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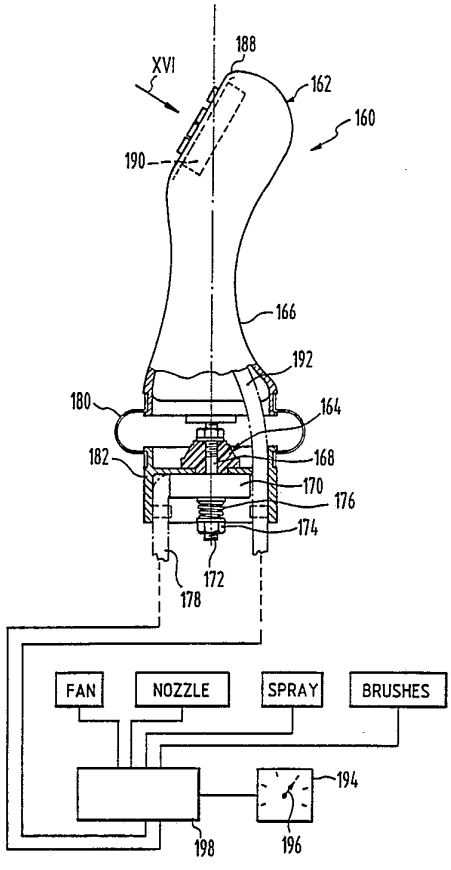
(54) Title: CONTROL MEANS FOR CLEANING VEHICLE

(57) Abstract

A self-propelled cleaning vehicle has cleaning gear including sweeping brushes, suction nozzle and associated equipment including spray nozzles for spraying clean water, and a wander hose. Control of the cleaning gear requires individual control of brush positions, attitude and loading, suction fan, water sprays, and other equipment. Control of all these functions is provided by means of a joystick having at its upper end an associated panel of finger or thumb-operable buttons or the like. These select cleaning gear programmes and change the function controlled by the joystick. In this way, the joystick provides means whereby arm and thumb control of a single lever enables detailed control of a multiplicity of functions to be provided.



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Control means for cleaning vehicle

This invention relates to cleaning vehicles comprising matter removal means such as brush gear and/or suction gear, and the invention is also applicable to other vehicles having multiple functions requiring driver control. An example of such a cleaning vehicle is a self-propelled vehicle for cleaning roads and/or runways and/or pavements and/or carrying out industrial cleaning and sweeping operations. Such vehicles have suction gear including a suction nozzle with brush gear in the form of side brushes rotating about upwardly extending axes and serving to sweep matter laterally inwardly into the path of the nozzle.

More particularly, this invention relates to the apparatus for effecting control of the cleaning gear of the vehicle, particularly the brush gear.

Previous systems for controlling brush gear and analogous equipment include the use of control levers actuating, for example, spool valves of hydraulic systems whereby slave hydraulic rams are appropriately controlled.

However, such an arrangement while capable of providing adequate control of one particular function is of very limited utility when one considers the multiplicity of functions which there are to control in a modern cleaning vehicle, these including brush raise and lower, brush tilting, brush downward loading, brush lateral movement, water spraying in front of the brushes, etc.

In order to simplify the control of these cleaning functions, and, if desired , other functions of the vehicle, or multiple functions in other vehicles, it would be desirable to provide a control system which could be operated by just one control element.

There is disclosed in our US specification 4,237,629 (Schmidt) apparatus for controlling the operation of a snowplough, in which a joystick is provided with a

single end push-button and a slideable hand grip, also in the region of the end of the joystick. The hand grip and the push-button provide for actuation, each, of one additional function of the snowplough, in order to supplement the four functions controlled by angular movement of the joystick, namely raising, lowering, adjusting to the right, and adjusting to the left. The push-button and the hand grip control two additional switches for actuating the two further functions. Thus, a total of six functions can be controlled.

In the case of cleaning vehicles and other vehicles having multiple functions, there is a need for simple control of a much larger range of functions than could possibly be provided by the, basically, arithmetic approach of adding switches to control additional functions.

Accordingly, an object of this aspect of the present invention is to provide cleaning and other vehicles in which a driver's control element permits single-handed control of a whole range of functions, in a simple manner, and/or to provide improvements in relation to one or more of the matters discussed above, or generally.

According to the invention there is provided a cleaning vehicle as defined in the accompanying claims.

In a preferred embodiment a cleaning vehicle comprises a vehicle body and ground wheels. Matter removal means is positionable in working relation to a surface to be cleaned, to remove matter therefrom, and control means is provided to control operation of the matter removal means.

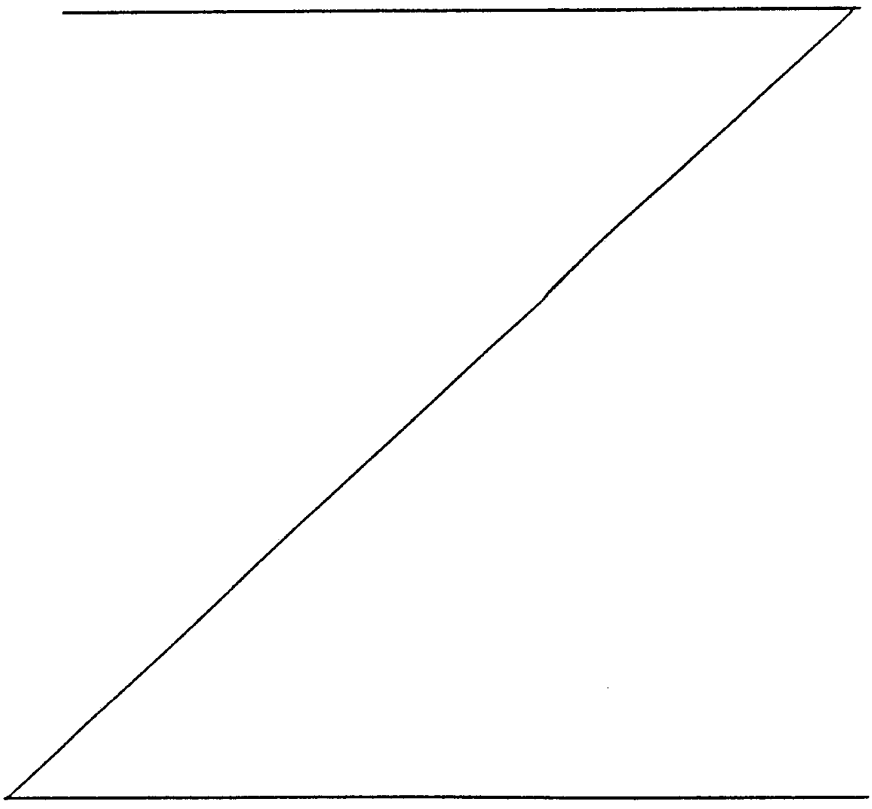
A notable feature of the system is that the control means comprises a joystick and the joystick is pivotably mounted to effect control of the fuction of the matter removal means by angular movement of the joystick. The joystick also has a plurality of finger (or thumb) operable control elements thereon. The control elements and the joystick are operable with one hand to change the funtion

of the matter removal means which is controlled by angular movement of the joystick. Thus, there is provided a cleaning vehicle in which control of the fuctions of the matter removal means is effected by pivotal movement of a joystick having finger (or thumb) operable control elements thereon to change the functions controlled by the joystick.

The control elements or buttons enable selection of a variety of functions of the vehicle. For each or any of the functions or programmes, there may be energised or de-energised, any one or more of a variety of functions and, of those energised, the joystick may provide control over one or more of these by angular movement thereof.

In addition to the functions selected by the panel of buttons or control elements on the joystick there may be provided a separate programme selector to provide further ranges of programmes which can be controlled.

The functions to be controlled may include aspects of such systems as the drive transmission of the vehicle.



Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which :

Fig 1 shows a plan view of the chassis of a cleaning vehicle, illustrating, inter-alia the wheel envelope described by each of the front steerable wheels;

Fig 2 shows a side elevation view of the cleaning vehicle chassis seen in Fig 1, the direction of viewing being indicated by arrow II in Fig 1;

Fig 3 shows a plan view, on a larger scale, of the left hand front steerable wheel of the vehicle of Fig 1, and including details not shown in Fig 1;

Fig 4 shows, on a larger scale, a front elevation view of wheel mounting apparatus of the chassis of Fig 1, the direction of viewing being indicated, approximately, by arrow IV in Fig 1;

Fig 5 shows a plan view of a suction nozzle and its mounting apparatus in relation to the steerable wheels of the cleaning vehicle, the apparatus being shown in its straight-ahead position;

Fig 6 shows, in a similar view, the apparatus of Fig 5 when the cleaning vehicle is turning to one side;

Fig 7 shows a plan view of a cleaning brush and its mounting apparatus;

Fig 8 shows a side elevation view of the apparatus of Fig 7 the direction of viewing being indicated by arrow VIII in Fig 7;

Figs 9 and 10 show, in plan views similar to that of Fig 7, the brush mounting assembly in its working position and in a released position after break-back respectively;

Figs 11 and 12 show, again in plan view similar to that of Fig 7, the brush mounting apparatus of that Figure executing a contour following function in response to a change in profile of, for example, a gutter;

Figs 13 and 14 show, in views similar to that of Figs

9 and 10 a further embodiment incorporating modified geometry whereby automatic inward retraction of the brush occurs upon break-back;

Fig 15 shows an elevation view of joystick apparatus for effecting control of the cleaning gear;

Fig 16 shows a plan view of brush control switches provided on a face of the joystick of Fig 15, the direction of viewing being indicated by arrow XVI in Fig 15;

Fig 17 shows a side elevation view of a cleaning vehicle illustrating recirculation of water through the vehicle, and showing also the fan assembly and an associated sound attenuation system;

Fig 18 shows a plan view, in the direction indicated by arrow XVIII in Fig 17 of the fan assembly and the sound attenuation duct;

Fig 19 shows, on a larger scale, an elevation view of the front end of a matter storage tank seen in Fig 17 the direction of viewing being indicated by arrows XIX - XIX in Fig 17;

Fig 20 shows a section through the front end of the tank of Fig 19, the section being taken on the line XX - XX in Fig 19;

Fig 21 shows, on a relatively large scale, a section through a portion of a screen for separating water from solid matter;

Fig 22 shows, somewhat diagramatically, suspension apparatus for the cab of the cleaning vehicle seen in Fig 17, the direction of viewing being approximately the same as in Fig 17 ie side elevation;

Figs 23 and 24 show side elevation and rear elevation views of a modification of the embodiment of Fig 21 illustrating a single link anti-pitch mounting with an associated leaf spring providing for anti-roll;

Figs 25 and 26 show side elevation and rear elevation views of a further modification, similar to that of Fig 22, and incorporating anti-roll facilities;

Fig 27 shows a perspective view of the cleaning vehicle cab illustrating the various glazing panels thereof;

Figs 28 and 29 show front elevation and side elevation views of the cab of Fig 27, showing the angles of inclination of double glazed panels;

Fig 30 shows a plan view of the cleaning vehicle illustrating two wander hoses in their stowed and deployed positions;

Fig 31 shows a side elevation view of the vehicle of 30, the direction of viewing being indicated by arrow XXXI in Fig 30;

Fig 31 shows, diagramatically, a plan view of the cleaning vehicle with the rear engine and an associated hydraulic drive system indicated, together with certain other control systems; and

Fig 33 shows the hydrostatic drive system of Fig 31 modified in accordance with the drive system of the vehicle of the above embodiments.

The front suspension will be described first.

As shown in Figs 1, 2, 3 and 4, a cleaning vehicle 10 comprises a vehicle body 12 comprising a chassis 14 mounted on front steerable ground wheels 16, and rear steerable ground wheels 18.

Vehicle 20 comprises cleaning gear in the form of matter removal means 20 comprising a suction nozzle 22 and brush gear 24 comprising left hand and right hand brushes 26, 28 respectively. A suction duct 30 is connected to nozzle 22 to remove matter therefrom and to deliver same to a matter storage tank 32.

Suspension means 34 for the front steerable wheels 16 comprises an axle assembly 36 and structure (comprising a leaf spring 38) interconnecting the wheels and 16 and extending laterally across the width of the vehicle. The leaf spring provides resilient means acting between the vehicle body and the wheels 16.

Suspension means 34, including leaf spring 38, is positioned and dimensioned so as not to interfere with the suction duct 30 during use of the vehicle. Leaf spring 38 is positioned so as to extend into the arc of clearance 40 in the envelope of movement 42 of each of the front steerable wheels, as shown in Fig 1.

Turning now to the details of the wheel suspension shown in Figs 3 and 4, the axle assembly 36 comprises a pair of swing axle assemblies, each constructed as shown at 36 in Figs 3 and 4, and mounted one at each side of a central zone 44 of the vehicle 10, through which zone the suction duct 30 extends. This feature of vehicle 10 is perhaps best seen in Fig 4 where the relationship of the axle assembly 36 to central zone 44 can be seen, with the corresponding opposite axle assembly 46, likewise indicated.

Leaf spring 38 is connected at its central region 48 to chassis 14 and thus to vehicle body 12, and at its outer ends enters the arcs of clearance 40 of the wheel envelopes 42 and is connected to the wheels.

Thus, the suction duct 30 passes through a channel or space constituted by central zone 44 between the axle assemblies 36 and 46 (and can be identified even in cab drawings Figs 26 to 28 where the duct passes partly through the cab under a channel section 47), and leaf spring 38 likewise crosses the channel and loads the wheels at its ends within the wheel envelopes, thereby providing relatively high vehicle body roll resistance, while being of a width (measured in the vehicle fore/aft direction) not sufficient to interfere with the suction duct.

Leaf spring 38 is rigidly fixed by bolting to the vehicle chassis 14 in its central region 48 so that its opposite end portions function independently in the sense that the spring does not pivot about its central region to transmit wheel movements between opposite sides of the vehicle.

As can be seen from Fig 2, the suction duct 30 passes over leaf spring 38, as viewed in the side elevation direction of the vehicle.

Turning now to the details of the wheel suspension, as shown in Figs 3 and 4, leaf spring 38 bears on lower swing axle or wishbone 52 at its end 54, on a wear plate. The inner end of swing axle 52 is journalled at 56 on chassis 14. Upper swing axle or wishbone 58 is likewise journalled at 60 on chassis 14. The inner ends of the swing axles are journalled at 62 and 64 on a king pin assembly 66 defining a steering axis 50 and providing a wheel bearing and axle assembly 68. A shock absorber 70 acts between the king pin assembly and a bump stop member 72 having a face 74 to engage a rubber stop 76.

In use, leaf spring 38 provides vehicle lateral roll resistance in combination with the necessary resilient suspension characteristics while the swing axles 52 and 58 provide improved wheel attitude control in co-operation with the leaf spring without interfering with the large wheel envelope and the whole assembly carrying the substantial vehicle weight without interfering with the suction duct 30.

Nozzle mounting and steering will now be described.

As shown in Figs 5 and 6, the cleaning vehicle 10 is otherwise contructed as described above. The matter removal means 20 comprises suction nozzle 22 connected to suction duct 30 and mounted for a degree of turning movement in response to steering movement of the steerable front wheels 16. Alternatively, the control of the turning movement of the nozzle may be provided in response to steering movements of the brush gear 24 (not shown in Figs 5 and 6). Alternatively, the steering movement of the nozzle may be in response to a hybrid function of both of the latter steering movements.

In the drawings, the steering axes of wheels 16 are shown at 50.

