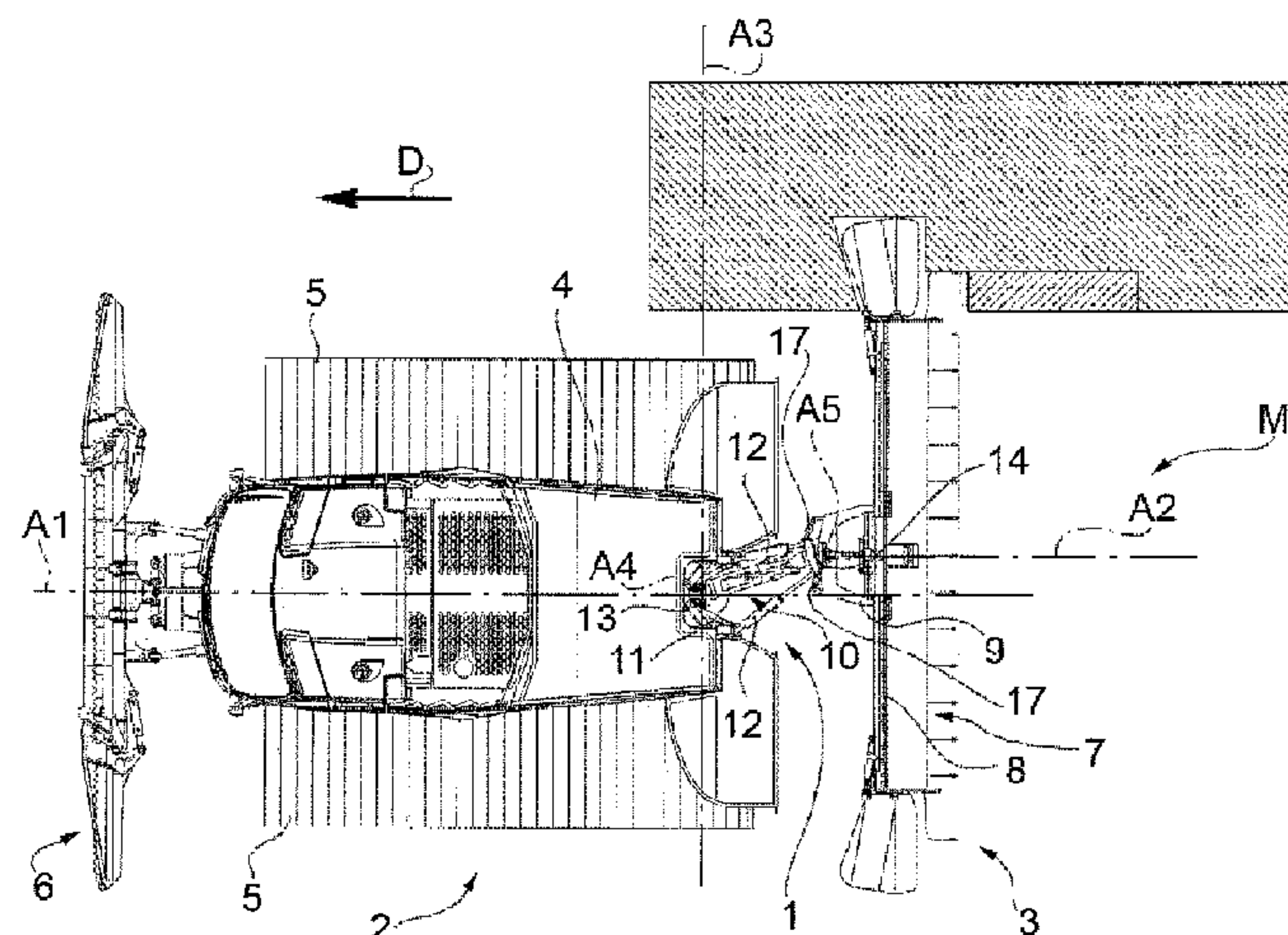




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(54) Titre : DISPOSITIF D'ATTELAGE PERMETTANT DE RELIER UN VEHICULE DE DAMAGE A UN OUTIL DE
DAMAGE DE PISTE DE SKI, ET PROCEDE DE COMMANDE FAISANT APPEL A CE DISPOSITIF D'ATTELAGE
(54) Title: HITCH DEVICE FOR CONNECTING A GROOMER VEHICLE AND A SKI SLOPE SNOW GROOMING
IMPLEMENT, AND CONTROL METHOD EMPLOYING SUCH A HITCH DEVICE



(57) **Abrégé/Abstract:**

A hitch device (1) for connecting a groomer vehicle (2) having a first frame (4) extending along a first axis (A1), and an implement (3), in particular a rotary snow tiller, for grooming the snow covering (M) of ski slopes and having a second frame (7) extending crosswise to and symmetrically with respect to a second axis (A2). The hitch device has an arm (10) hinged to the first frame (4) about a third axis (A3) perpendicular to the first axis (A1), and about a fourth axis (A4) perpendicular to the first and third axis (A1, A3); a first actuator (11) for adjusting the position of the arm (10) about the third axis (A3) with respect to the first frame (4) to lift and lower the implement (3); at least one second actuator (12) for adjusting the position of the arm (10) about the fourth axis (A4) with respect to the first frame (4); a movable coupling (14) movable between the arm (10) and one of the first and second frame (4, 7); and a third actuator (17) for adjusting the position of the arm (10) in a plane crosswise to the fourth axis (A4).

