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(72) Inventor: Bitelli, Romolo  
S. Lazzaro (BO) (IT)

(74) Representative: Bonini, Ercole  
c/o STUDIO ING. E. BONINI SRL  
Corso Fogazzaro 8  
36100 Vicenza (IT)

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(71) Applicant: BITELLI S.p.A.  
40061 Minerbio (BO) (IT)

(54) Heavy vehicle for breaking up ground with retracting and steering rear wheels

(57) A machine (1) for breaking up ground including, a frame (2) supported by at least one pair of front wheels or tracks (3, 3') and by at least one pair of rear wheels or tracks (4, 4'); a driver's cab (5) made out of said frame (2); means (6) of breaking up the ground connected to said frame (2); traction systems supported by said frame (2) for rotating one or more of said wheels or tracks (3,

3', 4, 4'). At least one rear wheel or track (4) having a horizontal axis (7) belonging to a chassis (8) integral with said frame (2) and provided with at least one first actuator (9) that works with manoeuvring systems (10) accessible from the driver's cab (5) to rotate the rear wheel or track (4) around a vertical axis (13) while turning the front wheels or tracks (3, 3') of the machine.

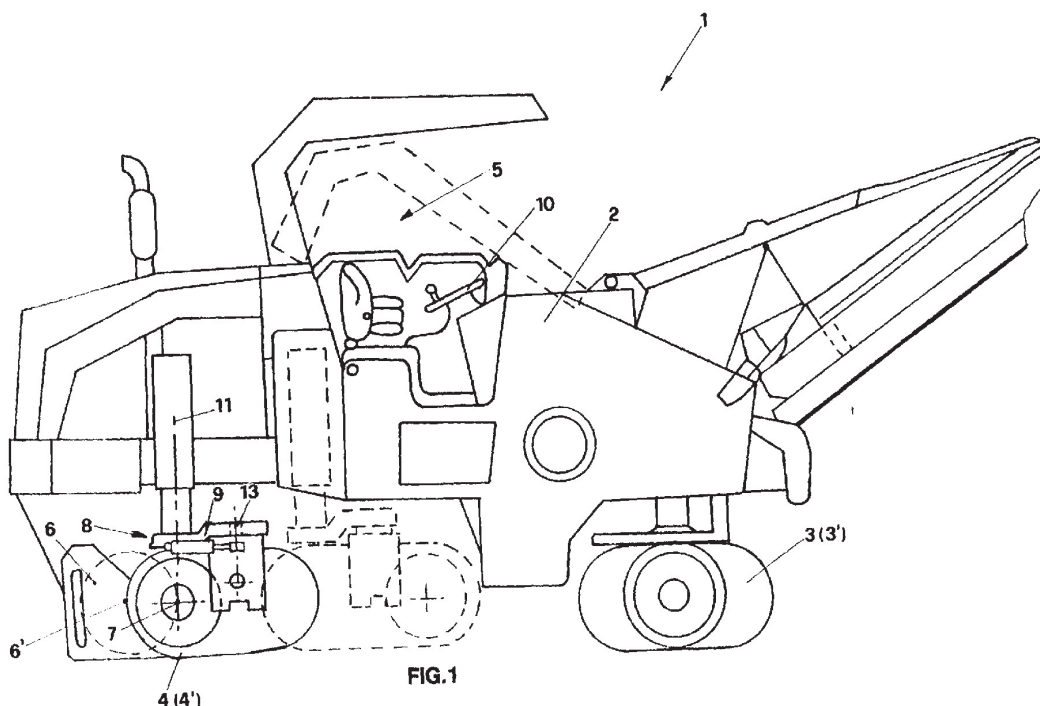


FIG. 1

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## Description

**[0001]** The invention concerns a heavy vehicle for breaking up ground provided with retracting and steering rear wheels.

**[0002]** It is known that for breaking up ground, specific heavy vehicles are used equipped with wheels or tracks depending on how they are implemented and provided with equipment suited to breaking up the actual ground.

**[0003]** Scarifiers are, for instance, known for this purpose that are heavy vehicles used to break up the bituminous surface covering road courses.

**[0004]** A scarifier fundamentally consists of a frame made of heavy-duty metal bodywork, provided with a ripper drum that is set against the ground to be broken up and is supported by a horizontal shaft around which it is rotated.

**[0005]** The frame, which is shaped to provide a driver's cab where the operator sits, is in turn supported by a pair of front drive wheels or tracks and a pair of rear wheels or tracks, either with drive or free, the latter being located next to the ripper drum.

**[0006]** Traction systems, housed in an engine compartment formed out of the frame, set the ripper drum in rotation to break up the ground and the wheels or tracks to move the machine.

