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

(11) Publication number: **0 445 087 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91830071.6**

(51) Int. Cl.5: **B22D 41/24**

(22) Date of filing: **04.03.91**

(30) Priority: **02.03.90 IT 1243590**

(43) Date of publication of application:
04.09.91 Bulletin 91/36

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

(71) Applicant: **NUOVA SANAC S.p.A.**
Via Martin Piaggio 13
I-16122 Genoa(IT)

Applicant: **ILVA S.p.A.**
Via Corsica 4
I-16128 Genoa(IT)

(72) Inventor: **Timossi, Giovanni c/o Nuova Sanac S.p.A.**
Via Martin Piaggio 13
I-16122 Genova(IT)

Inventor: **Cecchi, Franco c/o ILVA S.p.A.**
Via Corsica 4
I-16128 Genova(IT)

Inventor: **Martelli, Giancarlo c/o ILVA S.p.A.**
Via Corsica 4
I-16128 Genova(IT)

Inventor: **Ricci, Roberto Nuova Sanac S.p.A.**
Via Martin Piaggio 13
I-16122 Genova(IT)

Inventor: **Filippi, Massimo c/o Nuova Sanac S.p.A.**
Via Martin Piaggio 13
I-16122 Genova(IT)

(74) Representative: **Mariani, Giulio**
c/o Centro Sviluppo Materiali SpA P.O. BOX 10747
I-00129 Roma(IT)

(54) Box nozzle for ladles and the like, with lateral pressure springs.

(57) The invention concerns a box nozzle for ladles and the like, of the type which includes: (a) - a fixed upper metal plate (10) attached to the bottom of the ladle; (b) - a fixed lower metal plate (20), referred to as "the cover", supported by the latter by means of bolts (13) and tiltable and dismountable from the latter for maintenance of the box nozzle; (c) - a third metal plate (60) which runs between the previous two, through appropriate controls, called "the slide" for short; (d) - a first refractory plate (30) with an orifice, held in a fixed position by the fixed upper metal plate (10); (e) - a second refractory plate (70) with an orifice, held by the slide (60) and hence sliding with the latter.

According to the invention, the box nozzle also includes: (f) - a tilting frame (50) inserted between said slide (60) and said cover (20), as well as: (g) - spring assemblies (40) positioned between said cover (20) and said tilting frame (50), located along the long sides of the cover (20).

EP 0 445 087 A2

The object of the present invention is a box nozzle with lateral pressure springs, for ladles.

Box nozzles have been used for several years for discharging ladle, tundishes and the like, stagewise, if desired.

Their use has gradually spread to ladles of increasing size and their standard of reliability has grown in parallel with the improvement in quality of the refractories available on the market.

Box nozzles, of course, consist basically of a pair of refractory plates, one fixed, the other movable, each with an orifice: relative movement of these two plates permits regulation of the size of the opening through which the liquid steel leaves the ladle.

Said pair of refractory plates is associated with a first refractory coupling positioned beneath the sliding plate and moving with it, and a second refractory coupling, positioned above the fixed refractory plate, inserted in the thickness of the refractory lining of the ladle, plus a third refractory coupling that surrounds it.

These refractory parts are inserted in a support and movement device which generally includes:

- a metal levelling plate positioned beneath the bottom of the ladle and equipped with an appropriate opening for inserting and extracting the second fixed refractory coupling;
- a fixed upper metal plate, suitably connected by bolts to the bottom of the ladle to which said levelling plate belongs;
- a fixed lower metal plate, referred to as "the cover" for short, which must be detachable to permit maintenance of the mechanism and refractory parts of the box nozzle; said cover or fixed lower metal plate is generally connected to the fixed upper metal plate by means of hinged bolts;
- a sliding metal frame referred to henceforth as "the slide" for short, which runs between the fixed upper metal plate and the fixed lower metal plate or cover;
- guides positioned between the fixed lower metal plate, or cover, and the sliding metal frame, or slide.

  The aforesaid metal plates have a large central opening, of course.

The two refractory plates with orifices are suitably anchored, the fixed one to the lower face of the fixed upper metal plate, and the moving one to the upper face of the slide.

To ensure a good seal for the liquid metal it is evident, of course, that the mutually sliding contact faces of the fixed and movable refractory plates must be pressed evenly against one another.

It is equally evident that the required pressure must be provided by appropriate interaction of the connecting means between the fixed upper metal plate and the fixed lower metal plate or cover.

Moreover, said means of connection must be such as to ensure precise, rapid and safe control by the operators.

It should be added that perfect contact between the counterposed faces of the fixed and movable refractory plates must be assured despite any possible defects in coplanarity between the smoothed faces of the refractory plates, responsible for ensuring the seal, and the opposite faces, generally metal clad, whose function is to provide support and which rest respectively on the lower face of the fixed upper metal plate and the upper face of the sliding metal plate, or slide.

As the size of box nozzle increases, it becomes more and more difficult to achieve the above conditions simply and safely, guaranteeing good reliability.

The aim of the present invention is to overcome this difficulty. According to the invention an intermediate frame, which tilts on two perpendicular axes lying in the plane of movement of the slide, is inserted between the slide and the cover. Inclination of said tilting frame is achieved by means of two lines of springs supported by the cover and parallel to the long sides thereof.

The long sides of the intermediate tilting frame rest on the two lines of springs.

The slide on which is mounted the sliding refractory plate runs in guides on top of the tilting frame.

Hence the tilting frame can always keep the two counterposed faces of the fixed and movable refractory plates in perfect contact with one another.

According to the invention, to simplify assembly of the box nozzle, the means of connection between the cover and the fixed upper refractory plate consist of bolts that are hinged at one end. Said bolts are tightened until the faces of said cover and said fixed upper metal plate are completely flush: hence the bolt-tightening operations call for no particular control by means of torque spanners, for example. However, the tightening operation is done last.

When reassembling the box nozzle with the cover in the open position, spring assemblies, which protrude from the upper face of said cover, are inserted on the bottom of the cover through threaded holes.

The tilting frame is rested on the protuding ends of the spring assemblies and the moving slide is rested on top of this. Two pairs of counterposed guide strips are placed between the tilting frame and slide. The edges of the slide are then pushed towards the cover by means of a pair of counterstrips that are fixed to the cover by screws. Tightening the screws results in an initial compression

of the spring assemblies.

Subsequently, the cover which is now equipped with springs, tilting frame and slide, is turned over against the fixed upper metal plate and is pressed against it by fully tightening the hinged bolts which connect the cover to the fixed upper plate. During this tightening the spring assemblies receive a second and definitive compression which ensures that the counterposed faces of the fixed and movable refractory plates are urged elastically against one another.

According to the invention, provision is also made for suitable catches which ensure correct tightening of the aforesaid hinged bolts, as is explained in detail ahead.

