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(54) **Title:** MECHANICAL COUPLING SYSTEM

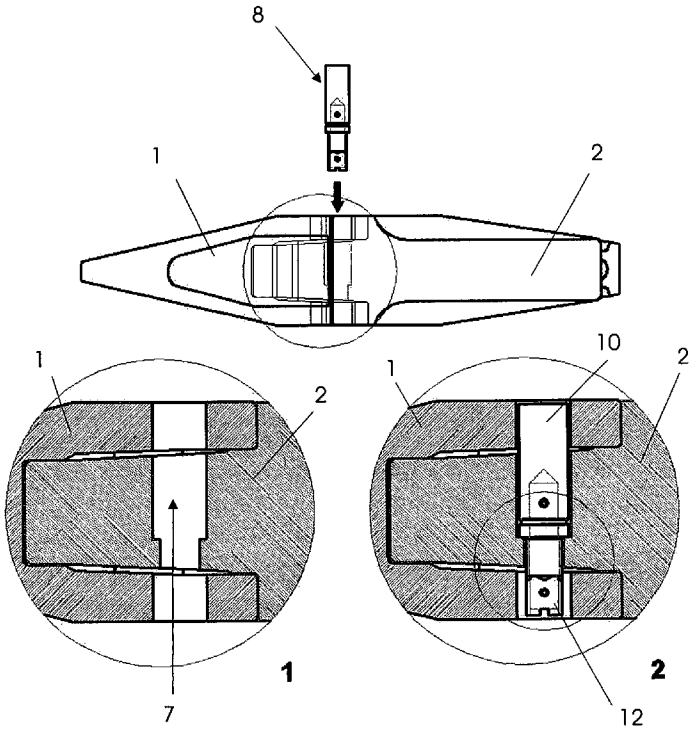

Fig. 11

(57) **Abstract:** It is described a mechanical coupling system having a first coupling element (1) and a second coupling element (2). The contact surfaces between the first coupling element (1) and the second coupling element (2) are well defined, strategically located to minimize the coupling efforts, and orthogonal or parallel to each other. All angles formed between the contact surfaces between the first coupling element (1) and the second coupling element (2) are straight, thus eliminating resulting forces that transmit efforts for a fixation pin (8) which may cause the breakage of such fixation pin. The first coupling element (1) and the second coupling element (2) are notched through a fixation pin (8), the axial notching of the lock set being made through rotation in relation to the 90° axial axis (clockwise/counterclockwise) of a second element (11) and made through an especial wrench (20) creating a mechanical interference due to the geometry change of the lock set in relation to the adaptor cavity.

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"MECHANICAL COUPLING SYSTEM"

This invention refers to a mechanical coupling system which construction allows the mechanical parts notching and decoupling without the need of hamming the fixation pin, as well as not damaging the fixation pin by means of resulting forces.

Description of the Prior Art

The state of the art mechanical couplings have a series of inconveniences, e.g. the extremity and adaptor coupling used on digging machines.

The digging machines and the like are often used to pull away, move and load soil, stones and ore. These equipments, which may be presented in a number of configurations, usually have bucket linked to a mechanical bracket. In order to avoid excessive wastage of the bucket cutting edge and improve the penetration of the material to be handled, it is a common practice to set up wastage elements along the digging edge, as cogs projecting ahead of the bucket cutting edge. Generally, the cogs are subject to severe working conditions, being exposed to high efforts and wastage, thus they need to be frequently replaced, and further, depending on the work the digging equipment is subjected to, changing the kind or shape of the cogs may be necessary.

It is desirable the wastage part being capable of be easily and quickly replaced in the field, thus minimizing the equipment inactive period. In order to make the replacement mentioned above easier and minimize the amount of material needing to be replaced due to wastage, the digging cogs are often composed by a number of parts including, for example, an adaptor, an extremity and a lock. The adaptor fastens into the bucket cutting

edge in a way almost permanent, through its rear end that is formed to such purpose, and a nose projecting forward for notching the extremity temporally. The notching is kept connected through a lock.

There are different kinds of notching systems between extremities and adaptors, in most of them being common that resulting forces opposed to the notch direction are generated when applying a vertical effort at the cog extremity anterior end. Such resulting force is generated due to the conical geometry of the adaptor nose and the extremity cavity that tend to disassemble the set, generating considerable efforts at the lock that maintains the set connected.

Another system available on the market nowadays consists on using hook-shaped extremity side shoulders that couples into the adaptor cavity with the same geometry. Such system is very efficient to the descending vertical effort at the anterior end of the cog extremity, once it tends to further "hooking" the coupling by increasing such effort intensity, however, when such effort is applied on this same direction on the opposed sense it tends to "unhooking" the set, generating great efforts at the lock set. Anther inconvenience of this system is the need of a circular movement at the adaptor extremity assembling and disassembling, creating the need of "hooking" these two components, as the extremities normally are heavy parts that do not have a good ergonomics when being used by the operator.

Patents PI 8102233 and US 6,735,890 B2, describe an assembling from a helical coupling. These systems have the ergometric inconvenience at the extremity assembling on the

adaptor, because it is necessary the rotation movement of the extremity in relation to its longitudinal axis to "screw it" on the adaptor, also making difficult the use of mechanical tackles on this operation.

Independently of the notch system, in order to make possible the removable assembling of the extremity at the adaptor, a lock system composed of a pin or bar with a retention device that is used so that the pin or bar do not get out of their assembling position is used.

An arrangement of the lock set on the configuration previously mentioned often used on the market. consists in the retaining device composed by a pressure washer, that is placed on a cavity of the adaptor and that defines a wrapping and positions it concentrically in relation to the corresponding bores of the extremity and adaptor. A pin with a diameter slightly bigger than the pressure washer bore is notched by means of a depression on the pin surface when a hammer hits it.

Since it is normally necessary to hit the pin horizontally, such operation becomes difficulty because the space between the cogs is limited, creating the need of auxiliary tools thus increasing the risk of an accident to the operator. Another inconvenience of this lock system consists in the need of two independent parts to compose the set, since the retaining device is normally small and subject to loss at the field.

US Patent 5,068,986 describes a locking system composed by two sub-sets plus a disassembling device. Although the use of this disassembling device, it is still necessary in a lower intensity to hit the system for its assembling and disassembling.

US Patent 6,030,143 describes a locking system composed by an elastomer with a metallic wrapping and a metallic shoulder composing a single set, however, there is still the need of hamming such set for assembling and disassembling of its operating position.

Patents PI 0318633-4 A and PI 0418595-1 A, describe locking systems where there is no need of hamming the set for assembling and disassembling it, only needing rotate the pin around its axial axis through a tool for make its retention at the operating position, however in both cases the systems are composed by two independent sub-sets. A worrying aspect for the system described on PI 0418595-1 A, is the gap dependency between the adaptor extremity at the efficiency of retention to rotation of the fixation pin, thus the wastage at the coupling area of the extremity set plus adaptor influences the reliability of the locking system.