Nozzle 22 is connected to vehicle body 12 by a trailing linkage 80 which permits turning movement while transmitting forward motion forces to the nozzle. Linkage 80 is connected to a forward region (with respect to the direction F of normal forward movement of vehicle 10), while a rearward portion thereof is connected to duct 30. The connection to linkage 80 is effected in a manner which permits movement laterally (with respect to the fore/aft axis of the vehicle), of the connection, as the ground wheels 16 and/or the brush gear are steered. This lateral movement of the nozzle tends to keep the nozzle front opening facing the direction of forward travel of the vehicle. This relationship is illustrated by a comparison between Figs 5 and 6. The lateral movement likewise maintains a proper relationship between the nozzle 22 and the brush gear (not shown).

Actuating means 84 is provided to effect the lateral movement of the connection means between linkage 80 and the nozzle, in response to the steering movement of the steerable wheels and/or the brush gear.

The connection means and the actuating means comprise a linear double-acting ram 86 which extends widthwise of nozzle 22 and has linkage 80 connected to a cylinder 88 of the ram assembly, which moves laterally in response to fluid pressure supplied, while the pistons 90, 92 of the ram assembly are fixed to the nozzle by brackets 94.

Trailing linkage 80 is in the form of a downwardly and rearwardly extending arm 96 connected at its front and upper end 98 to a plate 100 on chassis 14 of vehicle 12, the connection being such that relative pivotal movement (as can be seen has occurred in Fig 6) can readily take place. At its lower end, arm 96 is connected to cylinder 88 by a bracket 102, in a fixed right-angled relationship.

Suction duct 30 is connected to nozzle 22 through a connection assembly 104 which serves to transmit from the nozzle to the duct the degree of turning movement which can

be observed at the bend 106 in duct 30 in Fig 6.

Linkage 80 represents the sole structural connection to nozzle 22, so far as the application of tractive effort is concerned. The nozzle is trailed by arm 96 and skids 107, 105, 103 contact the swept surface and have a self-alignment effect. The skids are formed of a hard-wearing material, such as a nickle alloy. The only other connection to nozzle 22 is suction duct 30.

In use, the nozzle is steered in the manner illustrated in Figs 5 and 6 whereby its front opening is maintained in alignment with the general direction of forward sweeping. This effect is produced automatically in response to steering movements of the steerable wheels and/or the brush gear, and in this way the risk of trails of unremoved matter is greatly reduced, without requiring monitoring and intervention on the part of the driver.

Brush mounting and break-back will now be described.

The brush mounting incorporates brush break-back facilities. The brush mounting arm is articulated between its ends for this purpose. A latch mechanism is provided which has to be released before break-back can occur. The latch is arranged to be responsive to overload.

As shown in Figs 7 and 8 of the drawings, matter removal means 20 comprises brush gear 24 of which there is shown in Figs 7 and 8 the left hand brush 26 (left hand as seen from the driver's driving position in the cab). Brush 26 is rotatable about an upwardly extending axis 110 and is carried on a brush mounting arm assembly 112 extending generally forwardly with respect to the normal direction F of operative forward motion of the vehicle, to sweep laterally inwardly with respect to direction F. The brush rotates in direction R.

It should be noted that in Fig 7 the direction F has been shown at an oblique angle with respect to the longitudinal axis 114 of the brush mounting arm assembly, for the reason that this is the situation in which break-

back is most usually relevant. Figs 9 and 10 show the normal operating attitude of the brush assembly with respect to the travel direction F and the vehicle centre line VCL. Figs 9, 11, 12 and 13 show the normal attitudes of the brush mounting arms during sweeping. The brushes can be swung outwards individually or in unison for various reasons, and it is in such a situation that break-back is more likely to be needed. It can be reasonably assumed that the driver will be more likely to avoid impacts with immovable objects which lie directly in the path of the vehicle body itself, than with such objects which lie, perhaps, just outside the width of the vehicle body.

Brush mounting arm assembly 112 comprises inner 116 and outer 118 arm portions which are connected by pivot means 120 which has a generally upwardly extending pivot axis 122. The outer arm portion 118 is capable of pivoting with respect to the inner portion 116 upon impact with a foreign body, so as to yield in a rearward direction, by folding movement of the brush mounting arm assembly 112, as indicated by arrow 124 in Fig 7.

There is provided overload-responsive latch means 126 which acts between the arm portions 116 and 118 to retain same in their normal working relationship (as shown in Fig 7) until the latch means is released by overload. For this purpose there is provided a latch member 128 pivotally mounted on arm portion 116, which engages a latch pin 130 mounted on a latch bracket 132 fixed-to and projecting lengthwise from the outer arm portion 118. Thus, when latch means 126 is engaged, engagement of latch member 128 with latch pin 130 holds the two arm portions 116, 118 in their linear relationship with respect to pivot means 120.

In order to release the latch means, there is provided a movable latch release member 134 in the form of a block slidable on a rod 136 mounted on inner arm portion 116 between two brackets 138 and 140. The assembly of rod 136 and bracket 138, 140 is fixed in attitude with respect to

inner arm portion 116.

Coiled compression springs 142 (for break-back), 144 (for contour following) are received on rod 136 between block 134 and brackets 138, 140. Block 134 is positioned to engage a fixed pin 146 on latch member 128, to release same.

A brush lateral control ram 148 is connected to block 134 and to the vehicle frame at its inner end 150, through a shear-pin (not shown). Inner arm portion 116 is likewise-connected at 152.

A gas strut 154 interconnects brackets 156, 158 on arm portions 116 and 118. The strut provides a return force which operates to resiliently re-latch the brush mounting arm assembly after break-back.

The outer end of the brush mounting arm assembly 112 is connected to the brush member 159 itself through a bracket assembly 157 straddling the hyraulic brush - driving motor 155. A coiled compression spring 153 provides a resilient connection between bracket 157 and the outer arm portion 118 so as to resiliently resist pure compressive forces applied endwise to the brush and mounting arm assembly. The gas strut 151 permits accommodation by the brush member 159 of changes in road camber.

As shown in Fig 8 a brush lift ram 149 acts between the vehicle body or chassis and inner arm portion 116.

In use, the brush and mounting arm assembly are positioned by rams 148 and 149. Fig 9 shows the normal working position for one of the brush assemblies, with respect to the vehicle centre line VCL and direction F of forward motion of the vehicle. The circuit of the brush lateral control ram 148 has pressure relief valves operative to permit inward lateral movement of the brush when spring 144 has become fully compressed. This is at a relatively high load. Below this load, resilience for inward lateral movement of the brush is provided by contour

spring 144. Such lateral movement causes sliding movement of block 134 lengthwise of rod 136 causing compression of spring 144.

When the brush experiences forces acting in a direction to cause outward swinging movement (in the direction of arrow 124), this tends to cause block 134 to compress spring 142. As can be seen from the drawings, this latter spring is heavier than spring 144 and provides greater resistance. The arrangement is such that as soon as a relatively small degree of intial movement of the block has occurred in this direction, latch member 128 is tripped and pin 130 released whereupon the unopposed (except for gas strut 154) outward forces immediately cause break-back of the outer arm portion 118 in the direction of arrow 124 from the position of Fig 9 to that of Fig 10. It will be seen that the arm can swing in direction 124 until it adopts a slightly trailing attitude with respect to direction F, and can then swing inwards with respect to the vehicle centre line VCL against the action of contour spring 144. Such movement effectively releases the forces acting on the brush in most cases. The geometry of the assembly in this released position is such that inwardly-directed forces are generated on the whole brush mounting arm assembly.

Figs 11 and 12 illustrate the action of the brush mounting arm assembly during contour following. An example of such a situation is where the sweeper is following a profiled street kerb, at one side of the vehicle. Thus, in Figs 11 and 12 the kerb 147 moves away from the vehicle centre line VCL at location 145, and re-adjusts its profile again at 143. As shown in the drawings, contour following spring 144 accommodates such movement without requiring the driver to make any brush-controlling adjustments. In the Fig 11 position of the brush, the spring has been compressed. As the kerb changes profile, it automatically pushes the brush outwards and thus accommodates the profile

change. The change in compression of spring 144 is identified at 141 and 139.