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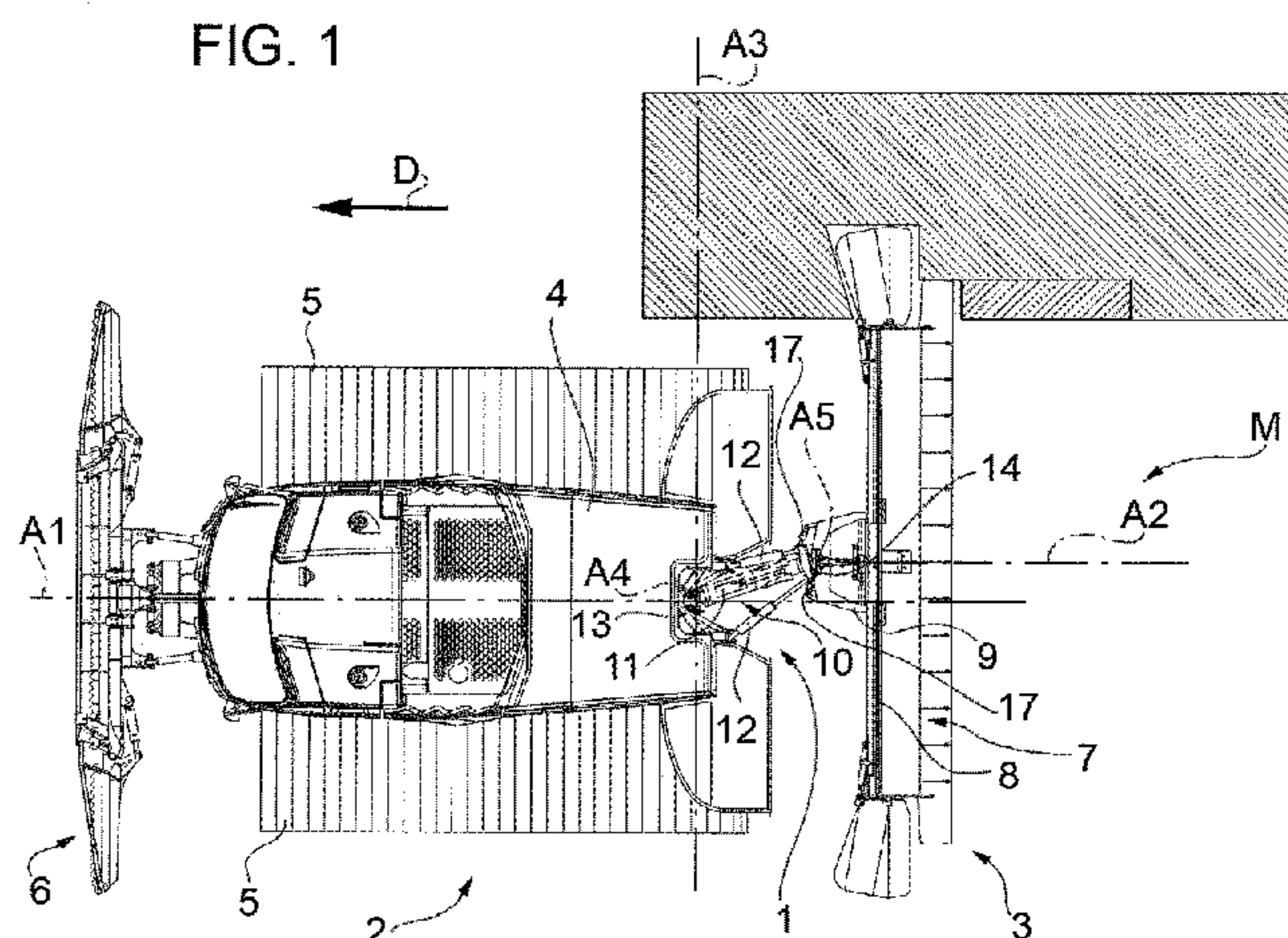
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(54) Title: HITCH DEVICE FOR CONNECTING A GROOMER VEHICLE AND A SKI SLOPE SNOW GROOMING IMPLEMENT, AND CONTROL METHOD EMPLOYING SUCH A HITCH DEVICE



(57) Abstract: A hitch device (1) for connecting a groomer vehicle (2) having a first frame (4) extending along a first axis (A1), and an implement (3), in particular a rotary snow tiller, for grooming the snow covering (M) of ski slopes and having a second frame (7) extending crosswise to and symmetrically with respect to a second axis (A2). The hitch device has an arm (10) hinged to the first frame (4) about a third axis (A3) perpendicular to the first axis (A1), and about a fourth axis (A4) perpendicular to the first and third axes (A1, A3); a first actuator (11) for adjusting the position of the arm (10) about the third axis (A3) with respect to the first frame (4) to lift and lower the implement (3); at least one second actuator (12) for adjusting the position of the arm (10) about the fourth axis (A4) with respect to the first frame (4); a movable coupling (14) movable between the arm (10) and one of the first and second frames (4, 7); and a third actuator (17) for adjusting the position of the arm (10) in a plane crosswise to the fourth axis (A4).

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HITCH DEVICE FOR CONNECTING A GROOMER VEHICLE AND A SKI
SLOPE SNOW GROOMING IMPLEMENT, AND CONTROL METHOD
EMPLOYING SUCH A HITCH DEVICE

5 TECHNICAL FIELD

The present invention relates to a hitch device for
connecting a groomer vehicle and a ski slope snow
grooming implement.

BACKGROUND ART

10 A groomer vehicle is normally a powered crawler
vehicle comprising a frame extending along a first axis;
and the snow grooming implement is normally a rotary
snow tiller drawn by the groomer vehicle and comprising
a second frame extending predominantly crosswise to and
15 symmetrically with respect to a second axis which, when
travelling along a straight path, is aligned with the
first axis, and, when travelling along a curved path,
forms an angle with the first axis.

 The hitch device comprises an arm or so-called boom
20 hinged to the first frame about a third axis
perpendicular to the first axis, and about a fourth axis
perpendicular to the first and third axis; a first
actuator connected to the first frame and the arm to
adjust the position of the arm about the third axis with
25 respect to the first frame; and at least one second
actuator connected to the first frame and the arm to
adjust the position of the arm about the fourth axis.

 The first actuator is actually a hydraulic cylinder

for lifting and lowering the arm to selectively lift and lower the rotary snow tiller with respect to the snow covering. The second actuator sets the angle between the first and second axis : when travelling along a straight path, the second actuator keeps the arm aligned with the first and second axis; and, when travelling along a curved path, the second actuator sets the arm to form a given angle with the first axis about the fourth axis.

