OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,085,295**

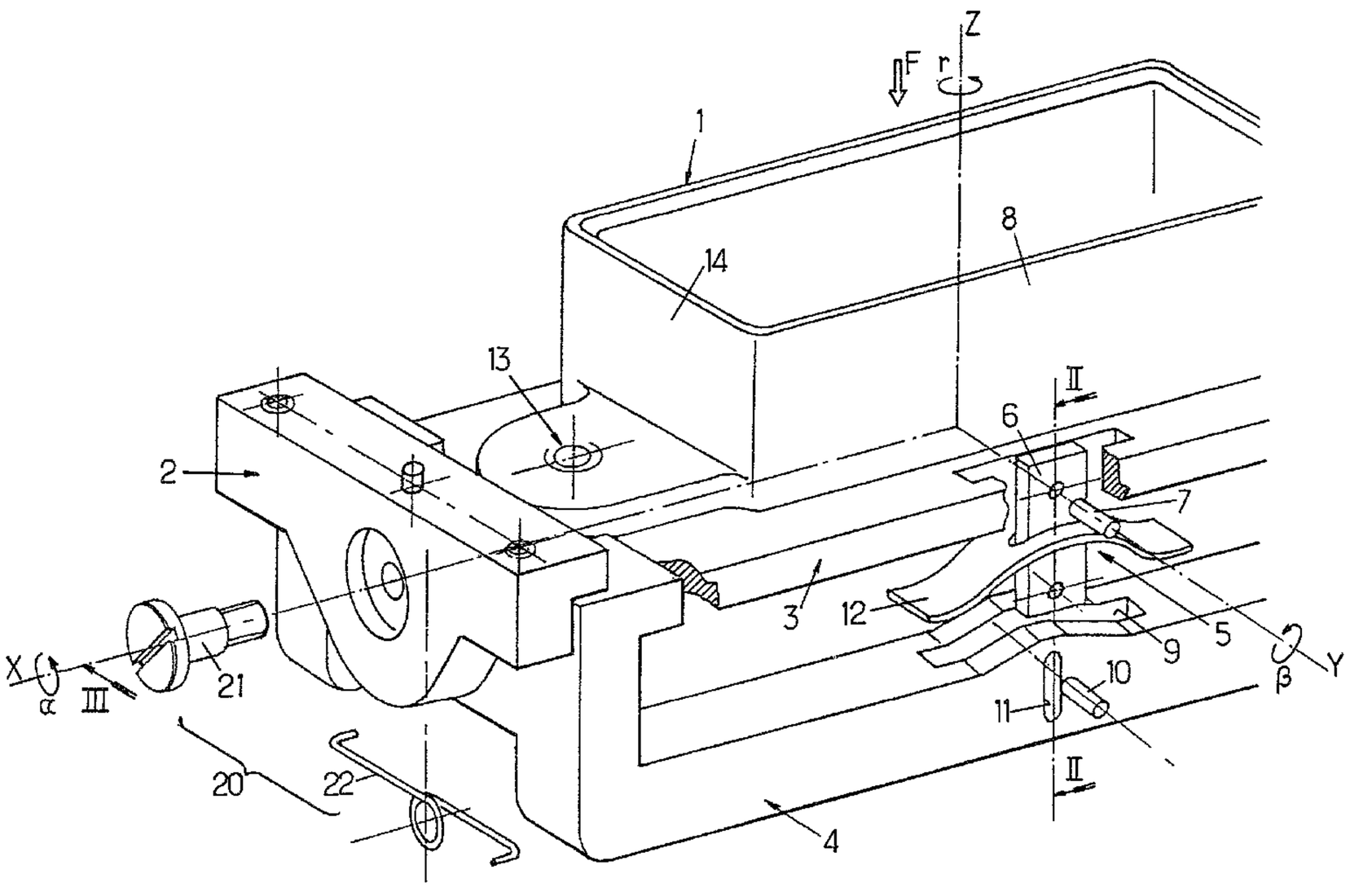
(22) 1992/12/14
(43) 1993/06/19
(45) 2001/05/15

(72) Villiers, Gérard, FR
(72) Dohan, Yves, FR
(73) FRAMATOME CONNECTORS FRANCE, FR

(51) Int.Cl.[5] H01R 13/46
(30) 1991/12/18 (91 15728) FR

(54) **PARTIE DE CONNECTEUR ELECTRIQUE PERMETTANT D'ASSUJETTIR LE CONNECTEUR A UN ELEMENT DE SUPPORT DE FACON FLOTTANTE**

(54) **ELECTRICAL CONNECTOR PORTION SUITABLE FOR FIXING IN FLOATING MANNER ON A SUPPORT MEMBER**



(57) An electrical connector portion that is fixable in floating manner to a support (2), where the connector portion includes a body (1) that is polygonal in cross-section, with link means (5, 13, 20) imparting six degrees of freedom to the body (1) relative to the support, and with resilient return means (12, 19, 22) for returning the body (1) to an equilibrium position relative to each degree of freedom. There are first link means (5) between the body (1) and the support (2) comprising first link means (6, 7) in rotation conferring one degree of freedom in rotation about an axis (Y) perpendicular to the coupling direction, and link means (9, 10, 11) in translation conferring one degree of freedom in translation along an axis (Z) parallel to the coupling direction.