A modification is illustrated in Figs 13 and 14. This embodiment is to be compared with that of Figs 7 to 12. The change in structure can best be seen in Fig 14, where it can be clearly seen that the brush lateral control ram 148 is connected to the outer arm portion 118 through an extension member 137, instead of through latch release member 134 and associated structures. The extension member could incorporate a contour-following spring assembly if desired.

The geometry of the modified brush mounting assembly is such that when break-back occurs (the assembly moves from the Fig 13 to the Fig 14 position), the ram 148 and arm portion 116 are caused to swing inwards towards the vehicle centre line VCL, in the manner illustrated in Fig 14, thereby moving the brush member 159 inwards likewise.

Brush contour following will now be described.

The structure and function relating to brush contour following have been largely described under brush break-back above and illustrated in Figs 11 and 12. The contour following function arises from the resilience of the brush mounting arm assembly to lateral movement under the action of forces generated during use. The above-described arrangement is such that the driver of the vehicle can position the brushes appropriately for sweeping purposes. Then, if (for example) the contour of the gutter which he is sweeping requires some lateral inward movement of the relevant brush, the driver need take no action himself, the brush will follow the contour of the pavement by resilient movement accommodated by compression of spring 144. This spring can take care of significant inward movement. Beyond that, the hydraulic system accommodates the movement by means of the pressure relief valve mentioned above. When the contour of the pavement moves away from the centre line of the machine the brush automatically returns to its

former working position under the action of spring 144 itself.

Cleaning gear control will now be described.

As shown in Figs 15 and 16 of the drawings, control means 160 to control operation of the brush gear and other cleaning gear/matter removal means functions of cleaning vehicle 10 comprises a joystick 162 which is pivotally mounted on a self-centring resilient bush 164 so as to effect control of the functions of the matter removal means by angular movement of the joystick.

There is provided below the main body 166 of the joy stick, a projecting rod 168 which extends through a micro-switch assembly 170 and there effects the requisite electrical switching functions for the purposes described below. Rod 168 has a threaded end portion 172 on which a nut 174 and a captive coiled compression spring 176 are received to maintain the operational relationship between the joystick 162 itself and the micro-switch 170. A control cable 178 leads from the micro-switch to an electrical control module for the brush gear and matter removal equipment.

A flexible gaiter 180 connects the bottom end of the main body 166 of the joystick and the structure 182 supporting bush 164 and micro-switch 170.

Joystick 162 also has a series of finger (or thumb)-operable control elements or buttons 184 provided on a pad 186 thereon in the region of the upper end 188 thereof.

Each of the buttons 184 is operable with the same hand which actuates the joystick, to change the functions of the matter removal means which are controlled by angular movement of the joystick. Thus the buttons 184 are mounted on a micro-switch assembly 190 having an associated cable 192 leading to the control module.

Associated with the joystick is a program control switch 194 having a rotary control element 196 enabling selection of any one of six control programs provided by

the control module 198.

As shown diagramatically in Fig 15, control module 198 provides control instructions to the fan which generates suction in the matter storage tank 32, and to the nozzle, and to the clean water spray equipment, and to the rotary cleaning brushes.

In the tabulation of fuctions set out below, there is indicated which functions are operating in each of six exemplary programs:

Function	Program Number	Left Hand Brush	Right Hand Brush	Nozzle	Suction Fan	Water Spray Left	Water Spray Right
Sweep Both	1	1	1	1	1	1	1
Wander Hose	2	0	0	0	1	0	0
Scrub	3	1	1	0	0	0	0
Suck	4	0	0	1	1	0	0
Sweep Left Hand	5	1	0	1	1	1	0
Sweep Right Hand	6	0	1	1	1	0	1

1 = 'DOWN' or 'ON' 0 = 'UP' or 'OFF'

After selecting the required program, the joystick is moved forwards to enegise the relevant items. This action

effects electrical 'latching' of the relevant functions so that when the joystick is released and spring-returns to centre, the relevant functions continue to operate.

In addition to the simple manual control of a multitude of functions in the above manner, simply by angular movement of the joystick, the buttons 184 on the joystick provide additional modification of the controls effected. Thus for example, the five buttons may provide the following functions:

1 Brush back pressure and nozzle debris button:
A. By moving joystick forwards, back pressure on the brushes is inhibited giving a harder scrub. When the joystick set is released, back pressure returns to the level set by the control module; and

B. By moving the joystick backwards, the nozzle is raised either to a 'small debris' position or a 'larger debris' position.

2 Brush lateral movement button: this is controlled by movement of the joystick to the left and right.

3 Unison brush movement button: in this position the brushes are latched so that left or right movement of the joystick moves both brushes in the same direction.

4 Opposed brush movement button: in this mode, movement of the joystick effects lateral movement of the brushes in opposite directions.

5 Cancel button: when this button is depressed all functions revert to their 'parked' or off conditions. Thus this effects electrical un-latching of all functions.

Many other arrangements could be provided including control of other additional or alternative functions,

including the vehicle transmission.

The water recirculation system will now be described.

As shown in Fig 17 of the drawings, suction duct 30 leads to tank 32, the duct terminating at 210 for deposition of matter in the tank.

Screening means 212 is provided for separating water from matter deposited in the tank. Below the screening means is provided a separated water tank 214 to store water separated by the screening means.

Recirculation means 216 is provided to deliver screened water from tank 214 to be mixed with the air stream containing matter (removed for example from a road surface) passing through duct 30. The recirculation means comprises a pump 218 delivering through hydraulic lines 220 to spray nozzles 222 and 224 located, respectively, at the lower and upper ends of duct 30. Thus, the separated water from tank 214 is re-injected into the suction duct for re-deposition with the solid matter passing therethrough, in the tank 32.

A clean water storage tank 226 is provided alongside tank 214 to store clean top-up water for a purpose to be described. The clean water tank 226 is of larger capacity than the separated water storage tank 214. In this embodiment the separated water tank is of capacity 150 litres and the top-up water tank 226 is of four times that capacity, namely 600 litres. During use, matter storage tank 32 holds, on average, about 300 litres of water in course of being screened from the matter, at any one time.

Top-up means 228 comprises a pump 230 delivering through a conduit 232 to tank 214. Level sensing means such as a float 234 actuating a control 236 is provided to maintain the level of water in tank 214. Control 236 may itself incorporate a valve connected to line 232 to control discharge from pump 230 which runs continuously. Alternatively, control 236 may be arranged to energise the

pump as and when required.

In Fig 17, the return flow of screened water from tank 32 to separated water tank 214 is indicated at 238. The inward flow of water is pumped from tank 214 to nozzles 222 and 224, this flow proceeding through suction duct 30 and mixed with the air blast therein is indicated at 240. There is mixed with this flow an additional amount of water which may have been sprayed onto the surface 242 being swept from spray jets as indicated at 244 by brush spray bars 246 or by a general spray bar at the front of vehicle 10. This water enters the vehicle in the air stream drawn into nozzle 22, as indicated at 248 and proceeds through duct 30 intimately mixed with the air flow and (soon afterwards) with the water flow 240 from nozzles 222.

In this embodiment the water supply to spray bars 246 is provided by pump 230 (or a separate pump) delivering water from tank 226 of fresh water. The hydraulic line 254 delivering from pump 230 to spray bar 246 is shown purely diagramatically in Fig 17.