**[0007]** The rear wheels or tracks are connected to a sole-plate supported by a hydraulic cylinder that allows a vertical movement to adjust the depth the ripper drum penetrates into the ground while an articulation fixed to the frame and connected to the actual sole-plate allows one or both wheels or tracks to be set in a retracted position inside the frame.

**[0008]** The rear wheels or tracks when extracted from the frame, allow better weight distribution primarily during the machine's use, while the possibility of at least one wheel or one track retracting under the frame, allows the machine to be used for digging right up to the wall of the work area.

**[0009]** What's more the position of one or more of the rear wheels or tracks when retracted into the side of the machine, allows to reduce the machine's overall dimensions and aid road transport when it is moved from one work site to another.

**[0010]** Known machines equipped with one or both rear wheels or tracks retractable are extended manually and therefore by operations that are awkward for the operator since, to carry them out he has to get down from the machine and go to one or both of its sides to shift the wheels or tracks.

**[0011]** As an alternative to manual retraction, the depositor of this invention has filed a patent application having protocol number VI98U000098 which describes a heavy vehicle for breaking up ground in which the changeover of one or both rear wheels or tracks from extracted to retracted into the frame and vice versa, as well as locking them in their final position, is achieved automatically by controls inside the driver's cab.

**[0012]** One limitation shown by the machine described in the aforementioned patent is that when the rear wheels or tracks are set in their retracted position inside the frame, when turning they scrape the ground with considerable resistance.

**[0013]** This problem is particularly accentuated when the machine is fitted with tracks rather than wheels, because in this case the resistance while turning is even higher because of the greater surface area in contact with the ground.

**[0014]** This invention sets the scope of eliminating this inconvenience by producing a machine for breaking up ground provided with at least one rear steering wheel or track.

**[0015]** An additional scope is that these steering wheels or tracks can also retract into the side of the machine.

**[0016]** Said scopes are achieved by producing a machine for breaking up ground that in accordance with the main claim includes:

- a frame supported by at least one pair of front wheels or tracks and by at least one pair of rear wheels or tracks;
- at least one driver's cab being part of said frame;
- means of breaking up the ground connected to said frame;
- traction systems supported by said frame to rotate one or more of said wheels or said tracks;

characterised in that at least one of said rear wheels or said rear tracks has its horizontal axis belonging to a chassis being a integral part of said frame and having at least one first actuator that works with manoeuvring systems accessible from said driver's cab to rotate said rear wheel or track around a vertical axis while turning the machine's front wheels.

**[0017]** According to a preferred form of execution the machine is a scarifier mounted on tracks where the two front tracks are both steering and two rear ones, one being fixed and one retractable and steering.

**[0018]** The means of turning the machine include first actuators that work with the rear wheel or track and second actuators that work with both front wheels or tracks, which consist of hydraulic cylinders supplied by slide valves.

**[0019]** In particular the slide valve that operates the steering hydraulic cylinder of the rear track is controlled by solenoid valves, while the slide valve that supplies the hydraulic cylinder for steering the front tracks is controlled directly by the power steering connected to the steering column in the driver's cab.

**[0020]** The operation of both hydraulic cylinders is interlinked by means of controls to co-ordinate turning, which include potentiometric position detectors or similar, cooperating mechanically with each hydraulic cylinder and electrically wired to an electronic control unit. This is also electrically wired to the solenoid valves that

pilot the slide valves supplying the hydraulic cylinder steering the rear track and a position signal for the rear wheel or track when it is set in its retracted position inside the frame.

**[0021]** An advantage of the scarifier invention is that it is easier to drive above all during turning operations.

**[0022]** Another advantage is that the wear on the tracks is also reduced.

**[0023]** The aforesaid scopes and advantages will be better illustrated during the description of a preferred form of execution of the invention that is given as a guideline but not a limitation and refers to the attached diagrams where:

- fig. 1 illustrates a line drawing of the side view of the machine invention;
- fig. 2 illustrates in a isometric drawing of a detail of the machine in fig. 1;
- fig. 3 illustrates an aerial view of the detail in fig. 2;
- figures 4 to 6 illustrate line drawings of aerial views of the set-up of the tracks on the machine in fig. 1 in three different working positions;
- fig. 7 shows the hydraulic control diagram of the tracks of the machine in fig.1 and electrical wiring of the control unit.

**[0024]** As seen in fig. 1 the machine invention, generally indicated by 1, is a scarifier suited for breaking up the bituminous surface that covers road courses.

**[0025]** The concepts that will be described below can nevertheless be applied to a machine for breaking up other kinds of terrain.

