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(54) Automatic gate opening device

(57) This invention relates to an automatic sliding gate opening device, which can be installed on existing gates or fitted on new gates, which is compact, easy to install and particularly effective for both passive and active safety purposes, comprising a set of assemblies that can be applied to the gate and which enclose the mechanical power transferable to the track with a motor powered indirectly by the mains, by means of a rechargeable battery, and also comprising the relevant operating, movement control and safety systems.

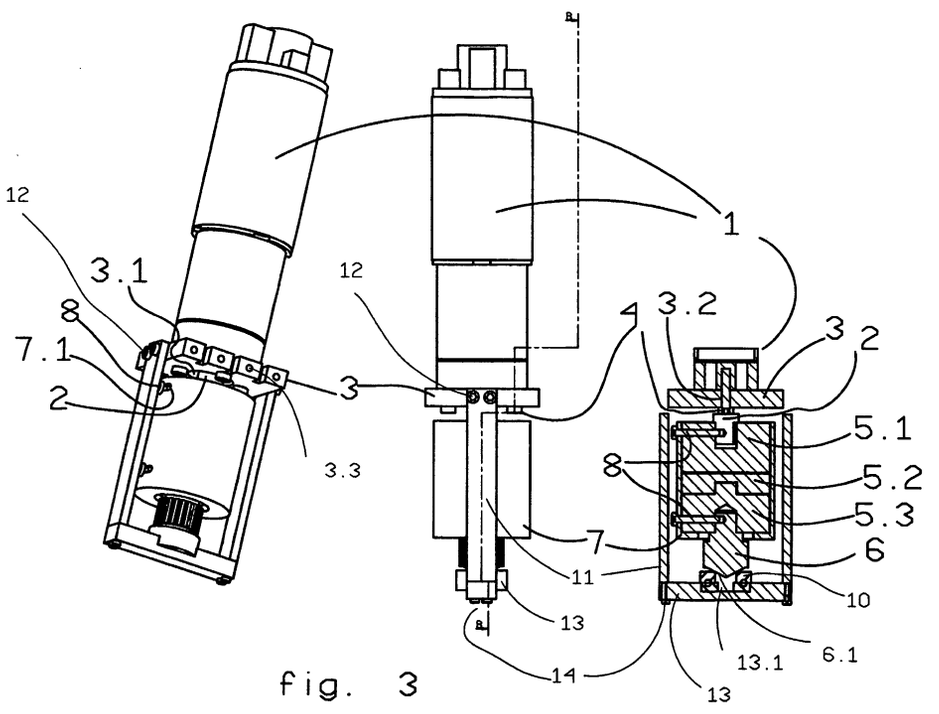

fig. 3

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Description

Technical field

[0001] This invention relates to sliding gate automation and consists of a gate system capable of storing the mechanical power that can then be transferred to the track by means of an engine powered directly by the mains, via a rechargeable battery, and in which the driving, control and safety systems are assembled therewith.

Background of art

[0002] Automatic sliding gates are becoming more and more widespread, for a number of reasons: because they're convenient and can be remotely controlled without having to get out of the car, an especially appreciated fact in winter; for security reasons, because not having to get out of the car can protect one from aggression by wrongdoers; furthermore, almost all automatic gates now feature a lock open / lock closed mode, which means that the gate closes automatically after the car has passed and no longer remains open for forgetfulness or sheer laziness.

[0003] At present, most automatic gates are operated by means of a motor installed on the ground, via rack and pinion drives (a crown gear that engages a rack-rail fastened to the gate leaf), so that by switching on the engine the gate opens and closes, and can be operated electronically too, by means of photocells, for safety purposes.

[0004] These gate automation devices, however, feature certain shortcomings, such as:

- shortcomings related to safety, due to the fact that these gate automation systems in accordance with the applicable safety regulations - feature two pairs of photosensors that can detect the presence of objects when the gate is partially/entirely open; pressure switch sensors consisting of rubber pipes that prevent crushing, but these devices, located far from the motor, receive and give indications by means of cables generally installed by jack-of-all-trade personnel, left hanging lose or wound up by spring-based systems; these cables are often unsuited for the purpose and subject to wear, thus jeopardising safety;
- they require a torque control (clutch) such that the closing power does not exceed 15 kg, but often gates work at higher forces;
- the clutch system (with motor and motor-reduction assembly to control the torque) require continuous maintenance, according to the season; this shortcoming is generally remedied by recalibrating the clutch, adjusting it towards the maximum, but this translates into non-compliance with the applicable regulations, which recite that "the limit on maximum movement force for sliding gates must be <= 15 kg, in order to prevent crushing and ensure the safety of the gate system";
- the (concrete) track platform is often damaged by the continuous passing of vehicles, which increases the backlash between the motor-reduction assembly and the rack-rail, resulting in the malfunctioning of the gates for (apparently) no reason; sometimes the track too tends to get damaged, also due to the action of any tree roots, amplifying the problem, and the gates get stuck more and more often, requiring maintenance and overhauling;
- when installing the rack-rail on the gate leaf the installer must ensure a certain slackness between it and the pinion gear of the motor, but this slackness tends to change in time, due to wear and tear or because the track is either lowered by the passing vehicles or raised by the tree roots, which blocks the gate, is considerably losened, whereby the pinion gear runs idle, in the case of gates 5 to 6 metres long;
- heat expansion causes the gate and rack-rail to buckle, and this leads to gripping or to the excessive distancing of pinion gear and rack-rail;
- the breaking of the spline of the driving shaft pinion gear, when opening and closing with locked clutch, moves or stops sizable inertias and, in some cases, determines the breaking of the driving shaft supports;
- mains powered a.c. motors do not feature an optimal torque at the start, and this entails boosting to achieve a suitable torque;
- if the gate has to follow a curved path, considerable problems must be overcome when a curved rack-rail is applied to a curved gate leaf running on a curved track.

Disclosure of invention

[0005] The aim of this invention is to remedy the aforementioned shortcomings and to streamline the sliding gate automation of an existing/new gate, designing a compact system that is easy to install and particularly effective with respect to safety, consisting of a device that can be installed on the gate and storing the mechanical power that can be transferred to the track by means of a motor indirectly powered by the mains, via a rechargeable battery, and wherein the driving, control and safety systems are assembled therewith.

[0006] According to the present invention, the automatic gate opening device substantially comprises a small low-power DC motor housed inside a carter made integral with the vertical end section of the gate leaf; the motor - which includes a movement and transmission multiplying device - transmits the movement to a shaped wheel that engages the gate's ground sliding track; the device also features electronic means for detecting the position of the gate in real time, during the opening and

closing operations, with respect to the total run, and safety systems for stopping the gate's movement, in the event any obstacles are detected in the gate's path, when opening or closing; the motor is powered by an accumulator housed inside the carter installed on the gate, which is re-charged by an induction system that is activated, if needed, when the gate is closed; the device also features electronic systems for adapting the motor's power to the effort required to operate the gate, also in connection with external factors affecting the gate, such as wind speed, temperature, etc..

Brief description of drawings

[0007] A specific embodiment of the invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 shows an automatic gate in the closed position
Figure 2 shows a semi-open gate
Figure 3 shows a motor with a reducer pre-assembled on the intermediate frame, including the characteristic components of this sub-group
Figure 4 shows a preferential cross-section of the driving system with ribbed profiles
Figure 5 shows a side view of the driving system, with a detail of the components to ensure the position of the face crown gear set
Figure 6 shows front, side and axonometric views, cross sections and necessary details of the principal casing
Figure 7 shows the closing door
Figure 8 shows the accumulator housing and of the electronic circuit with the closing, safety, power, alarm and radio reception devices, accumulator power system
Figure 9 shows the distance and transit rate measuring system, as a whole and certain details thereof
Figure 10 shows the extremely compact and symmetrical photcell safety system, for use in the low and high positions
Figure 11 shows the low installation position
Figure 12 shows the low installation position

Description of the preferred embodiment

[0008] Referring to the drawings, in the preferred embodiment of this invention, on the front end of a sliding gate, housed in a special carter, there is fastened with suitable means, which shall be described later on, an electric motor with a motor-reduction assembly (1) which, by means of special devices — which will be described in greater detail later on — drives a shaped wheel (27) engaging the gate's ground track.

[0009] The motor, with motor-reduction assembly 1 with exit in axis 2, is assembled on the connecting plate 3, by means of the hole 3.1 passing to the shaft 2 and the holes 3.2 for the screws 4; to the exit in axis 2 is connected the upper section 5.1 of the torsion joint 5, with interposed the turning part 5.2 a with the rigid terminal 5.3 fastened to a straight pinion 6.

[0010] The rigid sections of the joint 5 are housed inside a sleeve 7 and the screws 8 assure the transmission of the movement by means of the joint 5 from the shaft 2 of the motor to the pinion 6, also ensuring the dampening of the jolts in the start / stop phase, or the counter rotation due to the presence of the slits 7.1 on the sleeve 7; the pinion 6 drives a face crown gear 9 which - due to the type of coupling with the pinion 6 - generates thereon an axial component, with direction from the motor to the pinion, which tends to make the pinion slide from the housing in the joint; to prevent this the pinion 6 features a conical tip 6.1, underneath which there is an axial thrust bearing, kept in place by the vertical rods 11, fastened to the frame with the screws 12, which support the plate 13, which features a housing for the thrust bearing 13.1, compressed beneath the thrust bearing thanks to the screws 14 fastened to the rods 11; in order to ensure the described functionality the backplate 13 never touches the rods 11, not even when the screws 14 are tightened.

