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(54) Front structure of a railway electric locomotive with a retractable door for the access to the automatic coupler

(57) A front structure of a locomotive comprising a fixed part (1) on which an opening (1a) is formed and a movable door (2) pivotally connected to said fixed part and axially translatable within it, so that the door can be arranged in a closure position and in an open position rotated of about 90° with respect to said closing position and recessed inside the front structure. The door (2) is housed in said opening (1a) and is connected to actuating means (9, 11) integral with the fixed portion for transmitting it an axial translational motion to displace it from said closure position to an intermediate backwards position. Elastic means (8) are provided extending from said fixed position and eccentrically forcing against the door to keep it in the intermediate backwards position. The door is pivotally suspended to a frame (4) hinged to the fixed portion (1), the actuating means (9, 11) comprising connecting rod means (11) connected to the frame (4) and to a crank mechanism (9) operable from the outside of the structure.

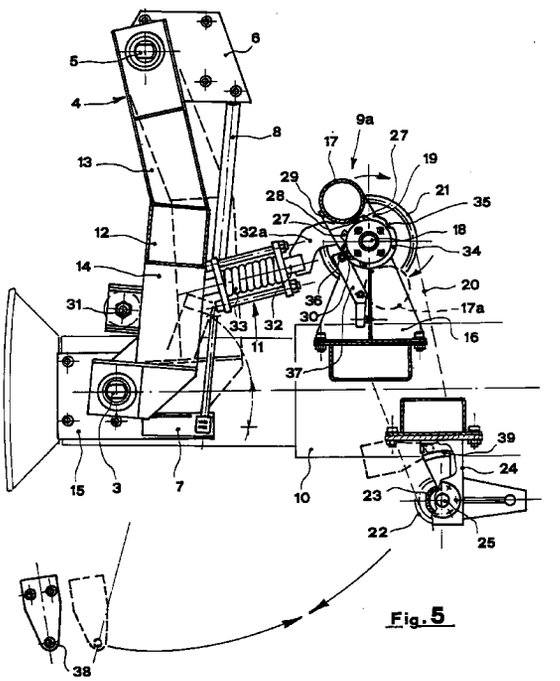

Fig. 5

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Description

The present invention relates to a front structure of a railway electric locomotive with a retractable door for the access to the automatic coupler.

The automatic coupling device located in the front side of modern railway locomotives must be housed inside the front structure on account of aerodynamic and aesthetic reasons. However, such coupling must be easily and rapidly accessible to allow the various manoeuvres of the locomotive to be performed. All the known systems provide the presence of a front door with single or double mobile panels which is opened when the access to the automatic coupler is required. In such an occasion, the door or its mobile panels keep on being opened and protruding, even during running. In some cases, in consequence of the shape of the front side of the locomotive, it is impossible to make doors which also allow both the lodging of and the access to the buffers, and alternative technical solutions to carry out the same function must be designed. Furthermore, the presence of front doors very often breaks off the aesthetic continuity of the front structure of the locomotive and causes undesired limitations to its configuration.

It is an object of the present invention to provide a front structure of a railway locomotive suitable to accomodate the automatic coupler so that it is not normally in view and to make it accessible by means of a a simple manoeuvre, when necessary.

A particular object of the present invention is to provide a new front structure of a locomotive of the type described above comprising a door suitable to be kept in a opened and a closed position, and equipped with a displacement device for guiding its movement from one position to the other using the manual action of an operator.

Another object of the present invention is to provide a front structure of a locomotive of the type described above in which the opening and the closing manouvres of the door can be carried out without requiring excessive manual effort and without involving dangerous situations for the operator.

A further object of the present invention is to provide a front structure of a locomotive of the type described above in which the displacement device is suitable to withstand mechanical and aerodynamic loads caused by train motion both with closed door as well as open door.

These results are achieved with the front structure for locomotives according to the present invention whose characteristic consists in that it comprises a movable door pivotally connected to said structure and translatable within said structure so that it can be arranged in a closed position and in a open position angularly spaced of about 90° with respect to said closed position and retracted inside said structure.

In the preferred embodiment of the invention a door displacement unit is provided for transmitting to the door a substantially translational motion inside the structure along the longitudinal axis of the locomotive, whereas the rotatory motion of the door is manually performed by the operator against the resistance of elastic means which tend to keep the door in the closed position.

In particular, the door is hingedly suspended from the fixed part of the structure and is slidingly mounted, along the edges of the front opening, to achieve its axial translational motion.

Further characteristics and advantages of the front structure of the locomotive according to the present invention will become more apparent in the following description of one of its possible embodiments, given as an example and not limitative, with reference to the attached drawings in which:

- figures 1, 2 and 3 are schematic side views of the front structure of a locomotive according to the invention in which the movable door is respectively in a closed position, an internally translated position, and an opened position;
- figure 4 is a plan view of a side of the front structure of the locomotive according to the present invention;
- figure 5 is a sectional side view according to arrows V-V of figure 6;
- figures 6 and 7 show in partially sectional front views of the right and the left side respectively of the front structure of the locomotive according to the present invention.

With reference to figure 1, there has been indicated at 1 an outline of the fixed front part of a railway locomotive on which an opening 1a is formed, and at 2 a movable front part, thereof hereinafter called "nose". The movable front part or nose 2 has such a shape that it can be accomodated without discontinuity within opening 1a and is pivotally connected at 3, to a floating frame 4 hinged at 5 to an anchor plate 6 integral with fixed front part 1 of the locomotive. An arm 7, integral with nose 2, is connected to plate 6 by elastic means 8 urging against arm 7.

