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# (54) METHOD AND DEVICE FOR THE AUTOMATIC ANGULAR PHASING OF A SPINDLE IN AN EXTRUSION PRESS

(57) A method for the automatic angular timing of a mandrel (7) of an extrusion press (1) with respect to an extrusion die (4) placed in a container (3) containing a billet to be extruded, the mandrel (7) being carried by a support member (15) and being subject to the thrust of a drilling piston (9), said mandrel (7) rotating about its longitudinal axis through the rotation about a same axis of such support member (15) placed within a fixed body (6), the mandrel (7) having a free end or head (8) adapted to cooperate with the billet during the extrusion. A first slow rotation of the mandrel (7) is carried out to make a first timing with respect to the extrusion die (4), a sample extrusion is carried out and the resulting piece is checked, at least a one further controlled rotation at low mandrel speeds being carried out before implementing a subsequent extrusion.

The device for carrying out such method is also claimed.

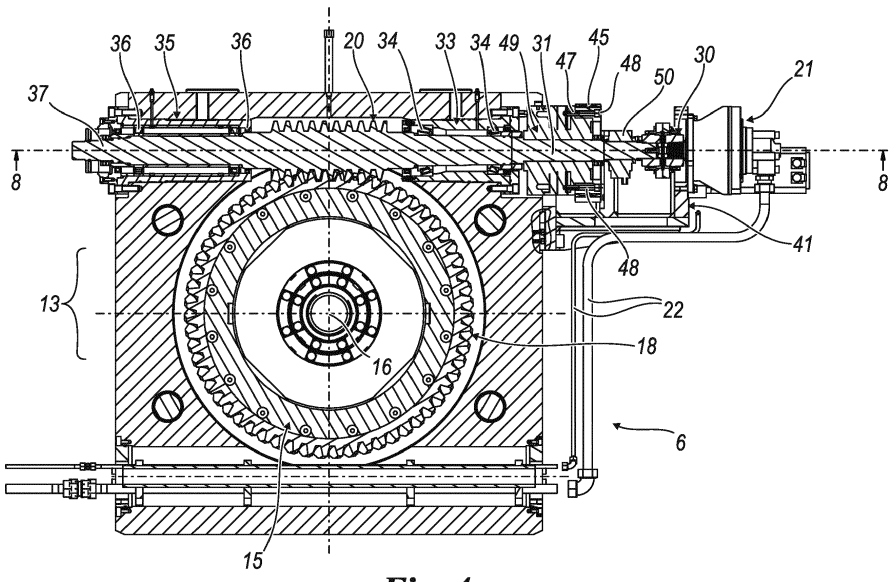


*Fig. 4*

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## Description

**[0001]** The objects of the present invention are a method and a device for automatically and angularly timing a mandrel of an extrusion press according to the preambles of the respective independent claims. The term "timing" or phasing means an angular alignment of the mandrel with an extrusion die of the press having a particular shape (polygonal or more complex) such as to allow the extrusion of an article (for example a section bar) having the desired cross-section, or shaped profile.

**[0002]** As is known, an extrusion press comprises a base on which a fixed structure is provided, comprising an extrusion die and a container (adapted to contain a metal billet, for example, aluminum) relative to which a mandrel moves, carried by a support member which is movable in a guided manner with respect to the base and subject to the thrust action of a drilling piston. The term "mandrel" or spindle identifies the actual mandrel (defined by a round rod) associated (by screwing) to a mandrel support rod coupled to the support member. The mandrel carries an end nose or head by screwing (adapted to cooperate directly with the billet).

**[0003]** In order to carry out an optimal extrusion process, the mandrel (and thus the member that supports it) must be able to maintain a correct angular position during the entire extrusion process or during the extrusion of a plurality of billets, for example aluminum. This is to prevent obtaining defective articles.

**[0004]** Since the mandrel head assembly consists of a series of components secured by threading, it is not possible to ensure that, after various extrusions, the mandrel is angularly and correctly timed with the die.

**[0005]** Therefore, there is the need to angularly time the mandrel with the extrusion die after at least several extrusions.

**[0006]** Currently, in order to obtain a correct angular position of the mandrel, one proceeds by operating manually on an element adapted to generate the rotation of the mandrel support and thus of the mandrel itself; this operation is carried out after the evaluation of the correct extrusion of an article and inside the press itself. This may cause problems related to safety for an operator performing such adjustment, and to the "environmental" conditions (high temperature) that the operator finds inside the extrusion machine or press.

**[0007]** More in particular, the mandrel support member usually comprises a toothed wheel in engagement with a worm screw actuated by a hydraulic motor that allows quick rotation thereof normally used for the lubrication of the mandrel.

**[0008]** The manual timing operation is carried out by acting directly on the worm screw using a specific tool or implement. This is because said hydraulic motor is not able to actuate rotations of few degrees of the mandrel support member (and thus of the mandrel itself). It is noted that the angular timing of the mandrel is essential for actuating a correct extrusion of products with shaped profile.

**[0009]** US 3 651 680 relates to a press having a device for adjusting the longitudinal and angular position of a mandrel thereof in order to center it with respect to an extrusion die associated with a container of a billet to be extruded; in particular, this angular adjustment is due when the extruded product (tube, usually metal) is not of circular section. This prior document describes a method for obtaining such angular adjustment which comprises a succession of steps which provide for the rotation of a mandrel support member, movable axially along a longitudinal axis, about said axis generated by an electric actuator on a worm screw functionally coupled with said support member. This adjustment is followed by an extrusion.

**[0010]** This prior art does not describe further steps after such extrusion and no angular micro-adjustment of the mandrel is provided after a first test extrusion.

**[0011]** US 4 399 676 describes a device for cleaning a mandrel of an extrusion press capable of automatically carrying out a cleaning operation of such press. The press comprises a usual mandrel adapted to cooperate with a billet placed in a container provided with an extrusion die.