The essential characteristics of the invention are summarized and schematized in the claims; the objects and advantages of the invention are also made clear by the following description concerning the embodiment selected purely by way of example, with particular reference to the accompanying drawings, in which:

- Fig.1 is an exploded view of the component parts of the box nozzle as per the invention;
- Fig.2 is a longitudinal view of the box nozzle, half sectionalized, with the nozzle in the open position, namely with the orifices of the fixed and movable plates lined up; the term "longitudinal" used in this context means the direction parallel to the direction of movement of the sliding refractory plate;
- Fig.3 is a half cross-section of the box nozzle;
- Fig.4 illustrates a detail of the preceding figure at larger scale;
- Fig.5 (right half) illustrates a section on the V-V plane of Fig.3, while Fig.5 (left half) illustrates a section on the VA-VA plane of Fig.3: the V-V plane coincides with the plane on which lies the lower face of the levelling plate; plane VA-VA coincides with the separation and contact plane of the fixed and movable refractory plates;
- Fig.6 (upper half) provides a bird's-eye view of the fixed upper plate, while Fig.6 (lower half) provides a worm's-eye view thereof;
- Fig.7 is a cross-section through the fixed upper plate along VII-VII of Fig.6;
- Fig.8 is a longitudinal section of the same plate along VIII-VIII of Fig.6;
- Fig.9 (upper half) provides a worm's-eye view of the fixed lower plate, namely the cover, while Fig.9 (lower half) provides a bird's-eye view thereof;
- Fig.10 is a cross-section of the cover along X-X of Fig.9;
- Fig.11 is a longitudinal section of the cover along XI-XI of Fig.9;
- Fig.12 (upper half) provides a bird's-eye view of the tilting frame, while Fig.9 (lower half) provides a worm's-eye view thereof;
- Fig.13 is a cross-section of the tilting frame along XIII-XIII of Fig.12;
- Fig.14 is a longitudinal section of the tilting frame along XIV-XIV of Fig.12;
- Fig.15 (upper half) provides a bird's-eye view of the slide, while Fig.15 (lower half) provides a worm's-eye view thereof;
- Fig.16 is a cross-section of the slide along XVI-XVI of Fig.15;
- Fig.17 is a longitudinal section along XVII-XVII of Fig.15.

Referring in particular to Fig.1, 10 indicates the fixed upper metal plate that is attached to the bottom of the ladle. Drilled hinge-pieces 11 and 12 are fixed to the longitudinal side of said plate. Hinged to these via pins are bolts 13 and catches 14.

By means of nuts 15 of bolts 13 fixed upper plate 10 supports a lower metal plate 20, which is also fixed when the box nozzle is in operation but can be detached from the fixed upper plate for nozzle maintenance operations.

Said fixed lower plate, known as the cover, is actually formed of a robust quadrangular frame with variously-shaped internal longitudinal flanges 21 in each of which are two large threaded holes 22, and external longitudinal flanges 23. The external flanges have notches 24 and 25 to permit the passage of bolts 13 and catches 14.

Spring assemblies 40 are inserted in holes 22. The assemblies protrude from the upper face of cover 20 and provide elastic support for tilting frame 50 complete with seats 51 for the upper ends of the spring assemblies.

Tilting frame 50 is complete with a large central opening 52 which is roughly rectangular in shape. On the upper face of the long sides there are guide strips 53 for slide 60 that also has a central opening 61, which is circular in shape, on the upper face of which there is a sliding refractory plate 70.

Fixed refractory plate 30 is mounted against the lower face 16 of the fixed upper plate. Fixed upper refractory coupling 31 rests against said fixed refractory plate.

To complete the parts illustrated in Fig.1 there is the small plate 80 which is attached to the upper face of a heat shield 81, connected to a ferrule 82 which surrounds and protects refractory coupling 71 that is attached to sliding plate 70.

Additionally, there are guide strips 61, fixed to the long sides of slide 60, destined to run on guide strips 53 attached to tilting frame 50. A third pair of strips 63 is fixed to the upper face of the long sides of cover 20 and, together with guide strips

53, ensures heightwise restriction of the movement of slide 60 which is moved by connecting shaft 83.

The function of the structural elements described by reference to Fig.1 is better understood by reference to Figs 2 to 5.

The third fixed refractory coupling 32, which surrounds coupling 31 and rests against the upper surface of levelling plate 33, is visible in Fig. 2.

Coupling 32, in turn, is surrounded by the inner refractory lining 35 of the ladle. Fig.2 also illustrates the metal cladding 36 of fixed plate 30, as well as the metal claddings 72 and 73 of sliding refractory plate 70 and sliding coupling 71.

It should be observed that nuts 15 of bolts 13 are tightened up to the external flange 23 of cover 10: this eliminates the need for the use of torque spanners, thus simplifying assembly.

It should also be noted that catches 14 do not support flange 23 when nuts 15 are tightened, since their function is to indicate to the operator that nuts 15 have been completely tightened: if this is not the case it is not possible to tilt the catches to the position illustrated in Fig. 2.

Catches 14 also provide a guarantee against accidental opening of bolts 13.

Fig.3 shows magnets 18 inserted in corresponding cavities of catches 14 and which act on the sides of cover 20 preventing the catches from turning outwards. It also illustrates the way spring assembly 40 supports tilting frame 50 on which slide 60 moves within guide strips 53 and 62.

Fig.4 illustrates in greater detail the Belleville washers 41 of assembly 40: the springs are inserted on flanged bush 42 which, in turn, is inserted on pin 43 that has a retaining ring 44 at one end while the other is screwed to a cap 45 whose outer cylindrical surface is threaded and screwed in ring 46 that is also threaded externally.

The purpose of ring 46 is solely to create a wear thread on cover 20 and so, from the functional aspect, it can be considered to form an integral part of cover 20 in whose threaded holes 22 it is screwed by means of its external thread. Spring assembly 41, formed of parts 41, 42, 43, 44 and 45, is screwed in hole 22, already equipped with ring 46, until it comes up against the outer flange of cap 45.

The spring assembly 40 can be fitted up with cover 20 in the open position illustrated in Fig.1 and, after this has been done, flanged bushes 42 rest against retaining rings 44 protruding from the inner face of cover 20.

In a second stage tilting frame 50 is rested against the ends 42 of spring assemblies 40. Subsequently slide 60 is rested on the frame. Slide 60 is attached to cover 20 by a pair of counter-strips 54 which - through screws - permit initial compression of spring assemblies 40.

In this position, clearance 120 (Fig.4) is nil owing to the thrust of the springs.

When the cover is closed, initially the counterposed faces of the two refractory plates 30 and 70 are brought into contact; subsequent tightening of bolts 13 causes further compression of springs 40 until clearance 120 is created (Fig.4).

Fig.4 also clearly illustrates conduit 47 which carries cold air to springs 41 via minor passages 48.

Figs 6, 7 and 8 show the structural details of fixed upper metal plate 10 with recess 111 on its upper surface to receive the base of the third fixed refractory coupling 32, inserted into the ladle, as visible in Figs 3 and 4.

The entire fixed upper metal plate 10 is pierced by a circular hole 112 which - as can be seen from Figs 2 and 3 - serves for the passage of the lower end of fixed refractory coupling 31 which can be extracted from below, from the outside of the ladle.

The lower face of fixed upper metal plate 10 also has elongated recess 113 for housing fixed upper refractory plate 30.

On the bottom of recess 112 are grooves 114 to facilitate correct positioning of fixed upper refractory plate 30 which, as already mentioned, is metal clad on the top and the sides. The same metal cladding is also utilized to retain refractory plate 30 in recess 113 by means of cylindrical magnets housed in blind holes 118. Prevision is also made on the long flanks upper metal plate 10 for centring and positioning recesses 115 and 116 for fixed hinge-pieces 11 and 12 which are attached to said metal plate by screws that, for simplicity, are indicated in Fig.6 only by the symmetry axis.

Holes 117 in fixed upper metal plate 10 serve to fix it to ladle-bottom levelling plate 33 via screws.

The structural details in Figs 9 to 11, referring to cover 20, have already been described by reference to the preceding figures.

The structural details of the tilting frame 50 illustrated in Figs 12 to 14 have also been referred to above. However, it should be mentioned that holes 150 are used to fix guide strips 53 for slide 60.

With reference to Figs 15 to 17, concerning slide 60, attention is drawn to circular hole 161 which runs right through the thickness of the slide and serves to house the end of sliding refractory coupling 71.

There is also an elongated recess 162 on the upper face of slide 60 to house sliding refractory plate 70 which, as already mentioned, is metal clad on the lower face and sides so as to permit the use of cylindrical magnets housed in circular holes 163

on the bottom of recess 162.