Sideways floating frame 4 a nose displacement unit is provided, generally indicated at 9, fixed to the body of buffers 10, which are mounted on the end sill (not shown) of the locomotive. The displacement unit 9 is connected to the floating frame 4 by connecting rod means 11.

As described in more detail in figures 4 and 5, floating frame 4 has light metal box-shaped construction and comprises an extruded tubular cross bar 12 with square section and side-arms 13 and 14 which extend upwardly and respectively downwardly from the two ends of the cross bar 12. The upper side-arms 13, which lean forward with respect to the alignment axis with the lower side-arms 14, are connected by means of pivots 5 to the respective plates 6, which are fitted in the composite material of the front of the locomotive, whereas the lower side-arms 14 are connected to plates

15 which are fixed to the sides of nose 2 by means of pivots 3. From plates 15 arms 7 extend in a substantially axial direction, which are connected to the respective plates 6 by means of elastic means 8, made up in particular by air springs.

As shown in figures 4 and 5, the displacement unit 9 comprises two crank mechanisms 9a and 9b located near the sides of the front part 1 and fixed connected to buffers 10 by means of supports 16 integral with them. Crank mechanisms 9a, b are connected to each other by means of a driven shaft 17, extending crosswise with respect to the locomotive, in order to assure the synchronism of their movements. Shaft 17 is oversized to such an extent as to have both high stiffness as well as reduced weight.

A drive shaft 18 extends parallel to driven shaft 17 and comprises a tubular central part 18a and two end parts 18b made out from a solid bar, which engage with support 16 and on which gear wheels 21 of a chain transmission 20 are keyed. Chain 20 engages with a second gear wheel 22, keyed on a small actuating shaft 23. From the ends of driven shaft 17 two radial plates extend which act as rotating arms 19 for drive shaft 18 with respect to the fixed part.

Small actuating shaft 23 is mounted on a support 24 integral with buffers 10. At the ends of tubular part 18a of drive shaft 18 flanges are provided each of them bearing protrusions 27 within which a corresponding radial tooth 28 extending from driven shaft 17 is engaged. This connection between drive shaft 18 and driven shaft 17 assures the transmission of the rotation between the two shafts and a certain clearance (in particular about 30°) between them, whose function will be explained hereinafter.

For each end of drive shaft 18 a chain transmission 20 and a respective small actuating shaft 23 are provided. At the end of each small actuating shaft 23 a small opening 25 is provided on both sides of the locomotive so that a drive key 26 can be inserted by the operator. Such key presents a reference tooth 26a, in correspondance to a notch, not shown, formed on a matching jig 25a before the fixed small opening 25, so that key 26 can neither be inserted nor extracted unless nose 2 is wholly closed or wholly open.

Arms 29 extend radially and rigidly close to the ends of driven shaft 17, and connecting rod means 11 engage on such arms. Each arm 29 comprises, as shown in figure 6, a pair of plates welded to driven shaft 17 and an articulated joint 30 for the respective connecting rod is provided at the end thereof. Each connecting rod 11 is connected, with the other end, to lower sidearms 14 of floating frame 4 by means of a joint 31 and comprises a strut 32 with a C-shaped lenght 32a to avoid interference with drive shaft 18 during the motion of the connecting rod, and a coil-spring mechanism 33 which assures the extensibility of the strut itself. In such a way it is possible to face small assembling defects which would otherwise cause damages.

By operating small actuating shaft 23, as will be said next, driven shaft 17 moves from a position situated over drive shaft 18 and illustrated full-line in figure 5 towards the position, substantially overturned, illustrated in dotted line and indicated at 17a in the same figure. The angular displacement of the shaft 17 is equivalent to 190° to be at least 5° beyond the dead centers at the ends of the displacement, assuring this way the irreversibility of the motion. Anyway, for further safety a cam-roll mechanism is provided (see figure 5) comprising a disk 34 integral with drive shaft 18 with two notches 35 along its edge which are spaced along the circumference of 190°. Inside the notches 35 a small roll 36 is engaged which is supported by a small arm 37 extending from support 16 and elastically abuting on the edge of disk 34.

The device described above works in the following way. Reference is made to figures 1, 2 and 3 where the device is schematically shown respectively in a closed position, in an intermediate backwardly retracted position, and in a completely retracted, open position.

To open nose 2 key 26 is inserted into one of small openings 25 situated on the two sides of front part 1 of the locomotive. After a first idle rotation of the key for an angle of about 50°, a following rotation of 360° causes a rotation of 190° of drive shaft 18, given the existing gear ratio . As a consequence of such rotation driven shaft 17, carried by arms 19 and by the connection formed by protrusions 27 and tooth 28 engaged between them, rotates of 190° from a position substantially overhanging drive shaft 18 to a position substantially below it, whereas small roll 36 is engaged in one of the two notches 35 to stabilize the reached position. During this rotation connecting rod 11 is trailed so that, in turn, it can trail floating frame 4, thus translating of about 80 mm the nose 2 integral with it inside the front part of the locomotive. The translation occurs in a substantially parallel way with respect to the longitudinal axis of the locomotive because of the presence of a slide guide working between nose 2 and fixed front part of the locomotive itself. As shown in figures 1, 2 and 3, the slide guide is formed by a pair of slides 41 (only one shown in the figures) integral with nose 2 and spaced from one another which are slidingly engaged with the edge of opening 1a where internally protruding dowels 42 are provided which engage, in turn, with seats 43 formed on slides 41.

