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(54) **PNEUMATIC CLAMP FOR PLATES WITH TILTING JAWS**

(57) The invention refers to an improved pneumatic clamp for a transfer stamping press or servo-press, wherein the clamp is of the type which holds a sheet or workpiece by means of two clamping tips, separated from each other, near the edge of the workpiece, and wherein said pneumatic clamp differs from the already known

ones in that it can be assured with total reliability that the two clamping tips apply the same force to the sheet, which guarantees a perfect (i.e. non-slip) clamping of the sheet by the clamp during the operations of taking the sheet at a first station, transferring it to the next station and leaving it at this next station.

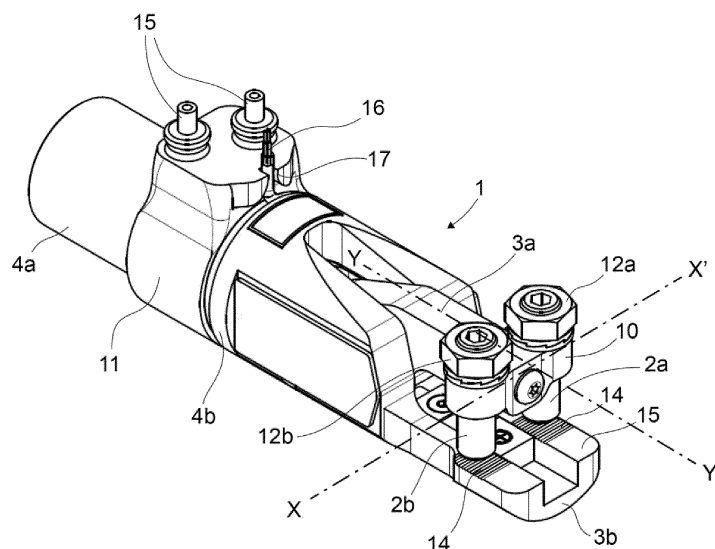


Fig. 1

Description

[0001] The present invention relates to an improved pneumatic clamp for a stamping press or servo-press with transfer system, wherein the clamp is of the type which holds a sheet or work piece by means of two clamping tips separated from each other, near the edge of the workpiece, and wherein said pneumatic clamp differs from the already known ones in that it makes it possible to ensure with total reliability that the two clamping tips apply the same force to the sheet, thus making the transfer press more reliable and productive, among other advantages which will be described below.

Background of the invention

[0002] Stamping presses are used in industry to shape metal parts, such as the formed sheets used in the automotive industry. These presses include an automatic plate positioning and transfer system, usually called a "transfer system", which allows the sequential die-cutting of a plate along a plurality of dies placed in the press.

[0003] The above-mentioned automated positioning and transfer system, hereinafter referred to as "transfer system", includes a plurality of pneumatic clamps that are distributed along a pair of clamp-holder profiles located notably parallel to each other and on both sides of the consecutive stamping dies of the press. Both clamp-holder profiles are coupled to several bars belonging to the press transfer that are able to make a back and forth movement in the direction of the advancement of the sheets to be stamped, so that a group of clamps associated to the same die is able to hold a sheet to be stamped, transfer it to the next die, and go back to its original die, while the sheet is being stamped. This process is repeated with the subsequent sheets to be stamped or die-cut.

[0004] The above-mentioned pneumatic clamps for stamping presses with transfer system generally comprise clamping arms for the sheet to be stamped and a support body which is equipped with an inner cavity where a pneumatic cylinder is housed. This cylinder has the function of operating a clamping arm that is connected and hinged to the support body. Each of the clamps includes tubes to feed the pneumatic circuit of the cylinder and electrical cables that feed one or more sensors for the presence of the sheet to be stamped. These clamping arms can be of different types, e.g. one fixed and one movable or two movable arms.

[0005] In operation, all clamping devices are synchronised so that they simultaneously remove a workpiece from one workstation and transfer the workpiece to the next workstation.

[0006] Stamping processes with presses that include transfer systems seek to increase production (i.e. parts per minute) by increasing the working speed of the system. As the working speed increases, so does the acceleration and deceleration of the transfer movement of the clamp with the clamped plate. However, it has been found that the higher the speed of the system, the greater the force that the clamp needs to exert on the sheet being stamped to prevent it from sliding or turning due to the difference in forces at each clamping point during the transfer movement to the next workstation (i.e. the next die).

[0007] A first problem that can occur when trying to increase the working speed of the workpiece transfer process between dies is the loss of grip on a workpiece and the workpiece falling off. Another problem that can occur is the sliding (without falling off) of the sheet metal held by one or more clamps, altering the entire stamping process and possibly triggering an accident, which can be very serious, for example, when the sheet is placed out of position in the next die. This type of incident of faulty positioning of the sheet metal in the next die can stop the entire stamping process, which has a very negative impact on the performance of the press as a whole (not just that of the workstation), and can also damage the workstation itself.

[0008] This problem of inadequate clamping of the sheets by the clamps is magnified and becomes even more relevant when they are used in presses where the sheets are cantilevered (i.e. clamped only on one side and free on the other), since the clamping force needs to be even greater in order to counteract the weight of the sheet. In the case of processes involving cantilevered sheets, production is doubled, since two sheets facing each other can be stamped at the same time, with each one clamped on one side. For this reason, cantilevered sheet metal stamping offers great advantages for the industry, while at the same time it is a challenge to design pneumatic clamps capable of clamping said sheets optimally.

[0009] Spanish Utility Model ES1140856U from the same holder, is well-known and describes an improved clamp for stamping presses with a transfer system. However, this clamp has the disadvantage that, in the embodiment of the movable upper arm equipped with two separate clamping tips, these clamping tips have a free end into which a profiled ball joint is inserted which protrudes slightly from the end of said tips and is configured to be able to turn slightly and to make contact with the upper surface of the sheet. This free profiled end (which is able to rotate freely by about 9°) has the disadvantage that two separate clamping tips at a certain distance create a small undesirable misalignment of said tips because the vertical position where the respective lower ends of each profiled ball joint are mounted is not exactly the same, which does not allow us to guarantee that the same force is exerted on the upper surface of the sheet metal at each tip. In addition, it should be noted that the plates sometimes have irregularities and slight inclinations that make

the task of clamping the tips even more difficult.

[0010] This misalignment between the positions in the vertical plane of the two lower ends of each tip inevitably leads to mechanical uncertainty (which means that it is not possible to know exactly whether the two profiled ball joints of the tips exert the same force or not), which causes clamping failures.

[0011] On the other hand, the clamp described in the Spanish Utility Model ES1140856U has pneumatic and electrical connections arranged in a fixed position on the side of the support body, which sometimes makes it difficult for the installer to position the pipes or cables in said connections during the connection operation because a specific position must be found and sometimes the pneumatic connections and/or electrical supply cables of the sheet metal presence sensor may be installed bent or in very forced positions, and may be choked, causing an undesired limitation of the air flow.

[0012] On the other hand, the clamp described in Spanish Utility Model ES1140856U has a fixed lower arm 3b on which the lower surface of the sheet is supported and which has a short length, which does not allow optimum support of the lower surface of the sheet, especially in cases where the sheet is clamped in cantilever (i.e. only on one side).

[0013] In addition, the clamp described in Spanish Utility Model ES1140856U has a support body 4 which is expensive to manufacture.

[0014] In view of the above, it is clear that it is necessary to obtain pneumatic clamps for stamping presses with a transfer system capable of exerting an equal effort for each clamping tip on the sheet to be stamped, in order to ensure total reliability in terms of perfect clamping of the sheet during the operations of taking the sheet, transferring it to the next workstation and leaving it at said next workstation (even when these operations are carried out at high accelerations), and thus be able to increase the speed of the press (cycles per minute) and achieve an increase in production (sheets per minute).

Description of the invention

[0015] The purpose of the present invention is to provide an improved pneumatic clamp for a stamping press or servo-press with a transfer system, wherein the clamp holds a sheet or workpiece by two clamping tips, ensuring that the two clamping tips apply the same force to the sheet, among other advantages to be described later.

[0016] Preferably, but non-limitatively, this clamp from the invention is intended to clamp to sheets or workpieces arranged in a cantilevered form, i.e. one or more clamps are clamped to a sheet or workpiece, but only on one side. However, the clamp from the invention may also be used satisfactorily to clamp a sheet metal or workpiece on both sides, that is, providing at least one clamp on each side of the sheet metal, so as to give greater clamping stability.

[0017] In accordance with this purpose, according to a first aspect, the present invention provides a pneumatic clamp comprising a first arm and a second arm between which the sheet or piece to be stamped is held and also comprises a support body which is equipped, at least, with an inner cavity where a fluid-dynamic cylinder for the operation of the first arm is housed, said cylinder being capable of operating the first clamping arm which is connected and hinged to said support body.

[0018] Unlike the state-of-the-art pneumatic clamps, the first articulated clamping arm from the clamp on the invention comprises at least the following elements:

- an arm element, whose body extends in the direction of a longitudinal Y-Y' axis;
- a compensating arm attached in a tilting manner to the front end of the arm element, where the compensating arm is arranged transversely to the Y-Y' axis, and where said compensating arm comprises two through holes spaced a certain distance apart, equidistant from the Y-Y' axis, one at each end of the compensating arm, configured to receive each clamping point inside, and wherein the compensating arm and the arm element are connected by tilting means configured so that the compensating arm can be tilted slightly from an X-X' axis transversal to the Y-Y' axis; and
- respective clamping points arranged inside each through hole of the compensating arm, each clamping tip being equipped with a clamping system, such as a nut or similar element, configured to attach each tip to the compensating arm.

[0019] Preferably, the clamping tips comprise a respective ball joint equipped with a profiled outer surface that protrudes slightly below its lower ends. This substantially improves the grip of the tips on the upper surface of the workpiece.

[0020] Thanks to this slight tilting of the tilting arm, the two clamping tips are able to rest perfectly on the uneven upper surface of each different work sheet by exerting the same force on each point. This results in a higher quality clamp that is able to hold the workpiece to be stamped much more securely, which means that the transfer system can be moved much more quickly and thus the productivity of the press can be increased.

[0021] The clamp from the present invention, in addition to providing a greater clamping capacity, which is its main purpose, provides other advantages which are described below.

[0022] The clamp from the invention may be of the type in which the first arm is a movable arm which is connected

and hinged to the support body and the second arm is a fixed clamping arm which is integrated into the support body extending forward.

[0023] Alternatively, the clamp from the present invention may also be of the type in which both the first arm and the second arm respectively are movable arms which are connected and hinged to said support body. In this second case,

[0024] The first clamping arm is preferably of the type that at the end opposite the tilting arm of the first clamping arm includes a groove that serves as a guide for an actuator bearing, which is solidly connected to the piston rod of the actuating cylinder of the first arm. However, an actuating sleeve (e.g. treated steel sleeve) can also be used instead of the bearing. The bearing has the advantage over the sleeve in that the clamping force of the clamp is substantially increased (about 290%). These two solutions (bearing and actuating sleeve) are already well-known on the market.

[0025] According to a preferred embodiment of the invention, the first clamping arm comprises the following elements:

- an arm element with a front end that has two flat side walls, and in addition the arm element has a longitudinal hole on its front surface with a diameter and depth such as to accommodate part of an inner axis;
- a compensating arm equipped on its rear surface with a central hole extending in a longitudinal direction X-X' to the body of the compensating arm with a diameter and depth such as to accommodate part of the inner axis and also equipped on this rear surface with a recess defining a socket surface with at least two flat side walls and where the distance between said flat walls is slightly greater than the distance between the two flat side surfaces of the arm element, so that the front end of the arm element is fitted perfectly into this socket surface but with a slight tilting clearance (with a turning angle of between 0 and 10° of the compensating arm in relation to the longitudinal axis Y-Y' of the arm element), and in addition the compensating arm comprises two lateral through-holes separated from each other by a certain distance, equidistant from the axis of rotation, one at each end of the compensating arm to receive each clamping tip inside it.
- respective clamping tips arranged inside each through hole in the compensating arm, each clamping tip equipped with a nut for attaching it to the compensating arm and equipped with a profiled ball joint which protrudes slightly from its lower ends; and
- the inner axis arranged inside both holes of the balance arm and the arm element, so that through the inner axis the compensating arm and the arm element are connected and at the same time this inner axis allows the slight rotation of one of the two pieces around said inner axis.