One end of slide 60 has threaded holes 164 for connecting to control shaft 83.

Though the invention is based on what has been described and illustrated above, many modifications and variations may be made in its embodiment, as per the following claims:

Claims

1. Box nozzle for ladles and the like, of the type which includes:
   (a)-a fixed upper metal plate (10) attached to the bottom of the ladle;
   (b)-a fixed lower metal plate (20), referred to as "the cover", supported by the latter by means of bolts (13) and tiltable and dismountable from the latter for maintenance of the box nozzle;
   (c)-a third metal plate (60) which runs between the previous two, through appropriate controls, called "the slide" for short;
   (d)-a first refractory plate (30) with an orifice, held in a fixed position by the fixed upper metal plate (10);
   (e)-a second refractory plate (70) with an orifice, held by the slide (60) and hence sliding with the latter;
   characterized by the fact that it includes:
   (f)-a tilting frame (50) inserted between said slide (60) and said cover (20), as well as:
   (g)-spring assemblies (40) positioned between said cover (20) and said tilting frame (50), located along the long sides of the cover (20).

2. Box nozzle for ladles and the like, according to the above claims, characterized by the fact that on the counterposed long sides of said slide (60) and of said tilting frame (50) pairs of guide strips (53,62) are inserted.

3. Box nozzle for ladles and the like, according to the above claims, characterized by the fact that two counter-strips (63) are screwed on the upper face of the cover, pressing the slide and the tilting frame elastically against the cover, thus partially overcoming the force of the springs mentioned.

4. Box nozzle for ladles and the like, according to the above claims, characterized by the fact that said springs (40) consist of an assembly of Belleville washers (41) inserted on a pin (43) between a flanged bush (42) and a threaded cap (45); wherein said threaded cap (45) is screwed into threaded holes (22) positioned in the cover (20) on the long sides of the tilting frame (50) on which rests said flanged bush (42).

5. Box nozzle for ladles and the like, according to the above claim, characterized by the fact that said springs (4) consist of an assembly of Belleville washers (41) inserted on a pin (43) between a flanged bush (42) and a threaded cap (45); wherein said threaded cap (45) is screwed into a ring (46), threaded both inside and out, which, in turn, is screwed into threaded holes (22), positioned in the cover (20) on the long sides of the tilting frame (50), on which rests said flanged bush (42).

6. Box nozzle for ladles and the like, according to the above claims, characterized by the fact that on the long sides of said door (20) there are conduits (47) carrying air under pressure to cool the spring assemblies (40).

7. Box nozzle for ladles and the like according to the above claims, characterized by the fact that both the upper face of the fixed refractory plate (30) and the lower face of the refractory plate (70) which slides with slide (60), as well as the sides of both are metal clad; wherein, moreover, beneath said sliding refractory plate (70) there is a coupling made of refractory material (71) also metal clad; said refractory coupling (71) being further protected by a ferule (82) which provides basal support for a heat shield (81), all carried by slide (60).

8. Box nozzle for ladles and the like, according to the previous claims, characterized by the fact that said cover (20) is further held, in a safe position, by said fixed upper metal plate (10) by means of a pair of swivelling catches (14) with magnets (18) that maintain contact with the cover (20); the swivelling of said catches assures the end of the tighening of the nuts (14) on bolts (13) which retain the cover (20).

9. Box nozzle for ladles and the like, according to the above claims, characterized by the fact that the connecting bolts (13) between the fixed upper metal plate (10) and cover (20) are tightened to a flush position which unequivocally establishes the relative position between said plate (10) and said cover (20).

10. Box nozzle for ladles and the like, according to the above claims, substantially constructed and installed as described and illustrated herein.

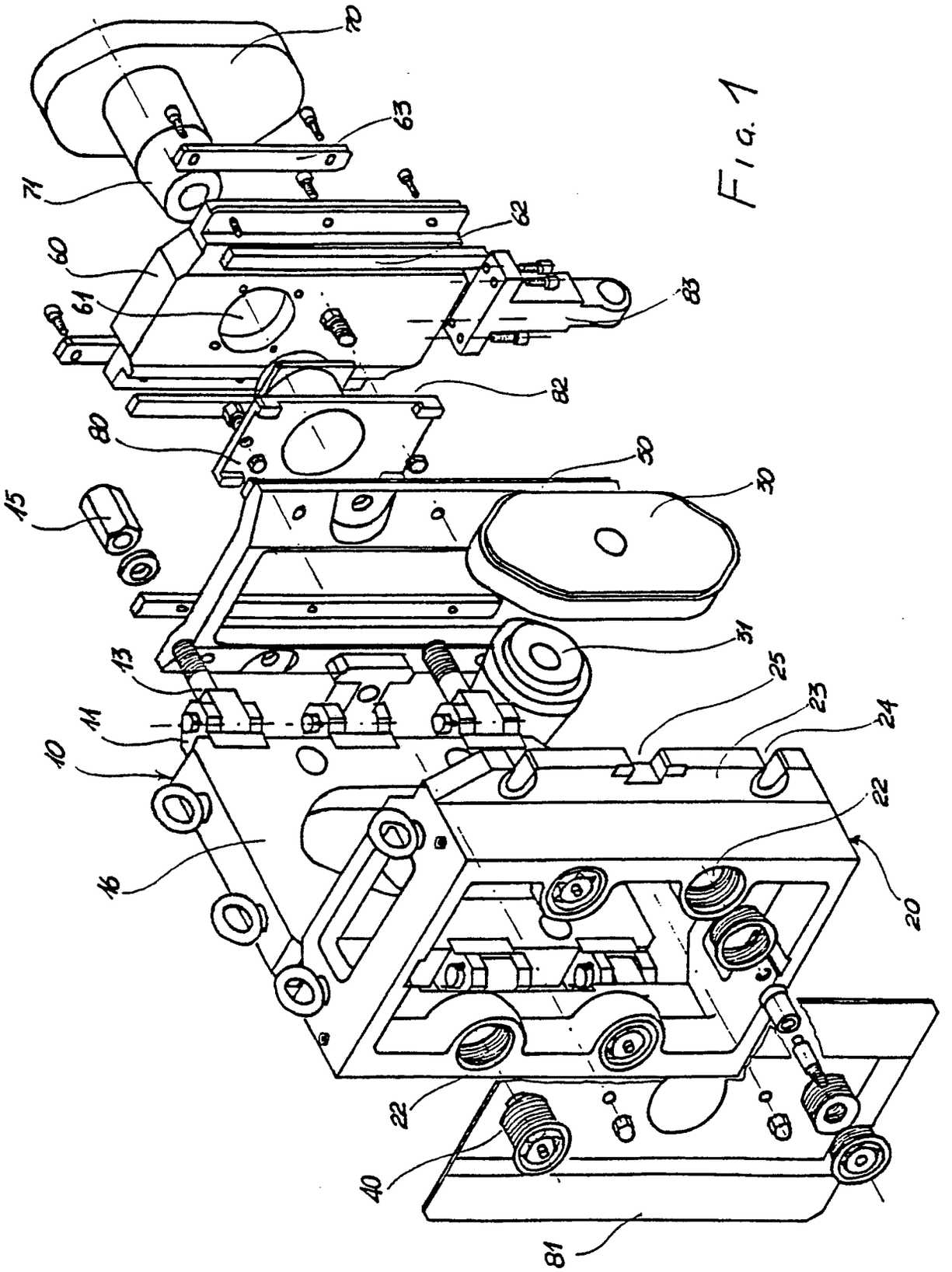
70
63
71
62
60
61
83
82
80
50
30
15
31
13
25
23
24
11
10
22
16
20
22
40
81