[0011] Having eliminated the axial component, the design ensures excellent operation, over the years, of the entire assembly and the assembly is housed inside the container 29; the flush screws 30 are introduced through the holes 29.1 and are placed in the threaded holes 3.3, and at the tightening of the flush screws the reaction obtained allows the good centering of the motor-frame assembly.

[0012] The face crown gear 9, which can be seen in figures 4 and 5, is positioned on the ribbed shaft 15 through the shaped hole 9.1, and maintains its position by means of the rods 16 introduced in the hole 15.1, which feature the holes 16.1 at the ends, integral with the face crown gear through the screws 17, introduced inside the holes of the face 9.2 and in the rod holes 16.1, the washers 18 and nuts 19; the rods maintain the position of the face crown gear 9 thanks to the threaded hole in the middle 16.2, inside which there operates a screw regulated system 20 introduced in a fragmented manner inside the cavity 15.2, in the centre of the shaft 15.

[0013] The shaped screw 20 of figure 5 is introduced inside the hole 15.2 of figure 4 on the opposite side of the rod passage slot 15.1, until the flat head 20.1 passes and goes beyond the threaded hole 16.2 and is screwed inside the same hole, because there is a threaded section 20.2, and when the head of the screw 20.3 is in contact with the end of the hole 15.3 the face crown gear is in the correct operating position in contact with the pinion gear. From the opposite side 15.4 is introduced a control positioner 21, which features a head 21.1 that is supported by 15.4, and this is when the slit 21.2 receives the flat part 20.1, which features a fastening hole 20.4, at an equivalent hole 21.3, and introducing the elastic

pin 22 this strengthens the control assembly, thanks to the axial backlash envisaged by the design.

[0014] The face crown gear receives the clockwise or counterclockwise rotation from the pinion gear and transmits it to the splined gear 23, via the shaped hole 23.1, to the shaft 15 and kept in position by the rabbet on the internal ring of the bearing 24 and the rabbet 15.5; in turn, the motion of the gear 23 is transmitted to the splined gear 25, via the shaped hole 25.1, on the ribbed shaft 26 and kept in position by the ring inside the bearing 27 and by the rabbet 25.1 on the profile of the ribbed shaft.

[0015] The gear guard 78 is installed using rivets 79 in the holes 78.1 of the guard and the holes 29.7 of the casing. On the shaft 26 there is a rabbet 26.2, on which is positioned the driving wheel 27, which features a shaped hole 27.1 suited to the splining on the shaft until the side 27.2 touches the rabbet 26.2, while on the other side is installed the element 28, which holds fast the entrainment wheel when the door is fitted with the relevant bearings. The guard for the face crown gear 80 is installed with rivets 79 in the holes 80.1 of the guard and the holes 29.8 of the casing.

[0016] The main body 29 features two holes 29.2 and 29.3 for the bearings 24 and 27, while from the opposite side it features a large opening, which is necessary for installing all the components and, in particular, there are the holes 29.4 for receiving the threaded inserts 31.

[0017] The casing, externally, on the side of attachment of the gate leaf to the post, features reinforcements 29.10, which provide better support to the weight, together with the thickness of the casing, and there are some internally as well; on the open part of the casing there are two projections 29.11, which act as accurate supports for the inspection door and supports for the threaded inserts.

[0018] The inspection door 32 of figure 7 features two holes 32.1 and 32.2 suited to receive the bearings 33 and 34, in the internal part there are vertical reinforcements, and also insist the holes 32.3 for fastening to the backplate, and here too by means of flush screws 33, which are inserted after the positioning of the inspection door, fastened by means of ball bearings, which are introduced on the two ribbed profiles; once the inspection door has been positioned it is fastened using the screws 30 which, once they have been tightened, ensure the positioning, which improves until it reaches the good level envisaged by the design, when in the holes 32.4 are mounted the other flush screws 34 and, once they have been tightened, the product is ready to be used for the opening / closing of a sliding gate. It can be observed that a carter suited to being a post of a gate has been used, containing internally everything it needs to work.

[0019] Observing figure 8 one can see that the motor-reduction assembly 1, by means of the cable 35, is connected to an electronic circuit 36, which receives and distributes power, when necessary, from the accumulation system 37 enclosed in the container 38 fastened to the main body 29.

[0020] The electronic circuit, via the accumulator supply cable 39, receives power from the secondary of a transformer 40 which, for ease of operation is of the withdrawable type, because the spring 40.1 contained between 40.2 and 40.3 prevents the two halves of the transformers 40 and 41 from crashing violently and breaking, during the closing of the gate, besides ensuring a minimum ar spacing between the electromagnetic flows that concatenate from the primary coil, thanks to the coil present in 41, which concatenates with the ferrite 41.3 with the coil 40.3 thanks to the ferrite 40.3. On the fixed post of the gate 42 there resides the primary of the transformer 41, which receives power directly from the mains, or from a transformer from 220 to 40 volts, for example, to reduce the risk of accidents and better comply with the safety standards.

[0021] To the electronic circuit 36 with the cable 43 is connected the electronically operated lock 44, which functions only if the closing element 45 has been disenabled with its key.

[0022] To the electronic circuit 36 is connected, via the cable 46, the radio receiver 47 and the light signal 48, which are fastened on the voltage rise system 49, installed on the gate post, by means of the screw 50 and the safety washer 51.

[0023] To the electronic circuit 36 is connected, via a cable 52, a measuring system 53, which measures and reports the space travelled during the operation of the gate.

[0024] The measuring system for the distance and transit rate 53 comprises a main support 54 with a release cap 55, to the support is connected the position roller 57, which runs on the ball bearings 58, one of which is present on the cap, and it is kept in the desired position by the stop ring 59, which rabbets at 57.1, in the track contact area, which is inserted in a forced capacity on the roller contact area 57.1, up to the stop 57.2, the inner ring of the bearing, keeping the roller united to the support in the desired position and capable of rotating freely; in the external part, the position roller may rotate freely when it is in contact with the track and is being pressed on it due to friction, it is obliged to roll when the gate moves. The roller 57 features a projection 57.3, shaped like a crown gear, which, rolling with the roller, drives the crown gear 57.4 contained between the two bearings in the support and the cap; this crown gear features, adjacently, the crown gear 57.5 and, in particular, the empty and full areas determined by the teeth interact with the optical sensor 59, connected to the electronic circuit, to which it transmits the information relating to motion, stop, distance travelled and transit rate.

[0025] The measuring system is fastened to the inside of the container 29, in a sheltered position, because the support 54 features a hole 54.1, in which is wedged the joint pin 60 which, in turn, is contained in the fastening bracket 61; before introducing the pin it is necessary to

insert on it the joint spring 61.1 which, pressing on one end of the shank of the support 54 and, on the other end 61.2 inside the fastening bracket, determines a downward thrust of the support, and this is needed by the measuring system to function continuously.

[0026] On the outside of the casing, on the closing side, besides the power supply by induction system and the electronically operated lock, there is a safety device 63 of figure 10, developed above the main support 64, with photocells 65, to ensure safety against crushing; this system is achieved by means of main support 64, which can be fastened to the casing 29 with the screws 66; on the support 64 is fastened a cap 68, with the screws 67, on which cap is fastened centrally, by interference, and parallel to the ground, a photocell 65, paired with the corresponding one fastened on the stop post, to allow the gate to stop in the case someone crosses the beam. Another two photocells 65 are placed vertically on the support 64 and by fastening the cap 68, with two screws 67, is achieved the described safety device, connecting the cables of the photocells 69 with the power supply and data transmission cable 70 to the electronic circuit.

[0027] If the safety assembly 63 is installed at the top - in an upside down position - it is connected to the electronic circuit with the cable 71.

[0028] The casing 29 with the inspection door 32, and all the accessories it contains and supports, is connected to the post of an existing gate thanks to the bottom attachments 72, which are two metal straps, generally at right angles, with the joint 72.1 at the bottom and the top, thus making them ambidextrous, supported by the female housing 29.5 of the casing, while through the holes 72.2 pass the bolts 73, in the corresponding holes made 78.1 on the gate post 78, and the fastening is achieved by tightening the nuts 74. The upper attachment 76 as well, composed by metal straps generally at right angles, is fastened in the same manner with nuts and bolts, by means of the holes 76.1, while the connection with the casing 29 is assured by means of the threaded pins 76.2, which are wedged into the slits 29.6 and are fastened with the opposing nuts 77.

[0029] As previously stated, the automatic gate opening device illustrated herein features electrical, electronic and optical systems that ensure its operation and maximum safety during operation; in order to allow the correct functioning of the device, the aforementioned systems must be set, immediately after their installation, to allow the memorization of certain parameters such as, for example, the distance travelled by the gate when opening / closing.