[0026] The inner axis is preferably attached by means of a nut with a rear extension which is located inside the front end of the axis and when mounted it is flush with the front face of the compensating arm.

[0027] Preferably, the profiled ball joint inserted in each lower end of the clamping tips is configured with such dimensions to enable it to be turned by a maximum of 9°.

[0028] The compensating arm preferably has a distance between the two holes for the tips between 19 and 70 mm, for example 20 mm or 50 mm. The greater this distance between the tips, the more stable the clamping of the sheet will be.

[0029] Preferably, the second clamping arm comprises an extended surface that extends forward beyond the vertical plane where the workpiece clamping tips are arranged. The provision of this extended surface allows the sheet to be conveniently supported on said extended surface, thus substantially improving the clamping of the sheet. By way of example, the extended surface is extended forward by between 12 and 60 mm.

[0030] Preferably, the second clamping arm comprises, on said extended surface, a grooved surface in at least each area where the tips are supported, and wherein this/these grooved surface(s) comprise(s) grooves or channels which extend in a transversal direction to the longitudinal Y-Y' axis of the support body (i.e. they extend in the direction of the transfer feed). Preferably, a grooved surface in the area where a tip rests occupies an area at least equal to the surface of the bottom of the tip.

[0031] According to one mode of embodiment of the invention, either a grooved surface can be provided in each area where the tips are supported, or a single grooved surface for both tips that extends transversely.

[0032] According to one mode of embodiment of the invention, this grooved surface has regular grooves of equal depth extending downwards and having a preferably trapezoidal or triangular section.

[0033] The applicant has carried out, among others, the following three empirical tests which show that the lateral retention required to make the sheet metal held by the clamp of the invention slide or turn in a closed position can increase up to 423.5% compared to the clamps already known in the market:

Number of test	Description of the test situation	Force required to turn the sheet held by the clamp in its closed position	Percentage improvement over test number 1
Test number 1	Clamp with a first arm without a tilting arm (i.e. like the arm from Utility Model ES1140856U)	75 Newtons	---
Test number 2	Clamp with a first arm with a tilting arm according to the invention but with the non-grooved surface of the second arm	85 Newtons	13.3%
Test number 3	First arm with a tilting arm according to the invention and with the grooved surface of the second arm	181 Newtons	241.3%

[0034] This large increase, of up to 241.3%, of the lateral retention required to make the sheet held by the clamp from the invention slide or turn in a closed position with respect to the clamps already known to be on the market is truly surprising and unexpected.

[0035] Optionally, the clamp from the invention may comprise, unlike conventional clamps, a rotating ring which is externally fixed in a particular position on the support body, but with the possibility of rotating (preferably completely) around the support body, wherein the rotating ring comprises fluid inlet and outlet ports, and wherein the ring is configured to be externally attachable to an external part of the support body. Preferably, the rotating ring also includes a channel for passing the electrical connections of the sheet metal presence sensor. This ring makes it easier to insert the fluid inlet and outlet ports and the electrical wiring, i.e. to gain in positioning versatility of the fluid inlet and outlet ports and the electrical connections, by being able to rotate the ring 360° around the support body, as appropriate in each case. This results in a reduction in the installation time of the fluid inlet and outlet ports and the electrical connections by the installer and also a reduction in installation errors and possible problems with fluid supply to the clamp due to the arrangement of connections or cables which are bent or in strained positions. Therefore, the provision of the ring results in an increase in productivity.

[0036] In order to be able to couple the ring, the improved clamp from the invention preferably presents a rear portion of the support body which has a grooved surface that facilitates the coupling of the rotating ring in such a way that it cannot be removed but can rotate. This grooved surface has a plurality of grooves at different points along the length of the support body. The purpose of these grooves is to insert the respective O-rings to channel the air ducts and also to help hold the ring in the specific working position, and with the possibility of rotation. In order to ensure that the ring cannot be removed or moved in the longitudinal direction of its working position, the support body portion may comprise a non-return flap that prevents removal of the ring by the user.

[0037] As an alternative to the embodiment mentioned in the last two paragraphs which has two fluid inlet and outlet ports on a rotating ring, the two fluid inlet and outlet ports can also be arranged in a fixed manner, leaving the rear face of the support body, preferably inserted in the shock absorber element that acts as a stop for the cylinder piston. This second embodiment without a ring is cheaper than the preceding embodiment with a ring because it has one less piece (the ring) although, on the other hand, it may involve a slightly longer clamp length and more ports than the solution with a ring.

[0038] In general, when there are no space problems, the fluid inlet and outlet ports are located at the rear of the clamp, and when there is little space to accommodate them at the rear, said ports are located at the side.

[0039] Preferably, the improved clamp from the invention features a back end configured to be attached by any known mechanical means to a clamp-holding piece.

[0040] In addition, and optionally, the support body of the improved clamp from the invention presents at least one external part in a substantially cylindrical form. This means that the cost of manufacturing the support body is significantly reduced, as it is much easier to machine than a prismatic piece, while requiring less material, so that the total cost of manufacturing the support body decreases. Preferably, both the back of the support body and the front have a substantially cylindrical outer part.

[0041] Advantageously, the first clamping arm is connected and hinged to the clamp's support body at a hinge point that is substantially aligned with the second clamping arm. This allows for the use of shorter clamping tips, which contributes to reducing the overall weight of the arm.

[0042] Preferably, the improved clamp from the invention comprises a collet groove which serves as a guide for an actuator bearing which is attached solidly to the piston rod of the actuating cylinder of said articulated arm. The holder of the present invention has observed that this actuator bearing contributes to extending the life of the clamp.

[0043] In relation to the support body, depending on a preferred embodiment, the rear chamber of the cylinder for the fluid inlet and outlet may include a damping element that acts as a stop for the cylinder piston. Said damping element is designed to absorb kinetic energy from the movement of the first articulated clamping arm and contributes to the speed of the upper arm. The provision of this dampening element allows, advantageously, a very significant reduction in the noise made by the clamp while working, thus improving the environmental conditions of the workplace.

[0044] Advantageously, the clamp can comprise a presence sensor for the piece to be stamped that includes a power cable from said sensor integrated into the portion of the support body that defines the second arm. This feature helps to reduce the overall height of the clamp, which releases more space.

[0045] Said fluid dynamic cylinder is a pneumatic fluid cylinder with a diameter of more than 20 mm, for example, a diameter of 25 mm or 32 mm, which contributes to a clamp with a higher clamping force.

[0046] Depending on the preferred embodiment, the clamp should preferably have two inlet and outlet ports for the feed fluid of the fluid-dynamic cylinder (e.g. pneumatic), which are preferably arranged on the ring.

[0047] The above-mentioned features result in an improved clamp with a simple and compact design that has the following advantages over state-of-the-art clamps:

- Its lateral retention to make the sheet held by the clamp of the invention slide or turn is 423.5% higher.
- Increased clamping security, i.e. a reduction in clamping errors.
- The support body is 16% lighter.
- Reduction in time and cost of manufacturing the support body.
- Greater versatility in positioning the pneumatic and electrical connections of the clamp.

[0048] All of these advantages result in greater lateral retention at the same time as said clamping is more reliable, thus significantly increasing the productivity and reliability of the stamping press.

Brief description of the drawings

[0049] In order to better understand the description made, a set of drawings has been provided which, schematically and solely by way of non-limiting example, represents a practical case of embodiment.

[0050] Figures 1 to 8 are drawings representing a first embodiment of the two-pronged clamp object of the present invention. Specifically:

- Figures 1 and 2 show perspective views of the first embodiment of the two-pronged clamp object of the present invention, in a closed and open position, respectively.
- Figure 3 shows a side elevation view of the first embodiment of the two-pronged clamp object of the present invention, in a closed position.
- Figure 4 shows a top view of the clamp from the preceding figures 1 to 3, in a closed position.
- Figures 5 and 6 show front and rear elevation views of the clamp from the preceding figures 1 to 4, respectively, in a closed position.
- Figures 7 and 8 show longitudinal sections of the clamp from the preceding figures 1 to 6, in a closed and open position respectively.

[0051] Figures 9 to 15 are drawings representing a second embodiment of the two-pronged clamp object of the present invention. Specifically:

- Figures 9 and 10 show perspective views of the second embodiment of the two-pronged clamp object of the present invention (in this case with a distance between prongs greater than the first embodiment), in a closed and open position, respectively.
- Figure 11 shows a view on the upper floor of the second embodiment of the clamp, in a closed position.
- Figures 12 and 13 show front and rear elevation views of the second embodiment of the clamp, respectively, in a closed position.
- Figures 14 and 15 show longitudinal sections of the second embodiment of the clamp, in a closed and open position,

respectively.

[0052] Figures 16 to 19 are drawings representing the first clamping arm of the first embodiment of the two-pronged clamp object of the present invention, wherein:

- Figure 16 shows a perspective view of said first mounted clamping arm.
- Figure 17 shows an exploded perspective view of said first clamping arm.
- Figures 18 and 19 show two different views of the tilting arm of said first clamping arm.

[0053] Figure 20 shows the same figure on the front elevation of the clamp from the second embodiment, wherein the small set of the turning angle α_1 between the tilting arm and the arm element has been represented.

[0054] Figure 21 shows a perspective view of a third embodiment of the two-pronged clamp object of the present invention, in a closed position, similar to the second embodiment, but in this case wherein the grooved surface of the second fixed arm occupies the entire extended surface. In Figure 21, 3 different details have been represented: detail 1 which refers to the grooved surface, detail 2 which refers to the lower end of the tip with which a sphere is equipped (in industry parlance called a ball joint) which is profiled to provide a friction with the surface of the sheet (not shown), and finally detail 3 which refers to the zigzag profile of the grooved surface. Detail 2 shows how the tip is formed by a screw 21 equipped with a lower hole wherein the profiled ball joint 22 is inserted.

[0055] Figures 22a, 22b and 22c show the arrangement of the clamp from the first embodiment once it is installed in a clamp holder and the same runs along a profile.

[0056] And Figures 23 to 28 are drawings representing a fourth embodiment of the two-pronged clamp object of the present invention, similar to the first embodiment, but in this case there is no ring and the air intakes are arranged on the rear face of the clamp and the second fixed arm has no extended surface, wherein:

- Figures 23 and 24 show perspective views of the fourth embodiment of the two-pronged clamp object of the present invention, in a closed and open position, respectively.
- Figure 25 shows a side elevation view of the fourth embodiment of the two-pronged clamp object of the present invention, in a closed position.
- Figure 26 shows a top view of the clamp from the preceding figures 23 to 25, in a closed position.
- Figure 27 shows a rear view of the fourth embodiment of the clamp in a closed position.
- Figure 28 shows a longitudinal section of the clamp of the fourth embodiment, in a closed position.

Description of some preferred embodiments of the invention

[0057] Several different embodiments of the pneumatic clamp 1, 100, 200, 300 for a transfer press or servo press from the present invention are described below, with reference to the attached Figures 1 to 28.