Fig. 1

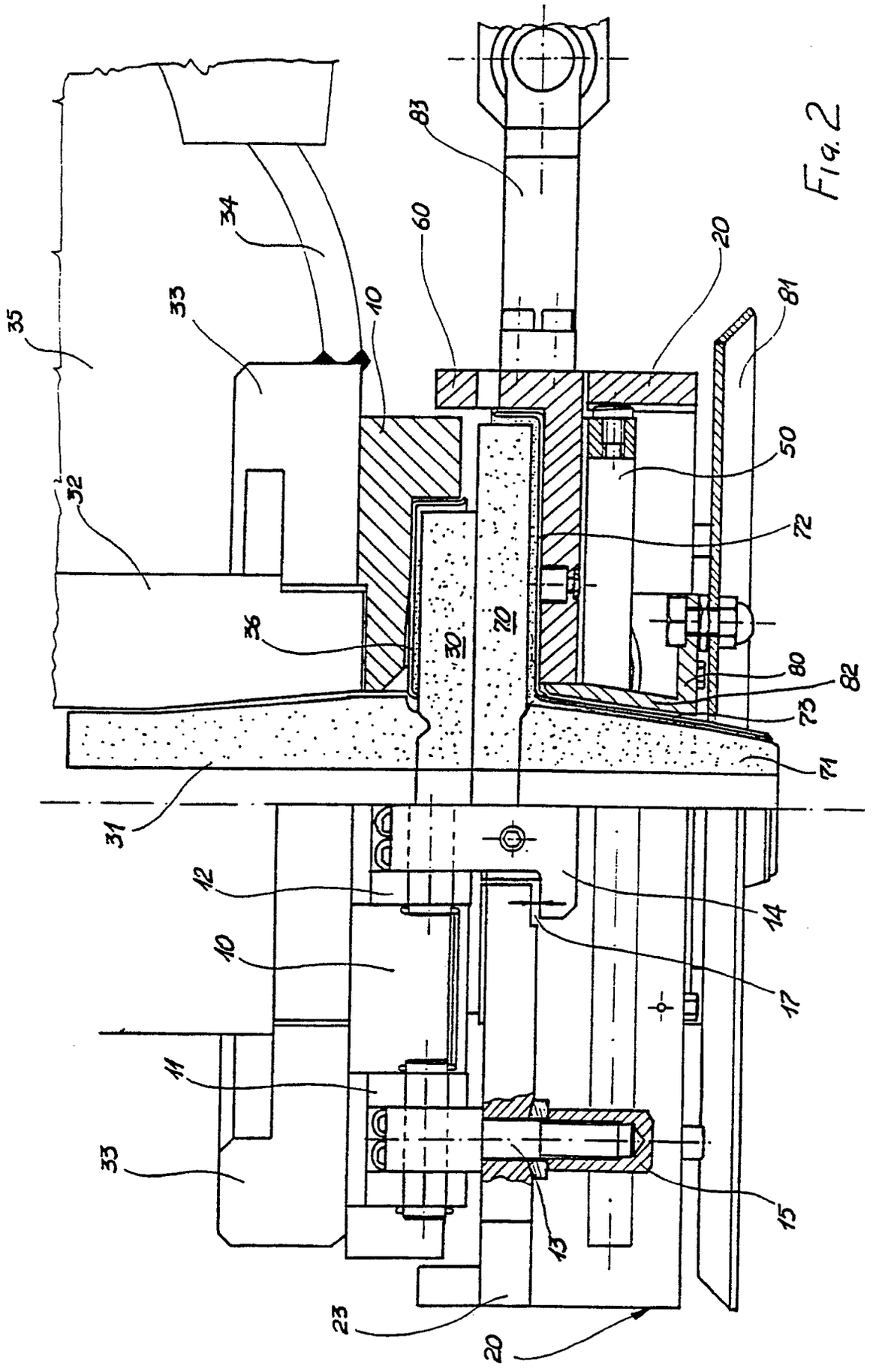
83
34
60
20
81
35
33
10
50
32
72
36
30
20
80
82
73
71
31
12
14
10
17
11
33
15
13
23
20

Fig. 2

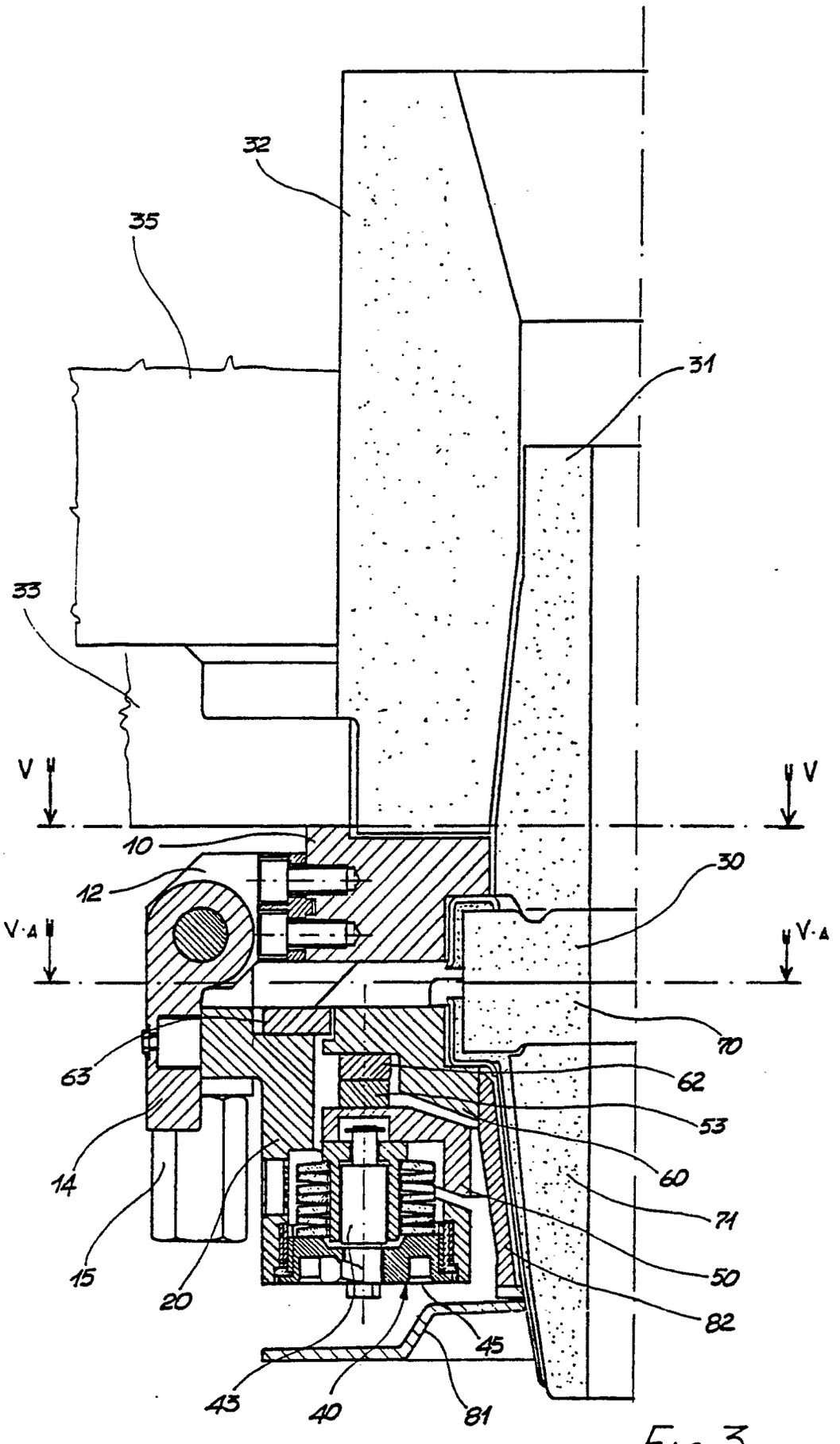
32
35
31
33
V
V
10
12
30
V-A
V-A
70
63
62
53
60
14
71
15
50
20
82
45
43
40
81