2085295

A B S T R A C T

An electrical connector portion that is fixable in floating manner to a support (2), where the connector portion includes a body (1) that is polygonal in cross-section, with link means (5, 13, 20) imparting six degrees of freedom to the body (1) relative to the support, and with resilient return means (12, 19, 22) for returning the body (1) to an equilibrium position relative to each degree of freedom. There are first link means (5) between the body (1) and the support (2) comprising first link means (6, 7) in rotation conferring one degree of freedom in rotation about an axis (Y) perpendicular to the coupling direction, and link means (9, 10, 11) in translation conferring one degree of freedom in translation along an axis (Z) parallel to the coupling direction.

AN ELECTRICAL CONNECTOR PORTION SUITABLE FOR FIXING IN FLOATING MANNER ON A SUPPORT MEMBER

The present invention relates to improvements to electrical connectors comprising two connector portions of polygonal cross-section supported by respective support members and suitable for mutual coupling and uncoupling when the two support members are moved towards each other or away from each other in a direction that is approximately parallel to the coupling direction of said connector portions.

More precisely, the invention seeks to improve an electrical connector portion organized to be fixed in floating manner to a first support member, said connector portion comprising a first body of polygonal cross-section and suitable for coupling and decoupling with a second body of a complementary connector portion secured to a second support member respectively when the first and second support members are moved towards each other and apart from each other along a direction approximately parallel to a coupling direction of the two connector portions, the connector portion comprising, interposed between the first body and the first support member, link means organized to impart six degrees of freedom to the first body, namely three degrees of freedom in translation along three directions that are substantially mutually orthogonal, one of the directions coinciding substantially with the coupling direction, and three degrees of freedom in rotation about the three above-mentioned directions, with resilient return means being associated with the link means to return the first body to an equilibrium position for each degree of freedom.

When the two connector portions are coupled together while their respective support members move towards each other and dock, achieving proper coupling depends on whether the support members are in the proper relative positions. When it is possible for them to be mutually

inclined and/or offset transversely within predetermined ranges of values, coupling between the connector portions needs to be achieved properly in spite of such unfavorable circumstances. This

situation arises in particular when the connectors are situated in environments that are critical or hostile (e.g. in space) so that connection or disconnection of the connector portions must be performed under remote control, being performed, for example, by means of the arm of a robot.

In general terms, the solution to this problem is known and consists in imparting to at least one of the two connector portions to be coupled together a certain amount of freedom of movement relative to its support, such that displacement thereof after it comes into contact with the other connector portion causes the axes of the two connector portions to be brought substantially into coincidence.

Practical solutions have been provided for connectors that are generally in the form of right circular cylinders, and these solutions which make use of a plurality of coaxial boxes or box portions supported by springs make it possible to achieve proper coupling even when the two connector portions are presented to each other without being in strict alignment.

However, with such cylindrical connectors, the number of degrees of freedom to be controlled is relatively small because of the axial symmetry in the shape of the connector, so known solutions in this context remain technologically simple.

In contrast, the problem becomes considerably more complicated when the connector is polygonal in section and for which a transverse offset may be combined with mutual inclination of the two connector portions to be coupled together, thus requiring up to six degrees of freedom to be controlled (three degrees of freedom in translation and three degrees of freedom in rotation). The problem becomes even more complex when the connector is of highly elongate polygonal section (commonly rectangular in section with long sides that are much longer than the short sides). Any attempt to couple together the two connector portions if they are presented to each other with their respective long sides mutually inclined is almost certain to lead to one of the connector portions jamming in the other, or even to them being damaged.

The large number of parameters to be controlled when using polygonal section connectors, in particular highly elongate connectors, means that known solutions for cylindrically shaped connectors are ineffective and unsuitable for being transposed.

An essential object of the invention is thus to provide a concrete solution for organizing a polygonal section connector portion that is mounted in floating manner with six degrees of freedom (namely three degrees of freedom in translation and three degrees of freedom in rotation) on a support member in such a manner as to ensure proper coupling between two connector portions even when presented to each other with their long dimensions mutually inclined, and even when the connector portions are highly elongate in section.

To this end, an electrical connector portion as defined above and organized in accordance with the invention is essentially characterized in that it comprises first link means interposed between the above mentioned first body and the above mentioned first support member, and comprising:

first link means in rotation interposed between the first body and the first support member and organized to enable the first body to rotate about an axis which is substantially perpendicular to the coupling direction;

first resilient return means in rotation for returning the first body to an equilibrium position relative to the first support member;

first link means in translation interposed between the first body and the first support member and organized to enable the first body to move in translation relative to the first support member along a direction approximately parallel to the coupling direction; and

first resilient return means in translation for returning the first body to an equilibrium position in which it is spaced apart from the first support member, the first resilient return means in translation being

rated so as to come into play when the first body is subjected to a force in the coupling direction which is greater than a coupling force between the two portions of the connector.

Because of the organization of the invention, the body of the connector portion presents a degree of freedom in rotation about an axis that is approximately perpendicular to the coupling direction (and thus to the long sides of the body when it is rectangular in section), and it is possible to couple properly with the complementary connector portion even though the connector portions are presented so that they are inclined relative to each other transversely to said axis (in particular with their respective long sides being mutually inclined when the bodies are rectangular in section). The body of the connector portion also has a degree of freedom in translation approximately along the coupling direction, thereby providing a safety margin of extra stroke which is in addition to the connection stroke per se and which is used in the event of a force greater than the normal connection force being applied, thus making it possible to ensure that the connection is properly completed.