[0030] Given by way of example only, following is the initialization procedure to be undertaken after the device has been installed.

[0031] The gate is in a semi-open position, the first radio impulse is transmitted, received by the receiver and transmitted to the electronic circuit; if the circuit has been enabled to open the gate, it controls the opening of the electronic lock and, in the preferred embodiment, it keeps the check system attracted and performs a small forward movement, to allow the disengagement of the check rod from the pin, the micro-controller has thus been programmed; the gate starts moving at a very slow speed, in the opening direction, until it reaches the final stopping position. In the meantime, the safety and measuring systems have also been activated, hereinafter called the "encoder": when the gate stops the encoder measures the position, stores the information and starts the closing movement at a very slow speed. During the opening and closing operations the electronic system, through the encoder, detects the conditions of friction, due to the contact between the driving wheel and the track, but also to the wind and to the roller guide generally present at the top of gates of this kind, and stores them; when the gate reaches the closed stopping position it stops and the encoder memorizes this new information, which allows it to measure the distance travelled by the gate, between the entirely open and the entirely closed positions. On each opening and closing operation, the encoder instantly detects the conditions of friction to maintain the transit speed of the gate constant, measuring and dosing the power to be supplied to the motor in direct current and very low power, but with a suitable pickup at the start and stop of the gate's movement.

[0032] Generally speaking, when the gate is closed there are devices that prevent the gate from being opened by raising it, such as the safety pin 83 which is wedged into the rabbet.

[0033] At each new opening operation, the system moves slowly in the closing direction, picks up speed when approaching the rabbet, the position of which is detected by the control unit because the required power increases, opens the electronic lock, which remains in the open position until the gate moves for a certain length; subsequently to the start of the operation the gate slows down to detect the conditions of friction, which ensures a speedy opening / closing operation, at the maximum speed permitted under the applicable regulations.

[0034] If there are any obstacles on the track, the system detects them by means of the horizontal photocell and the gate returns to the entirely open position and then starts moving again; if the obstacle has not been removed it stops in the open position until it is removed by an operator, warned by an anomalously flashing sign. The obstacle, however, could be located at the back of the gate, in which case the power required for moving increases and this signal is interpreted as an obstacle, so the gate starts closing for a small distance and then tries to open; if this obstacle is not removed the gate will try to complete the opening operation three times, failing which it will transmit an anomalous flashing signal for the operator.

[0035] Obstacles are detected by means of a photocell, following the interruption of the light signal or be-

cause of the increased power needed to move the gate, and this is the reason for the invention's inherent safety, given that the force needed to move a gate weighing 300 kg is generally of just a few kilograms; when an obstacle is felt the electronic control system commands the motor to rotate in the opposite direction, which determines the speedy contrary movement of the gate, thus preventing the gate from crushing a hand or even a single finger, because the finger (the obstacle) is detected as soon as it exerts a pressure on the light seal 87, which presses, for example, on a hand between the gate and the post. The seal (87) also prevents the safety assembly from accidentally breaking.

[0036] In the event of a power shortage for a long period of time, and consequent depletion of the energy accumulated in the battery, the gate can be opened manually, as follows:

insert the manual key into the lock 45, turn in a counterclockwise direction with the revolving plug and push open.

[0037] If it is necessary to operate the gate by means of a coin, changes must be made to the assembly 20, in a counterclockwise manner, detaching the face crown gear from the pinion gear, so that, by means of the rods, the former is pressed down by the coin and, if there are no obstacles, with the hand and a small effort it is possible to push the gate; access can be guaranteed by subsequently making sure the face crown gear resumes its former position. The same procedure is adopted when going out, by actioning the assembly 20 with a coin from the inside.

Claims

1. An automatic gate opening device comprising:

a small DC motor with motor-reduction assembly (1), made integral with the front rabbet of the gate; a torsion joint (5) connected to the motor shaft; a straight pinion (6) transmitting the movement to a face crown gear (9), which transmits it to a gear assembly (23), which in turn transmits it to a splined gear assembly (25) on the ribbed shaft (26), on which there is a rabbet (26.2), on which is positioned the driving wheel 27, which runs in the ground track;
an electronic circuit (36) connected to the motor-reduction assembly (1);
a power storage system (37);
a transformer, in which the secondary (40), installed on the gate, and the primary (41) is installed on the fixed end post of the gate and is powered directly by the mains;
a power supply cable (39) connecting the power transformer secondary (40) to the electronic circuit (36);
a radio receiving system (47) connected by cable (46) to the electronic circuit (36);
a measuring system (53), for measuring the distance travelled by the gate, with respect to the total distance, connected by means of the cable (52) to the electronic circuit (36);
a safety system (63), comprising photocells (65) installed on the gate, so they can sight the space both horizontally and vertically;
a carter (29) with a door (32), which houses, protects and allows the (partial) fastening of the above-mentioned devices.

2. The automatic gate opening device described in claim 1 wherein the torsion joint (5) ensures the transmission from the axis (2) of the motor to the pinion gear (6), also ensuring the dampening of the jolts in the start / stop phase or counter rotation.

3. The automatic gate opening device described in the preceding claims wherein the motor-reduction assembly 1 is connected to the electronic circuit 36 by means of the cable 35, which electronic circuit receives and distributes the power, as needed, from the power storage system 37, housed in the container 38 fastened to the main body 29.

4. The automatic gate opening device described in the preceding claims wherein the electronic circuit, by means of the cable 39 supplying power to the batteries, receives power from the secondary of a transformer 40, of the withdrawable type, in which the spring 40.1 - set between 40.2 and 40.3 - prevents the two halves of the transformers 40 and 41 from crashing violently and breaking, during the gate closing operation, besides ensuring a minimum ar spacing between the electromagnetic flows.

5. The automatic gate opening device described in the preceding claims wherein the electronic circuit 36, comprising the cable 52, is connected to a measuring system 53, which measures the space travelled during the movement of the gate; the said system 53 comprises a principal support 54, closed by a release cap 55; to the support is connected the position roller 57 placed on the bearings 58, one of which is on the cap, and maintained in the desired position by the stop ring 59, which stops at the rabbet 57.1, in the track contact area, which is inserted in a forced capacity on the roller contact area 57.1, up to the stop 57.2, the inner ring of the bearing, keeping the roller united to the support in the desired position and capable of rotating freely; in the external part, the position roller may rotate freely when it is in contact with the track and is being pressed on it due to friction, it is obliged to roll when

the gate moves. The roller 57 features a projection 57.3, shaped like a crown gear, which, rolling with the roller, drives the crown gear 57.4 contained between the two bearings in the support and the cap; this crown gear features, adjacently, the crown gear 57.5 and, in particular, the empty and full areas determined by the teeth interact with the optical sensor 59, connected to the electronic circuit, to which it transmits the information relating to motion, stop and distance travelled.

6. The automatic gate opening device described in the preceding claims wherein the safety device 63 comprises the main support 64, which can be fastened to the casing 29 with the screws 66; on the support 64 is fastened a cap 68, with the screws 67, on which cap is fastened centrally, by interference, and parallel to the ground, a photocell 65, paired with the corresponding one fastened on the stop post, to allow the gate to stop in the case someone crosses the beam. Another two photocells 65 are placed vertically on the support 64 and by fastening the cap 68, with two screws 67, is achieved the described safety device, connecting the cables of the photocells 69 with the power supply and data transmission cable 70 to the electronic circuit; if the safety assembly 63 is installed at the top - in an upside down position - it is connected to the electronic circuit with the cable 71.

7. The automatic gate opening device described in the preceding claims wherein the safety system, when an obstacle is felt, the electronic control system commands the motor to rotate in the opposite direction, which determines the speedy contrary movement of the gate, thus preventing the gate from crushing even the thinnest of obstacles, because the obstacle is detected as soon as it exerts a pressure on the light seal 87, which presses, for example, on a hand between the gate and the post; the seal (87) also prevents the safety assembly from accidentally breaking.

8. The automatic gate opening device described in the preceding claims wherein, in the event of depletion of the battery, or other types of failures, the gate can be manually opened by inserting the manual key into the lock (45), turning in a counterclockwise direction with the revolving plug and pushing it open; if it is necessary to operate the gate by means of a coin, this must be used on the assembly (20) in a counterclockwise manner, detaching the face crown gear from the pinion gear, so that, by means of the rods, the former is pressed down by the coin and, if there are no obstacles, with the hand and a small effort it is possible to push the gate; obviously, the same procedure is adopted when going out, and it is then necessary to make the face crown gear resume its previous position.

9. The automatic gate opening device described in the preceding claims wherein the abovementioned device can be sold installed in the gate post.

10. The automatic gate opening device described in the preceding claims wherein the abovementioned device can be installed on curved gates as well.

