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(54) Title: METHOD AND DEVICE FOR DEBURRING WELD BEADS FROM BILLETS

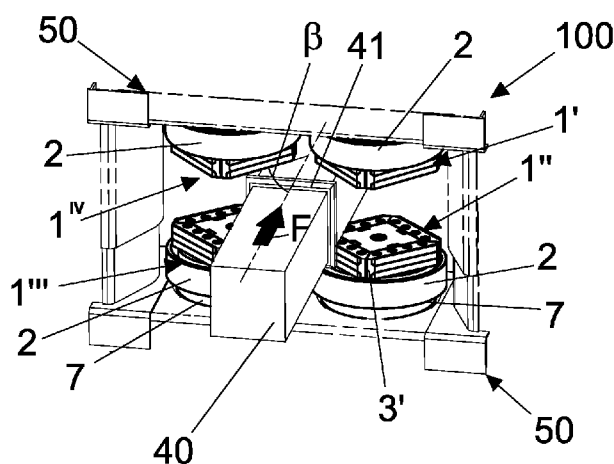


Fig. 1

(57) Abstract: The present device for deburring steel pieces comprises a stationary support structure (50) and four deburring cutters (1', 1'', 1''', 1'''') for cutting the welding seam (41) of a billet (40). The cutters (1', 1'', 1''', 1'''') are fastened to the support frame, axially inclined with no possibility of rotation about the vertical symmetry axis thereof during the cutting operation. The cutters have a support base and four cutting blades (3', 3'', 3''', 3''''), arranged diametrically opposite, two by two, and arranged along the sides of a square, each of the four blades being fastened to the support base (2) with detachable fastening means and wherein each cutting blade has one or more cutting profiles.



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MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
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METHOD AND DEVICE FOR DEBURRING WELD BEADS FROM BILLETS

FIELD OF THE INVENTION

- 5 The present invention relates to the steel processing field, and in particular to deburring operations following the welding of steel bars or the cutting thereof.

BACKGROUND ART

In the field of steel processing, for example after welding the heads of two steel bars, for example by flash welding, or when a bar is cut by means of flame torches, welding seams or burrs are generated, which remain in relief with respect to the
10 surface of the steel piece. It is almost always necessary to remove these burrs or welding seam(s), especially when the steel piece is to be subjected to subsequent rolling operations, so as not to incur into surface defects in the rolled product.

Nowadays, operations of this kind are carried out at high feeding rates of the steel piece and with the metal at high temperature, which causes a strong wear and tear
15 of the deburring tools and a strong stress thereto. In steel processing plants more performing, with high production capacity, it is therefore necessary that the cutting tools are frequently replaced, entailing a stop of the processing line, which causes a sharp slowdown in the production line.

20 The provision is therefore necessary of tools for cutting and removing burrs and welding seams from the surface of steel pieces, such as bars, and in particular billets, which are capable of carrying out the deburring operations at high speed and which can be replaced quickly when worn out, to reduce rolling interruptions as much as possible.

25 Patent publications EP2719498, EP1464429 are known, which disclose deburring devices which use cutters with circular or polygonal edges, which offer the advantages of being capable of being used in high-speed rolling mills to remove welding seams and burrs on edges of steel bars, such as billets, and which, in case of wear of sections of the cutting discs, after a certain period of work, can be rotated
30 so that sections of the disc not yet worn out carry out the cutting for a subsequent period of time. However, during the prolonged use of this type of cutting discs, micro cracks tend to form, causing increasingly larger chippings to propagate along the

cutting profile of the cutting discs. These chippings often lead to the detachment of pieces from the cutting disc, which are often noticed too late by the operator since these processes are carried out in a high temperature environment where operators cannot observe and work freely and at close range, determining, in addition to an
5 increased deburring of the pieces, even the risk of chips getting into parts of the machine which are delicate or difficult to access.

Therefore, when the prolonged deburring operation of welded billets begins to be inefficient or inaccurate, billets having surfaces in which the burr seams have been badly or incompletely removed can enter the rolling train. In situations of this kind,
10 the operator, once noticed the deburring defects, must rotate the cutting disc by 180°, so as to also wear the cutting edge of the arc of the circle opposite to the one now worn or broken. When also this other circle section of the cutting disc remains worn out after a certain period of use, it becomes necessary to replace the entire cutting disc. Therefore, the costs of monitoring the state of the discs and the
15 replacement of the tools in their entirety in the event of wear or breakage, even if only partial, increase the operating costs of such machines.