At this point nose 2 is in a backwards position with respect to the fixed part and it is possible for the operator to introduce his hand to push the nose downwardly to overcome the reaction of air springs 8 which tend to keep nose 2 up. The sizing of air springs 8 is such that they balance the weight of nose 2 with slight margin whereby the rotation is mildly hindered.

After nose 2 is rotated of about 90°, it is recessed within the front part of the locomotive and the automatic coupler is made accessible. Nose 2 must be kept firmly blocked in its opened position up to the next closure operation. To that end, as shown in particular in figures 5 and 6, a locking device is provided which comprises a

pair of pins 38 integral with nose 2 extending in mutual alignment toward the inside of the nose, and a cam 39 integral with small actuating shaft 23 to which pins 38 engage at the end of the rotation of 90° of nose 2 inside front part 1 of the locomotive. In practice, when rotating along with nose 2, pins 38 abut against cam 39 which is rotated backwards. At a certain moment the rotation of nose 2 leads pins 38 beyond the profile of cam 39 which moves backwards elastically, thereby locking pins 38. The elastic member of cam 39 is made up by two springs 40 (figure 4) coaxial with the driven gear wheel 21 of chain drive 20. The action of the pivot 38 against the cam 39 causes a rotation of the small drive shaft 23 of about 50° which, given the existing gear ratio with the drive shaft 18, causes a rotation of the latter of about 25°. However, in view of the existing clearance between drive shaft 18 and driven shaft 17 due to the connection between protrusions 27 and tooth 28 engaged therebetween, such rotation does not cause any displacement of the shaft 17.

The closing also occurs in two steps. From the operator point of view such closing requires only the rotation of the key, since the rotation of nose 2 is driven by air springs 8. In fact, the first part of the rotation of the key makes cam 39 rotate backwards, thus releasing the pivots 38 of nose 2. This one therefore goes upwards while rotating around joints 3 because of the action of air springs 8, until slides 41 abuts against the edge of opening 1a. Keeping the key on rotation displacement unit 9 is actuated, and as a consequence of an angular displacement of the driven shaft 17 of about 190°, connecting rod 11 is translated as well as floating frame 4 connected therewith, thereby nose 2 is pushed forward. During this motion, whereas slides 41 run on the edge of opening 1a, dowels 42 are engaged with seatings 43, thus assuring the right placing of nose 2 with respect to opening 1a of front part 1 of the locomotive. The possibility of extracting key 26 from small opening 25 assures that the closing position has been achieved.

Variations and/or modifications can be brought to the front structure for railway locomotives with a retractable door according to the present invention without departing form the scope of the invention itself, as defined in the appended claims.

Claims

1. A front structure of locomotive comprising a fixed part (1) on which an opening (1a) is formed and characterized in that it comprises a movable door (2) pivotally connected to said fixed part and axially translatable within it so that it can be arranged in a closure position and in a open position rotated of about 90° with respect to said closure position and displaced backwards inside said fixed part (1).

2. The structure according to claim 1, in which said door (2) is housed in said opening (1a) and is connected to actuating means (9) which are integral with said fixed portion (1) and suitable to transmit an axial motion of translation to displace said movable door (2) from said closure position to an intermediate backwards position, elastic means (8) being provided which extend from said fixed part and eccentrically forcing on said door to keep it in said intermediate backwards position.

3. The structure according to the previous claims, in which said door (2) is pivotally hanging from a frame (4) pivotally connected to said fixed part (1) and said elastic means (8) are connected to an arm (7) integral with said door (2), said actuating means (9) comprising connecting rod means (11) connected to said frame (4) and to a crank mechanism (9a, b) operable from the outside of said structure.

4. The structure according to the previous claims, in which said crank mechanism (9a, b) comprises a drive shaft (18) supported in a transversal manner by said fixed part (1) and operable from the outside of said structure, and a driven shaft (17) parallel with said drive shaft (18) and integral with it, to which said connecting rod means (11) are connected.

5. The structure according to the previous claims, in which said frame (4) is pivotally connected to said door (2) on both sides of the structure, said connecting rod means (11) comprising a pair of connecting rods hinged to radial arms (29) of said driven shaft (17).

6. The structure according to the previous claims, in which said drive shaft (18) is connected by transmission means (20, 21, 22) to an actuating stem (23) operable from the outside.

7. The structure according to claim 6, in which said actuating stem (23) comprises a rotation locking device when said door (2) reaches said open position rotated of about 90° comprising cam means (39) integral with said actuating stem (23) and a pin means (38) integral with said door suitable to match and to be engaged with them, a certain angular clearance between said drive shaft (18) and said driven shaft (17) being provided for.

8. The structure according to claim 7, in which said driven shaft (17) presents two rotation radial arms (19) through which it is pivotally connected to said fixed support (1) and at least a radial tooth (28) which engages with a corresponding fork (27) radially extending from said drive shaft (18).

9. The structure according to the previous claims, in which said drive shaft (18) is connected to said driven shaft (17) so as to transmit an angular displacement greater than 180° between two operative

positions situated one above and one below said drive shaft (18) and locking means (35, 36) of said driven shaft (17) are provided in said positions.

10. The structure according to claim 9, in which said locking means comprise a pair of notches (35) perimetrically formed on said driven shaft (17) at an angular distance equal to that of said operating positions, and a roll (36) carried by an arm (37), elastically connected to said fixed support (1), and suitable to engage with one or another of said notches (35) to lock said driven shaft (17) in the corresponding operating position.

11. The structure according to the previous claims, in which said door (2) comprises a slide guide (41) for driving its axial translation with respect to the fixed part (1).