Brief Description of the Drawings

Following, this invention will be more briefly described based on an execution example represented on the drawings. The figures show:

Figure 1 - a side view of an extremity of the state of the art;

Figure 2 - a side view of an extremity of the state of the art;

Figure 3 - a side view of an extremity of the state of the art;

Figure 4 - a side and superior view of the first coupling element notched on the second coupling element, object of

the present invention;

Figure 5 - a side sectional detailed view of the first coupling element notched on the second coupling element, object of the present invention;

Figure 6 - a sectional top detailed view of the first coupling element notched on the second coupling element, object of the present invention;

Figure 7 - a side and top view of the first coupling element;

Figure 8 - a sectional top detailed view of the gaps and shoulders of the mechanical coupling object of the present invention;

Figure 9 - a side sectional detailed view of the gaps and shoulders of the mechanical coupling object of the present invention;

Figure 10 - sectional top detailed views of the fixation pin set, object of the present invention;

Figure 11 - a sectional top detailed view of the fixation pin notched on the first coupling element and the second coupling element set;

Figure 12 - detailed views of the central fixation pin notched, object of the present invention;

Figure 13 - a top view of the fixation pin, object of the present invention;

Figure 14 - a side view of the fixation pin, object of the present invention;

Figure 15 - a side detailed view of the fixation pin assembling by means of the special wrench;

Figure 16 - a sectional top detailed view of the pin assembling by means of the special wrench.

Detailed description of the drawings and invention

As may be seen from figure 1, state of the art mechanical couplings, more precisely notches for digging machines extremities of the state of the art, showing the specific points where the resulting forces transmitting digging efforts for the fixation pin, which may cause the pin breakage.

The object of the present application may be seen from figure 4, where a first coupling element 1 notched on a second coupling element 2 is shown.

Preferably, the first coupling element 1 is an extremity and the second coupling element 2 is a digging machine adaptor, however, the system may be used for any type of mechanical coupling, since it is functional and in accordance with the teachings of the present invention.

The second coupling element 2 has a protuberant element 3, popularly called "nose", which will be notched in a recess 4 of the first coupling element 1. The protuberant element 3 further has an opening, which trespasses the whole thickness of element 3.

The first coupling element 1 has two sides 1a, which ends 1b have quadrangular, cooperating on the end of the course of the second coupling element 2. By its turn, the protuberant element 3 has an end 3a of squared shape cooperating at the end of the course of the first coupling element 1, positioned between sides 1a of the first coupling element 1.

Sides 1a, which have ends 1b, have an structural function on the coupling, minimizing coupling weight of this wastage item, thus increasing the weight percentage of the material available for wastage (it is not necessary to involve the whole second coupling element 2).

Recess 4 of the first coupling element 1 has a shape cooperating to that of the second coupling element 2 and an opening 6 on the sides 1a, that posterior to the notch of extremity 1 on adaptor 2, will be concentric to the opening 5, forming a channel 7.

The contact surfaces between the first coupling element 1 and the second coupling element 2 are well defined, strategically located to minimize the coupling efforts and parallel or orthogonal to each other.

All the angles formed between the contact surfaces between the first coupling element 1 and the second coupling element 2 are straight, as may be seen from figure 4, thus eliminating the resulting forces of the state of the art which cause the fixation pin 8 breakage.

This increases the distance between the coupling supports to the maximum for decreasing the "lever" effect at the coupling, thus minimizing the transversal section dimensions and increasing the penetration power.

Further, it should be seen that shoulders 15 are foreseen on the predefined contact surfaces, as may be seen from figures 8 and 9, causing the highest possible distance between the coupling supports and consequently gaps 16 are provided, intentionally created on the points where the contact is

undesirable.

Such embodiment uses less raw material for obtaining the mechanical coupling system and consequently decreases its weight.

The first coupling element 1 and the second coupling element 2 are notched through a fixation pin 8 which is a single set, the axial locking of the lock set being made through rotation in relation to the 90° axial axis (clockwise/counterclockwise) of the second element 11 (as will be explained next), made through an special wrench 20, creating an interference due to the geometry change of the lock set in relation to the adaptor cavity.

The fixation pin set 8 has a first fixed element 10 having a shape cooperating to channel 7. Posterior to the first fixed element 10, a second element 11 is disposed.

The second element 11 has shoulders 11a, cooperating to depressions 12a, provided on a third element 12. The functioning of such elements will be explained next.

The notching of the fixation pin set 8 is better explained from figure 7, the third element 12 is rotated along its longitudinal axis through the special wrench 20 which is clamped on a recess 8a, and thus the element 10 is also rotated, because it is mutual through the elastic pin 14.

The element 11 is not rotated because the adaptor pin set housing cavity geometry does not allow such movement. Therefore a relative movement is created between the two trapezoidal shoulders 11a of the element 11 (disposed at 180°) and the four trapezoidal depressions 12b of the element 12 (disposed

at 90°). This relative movement generates a resulting force on the pin axial direction that compresses an elastic material ring 15 through a metallic ring 16.

It should be noted that the amount of depressions 12b and shoulders 11a may vary, as well as that the depressions and shoulders may have other embodiments, since they are in accordance with the teachings of the present application.

When the rotation reaches 90°, it occurs the alignment between the depressions 12b of the element 12 and the shoulders 11a of the element 11, and thus the elastic material ring 15 returns on the rest position, the elements 10 and 12 being locked in a 90° position of the initial positioning, and thus the change of the element 12 geometry is generated creating the mechanical interference between the fixation pin set 8 and the channel 7 of the adaptor 2 housing. For unlocking the set, all is need is to repeat the operation previously described.

It should be noted that the fixation pin 8 geometry as well as the geometry of its elements might be any, since it is functional with the teachings of the present invention.

The present invention has a great number of vantages:

- Linear Assembling/Disassembling of the first coupling element 1 on the second coupling element 2 (better ergonomy - mainly for heavy sets making easier the use of tackles).

- All the axial efforts of the digging operation are transferred for the posterior area of the protuberant element

3 of the second coupling element 2, not transmitting efforts that may cause the buckling of the element 3 of the second coupling element 2;

- Contact surfaces geometry parallel and orthogonal to each other in order to not generate resulting forces that tend to decouple the set;

- The only effort transferred to the lock is the one of pulling away the first coupling element 1, thus, the lock does not suffers digging efforts which may have smaller dimensions than the ones actually in use;

- The hamming of the set for assembling and disassembling of the first coupling element 1 is not necessary;

- Lock formed by a single set;

- Axial positioning of the lock set is made by mechanical interference due to the geometry change of the housing cavity of the second coupling element 2;

- Tangential locking of the lock set through the "notch" of the shoulders/depressions of trapezoidal section, axially disposed at 90°, which freedom/locking degree is guaranteed by the axial movement offered by an elastic properties ring (elastomer);

- Lock positioning on the posterior area of the "nose" of the second coupling element, out of the rotation center. Aiming at avoiding the accidental rotation of the lock central movable part due to the coupling gaps.

- The use of the fixation pin 8 set allows the coupling and posterior decoupling of the first coupling element 1 and the second coupling element 2 without the need of hamming the

pin with mallet and/or hammer but with the help of a special wrench 20.

