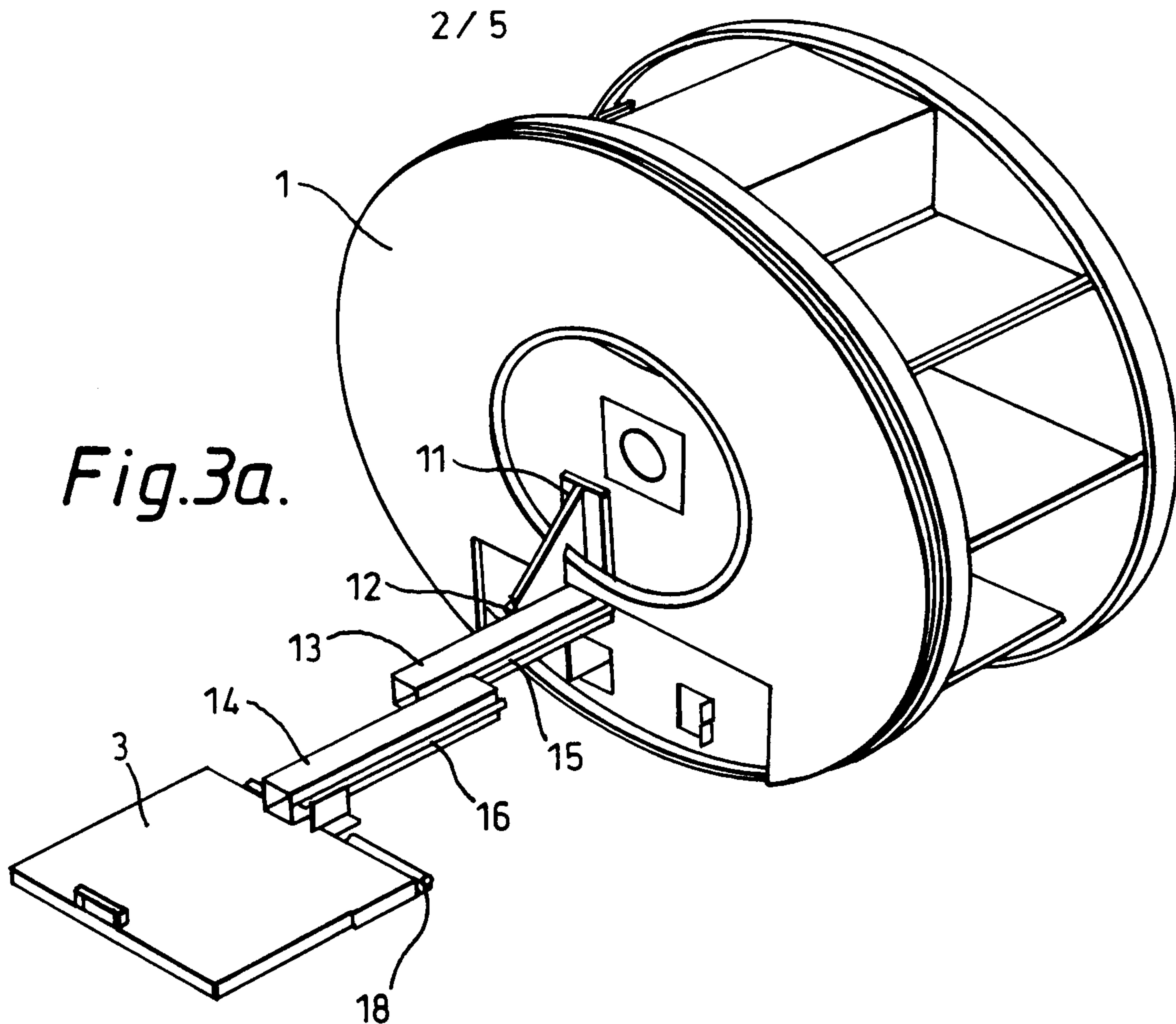
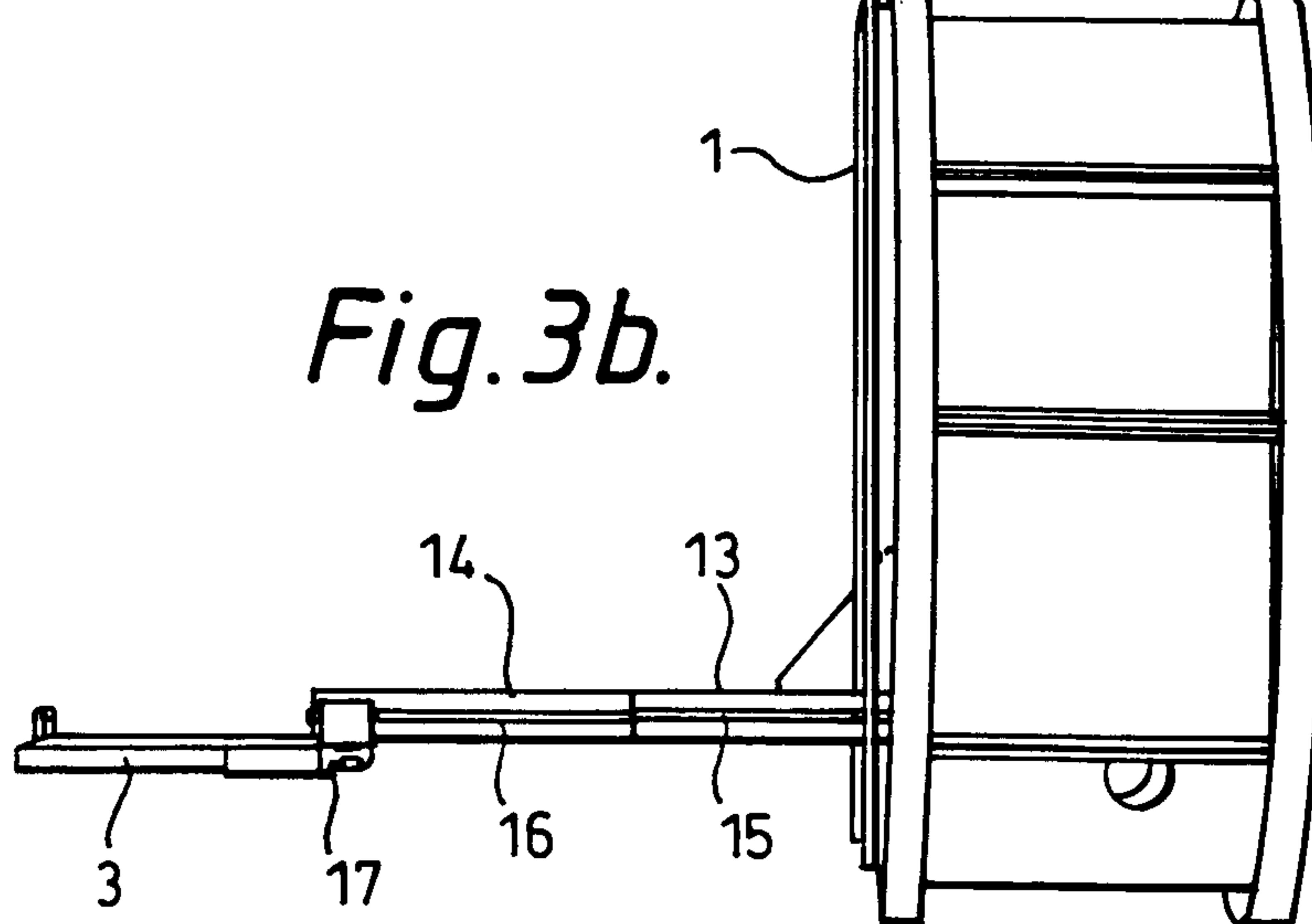
