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(54) Improvements for joining metal parts

(57) The pre-flanging and final flanging operations achieve the folding of the flange (3) provided on the contour of an exterior plate or panel (4) on the edge of another interior plate or panel (5) by plastic deformation.

The raising and lowering of the flanging tools (1, 2) is obtained with a servo-controlled electric drive (8) which acts by means of a transmission by belt (9) on a ball spindle (12) that acts on its corresponding nut (13). There are mechanical stops (15) for the proper positioning of the tools or cutters (1, 2).

The pre-flanging tool (1) is located under the final flanging tool (2) and is pneumatically retractile.

There is also a pneumatic holding-down plate (30) for the parts or plates, assembled on the tools or cutters (1, 2), kept continuously activated throughout the double flanging cycle.

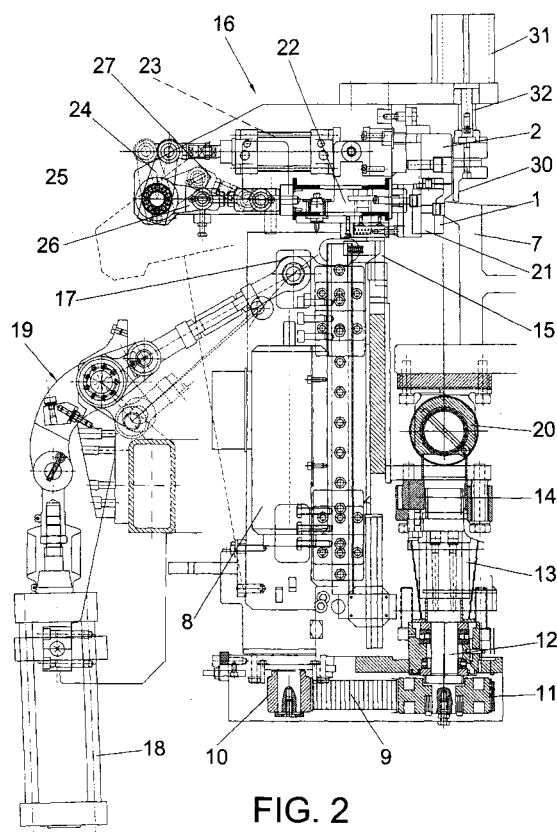


FIG. 2

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Description

[0001] The present invention, as expressed in the title of this specification, consists of improvements introduced in devices for joining metal parts by means of a system of flanging on a movable table, through which significant advantageous features are achieved in comparison with those existing at the present time and both in the structure as well as in the functionality of the mechanism.

[0002] The flanging operation is understood as the operation of the folding of the contour flange of an exterior plate or panel with respect to the edge of another interior plate or panel, with a plastic mechanical deformation taking place so as to establish the joining of both plates along all or part of their perimeter.

[0003] This folding is carried out in two successive operations: one pre-flanging (first operation) which folds said flange from a predetermined initial position to an intermediate position; and another final flanging (second operation) in which said flange is completely bent backwards on the edge of the interior plate.

[0004] An object of the invention is to achieve that the flanging phases or operations, performed with the relevant tools arranged in a toolholder head, are carried out consecutively and in a simpler manner, thus avoiding the tilting of the head between the two operations or phases.

[0005] Another object of the invention is that the raising and lowering of the flanging tools be obtained by means of an electric servo-controlled drive, which makes it possible to obtain a control of the speeds as well as a control of the position of the head dispensing with the need for positioning cams, wiring, box of micro-switches, etc.

BACKGROUND OF THE INVENTION

[0006] The flanging systems used at the present time are of two types: flanging in a press and flanging on a movable table.

[0007] The flanging system in a press is performed by means of a die that has catch fingers which, when activated, achieve the folding of the flange. This flanging system requires the installation of a press on civil work, and in addition, the maintenance of the equipment is very complex. Moreover, this system is costly and it is difficult to control the thickness of the package formed following the flanging, while it is only possible to act on the enveloping flange from a single direction.