**[0012]** The mandrel cooperates with a worm screw mechanism actuated by a hydraulic actuator adapted to set it in rotation about the longitudinal axis thereof. A grinder mechanism is provided to intervene on the end portion of the mandrel.

**[0013]** This document does not describe or suggest making any angular adjustment of the mandrel.

**[0014]** The object of the present invention is to provide a method and a device adapted to allow a precise angular timing of a mandrel with respect to an extruder die.

**[0015]** A further object is to provide a method and a device of the above type that allows obtaining said timing automatically and safely.

**[0016]** In particular, the object of the invention is to provide a device and a method of the above type that does not require access of an operator in the extrusion press for making such adjustment, thereby making the execution of this operation safer.

**[0017]** Another object is to provide a device of the above type which may be also associated with already operational extruders.

**[0018]** These and other objects which will be apparent to the man skilled in the art are achieved by a method and a device according to the accompanying claims.

**[0019]** For a better understanding of the present invention, the following drawings are attached by way of non-limiting example, in which:

figure 1 shows a longitudinal sectional view of an extrusion press provided with the device according to the invention;

figure 2 shows a perspective view of a part of the press in figure 1;

figure 3 shows top view of the part in figure 2;

figure 4 shows a sectional view according to line 4-4 in figure 3;
figure 5 shows a sectional view according to line 5-5 in figure 3;
figure 6 shows a perspective view from one side of a device according to the invention;
figure 7 shows a perspective view from another side of the device in figure 6;
figure 8 shows a sectional view according to line 8-8 in figure 4.

**[0020]** With reference to the above figures, an extruder machine or extrusion press 1 is shown in its entirety in figure 1 and comprises a base 2 that is associated with several known parts adapted to allow the extrusion of an aluminum (or other metal) billet, in particular comprising a container 3 where an extrusion die 4 is placed and integral to the base, a main axially movable cylinder 5, in which a member 15 moves both axially and rotationally, supporting a mandrel 7 provided with a head or nose 8 and attached at the other end 8A by screwing to the member 15. As will be described, the latter is subject to the axial moving action of a drilling piston 9 which moves it with respect to base 2. The extrusion die 4 has a hole or seat 10 adapted to receive nose 8 of mandrel 7 for the extrusion operation.

**[0021]** The support member 15 of mandrel 7 is associated with a body 6 having a part 13 attached to base 2 and a through hole 14 in which the support member 15 is placed to which end 8A of mandrel 7 is attached, screwed within a seat 16 of such member 15.

**[0022]** Member 15 is axially movable in the through hole 14 (i.e. along axis W of the latter coincident with the longitudinal axis of the drilling piston 9 and with the movement axis of mandrel 7, i.e. with the axis of extruder 1), but is torsionally integral with a peripheral toothed wheel 18 adapted to cooperate with a worm screw 20 actuated by a hydraulic motor 21 supplied by hydraulic lines 22 (see figure 4). The high speed rotation of screw 20 generated by motor 21 causes the rotation of the toothed wheel 18 and thus that of member 15 of body 6, said rotation being provided to lubricate mandrel 7.

**[0023]** The hydraulic motor, however, cannot be used to accurately angularly time mandrel 7 with respect to the extrusion die since such hydraulic motor by its nature is not able to slowly move the worm screw 20. In order to achieve this precise angular adjustment of member 15, and thus of mandrel 7 associated thereto, a device 26 according to the invention is provided.

**[0024]** More in particular, the hydraulic motor works, through a usual controllable coupling member or joint 30, with an output shaft 31 which defines the worm screw 20. Such shaft rotates within a first support 33, containing usual bearings 34, and within an end support 35 also containing bearings 36, on which a free end 37 of such shaft rotates.

**[0025]** Thus, the activation of the hydraulic motor 21, coupled through the coupling member (clutch) 30 to the output shaft 31 or to the worm screw 20 causes the rotation of the latter in a known manner. Supports 33 and 35 are integral to body 13 of mandrel 6.

**[0026]** As mentioned, in order to have a precise and fine angular adjustment of the angular position of mandrel 7 (obtained through the worm screw 20 and the toothed wheel 18), device 26 is provided. It comprises an electric motor 40 with gearbox 40A supported by a bracket 41 integral to part 13 of body 6, preferably the same bracket 41 supporting the hydraulic motor 21; such electric motor, for example of brushless type, to which a usual gearbox (not shown) is associated, controls an output shaft 43 on which a toothed wheel 44 is keyed which, preferably through a toothed belt 45 44 45 (but as an alternative also through direct coupling or other equivalent intermediate transmission member), cooperates with a pulley 47 attached by screws 48 to a toothed fitting 49 torsionally and detachably connectable to shaft 31. An encoder 50 (or equivalent measuring member) is also placed on the latter.

**[0027]** The toothed fitting 49 (or equivalent detachable mechanical coupling member) preferably is of electric type so that it can be easily controlled. Its function is to release the electric motor 40 from shaft 41 when the hydraulic motor 21 is actuated.

**[0028]** During the step of adjustment or angular timing of mandrel 7 with die 4, following the installation of a new mandrel or mandrel head 8 in the press, one proceeds as follows. A first rotation of such mandrel 7 is first carried out at low speed by actuating the electric motor 40 which sets member 15 in rotation through the cooperation of the worm screw 20 with the toothed wheel or gearing 18. During this adjustment, the toothed fitting 49 is in such position as to connect the electric motor 40 to shaft 31. The rotation of the latter generated by motor 40 is controlled by encoder 50.

**[0029]** A first extrusion is carried out and one checks whether the outcome has the desired shape, i.e. if there is conformity with a sample article (either manufactured or only designed). If this is not obtained (that is, if such conformity is not found), a further low-speed rotation of member 15 is carried out (in the manner described above, i.e. through the actuation of the electric motor 40) so as to have a micro-adjustment of the angular position of the mandrel. It is possible to have adjustments of tenths of a degree (e.g. 0.15°).

