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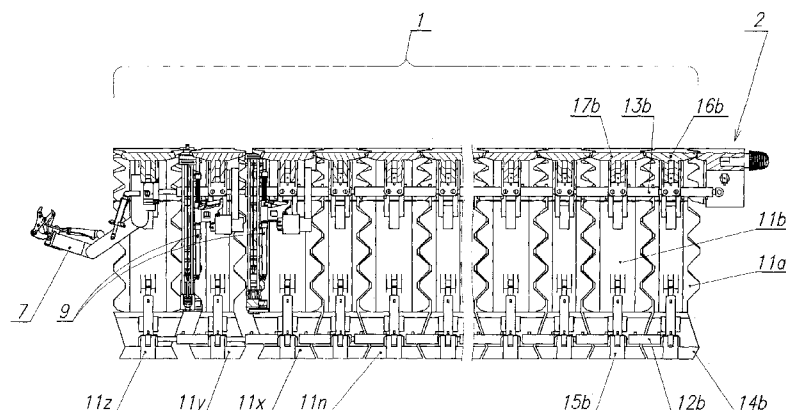


Fig. 1

(57) Abstract: The set of machines for driving drifts includes self-advancing supports (1), which consists of a number of interlocking sections (11), the first section (11a), the second section (11b) up to the last section (11z). The first section (11a) is connected to the second section (11b) through two pairs of shifters, the lower pair (12) and the top pair (13). The front of the first section (11a) has the extracting machine (2) having a structure disclosed herein. In addition, a manipulator (7) is mounted to the last section (11z), and two anchor drill rigs (9) to the earlier sections. Also disclosed is a method of driving drifts.

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METHOD OF DRIVING DRIFTS AND A SET OF MACHINES FOR DRIVING DRIFTS

5 The object of the invention is a method of driving underground drifts and a set of machines for driving drifts, including self-advancing supports and a cutting drum.

 The specification of Patent No. DAS 1156738 presents self-advancing supports, which consist of three sections parallel to each other, connected to each other via
10 shifters located at the floor. A section consists of two segments, symmetrical relative to the vertical axis of the cross section of the drift, connected by a straight joint, with an axis parallel to the drift and located centrally under the roof of the drift. This segment consists of a roof arch connected with overlap to the side wall arch resting on a prop attached to a skid. The roof arch has a roof-bar attached to it in the shape of
15 a comb, with teeth parallel to the axis of the drift and entering into the gaps in the roof-bar mounted to the adjacent section.

 The first section, starting from the front of the face, is connected to the second section via the first shifter mounted between the props. The second section is connected to the third section in the same manner. In contrast, the sections of the self-
20 advancing supports are controlled from the generator located under permanent, final supports which are located behind the third section.

 In a state where the sections are pulled off, for example when mining the face, their roof-bars entirely cover the roof. In contrast, during the advance of the supports, holes occur temporarily between the roof-bars of adjacent sections, in connection
25 with the shift of the teeth in the gaps. Spreading of a section occurs as a result of clamping the arches with the roof-bars to the roof. And in order to shift a section, the props are drawn off, roof-bars lowered, then through the shifters, connecting this section with the adjacent, spread-out section, it is moved to the new location. The joint connecting section segments allows, during the lengthwise shifting of the
30 section, to move the skid if necessary in the direction of the axis of the drift, so that the given segment has no contact with the side wall.

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In turn, the specification for Patent No. PL 88 164 describes self-advancing supports, which consist of two sets connected with shifters, wherein each set consists of two interconnected sections. A section in turn consists of two segments joined at the roof with a straight joint. A segment consists of the roof arc connected to the side wall arch via a ball joint, wherein the side wall arch is supported by a prop. Shifters are attached to the roof arches approximately in the middle of their length. Angle struts are attached to both segments of a single section, whose second ends are attached to the piston rod of an actuator suspended in the axis of the straight joint, so that the protrusion of the piston rod pushes the segments to the side wall. In order to support the roof and the lining the inside of the drift, the set is equipped with a series of beams parallel to each other, between which there are beams from the adjacent set. In the solutions known from the Patent No. PL 97 625 or PL 95 368, section segments are expanded laterally by the actuator arranged between horizontally.

However, the specification of Patent No. PL 194412 B1 describes supports which in the side wall section also contain horizontally arranged beams penetrating into the spaces between the respective beams from the adjacent set, and all sections are based on two travelways that lie on both sides of the drift.

The specification of Patent No. PL 137926 describes a roadheader for driving circular drifts, which contains the main full profile cutting drum, wherein the axis of the main cutting drum has an auxiliary cutting drum attached, with a smaller diameter than the main cutting drum. The face of the auxiliary cutting drum precedes the face of the main cutting drum, so that the driving of the drift proceeds in two stages, allowing for better use of the power of the engines driving the roadheader, than it is in the case of driving the drift with a full profile.

In turn, the specification of Patent No. GB 1,462,604 describes a roadheader for driving circular drifts with a full profile, in which the head is mounted pivotally to the axis of the body, and on the sides it is connected to it by means of two horizontal actuators. Protrusion of the piston rod of the first actuator, with the simultaneous withdrawal of the piston rod of the second actuator, results in deflection of the head, and thus driving of the drift on an arc. Specification of Patent No. PL 113949 B1 describes a machine for digging tunnels in the ground. The machine has a ring with a diameter greater than the dimension of the housing, sharpened on the face side. The

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ring is forced into the ground through a series of actuators arranged in its interior. The undisturbed soil surrounded by the ring is driven via a bucket attached to the articulated boom, and the excavated material is removed with a series of conveyors.

5 The essential feature of the method of driving a drift, in which the face is driven in a known manner and the resulting excavated material is removed, and the self-advancing supports are moved with the progress, and if necessary, the roof or side walls are braced, consists of the fact that prior to the driving, a recess is made in the roof section of the drift, after which a roof-bar is inserted into it. The face is driven
10 using a roadheader.

The roof-bar is preferably equipped with a cutting drum and is an independent extracting machine.

The recess, depending on the design and principle of operation of the roadheader, is driven after slotting in a single cycle or in several stages, wherein in one cycle an
15 alternative cutting drum is slotted, after which the body of coal is driven, and so on, until the desired recess depth is achieved, or the recess is made correctly with the full profile using a second, alternative machine having a number of cutting drums. The recess is preferably driven with a profile slightly larger than the profile of the roof part of the self-advancing supports and prior to the driving of the rest of the face.

20 During the driving of a drift, the final supports are preferably done at the same time, including the construction of sets or by anchoring the rock mass.

The essential feature of self-advancing supports for drifts, which contain a series of sections parallel to each other and connected via shifters, wherein a section consists of two segments attached pivotally to the drift axis, and also connected via
25 the actuator attached between their roof parts, and where each segment has a prop, lies in the fact that the first section has projections and depressions meshing with the corresponding elements of the second section, so that the self-advancing supports in a fully retracted position cover the drift roof. A manipulator is preferably attached to the last section of the supports, and the first anchor drill rig is attached to the
30 penultimate section. The machine extracting the recess is attached to the first section. The first section is preferably comprised of two segments, left segment and right segment which is the mirror image of the left segment respective to the plane passing

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through the pivot connecting them. The left segment consists of a left foot connected slidably with the side wall element, which in turn connects to the left roof-bar provided with eyes. The left foot is also preferably connected with the side wall element via the prop set at an acute angle to the vertical plane and inclined towards the side wall. The side wall element is connected to the left roof-bar preferably by means of a straight joint. The essential feature of the extracting machine mounted on the route, comprising a body, a motor and a cutting drum, lies in the fact that the route is fixed from the bottom to the lining, also referred to as a roof-bar, which is convex.

10 The lining contains several recesses and protrusions respectively interlocking with projections and recesses in the first section, so that the lining constitutes an extension of the roof parts of the self-advancing supports.

The cutting drum preferably has a cylindrical shape and its axis is oriented at an acute angle relative to the horizontal plane. The cutting drum preferably has a series of teeth arranged along a helical line with a number of coils surrounding a cylindrical core.