Known hitch devices have proved highly effective, both in lifting and lowering the rotary snow tiller, and as regards manoeuvring around bends and stabilizing the position of the tiller.

In some ski slope grooming conditions, however, it is necessary for the rotary snow tiller to go over an already groomed strip of the snow covering without the groomer vehicle travelling over it.

Known hitch devices allow this to be done, but force the rotary snow tiller to operate in a skew position with respect to the travelling direction, which increases energy consumption and reduces grooming width.

Moreover, when travelling along a curved path, known hitch devices are not always able to position the rotary snow tiller to cover the prints left by the groomer vehicle in the snow covering.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a hitch device for connecting a groomer vehicle and a ski slope snow grooming implement, designed to eliminate

the drawbacks of the known art.

According to the present invention, there is provided a hitch device for connecting a groomer vehicle comprising a first frame extending along a first axis, and an implement, in particular a rotary snow tiller, for grooming the snow covering of ski slopes and comprising a second frame extending crosswise to and symmetrically with respect to a second axis; the hitch device comprising an arm hinged to the first frame about a third axis perpendicular to the first axis, and about a fourth axis perpendicular to the first and third axis; a first actuator for adjusting the position of the arm about the third axis with respect to the first frame to lift and lower the implement; and at least one second actuator for adjusting the position of the arm about the fourth axis with respect to the first frame; and the hitch device being characterized by comprising a movable coupling movable between the arm and one of the first and second frame; and a third actuator for adjusting the position of the arm in a plane perpendicular to the fourth axis.

The present invention also relates to a control method.

According to the present invention, there is provided a method of controlling a hitch device for connecting a groomer vehicle comprising a first frame extending along a first axis, and an implement, in particular a rotary snow tiller, for grooming the snow

covering of ski slopes and comprising a second frame extending crosswise to and symmetrically with respect to a second axis; the hitch device comprising an arm hinged to the first frame about a third axis perpendicular to the first axis, and about a fourth axis perpendicular to the first and third axis; the method comprising adjusting the position of the arm about the third axis with respect to the first frame to lift and lower the implement; and adjusting the position of the arm about the fourth axis with respect to the first frame; and the method being characterized by further adjusting the position of the arm in a plane perpendicular to the fourth axis; the arm being connected to one of the first and second frame by a movable coupling.

15 BRIEF DESCRIPTION OF THE DRAWINGS

A number of non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a plan view, with parts removed for clarity, of a groomer vehicle connected to a snow grooming implement by a hitch device in accordance with the present invention and in a first operating position;

Figure 2 shows a plan view, with parts removed for clarity, of the Figure 1 groomer vehicle, snow grooming implement, and hitch device in a second operating position;

Figure 3 shows a schematic, larger-scale plan view, with parts removed for clarity, of the Figure 1 hitch

device in a third operating position;

Figure 4 shows a schematic plan view, with parts removed for clarity, of a hitch device in accordance with a second embodiment of the present invention;

5 Figure 5 shows a schematic plan view, with parts removed for clarity, of a hitch device in accordance with a third embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figures 1 and 2 indicates as a whole a
10 hitch device for connecting a groomer vehicle 2 and an implement 3, in particular a rotary snow tiller, for grooming the snow covering M of ski slopes. Groomer vehicle 2 is powered and tows implement 3 along the ski slope, while the hitch device provides for controlling
15 implement 3 according to the conditions imposed by the type of tilling operation to be performed.

Groomer vehicle 1 comprises a frame 4 extending predominantly along a central axis A1, two tracks 5 parallel to axis A1, and a shovel 6 connected to the
20 front of frame 4, and is connected to implement 3 by hitch device 1, in turn connected to frame 4.

Implement 3 has a central axis A2, extends crosswise to the central axis A2, and comprises a frame 7, in turn comprising a bar 8 perpendicular to axis A2,
25 and an arc-shaped bracket 9 connected rigidly to bar 8, located at the centreline of implement 3, and facing groomer vehicle 2.

With reference to Figure 3, hitch device 1 is

connected to frame 4 and frame 7 at respective central axes A1 and A2, and comprises an arm 10 hinged to frame 4 about an axis A3; and an actuator 11 - in the example shown, a hydraulic cylinder - connected to frame 4 and
5 to arm 10 to rotate arm 10 about axis A3 to selectively lift and lower arm 10 and implement 3 with respect to snow covering M.

Arm 10 is hinged to frame 4 about an axis A4 perpendicular to axes A1 and A3, and comprises two
10 actuators 12 - in the example shown, two hydraulic cylinders - each connected to frame 4 and to arm 10 to control rotation of arm 10 about axis A4. Actuators 12 are located symmetrically on opposite sides of arm 10.

Hitch device 1 comprises a universal joint 13
15 between arm 10 and frame 4 to permit rotation about axes A3 and A4; and arm 10 is hinged to frame 7 - in the example shown, by a hinge 14 - about an axis A5 parallel to axis A4.

More specifically, arm 10 comprises a straight bar
20 15; and a plate 16 connected rigidly to one end of bar 15. Universal joint 13 is located at the opposite end of bar 15 to plate 16, and hinge 14 is located along plate 16.

Actuator 11 is located over bar 15 and hinged to
25 frame 4 and bar 15; and each actuator 12 is located alongside bar 15 and hinged to frame 4 and plate 16.

Hitch device 1 comprises two actuators 17, each hinged to arm 10 and frame 7 to control rotation of

frame 7 about axis A5 with respect to arm 10. In the example shown, actuators 17 connect bracket 9 to plate 16, and are symmetrical with respect to axis A2.

Hitch device 1 comprises a control device 18, in turn comprising a hydraulic circuit 19 connected to actuators 11, 12, 17 and equipped with an assembly 20 of valves to selectively supply actuators 11, 12, 17 along hoses not shown; a control unit 21; linear sensors 22 associated with actuators 12; and linear sensors 23 associated with actuators 17.

Hydraulic circuit 19 comprises a pump P on board groomer vehicle 2 to pressure-feed circuit 19.