[0008] The other type of flanging, that is, by using the movable table system, is based on the system where the flanging units are placed in a working position and await the arrival of the parts to be flanged, arranged on the cradle, reaching the working position by means of a vertical drive system. This flanging system also presents certain drawbacks such as the fact that the place where the parts are loaded and unloaded is situ-

ated at a considerable height, which limits the possibilities of certain loading and unloading systems. The cost of the hydraulic drive is generally very high and it requires a high consumption of energy, with the weight of the machine also being considerable. Likewise, the stresses produced in the flanging operation cause the flanging units to tend to slip out of their working position. The maintenance of the hydraulic cylinder that moves the cradle is complicated on account of the difficulty of accessing it from the outside. This system is also capable of acting on the flange from one direction only.

[0009] At a later date, the same firm applying for this invention developed a modular table system for joining metal parts by flanging, which is the object of the Spanish patent no. P-9601677, where the exterior plate or panel is supported and fixed on a cradle, the support surface of which reproduces the shape of the exterior panel. Once the interior plate or panel is situated on the foregoing, the flanging operation commences by means of the combination of movements of the said flanging unit and takes place in two successive phases. In the first phase, an initial folding of the flange is performed, called pre-flanging, and afterwards the flange of the exterior panel is closed on the interior panel in an operation called final flanging.

[0010] In this aforementioned patent application, a preferably mechano-welded structure is considered on which a table is placed comprised by a thick plate with fastening means by other additional elements such as centring devices suitable for securing the placement of the cradle at coordinates, the fastening means of the cradle itself, as well as supports of the flanging units, of the holding-down element and of the centring devices supports in order to situate the said holding-down element properly.

[0011] The table has two mechanical stops for the flanging operation: one for the pre-flanging phase and the other for the final flanging phase. These mechanical stops act as landing dogs of the carriages of the flanging units, thus ensuring that the travel ends always at the same point and position in order to achieve the quality required and that the thickness of the package comprised by the exterior panel, the interior panel and the flanges of the exterior panel which returns and refolds over the interior panel is always repeated in a consistent manner.

[0012] The flanging units contemplated in this aforementioned patent are interchangeable modular movable elements, the drive of which is comprised by hydraulic cylinders, one for producing a tilting movement in order that the approach will take place and the subsequent withdrawal of the flanging unit to the working zone, and a second hydraulic cylinder suitable for performing the movements of execution of the two successive operations of pre-flanging and final flanging.

[0013] Each flanging unit is comprised by a part linked to the table, or tilting part, made up by a set of supports of the tilting shaft, with fastening means for the cutter-

holder carriage, with the movement being transmitted from the first cylinder by means of connecting rods. There is another movable part that slides with respect to the former and the movement of which is effected with the second hydraulic cylinder which is the one in charge of performing the flanging operations.

[0014] The mechanical stops provided for the different flanging units which are located at the points selected on the contour of the table, in order for the pre-flanging and final flanging operations to be performed correctly, are built preferably by means of a steel dolly. The sliding means for the action of the cutters are built preferably by means of symmetrical tempered and rectified steel strips, which have means for fastening to the sliding part of the flanging unit.

[0015] The flanging means located on the sliding part of the machine are comprised preferably of a cutter-holder with housing means and fixation of the pre-flanging cutters or tools and of the final flanging cutters or tools, with the cutters being of a shape in accordance with the shape and contour of the final part. These cutters are supplemented, for the zones of the contour corners of the part, with inserts appropriate for being joined to the adjacent cutters.

[0016] The existence of a mechanical stop for each flanging unit on the table, for the pre-flanging and final flanging operations, constituted preferably by means of a steel dolly, allow the rotation shaft of the flanging group to rest, thus extending the life of the said shaft, as well as the reliability of the machine.

[0017] The same firm applying for this invention improved this machine contemplated in the aforementioned patent, by improving the structure and functionality of the flanging units, with an electric drive in order to achieve the movements of the sliding part of the machines, as well as having the angular movement of approach and withdrawing to and from the working position be effected through a pneumatic cylinder. This is the object of the Spanish patent no. P-9702619, in which the support structure of the cutters was also improved together with the shape and arrangement of same in order to allow a shortening of the distance between the pre-flanging and final flanging zones, which reduces the cycle time of the system. According to this, one of the cutter-holders was eliminated, manufacturing as a single piece the pre-flanging cutter and another auxiliary flanging support cutter the existence and purpose of which was contemplated in the specification of the primary patent, with the financial advantage involved.