[0058] In all the embodiments shown in the enclosed figures, the pneumatic clamp 1, 100, 200, 300 includes two arms 3a, 3b for the clamping of a piece to be stamped (not shown in any of the enclosed figures) and a body 4a, 4b for the support which is equipped with an inner cavity 27 where a fluid-dynamic cylinder 26 is housed (see Figures 7, 8, 14 and 15). This fluid-dynamic cylinder 26 drives the first upper clamping arm 3a, which is movable and is connected and hinged to axis 25 of the support body 4a, 4b. This action of the fluid-dynamic cylinder 26 is carried out by means of an actuator bearing 31 associated with piston rod 28 of cylinder 26.

[0059] In all of the implementations described in the figures, the rear chamber 27 of the pneumatic cylinder 26 comprises a damping element 29 which acts as a stop for the piston 30 of the cylinder. This damping element 29 absorbs the kinetic energy from the movement of the first clamping arm 3a, thus reducing the noise produced by the pneumatic clamp 1, 100, 200, 300 during operation.

[0060] The pneumatic clamp 1 described in the first embodiment has a support body 4a, 4b made of treated steel and a pneumatic cylinder diameter of 25 or 32 mm.

[0061] The second clamping arm 3b, which corresponds to the lower arm and is fixed, is also integrated into the support body 4 of the pneumatic clamp 1, 100, 200, extending from a front portion 4a of the support body 4 itself, as shown in the attached figures.

[0062] The first movable arm 3a has in all cases two clamping tips 2a, 2b for the sheet to be stamped. In the first

embodiment of the pneumatic clamp 1 shown in Figures 1 to 8, the two clamping tips 2a, 2b are quite close to each other, about 20 mm, while in the second embodiment 100 and in the third 200 of the clamp are further apart, about 60 mm.

[0063] The pneumatic clamp 1, 100, 200 of the present invention is characterised by the fact that the first movable articulated clamping arm 3a is formed by an arm element 19 and attached transversely with a slight clearance at its front end, a compensating arm 10, where said compensating arm 10 comprises two through holes 13 separated from each other by a certain distance, one at each end of the compensating arm 10 to receive inside it each clamping tip 2, and a respective set of nut 12a, 12b and screw to attach each clamping tip 2 at the upper interior of each hole 13, and wherein said compensating arm 10 and element arm 19 are configured with a tilting means so that the compensating arm 10 can tilt slightly with respect to the longitudinal axis of the arm element 19.

[0064] The specific and advantageous configuration of the first movable articulated clamping arm 3a, which consists of an arm element 19 and attached transversely by means of a slight play at its front end a compensating arm 10, is clearly shown in Figure 16. It can be seen that the element arm 19 has a front end with two flat side surfaces 33, and in addition the arm element 19 has a longitudinal hole 18 that starts at its front surface with such a dimension and length such as to accommodate an inner axis 13 (shown, for example, in Figures 7, 15 or 17). Figures 7 and 15 show that the longitudinal hole 18 is slightly longer than the length of the inner axis 13, once it is correctly mounted inside it and attached by means of a nut 20.

[0065] On the other hand, the compensating arm 10, shown separately in Figures 17, 18 and 19, has an elongated body of a certain thickness with a central hole 22 on its rear surface (see Figures 18 and 19) which extends in a transverse direction to the compensating arm 10 so as to accommodate part of the axis 13 and which is also equipped with a recess 23 on this rear surface which defines a recess with at least two flat side walls 33 and where the distance between these flat walls is slightly greater than the distance between the two flat side surfaces of the arm element 19, so that the arm element 19 is fitted perfectly into this recess 23 but has a slight tilting clearance of 0 to 10° of the compensating arm 10 in relation to the longitudinal axis of the first arm.

[0066] Figure 20 schematically shows this clearance of the compensating arm 10 between 0 and 10° above or below the longitudinal axis of the arm element. This means that there would be 5° up and 5° down with respect to the longitudinal axis X-X' of arm element 19.

[0067] On the other hand, once mounted, the inner axis 13 is arranged inside both holes 22, 18 of the compensating arm 10 and arm element 19, and wherein through inner axis 13, the compensating arm 10 and the arm element 19 are connected and at the same time the axis allows the slight tilting of one of the two pieces 10, 19 around said inner axis 13.

[0068] Another feature of the pneumatic clamp 1, 100, 200 of the present invention lies in the particular configuration of the outer surface of the support body 4a, 4b which, as can be seen in Figures 1 to 15, is noticeably cylindrical. It has a cylindrical rear portion 4a, which extends frontally to form another front portion 4b, also significantly cylindrical.

[0069] Another optional feature of pneumatic clamp 1, 100, 200 from the present invention is in the provision of an extended surface 15 of the second clamping arm 3b, wherein said extended surface 15 comprises part or all of its upper surface in the form of grooves 14. In all the embodiments shown in the attached figures, these two grated surfaces 14 are formed by a plurality of homogeneous grooves that extend in a transverse direction to the longitudinal axis of the support body 4a, 4b. In the case of Figure 21, these two grated surfaces 14 cover the entire area of extended section 15, while in the case of Figures 1 to 15, they occupy only part (i.e. not all) of said extended sections 15.

[0070] As can be seen in details 1 and 3 of Figure 21, these two grated surfaces 14 have regular grooves of equal depth and the same section (in this case a zigzag section with a triangular profile). In detail 3, which depicts a groove, it can be seen that its depth is about 0.5 mm, the distance between the tips of the ridges is 1 mm and the angle between two adjacent ridge planes is 90°. This specific configuration of the plurality of grooves has been shown by the holder to be very advantageous, in order to provide optimum friction with the inner surface of the sheet, which rests on the lines of the different ridges that make up this grooved surface.

[0071] The applicant for this invention has shown (see the results obtained from the tests shown in the table above) that the combination of the clamp exercised by the tips held by the tilting arm together with the extended lower surface with the grooves gives truly surprising results that are not obvious to a person skilled in the art.

[0072] In this same Figure 21, detail 2 can be seen which shows the configuration of the lower part of the screw 21, which configures the tip 2b or 2a and whose lower end has a profiled ball joint 22 inserted inside this lower end. This profiled ball joint 22 has the capacity to rotate about 9° with respect to the body of the screw 21.

[0073] Figures 22a, 22b and 22c show the clamp of the first embodiment once it is installed in a possible clamp holder and it runs along some profiles (here only one of the two profiles 32 is shown). As can be seen, the ring 11 can be rotated manually by the user by acquiring the various angular positions desired, for example by pointing to the left side in Figure 22a, upwards in the following Figure 22b or to the right side in the last Figure 22c.

[0074] In particular, this first embodiment of the invention described has proved that clamp 1 with piston diameter provides a clamping force of up to 180 decaNewtons (daN) for a working pressure of 6 bar.

[0075] In the clamp 300 corresponding to the fourth embodiment of the invention, which is similar to that of the first embodiment, but in this case there is no ring, the fluid inlet and outlet ports 15 are arranged on the rear face of the clamp,

see Figure 27. In this fourth embodiment, moreover, the second fixed arm 3b does not have any extended surface, but, as shown in Figure 25, it is vertically aligned with the points 2, 2b. Figures 23 to 28 show how the end of the second fixed arm 3b comprises two grated surfaces 14 located at the two ends.

[0076] Figure 28 shows a longitudinal section of the clamp 300 of the fourth embodiment, in a closed position. This view shows how the fluid inlet and outlet ports 15 are embedded in the rear part of the clamp 300, and more specifically in the rear damping element 29. It can also be seen that the piece 30 is the same as the clamp 1 from the first embodiment. The only structural change to the internal components of the cylinder 26 is an intermediate piece which has a different and simpler configuration than that of the clamp 1 from the first embodiment as there is no ring.

[0077] Although reference has been made to specific embodiments of the invention, it is clear to a person skilled in the art that the pneumatic clamp 1, 100, 200, 300 as described, in its different variants, is susceptible to numerous variations and modifications, and that all the details mentioned can be replaced by others that are technically equivalent, without departing from the scope of protection defined by the attached claims.

Claims

1. Pneumatic clamp 1, 100, 200, 300 for a stamping press or servo-press with transfer system, of which one or more clamps are configured to clamp a sheet or piece on one end, and wherein the pneumatic clamp 1, 100, 200, 300 comprises:

- a first arm 3a and a second arm 3b, adapted to hold the sheet or piece to be stamped between them, and
- a support body 4, 4a, 4b which is equipped with an internal cavity where a fluid dynamic cylinder 26 is housed, said cylinder 26 being able to operate the first clamping arm 3a of the pneumatic clamp 1, 100, 200, 300 which is connected and hinged to said support body 4a, 4b,

characterised by the fact that at least the first articulated clamping arm 3a comprises:

- an arm element 19 extending in the direction of a longitudinal Y-Y' axis;
- a compensating arm 10 attached in a tilting manner to the front end of the arm element 19, where the compensating arm 10 is arranged transversely to the Y-Y' axis, and where said compensating arm 10 comprises two through holes 21 separated by a certain distance from each other, equidistant from the Y-Y' axis, one at each end of the compensating arm 10 configured to receive inside it a respective clamping tip 2a, 2b, wherein said compensating arm 10 and arm element 19 are connected by means of tilting devices configured in such a way that the compensating arm 10 can be tilted slightly from an X-X' axis transversal to the Y-Y' longitudinal axis; and
- the respective clamping tips 2a, 2b arranged inside each through hole 21 of the compensating arm 10, each clamping tip 2a, 2b equipped with a fastening system configured to attach each tip 2a, 2b to the compensating arm 10.

2. Pneumatic clamp 1, 100, 200, 300 according to claim 1, in which the first arm 3a is a movable arm that is connected and hinged to said support body 4 and the second arm 3b is a fixed clamping arm that is integrated into the support body 4.

3. Pneumatic clamp 1, 100, 200, 300 according to claim 1, in which both the first arm 3a and the second arm 3b are respective movable arms that are connected and hinged to said support body 4.

4. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, in which the first arm 3a comprises:

- an arm element 19 with a front end that has two flat side surfaces, and in addition the arm element 19 has a longitudinal hole 18 on its front surface with a diameter and depth such as to accommodate part of an inner axis 13;
- a compensating arm 10 equipped on its rear surface with a central hole extending in a longitudinal direction X-X' to the body of the compensating arm 10 with a diameter and depth such as to accommodate part of the inner axis 13 and also equipped on this rear surface with a recess defining a socket surface 23 with at least two flat side walls and where the distance between said flat walls is slightly greater than the distance between the two flat side surfaces of the arm element 19, so that the arm element 19 is fitted perfectly into this recessed surface 23 but with a slight tilting clearance from a rotation angle of between 0 and 10° of the compensating arm 10 in relation to the longitudinal axis Y-Y' of the arm element 19, and in addition the compensating arm 10 comprises two lateral through-holes separated from each other by a certain distance, equidistant from the axis

of rotation, one at each end of the compensating arm to receive each clamping tip inside it.

- the respective clamping tips 2a, 2b arranged inside each through hole 21 of the compensating arm, each clamping tip 2a, 2b equipped with a nut 12a, 12b for attaching them to the compensating arm and equipped with a profiled ball joint slightly protruding from its lower ends; and

- the inner axis 13 is arranged inside both holes 22, 18 of the compensating arm 10 and the arm element 19, so that the compensating arm 10 and the arm element 19 are connected through the inner axis 13 and at the same time the inner axis 13 allows the slight rotation of one of the two pieces 10 or 19 around said inner axis 13.

5. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, in which the compensating arm 10 has an equidistant distance between the two holes 21 for the tips with that distance being between 19 and 70 mm.

6. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, further comprising a nut 20 with a rear extension to attach the inner axis 13 and being configured to be arranged inside the front end of the inner axis 13 and when mounted it is flush with the front face of the compensating arm 19.

7. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, in which the second clamping arm 3b comprises an extended surface 15 that extends forward beyond the vertical plane where the clamping tips 2a, 2b are arranged.

8. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, in which the extended surface 15 extends forward by a length of 12 to 60 mm.

9. Pneumatic clamp 1, 100, 200, 300 according to the preceding claim, in which the extended surface 15 of the second clamping arm 3b comprises at least one grooved surface 14 in each area where the tips 2 are supported, and wherein the grated surface comprises grates extending in a transversal direction to the longitudinal axis of the support body 4.

10. Pneumatic clamp 1, 100, 200, 300 according to the preceding claim, in which the grooved surface 14 in the area where the tips 2a, 2b are supported occupies a zone at least equal to the surface of the lower part of the tip 2a, 2b.

11. Pneumatic clamp 1, 100, 200, 300 according to claim 7 or 8, in which the grooved surface 14 has regular grooves of equal depth and triangular section.

12. Pneumatic clamp 1, 100, 200, 300 according to any of the preceding claims, having a substantially cylindrical support body 4a, 4b.

13. Pneumatic clamp 1, 100, 200 according to any of the preceding claims, comprising a rotating ring 11 around the longitudinal axis of the support body 4a, 4b, wherein the rotating ring 11 comprises two fluid inlet and outlet ports 15, and wherein the ring 11 is configured to be coupled externally to a rear part 4a of the support body.

14. Pneumatic clamp 1, 100, 200 as per the preceding claim, in which the rotary ring 11 additionally comprises a channel 17 for passing the electrical connection(s) 18.

15. Pneumatic clamp 1, 100, 200 according to the preceding claims 9 or 10, in which a rear portion 4a of the support body has a surface with a plurality of grooves at different points to facilitate coupling of the rotating ring 11 in the specific working position without the possibility of removal but with the possibility of rotation.

16. Pneumatic clamp 300 according to claim 1, comprising the respective fluid inlet and outlet ports 15 arranged in a fixed manner, exiting from the rear face of the support body 4, 4a.

17. Pneumatic clamp 1, 100, 200, 300 according to claim 1, in which the opposite end of the first clamping arm 3a comprises a groove 24 that serves as a guide for an actuator bearing 31 that is connected solidly to the piston rod 28 of the actuating cylinder 26 of said articulated arm 3a.

18. Pneumatic clamp 1, 100, 200, 300 according to claim 1, in which said fluid dynamic cylinder 26 is a pneumatic cylinder with a diameter greater than 20 mm.

19. Pneumatic clamp 1, 100, 200, 300 according to claim 1, in which the clamping tips 2a, 2b comprise a respective

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ball joint 22 with a profiled outer surface protruding slightly below its lower ends.

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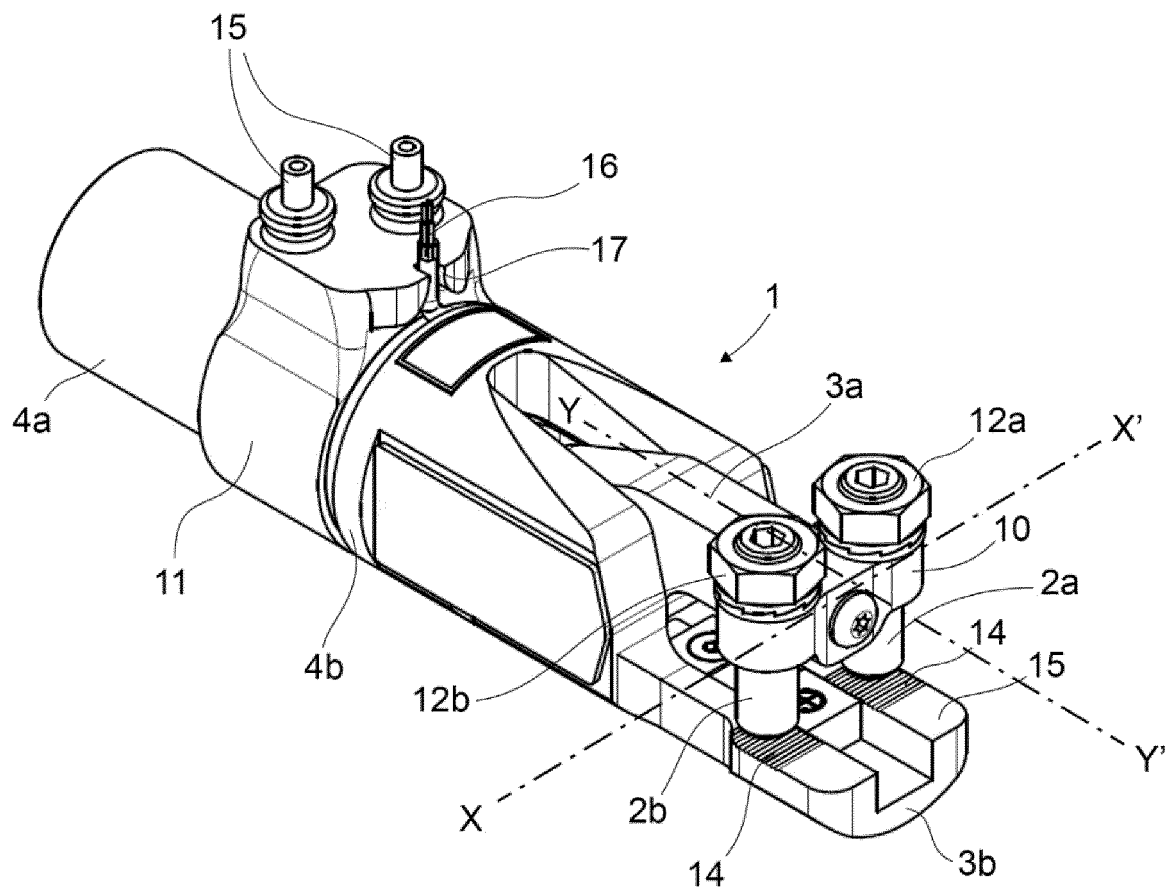