In a preferred embodiment, the first link means in rotation and the first link means in translation are structurally combined, comprising at least one single intermediate link piece which is rotatably connected to the first body by at least one pivot substantially transverse to the coupling direction and which is slidably connected via guide means relative to the support member. In which case, advantageously, the guide and link means of the intermediate piece comprise a passage defined relative to the first support member and in which the intermediate piece is freely engaged, and a system comprising a projecting finger and an elongate slot extending approximately in the coupling direction, which system is interposed between the intermediate piece and the first support member.

Furthermore, and preferably, the first resilient return means in rotation and the first resilient return means in translation are structurally combined, comprising at least one curved spring blade having a central region bearing against the pivot providing rotary linkage between the intermediate peice and the first body, and having two ends bearing against the first support member. This provides a structure that is remarkably compact.

It is also possible for an intermediate platform to be associated with the first body, the platform extending substantially perpendicularly to the coupling direction; for the first body to be fixed to the platform by second link means having three degrees of freedom, namely one degree of freedom in rotation about an axis parallel to the coupling direction, and two degrees of freedom in translation along two axes that are perpendicular to each other and to the coupling direction; and for the above-mentioned second link means to co-operate with said intermediate platform connected to the first body.

In a preferred embodiment, the second link means comprise at least one second pivot approximately parallel to the coupling direction and secured to the platform or to the first body, and second resilient return means deformable transversely to the coupling direction and interposed between the second pivot and the connector portion or the platform, as the case may be. It is then preferable for the second resiliently deformable means to comprise at least one spiral spring.

Finally, it is also possible to provide for an intermediate cradle to be associated with the first support member, this cradle extending approximately perpendicularly to the coupling direction; for the cradle to be fixed to the first support member via third link means having one degree of freedom in rotation about an axis substantially perpendicular to the coupling direction and to the axis of the first link means in

rotation; and for the above-mentioned first link means to co-operate with the cradle connected to the first support member.

Preferably, the third link means comprise at least a third pivot approximately perpendicular to the coupling direction and to the first pivot, and secured to the cradle or to the support member, and third resilient return means interposed between the cradle and the support member to return

said cradle to an equilibrium position relative to the support member.

A system is thus obtained which, in the absence of opposing forces, is normally centered under drive from resilient means associated with the translation or rotation link means while the body of the connector portion possesses all of the degrees of freedom desirable for enabling it to co-operate with the complementary connector portion, regardless of their relative position when they are presented to each other.

The invention will be better understood on reading the following detailed description of a preferred embodiment given purely by way of illustrative example; in the description, reference is made to the accompanying drawings, in which:

Figure 1 is a fragmentary exploded perspective view of a connector portion of rectangular section and organized in accordance with the invention;

Figure 2 is a half-section on line II-II of Figure 1 through a part of the connector portion of Figure 1;

Figure 3 is a fragmentary section view on line III-III of Figure 1; and

Figure 4 is an exploded perspective view showing a part of the Figure 1 connector portion.

With reference initially to Figure 1, reference 1 is an overall reference designating a connector portion body that is polygonal in section (in this case rectangular by way of example) and which is supported by a support member 2 (only a very small part of which is shown).

Between a platform 3 associated with the body 1 of the connector portion and substantially perpendicular to the Z-axis of the connector (corresponding approximately to the coupling direction F), and a cradle 4 associated with the support member 2 and substantially parallel to the platform 3, there are interposed first link means 5 made up as follows.

As can be seen in particular in Figures 1 and 2, an intermediate part 6, e.g. in the form of a strip, is connected to the platform 3 so as to be free to rotate about a pivot 7 (coinciding with the Y-axis that is perpendicular to the long

sides 8) at a point substantially in the middle of the long sides 8 of the body 1, with the pivot 7 extending substantially transversely relative to said long sides 8. The other end of the intermediate piece 6 is engaged in a guide passage 9 defined relative to the cradle 4 (with the passage being formed through an upright of the cradle 4 in this case) and supports a projecting finger 10 which is engaged in a guide slot 11 formed in the cradle 4, said slot extending substantially parallel to the Z-axis. A curved spring blade 12 has a middle portion bearing against the pivot 7 and end portions bearing against the cradle 4.

There are two such link means 5 disposed on either side of the body 1 of the connector portion along the Y-axis.

Using the references mentioned on Figure 1, the above-described assembly imparts a degree of freedom in rotation β about the Y-axis (pivot 7) to the body 1 of the connector portion, in association with a degree of freedom in translation along the Z-axis (slot 10), i.e. approximately parallel to the coupling direction F. When the body 1 is tilted about the Y-axis, the platform 3 tends to flatten the spring 12 adjacent to the pivot 7, thereby deforming the spring elastically such that for small pivot angles the spring provides a return to the equilibrium position by reacting against the platform 3. In addition, the spring 12 is rated so as to deform when the body 1 of the connector portion is subjected to a force in the coupling direction which is greater than the coupling force between the two connector portions. As a result it is possible to achieve extra stroke in the event of excess force being applied, thereby ensuring that proper coupling is achieved between the two connector portions. On its own, the spring 12 is sufficient to return the system to its equilibrium position both in rotation and in translation.