Fig. 3

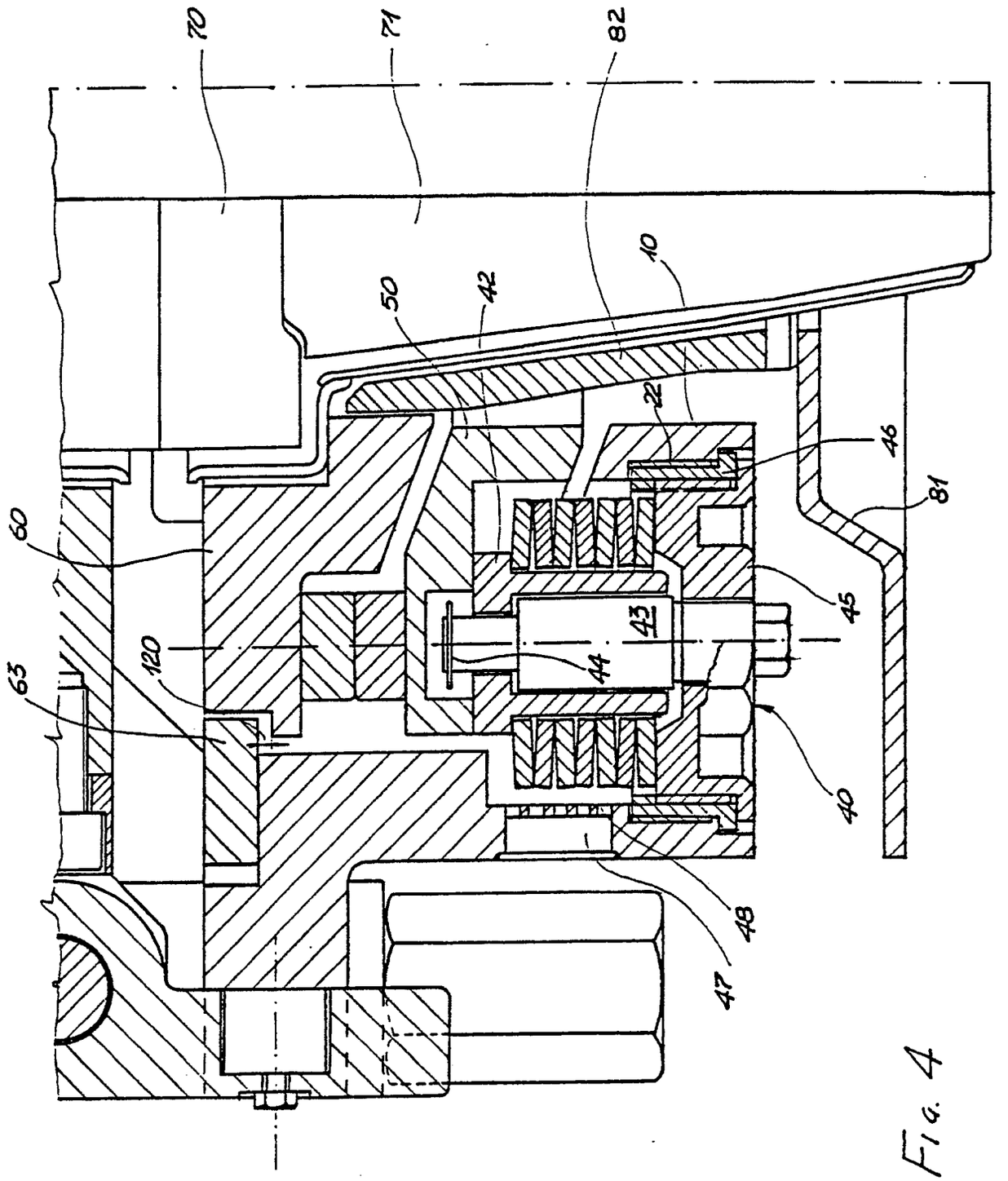

Fig. 4

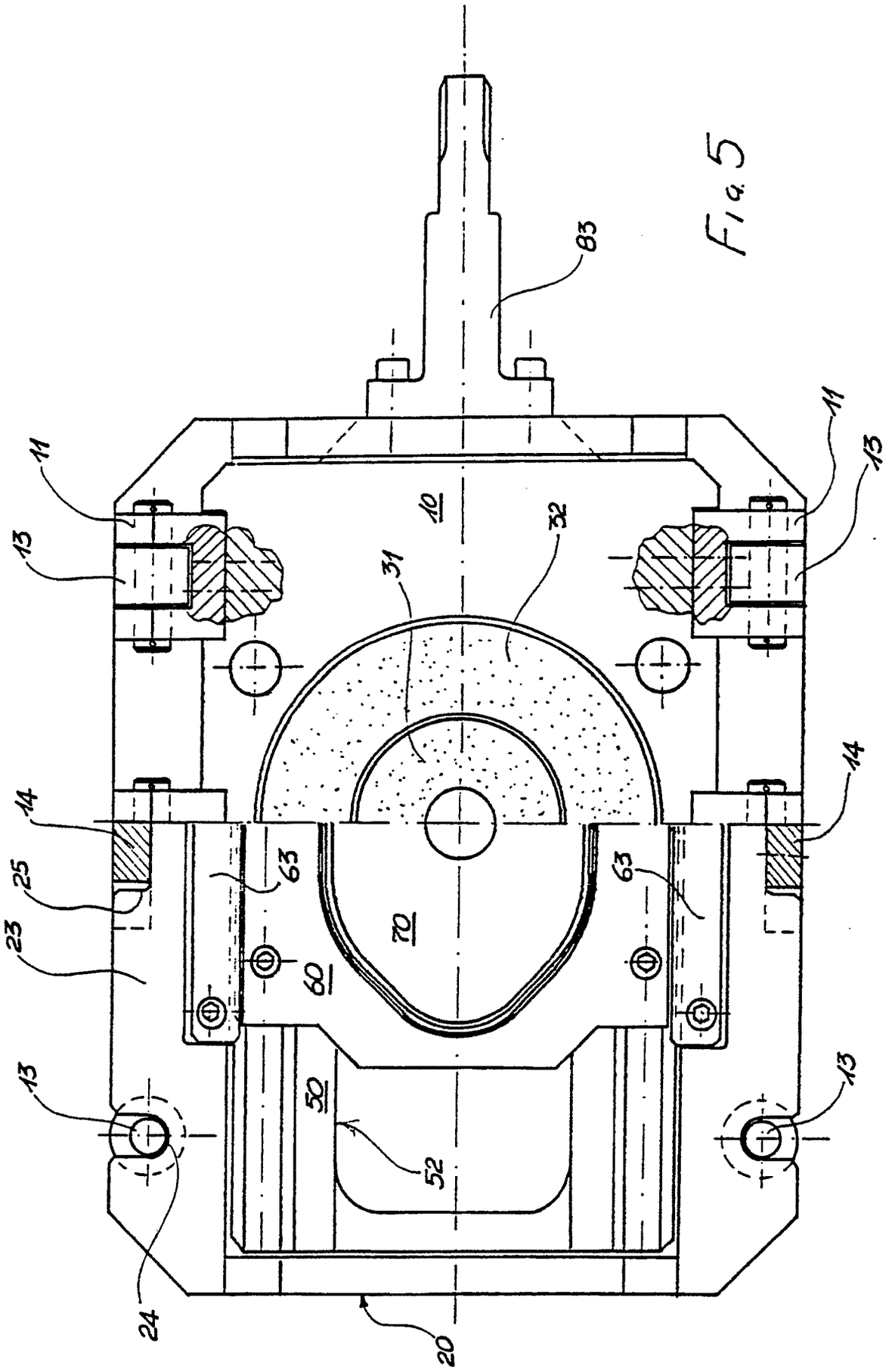

Fig. 5

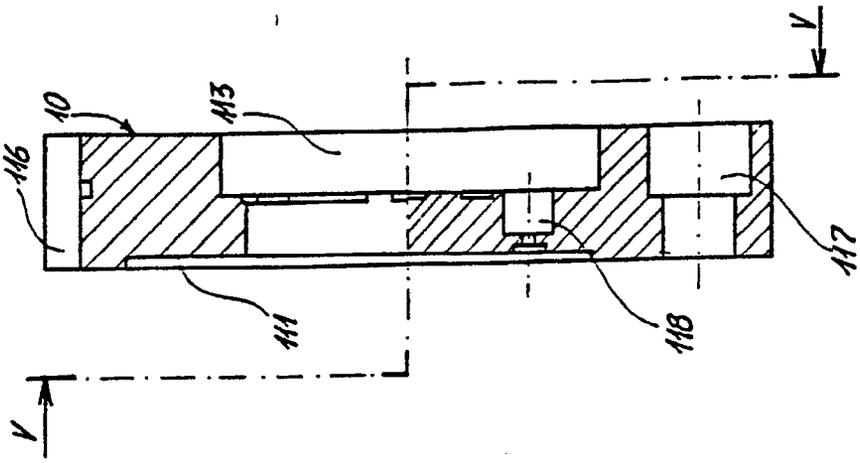

Fig. 7