Fig. 1

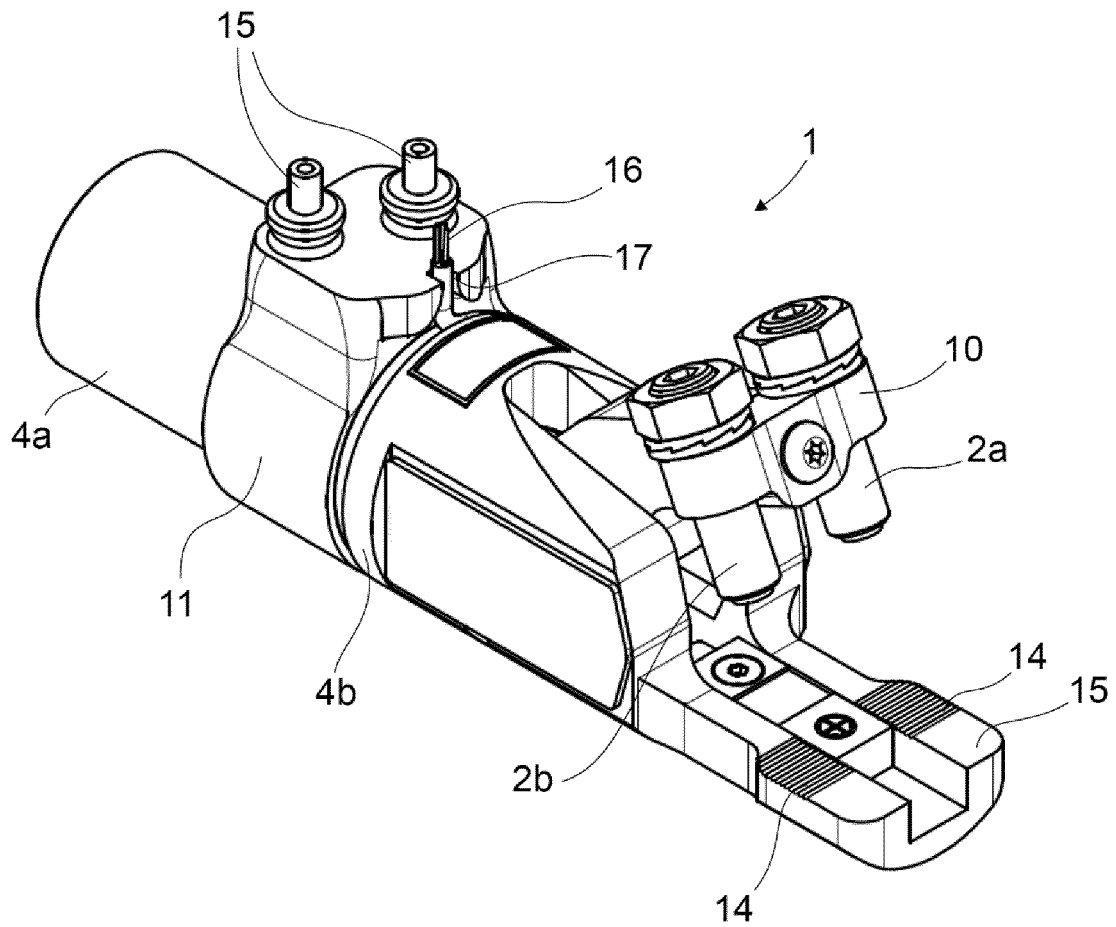


Fig. 2

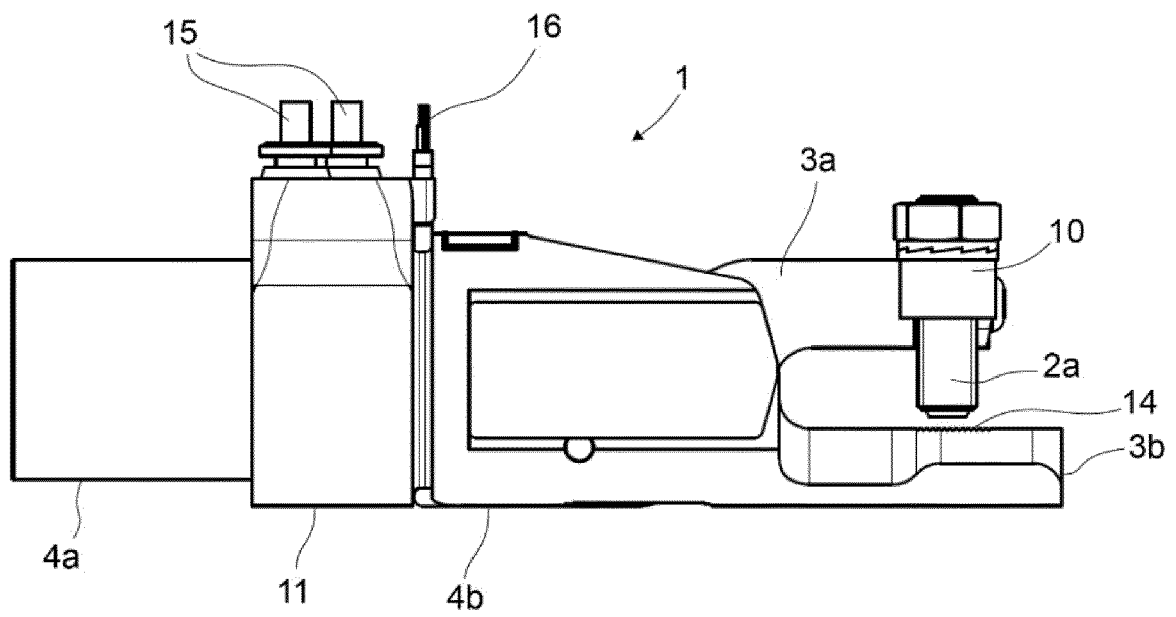
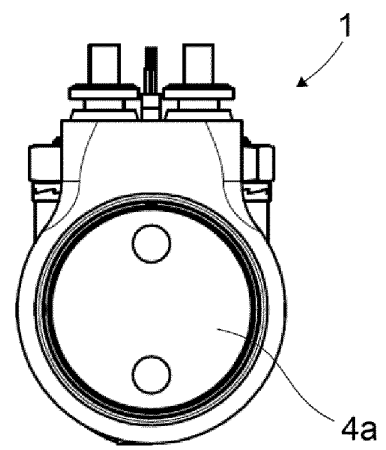
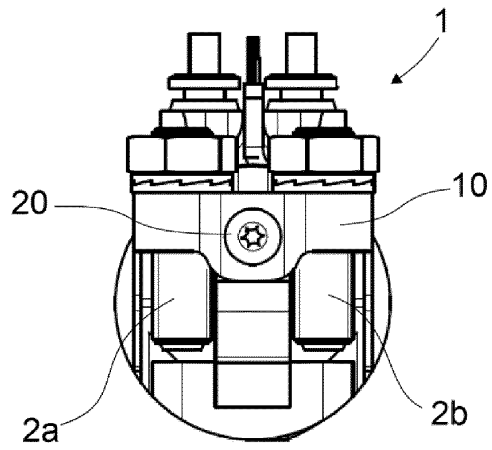
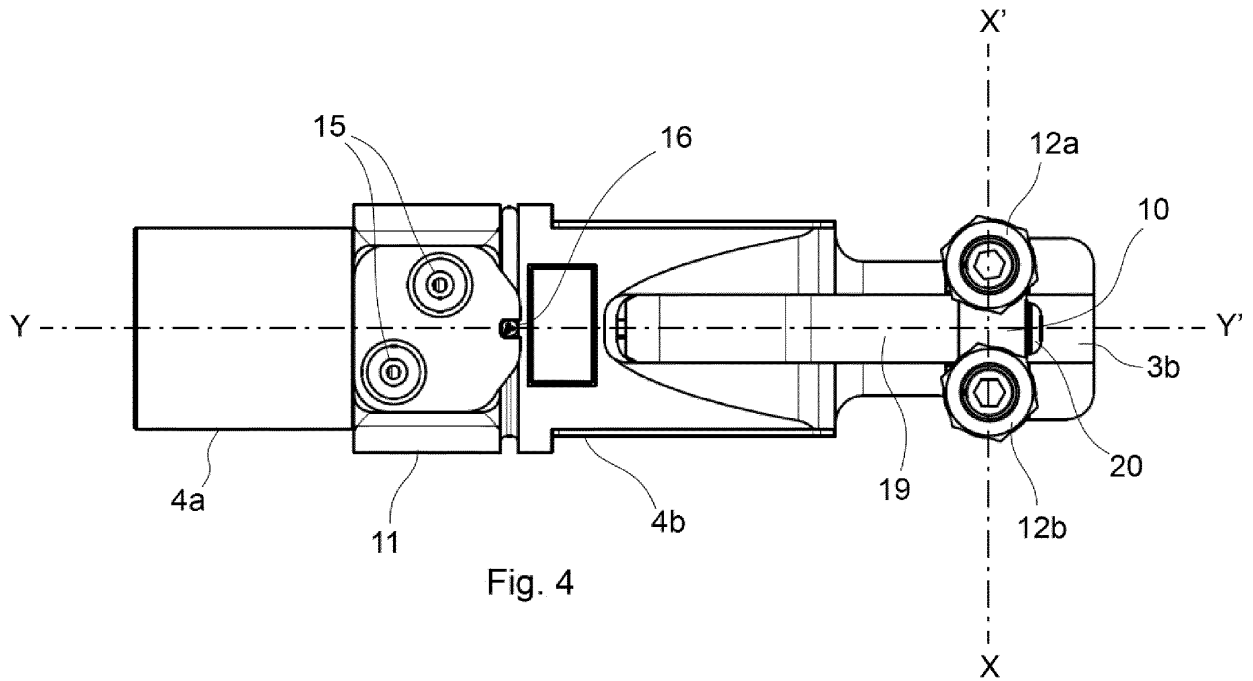


Fig. 3



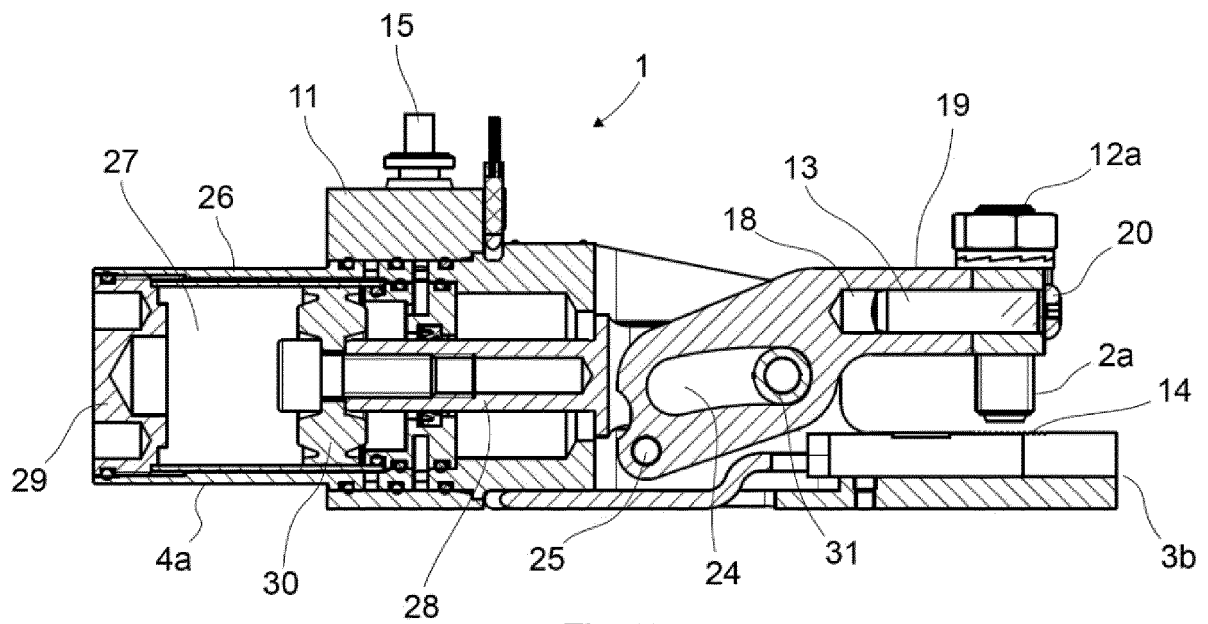


Fig. 7

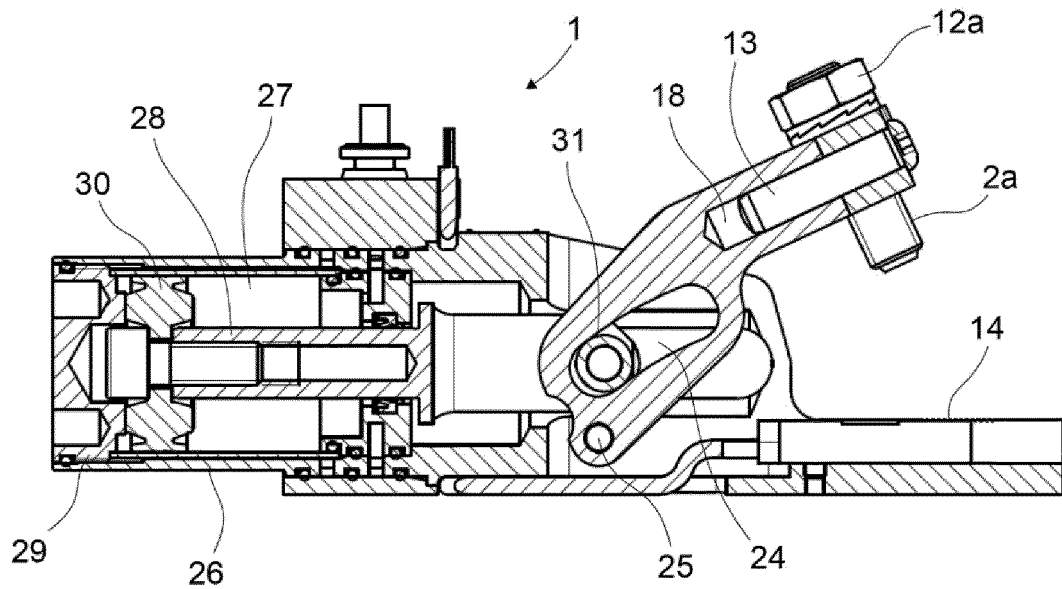
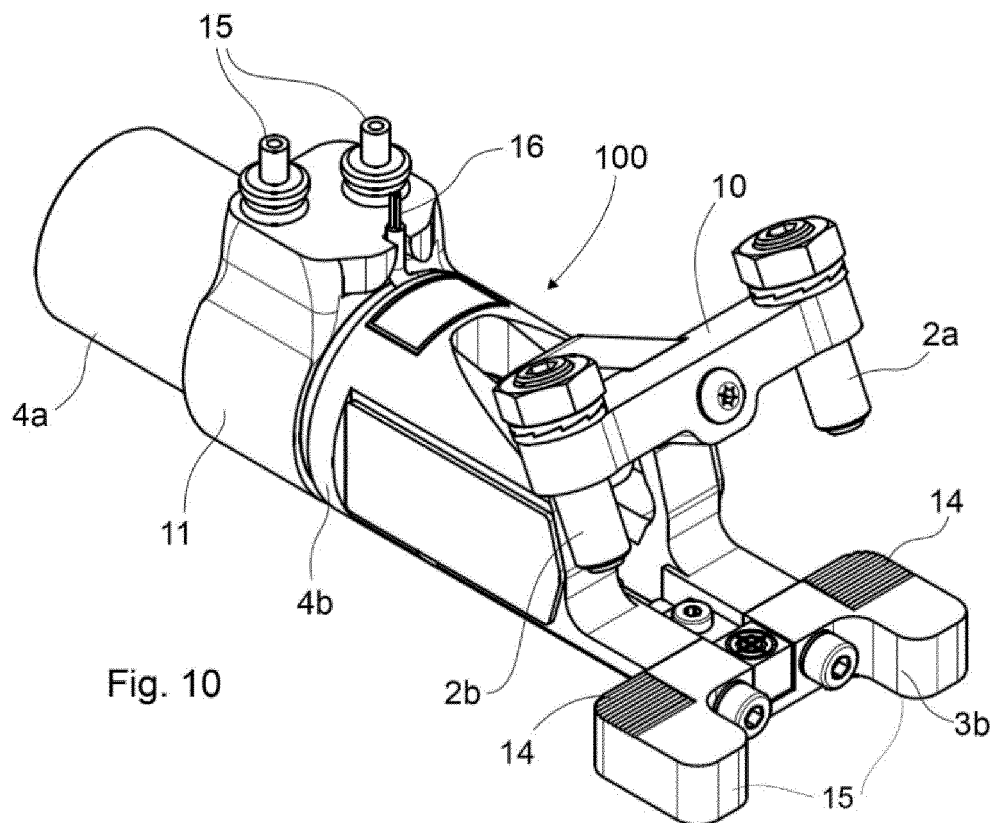
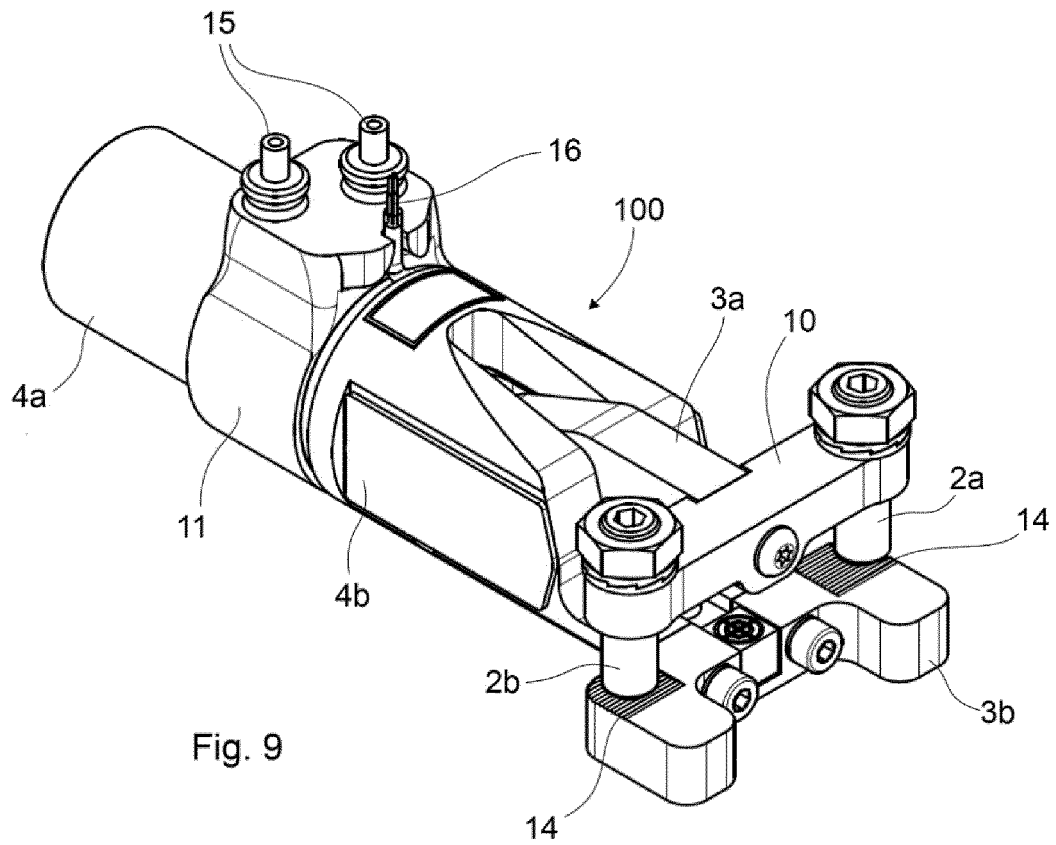