**[0030]** It is then possible to proceed to one or more extrusions and optionally proceed to a new angular timing after performing a fast rotation (via hydraulic motor 21) of mandrel 7. Even in this case, the angular micro-correction is obtained through device 26 by connecting fitting 49 to shaft 31, activating the electric motor 40 which, through its own gearbox and the connection between toothed gearings or pulleys 44 and 47, sets shaft 31 in slow rotation. The rotation of the latter is still controlled by encoder 50. Of course, the encoder and motors 21 and 40 are controlled by a single control unit through which an operator, even (relatively) distant from extruder

1 can obtain the desired adjustment.

**[0031]** Once said micro-adjustment has been carried out, the desired angular positioning of mandrel 7 is obtained again and one can proceed to one or more extrusion operations.

**[0032]** The invention therefore allows obtaining, in a safe manner, a precise "angular timing" of the end or nose of mandrel 7 (by adjusting the angular position of member 15 about axis W) with respect to the extrusion die 4, moving said end 8 to such a position as to obtain the extruded piece according to the desired features.

**[0033]** The invention allows obtaining such adjustment without intervening within machine 1, with obvious advantages for the operator.

**[0034]** A specific embodiment of the invention has been described. However, others can be inferred from the above description and are therefore to be deemed as falling within the scope of the following claims.

## Claims

1. Method for the automatic angular timing of a mandrel (7) of an extrusion press (1) with respect to an extruder die (4) of such extruder (1), such die being associated to a container (3) of a metal billet to be extruded, said mandrel (7) being carried by a support member (15) axially movable along a longitudinal axis (W) of the extruder towards the extrusion die (4), said support member (15) being rotatable about such longitudinal axis (W) and being moved by a hydraulic actuator (21) operating on a worm screw (20) functionally coupled to said member (15), wherein in a first step, a slow rotation of said member (15) and of the mandrel (7) associated thereto is carried out through the action of an electric actuator (40) on said worm screw (20), in a second step, said support member (15) and the mandrel (7) are axially moved along said longitudinal axis (W) so as to have an extrusion of an article, in a third step, a check of the article is carried out to check the conformity thereof to a desired article, and if such conformity is not found, a in a fourth step, a further slow rotation of said member (15) and mandrel (7) is carried out through the action of said electric actuator (40) on said worm screw (20) in order to have a micro-adjustment of the angular position of the mandrel.

2. Method according to claim 1, **characterized in that** the electric actuator (40) operates on a same rotatable member (31) actuated by the hydraulic actuator (21) adapted to rotate the support member (15) of the mandrel (7), said electric actuator (40) being separated from said hydraulic actuator (21) when the latter is set in action.

3. Method according to claim 2, **characterized in that** said rotatable member (31) is a shaft having a portion acting as worm screw (20), the latter being adapted to cooperate with a toothed gearing (18) integral with said support member (15).

4. Method according to claim 1, **characterized in that** the actuation of the hydraulic actuator (21) and of the electric actuator (40) is controlled remotely through an external control unit of the extruder (1).

5. Method according to claim 1, **characterized in that** said micro-adjustment of the angular position is of the order of tenths of a degree.

6. Device for adjusting the angular position of a mandrel (7) of an extruder (1) with respect to an extrusion die (4) of said extruder (1), such die being associated with a container (3) of a metal billet to be extruded, said mandrel (7) being carried by a support member (15) axially movable along a longitudinal axis (W) of the extruder towards the extrusion die (4), said support member (15) peripherally carrying a toothed wheel or gearing (18) adapted to cooperate with a worm screw (20) part of a shaft (31) set in rotation by a hydraulic actuator (21), the rotation of said shaft (31) and of the worm screw (20) setting in rotation said support member (15) about said longitudinal axis (W), **characterized in that** an electric motor (40) is provided, adapted to cooperate with said shaft (31) adapted to allow a fine adjustment of the angular position of the mandrel (7) with respect to the extrusion die (4).

7. Device according to claim 6, **characterized in that** said electric motor (40) is associated with a gearbox, a toothed wheel or gearing (44) being keyed on an output shaft (43) of said electric motor (40), said toothed gearing being adapted to cooperate with another toothed gearing (47) integral with a member (49) which can be fitted on said shaft (31) to transfer the rotary motion, generated by the electric motor (40) on said output shaft (43), to said shaft (31) having the worm screw (20).

8. Device according to claim 7, **characterized in that** the toothed gearing (44) placed on the output shaft (43) of the electric motor (40) is connected to the other toothed gearing (47) integral with the fittable member (49) alternately through a belt or other equivalent transmission member or directly.

9. Device according to claim 6, **characterized in that** it comprises a measuring element (50) of the angle of rotation of the shaft (31) having the worm screw (20) and placed directly on said shaft, said measuring element (50) controlling the rotation of said shaft generated by the electric motor (40), said measuring element being preferably an encoder (50).

**10.** Device according to claim 6, **characterized in that** said electric motor (40) is separated from the shaft (31) having the worm screw (20) when it is moved the hydraulic actuator.

**11.** Device according to claim 6, **characterized in that** it comprises a control unit which controls and monitors the actuation of the electric motor (40) and of the hydraulic actuator in order to adjust the angular position of the mandrel (7), said unit being distant from said mandrel (7);

**12.** Device according to claim 6, **characterized in that** the electric motor (40) and the hydraulic actuator (21) are carried by the same support (41) integral with the mandrel (7).