12. The structure according to claim 11, in which said slide guide comprises at least a slide (41) integral with said door (2) which is suitable to slidingly engage with the fixed part and at least a dowel (42) integral with said fixed part (1) for engaging in a corresponding seating (43) integral with said door (2).

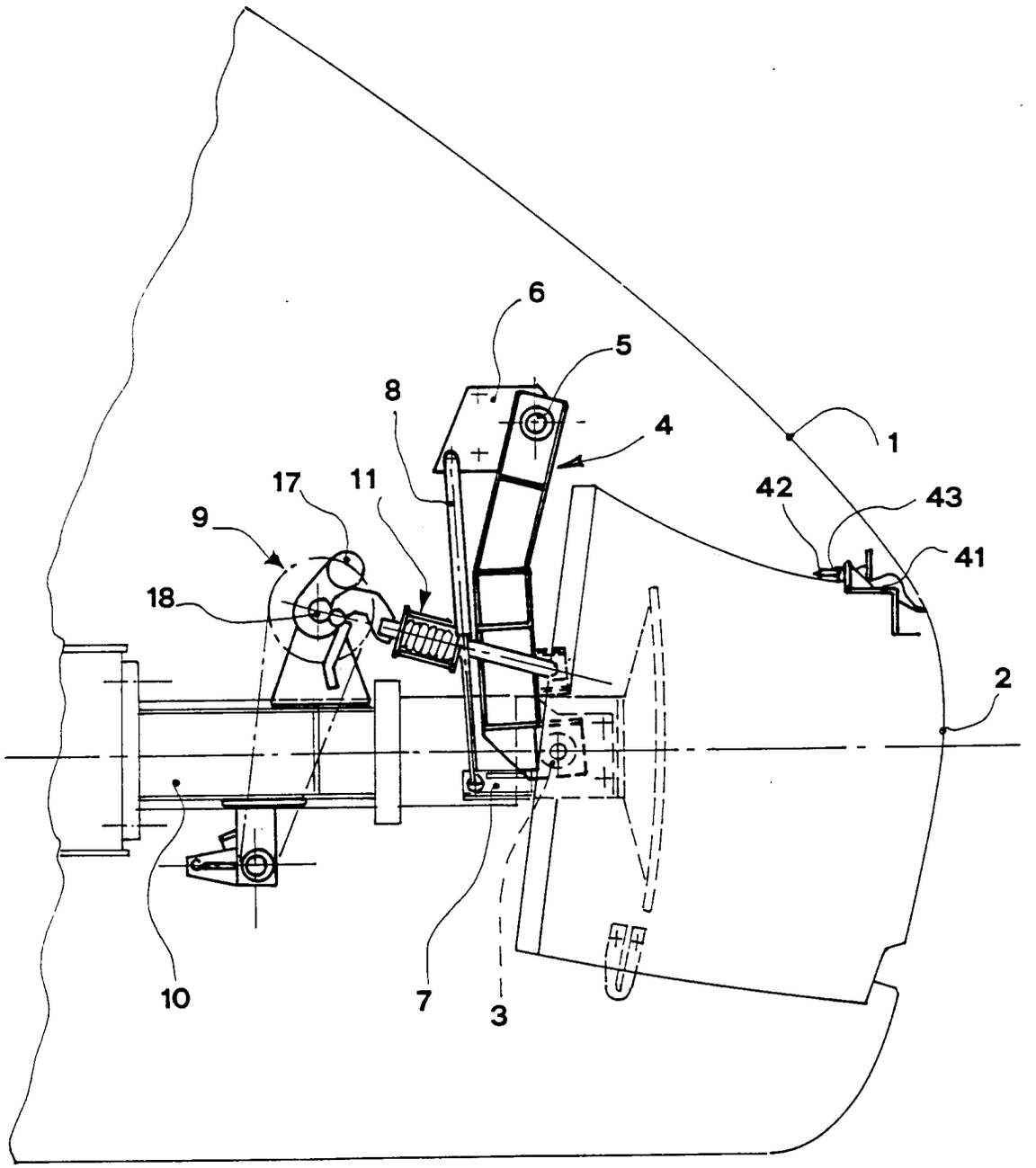