**[0026]** The scarifier includes a frame 2, supported by a pair of front tracks 3, 3' and by a pair of rear tracks 4, 4', which is shaped to provide a driver's cab generally indicated by 5.

**[0027]** To the rear of the machine and between the rear tracks 4, 4' there is a ripper drum 6 that is rotated around its horizontal axis 6' by traction systems inside the frame 2 and not illustrated here, which by means of gears and mechanisms, again not illustrated here, also rotate one or more of said tracks. It is clear that in different executions the machine invention may be fitted with wheels instead of tracks.

**[0028]** According to the invention at least one of said rear wheels or tracks 4 has its horizontal axis 7 belonging to a chassis 8 being an integral part of said frame 2 and having at least one first actuator 9 that works with manoeuvring systems 10 accessible from said driver's cab 5 to rotate said rear wheel or track 4 around a vertical axis 13 while turning the front wheels or tracks 3, 3' of the machine.

**[0029]** In particular the manoeuvring systems consist of the machine's steering column 10.

**[0030]** As seen in fig. 2 and also in fig. 3 the chassis generally indicated by 8 that support the rear track 4, includes a yoke 12 connected to the track 4, having a vertical pivot journal 13 that is coupled to revolve on a

support plate 14 fixed to a second actuator 15 being an integral part of the frame 2.

**[0031]** In detail, as seen in fig. 4, the second actuator 15 is a second hydraulic jack that has the end of its rod 16 fixed to the plate 14 and the cylinder end 17 where the rod 16 slides, being integral with the frame 2 of the machine.

**[0032]** In particular the cylinder 17, as seen in fig. 4, is connected to the frame 2 by means of a first articulation generally indicated by 18 and of the type described in the aforementioned patent VI98U000098.

**[0033]** This allows the whole chassis 8 to move with the track 4 connected to it, in any one of the directions of the arrow 19 with reference to a fixed point 20 on the frame, to retract the track 4 into frame of the machine as seen in fig. 1.

**[0034]** With regards to the first actuator generally indicated by 9 and belonging to the chassis 8, it can be seen that it consists of a first hydraulic jack that, as seen in fig.'s 2 and 3, has the rod end 21 hinged to the yoke 12 while the cylinder end 22, where the rod 21 slides, is hinged to the plate 14.

**[0035]** With regards to the front tracks 3, 3' it can be seen in fig. 4 that each of them is supported by a chassis 23, 23' that couples it to revolve on a pivot journal 24, 24' connected vertically to the frame 2.

**[0036]** The front tracks 3, 3' are moreover interlinked by means of a second articulation generally indicated by 25 that is made up of a central rod 26 hinged to a pair of side rods 26', 26'', each of them in turn being hinged to their relative chassis 23, 23' respectively of the front tracks 3, 3'.

**[0037]** It can also be seen that the front track 3 works with a third actuator generally indicated by 27 that consists of a third hydraulic jack having the rod end 28 hinged to the chassis 23 and the cylinder end 29, where the rod 28 slides, hinged to the frame 2 of the machine.

**[0038]** In this way, when the rod 28 thrusts in or out of its relative cylinder 29, it forces the track 23 to rotate around the vertical axis 24 and by means of the second articulation 25 also transmits this rotation to the front track 3' next to it, making the machine turn.

**[0039]** It can be seen in fig. 7 that the first and third hydraulic jacks 9 and 27 respectively are supplied by the pressurised oil distribution circuit generally indicated by 30. This includes a first slide valve 31 piloted by solenoid valves 31' and 31'' that supply the first hydraulic jack 9 and by a third slide valve 32 that is controlled by the steering column 10 of the machine, which supplies the third hydraulic jack 27.

**[0040]** The distribution circuit also includes a first position detector 33 of the first hydraulic jack 9 and a third position detector 34 of the third hydraulic jack 27 that consist of potentiometric position detectors or similar, connected to an electronic control unit 35 for the co-ordinated control of the turning angles of the front tracks 3, 3' and the rear track 4.

**[0041]** It can be seen that there is also a position sig-



nal 36 preferably consisting of a travel switch that detects the retracted position of the rear track 4.

[0042] The travel switch 36 together with the potentiometric detectors 33, 34' and the solenoid valves 31', 31", are electrically wired to the electronic control unit 35 that co-ordinates their operation, controlling the turn.

[0043] A pump 37 completes the circuit.

[0044] It works so that when the machine's traction systems are operating, adjusting the steering column 10 by turning it in any of the directions indicated by the arrow 40, pressure is applied to the third hydraulic jack 27 that turns the front tracks 3, 3', for instance making them turn anticlockwise 38 as illustrated in fig. 6 around a pivot centre 39.