Control unit 21 receives target signals indicating the desired position of frame 7 with respect to frame 4, i.e. the desired position of actuators 12 and 17, and actual-position signals, indicating the actual position of actuators 12 and 17, from linear sensors 22 and 23, and supplies valve assembly 20 with regulation signals calculated by control unit 21 according to the difference between the target signals and the actual-position signals.

With reference to Figure 1, in actual use, groomer vehicle 2 advances and tows implement 3 in a travelling direction D. Normally, when travelling along a straight path, axes A1 and A2 are aligned, and arm 10 is parallel to axes A1 and A2, as shown in Figure 3.

When travelling along a curved path, as shown in Figure 2, axes A1 and A2 form an angle of other than

180°, and arm 10 is inclined with respect to frame 4 by an angle determined by actuators 12. In some cases, to cover the prints left by tracks 5 of groomer vehicle 2, it is necessary to rotate frame 7 with respect to arm 10
5 by means of actuators 17. When travelling along a curved path, the steering curve of grooming vehicle 2 is transmitted to control unit 21 which calculates the position of actuators 12 and 17 accordingly, so implement 3 can groom the portion of snow covering M on
10 which prints have been left by tracks 5, as shown in Figure 2.

Control unit 21 also provides for setting given offset values between axes A1 and A2, i.e. advancing groomer vehicle 2 and implement 3 along a straight path,
15 with axes A1 and A2 offset and parallel, as in the operating position shown in Figure 1. The distance between axes A1 and A2 is set by a given rotation about axis A4, and by the same amount of rotation in the opposite direction about axis A5.

20 Each of the Figure 1-3 positions of implement 3 with respect to groomer vehicle 2 is achieved and maintained by control unit 21, which compares the signals from sensors 22 and 23 with the target signals, and emits regulation signals when the sensor signals
25 deviate from the target signals.

In one variation, linear sensors 22 and 23 are eliminated, and control device 18 comprises two angle sensors 24 and 25 (shown by dash lines in Figure 3) for

respectively determining the angle between arm 10 and frame 4 about axis A4, and the angle between arm 10 and frame 7 about axis A5.

In the Figure 4 embodiment, hitch device 1
5 comprises a slide 26 mounted to slide along a runner 27 parallel to axis A3; and an actuator 28 for selectively moving slide 26 along runner 27. Arm 10 is fixed rigidly to frame 7 in a position parallel to and aligned with axis A2, and is hinged about axes A3 and A4 with respect
10 to slide 26. And actuators 12 are connected directly to slide 26 and arm 10, while actuators 17 are eliminated.

In addition to linear sensors 22 of respective actuators 12, control device 18 comprises a linear sensor 29 associated with actuator 28, while linear
15 sensors 23 are eliminated.

In a variation of the second embodiment, linear sensors 22 are replaced by an angle sensor 30 shown by a dash line in Figure 4.

The second embodiment operates in the same way as
20 the first when travelling along a straight path, on which arm 10 is kept aligned with axes A1 and A2, and in fact cannot move with respect to axis A2. Axes A2 and A1 are offset by actuator 28 translating the whole of slide 26 along runner 27 by an amount equal to the desired
25 amount of offset.

When travelling along a curved path, the position of implement 3 with respect to groomer vehicle 2, and of axis A2 with respect to axis A1, is achieved by rotating

arm 10 about axis A4 and possibly translating slide 26 with respect to frame 4.

In the Figure 5 embodiment, hitch device 1 is connected directly to frame 4 by universal joint 13, and
5 is connected to frame 7 to slide in a direction perpendicular to axes A2 and A4. Plate 16 is integral with a slide 31 mounted to slide along a runner 32 of bracket 9 of frame 7. And hitch device 1 comprises two
10 actuators 33 connected to frame 7 and slide 31 to selectively set slide 31 to a given position with respect to frame 7.

In addition to linear sensors 22 of respective actuators 12, control device 18 comprises two linear
sensors 34, each associated with a respective actuator
15 33.

Instead of linear sensors 22, control device 18 may comprise an angle sensor 35 shown by a dash line in Figure 5.

The third embodiment operates in the same way as
20 the second, except that translation takes place between arm 10 and frame 7 as opposed to between arm 10 and frame 4.

CLAIMS

1) An assembly for grooming snow comprising a snow groomer tracked vehicle, a rotary snow tiller mounted behind the groomer vehicle, and a hitch device (1) for connecting the groomer vehicle (2) and the snow tiller (3), wherein the groomer vehicle (2) comprises a first frame (4) extending along a first axis (A1), and the rotary snow tiller (3) being configured for grooming the snow covering (M) of ski slopes and comprising a second frame (7) extending crosswise to and symmetrically with respect to a second axis (A2); the hitch device (1) comprising an arm (10) hinged to the first frame (4) about a third axis (A3) perpendicular to the first axis (A1), and about a fourth axis (A4) perpendicular to the first and third axis (A1, A3); a first actuator (11) for adjusting the position of the arm (10) about the third axis (A3) with respect to the first frame (4) to lift and lower the rotary snow tiller (3); and at least one second actuator (12) for adjusting the position of the arm (10) about the fourth axis (A4) with respect to the first frame (4); and the hitch device being characterized by comprising a movable coupling (14; 26, 27; 31, 32) movable between the arm (10) and one of the first and second frame (4, 7); and a third actuator (17; 28; 33) for adjusting the position of the arm (10) in a plane perpendicular to the fourth axis (A4) and a control unit (21) configured for setting given offset values between first and second axes (A1, A2) when advancing the snow groomer tracked vehicle (2) along

straight paths with first and second axes (A1, A2) offset and parallel.

2) A hitch device as claimed in Claim 1, characterized in that the movable coupling (14; 26, 27; 31, 32) comprises a hinge (14) hinging the arm (10) and the second frame (7) about a fifth axis (A5) parallel to the fourth axis (A4); the third actuator (17) being connected to the arm (10) and to the second frame (7) to adjust the position of the second frame (7) with respect to the arm (10) about the fifth axis (A5).

3) A hitch device as claimed in Claim 2, characterized by comprising two third actuators (17) connected to said arm (10) and to the second frame (7) and located on opposite sides of the arm (10).