After having described a preferred example of execution, it should be understood that the scope of the present invention embraces other possible variations, and it is limited only by the contents of the attached claims, which include the possible equivalents.

C L A I M S

1) **"MECHANICAL COUPLING SYSTEM"**, having a first coupling element (1) and a second coupling element (2), wherein:

- the contact surfaces between the first coupling element (1) and the second coupling element (2) are well defined, strategically located to minimize the coupling efforts and parallel or orthogonal to each other;

- all angles formed between the contact surfaces between the first coupling element (1) and the second coupling element (2) are straight, thus eliminating resulting forces that transmit efforts for a fixation pin (8) which may cause the breakage of such fixation pin; and

- the first coupling element (1) and the second coupling element (2) are notched through the fixation pin (8) which is a single set, the axial locking of the lock set being made through rotation in relation to the 90° axial axis (clockwise/counterclockwise) of a second element (11) and made through a special wrench (20) creating a mechanical interference due to the geometry change of the lock set in relation to the adaptor cavity.

2) **"MECHANICAL COUPLING SYSTEM"**, according to claim 1, wherein the first coupling element (1) is an extremity and the second coupling element (2) is an adaptor.

3) **"MECHANICAL COUPLING SYSTEM"**, according to claim 1, wherein the axial efforts from the digging operation are transferred to the posterior area of the protuberant element (3) of the adaptor (2).

4) **"MECHANICAL COUPLING SYSTEM"**, according to

claim 1, wherein the recess (4) of the first coupling element (1) has a shape cooperating to that of the second coupling element (2) thus forming a channel (7).

5) **"MECHANICAL COUPLING SYSTEM"**, according to claim 4, wherein the fixation pin set (8) has a first fixed element (10) with a shape cooperating to channel (7), and a second element (11) is disposed posterior to the first fixed element (10).

6) **"MECHANICAL COUPLING SYSTEM"**, according to claim 5, wherein the second element (11) has shoulders (11a) cooperating to depressions (12a), provided on a third element (12).

7) **"MECHANICAL COUPLING SYSTEM"**, according to claim 6, wherein shoulders (15) are provided on the predefined contact surfaces, producing the longer distance possible between the coupling supports, and consequently gaps (16) are provided, intentionally created on the points where the contact is undesirable.