In addition, second link means 13 are interposed between the body 1 and the platform 3, with the second link means being more clearly visible in Figures 3 and 4. To this end, at the base of each of the short sides 14, the body 1 has a projecting tab 15 which is provided with a tapped hole 16. The platform 3

has respective facing housings 17 receiving a shouldered screw 18 screwed into the hole 16. The housing 17 houses a spiral spring 19 interposed between the shank of the screw 18 which forms a pivot and the wall of the housing. There are two link means 13 disposed on either side of the body 1 of the connector portion, along the X-axis.

Using the conventions given in Figure 1, the link means 13 impart three degrees of freedom to the body 1, namely two degrees of freedom in translation along the X-axis (perpendicular to the Y-axis and the Z-axis) and along the Y-axis (plane displacement over the plane of the body 1 relative to the platform 3), plus one degree of freedom in rotation Γ about the Z-axis. The spiral spring 19 serves on its own to return to the equilibrium position both in translation and in rotation.

Finally, third link means 20 are interposed between the support member 2 and the cradle, as can be seen in Figures 1 and 3. The link means 20 comprise a pivot 21 (constituted in this case by a shouldered screw) connecting the support member 2 and the cradle 4 so as to leave them free to rotate, and extending perpendicularly to the short sides 14 of the connector body 1. A spring 22 is interposed between the support member 2 and the cradle 4 to return it towards its equilibrium position. There are two link means 20 disposed at opposite ends of the body 1 along the X-axis, facing the short sides 14 of the body.

Using the conventions given in Figure 1, the link means 20 impart one degree of freedom in rotation α about the X-axis.

In the connector portion fitted with link means 5, 13, and 20, the body 1 has six degrees of freedom: three degrees in translation along the X, Y, and Z axes, and three degrees in rotation in angular directions α, β, and Γ, thereby making it possible for the body to move in any manner relative to its support member 2.

Naturally, and as can be seen from the above, the invention is not limited in any way to the applications and embodiments described in particular detail. On the contrary, the invention extends to any variants thereof.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS.

1/ An electrical connector portion organized to be fixed in floating manner to a first support member, said connector portion comprising a first body of polygonal cross-section and suitable for coupling and decoupling with a second body of a complementary connector portion secured to a second support member respectively when the first and second support members are moved towards each other and apart from each other along a direction approximately parallel to a coupling direction of the two connector portions, said connector portion comprising, interposed between the first body and the first support member, link means organized to impart six degrees of freedom to the first body, namely three degrees of freedom in translation along three directions that are substantially mutually orthogonal, one of the directions coinciding substantially with the coupling direction, and three degrees of freedom in rotation about said three directions, with resilient return means being associated with said link means to return the first body to an equilibrium position for each degree of freedom;

characterized in that it comprises first link means interposed between the first body and the first support member, and comprising:

first link means in rotation interposed between the first body and the first support member and organized to enable the first body to rotate about an axis which is substantially perpendicular to the coupling direction;

first resilient return means in rotation for returning the first body to an equilibrium position relative to the first support member;

first link means in translation interposed between the first body and the first support member and organized to enable the first body to move in translation relative

to the first support member along a direction approximately parallel to the coupling direction; and

first resilient return means in translation for returning the first body to an equilibrium portion in which it is spaced apart from the first support member, said first resilient return means in translation being rated so as to come into play when the first body is subjected to a force in the coupling direction which is greater than a coupling force between the two portions of the connector.

2/ A connector portion according to claim 1, characterized in that the first link means in rotation and the first link means in translation are structurally combined, comprising at least one single intermediate link piece which is rotatably connected to the first body by at least one pivot substantially transverse to the coupling direction and which is slidably connected via guide means relative to the first support member.

3/ A connector portion according to claim 2, characterized in that the guide and link means of the intermediate piece comprise a passage defined relative to the first support member and in which the intermediate piece is freely engaged, and a system comprising a projecting finger and an elongate slot extending approximately in the coupling direction, which system is interposed between the intermediate piece and the first support member.

4/ A connector portion according to claim 2, characterized in that the first resilient return means in rotation and the first resilient return means in translation are structurally combined, comprising at least one curved spring blade having a central region bearing against the pivot providing rotary linkage

between the intermediate piece and the first body, and having two ends bearing against the first support member.

5/ A connector portion according to claim 1, characterized in that an intermediate platform is associated with the first body, said platform extending substantially perpendicularly to the coupling direction; in that the first body fixed to said platform by second link means having three degrees of freedom, namely one degree of freedom in rotation about an axis parallel to the coupling direction, and two degrees of freedom in translation along two axes that are perpendicular to each other and to the coupling direction; and in that said second link means co-operate with said intermediate platform connected to the first body.

6/ A connector portion according to claim 5, characterized in that the second link means comprise at least one pivot approximately parallel to the coupling direction and secured to the platform or to the first body, and second resilient return means deformable transversely to the coupling direction and interposed between said pivot and the connector portion or the platform.

7/ A connector portion according to claim 6, characterized in that the second resiliently deformable means comprise at least one spiral spring.

