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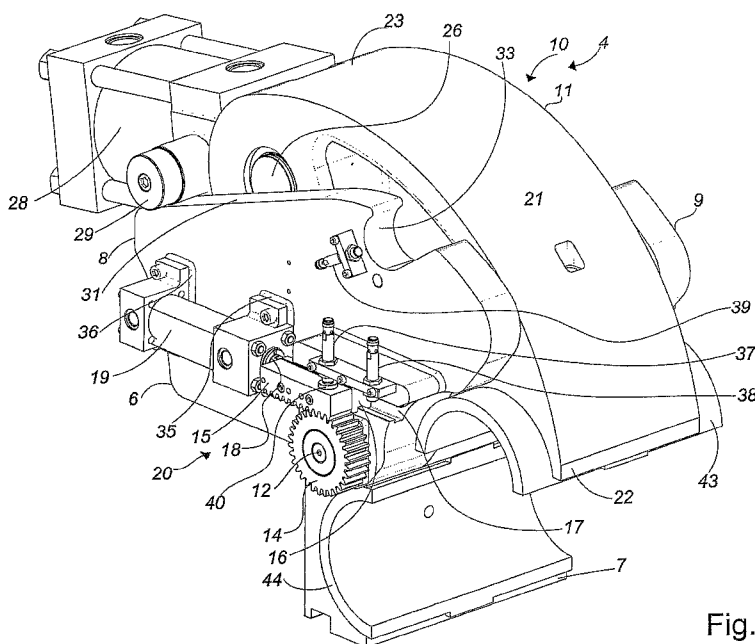
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(54) Title: VISE PROVIDED WITH A MOVABLE JAW DEVICE HAVING SEPARATED APPROACHING AND CLAMPING STEPS IN A PIPE BENDING MACHINE DIE



(57) Abstract: A vise provided with a movable jaw device having separated approaching and clamping steps in a bending machine die, said vise (4) having a fixed jaw portion (7) and a movable jaw device (10) comprising a body (6) having two abreast supporting walls (8, 9), on an external side of one of which an operation mechanism (20) of the movable jaw is mounted, and upper edges (31, 32) of the supporting walls acts as cams for opposite spindles (29, 30) laterally projecting from one hydraulic cylinder (28) that is swing mounted on the movable jaw (11). The upper edges (31, 32) have two respective notches (33, 34) designed to receive the projecting spindles (29, 30) in such a way that the extension of the rod (27) of the hydraulic cylinder (28), being locked in position by its projecting spindles (29, 30) in the respective notches (33, 34), keeps the movable jaw (11) in closed position.

Fig. 2

WISE PROVIDED WITH A MOVABLE JAW DEVICE HAVING
SEPARATED APPROACHING AND CLAMPING STEPS IN A PIPE
BENDING MACHINE DIE

5 TECHNICAL FIELD

The present invention relates to a vise provided with a movable jaw device having separated approaching and clamping steps in a bending machine die.

BACKGROUND ART

The Applicant is the owner of the European patent No. EP 1 623 772 granted
10 on 26 March 2008, that discloses a vise for clamping an elongated workpiece to be bent on a bending machine die. The vise comprises a jaw being rotatable about a pivoting end so that the jaw is approachable to and removable from a circumferential groove of the die in order to surround, from opposite parts, an elongated workpiece. The movable jaw is rotated by an operation mechanism
15 comprising a first hydraulic cylinder that is provided with a rack being connected to its cylinder rod, and a pinion being keyed to the movable jaw and meshing with the rack. Once the rotatable jaw has approached the elongated workpiece to be bent, a retaining device being operated by a second hydraulic cylinder is able to grip a jaw retaining end opposite to the jaw pivoting end in
20 order to clamp the elongated workpiece to be bent in a closed position.

In the above cited European patent there are two separated steps, the one being an approaching step to, the other being a clamping step of an elongated workpiece to be bent in a pipe bending machine. This allows an elongated workpiece to be retained with a high reliability in bending operation.
25 However, as the operation mechanism is fixed on a die side and the retaining device is fixed on the opposite die side, the vise is cumbersome especially in its part that is situated in the lower die side. This prevents some design choices to be made, and generally a pipe bending machine increases in size.

The present invention aims to overcome the drawback above mentioned.

30 In particular, a main object of the invention is to allow a die to be made having a gripping device of the workpiece to be bent, gripping device that

operates with a jaw having two separated approaching and clamping steps, without requiring parts of the gripping device of the workpiece to be bent on both sides of the die.

DISCLOSURE OF THE INVENTION

- 5 The object is achieved by an invention that gives a vise provided with a movable jaw device having separated approaching and clamping steps in a bending machine die, wherein the movable jaw device comprises a body being fixed on the die and having two abreast supporting walls, on an external side of one of which said operation mechanism of the movable jaw is mounted,
- 10 and upper edges of the supporting walls act as cams for opposite spindles laterally projecting like trunnions from said second hydraulic cylinder that is swing mounted by means of a connection of its cylinder rod with a small shaft being transversally pivoted in the movable jaw in a rear end thereof opposite to the front gripping end thereof, the upper edges of the supporting walls
- 15 having two respective notches designed to receive the projecting spindles of said second hydraulic cylinder in such a way that the extension of the rod of the second hydraulic cylinder, being locked in position by its projecting spindles in the respective notches, keeps the movable jaw in closed position.

BRIEF DESCRIPTION OF THE DRAWING

- 20 The present invention will be described with reference to a preferred embodiment thereof in connection with the accompanying drawing, in which:
- Figure 1 shows in a fragmentary perspective view a dual headed bending machine with a pair of dies each being provided with a vise for clamping an elongated workpiece according to the present invention;
- 25 Figure 2 shows in an enlarged perspective view the vise in Figure 1 in its opened position;
- Figure 3 shows in a side elevational view the vise in Figure 2 in a side of an operation mechanism;
- Figure 4 shows in a side elevational view the vise in Figure 2 in its side
- 30 opposite to the side carrying the operation mechanism;

Figures 5 shows in an enlarged perspective view the vise in Figure 1 in its closed position;

Figure 6 shows in a side elevational view the vise in Figure 5 in its side carrying the operation mechanism;

5 Figure 7 shows in a side elevational view the vise in Figure 5 in its side opposite to the side carrying the operation mechanism; and

Figure 8 shows in a partially cross-sectioned, side elevational view the vise according to the invention in its side carrying the operation mechanism, in a clamping position.