4) A hitch device as claimed in Claim 1, characterized in that the movable coupling (14; 26, 27; 31, 32) comprises a slide (26) and a runner (27) located between the arm (10) and the first frame (4); the slide (26) engaging the runner (27) to slide parallel to the third axis (A3); and the third actuator (28) adjusting the position of the slide (26) along the runner (27).

5) A hitch device as claimed in Claim 4, characterized in that said arm (10) is hinged to said slide (26) by a universal joint (13); the first and second actuator (11, 12) being connected to the slide (26) and the arm (10).

6) A hitch device as claimed in Claim 1, characterized in that the movable coupling (14; 26, 27; 31, 32) comprises a slide (31) and a runner (32) located between the arm (10) and the second frame (7); the slide (31) engaging the runner (32) to move in a direction perpendicular to the second and fourth axis (A2, A4); and the third actuator (33) adjusting the position of the slide (31) along the runner (32).

7) A hitch device as claimed in Claim 6, characterized in that said arm (10) is hinged to the first frame (4) by a universal joint (13), and is connected rigidly to the slide (31); the first and second actuator (11, 12) being connected to the first frame (4) and the arm (10).

8) A hitch device as claimed in claim 1, characterized by comprising two second actuators (12) located symmetrically on opposite sides of the arm (10).

9) A hitch device as claimed in Claim 1, characterized by comprising a control device (18), in turn comprising a hydraulic circuit (19) for supplying the first, second, and third actuator (11, 12, 17; 11, 12, 28; 11, 12, 33), and a

control unit (21) for emitting regulation signals to adjust the hydraulic circuit (19).

10) A hitch device as claimed in Claim 9, characterized in that the control device (18) comprises first sensors (22; 24; 22, 29; 29, 30; 35) for determining the position of the arm (10) with respect to the first frame (4), and for supplying signals to the control unit (21).

11) A hitch device as claimed in Claim 9, characterized in that the control device comprises second sensors (23; 29; 34) for determining the position of the arm (10) with respect to the second frame (7), and for supplying signals to the control unit (21).

12) A hitch device as claimed in Claim 10, characterized in that said first and second sensors (22, 23; 24, 25; 22, 29; 29, 30; 22, 34; 34, 35) comprise position sensors selected from at least one of linear sensors (22, 23, 29, 34) and angular sensors (24, 25, 30, 35).

13) A method of controlling a hitch device (1) for connecting a groomer vehicle (2) comprising a first frame (4) extending along a first axis (A1), and an implement (3) for grooming the snow covering (M) of ski slopes and comprising a second frame (7) extending crosswise to and symmetrically with respect to a second axis (A2); the hitch device (1) comprising an arm (10)

hinged to the first frame (4) about a third axis (A3) perpendicular to the first axis (A1), and about a fourth axis (A4) perpendicular to the first and third axis (A1, A3); the method comprising adjusting the position of the arm (10) about the third axis (A3) with respect to the first frame (4) to lift and lower the implement (3); adjusting the position of the arm (10) about the fourth axis (A4) with respect to the first frame (4); and the method being characterized by further adjusting the position of the arm (10) in a plane perpendicular to the fourth axis (A4); the arm (10) being connected to one of the first and second frame (4, 7) by a movable coupling (14; 26, 27; 31, 32); and setting given offset values between first and second axes (A1, A2) when advancing the snow groomer tracked vehicle (2) along straight paths with first and second axes (A1, A2) offset and parallel by means of a control unit (21).

14) A method as claimed in Claim 13, characterized by determining the position of the arm (10) with respect to the first frame (4) of the groomer vehicle (2) by means of position signals; comparing the position signals with target signals indicating the desired position; and emitting a regulation signal to activate a second and third actuator (12; 12, 28) to correct the position of the arm (10) with respect to the first frame (4).

15) A method as claimed in Claim 13 or 14, characterized by determining the position of the arm (10) with respect to the

second frame (7) of the implement (3) by means of position signals; comparing the position signals with target signals indicating the desired position; and emitting a regulation signal to activate a third actuator (17; 33) to correct the position of the arm (10) with respect to the second frame (7).

16) A method as claimed in Claim 13, characterized by rotating the arm (10) by a first angle about the fourth axis (A4) with respect to the first frame (4); and rotating the second frame (7) with respect to the arm (10) about a fifth axis (A5) parallel to the fourth axis (A4), and by a second angle equal to and opposite the first angle.

17) A method as claimed in Claim 13, characterized by translating the arm (10) with respect to the first frame (4) in a direction parallel to the third axis (A3).

18) A method as claimed in Claim 13, characterized by translating the second frame (7) with respect to the arm (10) in a direction perpendicular to the second and fourth axis (A2; A4).