15 In another version, the cutting drum consists of a front cutting part and a transport part in the form of a screw, while its axis is substantially horizontal. In another version, the cutting drum consists of a number of drilling bodies arranged one after the other along a curved line. The route preferably is composed of two parallel tracks, and each track equipped with a ledge directed towards the other track, and also has a ladder arranged in parallel. Accordingly, the body of the machine is equipped with rollers adjacent on both sides to the ledge and gears working with the ladders, whereby, a hydraulic motor is mounted to the body, driving the gears and the cutting drum. The essential feature of the set of machines for driving drifts, comprising of self-advancing supports and a roadheader, lies in the fact that the front of the self-advancing supports has an extracting machine attached which drives the recess with a height greater than the height of the set profile but much less than the height of the drift, whereas the extracting machine also has the function of early-bearing props.

20 25 30 A loader preferably preferably is attached to the roadheader, with a feeder attached to it, whose hopper is slidably mounted on or above the conveyor. The loader preferably is suspended on the transport set, on which a dust collector is also suspended.

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A manipulator is attached to the last section of the self-advancing supports, and the first anchor drill rig is attached to the another section.

The cutting part of the cutting drum preferably precedes the roadheader head.

5 The method of driving drifts and the set of machines for driving drifts according to the invention allow for mining the face by a roadheader which is continuous and independent of other work. Also, the assembly of support arches or bracing is also independent of the work of the roadheader.

10 In addition, driving of the recess in the mine face in the shape of a roof-bar of arched supports while keeping the extracting machine there acting at the same time as a prop ensures an immediate and continuous support of the roof to protect it against separation during subsequent mining by a roadheader. Moreover, remotely control of the set is possible, allowing for removing people from the mine face, and thus increasing the safety and health at work.

15 The object of the invention is illustrated in the examples of design versions in schematic drawings, in which:

- Figure 1 shows a longitudinal section through the self-advancing supports,
- Figure 2 shows the drift outside the supports,
- Figure 3 shows a top view of the supports, from the direction W_1 indicated in Fig. 1,
- Figure 4 shows a view of a section of the supports,
- Figure 5 shows the extracting machine in an axonometric view,
- Figure 6 shows the extracting machine in a side view,
- Figure 7 shows the cutting drum,
- Figure 8 shows an alternative extracting machine,
- Figure 9 shows a schematic diagram of trajectories of mining the recess,
- Figure 10 shows the face of the self-advancing supports equipped with a second, alternative extracting machine,
- Figure 11 shows the method of vertical correction of supports,
- Figure 12 shows the method of horizontal correction of supports,

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- Figure 13 shows the arrangement of cutting drums during excavation, in a side view,
- Figure 14 shows the arrangement of cutting drums during excavation, in a top view.

5

The set of machines for driving a drift comprises of self-advancing supports hereinafter referred to as supports (1), to the front of which an extracting machine is mounted (2), wherein the mine face is generally mined using the roadheader not shown in the picture, from which excavated material is discharged through feeders attached thereto (3) onto the tray (4) and further to a conveyor (5). The dust collector (6) is suspended above the tray (4). The manipulator (7) for installing the sets (8) is mounted to the last section of the supports (1) counting from the front, while two anchor drill rigs (9) are attached to the earlier sections of the supports (1).

Figure 1 shows a longitudinal section through the supports (1), to the front of which the extracting machine (2) is mounted. Supports (1) consist of a number of interlocking sections (11), the first section (11a), the second section (11b) up to the last section (11z) counting from the mine face. The first section (11a) is connected to the second section (11b) through two pairs of shifters, the lower pair (12) and the top pair (13). The lower pair (12) consists of two shifters parallel to each other and substantially to the floor, the first shifter (12a) and the second shifter (12b), whereas the second shifter (12b) is mounted between the right foot (14b) of the first section (11a) and right foot (15) of the second section (11b). The top pair (13) consists of two shifters parallel to each other and substantially to the floor, the third shifter (13a) and the forth shifter (12b), whereas the forth shifter (12b) is mounted between the right roof-bar (16b) of the first section (11a) and right roof-bar (17b) of the second section (11b). Each two adjacent sections are respectively connected to each other.

Figure 2 shows a part of the set of machines for driving drifts following the self-advancing supports (1). A number of sets (8) was installed using the manipulator (7), as the mining advanced. One end of the feeder (3) is attached to the roadheader not shown in the picture, and the second is suspended from the trolley (19) mounted on the track (20) of a suspended cableway. To the second end of the feeder (3), a return station (21) of the tray (4) are attached, the output of which is slidably

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mounted on the conveyor (5) which is a section of the main discharge line. The trolley (19) is part of the conveying unit (22) to which the dust collector (6) is also attached.

Figure 3 shows the self-advancing supports (1) with the extracting machine (2) in top view. Supports (1) consist of a number of interlocking sections (11), the first section (11a), the second section (11b) up to the last section (11z) counting from the mine face. The manipulator (7) is mounted to the last section (11z), the first anchor drill rig (9a) is mounted to section (11y), and the anchor drill rig (9b) to the next section (11x). The line of contact (24) of the first section (11a) with the second section (11b) has the shape of a broken line, so that the projections (25) of the first section shell (11a) enter the recesses (26) in the second section shell (11b). The front of the first section (11a) has the extracting machine (2) attached, equipped with the cutting drum (27).

Figure 4 shows the first section (11a), as seen from the direction W_2 indicated in Figure 3. The first section (11a) is comprised of two segments, left segment (28) and right segment (29) which is the mirror image of the left segment (28) respective to the plane passing through the pivot (30) connecting them. The left segment (28) comprises of a left foot (14a) connected slidably to the side wall element (31), which in turn is connected with the left roof-bar (17a) whose end is provided with eyes (32), through which the pin (30) is inserted. The left foot (14a) is also connected to the side wall element

(31) through a prop (33), positioned at an acute angle to the vertical plane, so that as a result of ejecting the piston rod (34) there is a simultaneous pressing of the side wall element (31) to the side wall and the left roof-bar (17a) to the roof.

Moreover, the left segment (28) is connected with the right segment (29) through the actuator (35) arranged horizontally, which provides additional expansion thereof.

The side wall element (31) is connected with the left roof-bar using a straight joint (36) with an axis parallel to the axis of the pivot (30). The side wall element (31) consists of a support element (37) and the shell (38) covering it from the outside. The shell (38) has projections (25) and depression (26). The construction of the left roof-bar (17a) is suitable. Movement of the supports is based on cyclical driving of one section and shifting it relative the expanded adjacent section by a predetermined

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advance by means of two pairs of shifters, the bottom pair (12) and the top pair (13) and then expansion between the roof and the floor using props (33) and the actuator (35).

Figure 5 shows the extracting machine (2) in an axonometric view in front of the mine face (40) with the recess (41) formed by the cutting drum (27). The extracting machine (2) comprises of lining (42) provided with a route from the bottom (43) on which the extraction unit (44) is mounted, fitted with the cutting drum (27). The lining (42) is convex and its shape corresponds to the shape of the roof part of the first section (11a), and has a number of depressions (45) and projections (46) on its side, respectively meshing with the projections (25) and depressions (26) in the first section (11a). This makes the lining (42) an extension of the self-advancing supports (2).

The route (43) is composed of two parallel tracks (43a, 43b), and each track (43a, 43b) is equipped with a ledge (47) directed towards the other track, and also has a ladder (48) arranged in parallel. The route (43) has the extraction unit (44) attached, which consists of a body (49) provided with rollers (50) adjacent on both sides to the ledge (47) and gears (51) cooperating with the ladders (48). The body (49) has a hydraulic motor (52) mounted, which drives the gears (51) and the cutting drum (27) via a transmission (53).

Figure 6 shows a section through the extracting machine (2) during the mining of the recess (41). The extracting machine (2) comprises of lining (42) provided with a route from the bottom (43) on which the extraction unit (44) is mounted, fitted with the cutting drum (27). The lining (42) is convex, its shape corresponds to the shape of the roof part of the first section (11a), and has a number of depressions (45) and projections (46) on its side.