Fig. 1

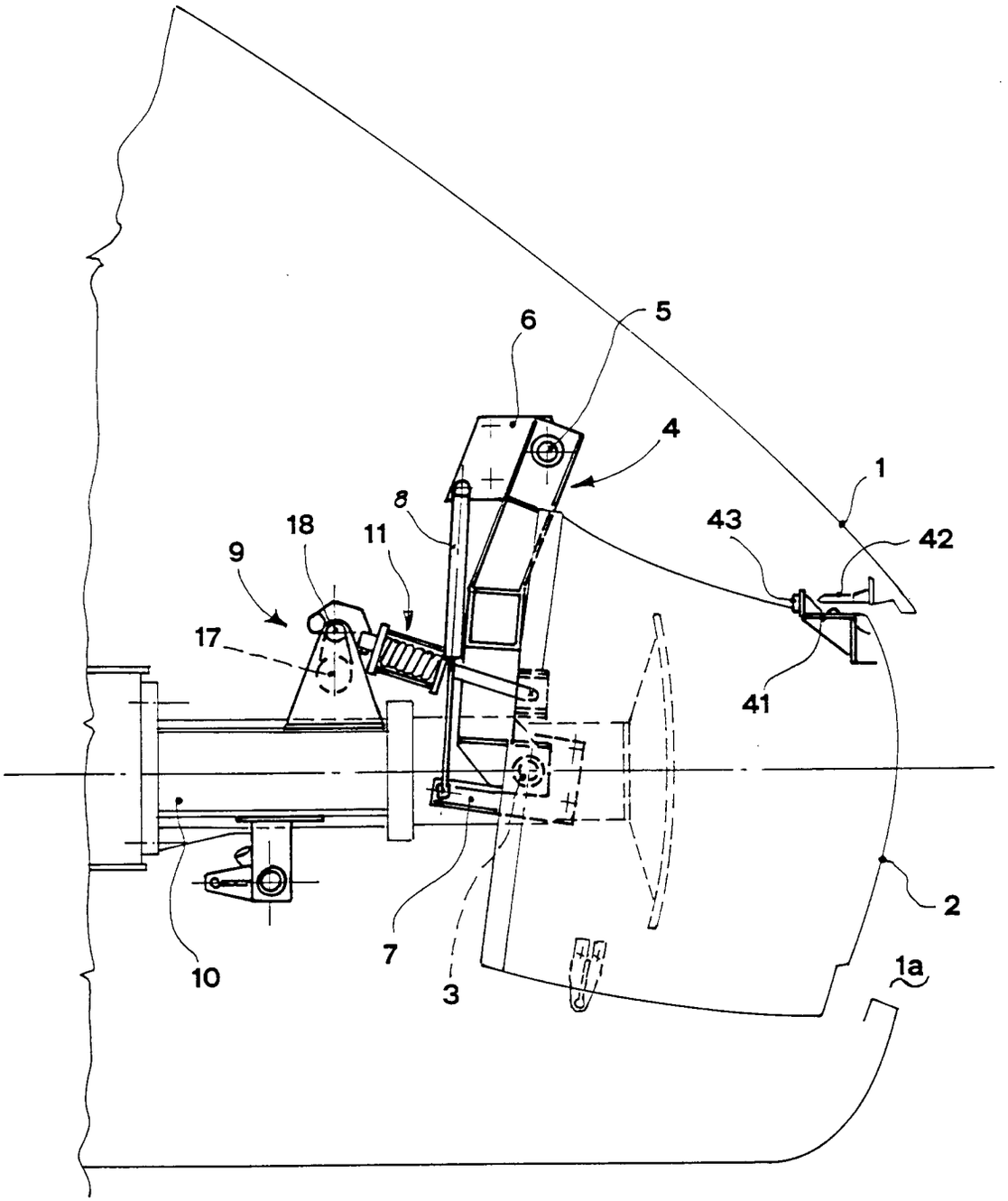

Fig. 2

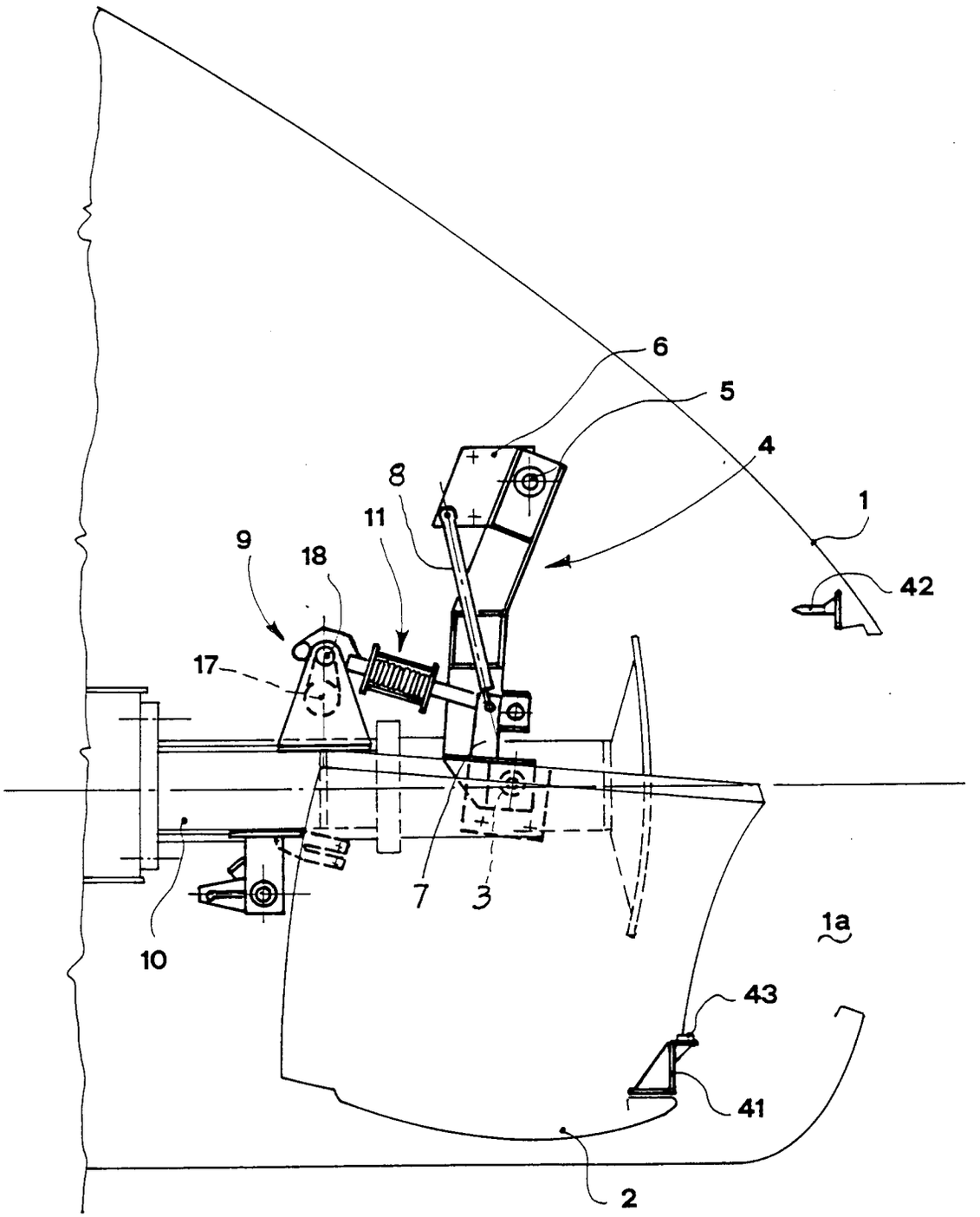

Fig. 3

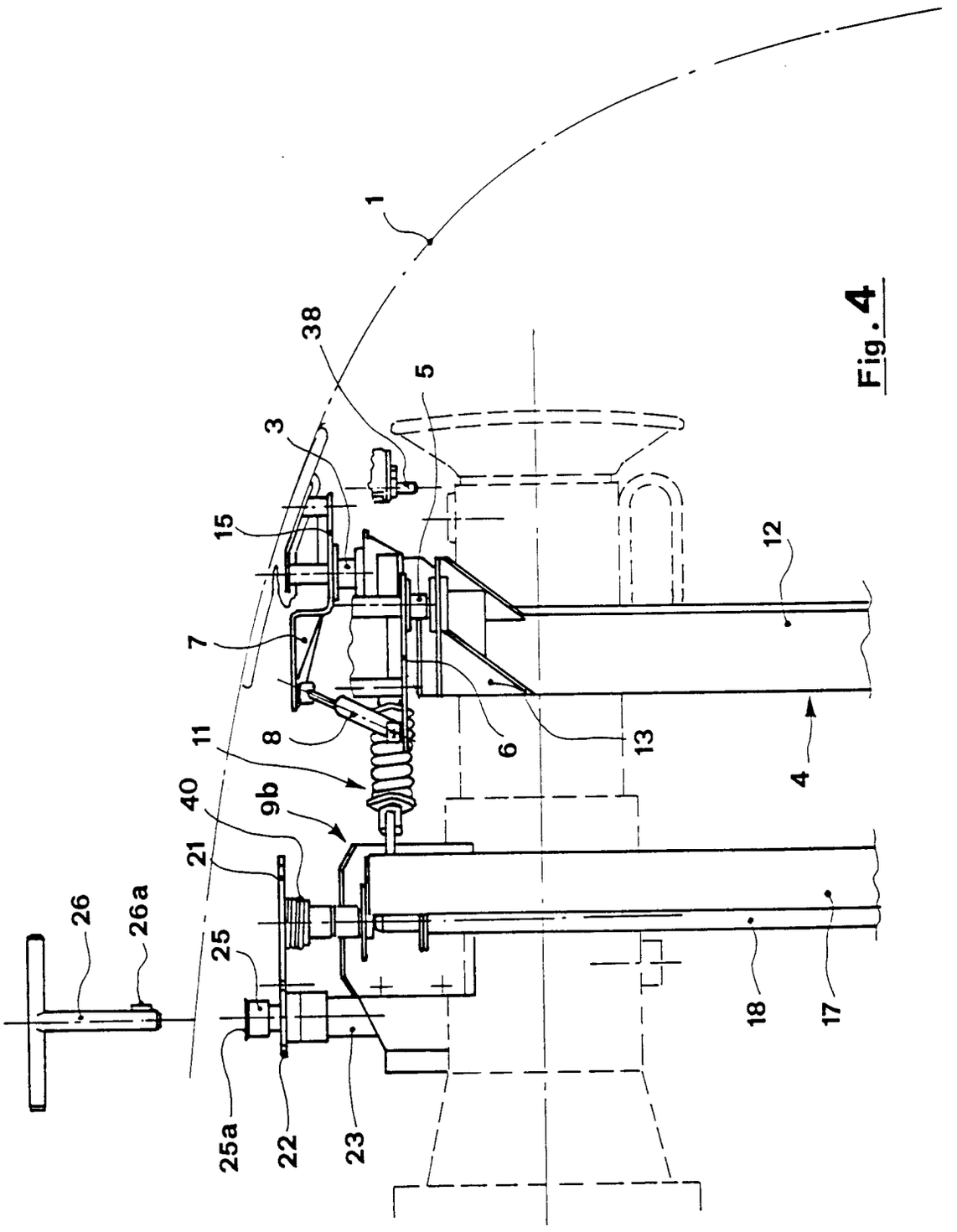

Fig. 4

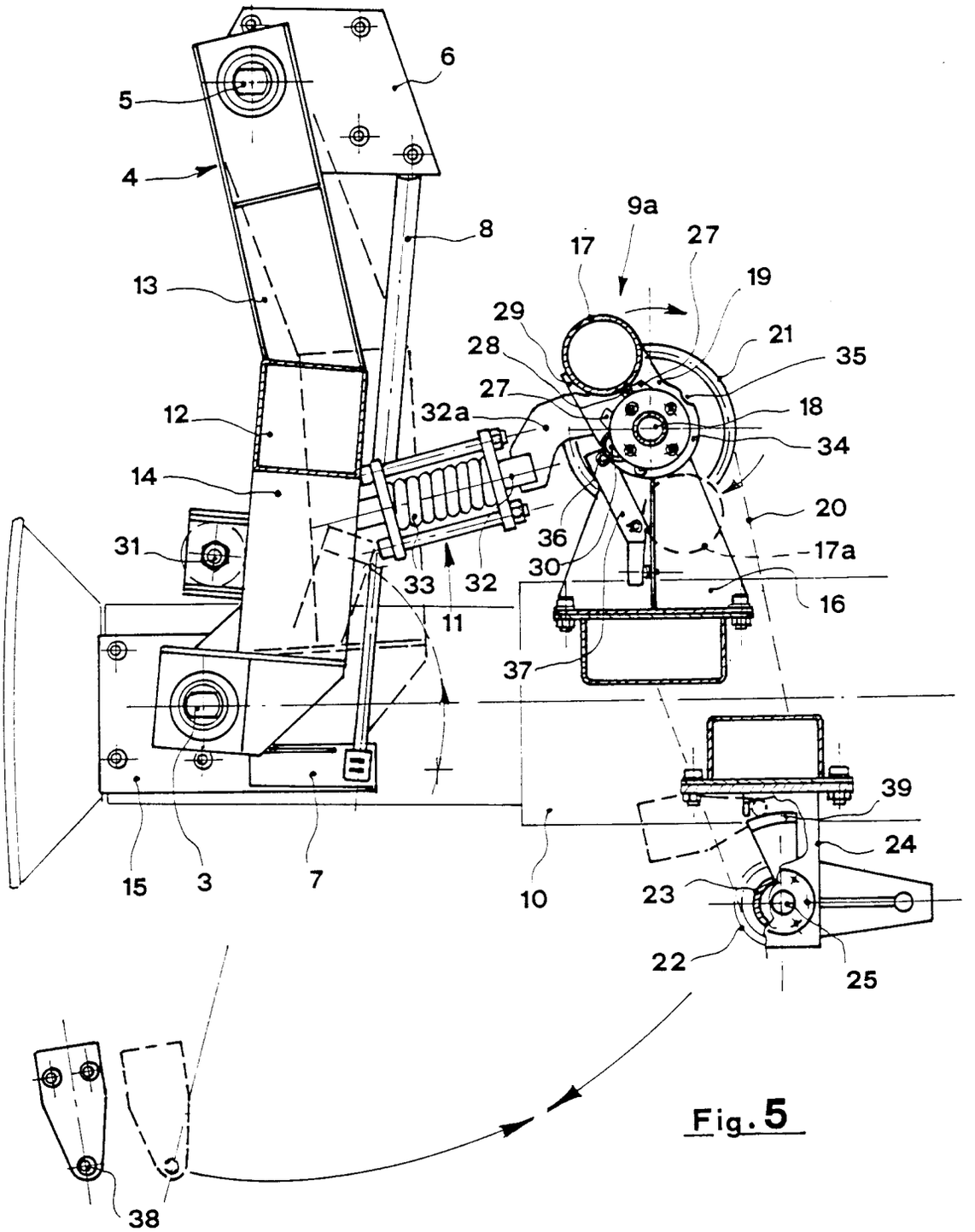