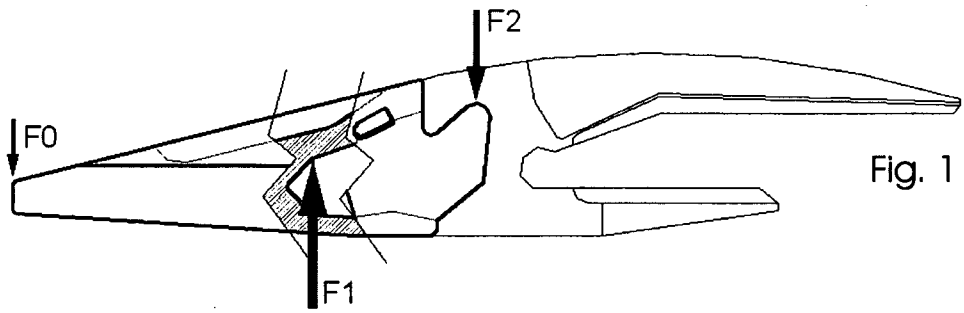


Fig. 1

Prior art

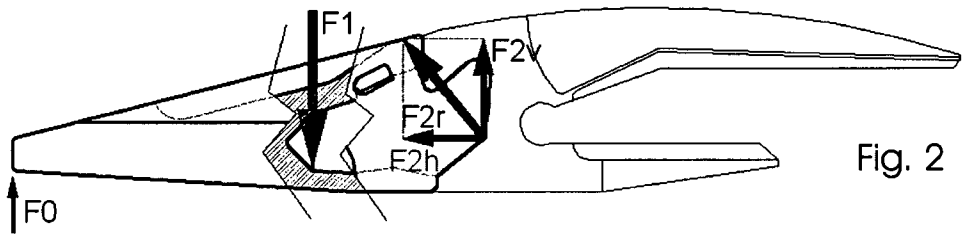


Fig. 2

Prior art

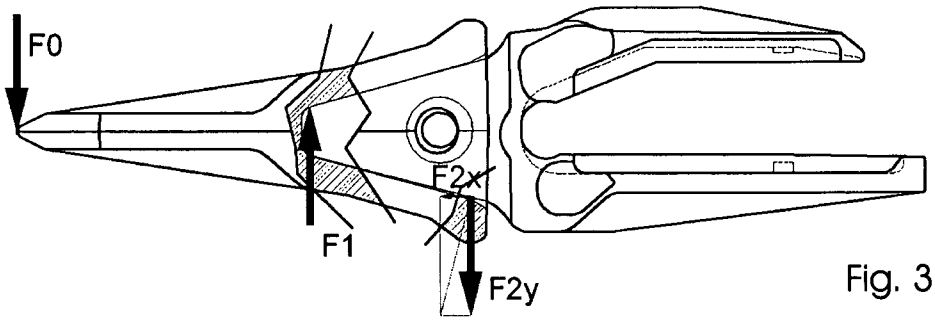


Fig. 3

Prior art

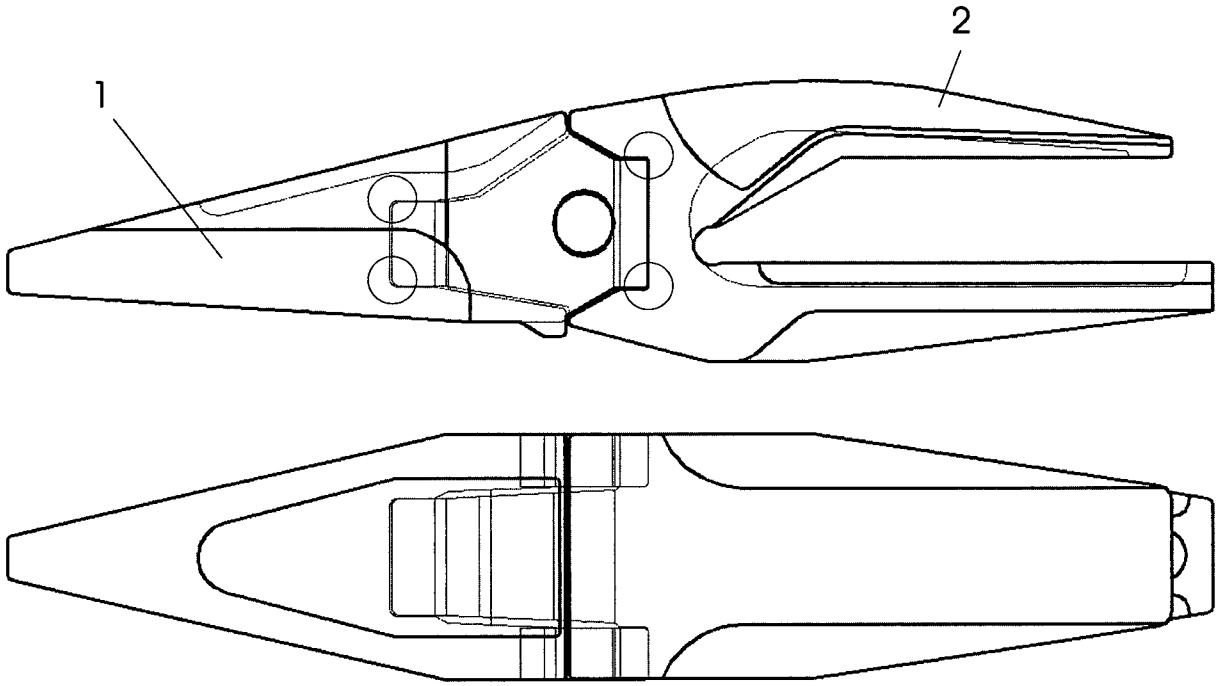


Fig. 4

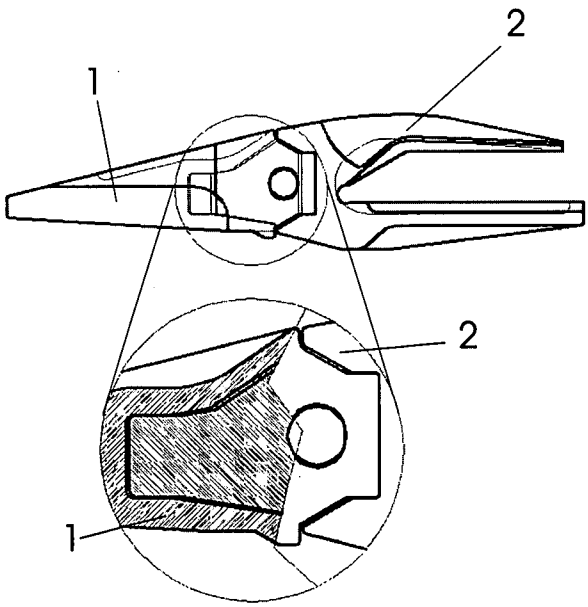