The route (43) is composed of two parallel tracks, and each track equipped with a ledge (47) directed towards the other track, and also has a ladder (48) arranged in parallel. The route (43) has the extraction unit (44) installed, which has a hydraulic motor (52), which drives the cutting drum (27) via a transmission (53). The axis of rotation (54) of the cutting drum (27) is oriented at an acute angle relative to the horizontal plane, so that gravity can assist in the removal of excavated material from the recess (41) to the face. In this case the recess (41) is excavated to the target depth

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at once. Slotting of the cutting drum (27) is made possible by the top pair of shifters mounted between the extracting machine (2) and the first section (11a).

Figure 7 shows the cutting drum (27) in a side view. The cutting drum (27) has a series of teeth (55) arranged along a helical line with a number of coils
5 surrounding a cylindrical core (56).

Figure 8 shows a section through an alternative extracting machine (57) during the excavation of the recess (58). The extracting machine (57) comprises of lining (59) provided with a route from the bottom (60) on which the extraction unit (61) is mounted, fitted with the cutting drum (62). The lining (59) and the route (60) are the
10 same as the lining (42) and the route (43) in the basic version.

The route (60) has the extraction unit (61) installed, which has a hydraulic motor (62), which drives the alternative cutting drum (27). The axis of rotation of the alternative cutting drum (63) is horizontal. Slotting of the alternative cutting drum (63) is made possible by the top pair of shifters (13) mounted between the extracting
15 machine (2) and the first section (11a).

The alternative cutting drum (63) comprises a front cutting section (64) and the transport section (65) in the form of a screw, which discharges excavated material outside the recess (58). The height of the recess (58) is greater than the height of the set profile (8) and considerably smaller than the height of the heading driven.

Figure 9 shows a diagram of the trajectory of mining the recess (58) using the
20 alternative cutting drum (63). The length (L) of the front working section of the cutting part (64) is smaller than the total length of the alternative cutting drum (63) and smaller than the final depth of the recess (58), hence after slotting the alternative cutting drum (63) to a depth equal to length (L), excavation is performed from one
25 side to the other, and once again the alternative cutting drum (63) is slotted to the same depth and excavation is performed in the opposite direction. These steps are repeated until the recess (58) is excavated to the target depth. The trajectory (65) of excavation of the recess consists of several sections with length (L), corresponding to the slotting, connected by lines (U) corresponding to the mining process.

Figure 10 shows the face of the self-advancing supports (1) equipped with a
30 second, alternative extracting machine (67) attached to the first section (11a). The second, alternative extracting machine (67) comprises a series of drilling bodies (68)

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arranged one after the other along a curved line corresponding to the shape of the roof part of the self-advancing supports (1). Anchor drill rigs (9) are visible within the clearance of the self-advancing supports (1), fixed to it in a later section. In this case, the excavation of the recess occurs as a result of advance of the whole
5 alternative extracting machine (67) into the body of coal.

Figure 11 shows the method of correcting the vertical line of advance of supports, thereby changing the direction of excavation of the heading, shown in the drawing, which shows a longitudinal section of the self-advancing supports (1) in a vertical plane. In order to excavate upwards, after moving the first section (11a) forwards, the
10 top pair shifters (13), including the fourth shifter (13b) are slid off completely, and the lower pair (12), including the second shifter (12b) is stopped in advance so that its static length is greater than the length of the fourth shifter (13b) which causes that the axis of the supports is curved towards the top. Accordingly, the housing axis curves towards the bottom.

Figure 12 shows the method of horizontal correction of the supports shown in the drawing, which shows a longitudinal section of the self-advancing supports (1) to the horizontal plane, parallel to the floor. It runs similarly, whereas for this purpose the difference in the advance is created between the lying shifters on one side of the supports (1), including the first shifter (12a) and the shifters on the other side of the
20 supports, including the second shifter (12b). The result is a twist of the heading to the left or to the right.

Figure 13 shows the method of driving a heading, on a longitudinal section of the heading in a vertical plane. Alternate cutting drum (64) made a recess (58) while the extracting machine entered into it securing the roof for works carried out by a
25 roadheader, whose head (70) safely drives the body of coal below the recess (58).

Figure 14 shows a longitudinal section of the heading in horizontal plane parallel to the floor. The front face of the recess (58), which is rectangular, precedes the front of the works carried out by a roadheader. The roadheader, with the exception of the recess, mines the remaining profile of the heading for the target supports.

CLAIMS

1. The method of driving a drift, in which the face is driven in a known manner and the resulting excavated material is removed, and the self-advancing supports are moved with the progress, and if necessary, the roof or side walls are braced, wherein prior to the driving, a recess (41, 58) is made in the roof section of the drift, after which a roof-bar is entered into it.
2. The method according to claim no. 1 is characterised in that the heading is driven using a roadheader.
3. The method according to claim no. 1 is characterised in that the roof-bar is equipped with a cutting drum (27, 63, 68) and constitutes an independent extracting machine (2, 61, 67).
4. The method according to claim no. 1 is characterised in that the recess (41) is driven after slotting in a single cycle.
5. The method according to claim no. 1 is characterised in that the recess (58) is driven in several steps, whereby the alternative cutting drum (63) is slotted in a single step, after which the body of coal is mined, and so on, until achieving the desired depth of the recess (58).
6. The method according to claim no. 1 is characterised in that during the driving of a drift, the final supports are done at the same time, including the construction of sets (8) or anchoring the rock mass.
7. The method according to claim no. 1 is characterised in that the recess (41, 58) is driven with a profile slightly larger than the profile of the roof part of the self-advancing supports (1).
8. The method according to claim no. 1 is characterised in that the recess (41, 58) is driven prior to mining the rest of the heading.
9. The method according to claim no. 1 is characterised in that the recess is made using a full profile using the second alternative machine (67) comprising a number of drilling bodies (68).

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10. The self-advancing supports for drifts, which contain a series of sections parallel to each other and connected via shifters, wherein the section consists of two segments attached pivotally to the drift axis, and also connected via the actuator attached between their roof parts, and where each segment has a prop, is
5 characteristic in that the first section (11a) has projections (25) and depressions (26) meshing with the corresponding elements of the second section (11b), so that the self-advancing supports (1) cover the drift roof in a fully retracted position.
11. The supports according to claim no. 10 are characterised in that a manipulator (7) is attached to the last section (11z).
- 10 12. The supports according to claim no. 10 are characterised in that the first anchor drill rig (9a) is attached to the penultimate section (11y).
13. The supports according to claim 10 are characterised in that the machine extracting (44, 61, 67) the recess (41, 58) is mounted to the first section (11a).
14. The supports according to claim are characterised in that the first section (11a) is
15 comprised of two segments, left segment (28) and right segment (29) which is the mirror image of the left segment (28) respective to the plane passing through the pivot (30) connecting them.
15. The supports according to claim no. 14 are characterised in that the left segment (28) consists of a left foot (14a) connected slidably with the side wall element
20 (31), which in turn connects to the left roof-bar (17a) provided with eyes (32).
16. The supports according to claim no. 14 are characterised in that the left foot (14a) is also connected with the side wall element (31) via the prop (33) set as an acute angle to the vertical plane and inclined towards the side wall.
17. The supports according to claim no. 14 are characterised in that the side wall
25 element (31) is connected to the left roof-bar (17) via the straight joint (36).
18. The extracting machine mounted on the route, comprising a body, a motor and a cutting drum, is characterised in that the route (43) is fixed from the bottom to the lining (42), which is convex.