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FIG. 1

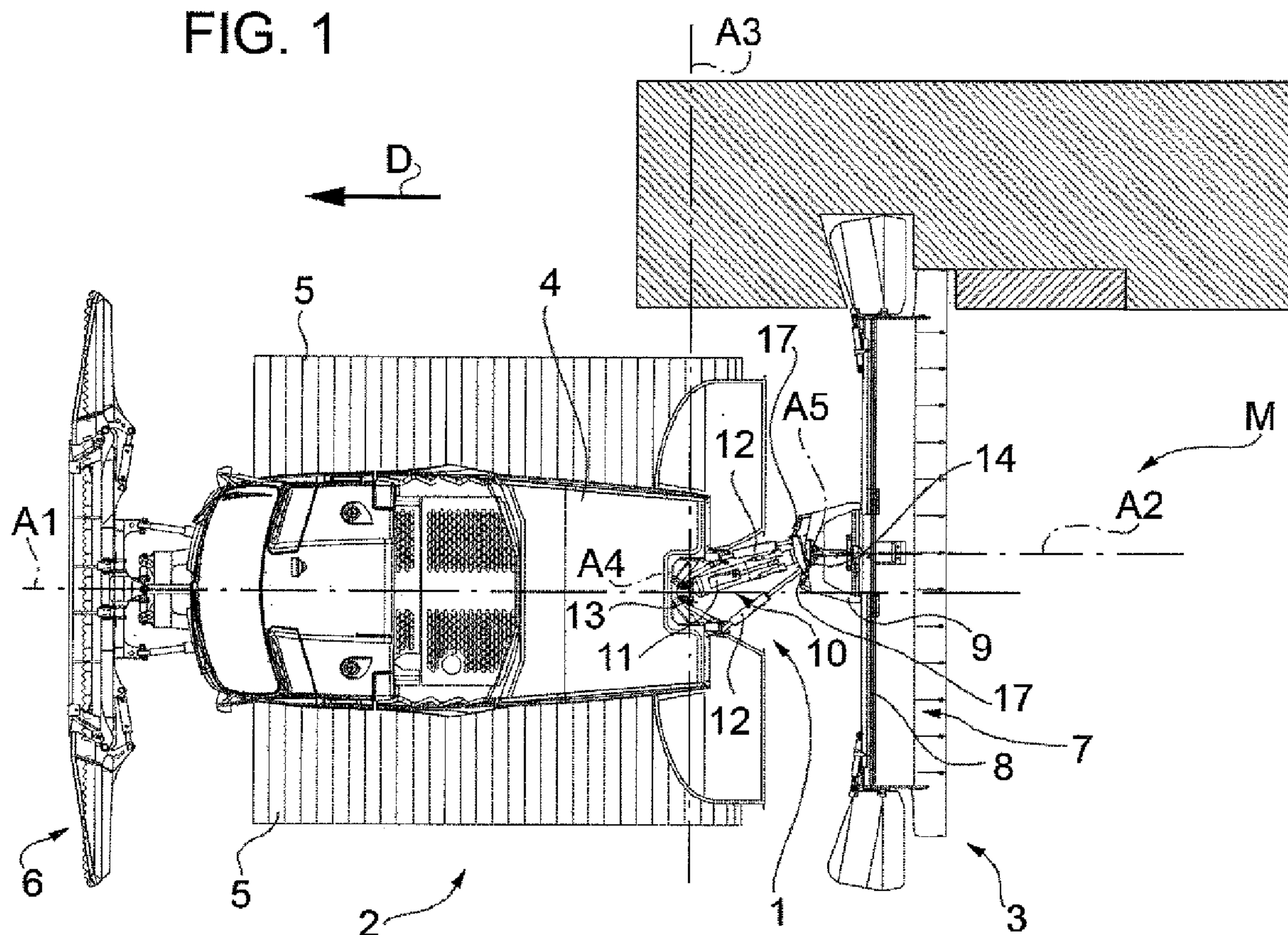