Fig. 5

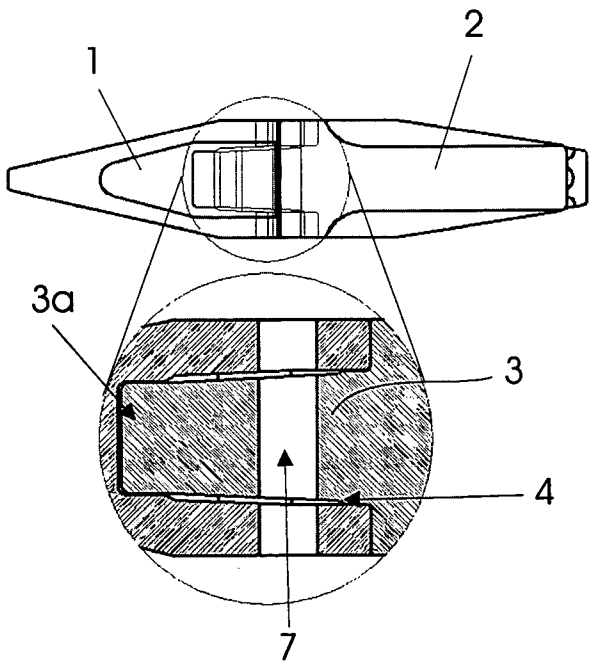


Fig. 6

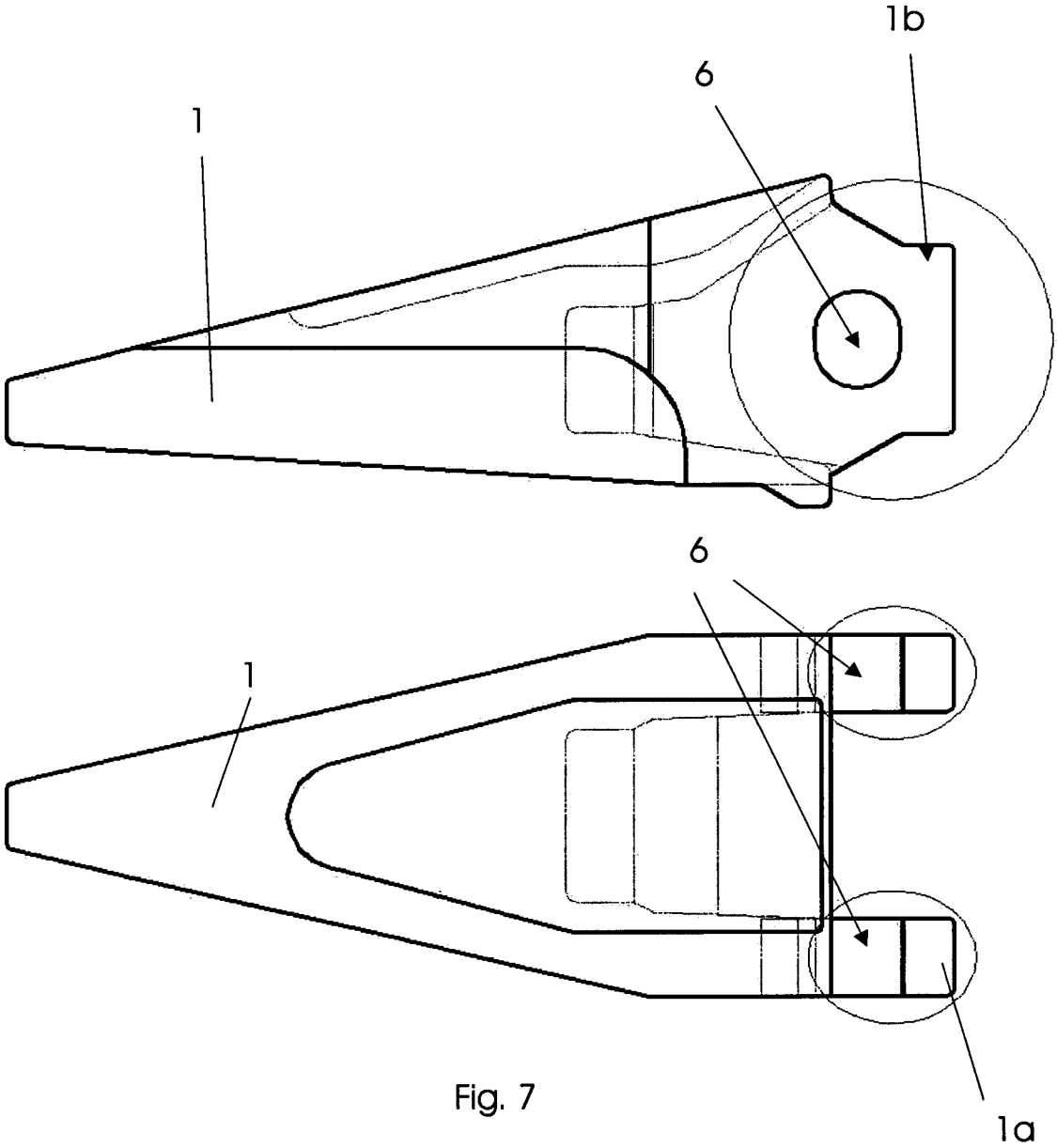


Fig. 7

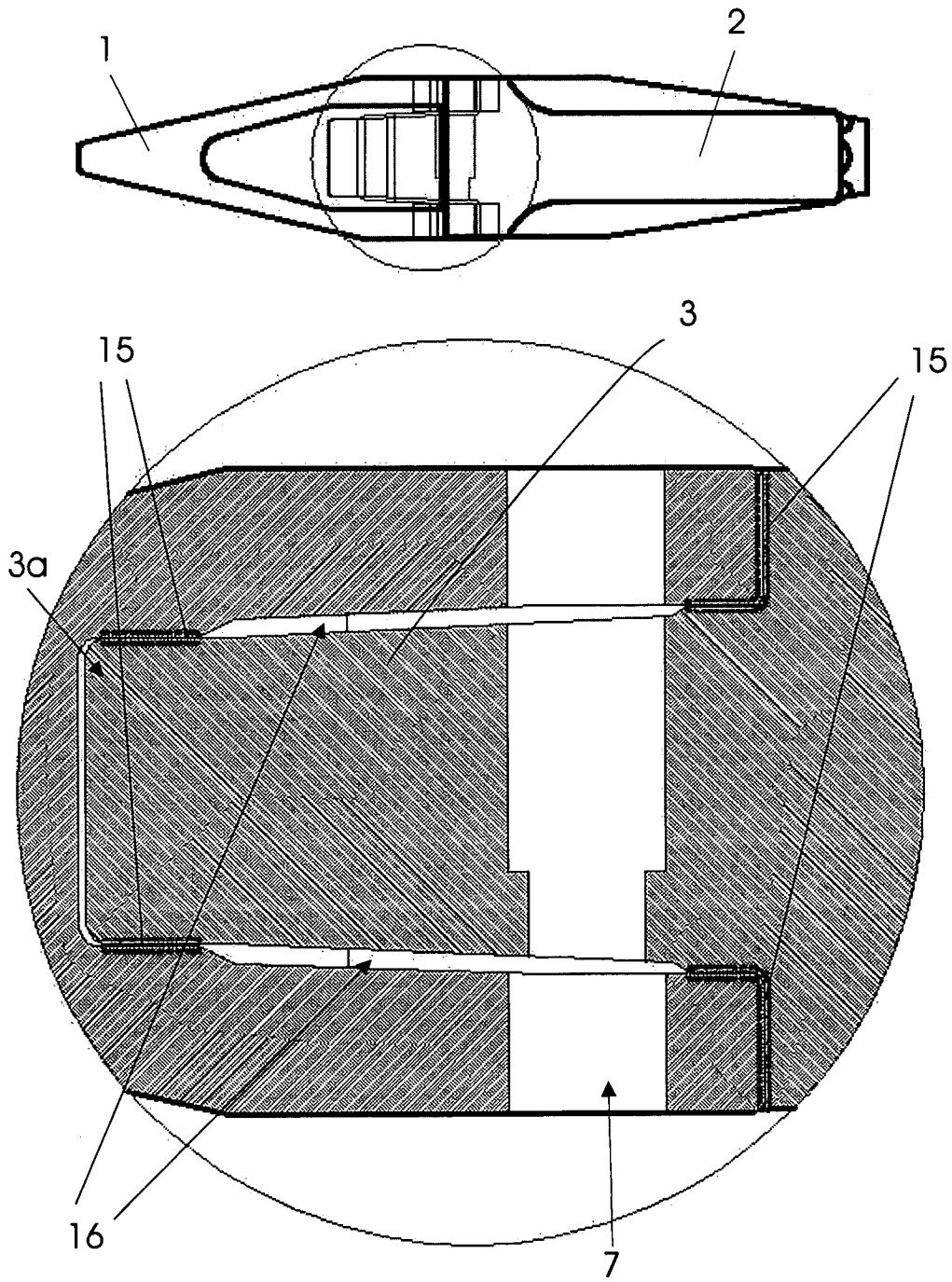


Fig. 8

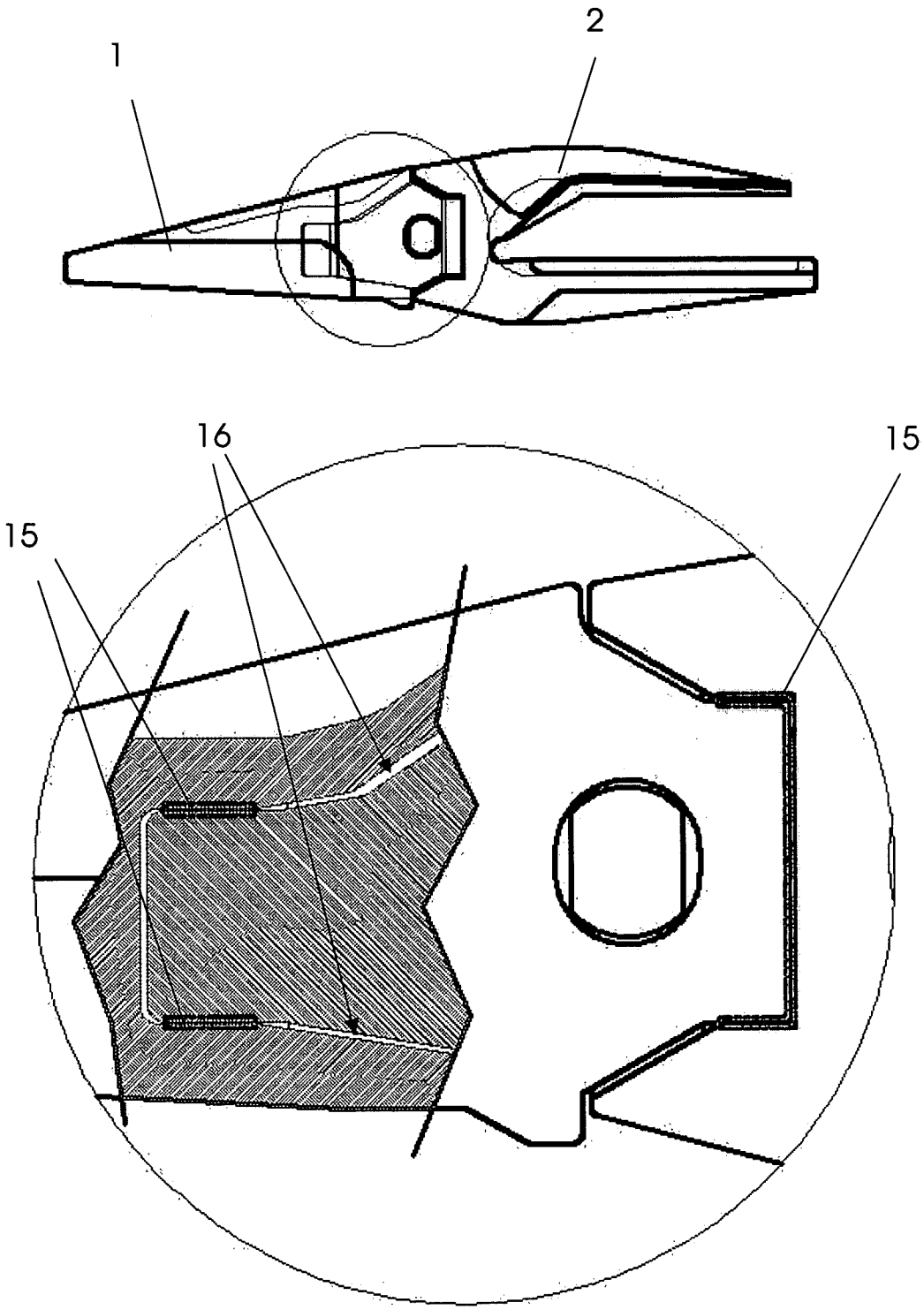
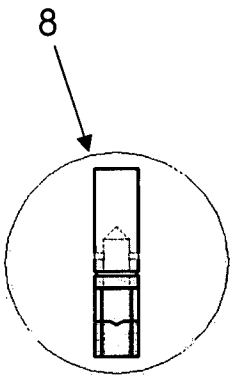