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19. The machine according to claim no. 18 is characterised in that the lining (42) contains several depressions (45) and projections (46) respectively meshing with the projections (25) and depressions (26) in the first section (11a).
- 5 20. The machine according to claim no. 1 is characterised in that the lining (42) is an extension of the roof part of the self-advancing supports (1).
21. The machine according to claim no. 18 is characterised in that the cutting drum (27) has a cylindrical shape and its axis is oriented at an acute angle relative to the horizontal plane.
- 10 22. The machine according to claim 21 is characterised in that the cutting drum (27) has a series of teeth (55) arranged along a helical line with a number of coils surrounding a cylindrical core (56).
23. The machine according to claim no. 18 is characterised in that the cutting drum (63) comprises a front cutting part (64) and a transport part (65) in the form of a screw.
- 15 24. The machine according to claim no. 23 is characterised in that the axis of the cutting drum (63) is substantially horizontal.
25. The machine according to claim no. 18 is characterised in that the cutting drum consists of a number of drilling bodies (68) arranged one after the other along a curved line.
- 20 26. The machine according to claim no. 18 is characterised in that the route (43) is composed of two parallel tracks (43a, 43b); and each track equipped with a ledge (47) directed towards the other track, and also has a ladder (48) arranged in parallel.
- 25 27. The machine according to claim no. 18 is characterised in that the body (49) is equipped with rollers (50) adjacent on both sides to the ledge (47) and gears (51) working with the ladders (48), whereby, a hydraulic motor (52) is mounted to the body (49), driving the gears (51) and the cutting drum (27).

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28. The set of machines for driving drifts, comprising of self-advancing supports and a roadheader, is characterised in that the front of the self-advancing supports (1) has an extracting machine (2, 61, 67) attached, which drives a recess (41, 58) with a height greater than the height of the set (8) profile, but much smaller than the height of the drift, whereas the extracting machine (2, 61, 67) also acts as early-bearing props.
29. The set according to claim no. 28 is characterised in that the roadheader has a feeder (3) attached, to which a tray (4) is attached, which is slidably mounted on or above the conveyor (5).
30. The set according to claim no. 29 is characterised in that the feeder (3) is suspended from the transport assembly (22) to which the dust collector (6) is also suspended.
31. The set according to claim no. 28 are characterised in that a manipulator (7) is attached to the last section (11z) of the self-advancing supports (1).
32. The set according to claim no. 28 is characterised in that the first anchor drill rig (9a) is attached to the self-advancing supports (1).
33. The set according to claim no. 28 is characterised in that the cutting part (64) of the extracting machine (61) is in front of the roadheader head (70).