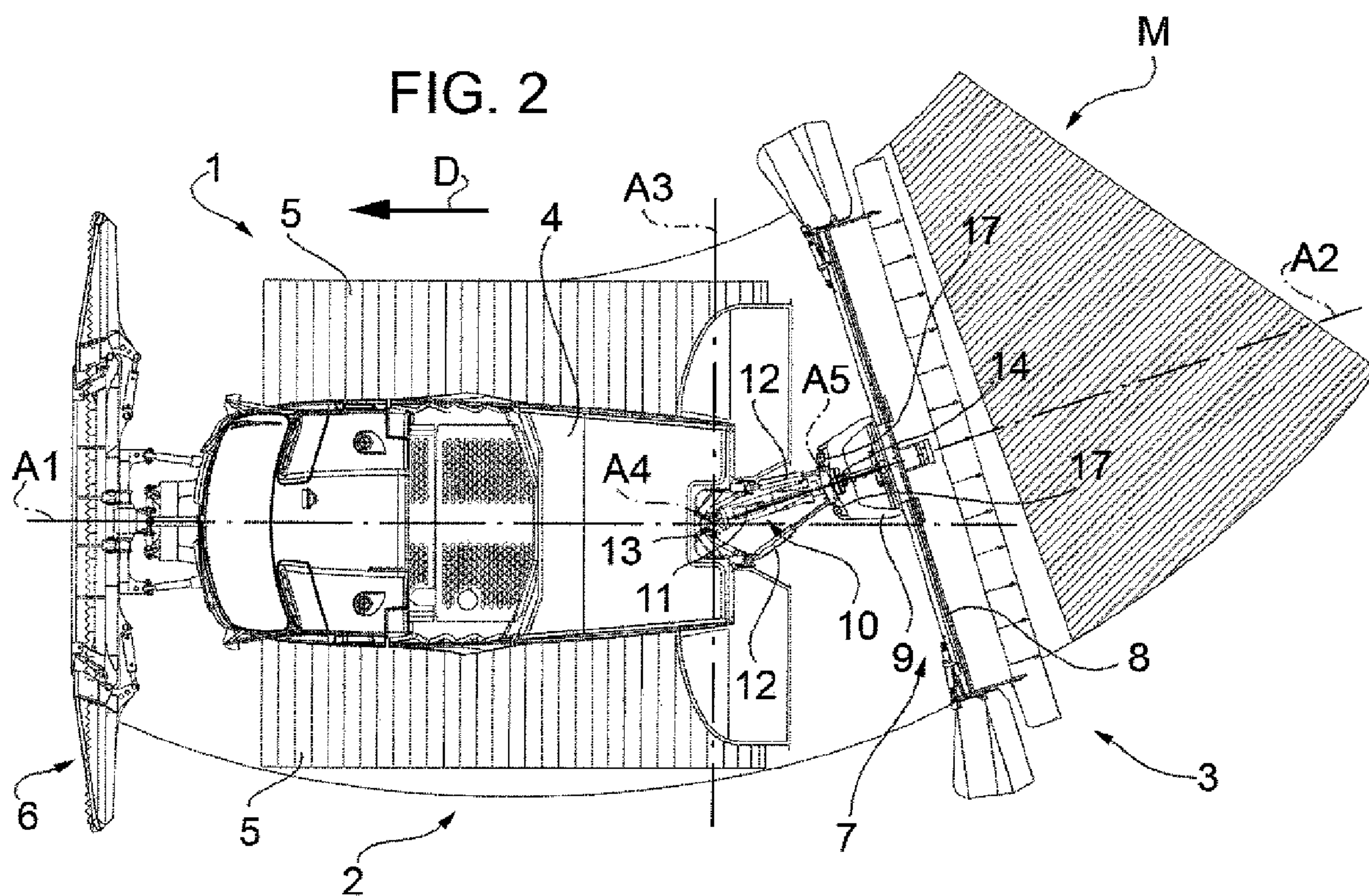
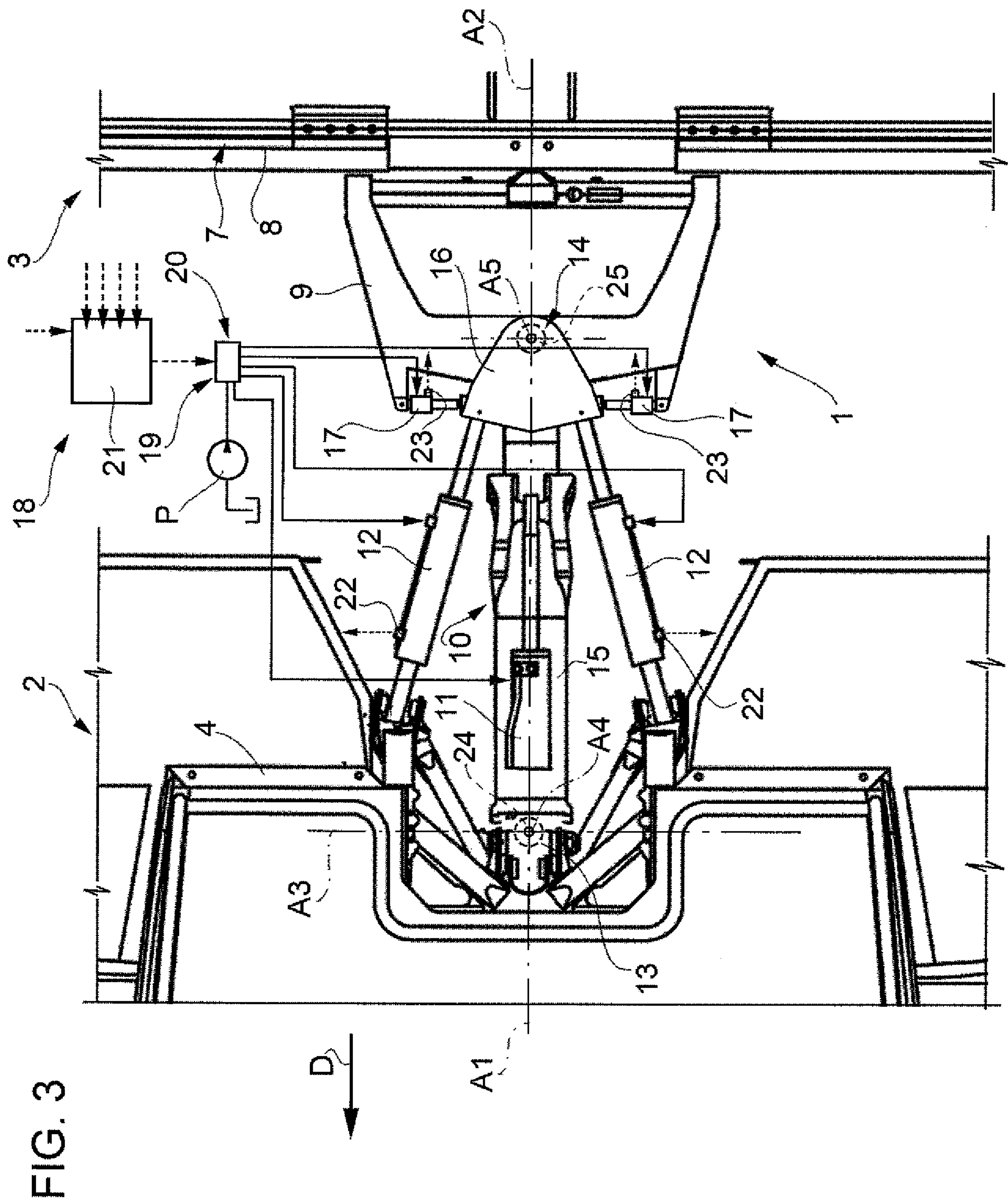
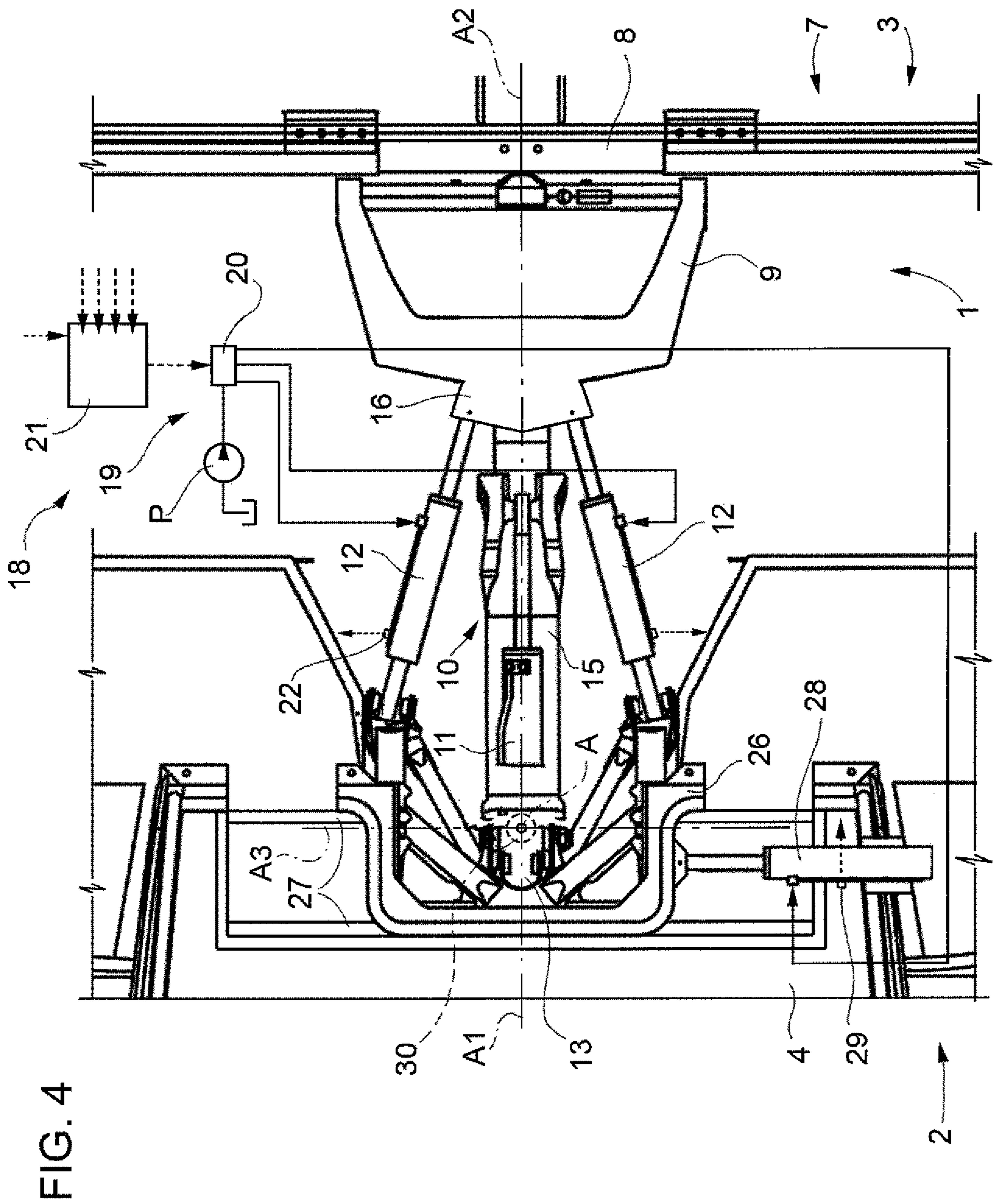