[0045] The third position detector 34 transmits the signal to the electronic control unit 35, which operates the solenoid valve 31' or 31" of the first hydraulic jack 9, causing a rotation also for the track 4 according to a calculated geometry in the same anticlockwise direction 38 around the same pivot centre 39.

[0046] The third position detector 33 keeps control of how the turn is progressing by sending signals to the electronic control unit 35.

[0047] The position signal 36 detects when the rear track 4 is in its retracted position inside the frame that can be seen in fig. 6.

[0048] It is nevertheless clear that the rear track 4 can also be turned when it is in its extracted position.

[0049] The track 4 is set in its retracted position inside the frame and then is reset in the extracted position that can be seen in fig. 4 by acting from inside the driver's cab by means of control systems of the first articulation 18, that has not been illustrated, that is thereby made to turn in any of the directions of the arrow 19 and whose operation is illustrated in the aforementioned patent VI98U000098.

[0050] The above description amply shows that the machine invention achieves all the set scopes.

[0051] In a different form of execution, the machine invention may have both rear tracks steering.

[0052] In the execution phase, the machine invention may undergo changes or variations in construction all falling under the protection of the main claim that shall therefore all be considered protected by this patent.

## Claims

1. Machine for breaking up ground including:

- a frame supported by at least one pair of front wheels or tracks and by at least one pair of rear wheels or tracks;
- at least one driver's cab made out of said frame;
- means of breaking up the ground connected to said frame;
- traction systems supported by said frame for rotating one or more of said wheels or tracks;

**characterised in that** at least one of said rear wheels or said rear tracks (4) has a horizontal axis (7) belonging to a chassis (8) being a integral part of said frame (2) and provided with at least one first actuator (9) that works with manoeuvring systems (10) accessible from said driver's cab (5) to rotate said rear wheel or track (4) around a vertical axis (13) while turning the front wheels or tracks (3, 3') of the machine.

2. Machine (1) according to claim 1) **characterised in that** said chassis (8) includes a yoke (12) that supports said rear wheel or said rear track (4) having a vertical pivot journal (13) coupled to revolve on a support plate (14) fixed to the end of a second actuator (15) integral with said frame (2).

3. Machine (1) according to claim 2) **characterised in that** said first actuator is a first hydraulic jack (9) that has the rod end (21) fixed to said yoke (12) and the cylinder end (22), where said rod (21) slides, fixed to said plate (14).

4. Machine (1) according to claim 2) **characterised in that** said second actuator is a second hydraulic jack (15) set with a vertical axis (11), which has the rod end (16) fixed to said plate (14) and the cylinder end (17), where said rod (16) slides, integral with said frame (2).

5. Machine (1) according to claim 4) **characterised in that** the cylinder (17) of said second hydraulic jack (15) is a integral part of said frame (2) being connected to it by means of a first articulation (18) suited to move said chassis (8) with respect to a fixed point (20) on said frame (2) in order to move the relative wheel or track (4) towards the inside of said frame (2).

6. Machine (1) according to claim 1) **characterised in that** the chassis (23, 23') of said front wheels or tracks (3, 3') are interlinked by means of a second articulation (25), at least one of said chassis (23) cooperating with a third actuator (27) suited to make it rotate around a vertical axis.

7. Machine (1) according to claim 6) **characterised in that** said third actuator consists of a third hydraulic jack (27) that has the rod end (28) pivoted to said chassis (23) of said front wheel or track (3) and the cylinder end (29), where said rod (28) slides, pivoted on said frame (2).

8. Machine (1) according to claim 2) or 3) or 7) **characterised in that** said jacks are hydraulic two-way jacks connected to a distribution circuit (30) of oil under pressure.



9. Machine (1) according to claim 8) **characterised in that** said distribution circuit (30) of oil under pressure includes:

- a first slide valve (31) piloted by solenoid valves (31', 31'') that supply said first hydraulic jack (9); 5
- a third slide valve (32) controlled by said manoeuvring system (10) of said machine (1) that supply said third hydraulic jack (27);
- a first position detector (33) cooperating with said first hydraulic jack (9); 10
- a third position detector (34) cooperating with said third hydraulic jack (27);
- a position signal (36) of said rear wheel or track (4); 15
- an electronic control unit (35) electrically wired to said position detectors (33, 34), to said position signal (36) and to said solenoid valves (31', 31'') of said first slide valve (31). 20

10. Machine (1) according to claim 9) **characterised in that** said position detectors (33, 34) are detectors of a potentiometric kind.