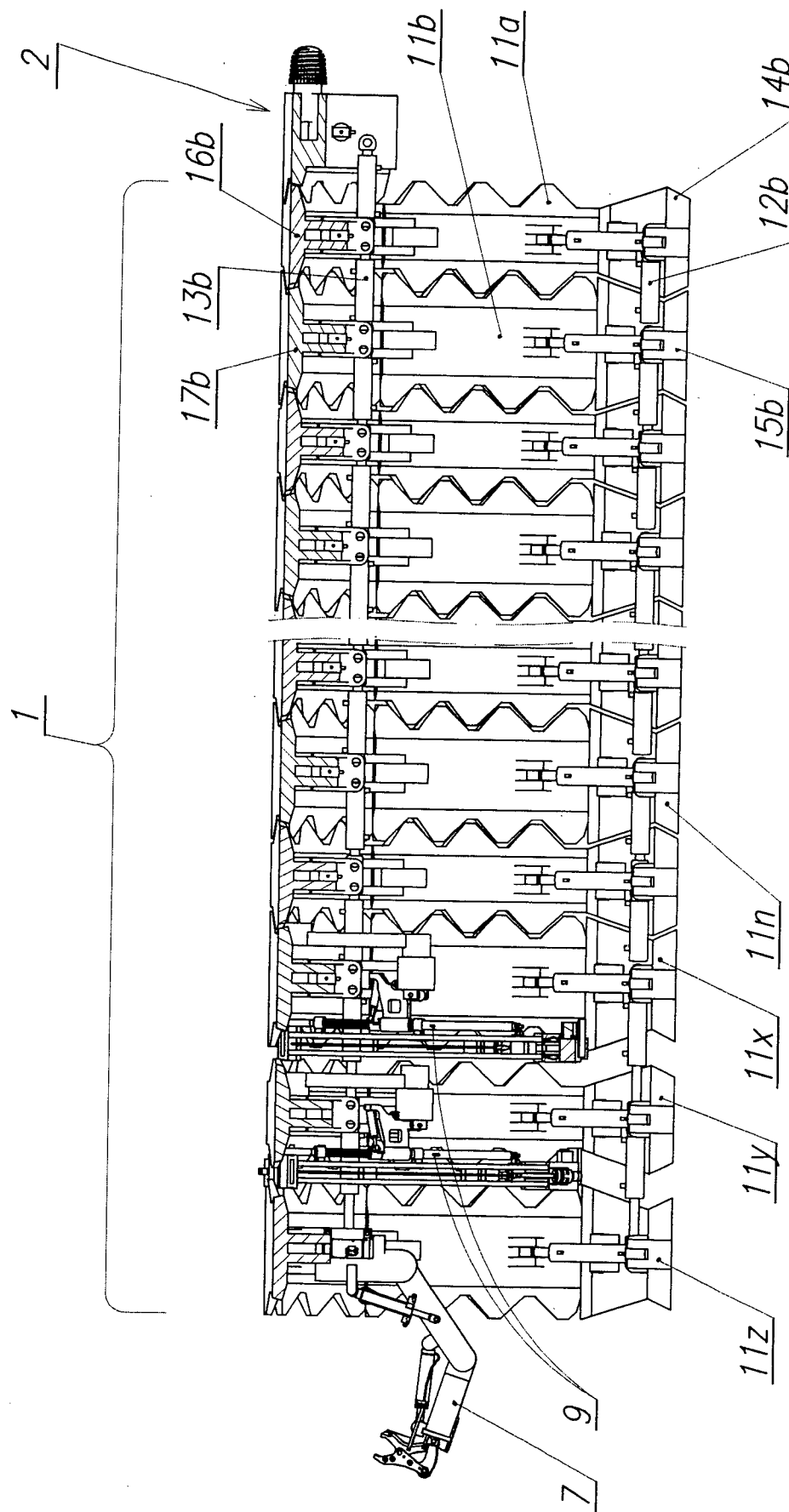


Fig. 1

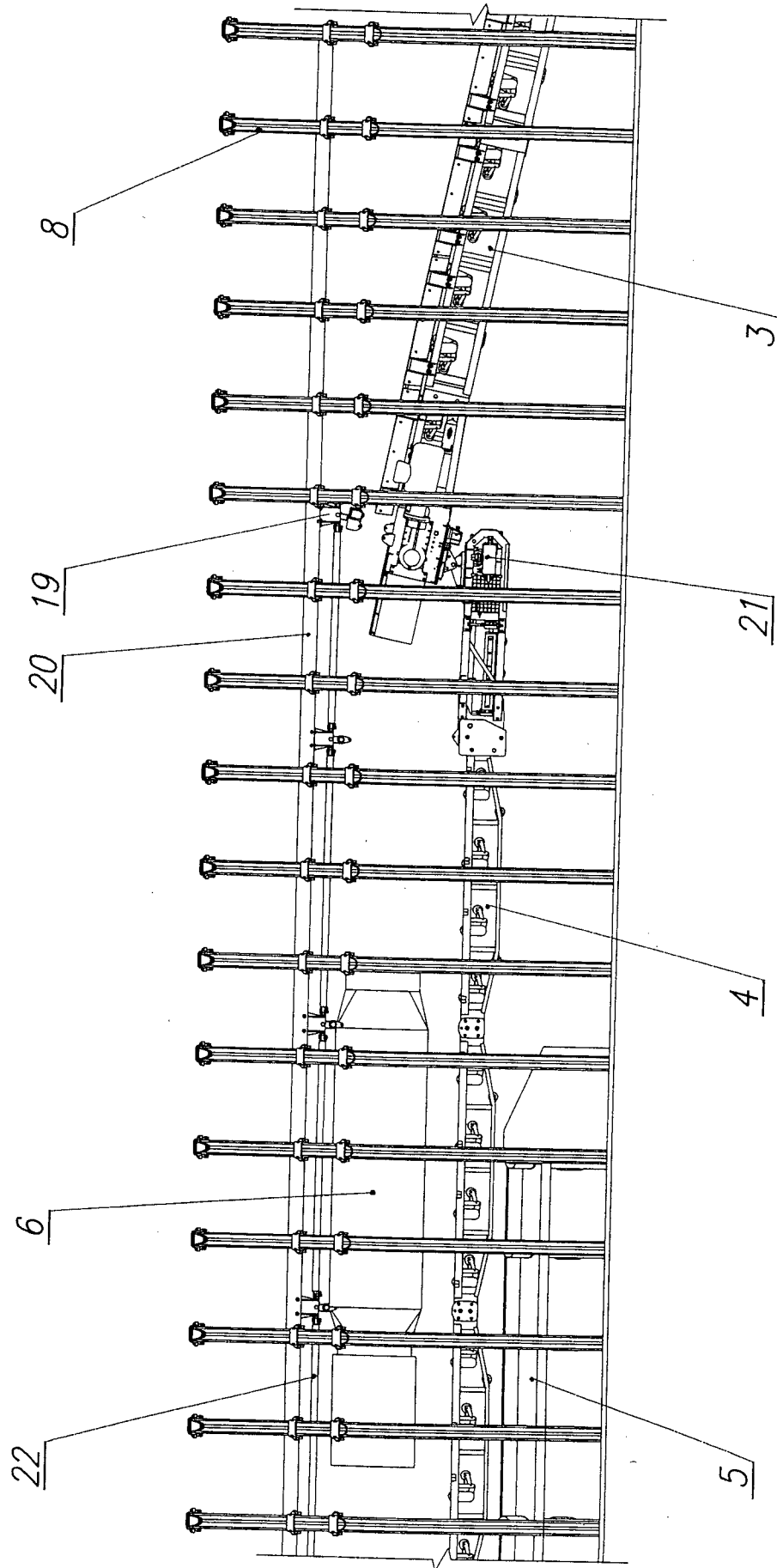


Fig. 2