There is also shown in Fig 17 an oil pump 256, an oil heat exchanger 258, and oil conduits 260 forming part of a hydraulic drive system for various fuctions in vehicle 10, including the rotable sweeping brushes 26, 28, and/or the fan 500 (to be described later) which exhausts air from tank 32, and/or indeed the hydraulic drive for rear-wheels 18 of the vehicle. These hydraulic drives all generate heat and, in this embodiment, this heat is utilized to raise the temperature of the water in tank 226 to avoid problems of freezing occurring under winter sweeping conditions. The pump, conduits and heat exchanger are constructed in water-submersible form, and thus all effectively form heat exchangers to some extent, and the heat exchanger element 258 is specifically constructed for this purpose.

While it has been previously proposed to provide heat exchange facilities in the screened water tank of a

cleaning vehicle of this kind, the above arrangement in which this water heating facility is provided in a previously unknown top-up tank enables a much greater degree of control to be exercised over this facility in terms of the regulated and predictable volume of water in the top-up tank.

Turning now to the arrangements for mounting and removing the screening means 212, reference is directed to Figs 19 and 20 of the accompanying drawings. In Fig 19, tank 32 is seen to be provided with connection means 262 for suction duct 30. Though not shown in Fig 20, it can be seen from Fig 17 that duct 30 continues to its end 210 within tank 32.

Screening means 212 comprises two rectangular screens 266, 268, one at each side of the central connection means 262.

Each of the screens 266, 268 is of wedge wire construction. That is to say, the screen consists of parallel elements of wedge or triangular-section metallic material, these being cross-reinforced by transverse supports at intervals. The effective screen size is defined by the space between the adjacent front edges of the screen elements. This is illustrated in Fig 21 in which four representative screen elements 268 are shown, and the "mesh size" is indicated at 270. The inner side (at which solid matter is retained) of the tank is identified at 272. In this embodiment, the mesh size is 1.5 mm. The range of useable mesh sizes is from 0.5 to 3.0 mm and preferably from 1.0 to 2.0 mm.

As shown in Fig 20, screen 266 has a support frame 274 and is secured in position by location behind clips 276 by manipulation using handles 278, but is manually-removable from its in-use postion shown in Fig 3 after releasing a water collection housing 280 (not shown in Fig 20) by means of an over-centre action release handle 282. Housing 280 servies to collect screened water. The housing

extends laterally across the width of the vehicle. Housing 280 defines a transversely-extending channel 284 serving to collect and deliver the screened water emerging from tank 32 through openings 281, 283 therein to tank 214 at one side of the vehicle (opposite the vehicle engine).

When housing 280 has been released, the screens 266 and 268 can be manually removed through the openings 281, 283 and the screens can then be cleaned, for example by back-washing with a hose. The screens are then replaced and the housing is closed.

The cab mounting will now be described.

As shown, somewhat diagramatically, in Fig 22 of the drawings, the cab 290, which houses controls for the vehicle, has mounting means 292 for mounting the cab on the chassis 14 of vehicle 10.

Mounting means 292 comprises resilient means in the form of a coiled spring 294 and an associated damper 296 interconnecting brackets 298, 300 on the chassis and the cab.

Mounting means 292 further comprises upper and lower link members 302, 304 which pivotally interconnect the cab 290 and the vehicle body or chassis, whereby movement of the cab on its mounting is limited.

Links 302 and 304 are pivotally connected between brackets 306 and 308 on the vehicle body or chassis, and corresponding brackets 310, 312 on the cab.

Fig 22 shows the assembly in its at-rest condition. It will be noted that upper link 302 lies in a plane 314 which extends, generally horizontally, through the centre of gravity 316 of the cab. This latter arrangement has considerable significance in relation to the dynamic performance of the cab during use, and reduces cab pitch to a minimum. Positive or negative pitch may be permitted by disposing the link below or above the centre of gravity.

In the above embodiment, the links 302, 304 define two sides of a parallelogram. However, the links could be of

different lengths and non-parallel to compensate for inertia forces and chassis dynamics, eg pitch induced by braking.

Not shown in Fig 22 is a panhard rod extending laterally of the cab and connected at one end to one of the brackets 310 or 312, and at its other end to the vehicle chassis, so as to provide lateral pitch/roll resistance for the cab. In use, cab movement on its suspension 292 with respect to the vehicle chassis is limited by the link 302, 304 to up and down movement. The tendency for the cab to pitch forwards can be entirely eliminated if the alignment of link 302 is as shown as in Fig 22.. Alternatively, if link 302 is disposed slightly above the centre of gravity 316, then there is a negative pitch effect, and the cab tends to rise slightly under the dynamic forces. The converse applies if link 302 is located slightly below the centre of gravity 316.

Considerable modification can be provided in the arrangement and disposition of the links, the exact locations where they are connected to the cab and their dimensions and the location of the brackets by which they are connected to the cab. In the above embodiment, bracket 310 is located significantly forward of bracket 312. Likewise, a considerable variety of different cab suspensions may be provided. For example, as described below, in place of the coiled spring 294, a leaf spring assembly could be provided.

It will be noted that the two pairs of links 302, 304 at each side of the cab constitute, effectively, a four bar linkage connecting the cab to the chassis or vehicle body. In operation, the cab's dynamic movement during use is more closely controlled by means of the linkages described above. In this way, the tendency for cabs in previously proposed vehicles to pitch and roll is significantly reduced and the result is a more acceptable ride quality.

In the embodiment of Figs 23 and 24 the cab 290 has a

single pitch control link 318 at each side of the cab, and corresponding to the upper link 302 in the preceding embodiment. Dampers 319 are provided, corresponding to dampers 296. In place of coil springs 294, there is provided a transverse leaf spring 317 connected at one end to brackets 315 on the cab, fixed centrally at 313 to the chassis 14, and having a captive roller end fitting 311 to load its other end from the cab.

Link 318 controls pitch. Transverse leaf spring 317 provides resilient suspension and roll resistance.

In the embodiment of Figs 25 and 26 the general arrangement of the pitch control links and suspension and dampers is as in Fig 22, and these parts are therefore numbered as in Fig 22. In addition, there are provided upper and lower panhard rods 309, 307 connected, respectively, between brackets 305 and 303, and the chassis 14, and extending (in the equilibrium condition of the cab) generally horizontally and transversely with respect to the forward travel direction F.

In this embodiment the links 302, 304 control pitch and rods 307, 309 control roll while springs 294 provide resilient support and dampers 296 attenuate vertical movement.

In this and the preceding embodiment, the cab suspension components are, as far as possible, located within a region 301 below the cab in which the floor 299 of the cab has been stepped upwardly, thereby creating space for location of the suspension assembly.

The above - described cab mounting may be applied not only to cleaning vehicles but to other vehicles in which an independent cab mounting is required and pitch and roll control is required and the space available for locating the suspension below the cab in the forward region (at least) thereof is limited.

The cab glazing will now be described.

In the embodiment, the cab has an upper glazed portion

of which the outer side faces at least slightly upwardly of horizontal, and a lower portion of which the outer side faces somewhat downwardly of horizontal, the lower portion being double or triple glazed. In this way, an unexpectedly large reduction of tranmission of noise into the cab is achieved at a relatively low cost, as will be explained.

As shown in Fig 27 of the drawings, cab 290 comprises panels of glazing material numbered 320, 322 and 324 (upper panels), and 326, 328 and 332 (lower panels). These panels provide visibility for manoeuvring the vehicle and for controlling the matter removal means of the vehicle (brush gear, spray nozzles and suction nozzle) located at a lower level than the cab.

The lower panels face downwardly of horizontal at an angle of 15 degrees. It will be noted that the lower panels include a panel 332 in the floor of the cab to provide direct downward viewing of the nozzle region of the vehicle. This panel lies, of course, approximately in a horizontal plane itself and thus faces approximately vertically.