10 DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

With reference to the drawings, Figure 1 shows in a fragmentary perspective view a dual headed bending machine with a pair of dies each being provided with a vise for clamping an elongated workpiece according to the present invention.

15 In Figure 1 a bed of the bending machine is indicated at 1 and a box-shaped structure at 2, the latter being disclosed in a previous patent application of the same Applicant. A pipe to be bent is designated at T whose portion 3 is surrounded by a vise 41 that is mounted on a die generally indicated at 51 in a first head of the dual headed bending machine. The first head vise 41 is depicted after the movable jaw has approached the pipe T and before clamping the same.

A vise and a die in a second head, that is not engaged at the moment in a bending operation are indicated at 42 and 52, respectively.

25 Other reference numeral relating to other bending machine parts that are useless for understanding the present invention are not indicated in Figure 1.

The invention is limited to a vise generally indicated at 4, which is described in detail below by an embodiment thereof with reference to Figures 2 to 8, where the vise is shown in perspective views (Figures 2 to 5) and in side elevation views (Figures 3, 4, 6, 7, and 8), respectively, in several operation positions.

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First, reference is made to Figures 2 to 4 that show the vise in an opened position.

The vise 4 has a body 6 with a fixed jaw portion 7 projecting downward. Conventionally, the fixed jaw portion 7, being located adjacent a circumferential half-cylindrical concave groove of the die, acts as an insert integral with the die. In Figure 3, an elongated projection designed to engage a corresponding hollow part of the die is indicated at 45. A half-cylindrical hollow part 44 is inserted in the fixed jaw portion to adapt the fixed jaw to the size of the elongated workpiece T to be bent.

According to the present invention the body 6 of the vise 4 laying on the top of the die as shown in Figure 1, projects upward with two supporting walls 8, 9 that are generally parallel and co-operate with a movable jaw device 10 having a movable jaw 11. The movable jaw 11 is rotatably mounted being connected to a pivot 12 that is transversally arranged to the body 6 of the vise 4 in a position over the fixed jaw portion 7. The pivot 12 is keyed by a key 13 to a pinion 14, as shown in Figure 3, where a covering washer as in Figure 2 is not represented. The pinion 14 engages a rack member 15. The rack member 15 is laterally fastened to a slider 16 that is shaped to slide in a prismatic guide 17 projecting from the wall 8. The slider 16 is attached to a free end of the rod 18 of a first hydraulic cylinder 19 that is laterally fixed to the wall 8. Pinion 14, rack member 15, slider 16, guide 17 and hydraulic cylinder 19 with rod 18 form together an operation mechanism generally indicated at 20. For clarity sake neither hydraulic or electrical circuits are depicted in the figures.

In the operation mechanism 20 the rod 18 of the first hydraulic cylinder 19 has the slider 16 slidable along a cylinder axis in the prismatic guide 17 being connected to the external side of the supporting wall 8, and the rack member 15 that is laterally fixed to the slider 16, has a path parallel to the axis of the hydraulic cylinder 19.

The operation mechanism 20 serves to rotate the movable jaw device 10 in order to bring the movable jaw 11 near to the fixed jaw portion 7 and remove the one from the other. It should be evident that alternatively another

operation mechanism, for example a worm screw, with an electric motor or other, could be used.

The movable jaw 11, which is provided with a partially elliptical external profile 21, has a front gripping end 22 having a concave half-cylindrical shape, which is of the same shape matching, in closed position, the half-cylindrical concave shape of the fixed jaw portion 7. A half-cylindrical hollow part 43 is inserted in the front gripping end 22, like that on the fixed jaw portion 7. The movable jaw has a convex centrally-lightened rear end 23 to obtain two rear side projections 24, 25 (Figure 5). In these rear side projections 24, 25 a through hole is made transversally, inside which a small shaft 26 (as best seen in Figure 8) is housed rotatably. The small shaft 26 has a T-connection with the rod 27 of a second hydraulic cylinder 28. Two preferably aligned spindles 29, 30, protrude transversally from the second hydraulic cylinder 28 and are designed to act as cam followers for the upper edges 31, 32, acting as cams, of the respective supporting walls 8, 9. Further sections of the rear side projections 24, 25 of the rear end 23 act as cams for the spindles 29, 30, in order to make the movement of the spindles 29, 30 more continuous.

The spindles 29, 30 are similar to trunnions, and the supporting walls 8, 9 form a mount on which the hydraulic cylinder 28 can slide. The upper edges 31, 32 of the supporting walls 8, 9 have two correspondent notches 33, 34 opened ahead.

The spindle 30, the upper edge 32 and the notch 34 are shown in Figure 4, which is a view of the vise 4 from the side opposite to that one on which the operation mechanism 20 is arranged. However, a guide 17 and bosses 35, 36 are provided also on the external side of the supporting wall 9 in case the operation mechanism 20 is located on the supporting wall 9.

The small shaft 26 being T-connected with the rod 27 of the second hydraulic cylinder 28, the same second hydraulic cylinder 28, together with the upper edges 31, 32 of the supporting walls 8, 9 form a clamping mechanism, as it will be evident in the following description.

Reference is made now to Figures 5 to 7, which show the vise in the closed but not clamped position. This is the position that the movable jaw 11 takes when the operation mechanism 20 rotates forward the movable jaw 11, together with the device 10, up to match the fixed jaw portion 7 and the front end 22 of the movable jaw 11, with the respective inserts 44, 43, for the adaptation to the diameter of the elongated workpiece. In this position, the second hydraulic cylinder is kept always near to the rear end 23 of the movable jaw, even if the trunnion spindles 29, 30 of the second hydraulic cylinder 28 have gone beyond the respective notches 33, 34, placing themselves on the crest of the supporting wall edge ahead of them.