The further disadvantage of the cutting discs, as disclosed in the two patents mentioned above, is that the entire cutting disc must be built with noble and expensive metal, being a generally monolithic piece, so that it can have a long
20 operating life over time, and once both sides are worn, in any case, the whole cutter must be discarded.

The need is therefore felt to have available devices for removing burrs and welding seams which is efficient in the cutting capacity thereof and inexpensive in the manufacturing and operation thereof. Furthermore, it is also necessary to be
25 provided with a system for detecting the state of wear of the cutter which operates so as to minimize the risks of inefficient cleaning.

SUMMARY OF THE INVENTION

These mentioned objects of the invention, in addition to other objects which will become apparent in light of the following description, are achieved by a deburring
30 device which, in accordance with claim 7, comprises a stationary support structure, at least four deburring cutters having the features of one of claims 1 to 6 and

fastened to the stationary support structure with no possibility of rotation about a vertical symmetry axis thereof during the cutting operation.

Other objects of the invention are further obtained by a deburring cutter which, in accordance with claim 1, comprises a support base, a cutting body fastened to said support base with detachable fastening means, in which the support base is adapted to be constrained to a stationary support structure, in which the cutting body is prismatic in shape and has a first base which is proximal to the support base and a second base which is distal from the support base, in which each side of the cutting body has a first cutting profile at a corner formed by the junction of the side of the cutting body with the first base of the cutting body and a second cutting profile at a corner formed by the junction of the side of the cutting body with the second base of the cutting body, and in which the cutting body can be mounted on the support base in a position such that the first and the second cutting profiles of each side of the cutting body can be arranged in the burr portion cutting position during different operating steps.

Further objects of the invention are achieved by a method for cleaning burrs which, in accordance with claim 10, uses a device according to one of claims 7 to 9 and in which a burr portion of a steel piece is removed by one or more deburring cutters at a time with a relative movement of the one or more deburring cutters with respect to the steel piece.

It is immediately apparent to those skilled in the art that the new design of deburring cutter with the features listed above and in particular with the quadrilateral configuration, preferably a square, of the cutting body which is detachably fastened on the support base or plinth which, not being rotating, but fastened, allows to keep the entire structure of the deburring cutter integrally anchored to the fastened support structure or frame of the deburring device. It is apparent that the cutting body can also advantageously have a lozenge or rhombus shape.

This design of the deburring cutter offers several advantages, among which a few are mentioned below:

- the cutting profiles of each deburring cutter can be made operational in sequence, each time it is necessary to replace a cutting profile due to wear or breakage, for a total of eight times and even more, up to a number of sixteen replacements when a

pair of cutting profiles, which can be used for each side of the cutting body, is provided, moving the cutting body by 90° each time, and then disassembling the individual cutting blades or the whole cutting block and fastening them in an inverted position on the support plinth with the new cutting profile in the cutting position and
5 the worn or broken cutting profile in the position in contact with the support plinth. When the second set of cutting profiles of all the blades is also worn or no longer efficient, the complete replacement of the blades mounted on the deburring cutter is carried out;

the presence of eight cutting profiles on each deburring cutter mounted on a
10 deburring device allows an extension of the operating life of the deburring cutter, with a lower cost with respect to previous solutions, since all four cutting blades are equal to each other and therefore can be made in series, the same goes in the case of cutting profiles made in a monolithic cutting body, to be mounted on the cutter, another advantage of the solution of the invention is the possibility of manufacturing
15 only the cutting profiles using a noble material, so as to save money by building the rest of the blades and also the structure of the cutter using cheaper materials.

Furthermore, in a preferred embodiment of the invention, only a first half of the length of the cutting profile of each cutting blade is used for the cutting in each operating step, while the second half of the corresponding cutting profile of the blade
20 does not contact the deburring during that operational step. This operating manner allows to considerably increase the life of each cutting profile, since a cutting profile is used in two different operating steps and therefore the portions of cutting profile which can be used for the deburring in a cutting block of a cutter according to the invention can reach a total of sixteen, when each cutter is equipped with a cutting
25 block with four blades or four sides, each with two cutting profiles, in which each cutting profile can be divided into two halves, of which only one half carries out the cutting in each operating step. When the allowable wear limit is reached for each section of the cutting profile, the individual cutting blades or the monolithic cutting body can be repositioned on the respective support base so that the worn halves of
30 the cutting profiles are not at the burrs, and that the new halves of the cutting profiles are at the burr seam for the related cleaning operation.