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Fig. 5

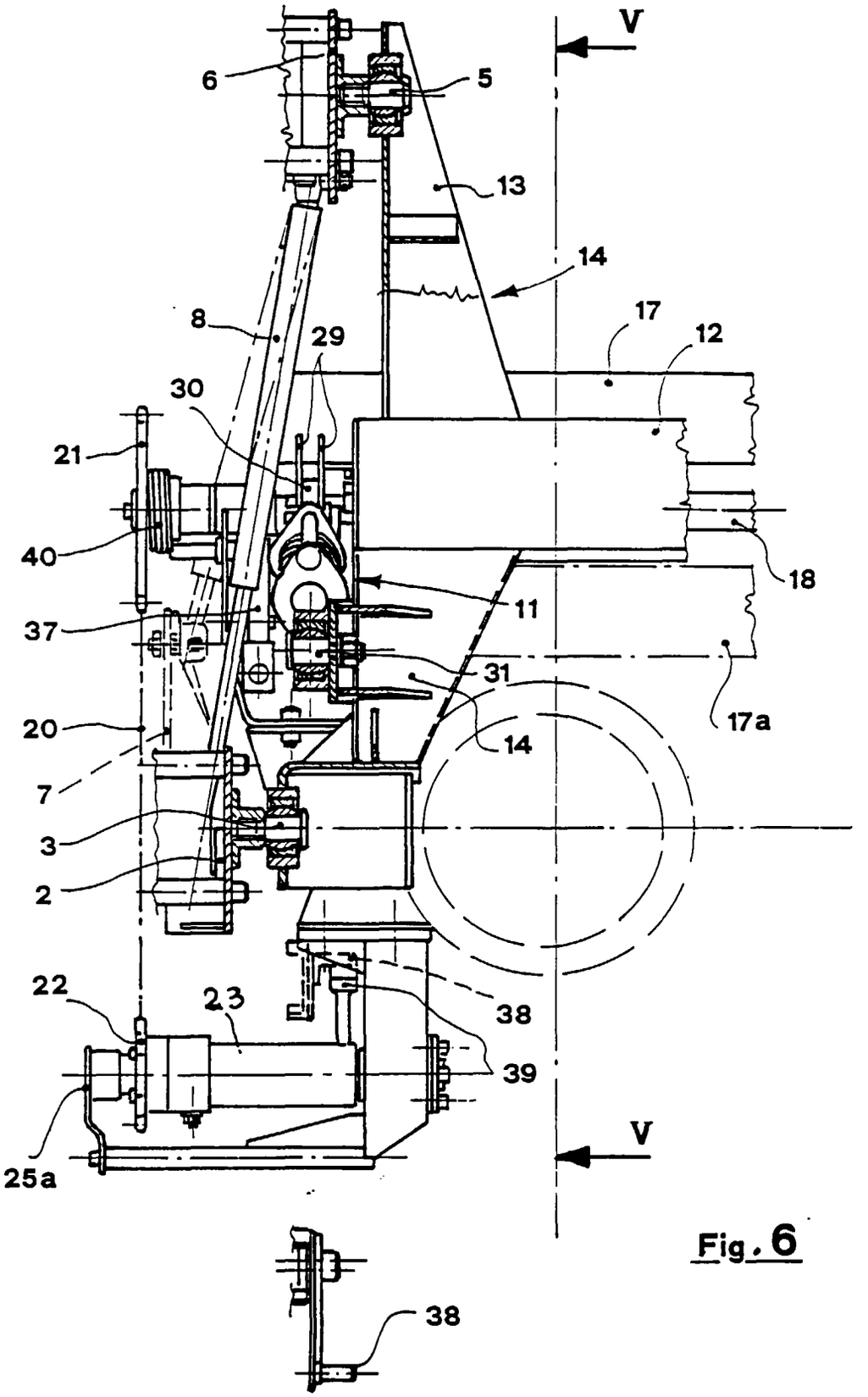
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Fig. 6