As show in Figures 2, 3, 5, 6, and 8, proximity sensors, indicated at 37, 38, and 39 are provided to detect the position of the rack member 15 and of the trunnion spindles 29, 30.

In particular, when the vise 4 is in its opened position, the front end of the rack member sights with a projection 40 thereof the first proximity sensor 37, and when the vise 4 is in its closed position, the proximity sensor 38 is sighted.

It is clear that such a position of simple closure does not allow the vise to retain the elongated workpiece to be bent, as the operation mechanism of the movable jaw is not able to withstand the stresses occurring in a bending operation. For this purpose there are the notches 33, 34 designed to receive the trunnion spindles 29, 30 projecting from the second hydraulic cylinder.

Reference is made to Figure 8, which shows in a side elevation view the clamped position of the vise. This position is achieved by extending the rod 27 of the second hydraulic cylinder 28 from the closed position of the movable jaw 11, as depicted in Figures 5 to 7. Since the second hydraulic cylinder 28 is free to swing together with the small shaft 26, the second hydraulic cylinder 28 displaces downward by its weight causing the trunnion spindles 29, 30 to fall into the respective notches 33, 34 of the supporting walls 8, 9. By further extending the rod 27, the second hydraulic cylinder 28 exercise a thrust on the rear end 23 of the movable jaw 11, which results in an effect counteracting the stresses of the elongated workpiece in the bending operation, stresses that

would try to open the vise. In this way a very reliable clamping of the elongated workpiece is achieved. The position of the trunnion spindles 29, 30 inside the respective notches 33, 34 of the supporting walls 8, 9 is detected by the proximity sensor 39, sensor which gives its consent for pressuring a fluid
5 inside the second hydraulic cylinder to counteract the opening of the vise 4. It should be clear that other detection systems can be adopted.

One of the main advantages of the present embodiment of the vise according to the invention is that its size is very reduced. This is above all due to the fact that the movable jaw is optimally shaped and the cylinder of the clamping
10 mechanism has no permanent fixing point but only an anchoring in the notches when a counteracting force is requested.

Further, the vise is comprised of a reduced number of parts, so that it can be assembled easily and is cheap. Its operation is quick. The vise can be easily adapted, by virtue of the inserts of the jaws, for bending elongated workpieces
15 with a wide diameter range. Furthermore, the vise is made symmetrically and can be assembled for dies bending both in a direction and in the opposite direction. The vise is mounted on the dies by means of normal screws or by male-female coupling.

In the preceding description an exemplifying but not limiting embodiment of
20 the invention has been given which is defined in the enclosed claims.

CLAIMS

1. A vise provided with a movable jaw device having separated approaching and clamping steps in a bending machine die, said vise (4) having a fixed jaw portion (7) like an insert integral with the die and a movable jaw device (10) being provided with a gripping end (22) approachable and removable with respect to the fixed jaw portion (7) between a closed position and an opened position with respect to the elongated workpiece (T) to be bent, the movable jaw device (10) having an operation mechanism (20) of the movable jaw, comprising a first hydraulic cylinder (19), being associated with a rack member (15) connected to its cylinder rod (18), and a pinion (14) being connected to the movable jaw (11) and engaging the rack member (15), and a movable jaw clamping mechanism comprising a second hydraulic cylinder (28), characterised in that the movable jaw device (10) comprises a body (6) being fixed on the die and having two abreast supporting walls (8, 9), on an external side of one of which said operation mechanism (20) of the movable jaw is mounted, and upper edges (31, 32) of the supporting walls act as cams for opposite spindles (29, 30) laterally projecting like trunnions from said second hydraulic cylinder (28) that is swing mounted by means of a connection of its cylinder rod (27) with a small shaft (26) being transversally pivoted in the movable jaw (11) in a rear end (23) thereof opposite to the front gripping end (22) thereof, the upper edges (31, 32) of the supporting walls (8, 9) having two respective notches (33, 34) designed to receive the projecting spindles (29, 30) of said second hydraulic cylinder (28) in such a way that the extension of the rod (27) of the second hydraulic cylinder (28), being locked in position by its projecting spindles (29, 30) in the respective notches (33, 34), keeps the movable jaw (11) in closed position.

2. The vise according to claim 1, characterised in that said rear end (23) of the movable jaw (11) has rear side projections (24, 25) acting as cams for opposite spindles (29, 30) of said second hydraulic cylinder (28).

3. The vise according to claim 1, characterised in that the rod (18) of the first hydraulic cylinder (19) has a slider (16) being fixed to the free end of the rod (18) and being slidable along an axis of the cylinder (19) in a prismatic guide

(17) integral with said external side of supporting wall (8), and said rack member (15), being fixed laterally to said slider (16), has a path parallel to the axis of the cylinder (19).

4. The vise according to claim 2, characterised in that at least a pair of
5 proximity sensors (37, 38) is arranged on said external side of supporting wall (8) to sight on said path of the rack member (15) positions in said path corresponding to a opened position and closed position respectively, of the movable jaw (11).

5. The vise according to claim 1, characterised in that a proximity sensor (39)
10 is mounted on said external side of supporting wall (8) laterally to said notch (33) for detecting said spindle (29) of second hydraulic cylinder (28), when said spindle (29) is in said notch (33).