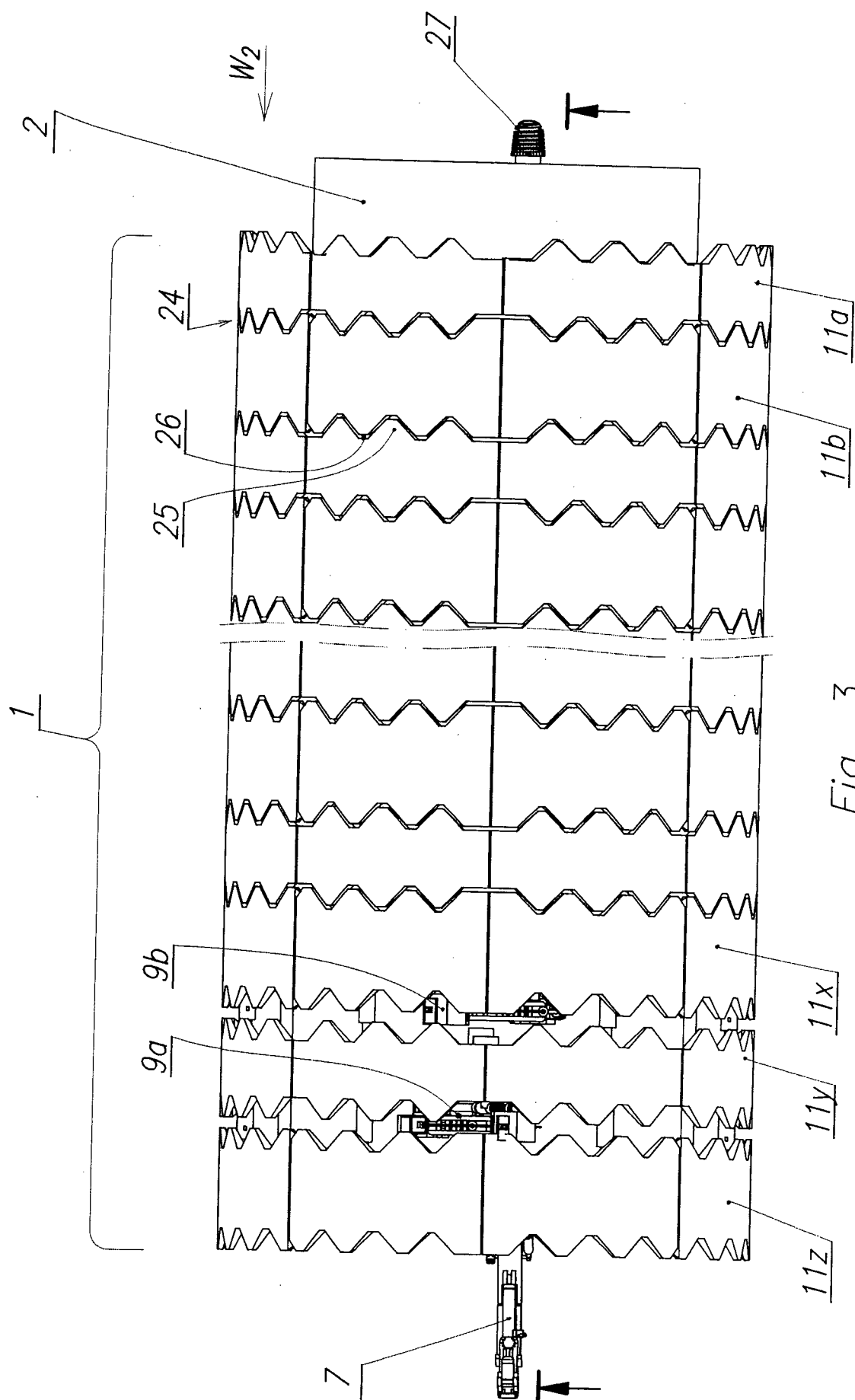


Fig. 3

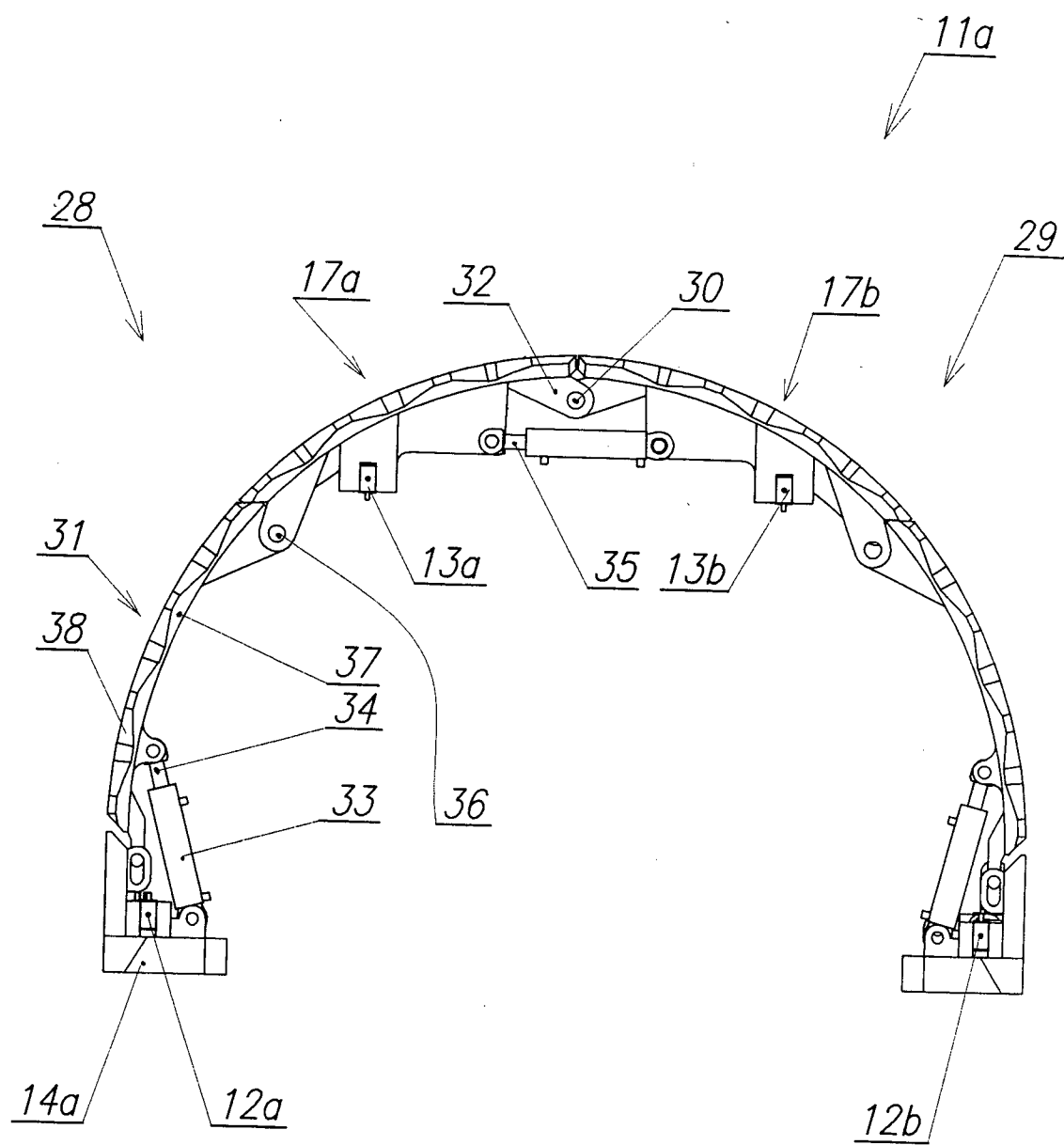
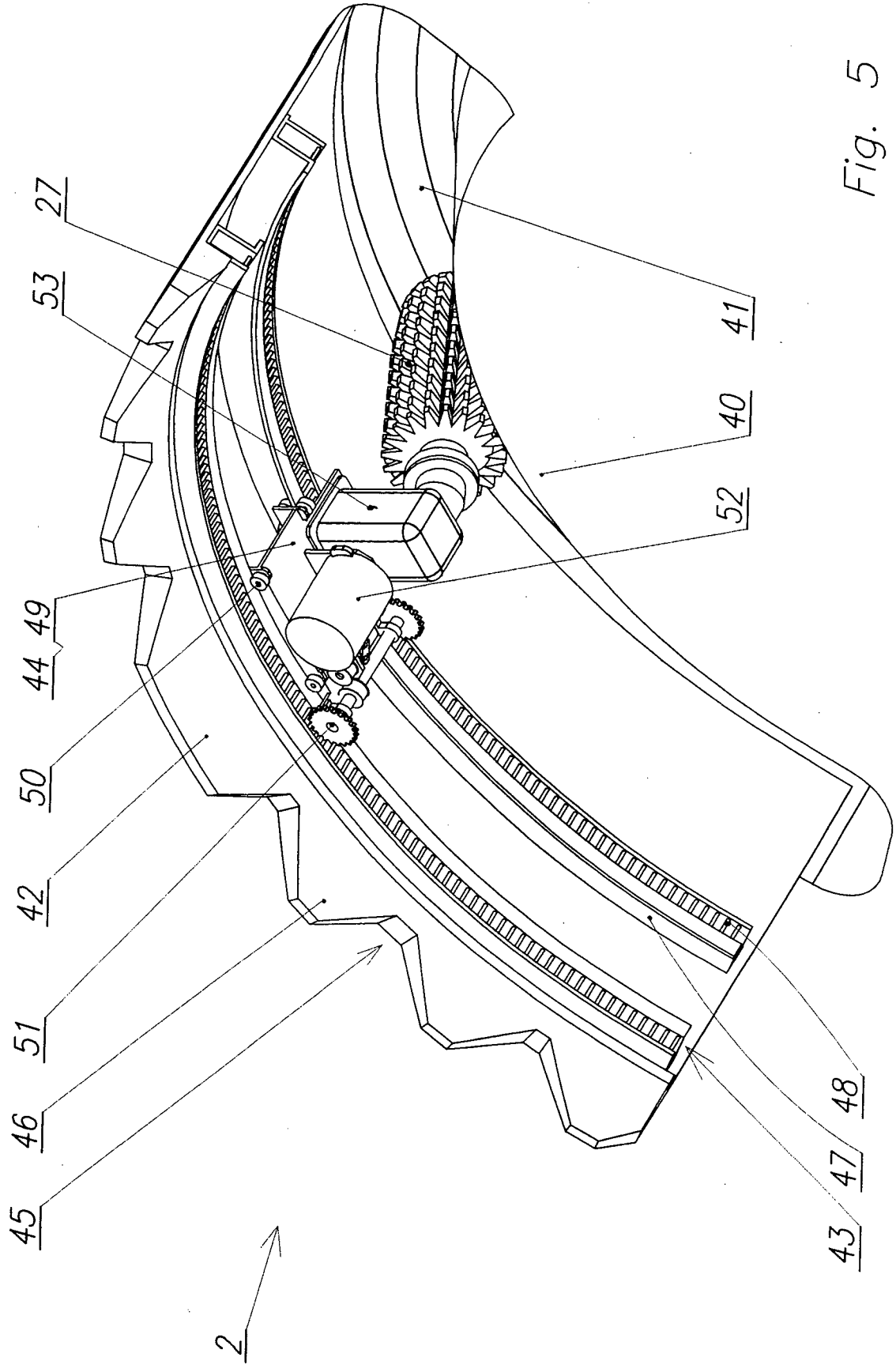