8/ A connector portion according to claim 1, characterized in that an intermediate cradle is associated with the first support member, said cradle extending approximately perpendicularly to the coupling direction; in that said cradle is fixed to the first support member via second link means having one degree of freedom in rotation about an axis substantially perpendicular to the coupling direction and to the axis

of the first link means in rotation; and in that said first link means co-operate with said cradle connected to the first support member.

9/ A connector portion according to claim 8, characterized in that:

the first link means in rotation and the first link means in translation are structurally contained and comprise at least one single intermediate link piece which is rotatably connected to the first body by at least one first pivot substantially transverse to the coupling direction; and

the second link means comprise at least one second pivot approximately perpendicular to the coupling direction and to said at least one first pivot, and secured to the cradle or to the first support member, and second resilient return means interposed between the cradle and the first support member to return said cradle to an equilibrium position relative to the first support member.

10/ A connector portion according to claim 1, characterized in that said first link means are provided in duplicate and are situated respectively on opposite sides of the first body.

11/ A connector portion according to claim 5, characterized in that said second link means are provided in duplicate and are situated respectively on opposite sides of the first body.

12/. A connector portion according to claim 8, characterized in that said second link means are provided in duplicate and are situated respectively on opposite sides of the first body.

2085295

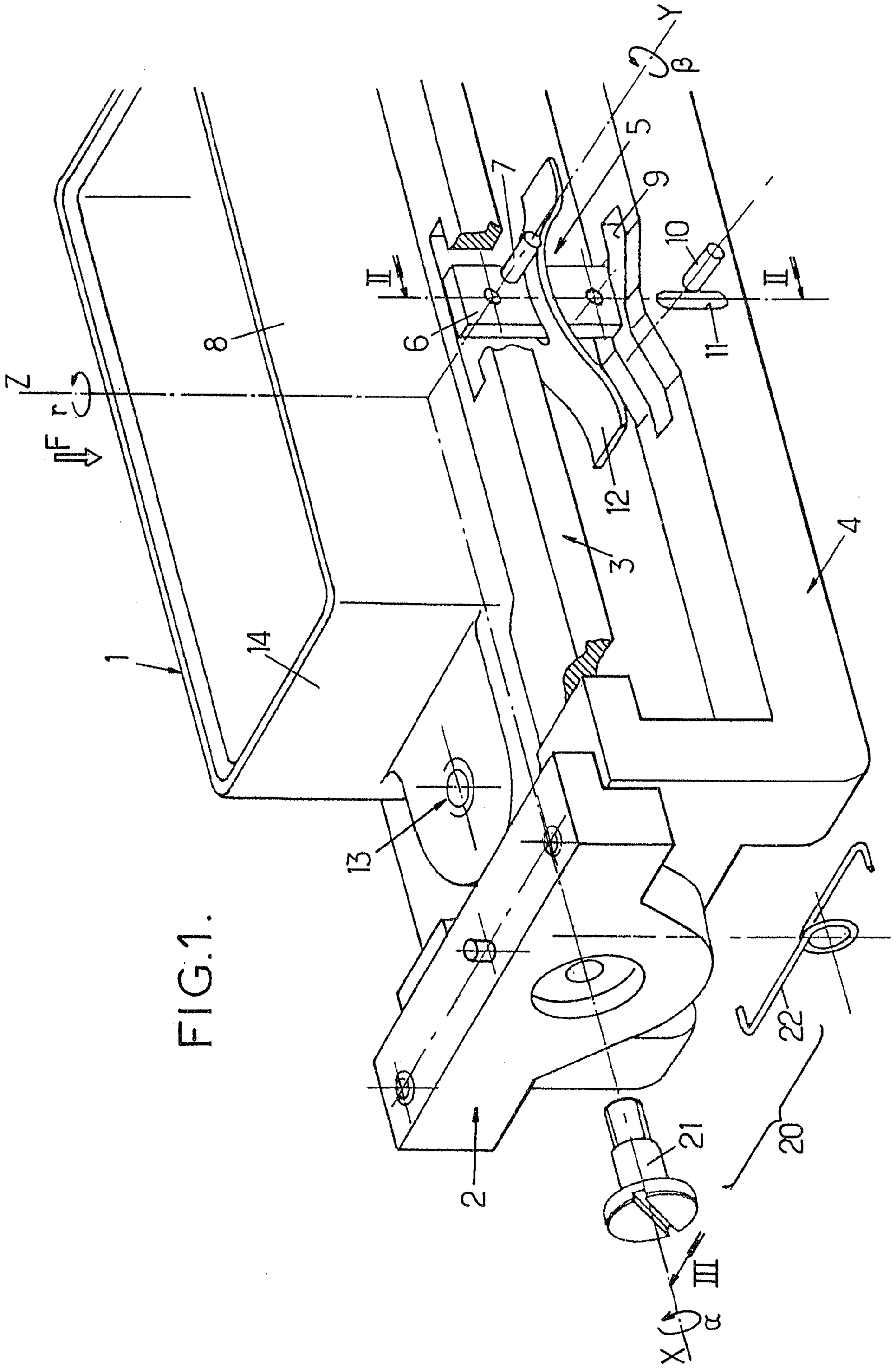


FIG.1.