[0018] In this last patent mentioned, the upward-downward movement of the sliding part of the flanging unit, is carried out by means of a geared motor by transformation of the rotating movement of its shaft, into a linear movement of a ball spindle rigidly joined in an axial direction to the sliding part of the flanging unit, which passes through its relevant ball nut, elastically joined to the tilting part. By means of a simple system of pulleys and a cog belt the transmission of the turning motion to

the spindle is achieved. Depending on the direction of rotation, the ball spindle will be forced to make an ascending or a descending movement on sliding through the ball nut and thus the raising or the lowering of the cutters or tools anchored to the sliding part of the flanging unit will take place, as we had indicated earlier.

[0019] Also, in this last patent mentioned number P-9702619, the tilting movement of the flanging unit is achieved by means of the action of a pneumatic cylinder that moves a system of connecting rods linked to the flanging unit. Both cutters are fixed to a single cutter-holder, with the final flanging cutter being arranged on the top part of the cutter-holder, while the pre-flanging cutter is located on the lower part; this arrangement is the reverse of that contemplated in the primary patent, which determined that another auxiliary final flanging cutter would also be necessary which was located in a position prior to the final flanging cutter and on the same cutter-holder as the latter.

[0020] As this last arrangement, that is with the auxiliary cutter defined by a portion of the final flanging cutter itself, is more advantageous since it achieves a shortening of the distance between the working zones of the cutters, which reduces the cycle time, as well as being more economical, it has been observed that it can be improved in accordance with the present invention and in the terms set out below.

DESCRIPTION OF THE INVENTION

[0021] In general, the improvements introduced in devices for joining metal parts by means of a system of flanging on a movable table which constitutes the object of this invention, consist of providing that the drive motor for raising and lowering the flanging tools becomes servo-controlled, with the advantage of controlling speeds and position of the head dispensing with positioning cams, etc.

[0022] A further basic improvement of the invention consists of improving the arrangement or the flanging tools which change from being integrally fixed to the toolholder, to having one of them, the pre-flanging tool, retractile or retractable thus avoiding the tilting of the entire head between the first operation and the second operation.

[0023] Due precisely to that non-tilting characteristic between these operations, it is possible to install a part-product holding-down plate, from the time the first operation is initiated until the second operation is finished, thus improving the quality of the product, as the immobilisation of the parts is ensured.

[0024] The location of the mechanical positioning stops to precisely carry out the different phases of the flanging is changed. They are situated on the head itself instead of on the fixed table, as occurred in the patent P-9702619 commented above. These mechanical stops are also designed to be retractile or retractable.

[0025] The drive, both for the tilting system of the head

as well as for the retractile tool of the first operation, or of the holding-down plate or plates, is entrusted to pneumatic actuators constituted by cylinders.

[0026] The fixed and retractile tools or cutters have coupled to them respective dollies that reach a coincident position of superimposition when the retractile one is in the advanced position, that is, for the pre-flanging operation to take place. Thus, when the drive motor acts, the reaction stress produced on this tool is properly borne.

[0027] In order to facilitate an understanding of the characteristics of the invention and forming an integral part of this specification, pages of drawings are attached. The following is represented with an illustrative and not restrictive nature, in the figures of said pages:

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Figure 1 shows in schematic form how the flanging operation takes place, according to three phases of work of the tool.

Figure 2 is a side view of a device for joining of metal parts by means of the system of flanging on a movable table, including the improvements which are the object of the invention.

Figure 3 is a side view of the tool-holder with the pre-flanging and final flanging cutters in a coincident position and therefore in the position of the head in which the first operation may be carried out.

Figure 4 is a view similar to figure 3, in the retracted position of the pre-flanging cutter and therefore with the head ready for performing the final flanging operation.

Figure 5 is a side view, on a larger scale, of the part of the head where the mechanical positioning stop of the first and second operations is located.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

[0029] Making reference to the numbering adopted in the figures, it can be seen how the flanging operation takes place in the phases shown in figure 1, by means of the pre-flanging tool 1 and the final flanging tool 2. In the first place, in phase a), the pre-flanging tool or cutter 1 approaches the flange 3 of the exterior metal plate or panel 4 to make the flange 3 move to the position shown with a continuous line, from the position shown with broken lines.