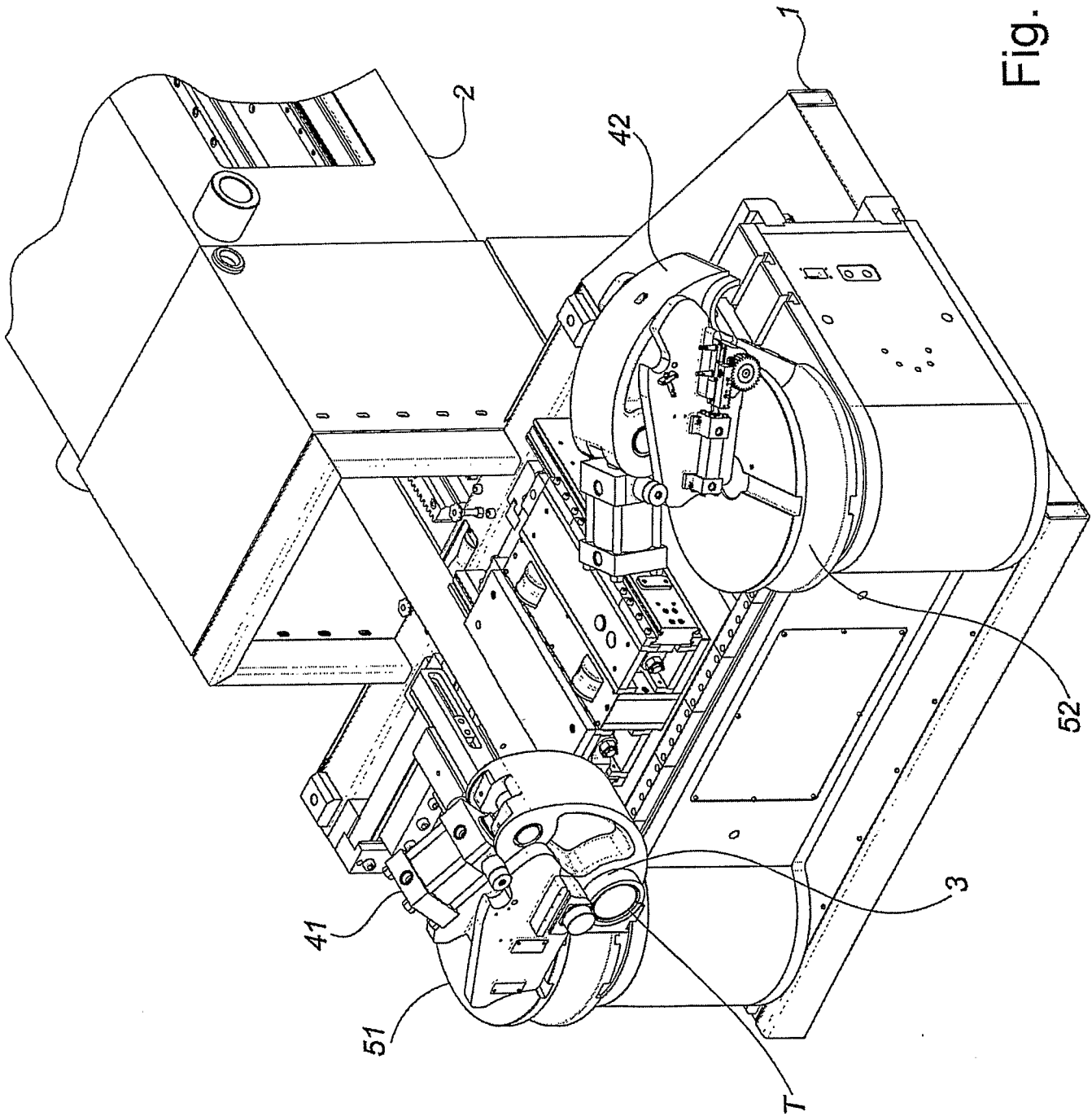


Fig. 1

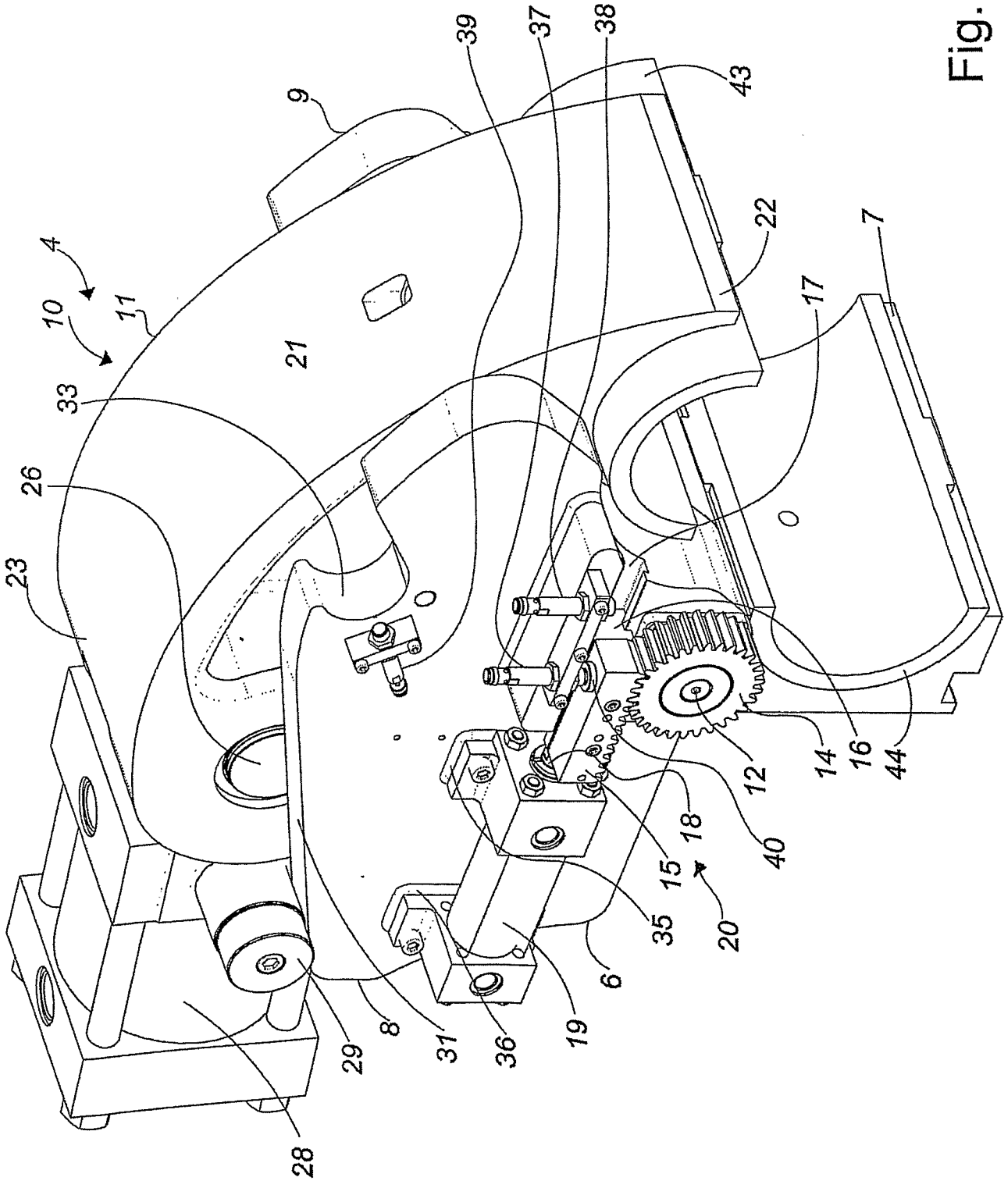


Fig. 2