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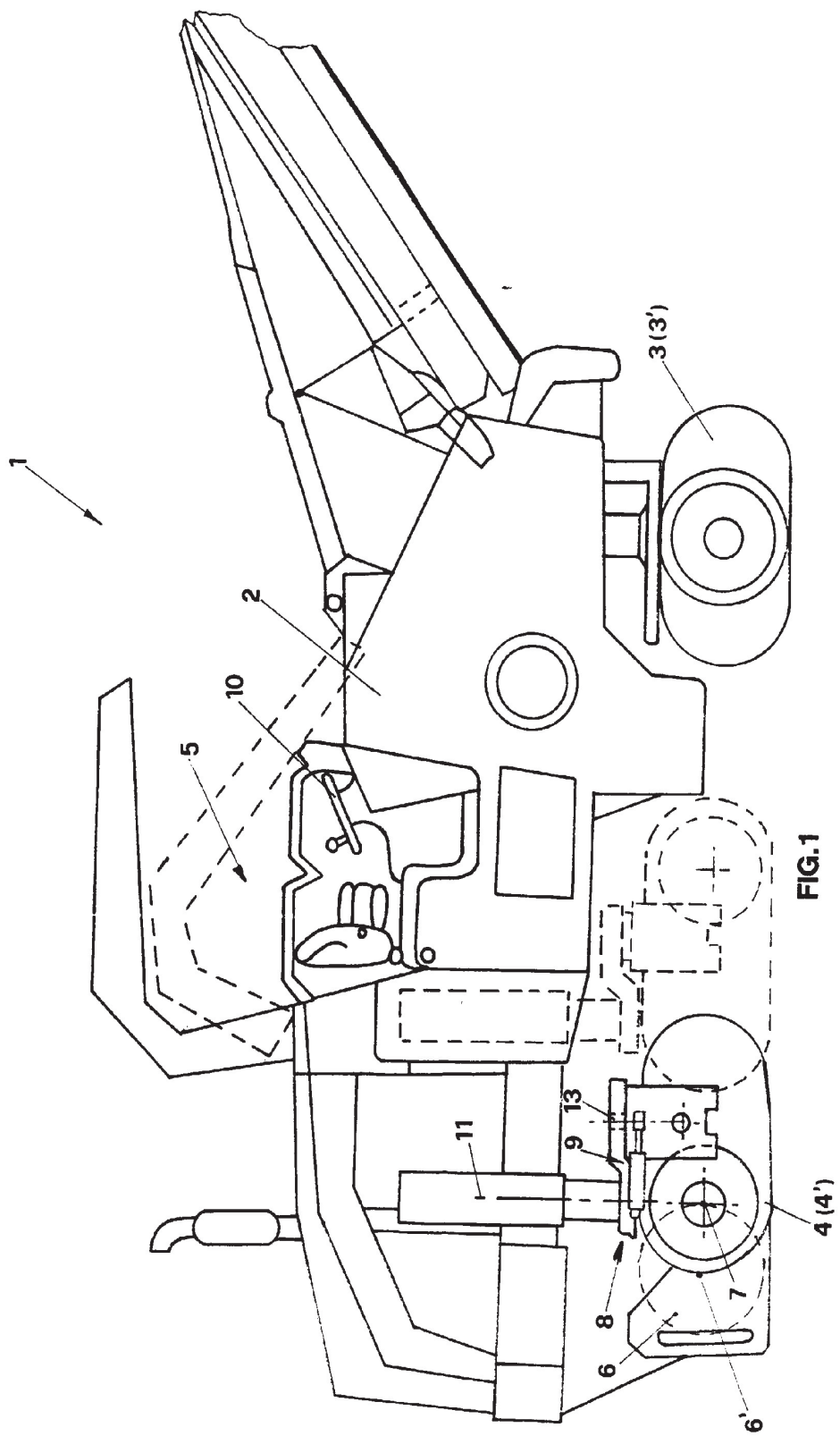
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