Fig. 4



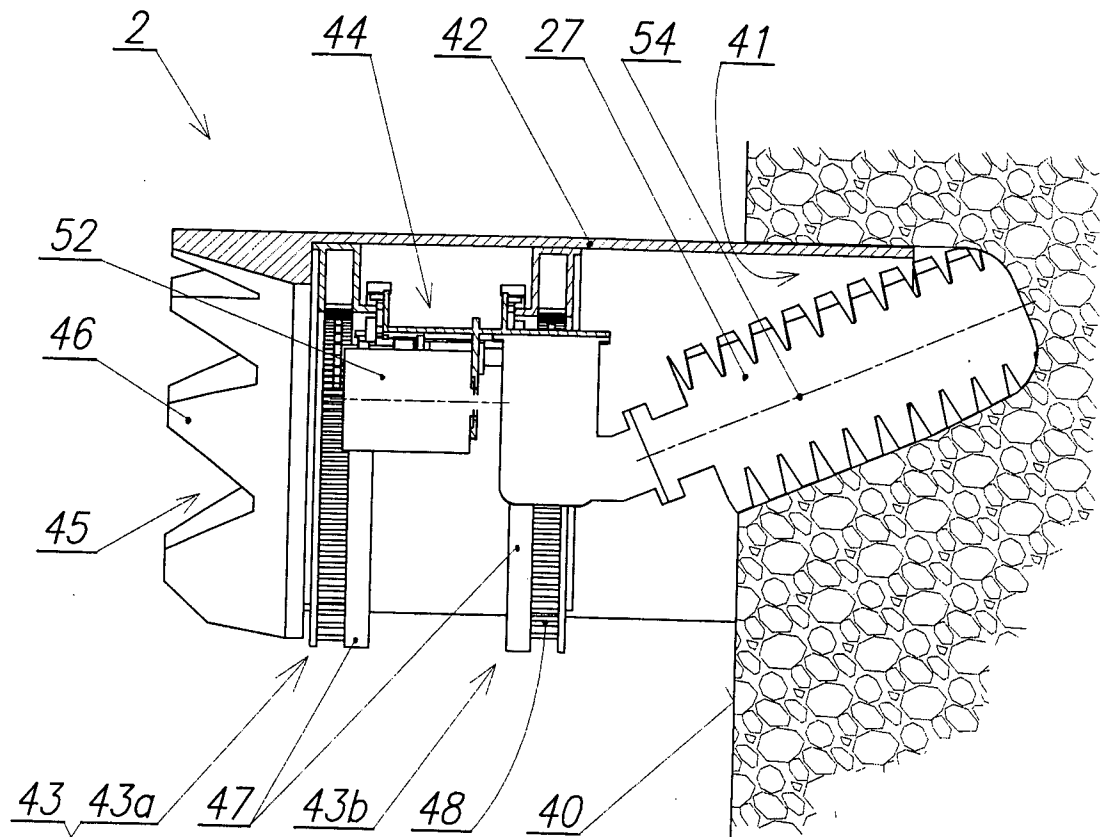


Fig. 6

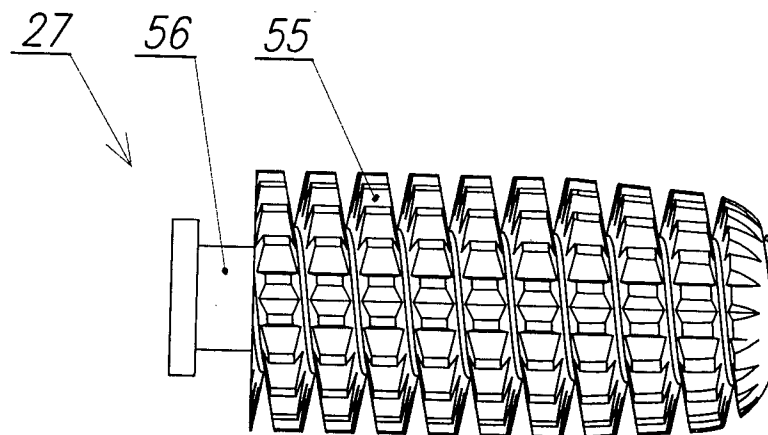
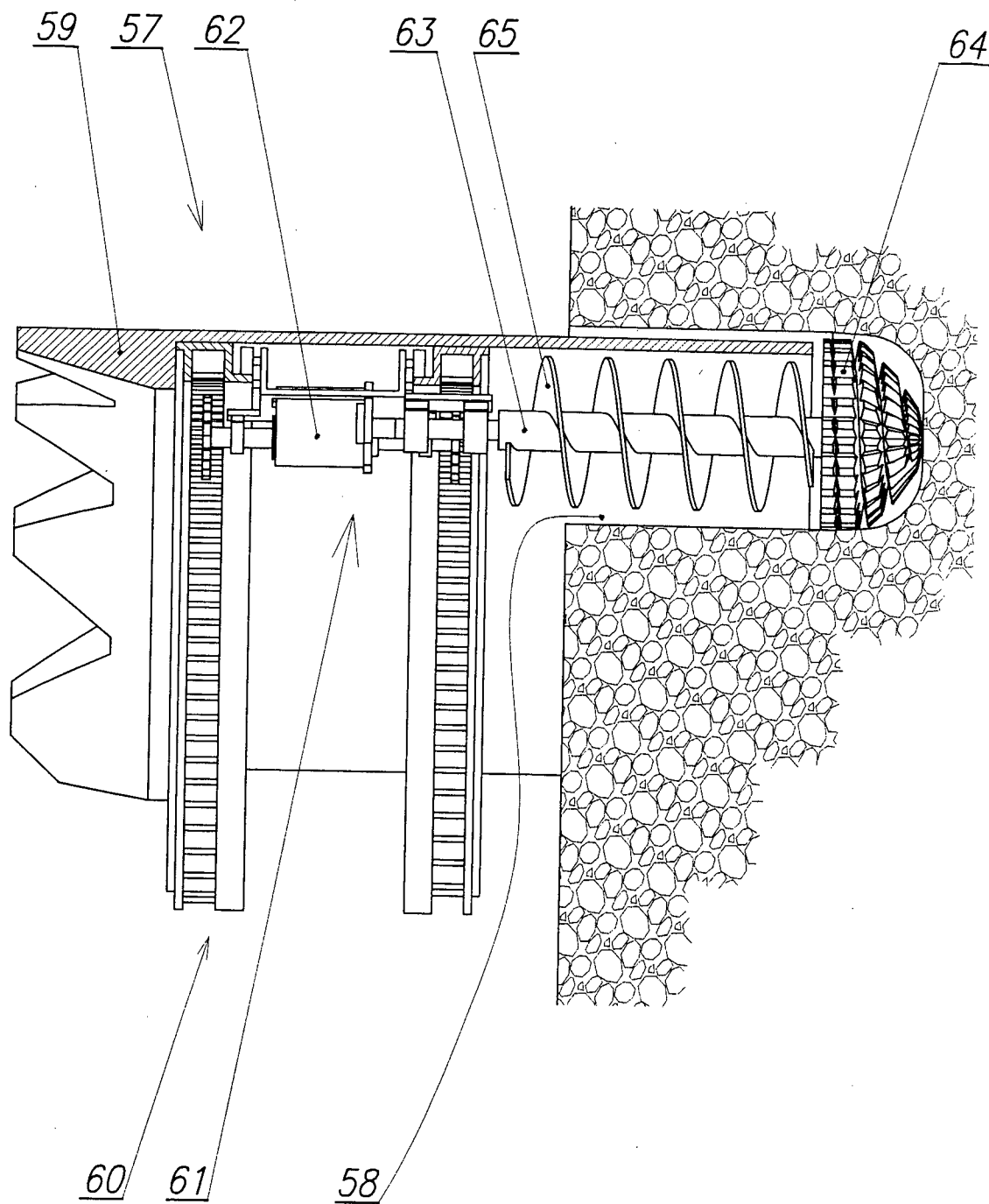
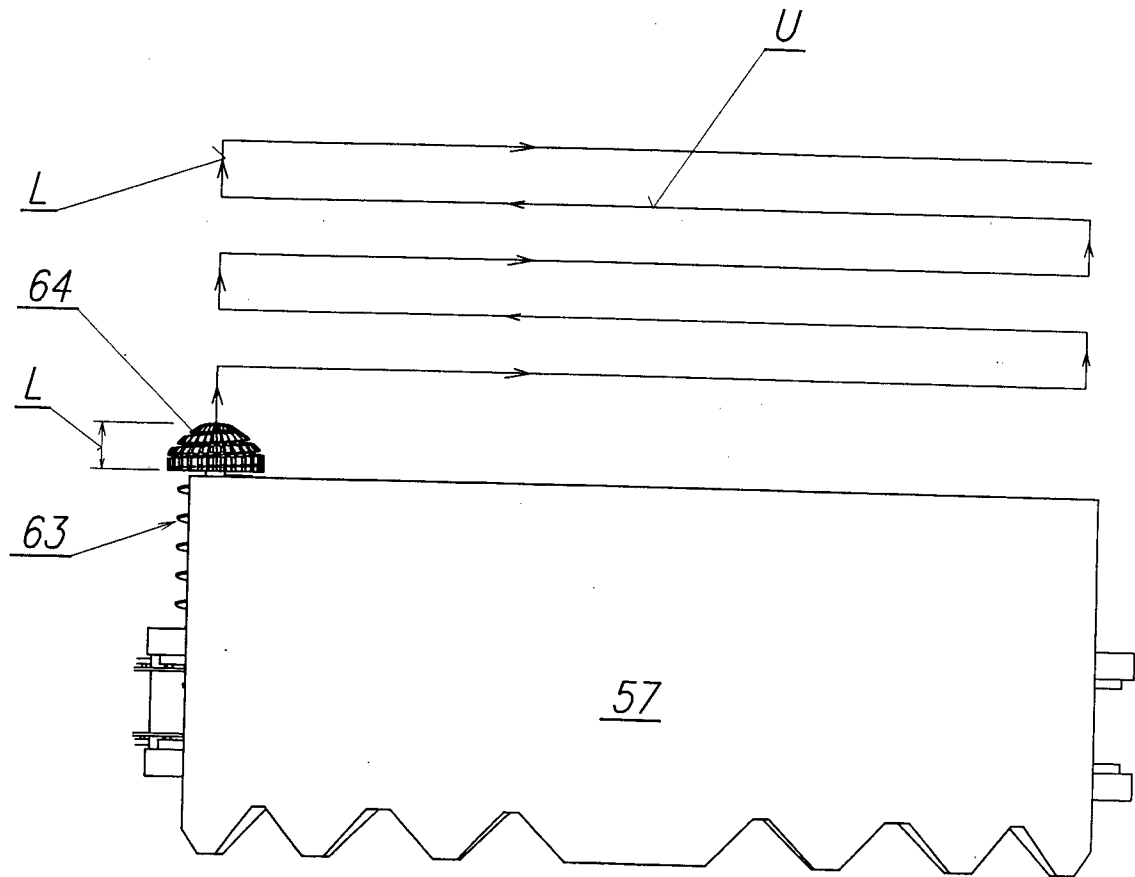