[0030] In the phase b), the tool 1 descends to thus perform the pre-flanging operation, where the flange 3 takes an intermediate position.

[0031] Finally, in phase c) the final flanging tool or cutter 2 completely folds the flange 3 until it is fully adhered to the edge of the interior plate 5.

[0032] Reference 6 in figure 1 designates the adhesive used for the sealing.

sive used for the sealing.

[0033] The exterior plate 4 is well supported on the support cradle 7 and at different points of its periphery other flanging devices identical to the one shown in the figures are mounted.

[0034] Now with particular reference to figure 2, it can be seen therein, referenced with number 8, the servo-controlled electric drive that acts by means of the transmission by belt 9 laid between the driving pinion 10 and the driven pinion 11 on the ball spindle 12 that activates its corresponding nut 13. The raising and lowering of the flanging tools 1 and 2 are achieved with this transmission.

[0035] For absorption of overloads, an elastic package 14 is assembled between the nut 13 and the activated means.

[0036] The functional positioning of the pre-flanging tool 1 and final flanging tool 2 is made on adjustable mechanical stops 15, as can be seen more clearly in the enlarged view of figure 5.

[0037] The toolhead, referenced in general by number 16, has a tilting portion 17 that is joined to the pneumatic cylinder 18 through the system of connecting-rods 19, rotating around the tilting shaft 20 fixed to the frame of the machine. This tilting of the head 16 is observed in diagram form in figure 2, shown with broken lines.

[0038] Once the toolhead reaches the vertical position of figure 2, the electric motor 8 acts so as to perform the flanging operations.

[0039] The tool of the first operation, formed by the pre-flanging cutter 1 (see figures 3 and 4) is arranged in a position under the fixed tool of the second operation, the final flanging operation. The tool or cutter 1 is fastened to the tool-holder 21 mounted on guides 22 and constitutes the cutter that has the retractile function. This movement is caused by the action of the pneumatic cylinder 23 that acts on the connecting rod 24 integrally joined to the transmission shaft 25 that distributes its torsional stress to two sets of connecting rods 26 and 27 of the toggle link system.

[0040] The forward-backward retractile movement of the tool-holder corresponds: forward, first operation working position; back, withdrawn position so as to allow the lowering of the fixed tool 2 to the working position (see figures 3 and 4).

[0041] The reaction stress that is produced on the tool of the first operation, that is, on the pre-flanging cutter 1, are borne in a horizontal direction, towards the left of the figures, by the alignment of the guides 22 and the system of connecting rods 26 and 27, with three aligned points. In a vertical direction, the reaction stresses are borne by means of the dollies 28 inserted between the fixed tool 2 and the movable tool 1 (see figures 3 and 4). The working precision positioning, forward-backward, of the pre-flanging tool 1 is carried out by means of the adjustable gauges 29, as can be seen more clearly in figure 5. Also, with the forward movement for the

first operation and backward movement for the second operation, action is exerted on the movable positioning stops of the tools- on the product plate arranged on the cradle 7, reproducing the same conditions as the pre-flanging tool 1, that is, forward stop, working position to perform the first operation and back stop, working position for the second operation.

[0042] During the two working operations, the holding-down plate 30 pneumatically driven by means of the cylinder 31, continuously acts on the product plates 4-5, keeping the parts still and steady during the flanging phase. Reference 32 in figure 2 designates the means for guiding the vertical movement of the holding-down plate 30.

Claims

1. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

performing in a first operation an initial folding of a flange (3) shaped on the periphery of an exterior panel or plate (4) with respect to the edge of an interior panel or plate (5) in a pre-flanging phase, a refolding of said flange (3) according to a final flanging phase taking place afterwards; the pre-flanging and final flanging movement being carried out by means of an electric drive and the tilting of the flanging unit when approaching and withdrawing from the working position being carried out by means of a pneumatic drive, with mechanical stops limiting the correct positions of tools or cutters (1, 2), **characterised in that** the electric drive is carried out by a motor (8) which is servo-controlled for detection of speed and position, and **in that** the tools or cutters (1, 2) comprising the flanging unit of toolhead (16) are fixed to a tool-holder (21) in such a way that one of them is retractile, enabling the successive execution of both flanging phases without tilting of the head (16).

2. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

according to claim 1, **characterised in that** it further comprises a holding-down plate (30) linked to the toolhead (16), which uninterruptedly acts during the two phases of operation, by means of the action of a pneumatic cylinder (31).

3. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

according to claim 1, **characterised in that** the mechanical stops (15) for the positioning of the first and second flanging operations are located on the toolhead (16) itself and are also retractile in nature.

4. **IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,** according to claim 1, **characterised in that** the fixed tool (2) and retractile tool (1) have dollies (28) mounted in an intermediate position, said dollies being superimposed when the retractile tool (1) is in the advanced position.

5. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

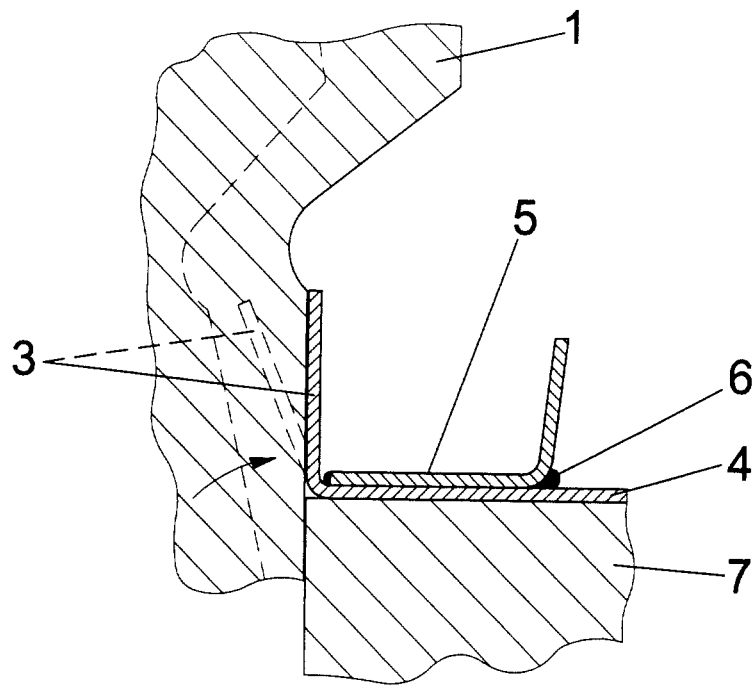
according to claim 1, **characterised in that** the forward-backward precision working positioning of the pre-flanging tool (1) is performed by means of adjustable gauges (29) on the displacement guides (22) of the tool.

6. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

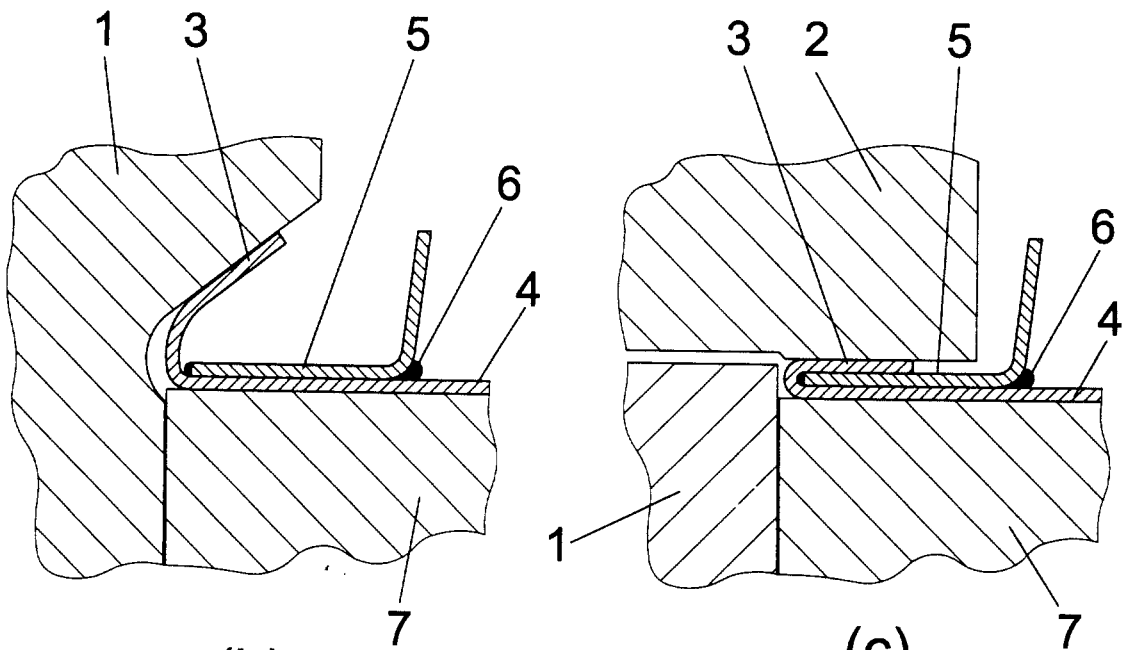
according to claim 1, **characterised in that** the pre-flanging tool (1) is arranged under the final flanging tool (2), and the former (1) is fastened to a toolholder (21) mounted on guides (22) so as to achieve the retractile function upon acting on a pneumatic cylinder (23).