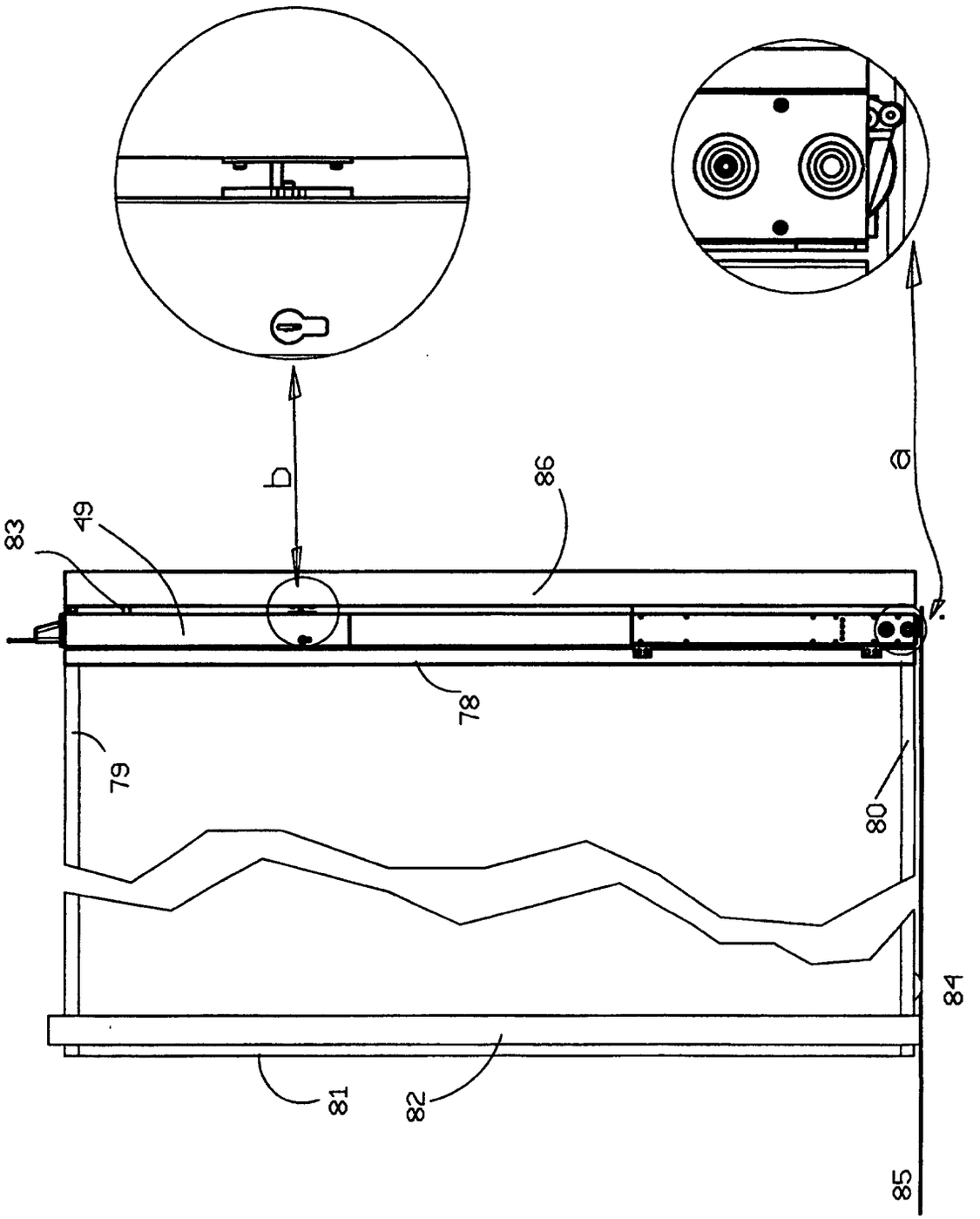

fig. 1

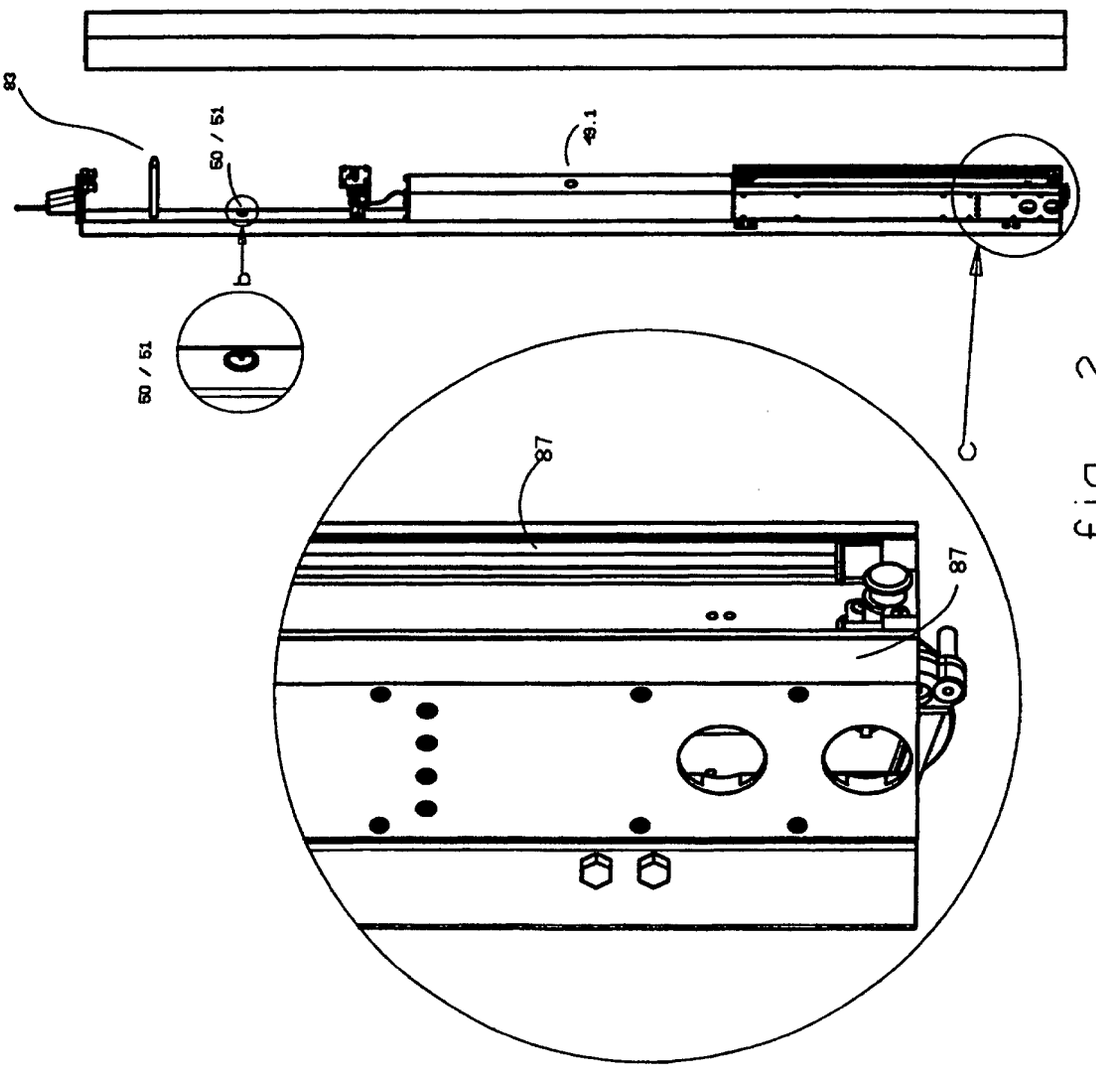

fig. 2

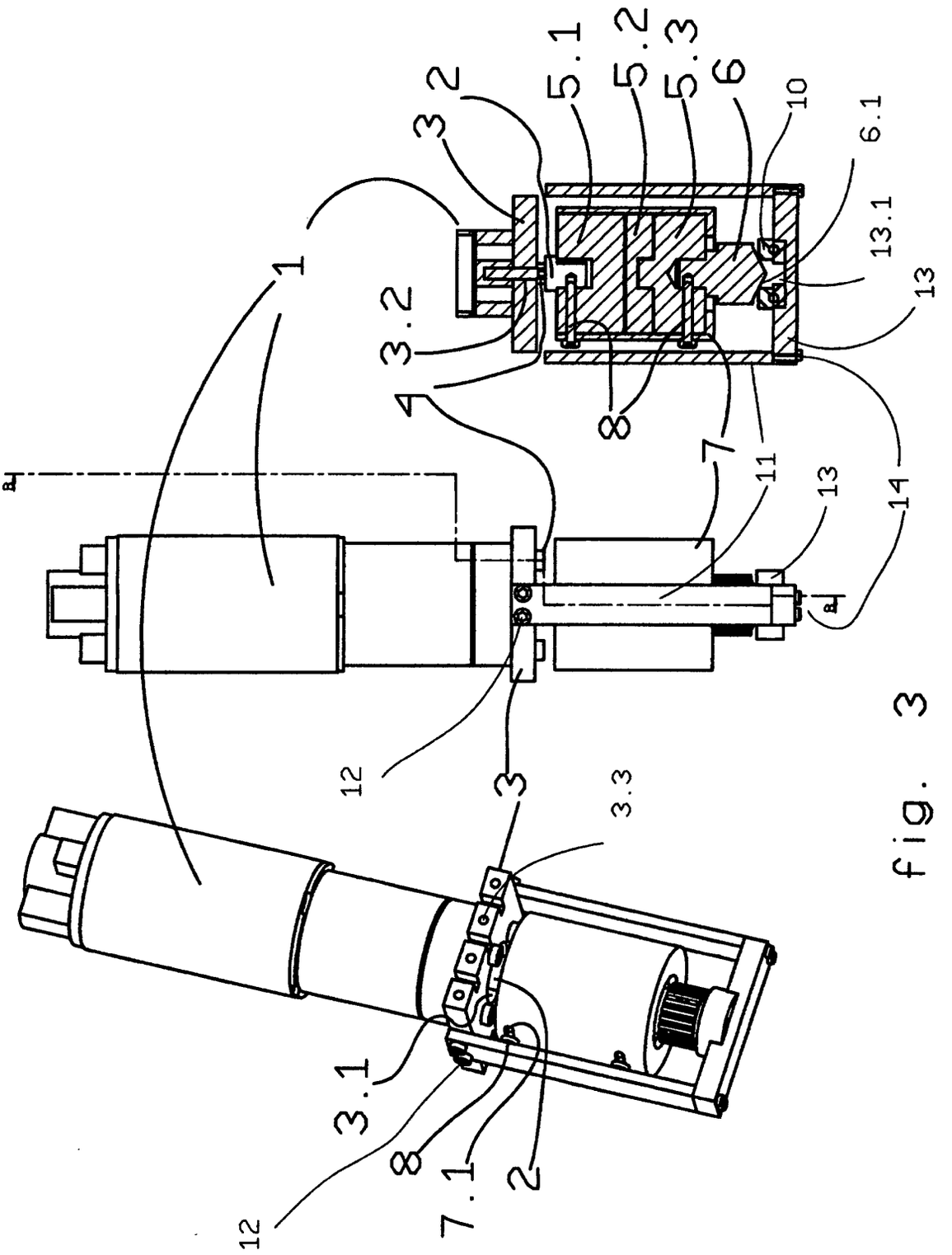