Fig. 8

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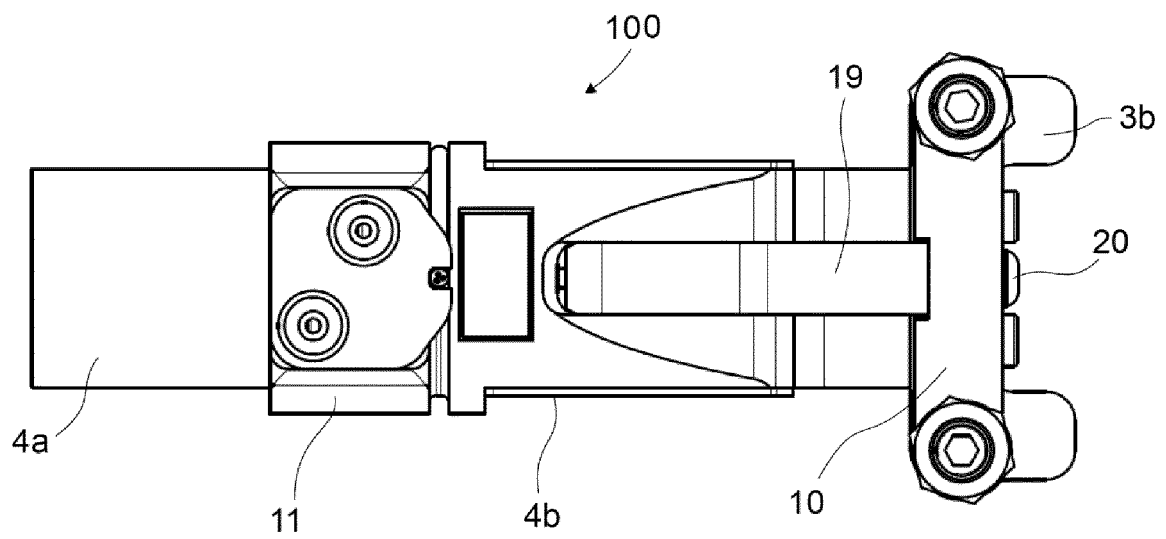