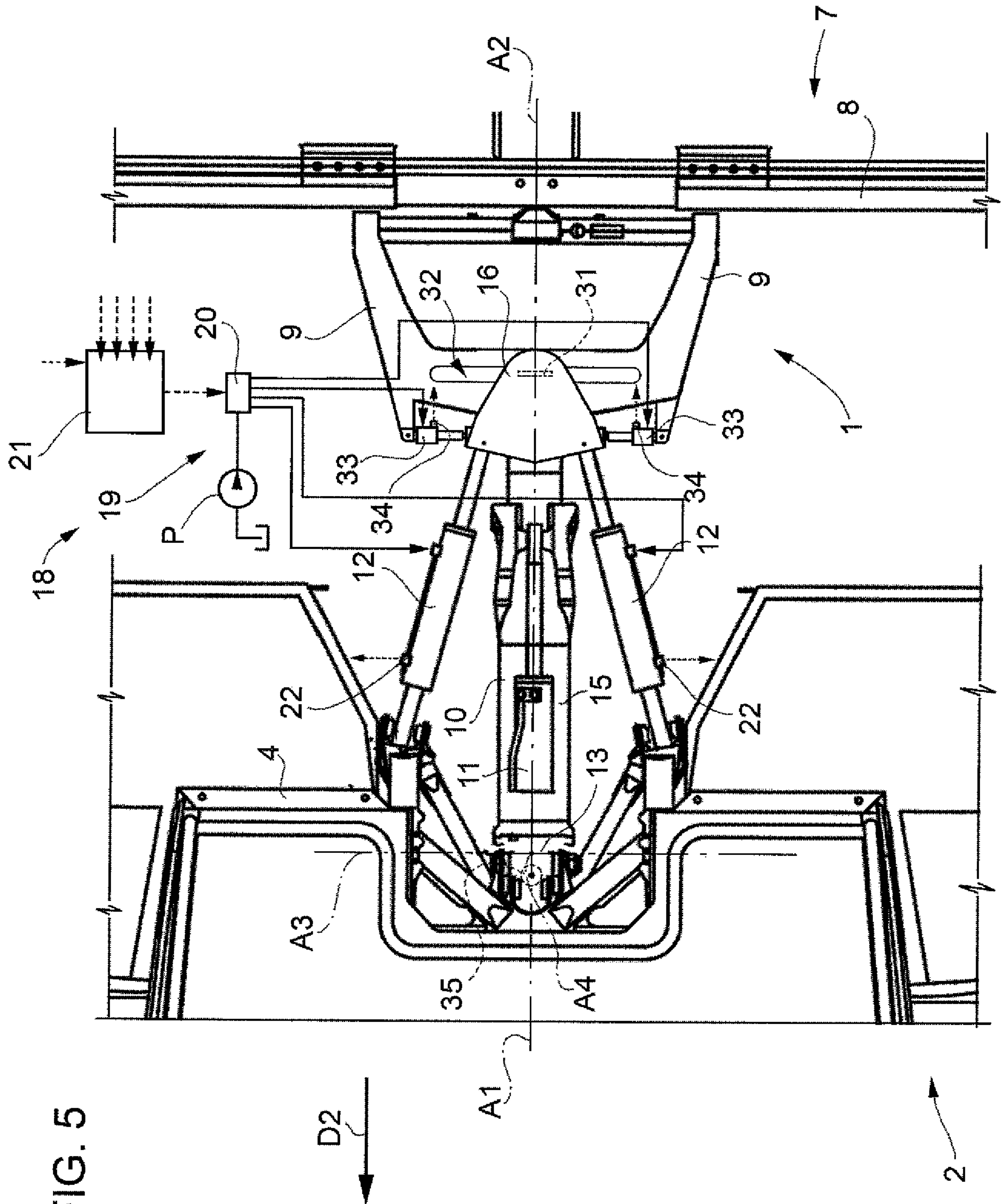


FIG. 2









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