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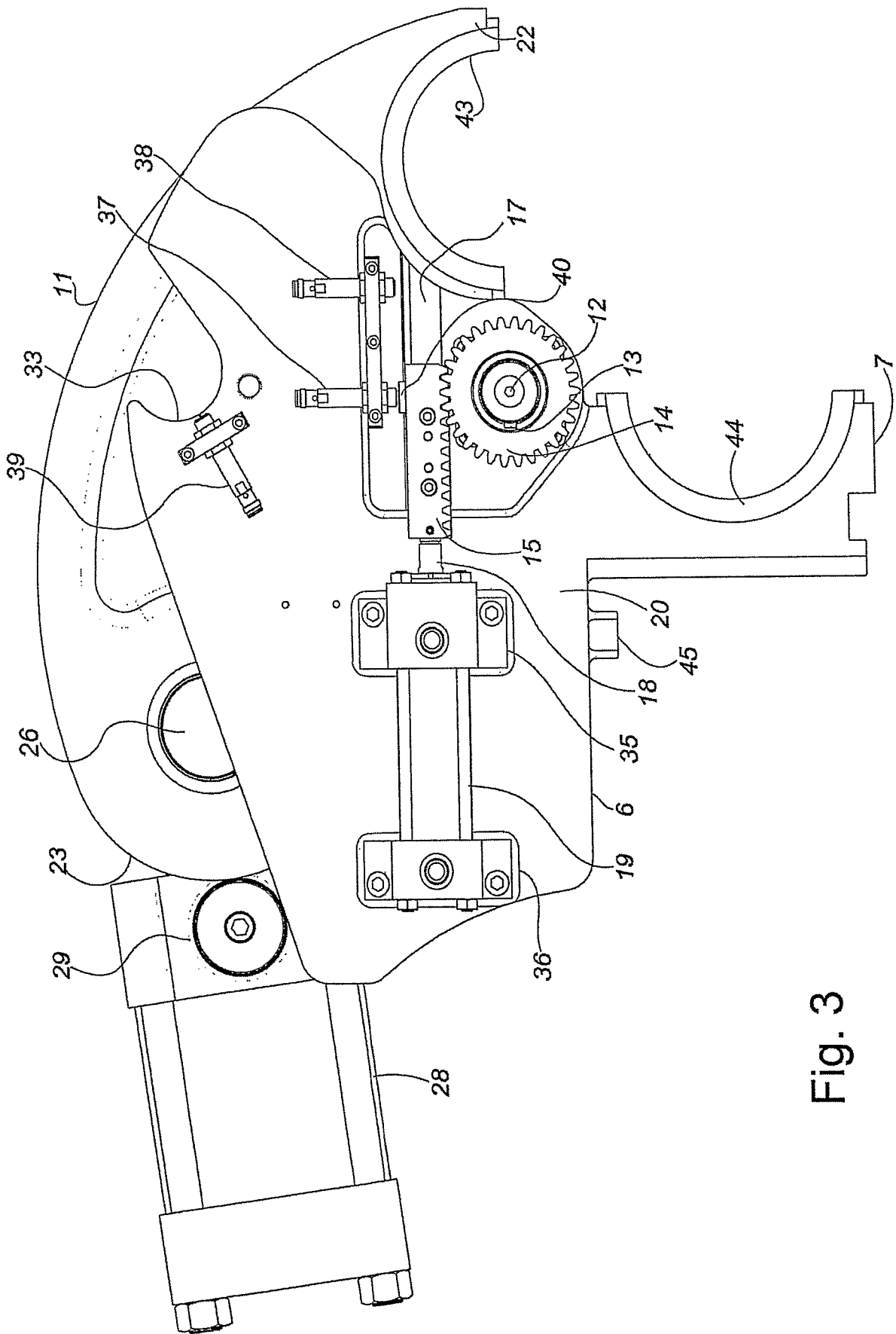