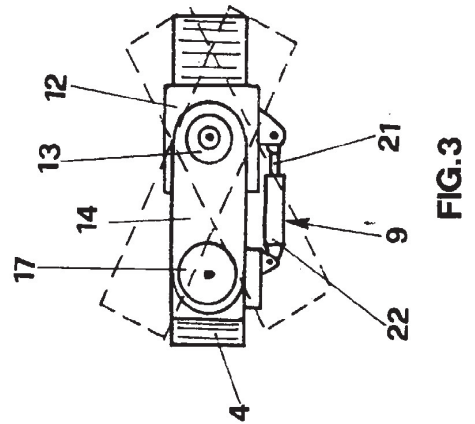
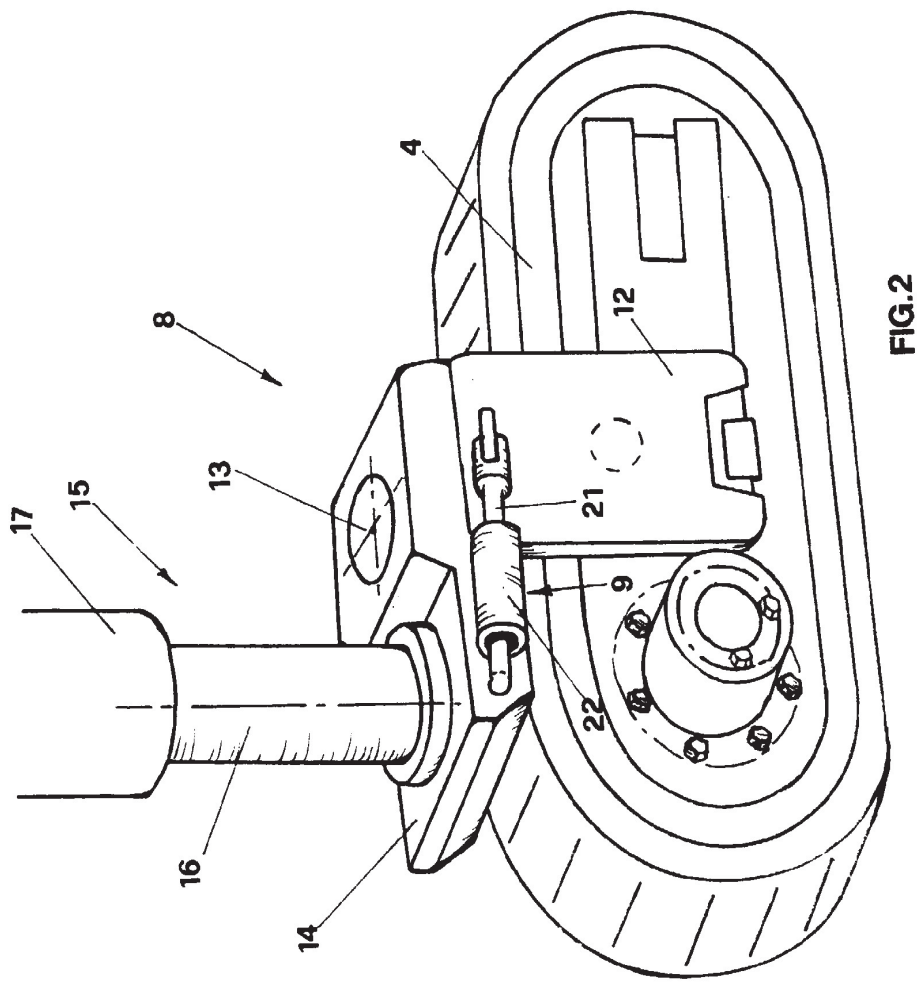
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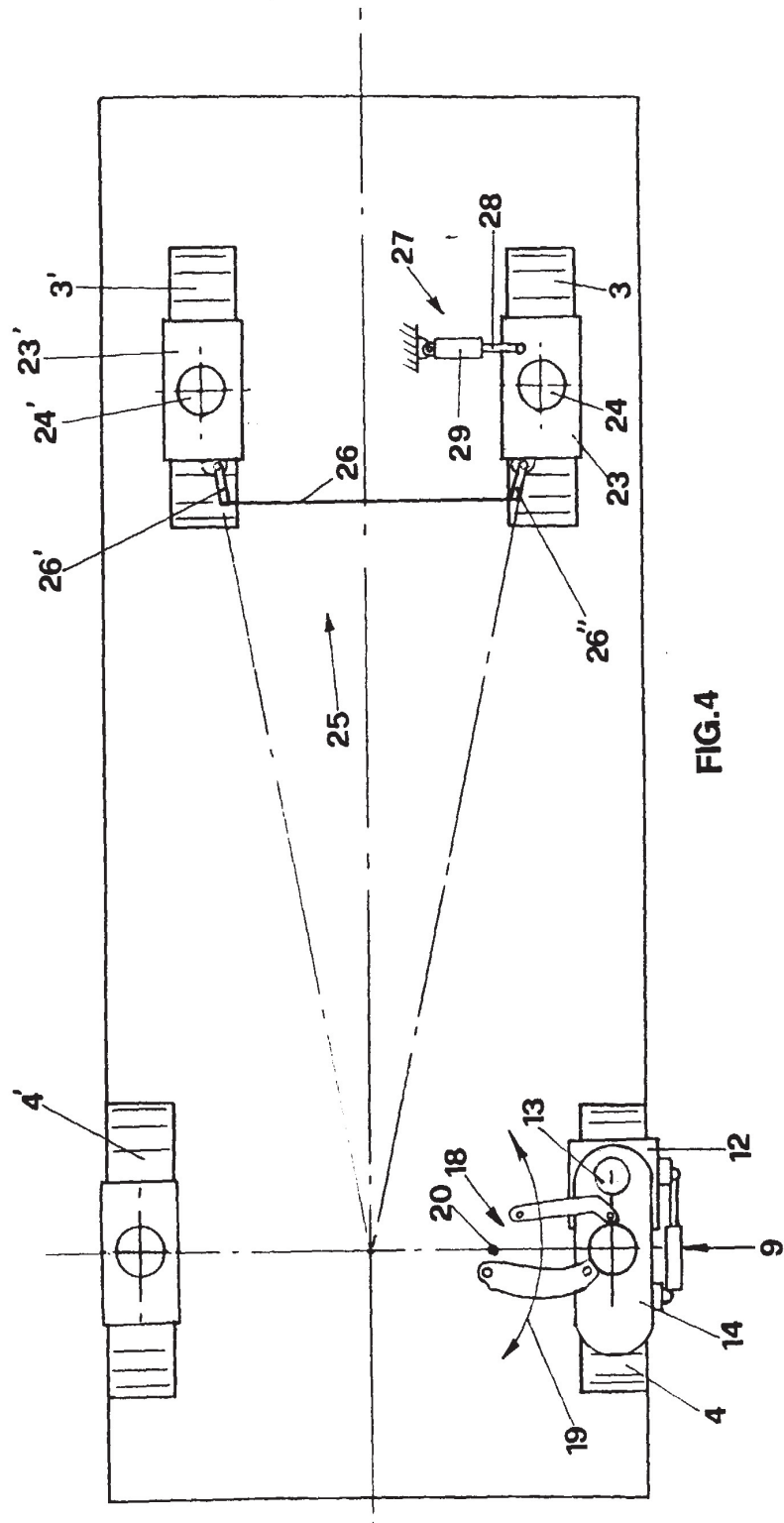