fig. 3

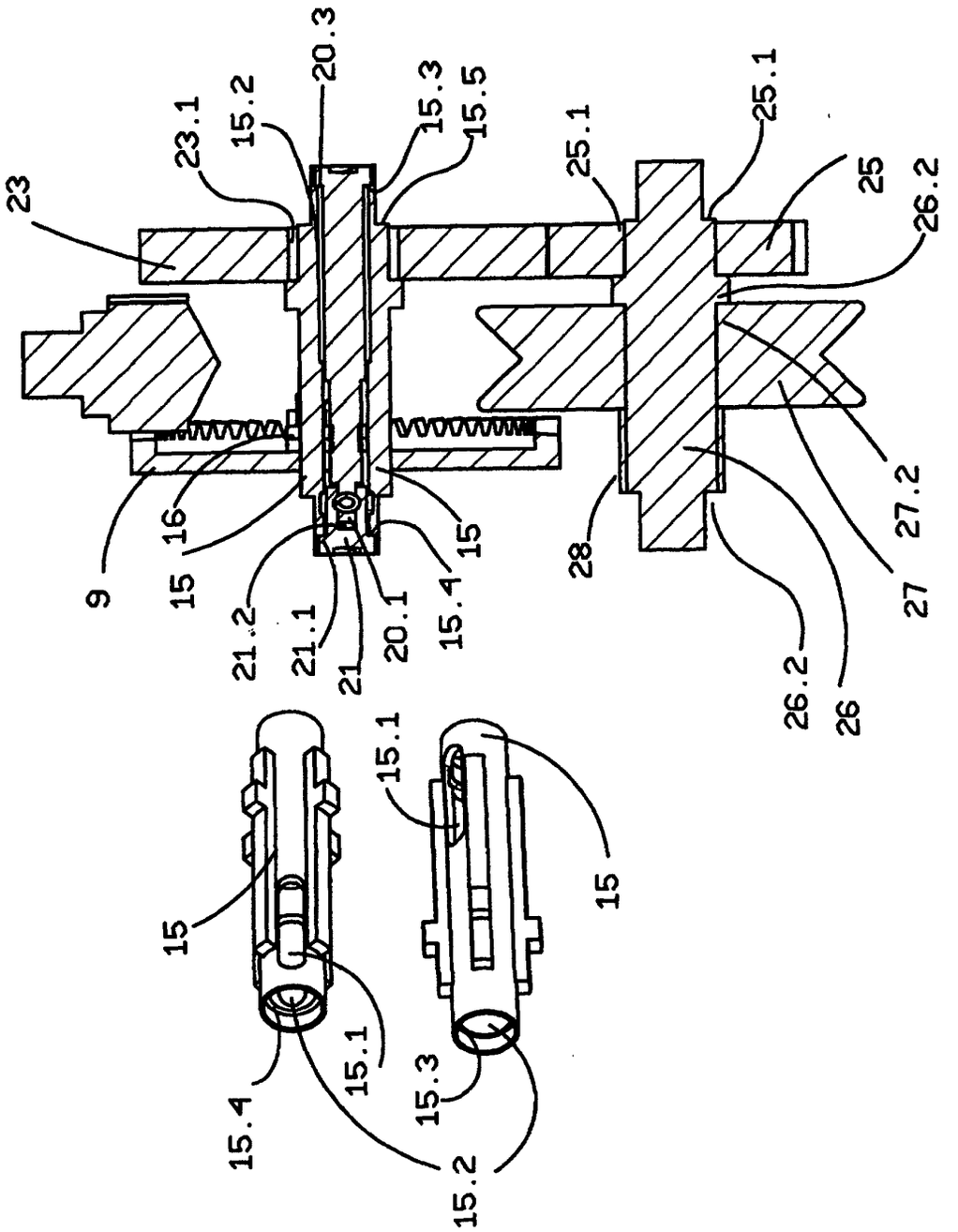
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fig. 4