Fig. 9



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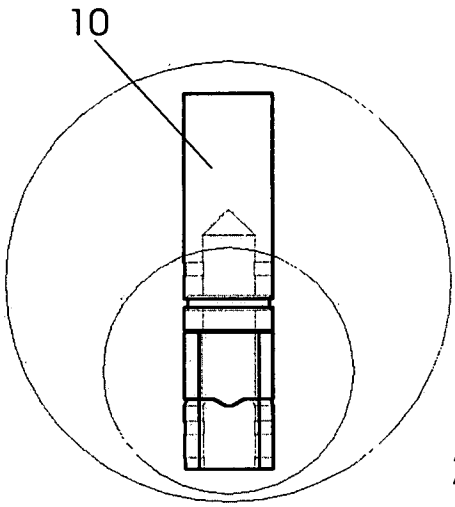

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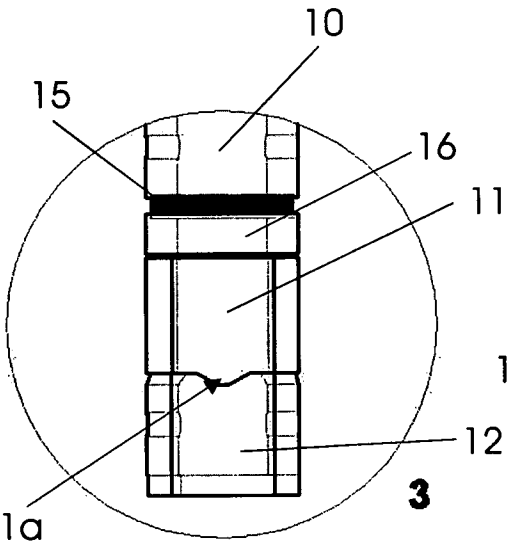

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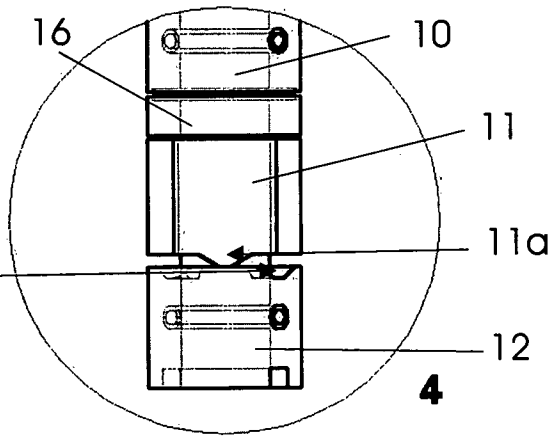

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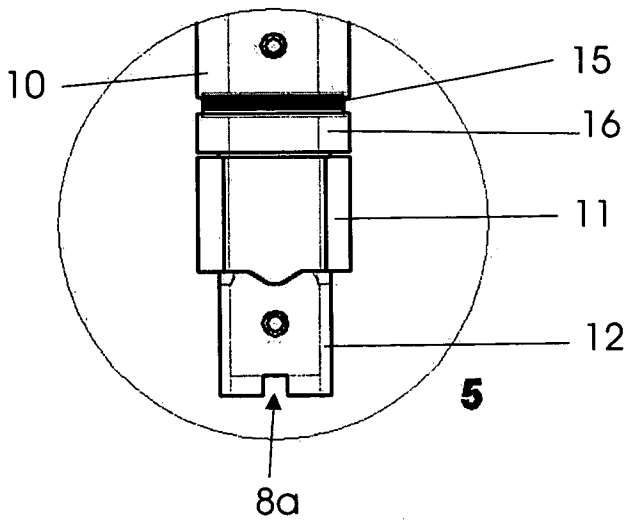