Agents for the Applicants: Gee & Walker

2085295

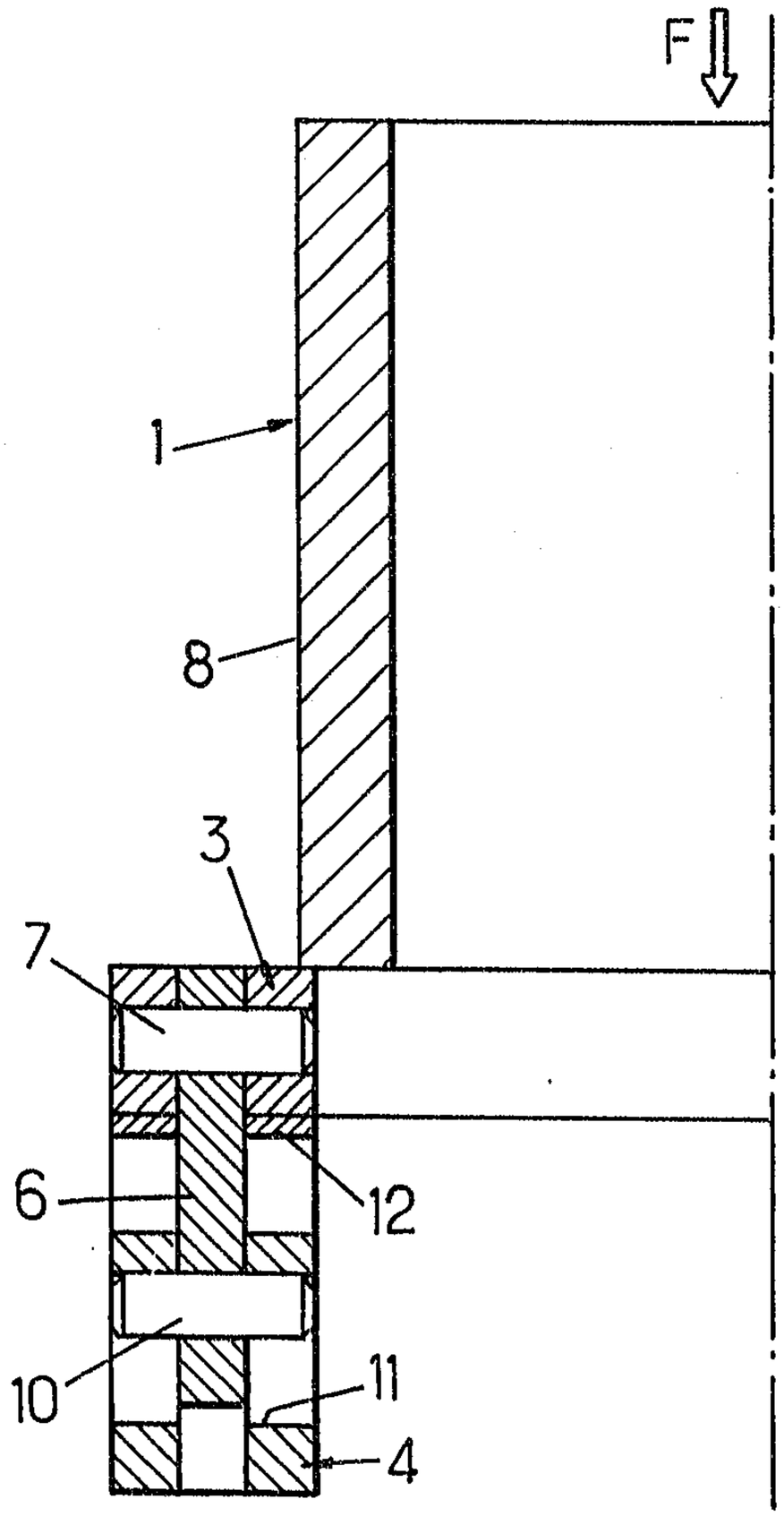


FIG. 2.