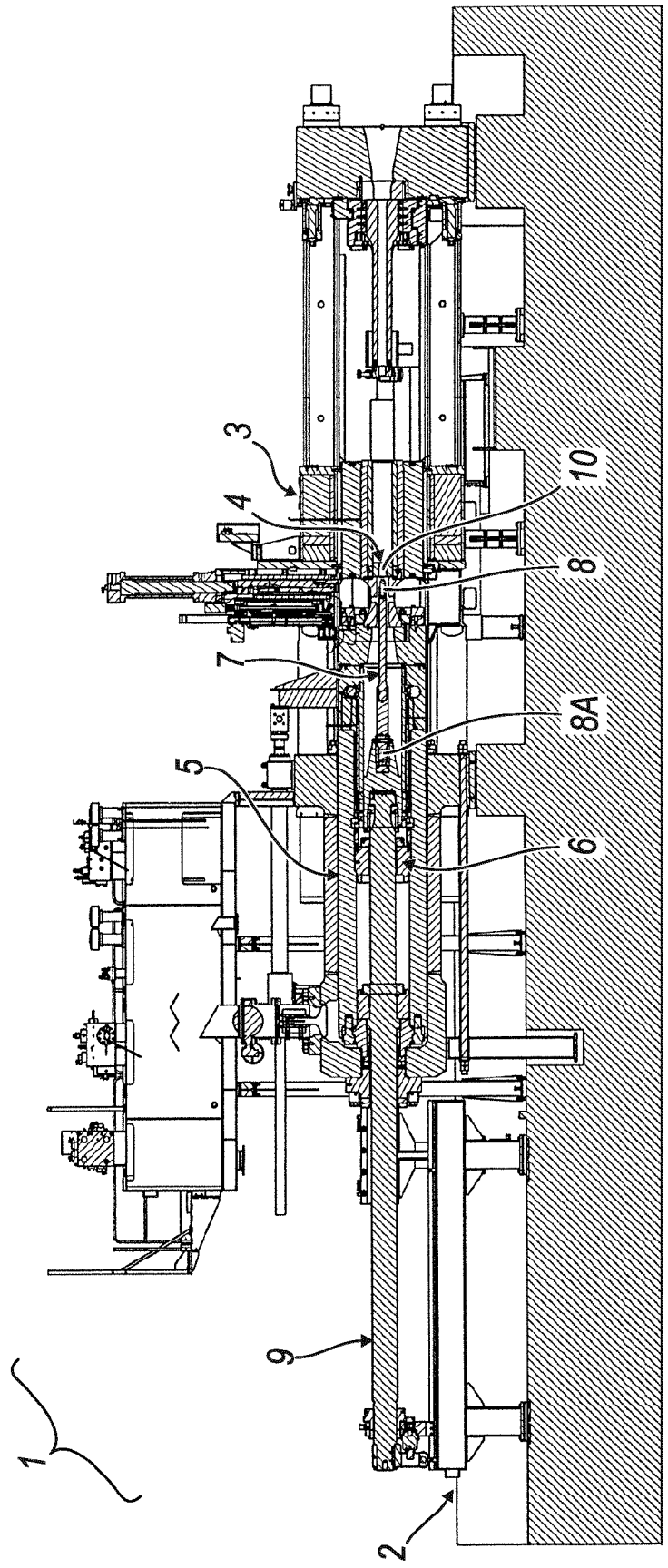


*Fig. 1*

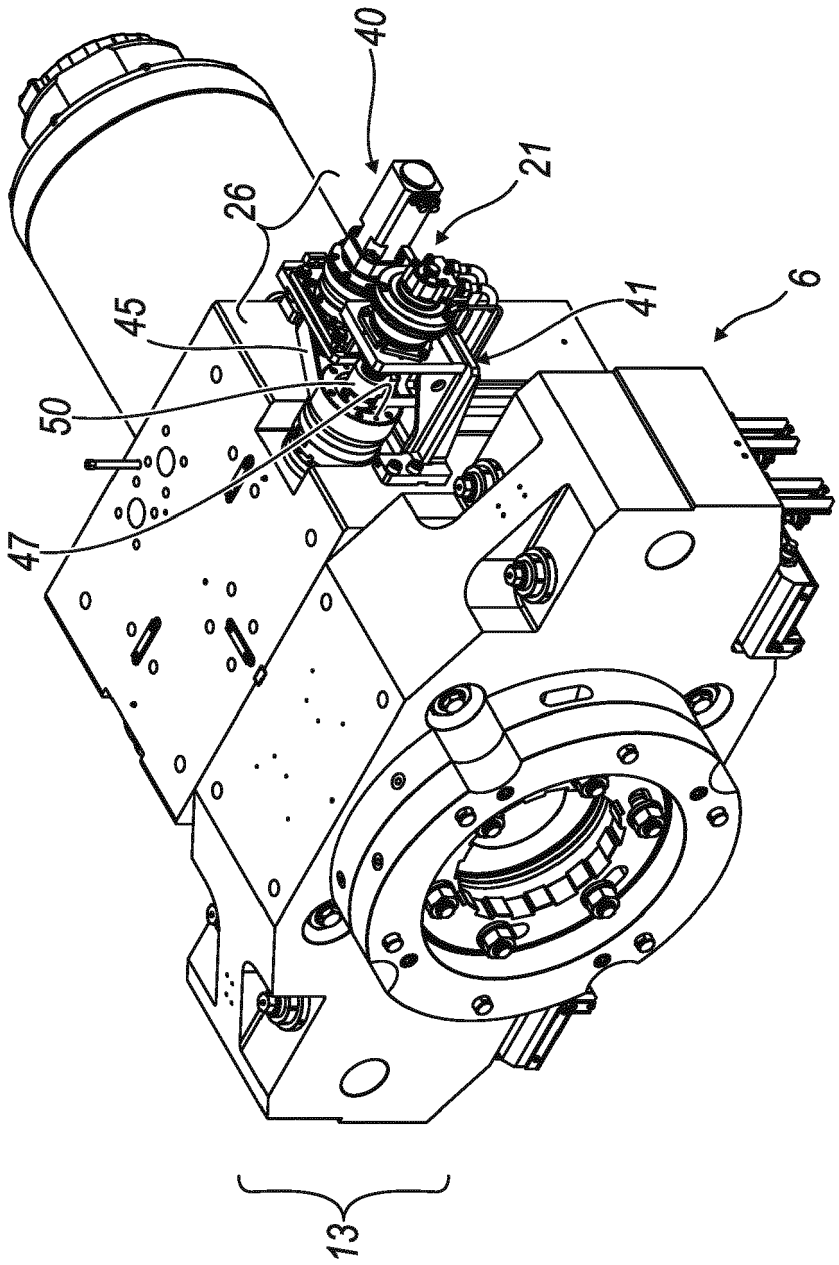


*Fig. 2*

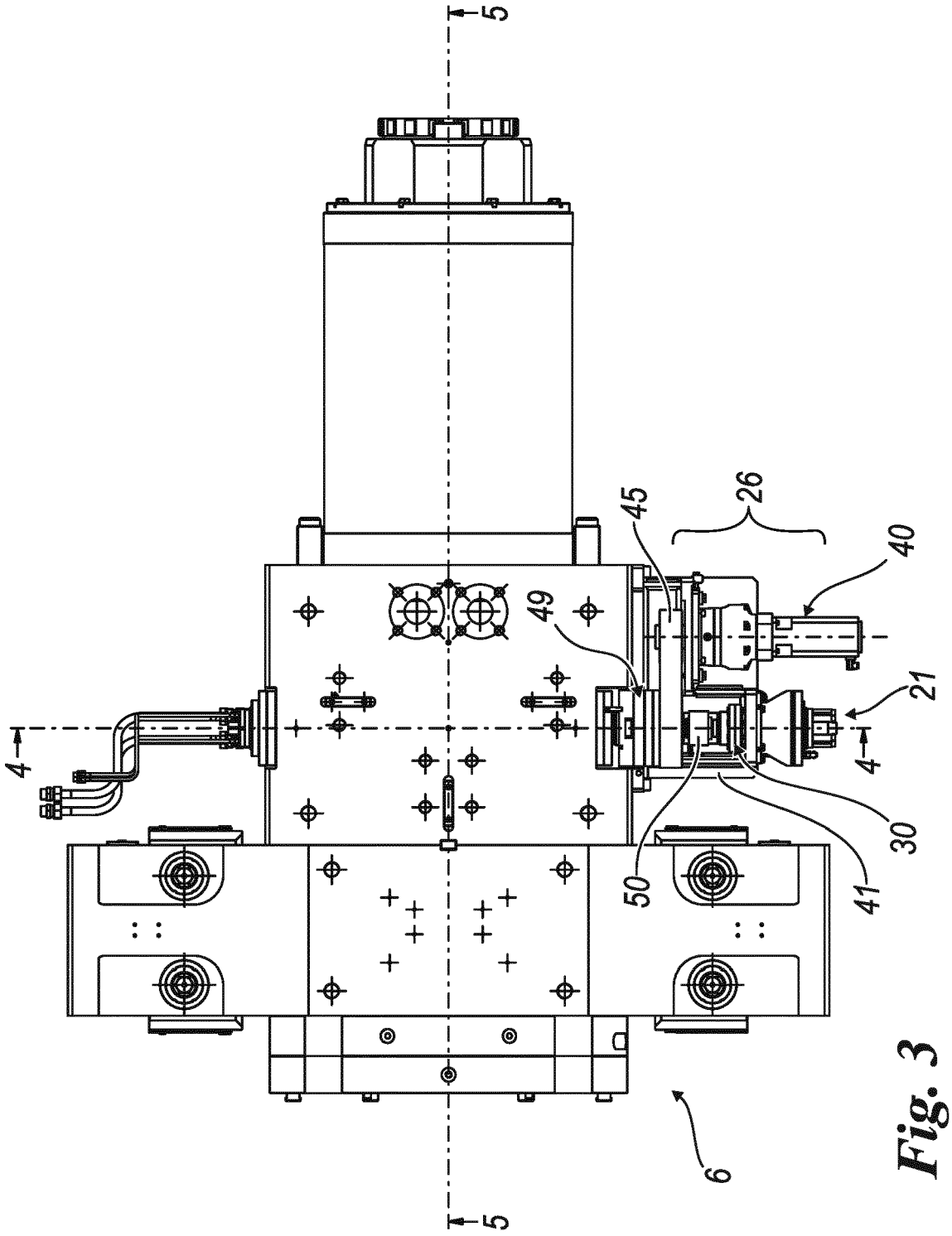