This preferred embodiment of the invention, which favors a better distribution of the wear on the cutting profiles and an extension of the life of the cutters, is also applicable to the embodiment of the cutter in which the cutting body is monolithic, as described below in the description.

- 5 A further advantage of the deburring device of the invention is that the change of blade with the repositioning of the monolithic cutting body or of the individual cutting blades with respect to the burr seam can be carried out on the basis of feedback information from the line itself, instead of solely relying on the operator's observation skills or experience. For example, it is possible to decide when to change the blade
- 10 using a video system which detects the state of the cutters after each cut and, if they are damaged, warns the operator. This solution can be achieved by providing, alternatively, or in combination with, a counter of welded and then rolled billets, so that, when a predefined value is reached, corresponding to a critical level of wear of the cutting profiles determined by a certain number of cuts of burr, on the basis of
- 15 previous data collected over time, the operators are warned about the need to change the cutting profiles or the work portion thereof and, at the first stop of the rolling for the change of the rolling cylinders, the cutters are turned by 90° around the symmetry axis thereof, or the individual blades or the monolithic cutting body are overturned, or the blades are positioned so that the respective non-worn half of
- 20 the cutting blades is in the cutting position, for example by moving the axes of the cutters, or a combination of such operations is made, as more appropriate and economical it is to achieve a planned wear of the cutting profiles of the cutters.

BRIEF DESCRIPTION OF THE FIGURES

- Further objects and advantages of the present invention will become apparent from
- 25 the following detailed description of an embodiment thereof and from the accompanying drawings, merely given by way of explanation and not by way of limitation, in which:

Figure 1 shows an axonometric view of the deburring device of the invention;

Figure 2 is a side view of the device of Figure 1;

- 30 Figure 3 shows an axonometric view of a cutting blade of the deburring cutter belonging to the deburring device of Figure 1;

Figure 4 shows a section along a median vertical plane of the deburring cutter of Figure 1;

Figure 5 shows a section of the cutting blade of Figure 3 along a median vertical plane;

5 Figure 6 shows a plan view of a cutting blade of a deburring cutter of Figure 1;

Figure 7 shows a plan view of a variant of a cutting blade of a deburring cutter according to the invention;

Figure 8 shows a partial section along a median vertical plane of the component of Figure 7.

10 The same reference numbers and the same reference letters in the drawings identify the same elements or components.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

With reference to Figures 1 to 6, the deburring device of the invention, overall indicated with the reference 100, comprises a stationary support structure or frame

15 50 which acts as a support for other components of the device. On the frame 50 there are fastened, for example, four deburring cutters 1', 1'', 1''', 1'''', and two of the cutters 1', 1''' are arranged with the cutting profiles 6 in a position such as to cut at least one portion of the welding seam 41 of the upper surface of the billet 40, and two other cutters 1'', 1''' are arranged with the cutting profiles 6 in a position such as
20 to cut at least one part of the welding seam 41 of the lower surface of the billet 40. In an alternative embodiment not shown, further cutters arranged to complete the cleaning of the remaining burr portions can be arranged along the machine 100, for example upstream or downstream of the cutters 1', 1'', 1''', 1'''.

It is apparent that the arrangement of the deburring cutters shown in this
25 embodiment is determined by the fact that the billet 40 has a square section with a welding seam 41 arranged transversely, or orthogonally, to the rolling direction of the billet 40 indicated with the arrow F. Other arrangements of the deburring cutters 1', 1'', 1''', 1''' are possible, without departing from the scope of the invention, since it is apparent that factors influencing the position of the cutters are for example the
30 position of the burrs or the sectional shape of the steel bar 40 or the size thereof or the geometry of the welding seams 41, among other factors.

The deburring cutters 1', 1'', 1''', 1'''' are all of the same or similar construction, regardless of those features which must possibly be adapted to be capable of arranging the cutters in the various cutting positions. Therefore, herein, only one of them will be described, being understood that the other cutters are preferably identical. Also the number of deburring cutters can be greater than four, e.g., six or even more than six if the size of the bar 40 and the configuration of the burr seams require it, as a group of deburring cutters which cut the part of the burr seam which is placed on the vertical sides of billet 40 can also be provided, at a not great distance from the device of Figures 1 and 2.