Fig. 3

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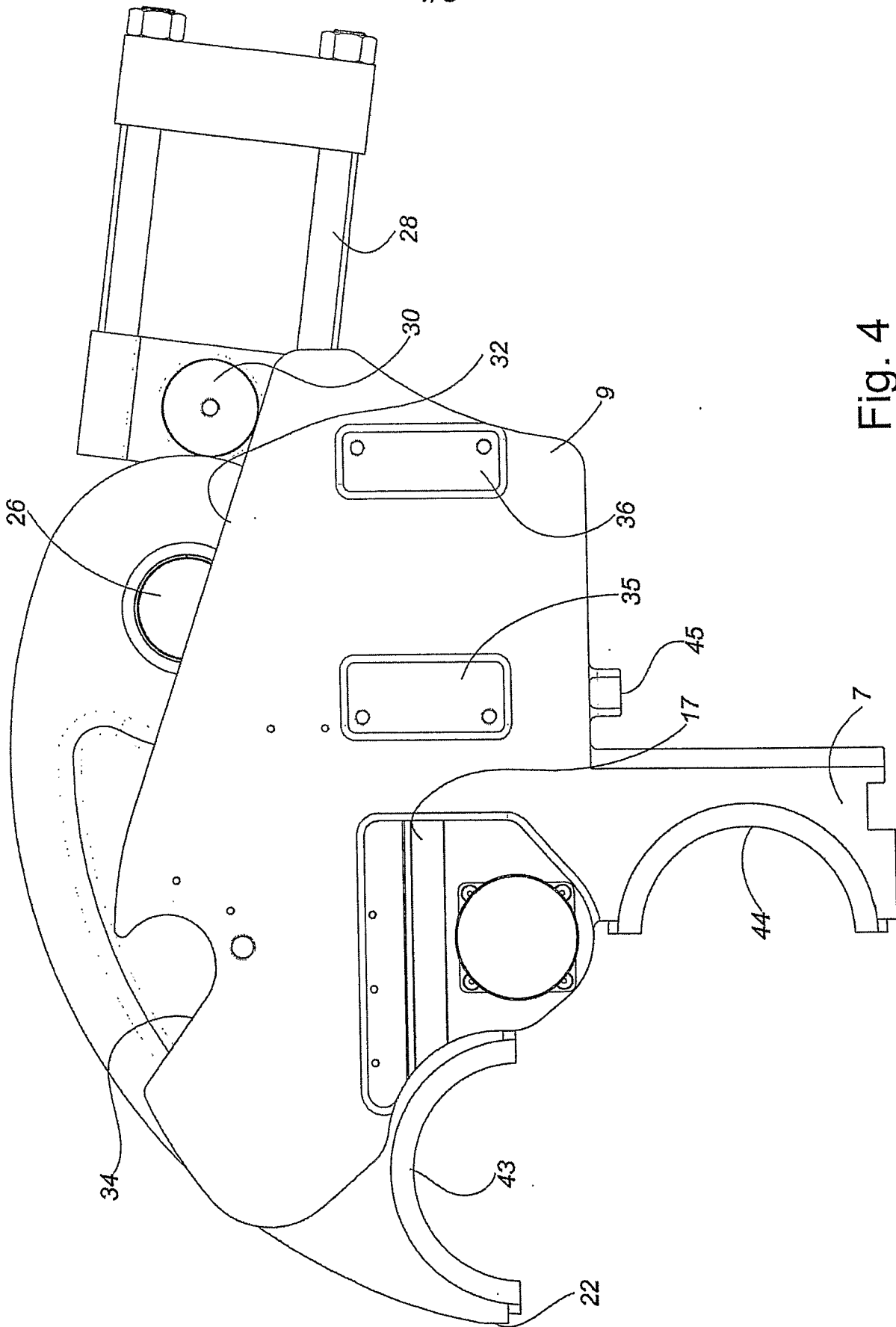