Likewise, the upper panels 320, 322 and 324 face upwardly of horizontal at an angle of 15 degrees. Whereas the upper panels 320, 322 and 324 of glazing material are of single glazed material, comprising a single pane or sheet of glass or other glazing material, the panels 326, 328, 330 and 332 are double or triple glazed, comprising two or three (or more) sheets of glazing material disposed generally parallel to each other and separated either by a partial vacuum or by air or gas at approximately atmospheric pressure, the arrangement being such that tranmission of sound through the glazing panels is significantly reduced.

Figs 28 and 29 show the angles of inclination 342, 344, 346 with respect to the horizontal 340, of, respectively, upper, lower, and floor glazing panels.

These angles are 105 degrees, 75 degrees and 5 degrees. The preferred range of angles is : upper panels facing up to 25 degrees upwardly of horizontal (angle 342 up to 90 + 25 = 115 degrees) and more preferably 10 degrees to 20 degrees upwardly of horizontal. For the lower panels the usable range is the same, but facing downwardly of horizontal. For the floor panel the range is from horizontal to 25 degrees with respect thereto or beyond, the limit being set only by visibility factors.

We have determined that by virtue of the differences in inclination of the upper and lower glazing panels there is an unexpectedly high benefit in terms of reduced noise transmission into the cab resulting from the double or triple glazing of the lower panels. As a result, the upper panels can be left single glazed, and the substantial cost savings (as compared with double or triple glazing all panels) are thereby of benefit to the user. A cab which is double or triple glazed throughout all glazing panels is of course a perfectly practicable proposition, but the costs thereof are generally unacceptable and such is not covered by the present application.

In this embodiment, in order to achieve an even greater reduction in sound transmission into the cab, the glazing materials chosen for the double (or triple)glazed lower portions of the cab are chosen so as to have differing physical characteristics, particularly with respect to sound transmission. For this purpose, there is provided an outer layer of toughened glass and an inner layer of laminated glass, spaced from each other in the usual manner for double glazing situations. The differing sound transmission characteristics of these layers (arising not least from the plastic/glass/plastic laminated structure of the laminated glass layer) causes significant further sound attenuation, probably by virtue of the differences in frequency, as between the two layers of glazing material, at which they absorb sound most

effectively.

The toughened glass layer is preferably provided on the outer surfaces of the cab glazing panel so as to maximised resistance to stone damage from passing vehicles, while the laminated glass layer is provided at the inside of the cab to maximise the driver's protection in the event of collision.

It will be understood that the use of this non-homogeneous hybrid glass sandwich may be applied to all panels of a cab in a vehicle requiring such complete double or triple glazing, and that the use, in this manner, of toughened glass represents a deviation from the trend in recent times away from the use of toughened glass for vehicle cabs and windscreens, and towards the use of the more modern laminated glass throughout.

It will be understood that the openings 334 and 336 in the metallic structure 338 of the cab define apertures to receive headlight units (not shown) for the vehicle. The structure of the body of the cab is largely of sheet metal pressings defining the openings for the glazing panels discussed above. The side panels 320 and/or 324 may form part of openable doors providing access to the cab.

The wander hose assembly will now be described.

As shown in Figs 30 and 31, vehicle 10 is provided with wander hose means 350 connected to the tank 32 to enable suction cleaning to be effected by application of the ends 352, 354 of hoses 356, 358, to selected locations on both sides of the vehicle.

Mounting means 360 is provided for the wander hose means 350 and permitting guidance of the ends of the hoses to selected cleaning locations.

As best shown in Fig 30, the wander hose means 350 comprises two wander hose assemblies 362, 364, one for each side of the vehicle 10, and each connected to the matter storage tank 32. As shown in Fig 31, each of the wander hose assemblies is mounted at a location below the level of

the maximum height 366 of the vehicle. The wander hose assemblies are mounted at their respective sides of the vehicle and, in their stowed positions, extend lengthwise of the vehicle and each assembly is pivotable outwardly from the vehicle about an upwardly extending axis, 368, 370.

As can be seen in Fig 31 in their stowed positions, the wander hoses are disposed in a generally U-shaped arrangement comprising upper, lower and intermediate portions 372, 374 and 376 respectively, these portions lying in a generally vertical plane.

An articulated hose support structure 378, 380 is provided for each of the wander hose assemblies. These structures provide support for the hoses in their outwardly -deployed positions, and each permits articulation about an upwardly extending axis 382, from a laterally outwardly - projecting position (seen on the right hand side of the vehicle in Fig 30) to a forwardly extending position (seen on the left hand side of the vehicle in Fig 30, and also in Fig 31), whereby the hose has an arc of movement 384 of the order of 180 degrees at its respective side of the vehicle

The hose support structures 378 and 380 each comprise a hinge assembly in the form of a metallic fabrication, secured by straps or hoops to the wander hose, and extending from a pivot at the respective axis 368 or 370 to an outer end 386, with the intermediate pivot axis 382 approximately mid-way between the opposite ends.

As can be well seen at the left hand side of the vehicle in Fig 30, the first portion 388 of the wander hose is capable of flexing significantly to enable the hose to attain its forwardly-extending position.

As shown in Fig 31, the hoses 356 and 358 are connected to tank 32 on a recessed portion 390 of the tank by means of a connector 392. Thus, the tank has, at each side thereof, a longitundinally extending upper recess 392

and 394 to accommodate the upper portion 372 of the respective hose and corresponding parallel lower recess 393 for the lower portions of the hose. This provision togeter with the double hose assembly and the ability to articulate forwards to extend round the corners 396 of the cab enable the wander hose provision to be met without an increase in vehicle height.

In place of the wander hose arrangement shown in Fig 30, there could be provided a modification in which a single wander hose is provided, itself constructed in a manner very similar to that of the above-described embodiment, and located on the centre line of the vehicle, just rearwardly of the generally U-shaped duct 512 (to be described below). By arranging for the pivot axes 382 to be located at the rear corners of the vehicle, when the wander hose is swung to one side and to the other, the outer portion of the wander hose can then extend forwardly and lengthwise of the vehicle, so as to cover an arc centered close to the vehicle corner and extending forwardly therefrom. This is indicated in Fig 30 at 397. In this way, a single wander hose is provided with substantially all the advantages of the embodiment described above, and covering all the rear region of the vehicle, and extending in coverage forwardly therefrom, as indicated. The major longitudinally-extending portions of this wander hose arrangement could be accommodated at one side of the vehicle, in a manner analogous to that of the above-described embodiment.

The system for controlling vehicle speed will now be described.

In Fig 32, the diagrammatic representation of vehicle 10A does not correspond closely with vehicle 10 described above. For example, Fig 32 shows a front beam axle (instead of the transverse leaf spring), a rear transverse engine (instead of a side-mounted fore/aft engine), and individual wheel motors for the rear wheels (instead of a

single hydraulic motor driving through a back axle assembly with differential). However, the principles described and claimed herein with reference to Fig 32 are equally applicable to the vehicle 10 described above, and Fig 33 illustrates the application of the principles accordingly. Other features of Fig 32 are to be applied in Fig 33 with any necessary minor changes likewise.

As shown in Fig 32, a power plant 400 in the form of a petrol or diesel engine is drivably connected to the rear wheels 18 by a hydraulic or hydrostatic transmission 402 comprising a hydraulic pump 404 driven by power plant 400, hydraulic motors 406, 408 connected to wheels 18, and hydraulic lines 410 interconnecting the pump and motors.

Control means 412 is provided for the hydrostatic transmission 402 in the form of an electronic processor 414 having input signal feed lines 416, 418 and 420 providing signals from sensors 422, 424 and 426, 428 and 430, 432. These sensors sense respectively, movement of the driver's speed and brake control pedals 434, 436 (sensors 422, 424) and front wheel speed and steering angle (sensors 426, 428) and brush mounting arm angle (sensors 430, 432). The output lines 438, 440 and 442 are connected respectively to the wheel motors 406, 408, the pump 404, and to a by-pass valve 444. A further output 446 is provided for connection to a steering control system for the rear wheels 18 which is designated generally by arrow 448 in Fig 1, and likewise in Fig 32, though the steering facility is not shown in that figure.