*Fig. 3*

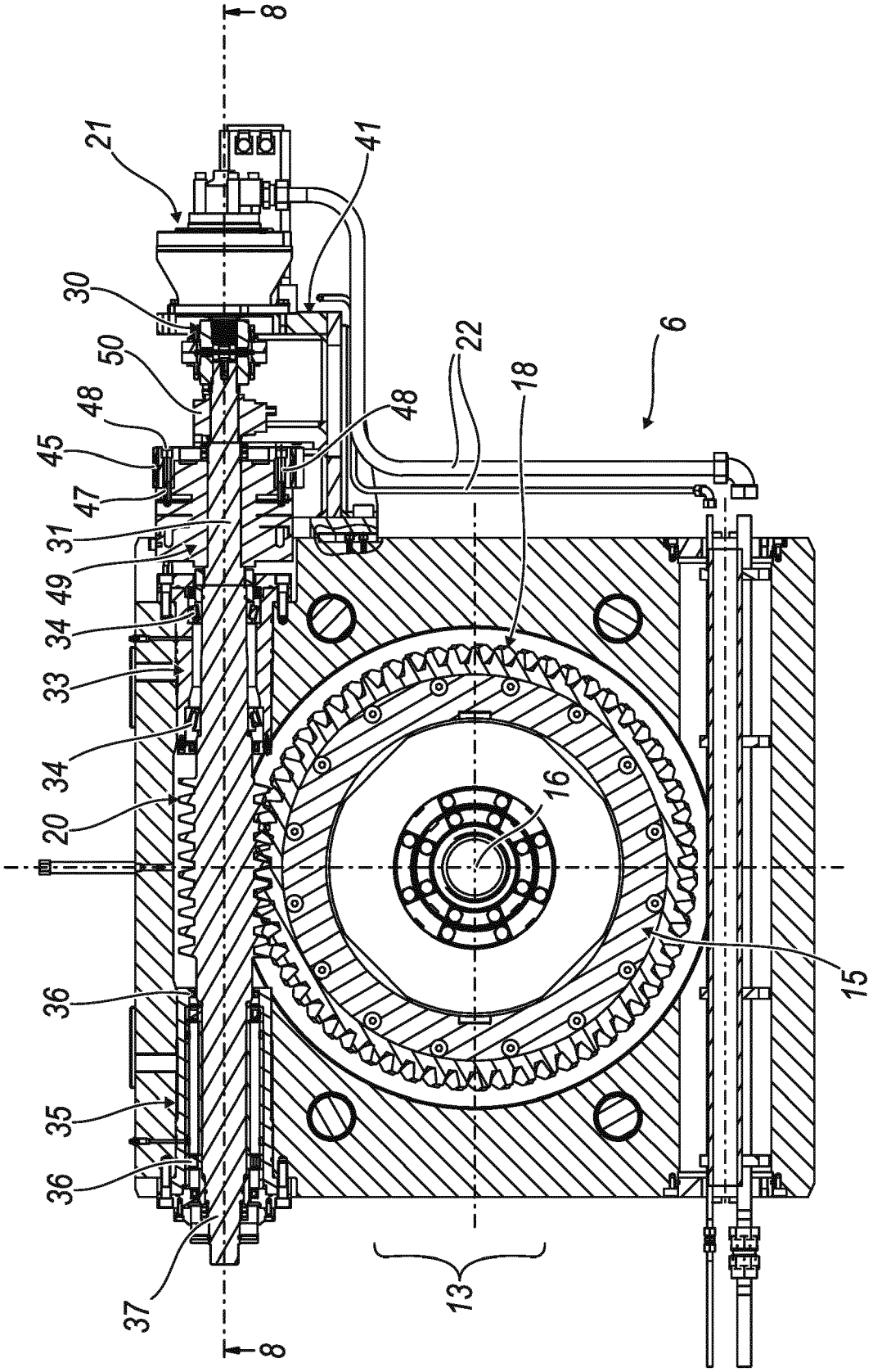


*Fig. 4*

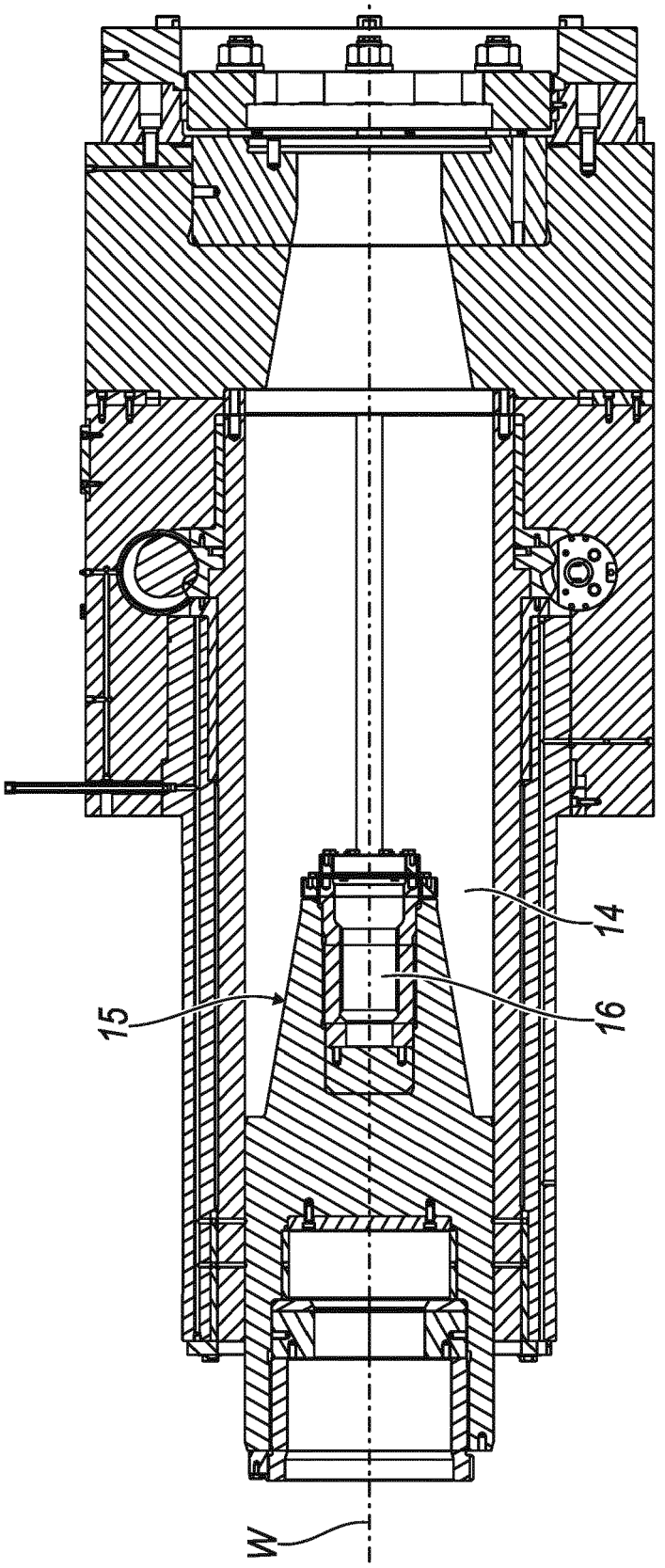


*Fig. 5*