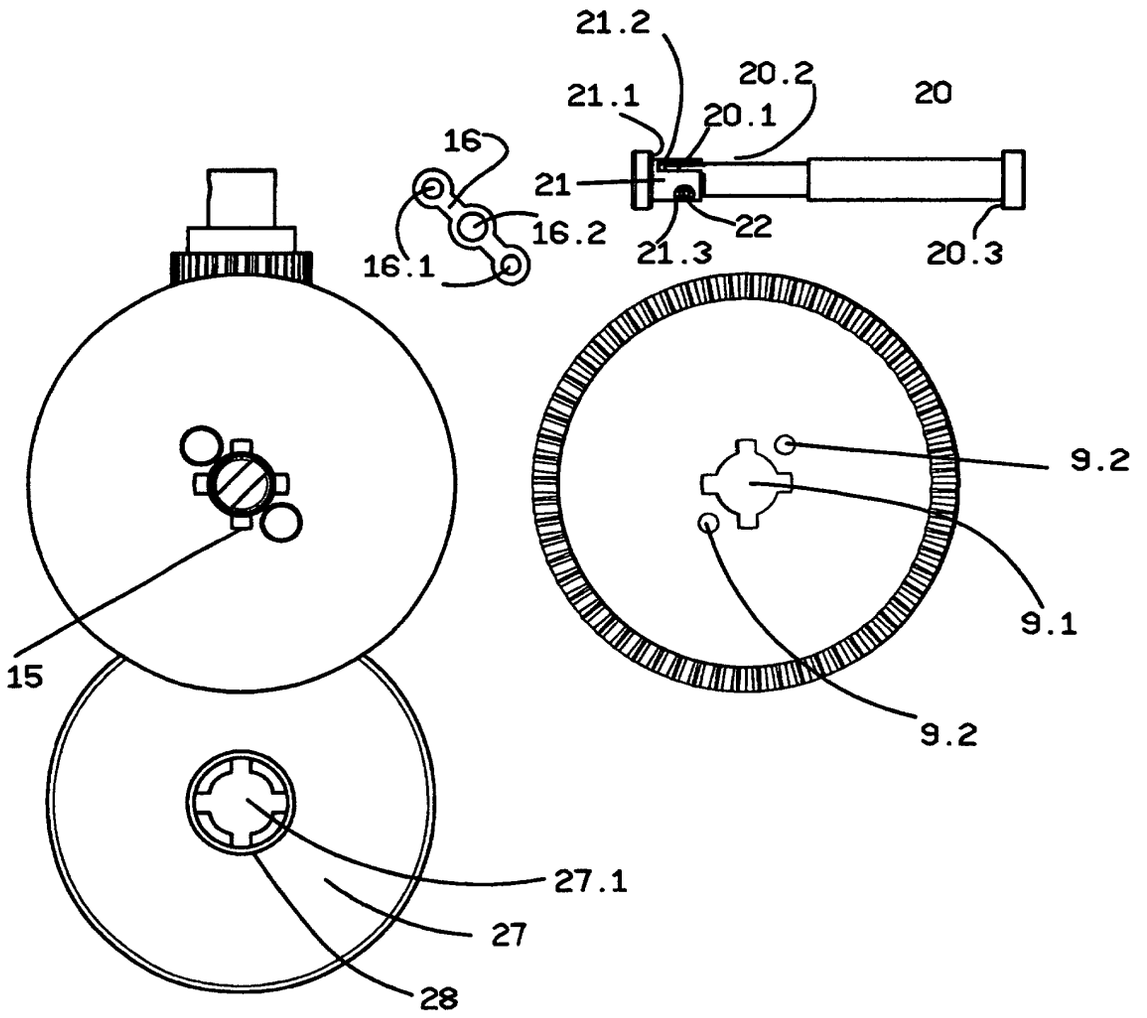


fig. 5

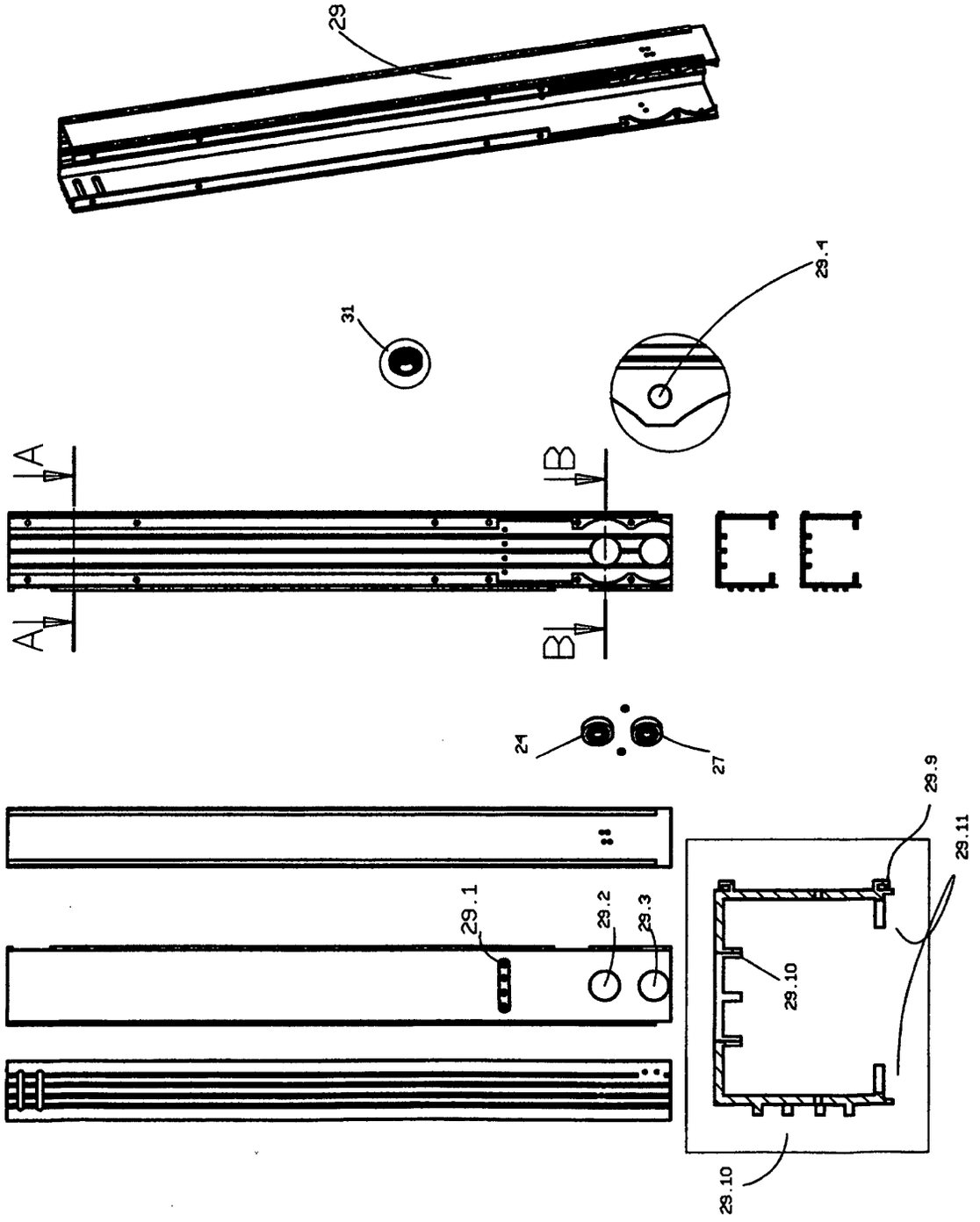


fig. 6

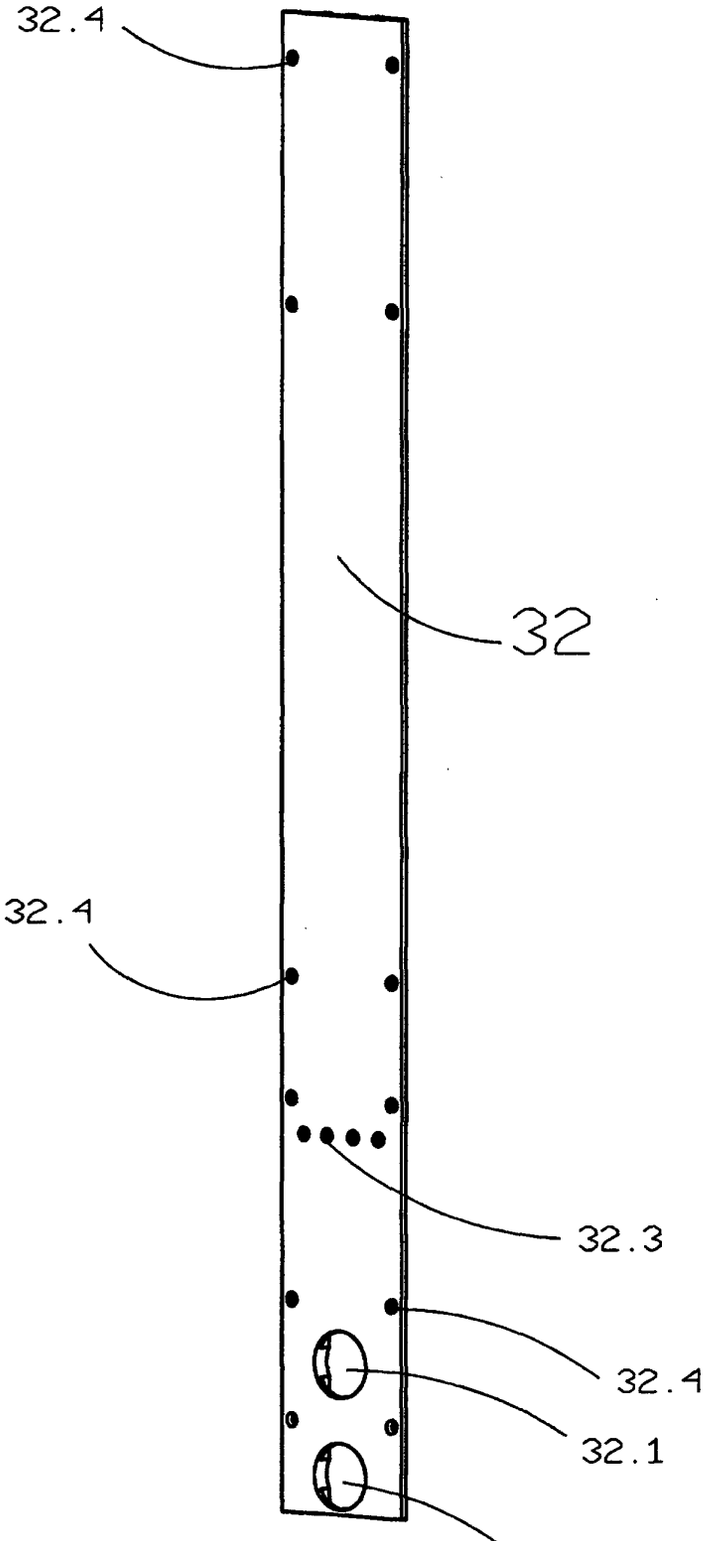
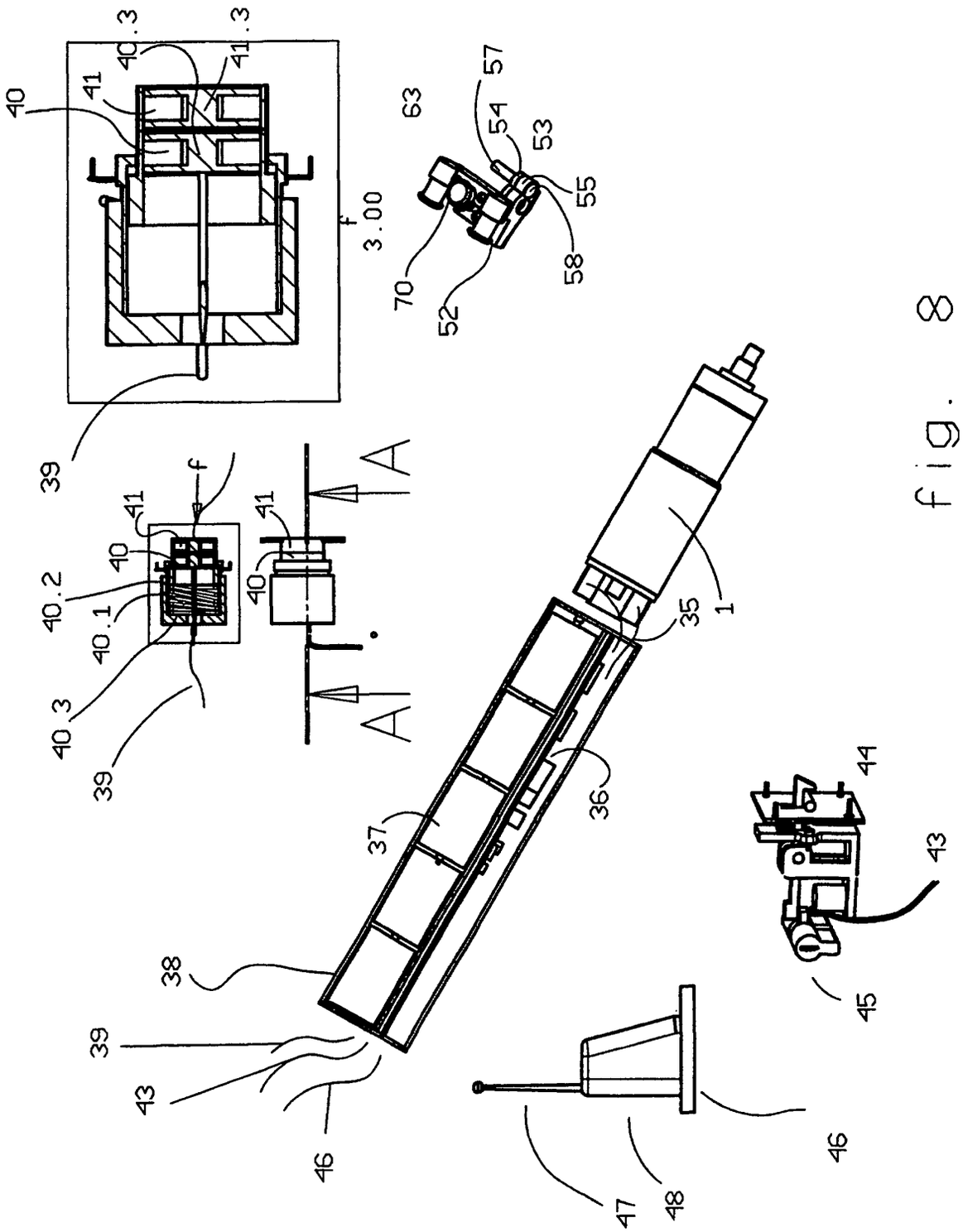