FIG. 4

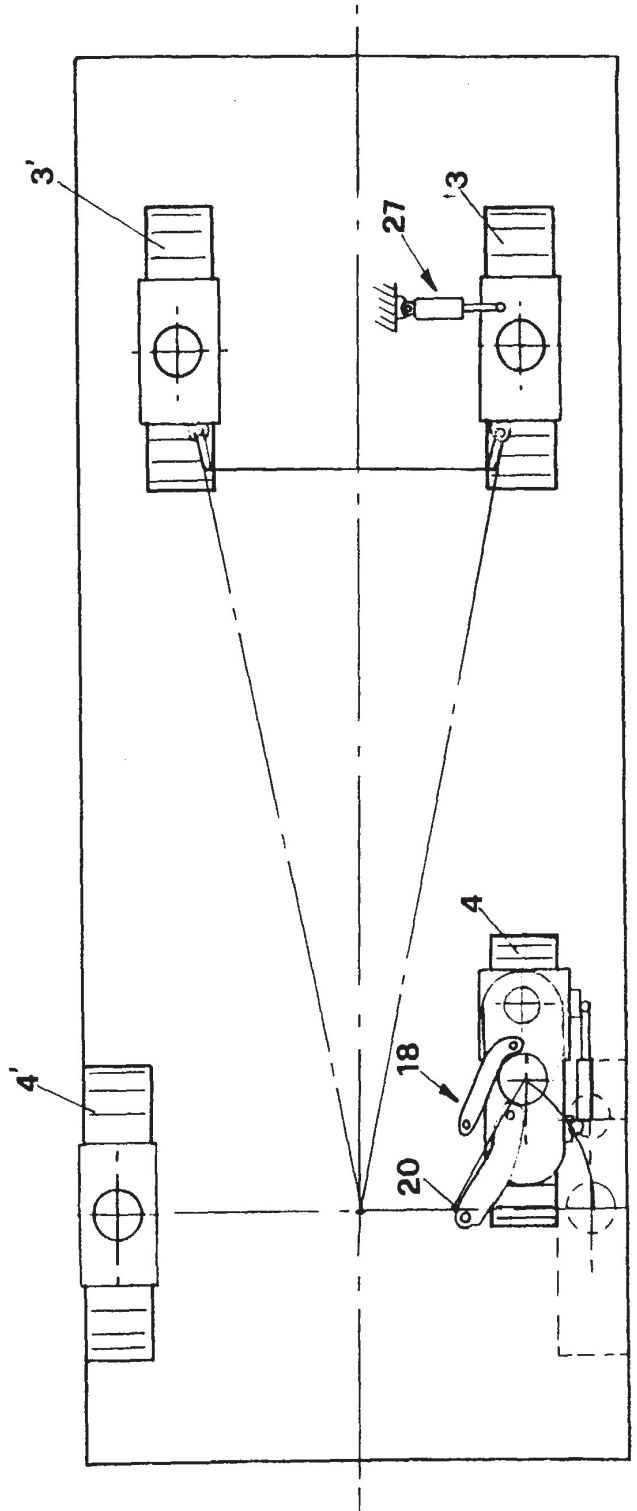


FIG.5