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14

15

16

18

*Fig. 3b.*

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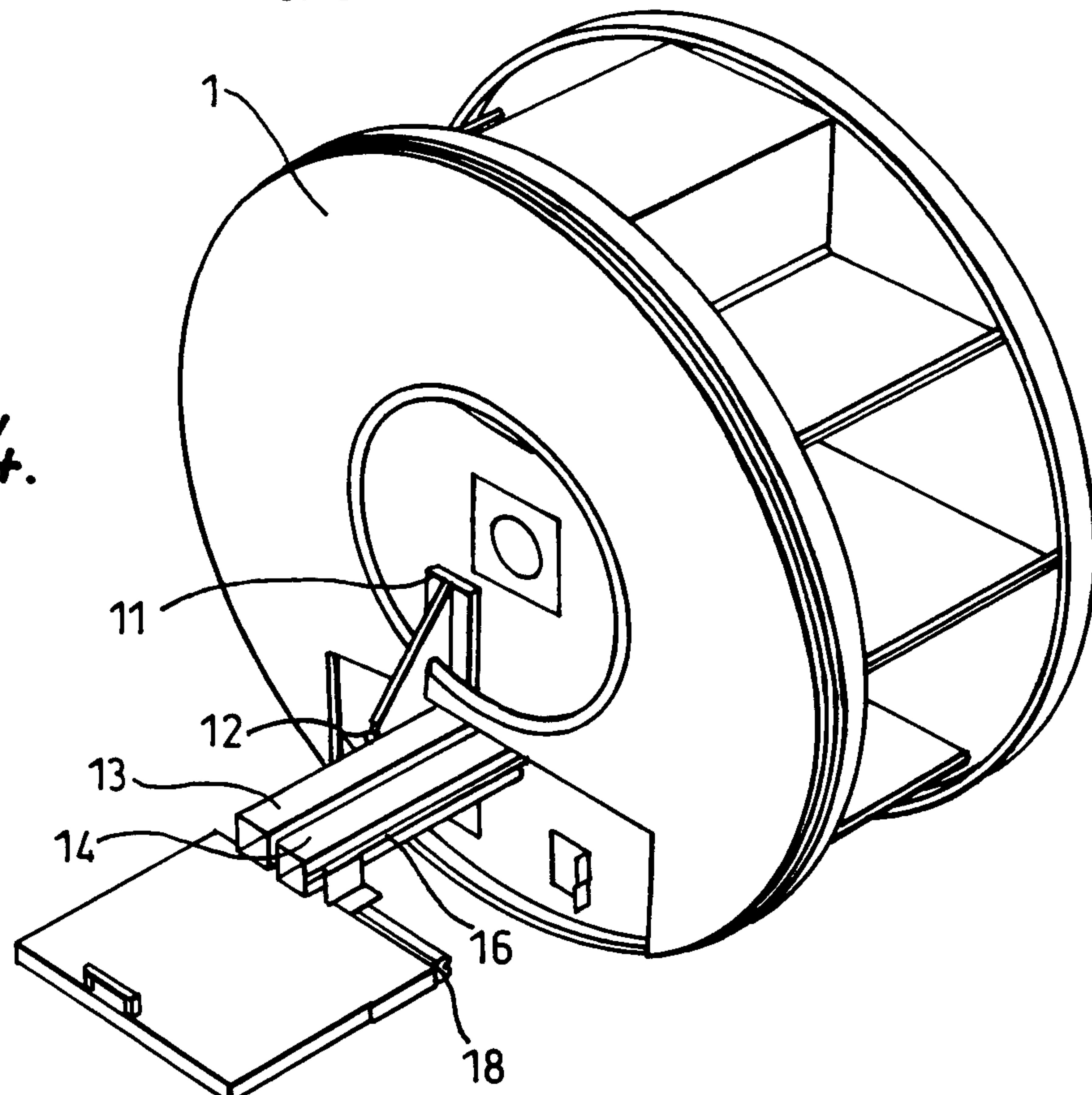
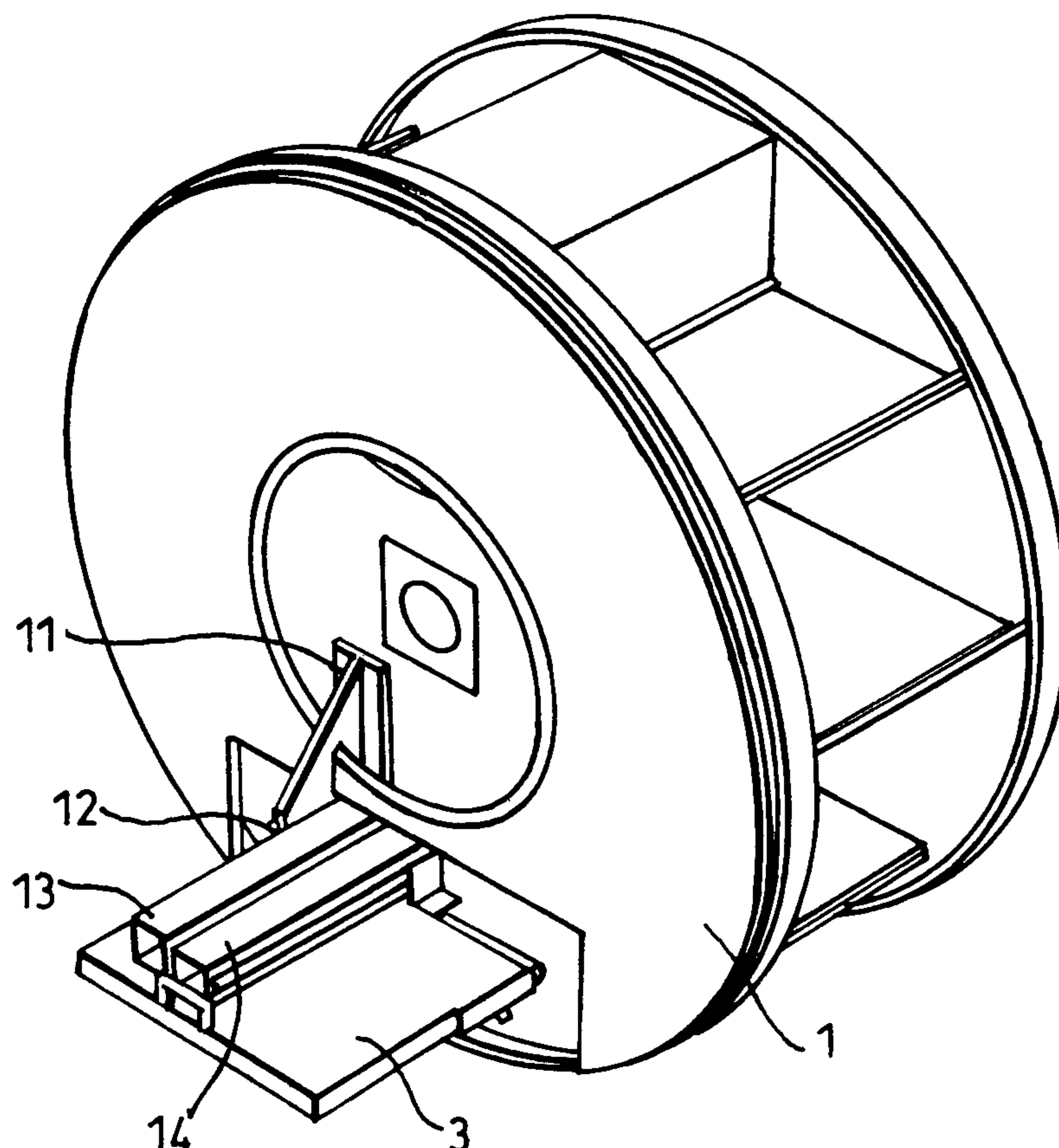


Fig. 4.