Southern Agency Owner's Nominee Walker

2085295

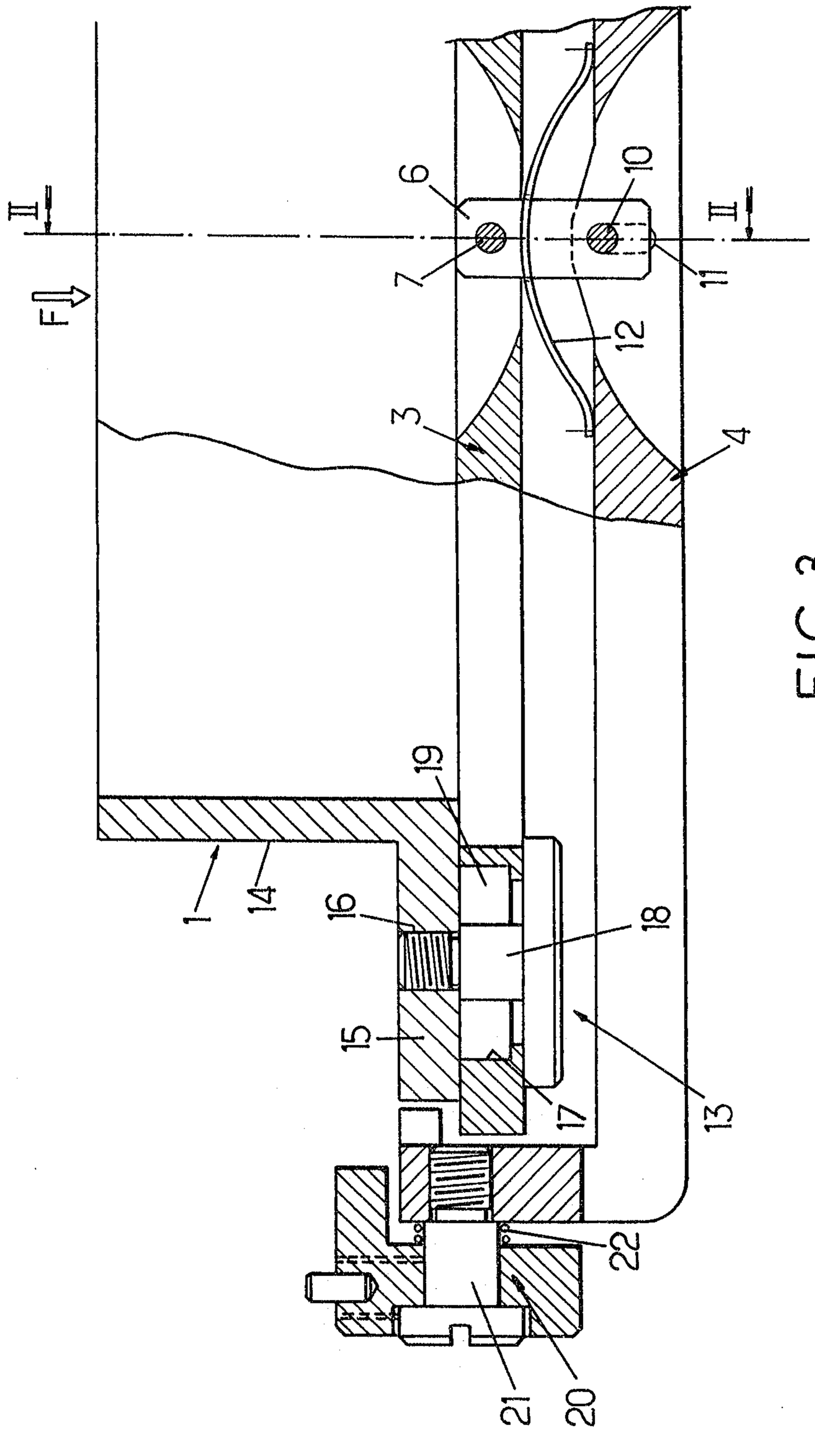


FIG.3.