Fig. 4

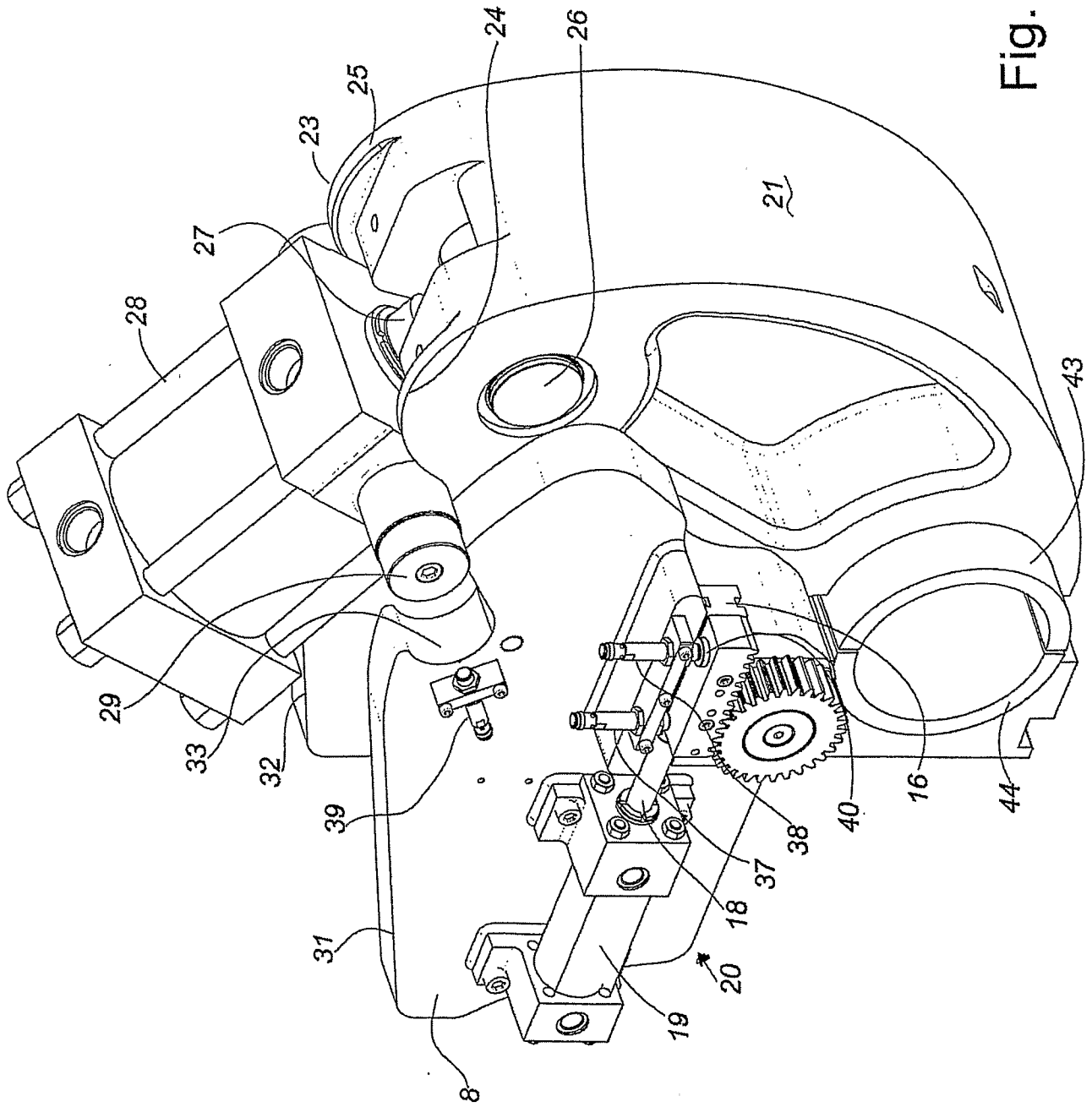
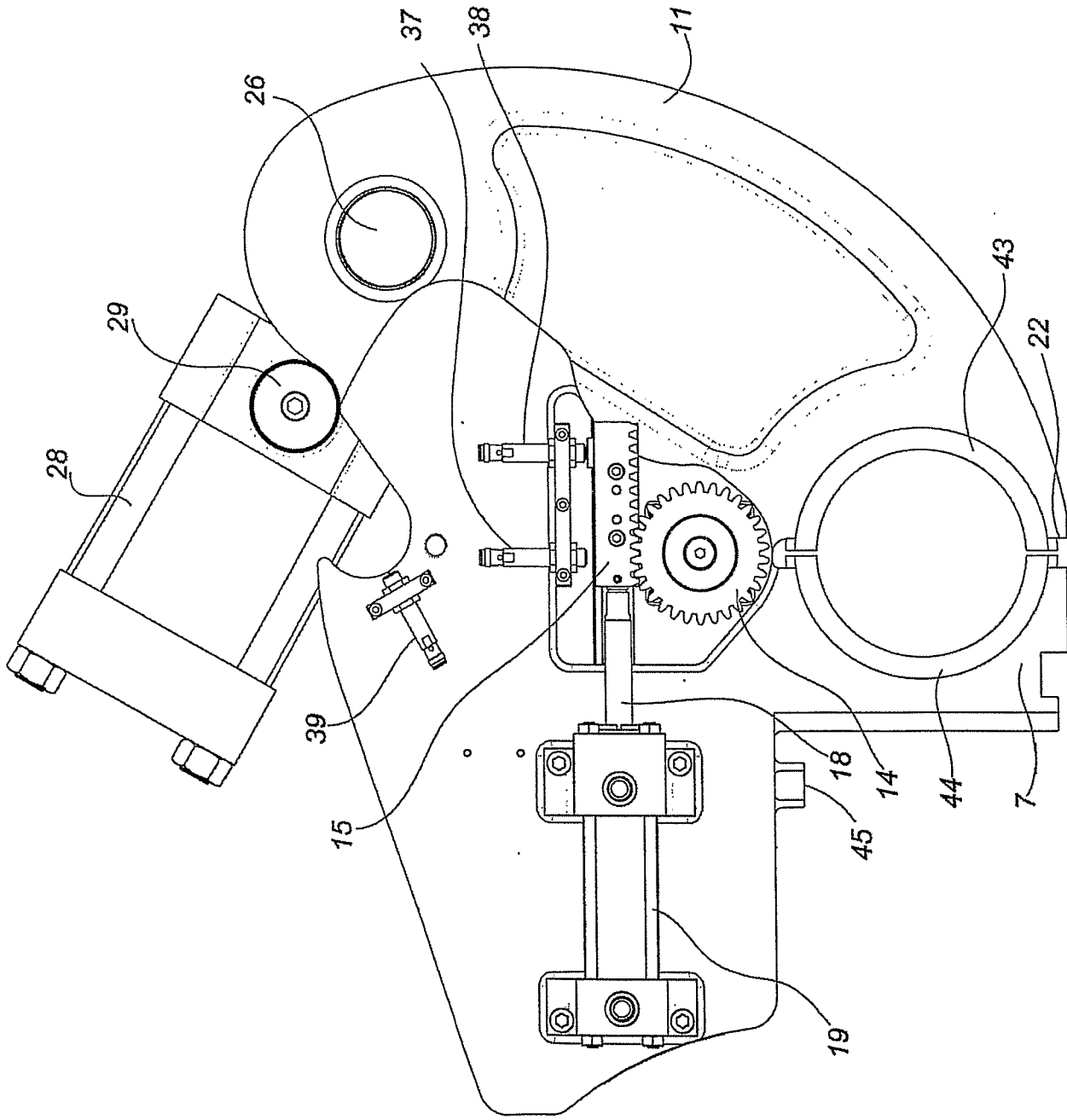