fig. 7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41.3
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53
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52
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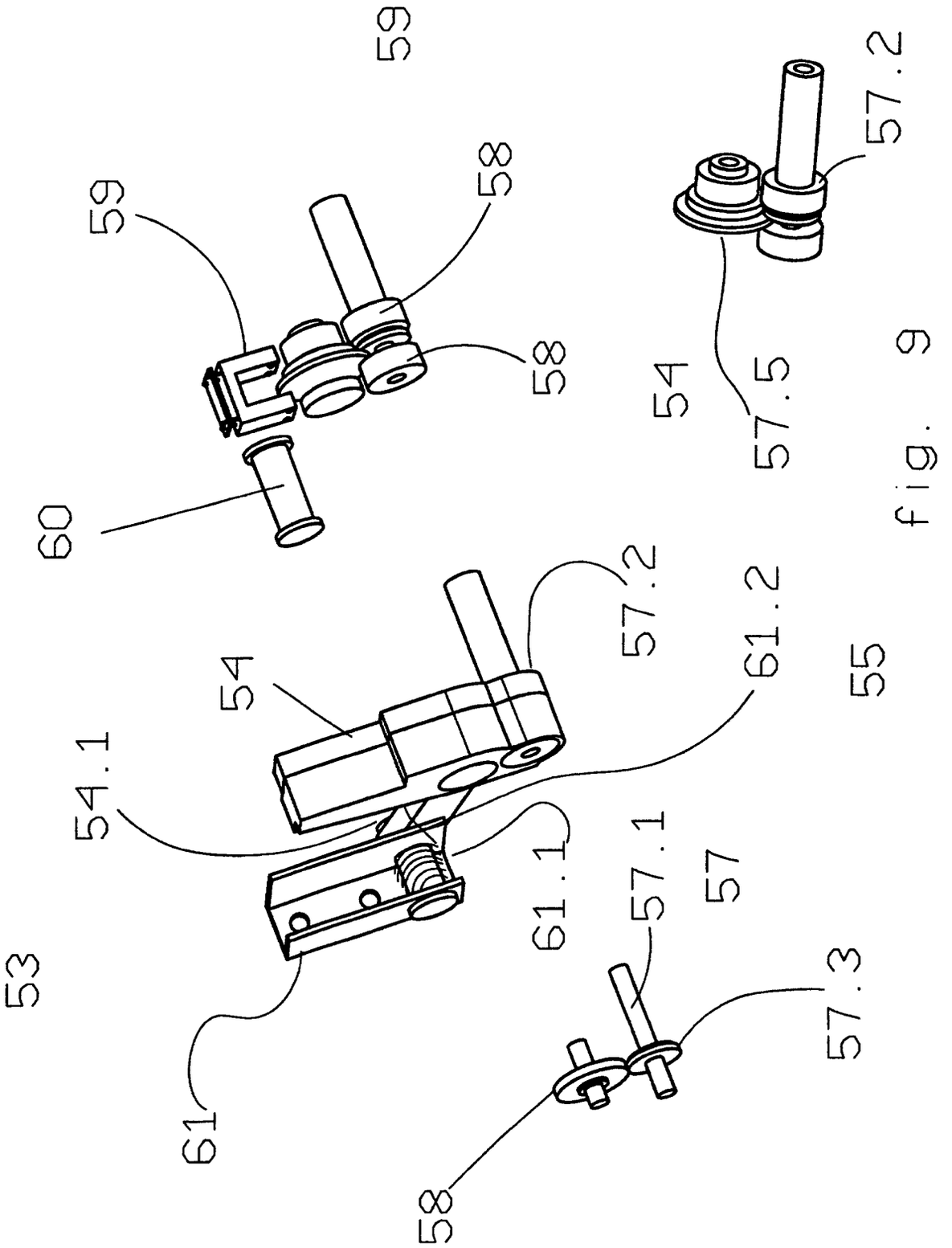
fig. 8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58
59
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60
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57.5
fig. 9
57.2
61.2
55
54
54.1
61.1
57.1
57
53
57.3
61
58