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Fig. 10

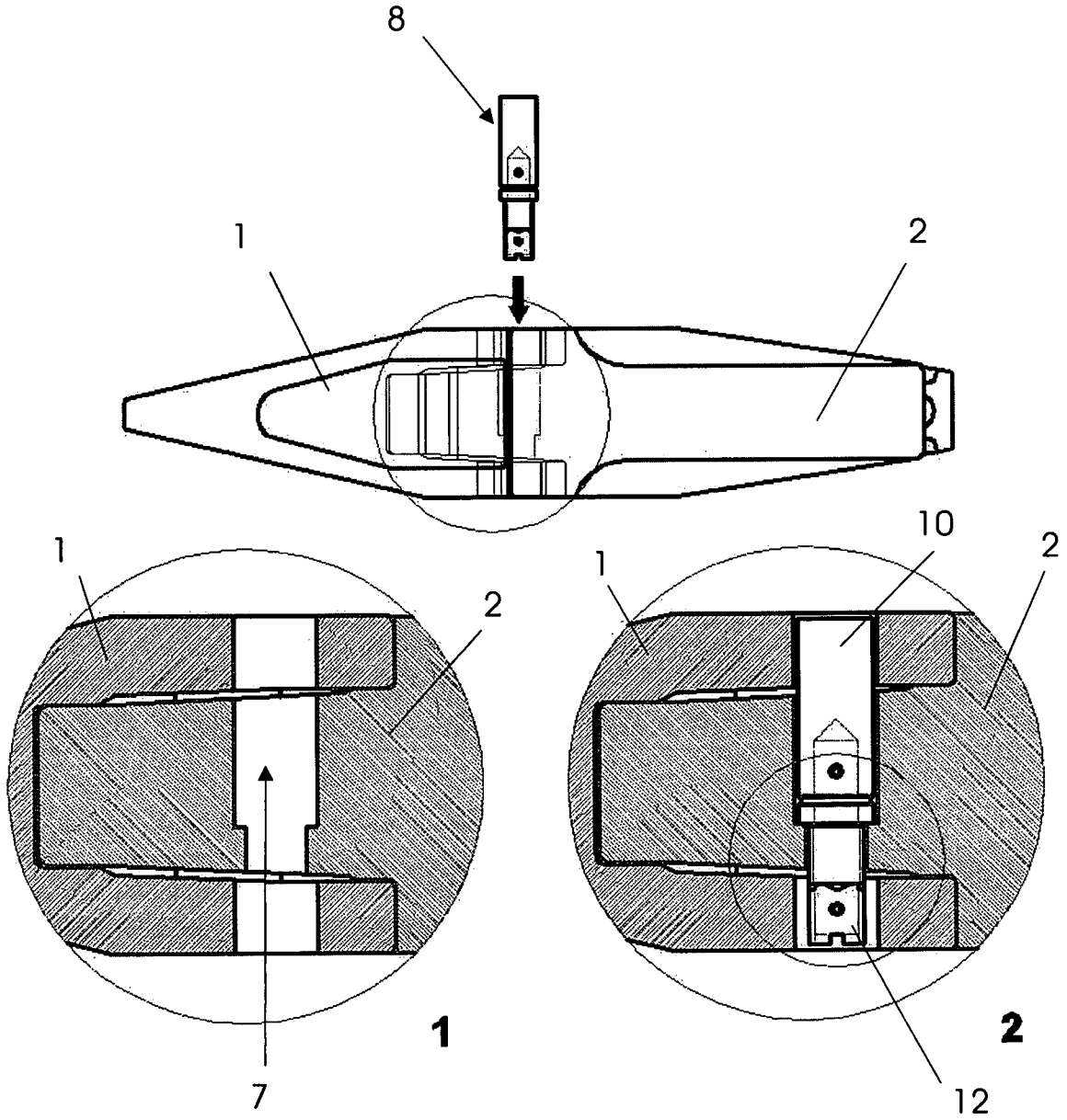
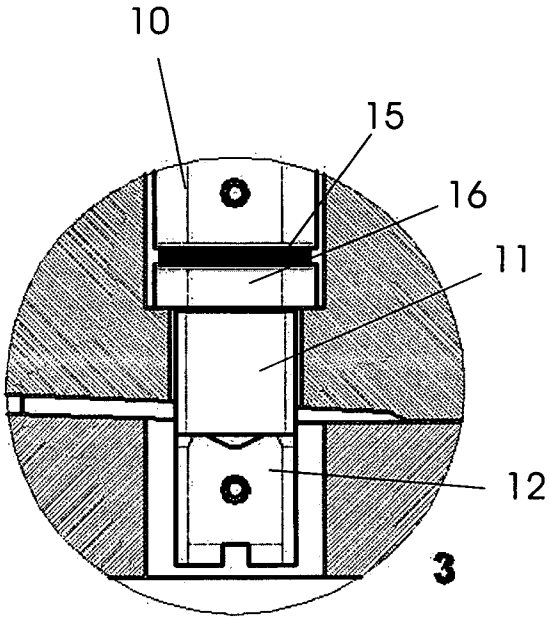
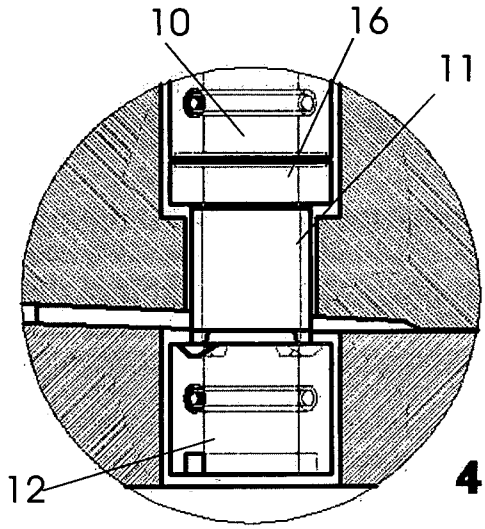