*Fig. 5.*

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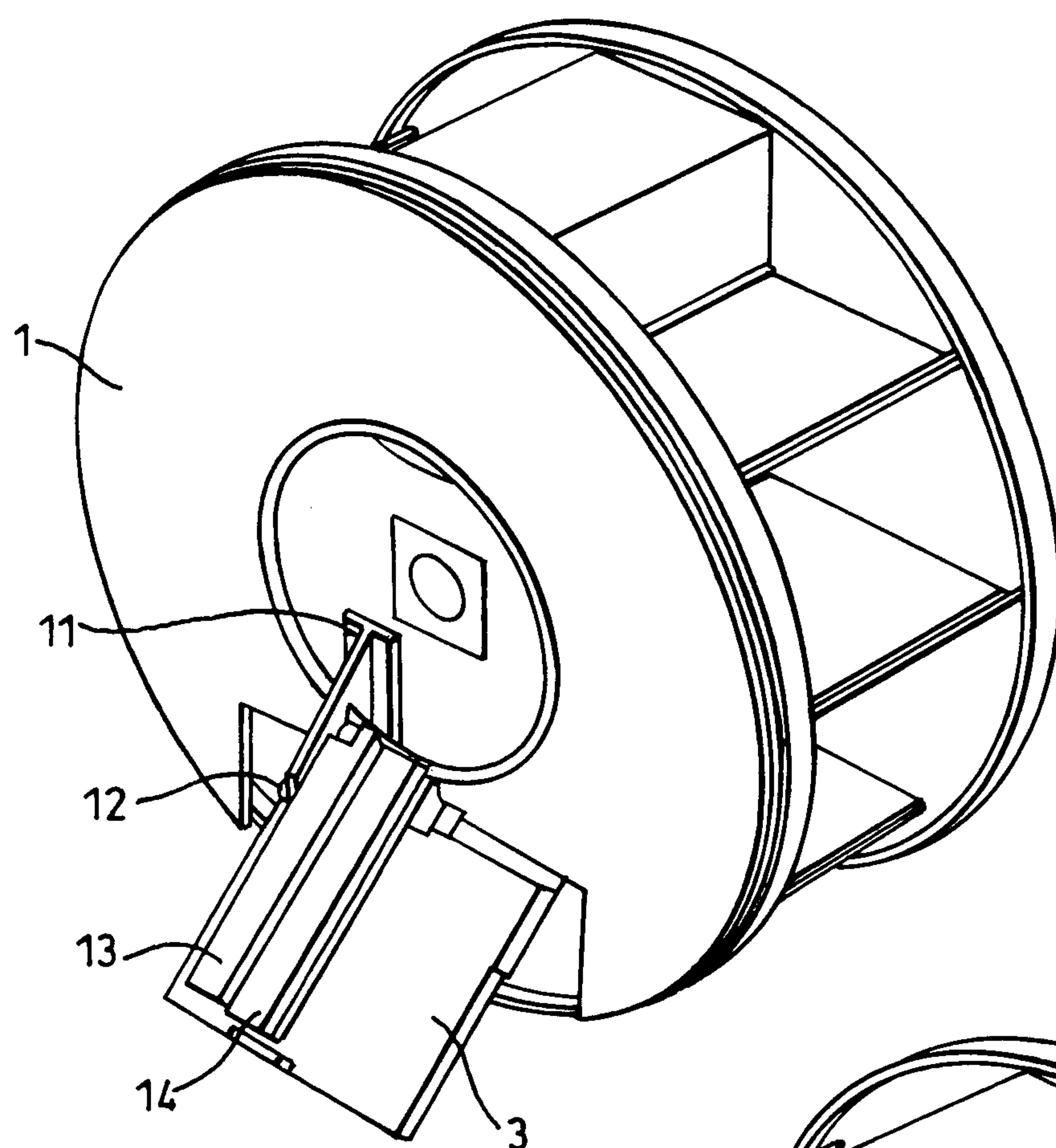


Fig.6.