7. IMPROVEMENTS INTRODUCED IN DEVICES FOR JOINING METAL PARTS BY MEANS OF A SYSTEM OF FLANGING ON A MOVABLE TABLE,

according to claim 6, **characterised in that** the pneumatic cylinder (23) acts on a connecting rod (24) integrally joined to a transmission shaft (25) that distributes its torsional stress to two sets of connecting rods (26, 27) of a toggle link system, achieving, in the forward working position, the condition of maintaining three points in line so as to withstand the reaction stress that avoid the retracting of the retractile cutter (1).



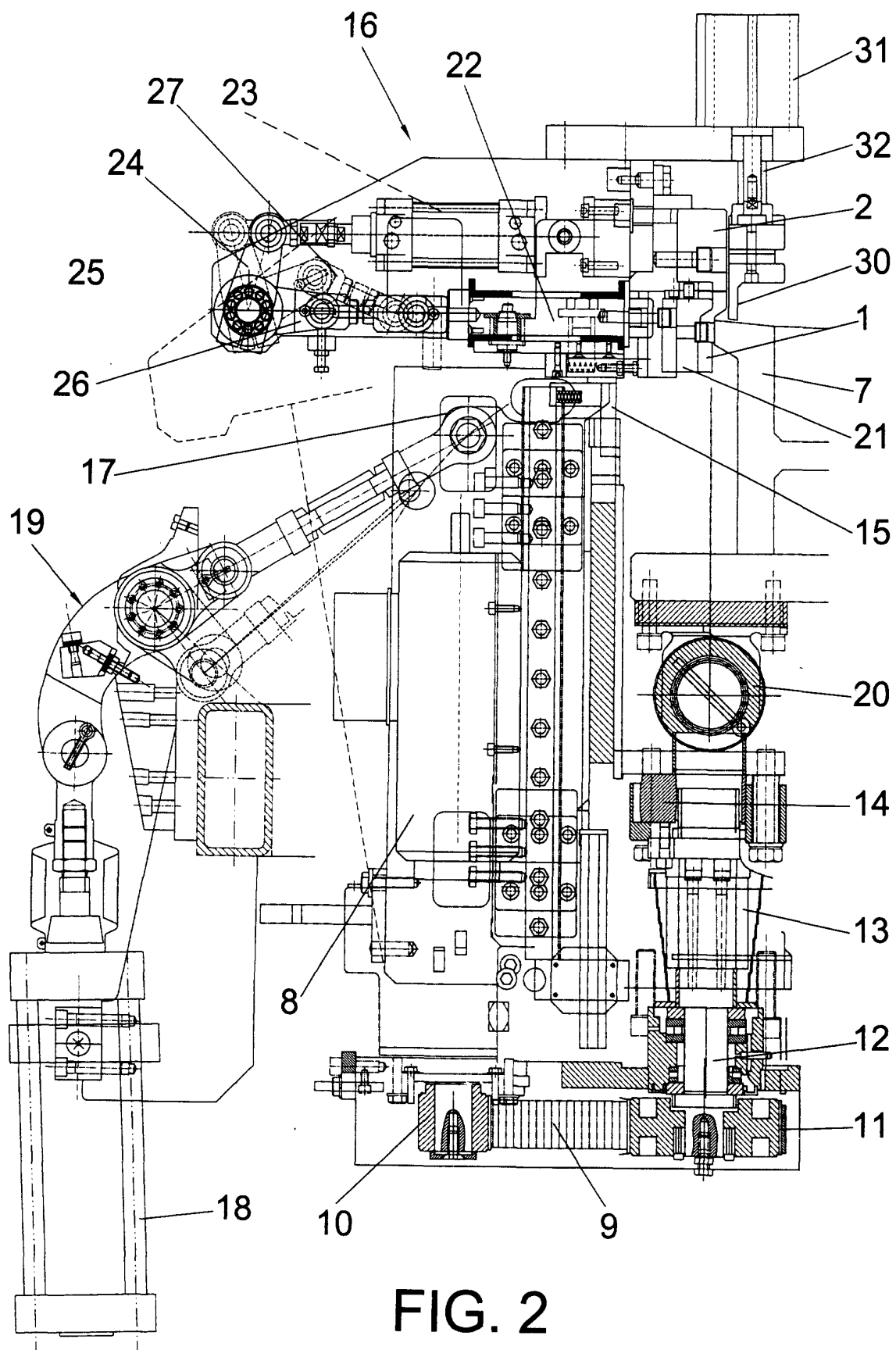
(a)