Fig. 5

Fig. 6



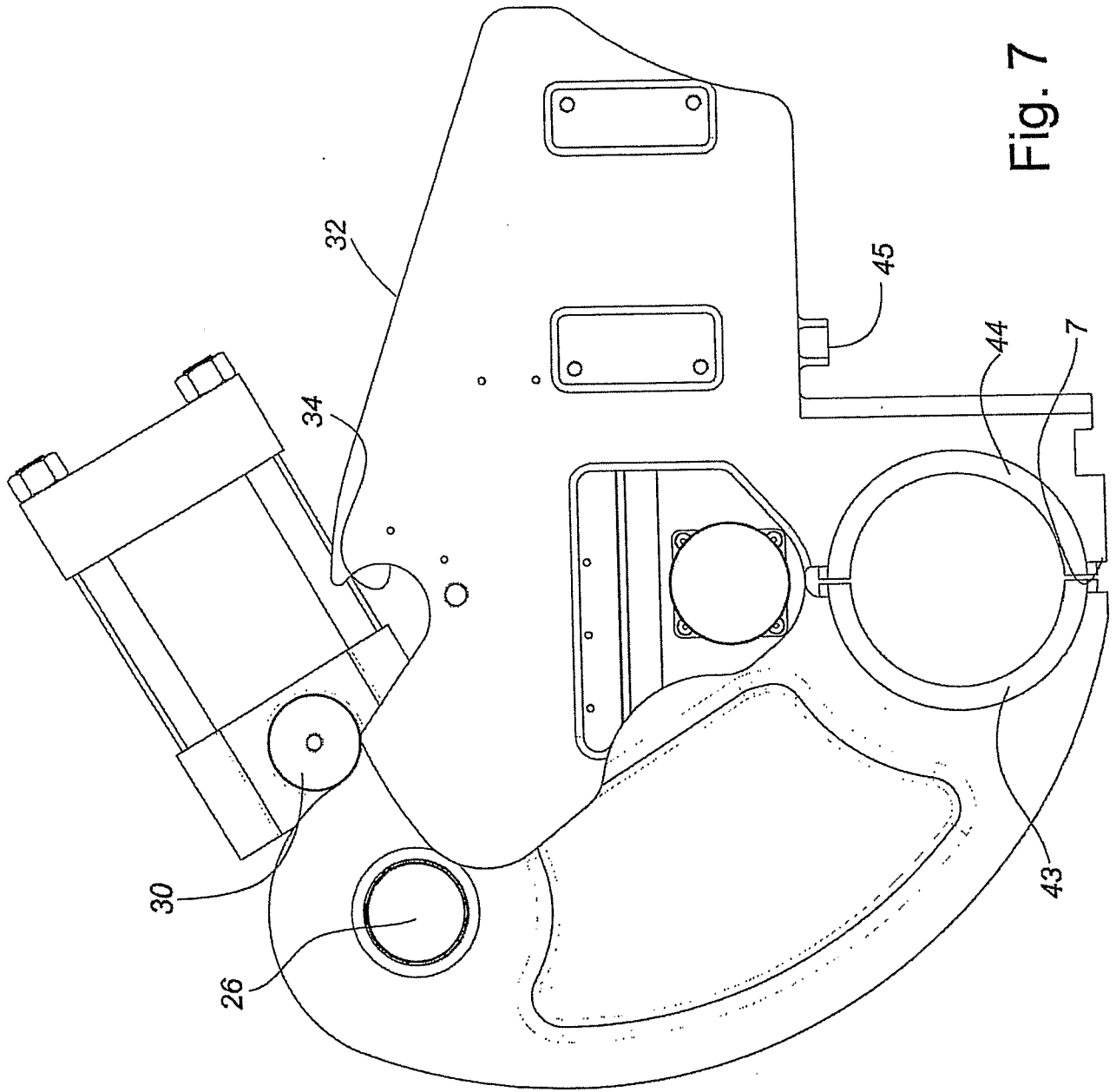


Fig. 7

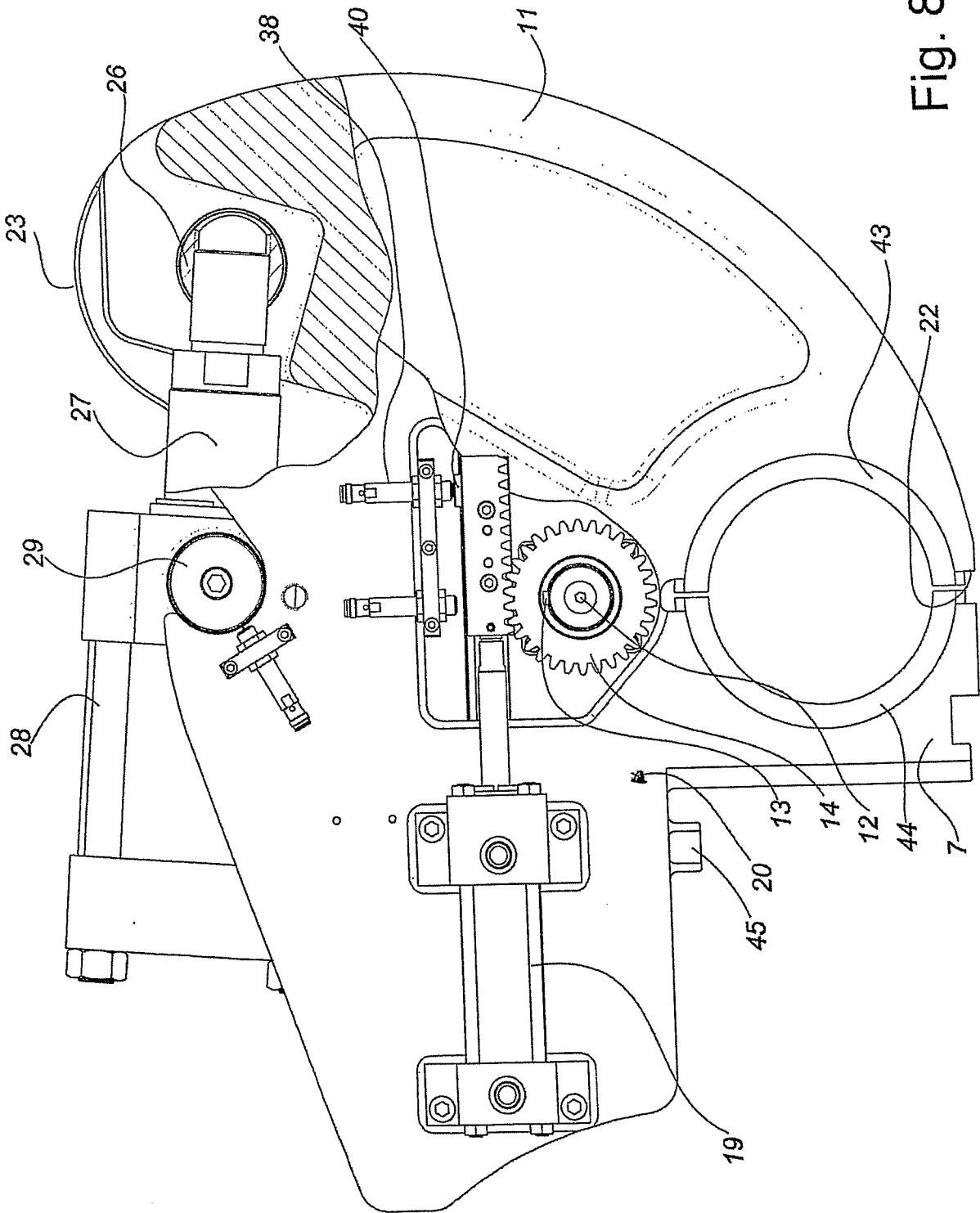


Fig. 8