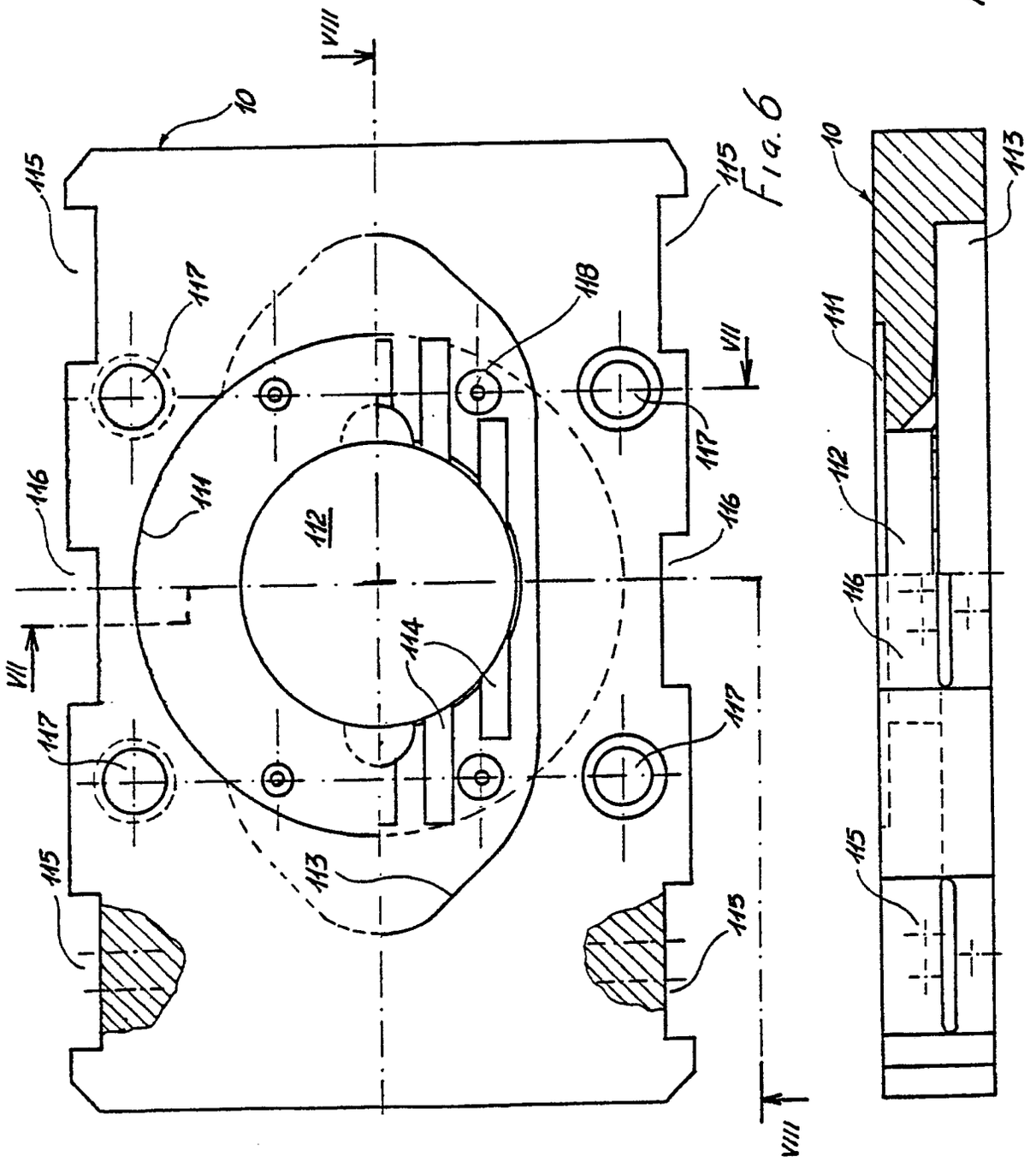

Fig. 6

Fig. 8

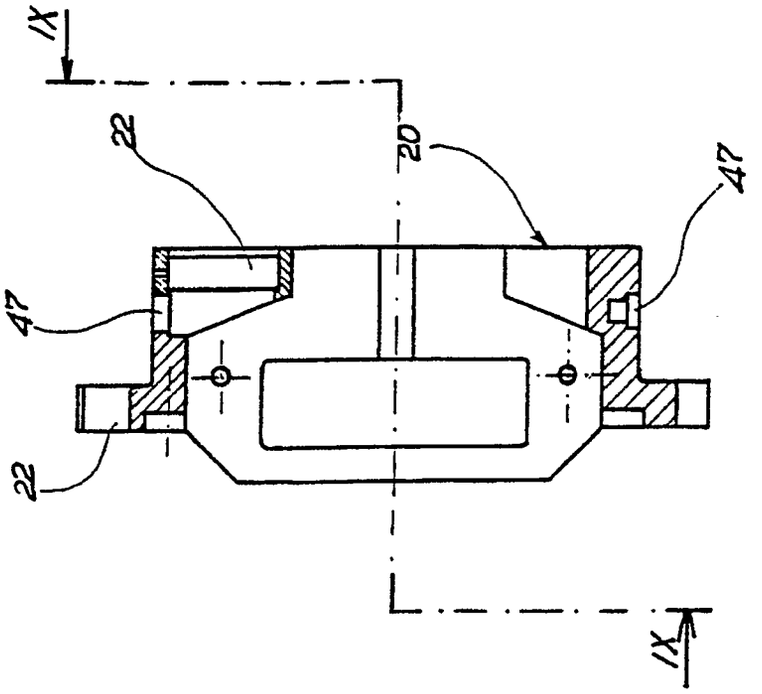

Fig. 10

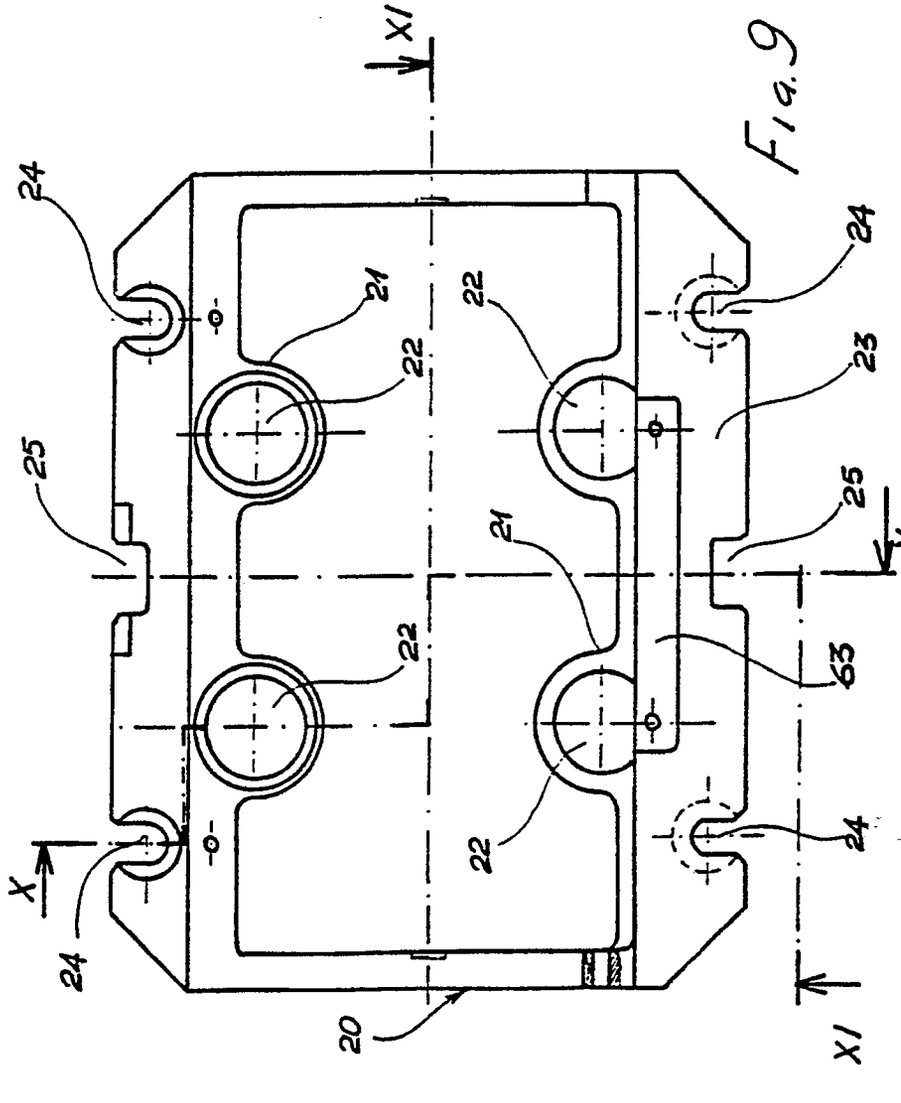

Fig. 9