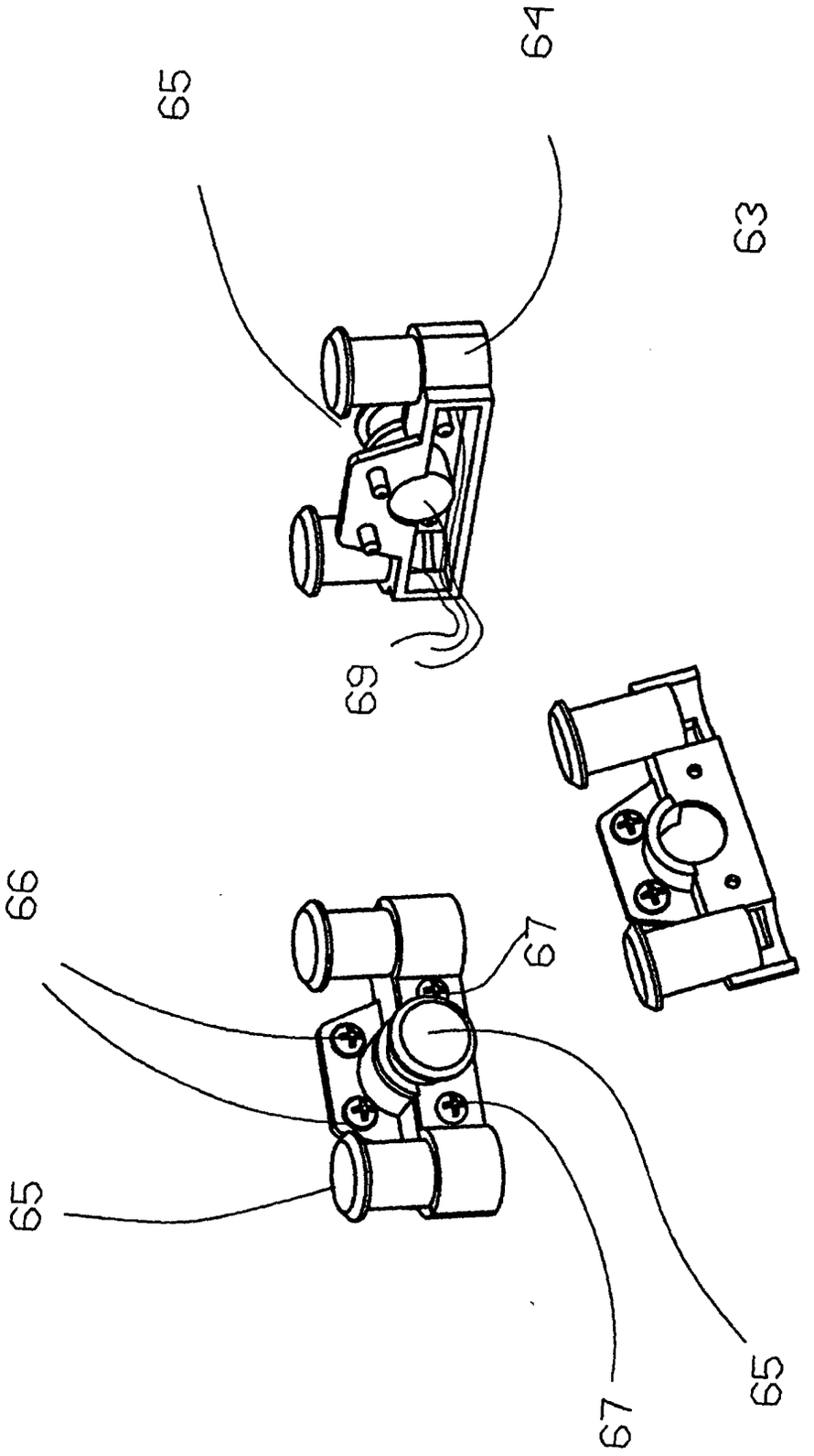

fig. 10

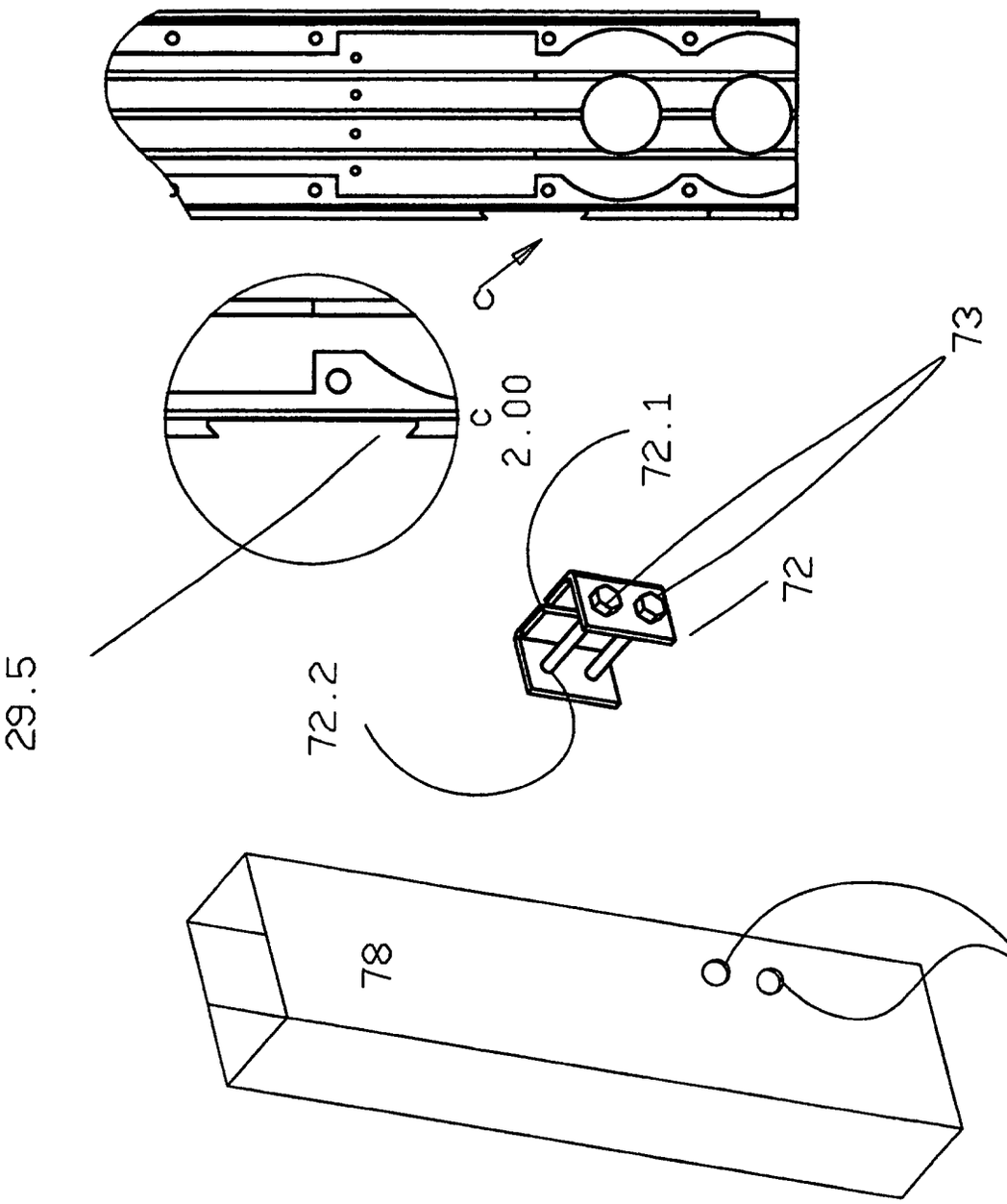

fig. 11

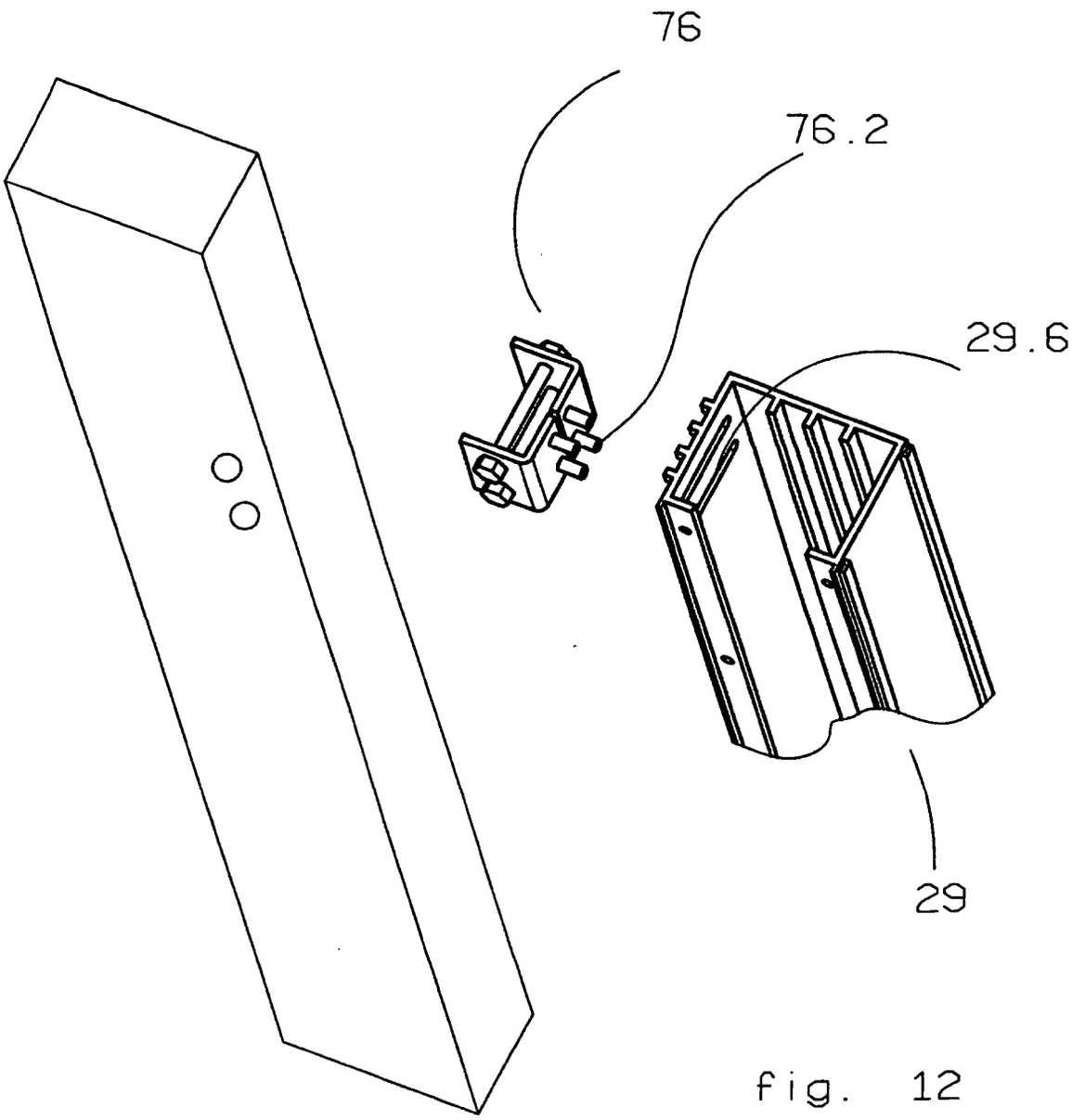

fig. 12