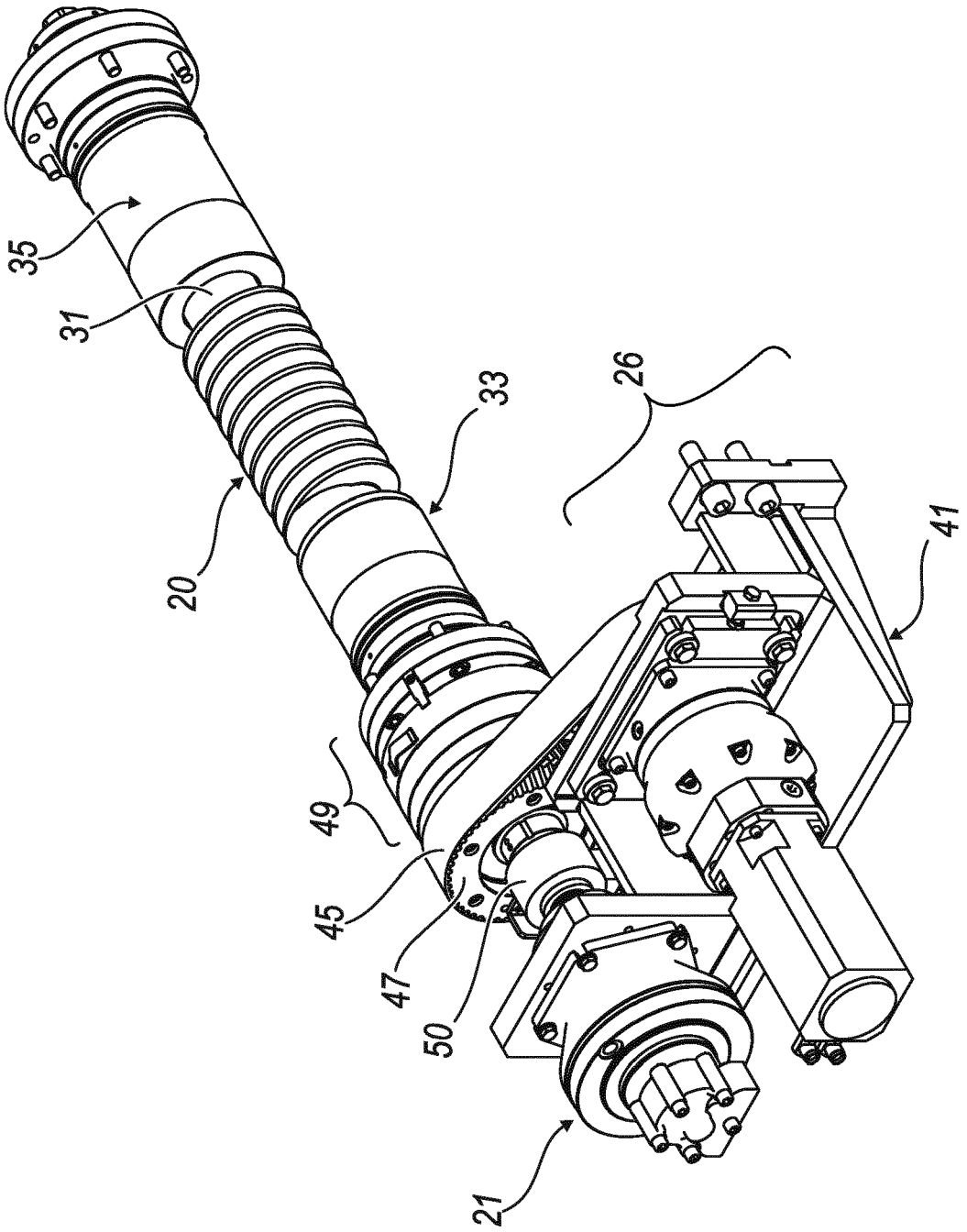


*Fig. 6*

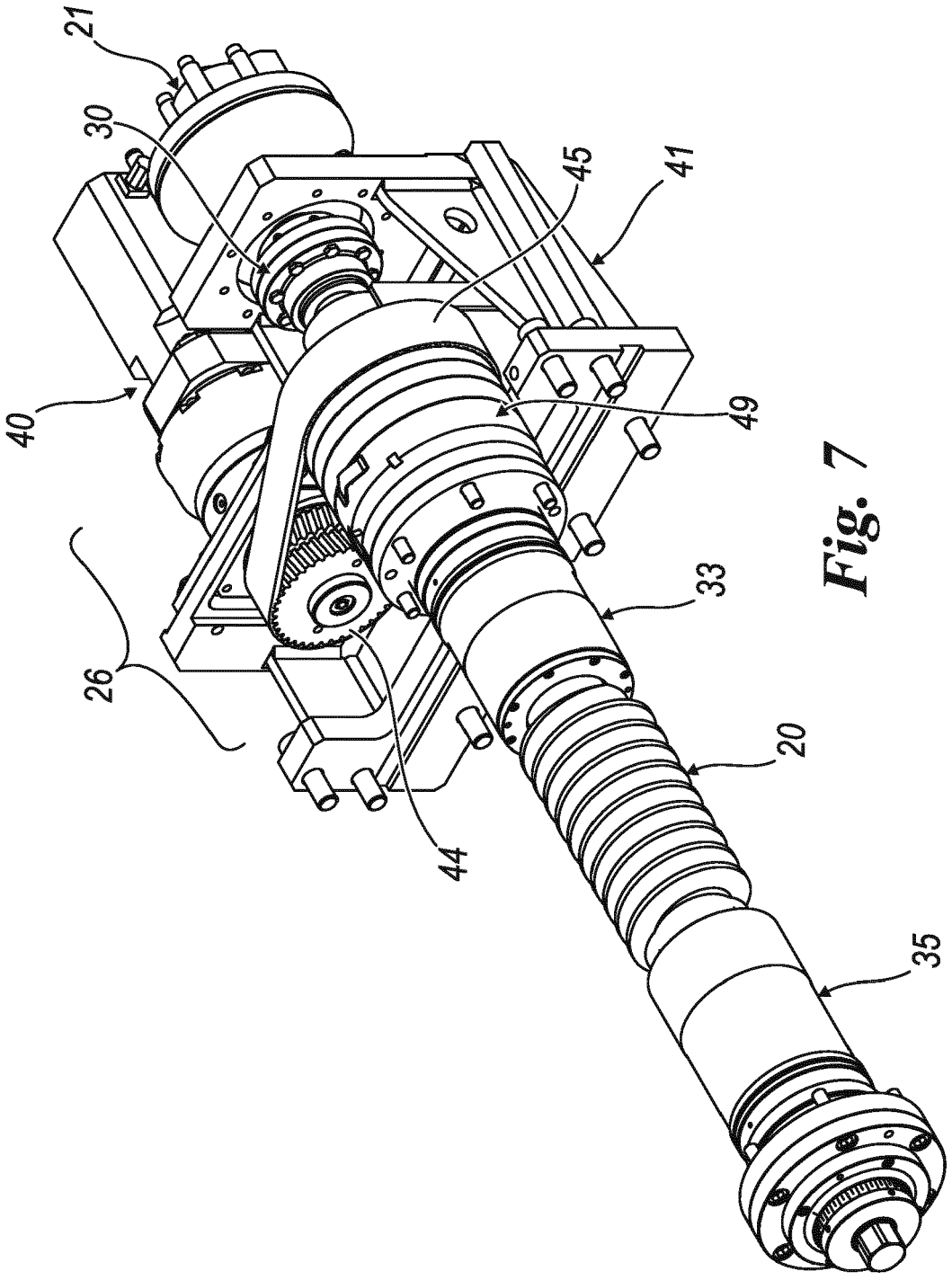


Fig. 7

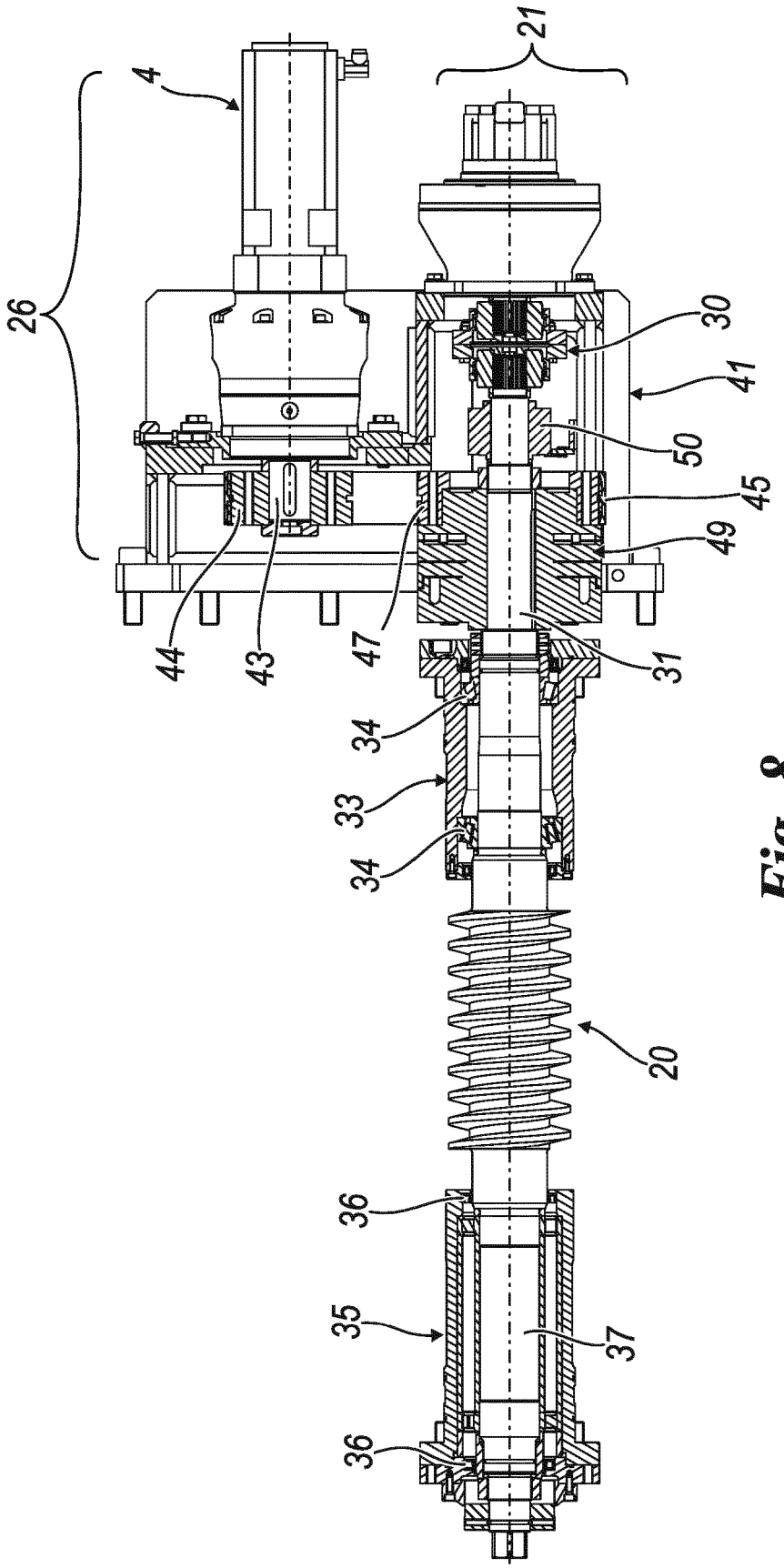


*Fig. 8*

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Application Number
EP 16 17 9045

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 28 November 2016 | Charvet, Pierre |

CATEGORY OF CITED DOCUMENTS

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