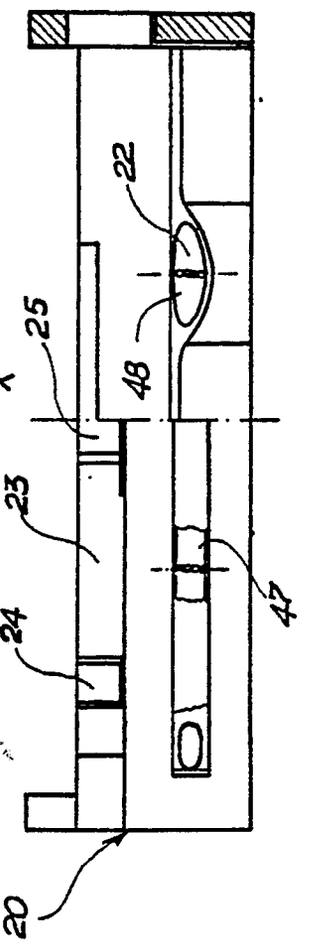

Fig. 11

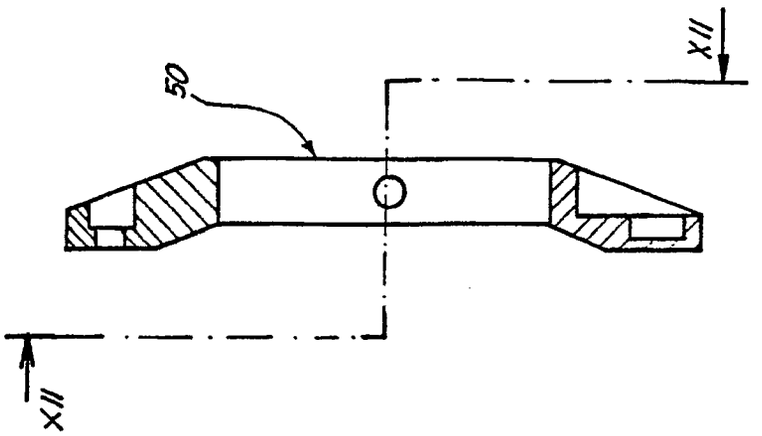

Fig. 13

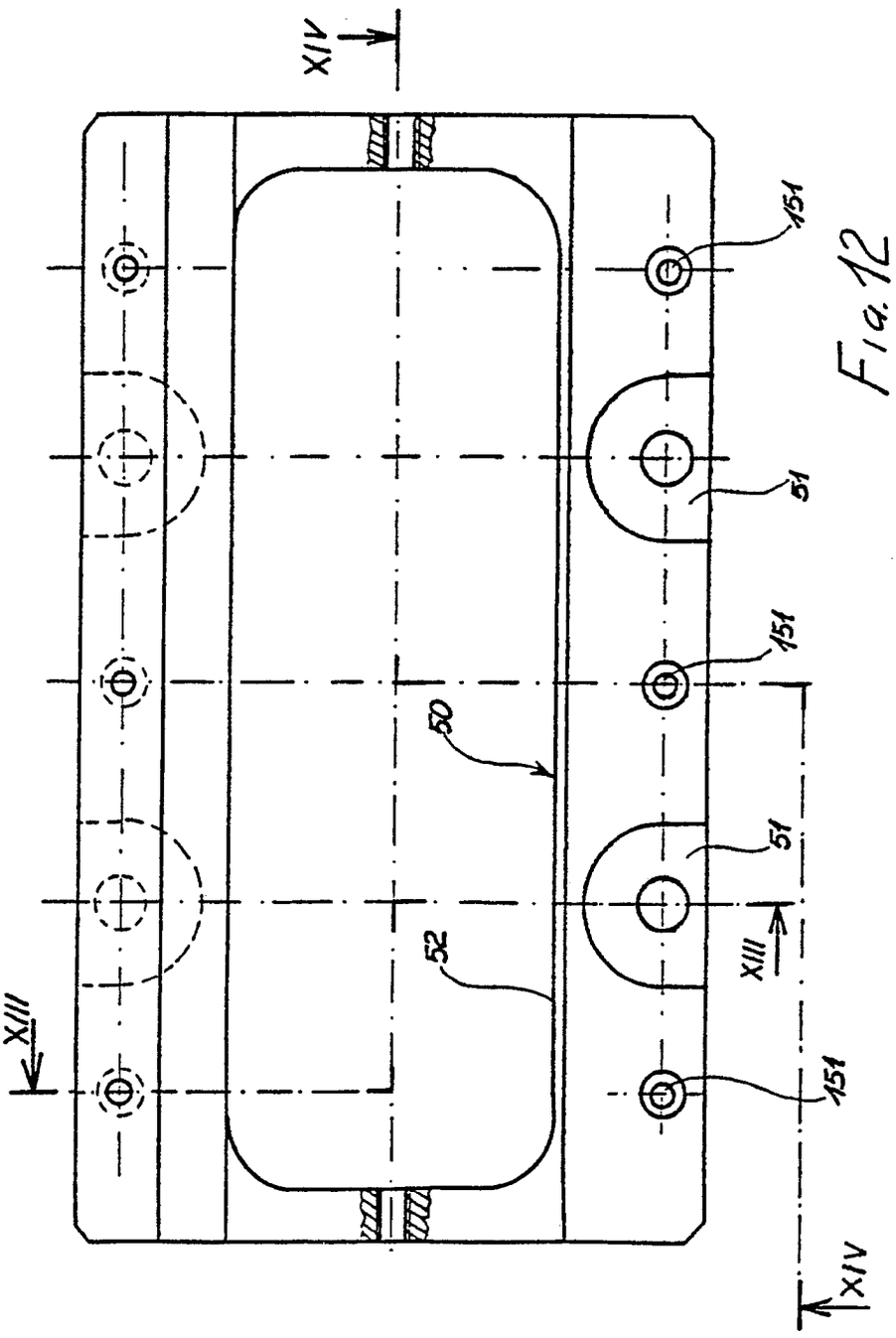

Fig. 12

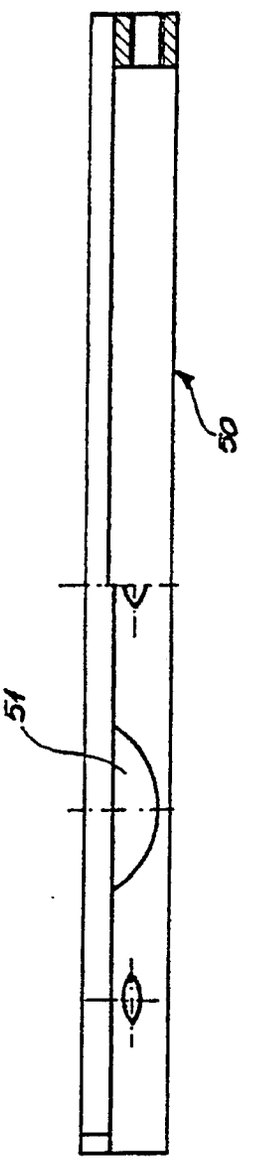