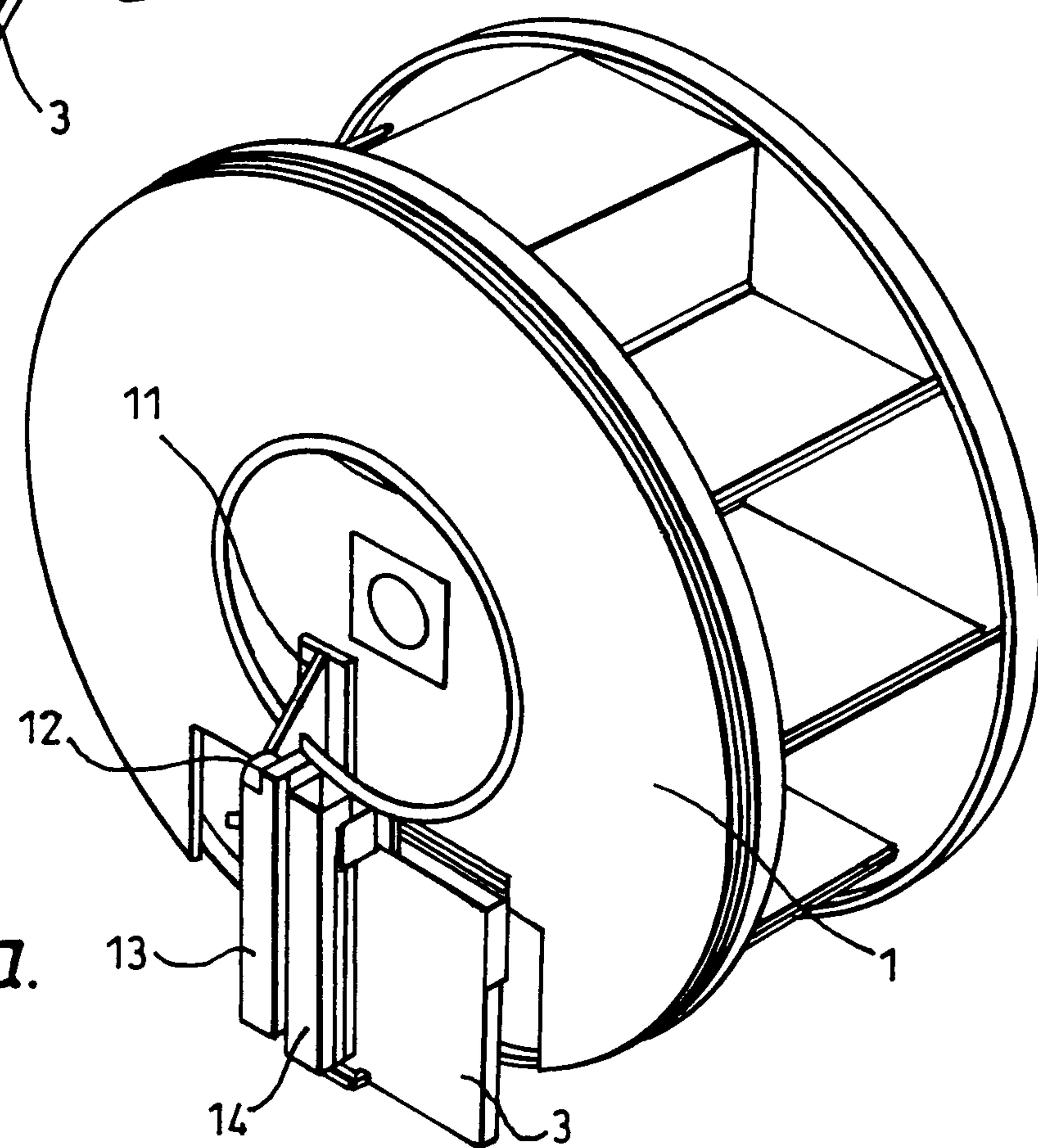


Fig.7a.