A braking system for the ground wheels is provided and is controlled by the pedals 434, 436 in the driver's cab. The braking system comprises hydraulic braking means provided by the hydrostatic transmission. In addition, the braking system comprises further braking means providing additional braking effective to meet the requirements for emergency braking during cleaning operations. This further braking means includes the driver-operated foot pedal 436

which is connected through a hydraulic master and slave system to drum-type brakes mounted in the vehicle wheels.

The hydrostatic transmission 402 provides two modes of operation, namely a slow speed mode for cleaning operations and a higher speed mode for use when the vehicle is in transit between cleaning locations. Likewise, the braking means provides at least two corresponding modes of operation, namely a low speed mode for use during cleaning operations, and a higher speed mode for use when the vehicle is in transit. The low speed braking mode is provided by the hydraulic braking effect of the hydrostatic transmission itself, and the higher speed braking mode is provided by the further braking system actuated by the pedal 436 and its associated hydraulic control system.

Automatic change-over means is provided by processor 414 to change the transmission and the braking means from one mode to the other and vice versa, in response to changes in vehicle speed under the control of the driver. Such change-over could be effected purely in relation to vehicle speed sensed, or in automatic response to a driver-effected selection of a speed-related function (eg on the joystick or a speed-increasing kickdown function on the foot control pedal, or a manual pump/motor displacement change lever), or by a hybrid function of both. The vehicle's control system can be arranged to effect suitable automatic response to transit speed travel by eg parking the brushgear and vice versa.

In order to eliminate the hydrostatic braking effect of the transmission 402 at vehicle transit speeds, processor 414 is operative to switch by-pass valve 444 across the hydraulic lines 410, whereby the wheel motors 406, 408, can effectively free-wheel. Alternatively, the arrangement may be such that the hydraulic fluid (resistance to the flow of which would otherwise cause a braking effect) can be dumped to a reservoir when the driver lifts his foot from the control pedal 434 during

transit. Another possibility is to arrange that during transit the motors remain in a low displacement (low resistance) mode, thereby reducing (but in some cases not entirely eliminating) the hydrostatic braking effect.

In order to switch the hydrostatic transmission itself between its low speed and higher speed modes, processor 414 has to effect a switch-over in the control arrangements whereby pedal 434 controls the displacement of pump 404 at generally constant engine speed during low speed use, and pedal 434 changes engine speed at generally constant pump displacement during transit use.

Control of the hydrostatic transmission and braking and steering systems is effected automatically by speed responsive means constituted by processor 414 utilizing speed signals from sensors 426, 428, whereby the processor is effective to change-over between the low and the higher speed modes of operation of the transmission and braking systems, without any specific driver intervention. In addition, a manually operable control may be provided in the driver's cab for actuation by the driver and connected to processor 414, the control providing single lever control of the transmission of the vehicle in the manner of the control of a conventional transmission of an automobile having an internal combustion engine and a torque converter/planetary gear train transmission.

Turning now to the steering arrangements, the forward steering wheels 16 are provided with a conventional steering wheel 450. The rear steerable wheels 18 are provided with a similar steering control system so far as the mechanical mounting and pivoting arrangements for the wheels are concerned. However, the control of the rear wheel steering is effected by the driver's steering wheel indirectly through automatic control means provided in processor 414 which is responsive to vehicle speed and to the steering movments of front wheels 16 as sensed by sensors 426, 428. The degree of steer of the rear wheels

varies in accordance with vehicle speed. In low speed transit mode the degree of rear wheel steer is maximum, as required for vehicle manoeuvrability. The degree of rear wheel steer at transit speeds is zero or substantially zero. Change-over between the two modes of steering is effected automatically in response to vehicle speed. For extreme manoeuvrability, the rear wheels are steered in the opposite sense to the forward wheels.

In use, the control of vehicle 10 is extremely simple. During low speed sweeping operations the hydrostatic transmission provides the advantages of fine control of vehicle speed. In addition the rear wheel steering, automatically effected under computer control, ensures that very tight turning circles can be achieved. Moreover, when sweeping around short radius bends, it is easier for the driver to maintain the vehicle body precisely where he requires it in relation to the adjacent edge of the road, than with a two-wheel steer vehicle. When he then reverts to a higher speed transit mode, the danger of overlooking the requirement to disconnect the rear wheel steer is cut out as soon as the vehicle speed rises sufficiently to render such steering undesirable. The rear wheels are then maintained in the straight ahead position.

When the driver increases vehicle speed for transit purposes, the hydrostatic transmission automatically changes to its higher speed mode at the appropriate vehicle speed, and likewise the processor makes a corresponding response to eliminate hydrostatic braking when the driver lifts his foot from control pedal 434. When he does so, significant hydrostatic braking is not applied to the vehicle. The separate braking system controlled by pedal 436 provides normal braking at transit speeds and emergency braking at sweeping speeds.

Control of all these operations is effected by processor 414 with driver intervention by means of the control lever where he desires to do so.

Interestingly, in the above embodiment, the cleaning vehicle has been provided with the desired transport speed and associated functions without the expense of an additional transmission. Moreover, the step of switching the transmission from one speed range to another is effected automatically, and likewise the arrangement for eliminating and re-establishing hydrostatic braking. The provisions of the legally required braking systems for transit speeds has been achieved with little more expense than was associated with the previously required emergency braking system, and thus the entire transport and braking system has been provided without substantially increased equipment costs. Four wheel steering has likewise been provided, in a safe manner, utilizing the vehicle's control systems to vary the degree of rear wheel steer in accordance with vehicle speed, using the speed sensing and control equipment in a simple manner alongside the parallel equipment provided for braking and transmission control.

Vehicle speed sensing could be achieved by monitoring a speed-related function such as motor and/or pump displacement in the hydrostatic transmission or, for example, by monitoring a driver control function such as a kickdown function provided on the motor control foot pedal.

The sound attenuation systems will now be described.

As shown in Figs 17 and 18 and 30 of the drawings, there is provided a fan assembly 500 to evacuate tank 32 and thereby to cause suction to be applied to suction duct 30. Fan assembly comprises a fan housing 502 in which a radial flow fan 504 is rotatable about an upwardly extending axis 506 to apply suction through a downwardly facing inlet opening 508 communicating with tank 32. The pressure side of the fan communicates with a fan outlet housing 510 leading to a sound attenuation duct 512.

Sound attenuation duct 512 comprises a generally linear receiving portion 514 connected to volute-shaped fan outlet housing 510, and a generally linear discharge

portion 516, these portions being connected by a curved connecting portion 518. Receiving portion 514 has a slight upwardly-joggled duct portion 519. These three main portions of the sound attenuation duct 512 are of generally rectangular cross sectional shape.

Thus, receiving portion 514 of the sound attenuation duct 512 is connected to the pressure side of the fan. The discharge portion of the sound attenuation duct has an upwardly facing outlet 520, of generally square shape, with a smoothly curved and upwardly sloping air guide surface 522 below it to minimise turbulance as the air changes from a horizontal trajectory to a generally vertical one.

Sound attenuation duct 512 is largely mounted on a rear portion 526 of the top wall of tank 32. Portion 526 is hinged at 528 so as to be openable for rearward tipping and emptying of the tank at intervals. Rubber seals (not shown) seal between wall portion 526 and the rest of the tank, and thus serve to damp vibration. A similar arrangement may be provided for fan 504 or it may have its own resilient mountings.

From the foregoing, it will seen that the central axis 524 of the sound attenuation duct 512, which extends longitudinally of the duct through its three portions, also extends generally horizontally, and thus the air discharged from the pressure side of fan 504 likewise passes generally horizontally first away from the fan through portion 514, then through 180 degrees through connecting portion 518, and then towards the fan again through portion 516, followed by a smooth change of direction from horizontal to vertical as the air passes through outlet 520. The result is a relatively long path of the air from the fan before it reaches the outlet, with a direction change of 180 degrees in one plane followed by 90 degrees in another, after an initial upward shift at 519 in the generally horizontal trajectory. Sound attenuation materials may be secured to the walls of the duct. The net result is a very

significant reduction in fan discharge noise, without significant reduction in fan efficiency.