Each cutter has a support base or plinth 2 which has plan which is cylindrical or polygonal in shape, with a part in relief, like a turret 2', preferably, but not necessarily, having a plan which is quadrilateral in shape, with seats for accommodating the four cutting blades 3', 3'', 3''', 3''', about it and arranged diametrically opposite, two by two, so that the cutting profiles of each cutter are arranged like the four sides of a square, after the assembly thereof.

An advantageous and preferred embodiment of the cutting blades 3', 3'', 3''', 3''', is shown in greater detail in Figures 3, 4 and 5. Herein, a single blade 3' is described, being well understood that all the other cutting blades substantially have the same features.

The blade 3' has a plan which is substantially trapezoidal in shape, with the longer base provided with two seats for inserting two cutting profiles 5 and 6 at two corners of the base of the trapezoid and on the outer perimeter of the cutter. The cutting blade 3', by virtue of these two cutting profiles 5 and 6, can be fastened on the support base 2 in two alternative and overturned positions in each of which one of the two cutting profiles 5, 6 is in turn in the cutting position where the deburring cutter can cut the welding seam or burr on the surface of the steel piece.

These cutting profiles 5 and 6 are made with high-quality material suitable for cutting steel. A particularly advantageous material for obtaining the cutting profile 5, 6 is a steel preferably having a hardness =38-45HRC.

There are provided holes 11 for the passage of screws and bolts 8 required for fastening the cutting blade 3' on the support base 2. A key 10 or a positioning or fastening element with a similar function is provided on the lower base of the cutting

blade 3' to help reinforce the fastening of the cutting blade on the turret 2' of the support base 2.

The support base 2 is in turn integrally fastened on the frame 50 by means of a constraint element 4 by means of the screw 9 which leaves the cutter 1' no possibility of rotation about the vertical symmetry axis X thereof during the cutting operation of the burr.

The deburring cutter 1' can be fastened on the support structure 50 so that the distal base of the cutter comprising the cutting profile 6, which is in the cutting position in that operating step, is inclined by an angle α of a value between 0 to 5° with respect to the surface of the steel piece 40, and preferably by an angle equal to 2°. To arrange the cutter 1' in such inclined position, for example, the cutter is installed with the symmetry axis thereof inclined by an angle α by means of a disc or cylinder 7 with base surfaces inclined with respect to each other by the same angle α .

Furthermore, the cutting profile 6 which is in the cutting position in that operating step for each deburring cutter 1', 1'', 1''', 1'''' is arranged with the corner inclined by an angle β with respect to the feeding axis A of the billet. Such angle is advantageously smaller than 90°, and more preferably smaller than 65°.

Without departing from the scope of the invention, a further advantageous embodiment of the cutter of the invention includes manufacturing the cutting block 30 in one piece, instead of manufacturing it divided into four cutting blades 3', 3'', 3''', 3''''. In the plan view shown in Figure 7, the cutting blade has therefore a single-piece body 33 with a plan which is square in shape with an empty central part 31. The cutting profiles 36, 37, 38, 39 are fastened to the four corners thereof of one of the two bases of the body 33 along the four larger sides and on the second base of the body 33 the other four cutting corners are there, of which only the edge 35 is shown in the section of Figure 8. The body 33 has holes 32 for the fastening to the base 2, by means of screws and bolts, by arranging the empty seat 31 about the turret 2'.

In a further advantageous variant of the invention, video systems are provided in the deburring system 100, which allow the cutters to be observed regularly and, if damaged tools are detected, they warn the operator.

The deburring device 100 is positioned, for example, upstream of a line for rolling steel bars, such as billets, and downstream of a billet head welding apparatus, not shown in the Figures, since it is a technology well known to those skilled in the art.