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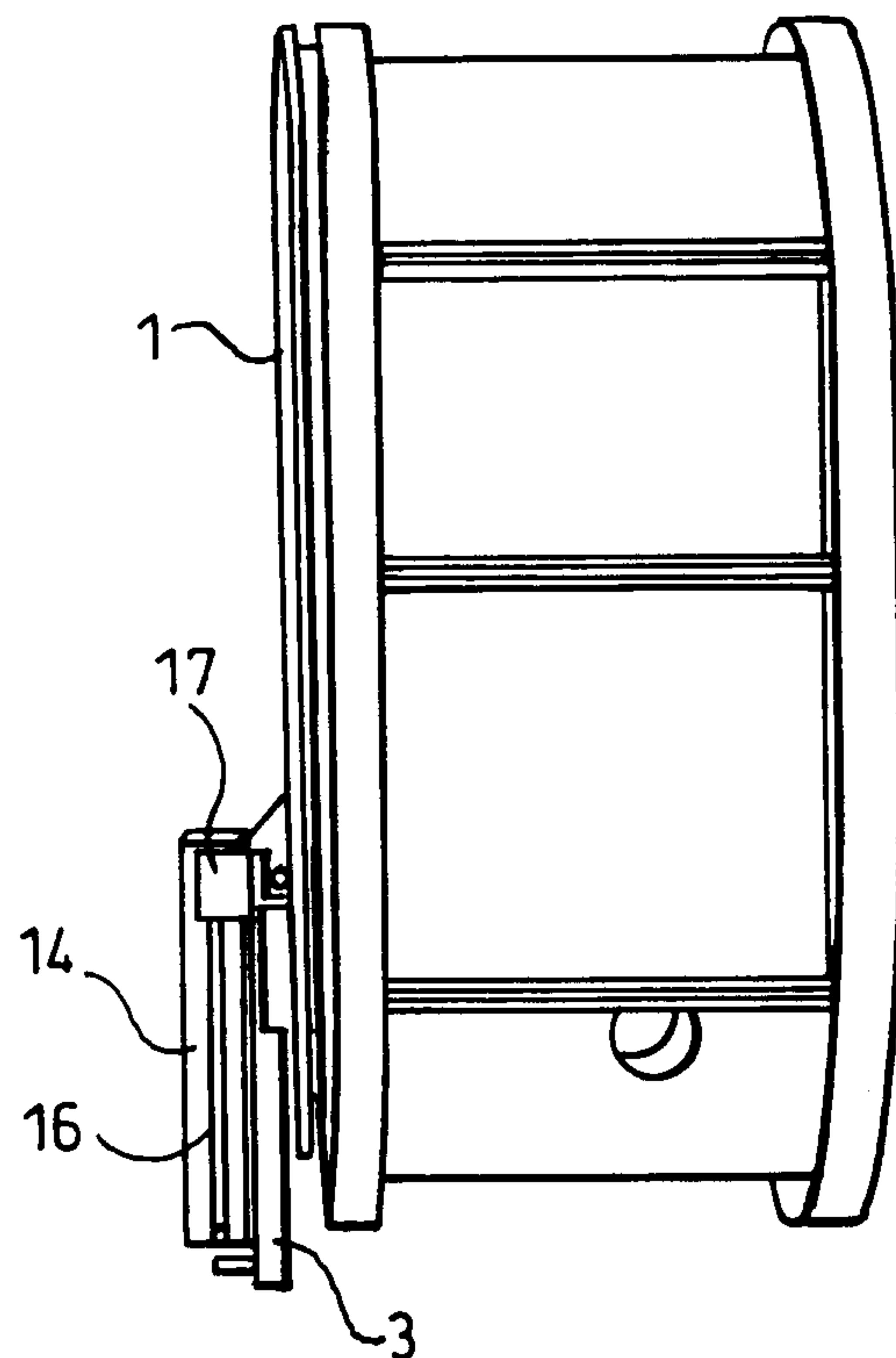