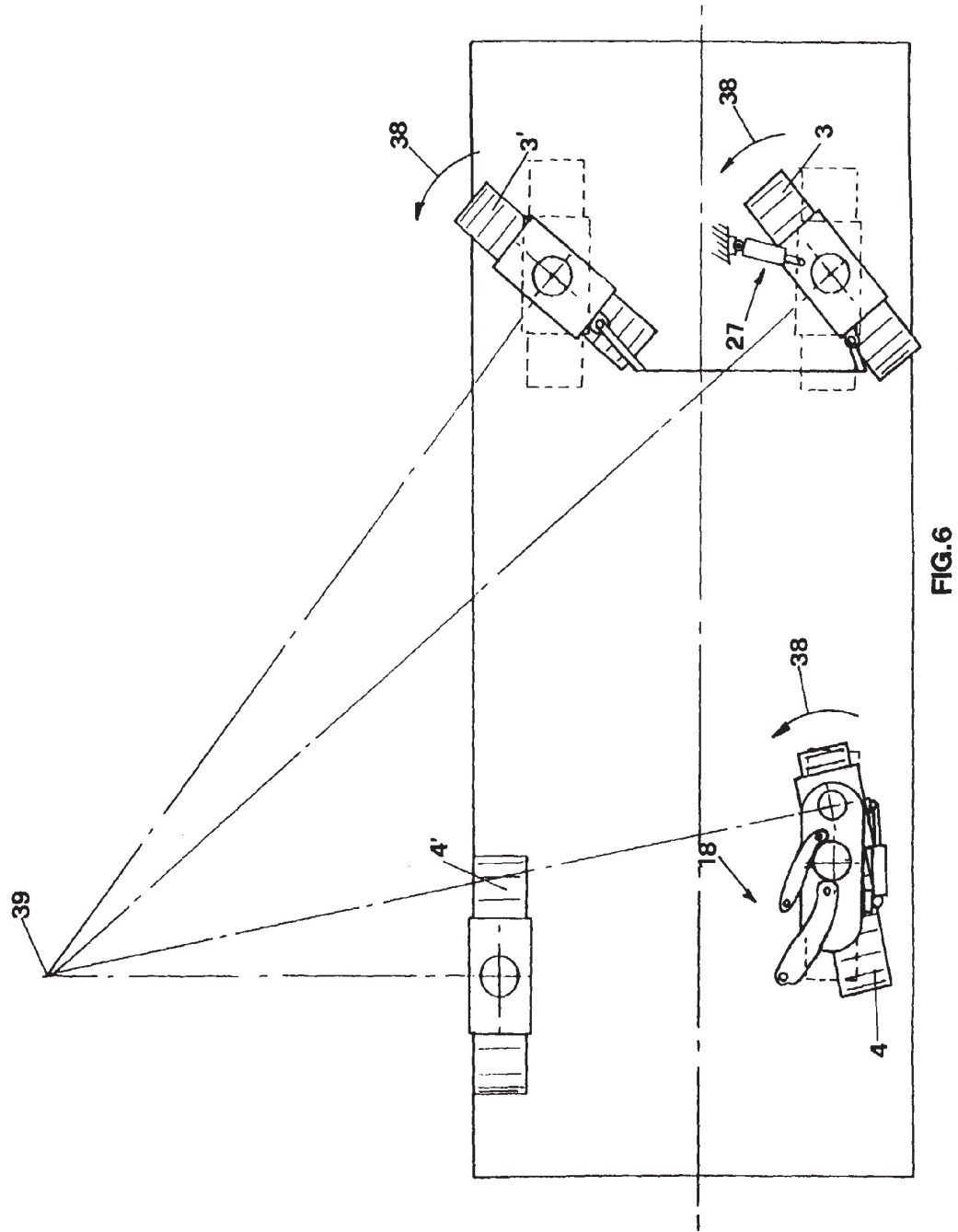


FIG. 6