Fig. 11

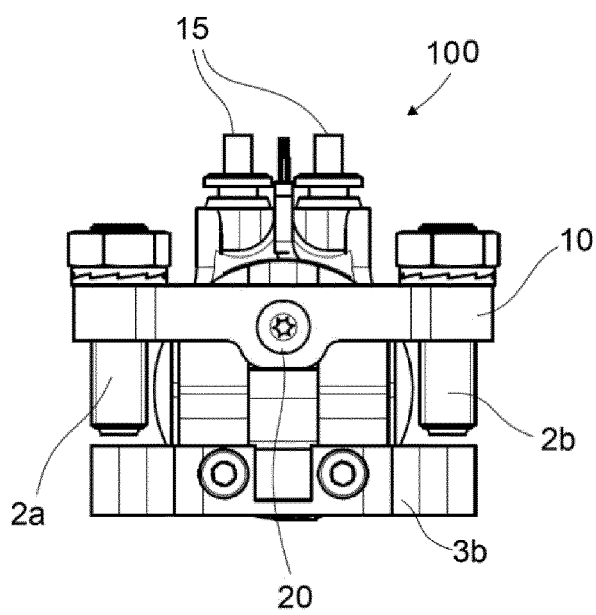


Fig. 12

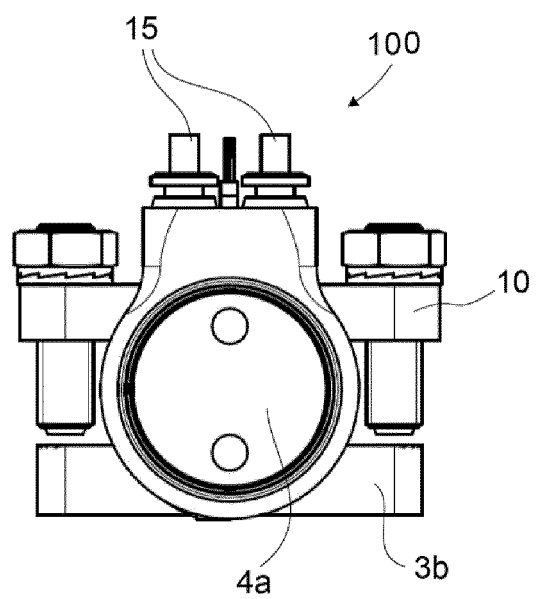


Fig. 13

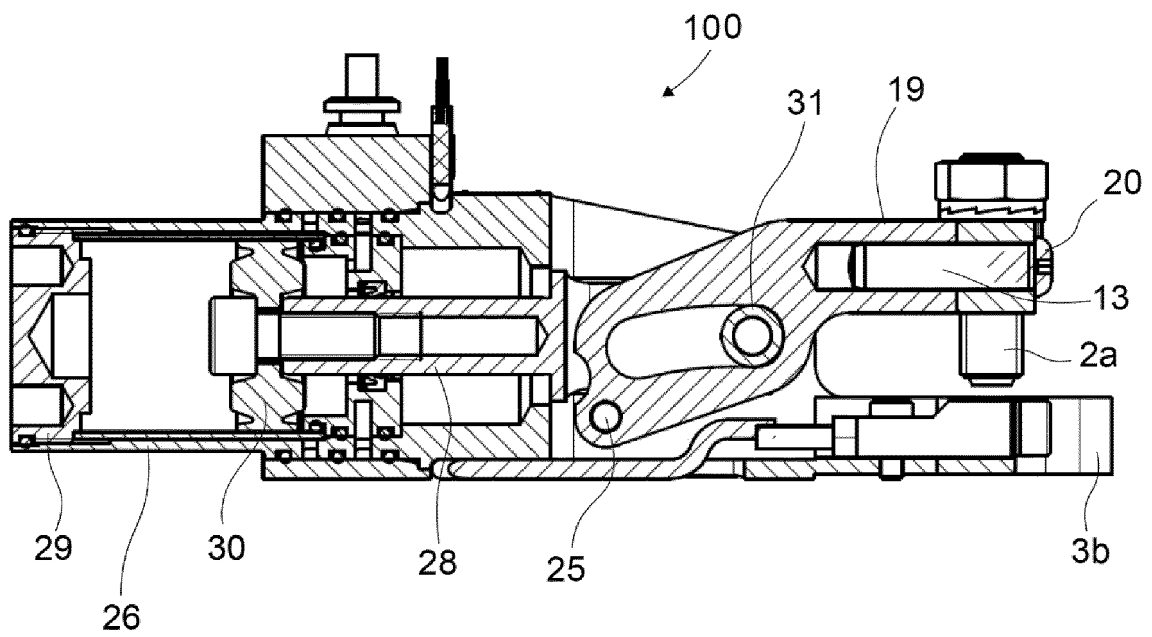


Fig. 14

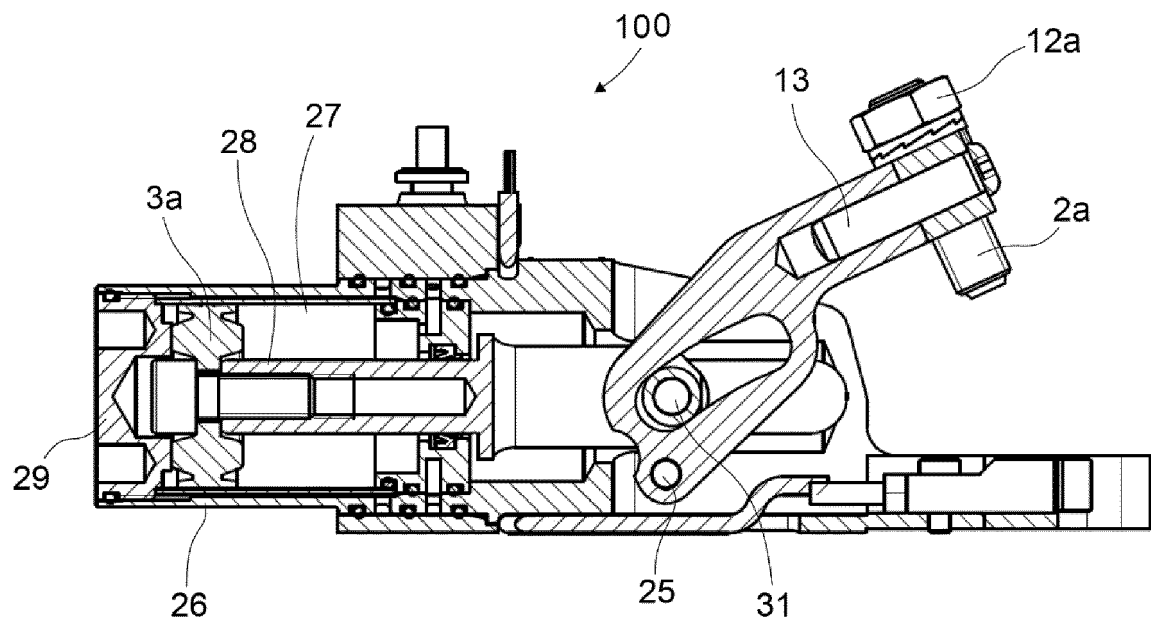


Fig. 15

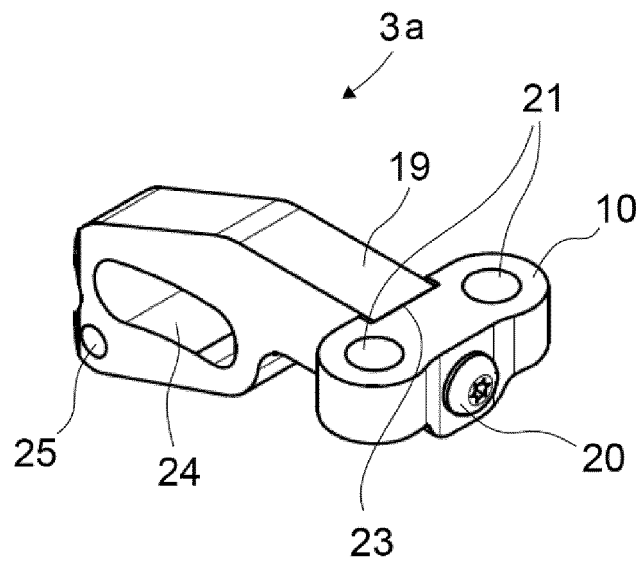


Fig. 16

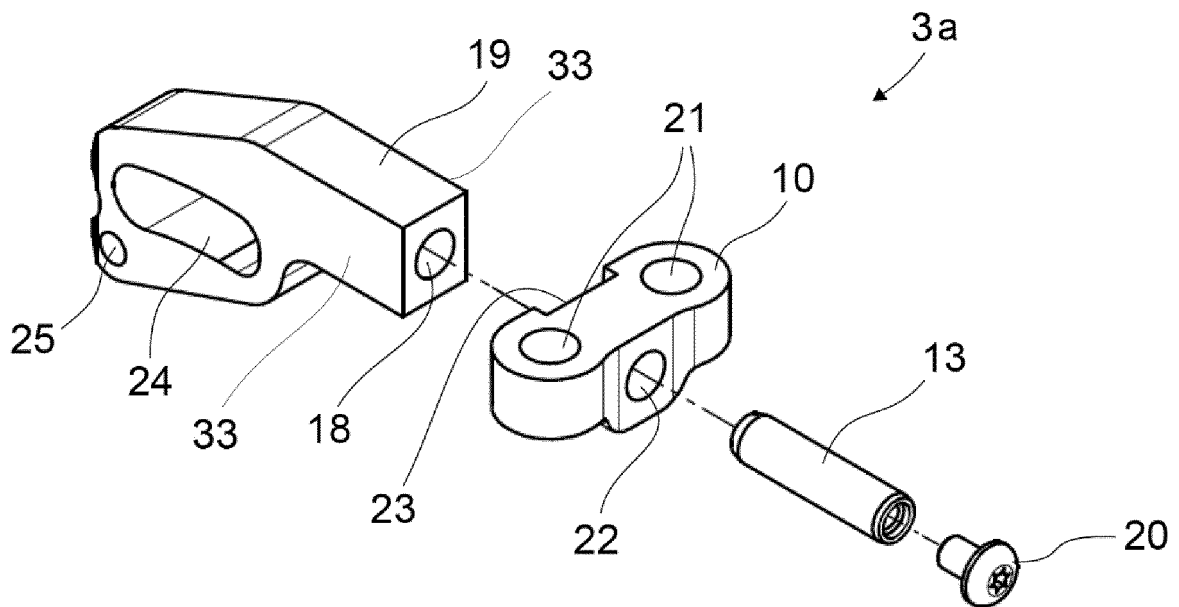


Fig. 17

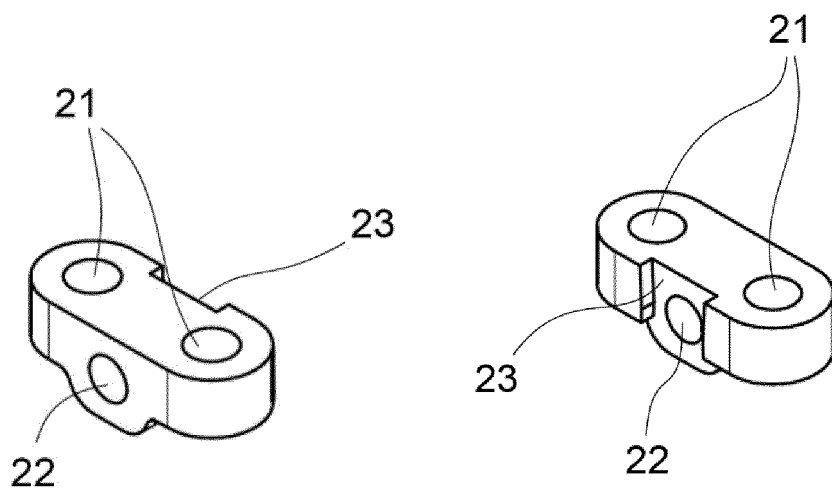


Fig. 18

Fig. 19

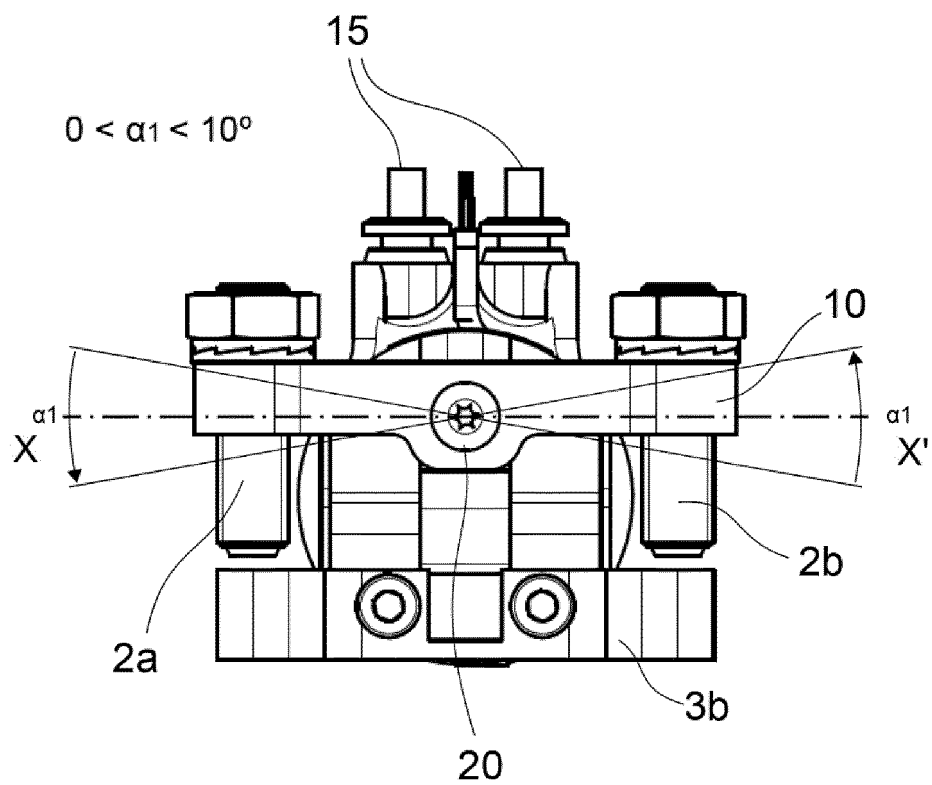


Fig. 20

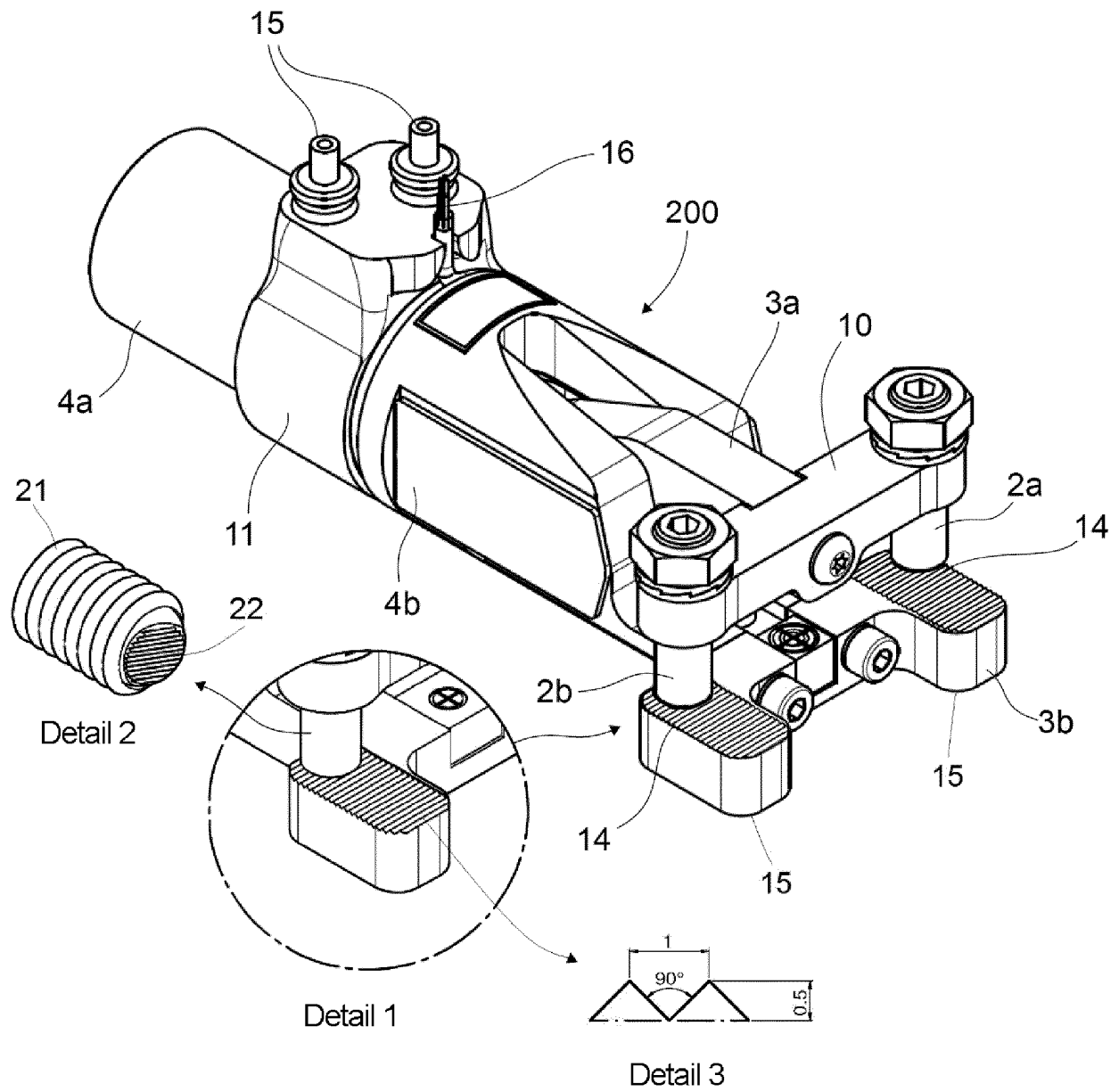
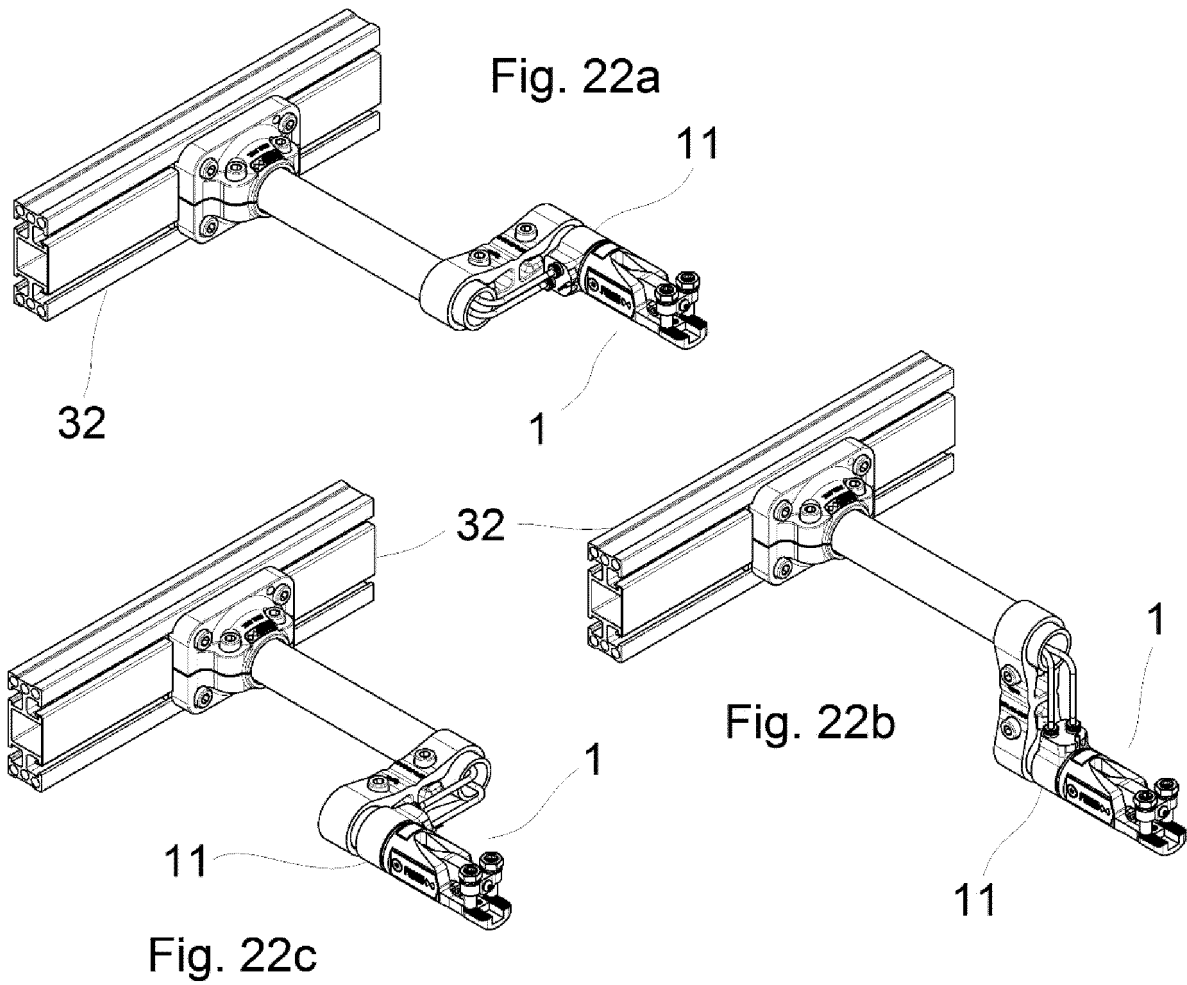