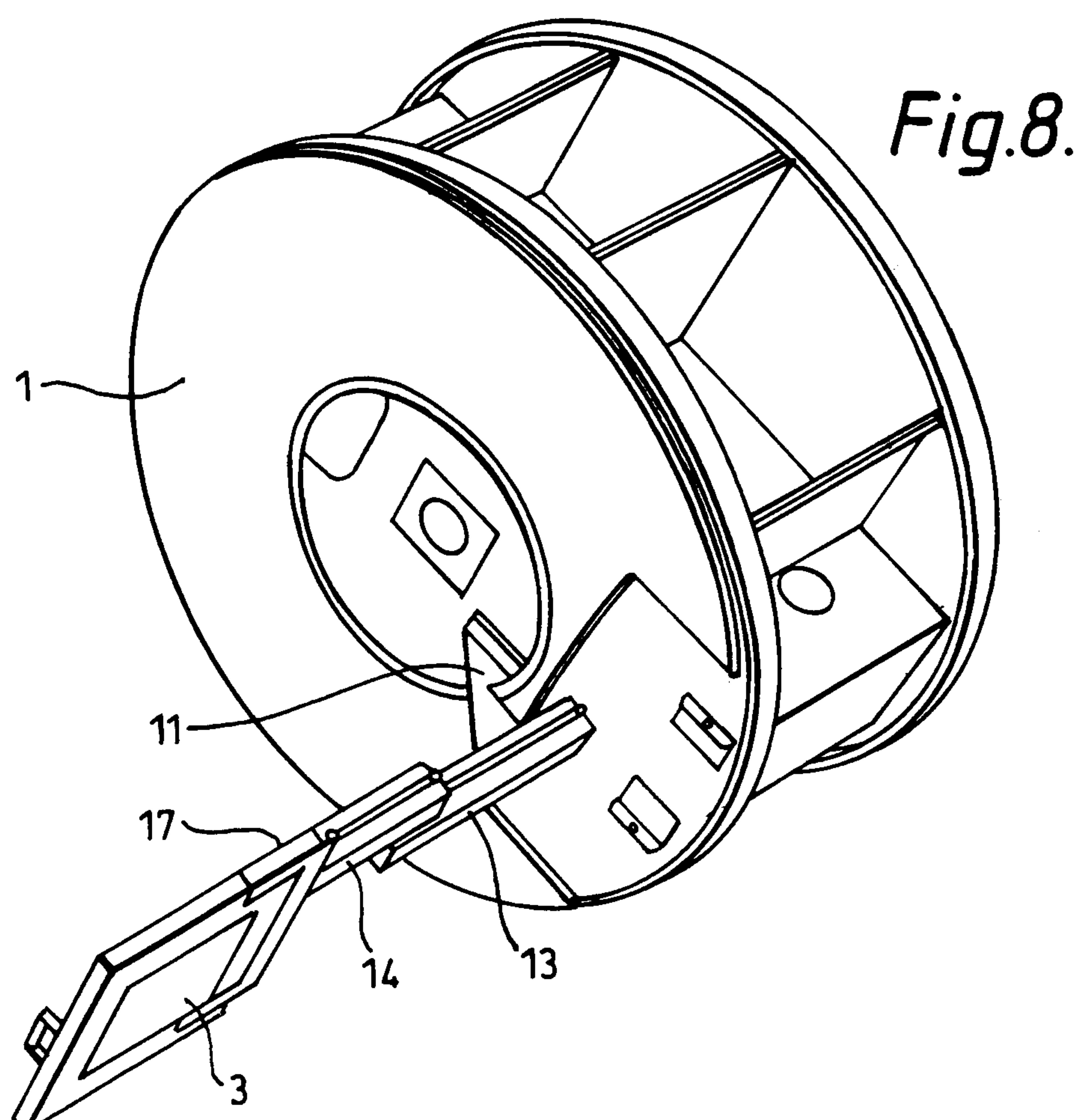


Fig. 7b.



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