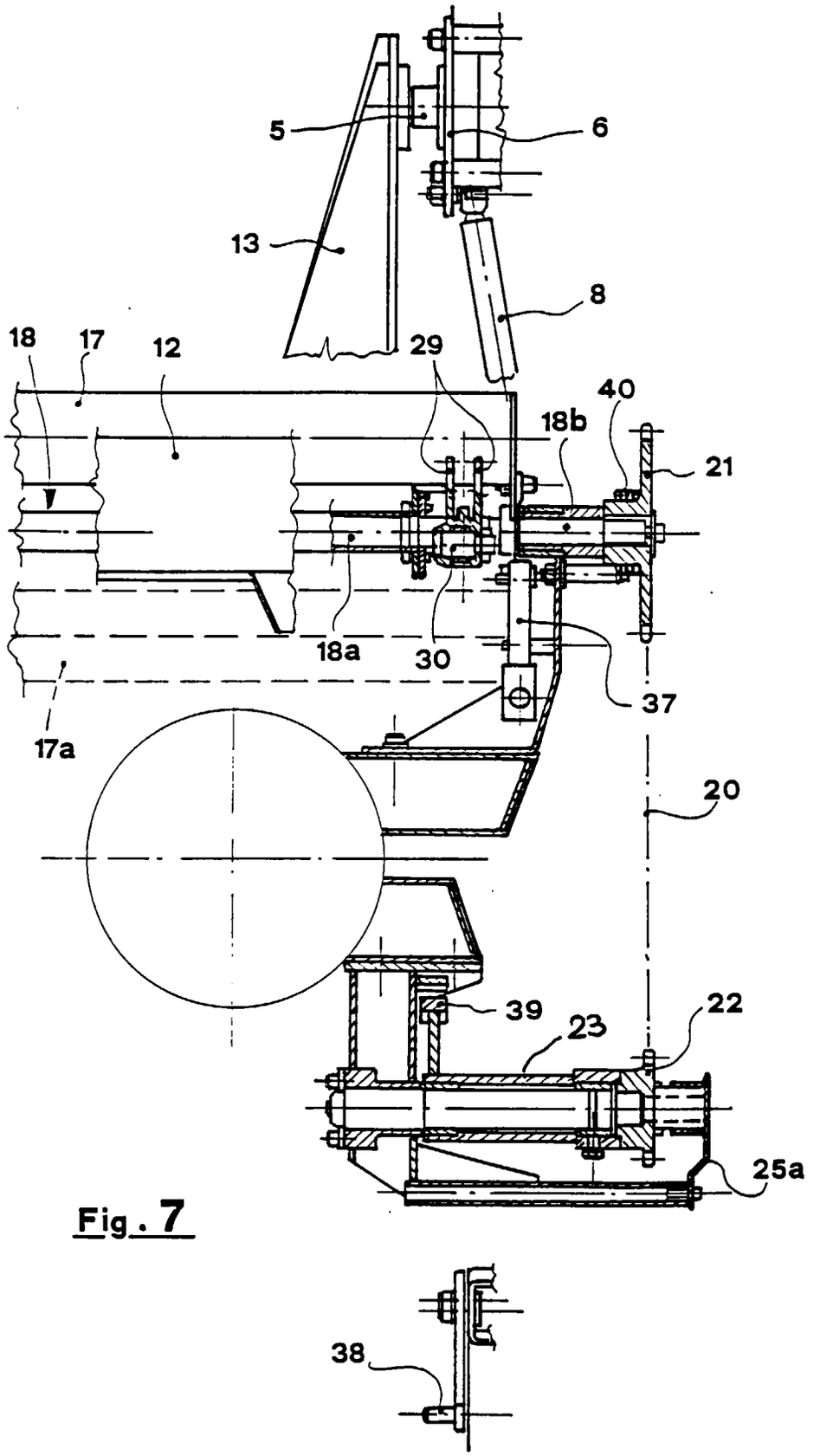

Fig. 7