Fig. 7

*Fig. 8*

*Fig. 9*

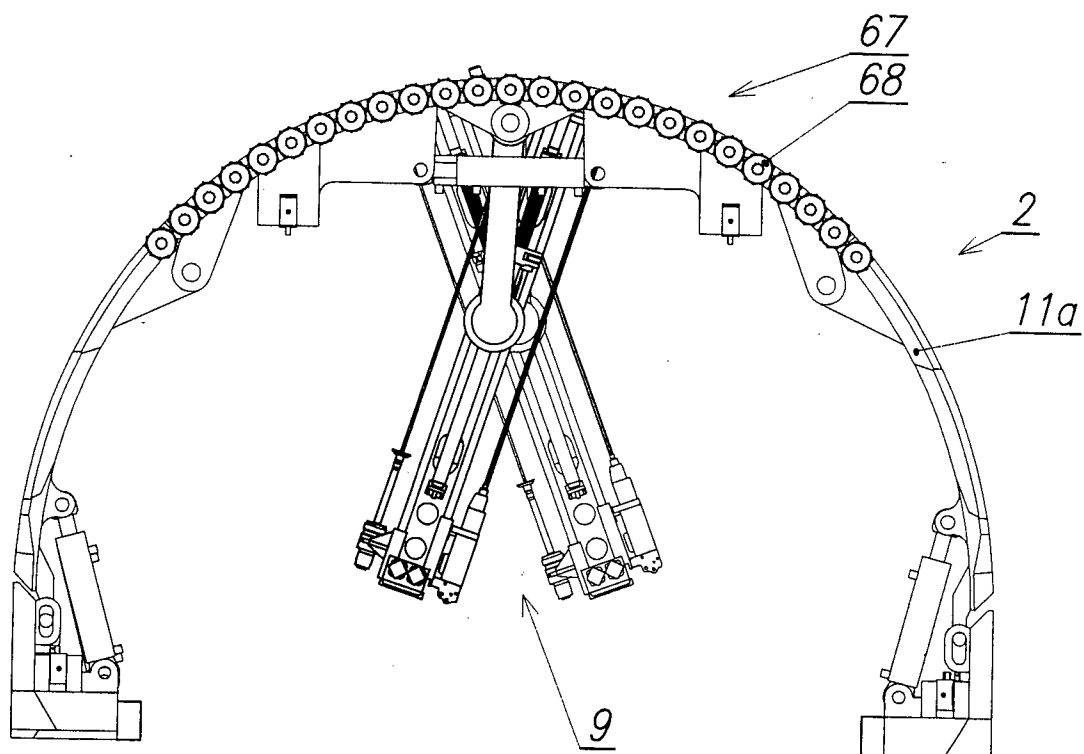


Fig. 10

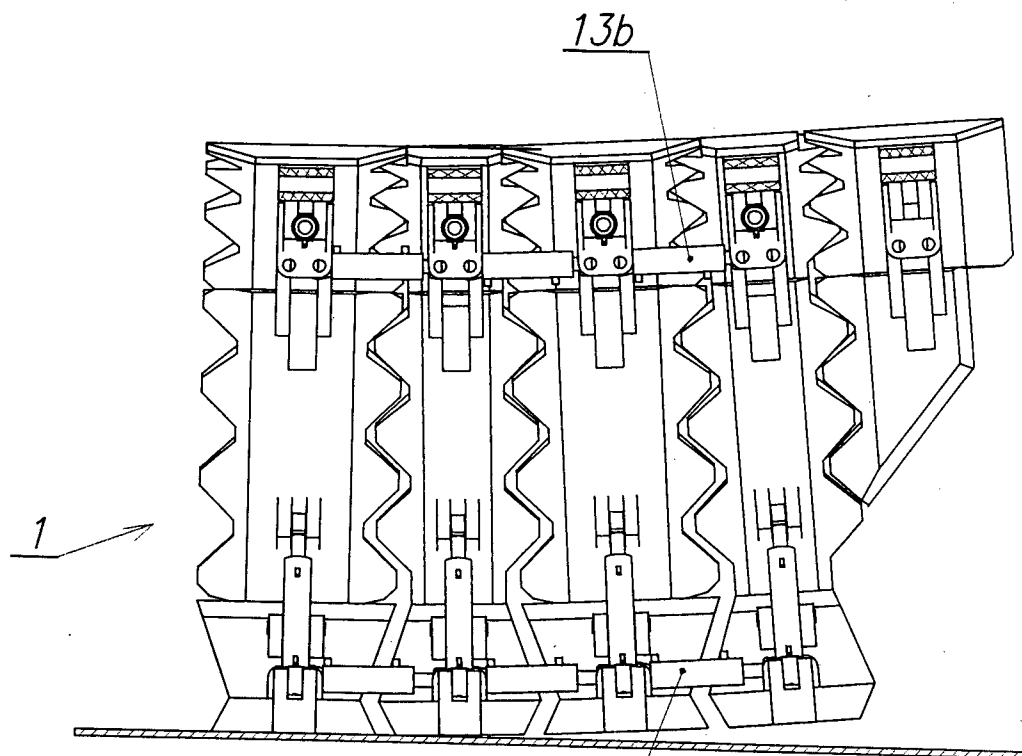


Fig. 11

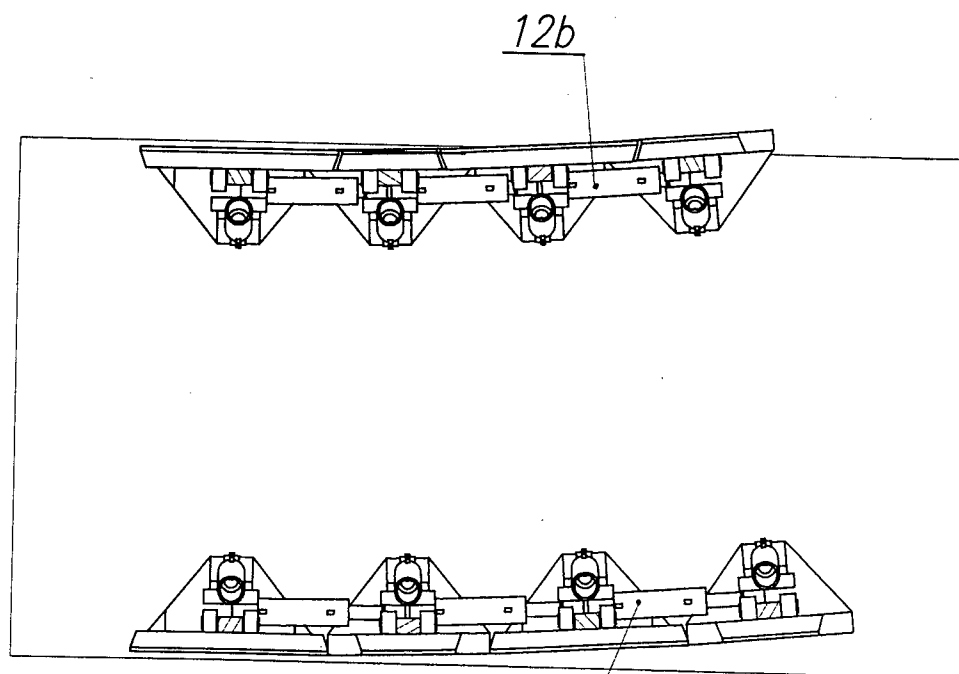


Fig. 12