(b)

(c)

FIG. 1



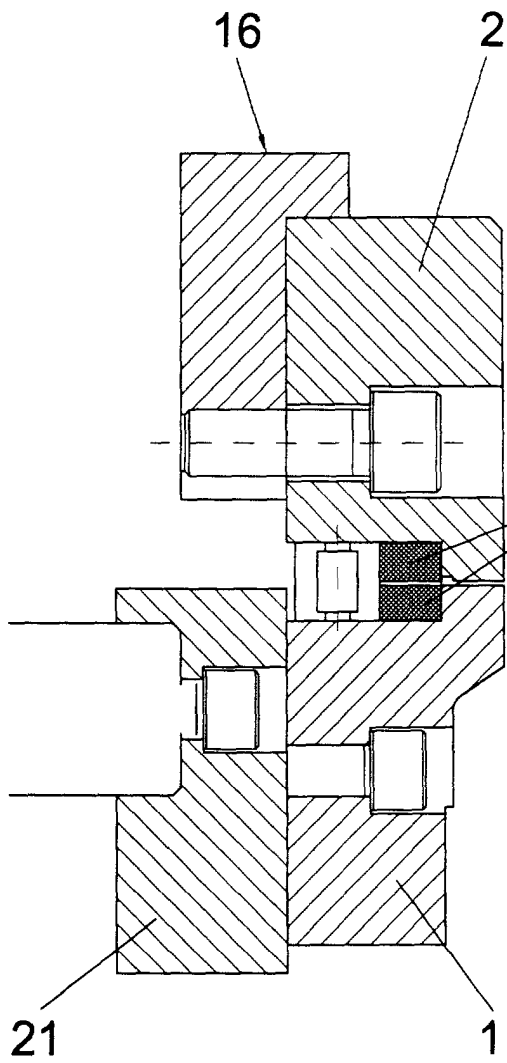


FIG. 3