CLAIMS

1. A deburring cutter, for cutting and removing at least one burr portion (41) from the surface of a steel piece (40), said cutter (1', 1'', 1''', 1''') comprising a support base (2), a cutting body (3', 3'', 3''', 3''', 30) fastened to said support base (2) with detachable fastening means, wherein the support base (2) is adapted to be fastened to a fixed support structure (50), wherein the cutting body (3', 3'', 3''', 3''', 30) is prismatic in shape and has a first base which is proximal to the support base (2) and a second base which is distal from the support base (2), wherein each side of the cutting body (3', 3'', 3''', 3''', 30) has a first cutting profile (5, 35) at a corner formed by the junction of the side of the cutting body (3', 3'', 3''', 3''', 30) with the first base of the cutting body (3', 3'', 3''', 3''', 30) and a second cutting profile (6, 36) at a corner formed by the junction of the side of the cutting body (3', 3'', 3''', 3''', 30) with the second base of the cutting body (3', 3'', 3''', 3''', 30), and wherein the cutting body (3', 3'', 3''', 3''', 30) can be mounted to the support base (2) in such a position that the first and second cutting profiles (5, 6, 35, 36) of each side of the cutting body (3', 3'', 3''', 3''', 30) can be arranged in a cutting position of the burr portion in different operating steps.
2. A deburring cutter according to claim 1, wherein the cutting body (30) is a single-piece structural element with four sides.
3. A deburring cutter according to claim 1, wherein the cutting body has four sides wherein each side consists of a cutting blade.
4. A cutter according to one of claims 2 or 3, wherein the support base (2) is cylindrical or polygonal in shape, provided with fixing elements (8, 9) which removably fasten the cutting body (3', 3'', 3''', 3''', 30) to said support base (2, 2').
5. A cutter according to claim 4, comprising means for fastening to the stationary

support structure (50) so that the side of the cutter containing the cutting profile which is in the cutting position is inclined by an angle α which is smaller than 5° with respect to the surface of the steel piece.

- 5 6. A cutter according to claim 5, comprising means for fastening to the stationary support structure (50) so that the side thereof containing the cutting profile which is in the cutting position is inclined by an angle α which is equal to 2° with respect to the surface of the steel piece.
- 10 7. A device for deburring steel pieces comprising a fixed support structure (50), at least four deburring cutters (1', 1'', 1''', 1''') having the features of any claim 1 to 6 and fastened to the stationary support structure (50) with no possibility of rotation about a vertical symmetry axis (X) thereof during the cutting operation.
- 15 8. A device for deburring steel pieces according to claim 7, comprising a video system adapted to detect the state of wear of the cutters after each deburring cut.
9. A device for deburring steel pieces according to claim 7 or 8 comprising a counter of steel pieces on which the deburring is performed to allow determination of the
- 20 moment for the replacement of the cutting blades or of the cutting bodies.
10. A method for cleaning burrs by means of a device according to one of claims 7 to 9, wherein a burr portion (41) of a steel piece (40) is removed by one or more deburring cutters (1', 1'', 1''', 1''') at a time with a relative movement of the one or
- 25 more deburring cutters (1', 1'', 1''', 1''') with respect to the steel piece (40).
11. A method for cleaning burrs according to claim 10, wherein the burr portion (41) is removed by two deburring cutters at the same time.
- 30 12. A method for cleaning burrs according to claim 10 or 11, wherein the cutting profile of the blade performing the cutting operation is inclined with respect to the direction of the burr portion by an angle preferably smaller than 90° , and more

preferably smaller than 65°.

13. A method for cleaning burrs according to claim 12, wherein the need for a replacement due to the wear of the deburring cutters (1', 1'', 1''', 1''''), and/or of the cutting bodies (30) and/or of the cutting blades (3', 3'', 3''', 3'''') is performed taking into account the information provided by an automatic detection system comprising a video camera and/or a billet counter.