Fig. 11





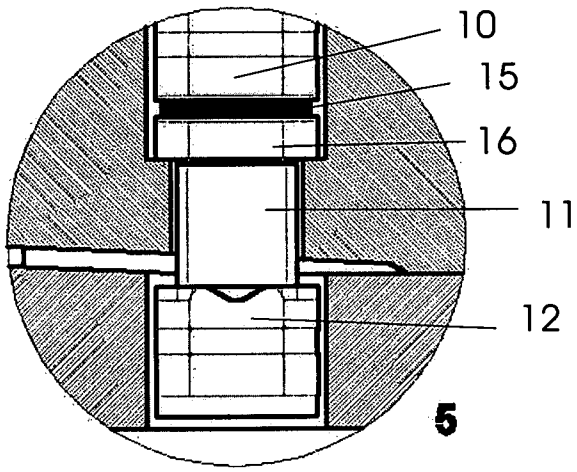


Fig. 12

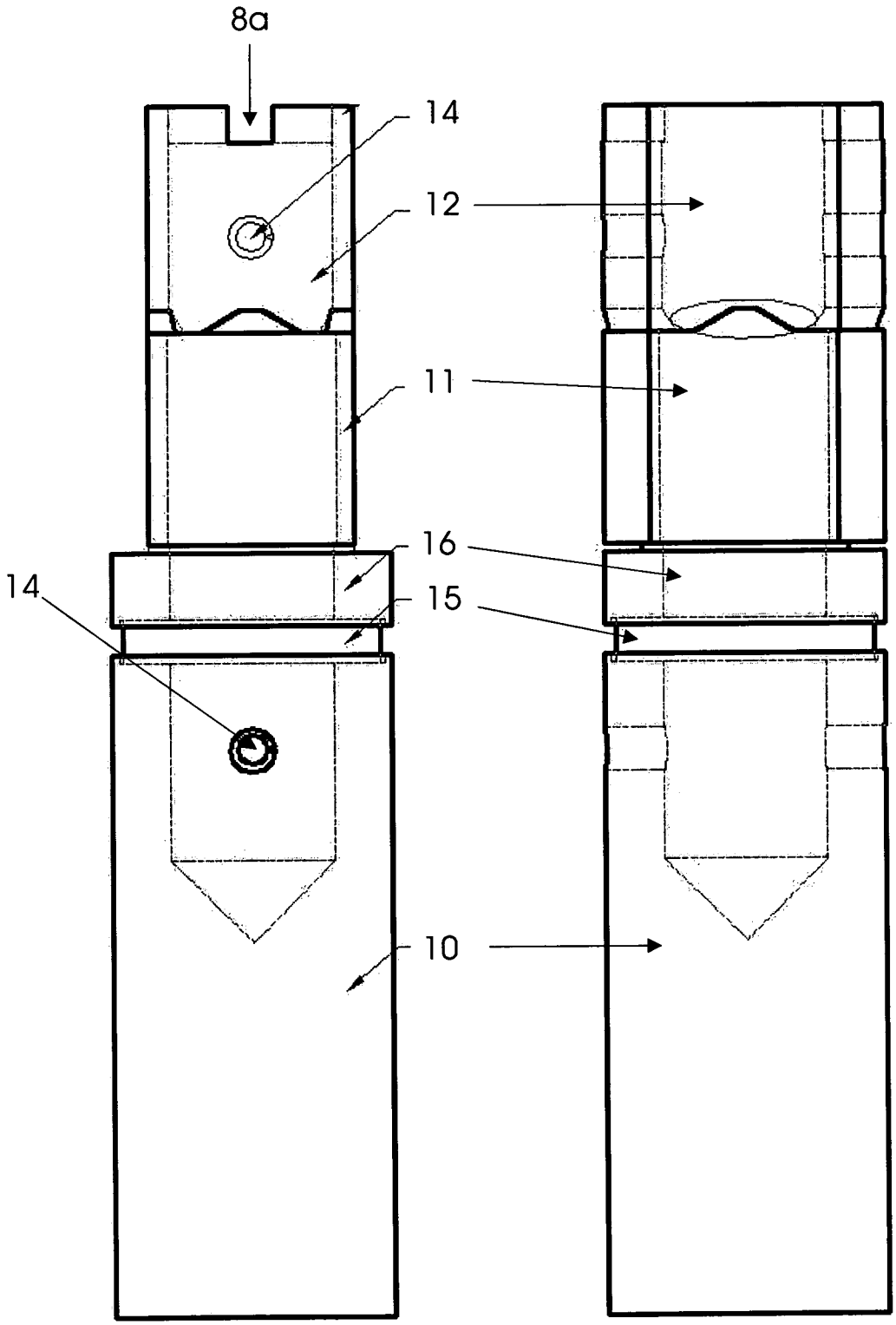


Fig. 13

Fig. 14

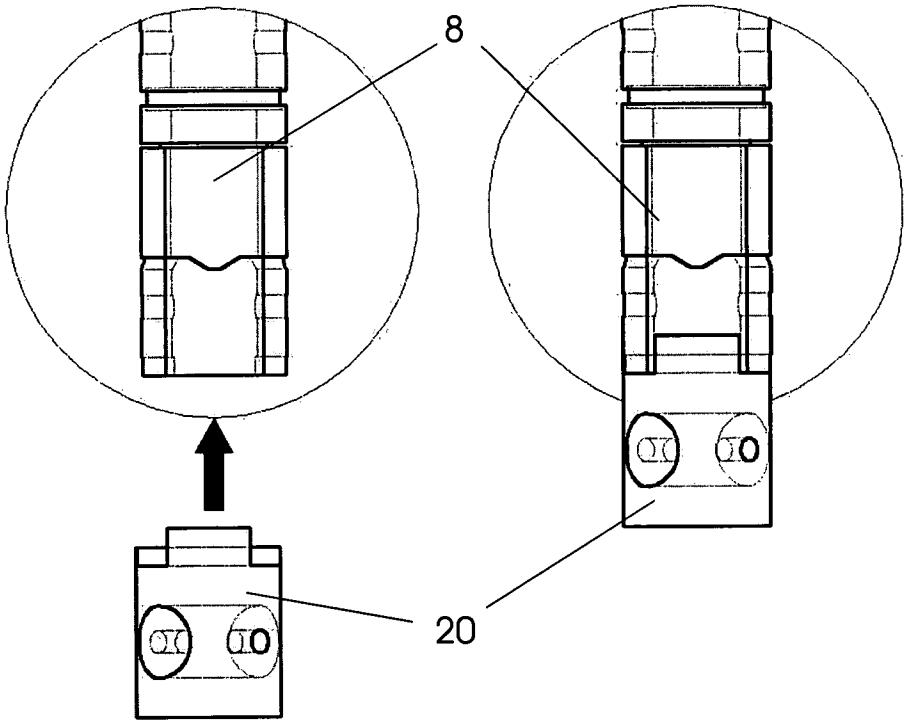


Fig. 15

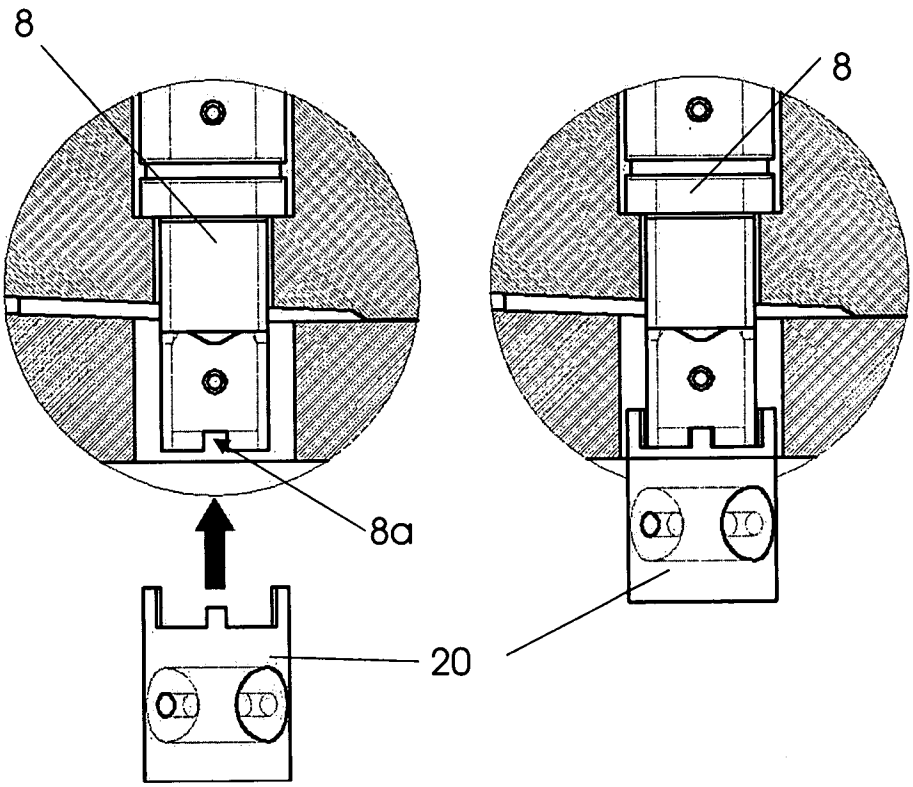


Fig. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 2008/000042

A. CLASSIFICATION OF SUBJECT MATTER

IPC[8]: ***E02F 9/28*** (2006.01); ***F16B 1/00*** (2006.01); ***F16B 21/00*** (2006.01)

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)

IPC[8]: E02F, F16B, A01B, B25G, B23P

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)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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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	Date of mailing of the international search report
15 July 2008 (15.07.2008)	30 July 2008 (30.07.2008)

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A	US 5 937 551 A (Moehnke et al.) 17 August 1999 (17.08.1999) *Fig. 1-4*	3,7
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Information on patent family members

International application No.
PCT/BR 2008/000042

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