Fig. 21



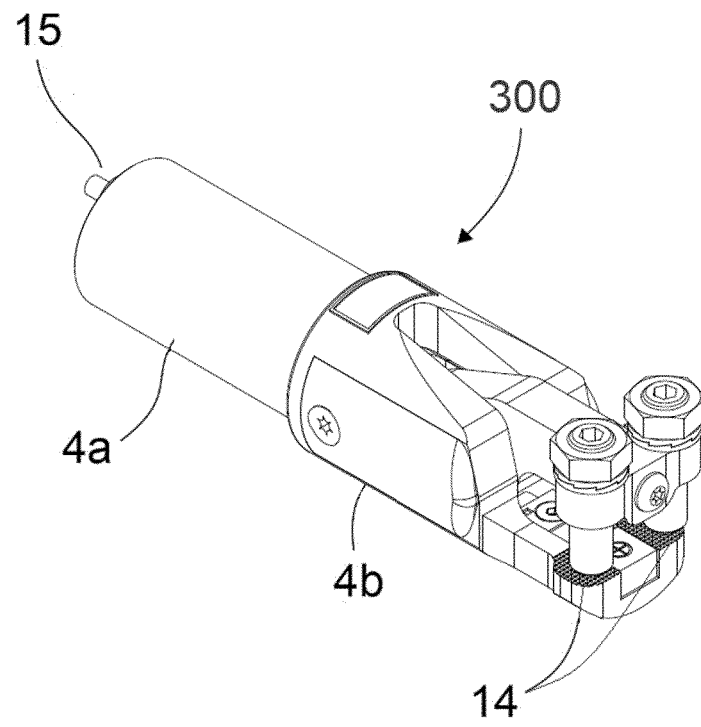


Fig. 23

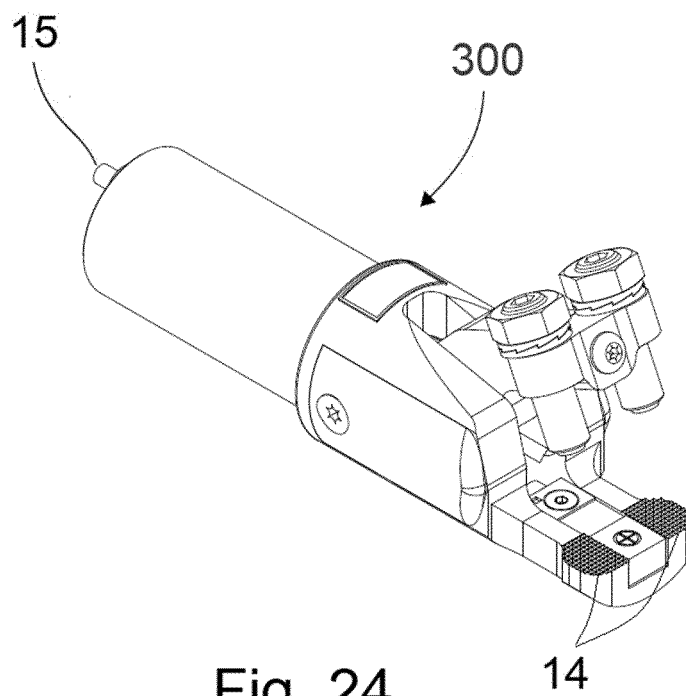


Fig. 24

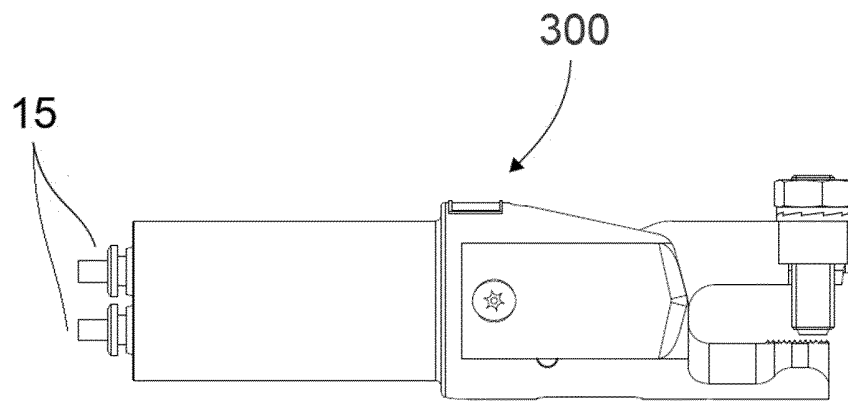


Fig. 25

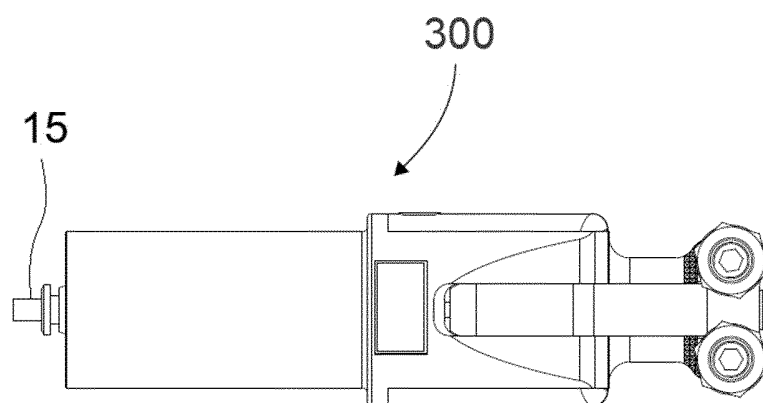


Fig. 26

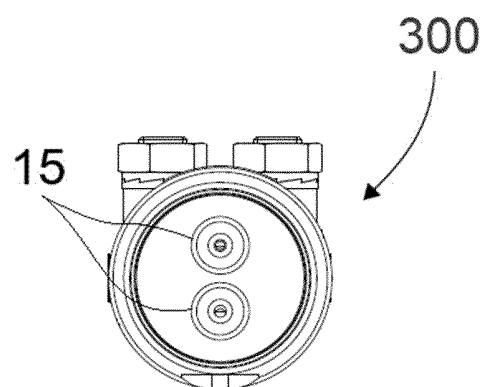


Fig. 27

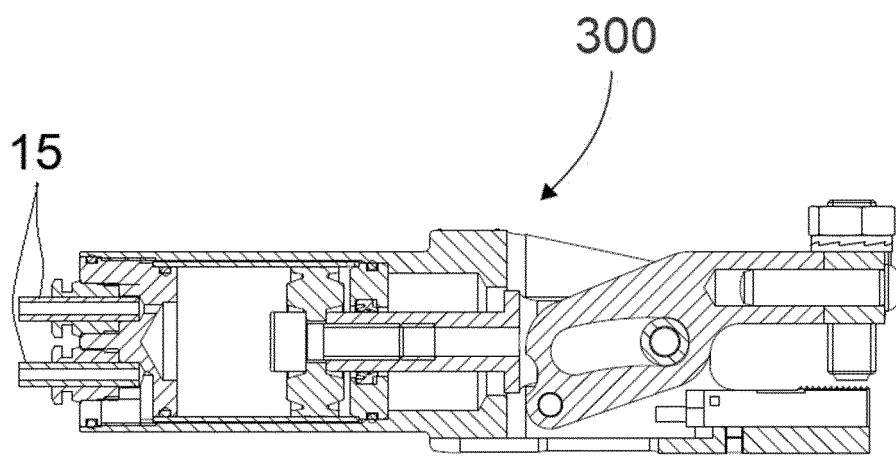


Fig. 28

INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2020/070373

5	A. CLASSIFICATION OF SUBJECT MATTER INV. B25B5/06 B21D43/11 B25B5/14 B25B5/16 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC			
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B25B B21D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched			
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EP0-Internal, WPI Data		
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
25	Y	ES 1 140 856 U (SARABIA TRILLA MIQUEL) cited in the application paragraphs [0056] - [0092]; figures 1-8 -----	1-19
30	Y	CN 109 676 049 A (JINAN KAIFENG CNC MACHINERY CO LTD) 26 April 2019 (2019-04-26) the whole document -----	1-19
35	Y	US 2001/038215 A1 (MOILANEN STEVEN M [US] ET AL) 8 November 2001 (2001-11-08) paragraphs [0084] - [0090]; figures 16-19 -----	9,11
	A	DE 20 2010 010687 U1 (KRAHN HEINRICH [DE]) 30 September 2010 (2010-09-30) paragraphs [0001] - [0003]; figures 5-8 -----	1-19
		-/--	
40	☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
45	* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
50	Date of the actual completion of the international search 9 September 2020		Date of mailing of the international search report 18/09/2020
55	Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Pastramas, Nikolaos

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INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2020/070373

C(Continuation). 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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