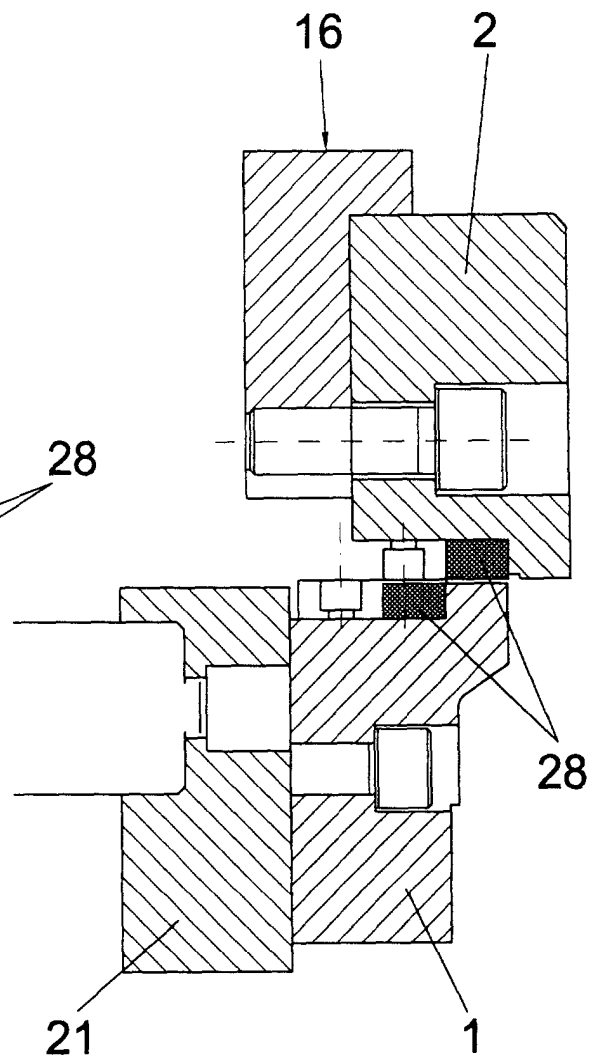


FIG. 4

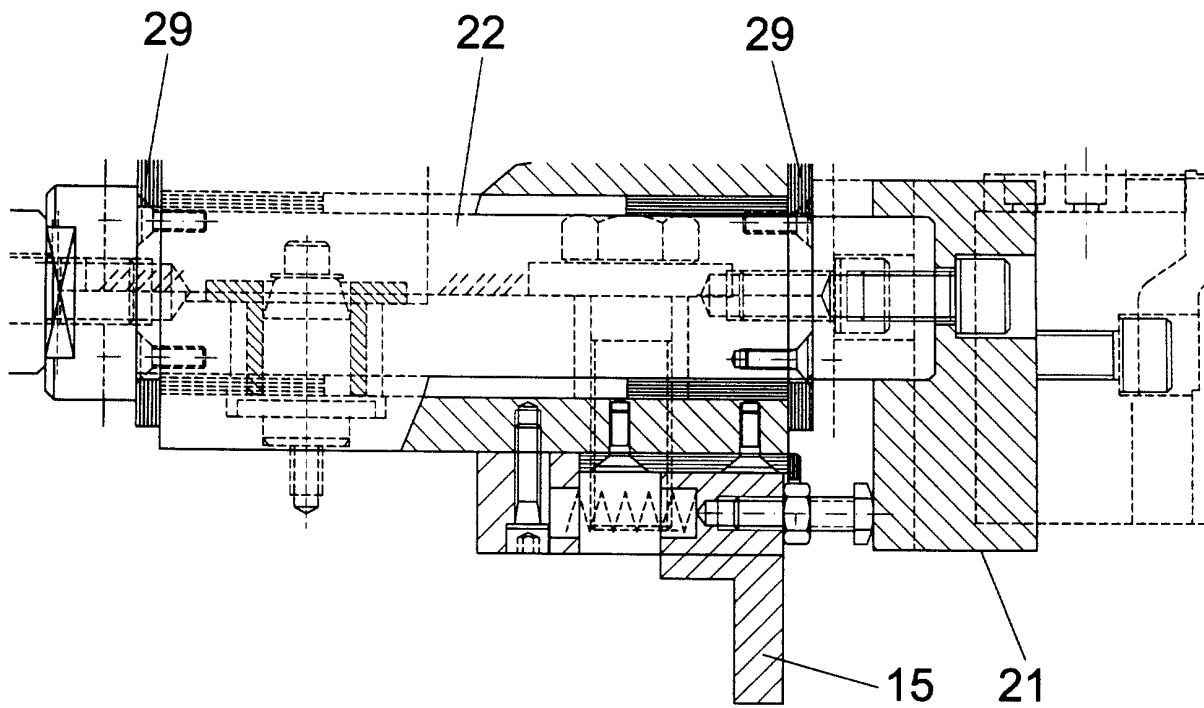


FIG. 5