Goudreau Gage Dubuc & Henderson Walker

2085295

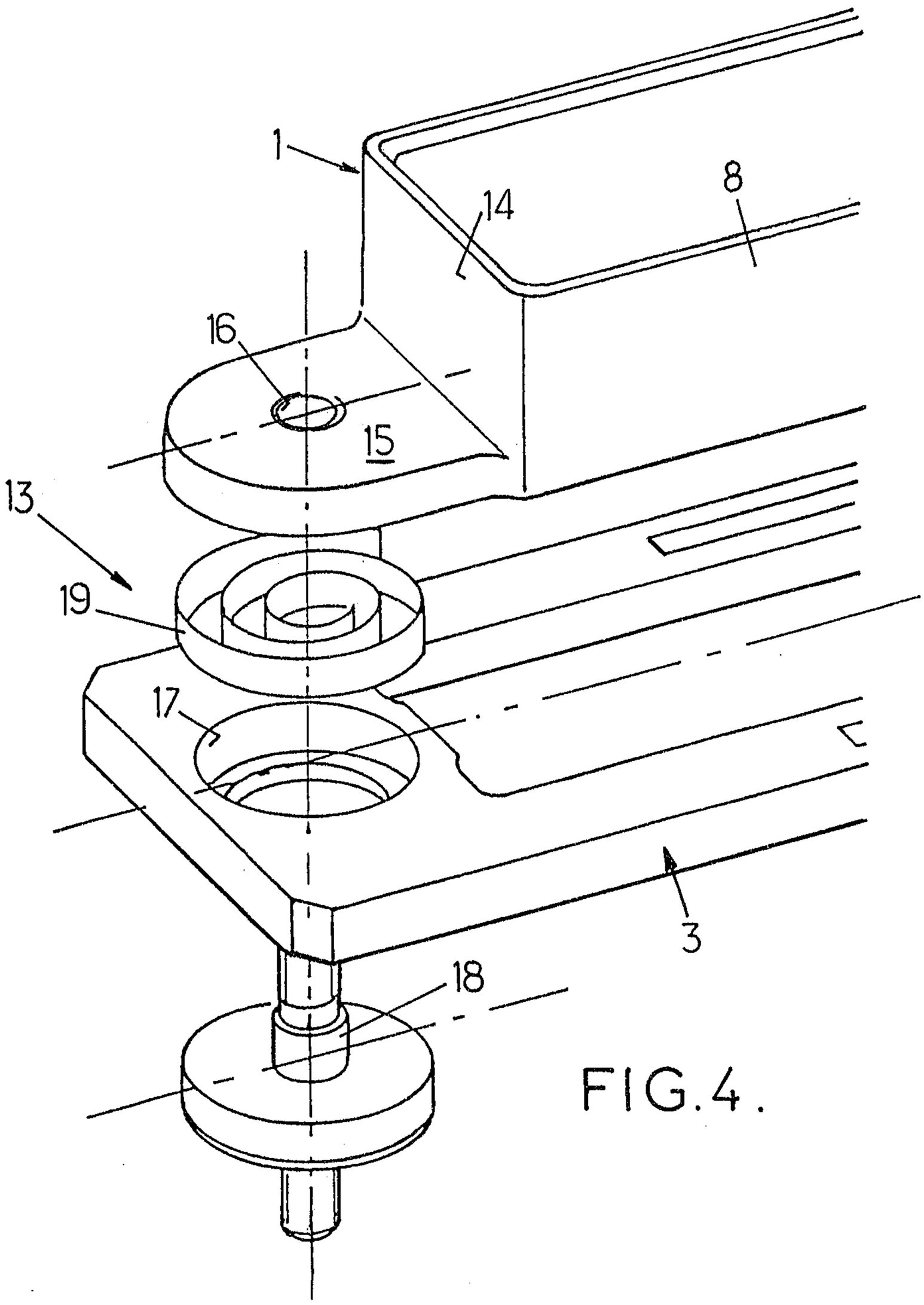
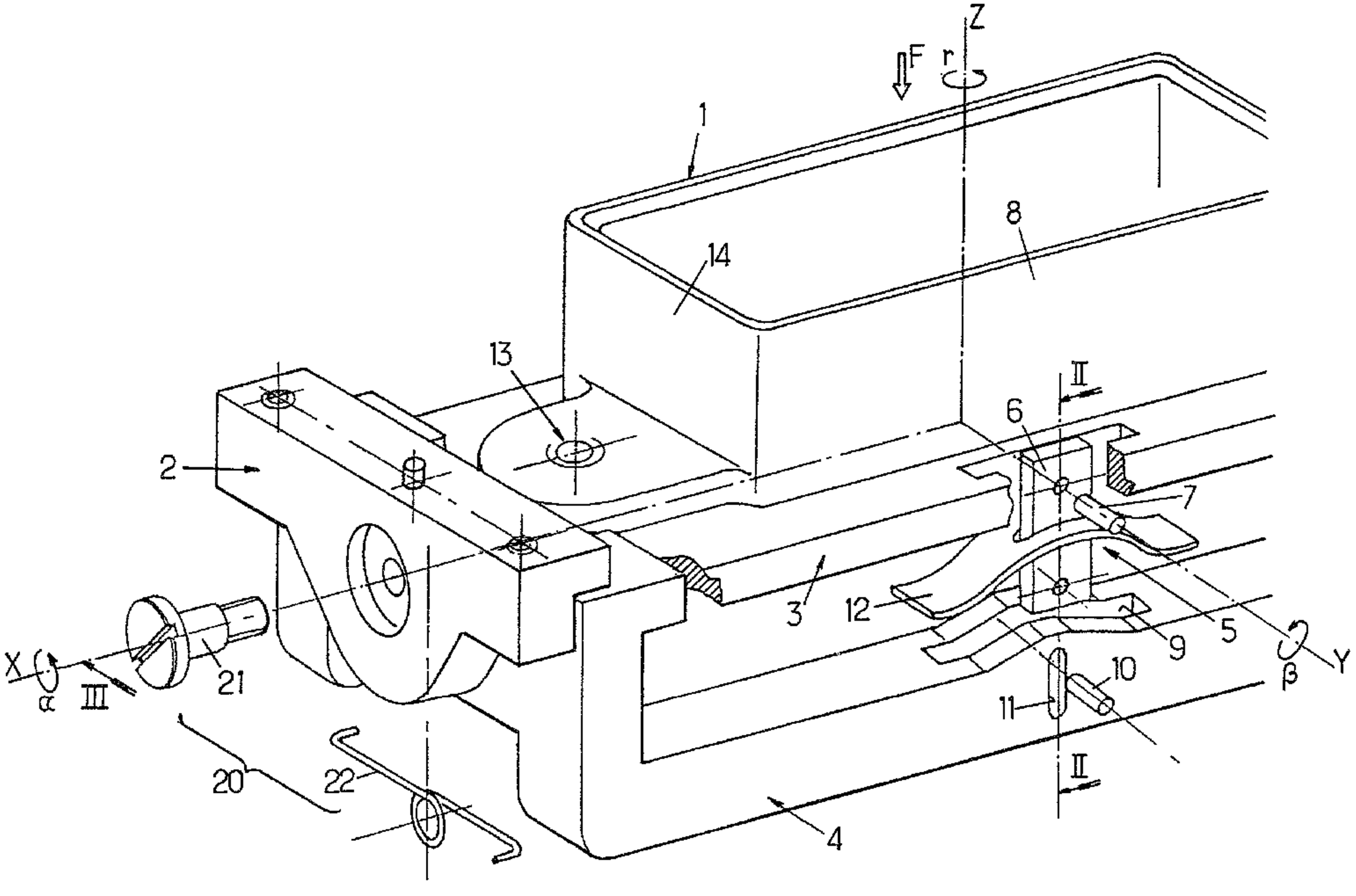


FIG.4.

Goodrean Page Davies & Martineau Walker


Z
F
r
1
8
14
13
II
6
2
7
3
12
5
9
X
α
III
21
β
Y
10
11
20
22
II
4