Fig. 14

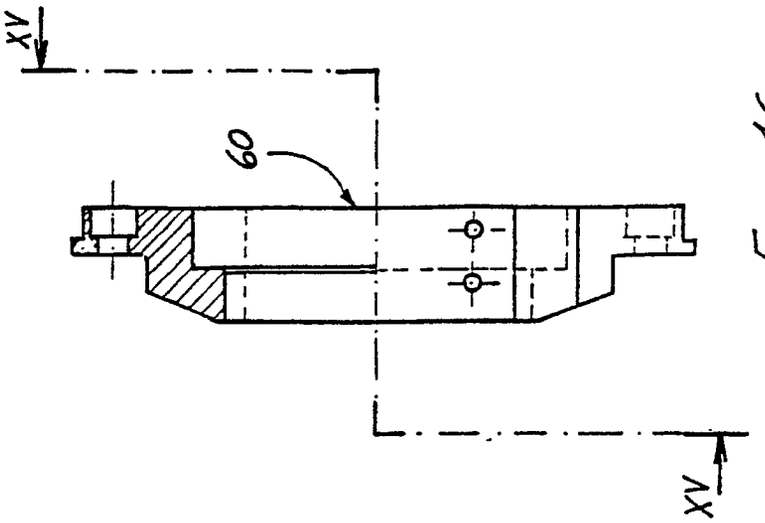

Fig. 16

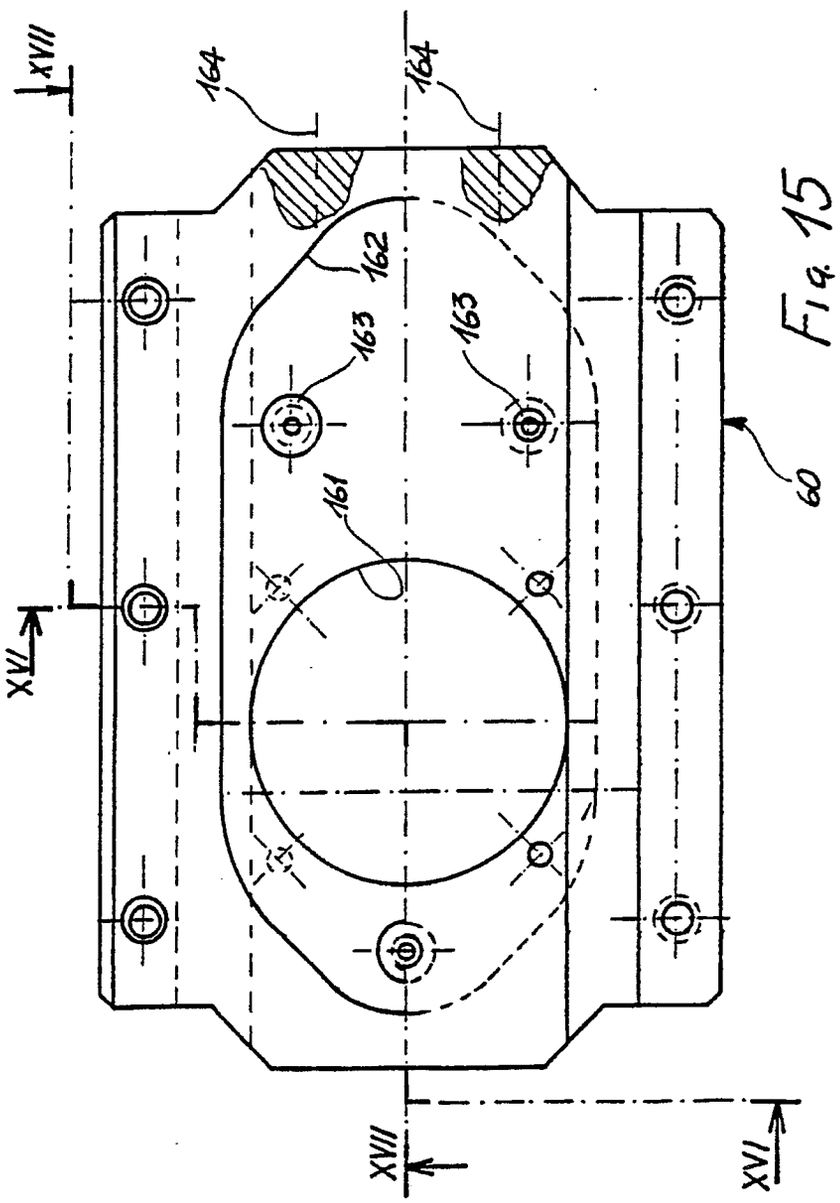

Fig. 15

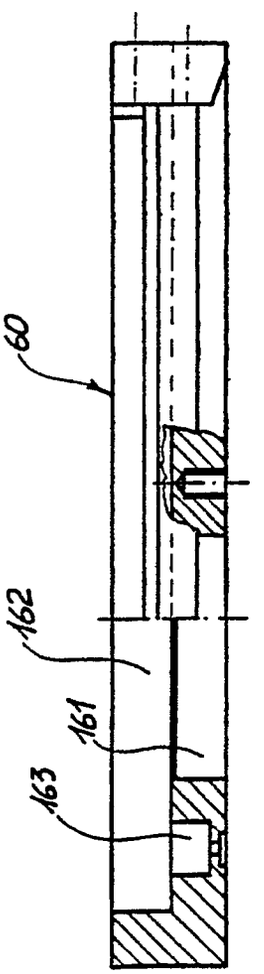

Fig. 17