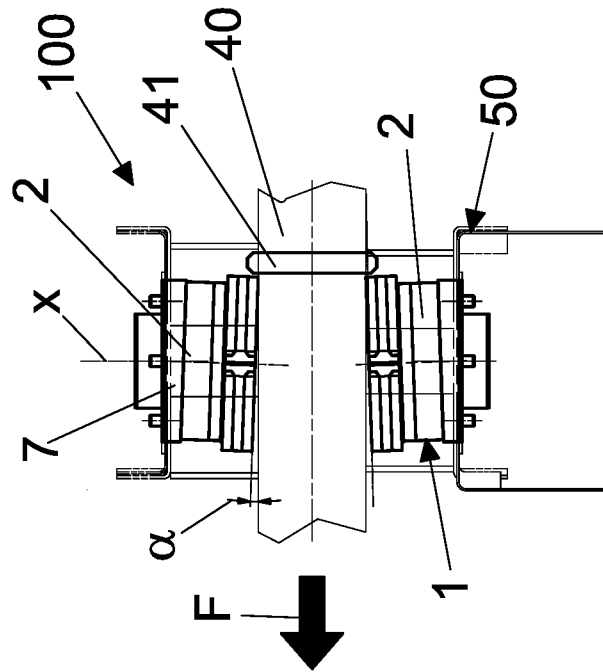


Fig. 2

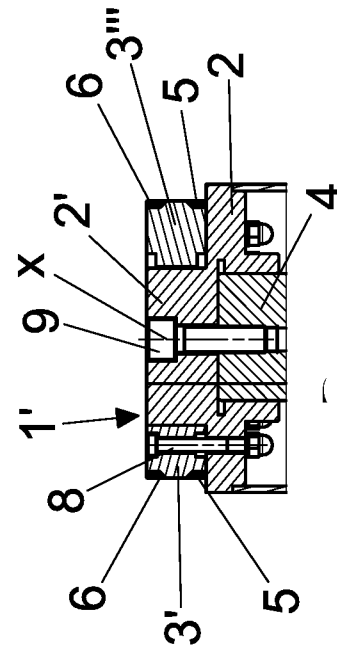


Fig. 4

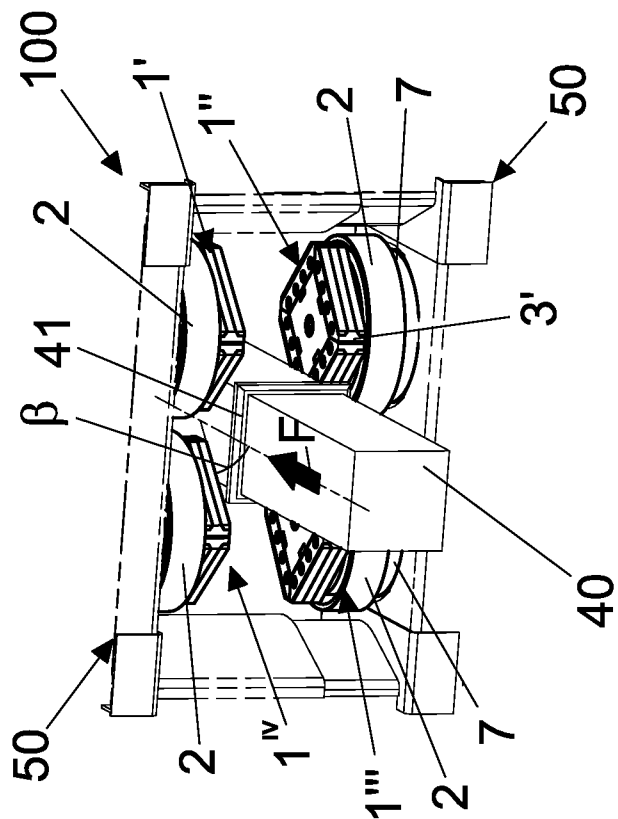


Fig. 1

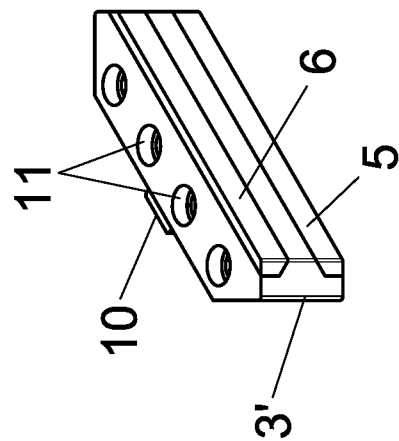


Fig. 3

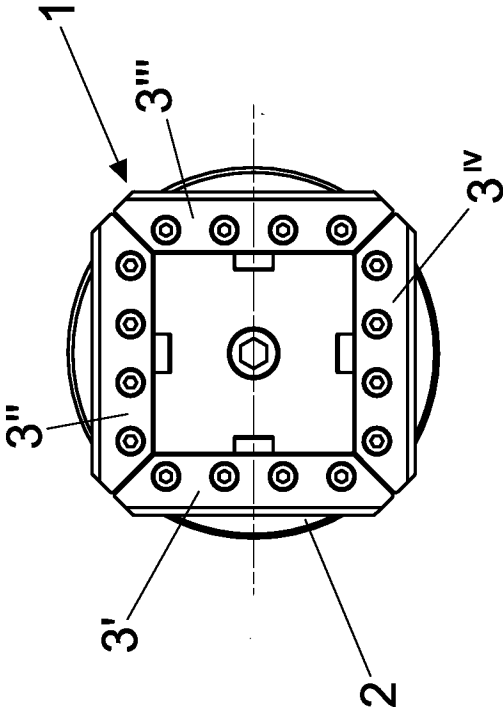


Fig. 6

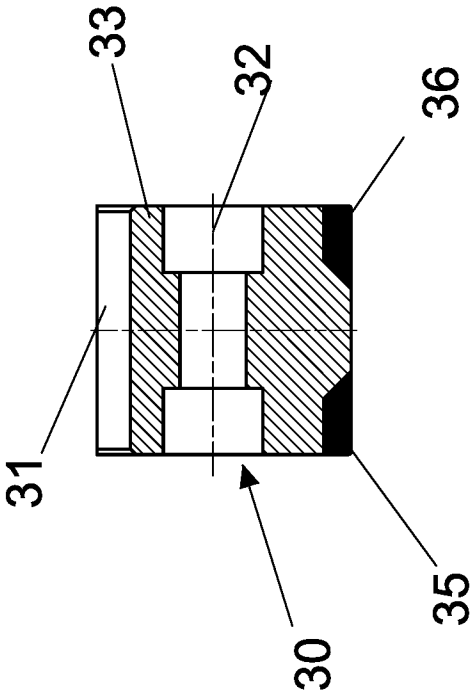


Fig. 8

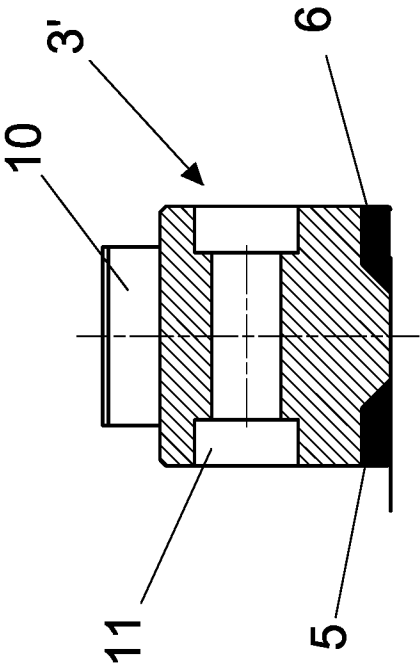


Fig. 5

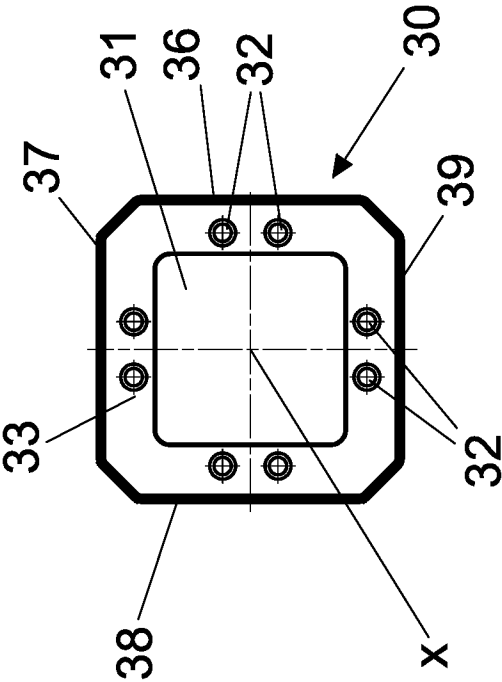


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/060644

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23D79/02 B23K37/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B23D

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 719 498 A1 (SIEMENS VAI METALS TECH GMBH [AT]) 16 April 2014 (2014-04-16) cited in the application the whole document -----	1-13
A	EP 1 464 429 A2 (NIPPON KOKAN KK [JP]; JP STEEL PLANTECH CO [JP]) 6 October 2004 (2004-10-06) cited in the application figures 2,8 -----	1-13
A	DE 14 27 211 A1 (SIEMENS AG) 27 February 1969 (1969-02-27) figure 1 -----	1
A	US 3 242 301 A (OSBORN JR HARRY B) 22 March 1966 (1966-03-22) figure 1 -----	1

☐

Further documents are listed in the continuation of Box C.

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See patent family annex.

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Date of the actual completion of the international search

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Rabolini, Marco

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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