CLAIMS

1 A cleaning vehicle comprising:

a) a vehicle body;

b) ground wheels to support said vehicle body and including a pair of steerable wheels mounted for steering movement;

c) matter removal means positionable in working relation to a surface to be cleaned, to remove matter therefrom;

d) control means to control operation of said matter removal means;

characterised in that

e) said control means comprises a joystick; and

f) said joystick being pivotally mounted to effect control of the functions of said matter removal means by angular movement of the joystick; and

g) said joystick also having a plurality of finger (or thumb) operable control elements thereon, said control elements and said joystick being operable with the same hand which controls the joystick to change the functions of said matter removal means which are controlled by angular movement of said joystick.

2 A cleaning or other vehicle in which control of the functions of the matter removal means, or other multiple functions, is effected by pivotal movement of a joystick having finger (or thumb) operable control elements thereon to change the functions controlled by the joystick.

3 A cleaning vehicle according to claim 1 or 2 characterised in that said matter removal means comprises brush gear pivotally mounted for lateral movement towards and away from the fore/aft centre-line of the vehicle, and said control means for said matter removal means comprises brush gear positioning means constructed upon actuation thereof to position said brush gear in a defined starting position with respect to the centre-line of the vehicle, from which it can be moved by actuation of said joystick.

4 A cleaning vehicle according to any one of claims 1 to 3 characterised in that switch means actuated by said joystick effects at least two different control functions according to the direction of pivotal movement of the joystick.

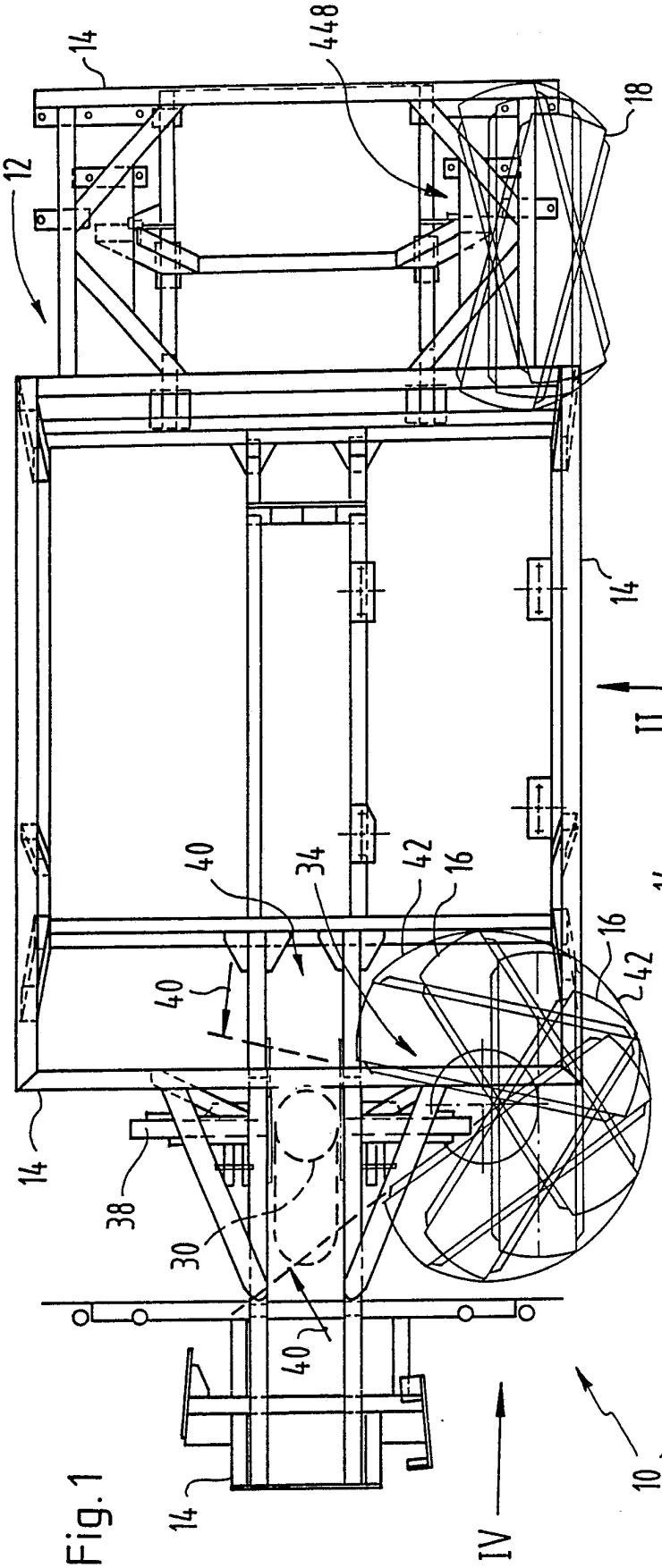
5 A cleaning vehicle according to claim 4 characterised in that said directions of pivotal movement include fore/aft movement and left/right lateral movement of the joystick.

6 A cleaning vehicle according to any one of preceding claims characterised in that movement of said joystick to control a function effects a change in that function and the function continues to operate in its changed mode or value until a further control signal for that function is generated.

7 A cleaning vehicle according to any one of the preceding claims characterised in that said control elements also control other functions of the cleaning vehicle (eg a suction fan) not controlled by angular movement of the joystick.

8 A cleaning vehicle according to claim 2 substantially

as described herein with reference to the accompanying drawings.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34
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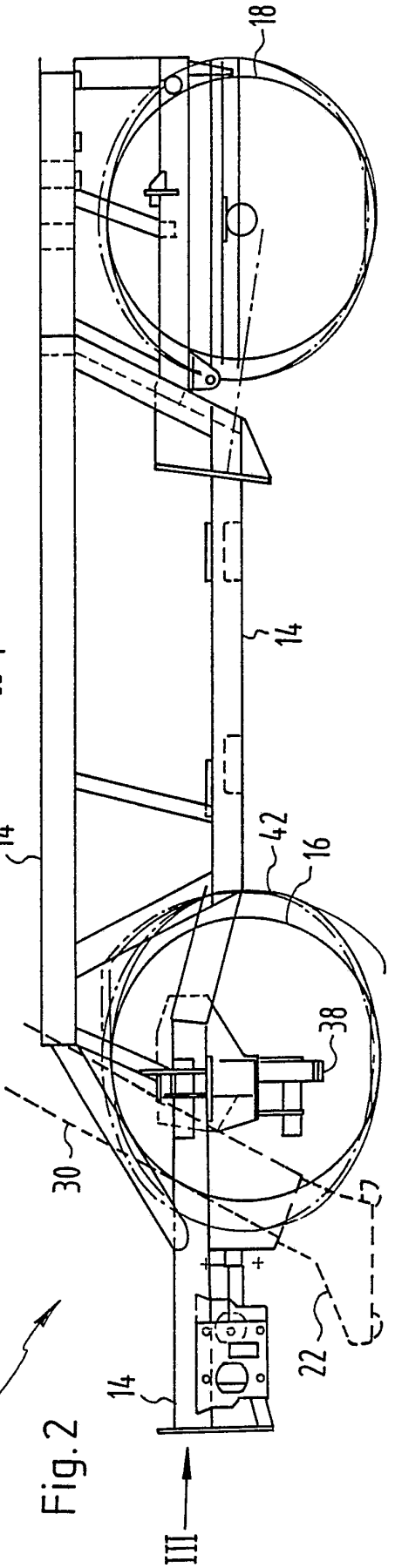
IV
10

Fig. 1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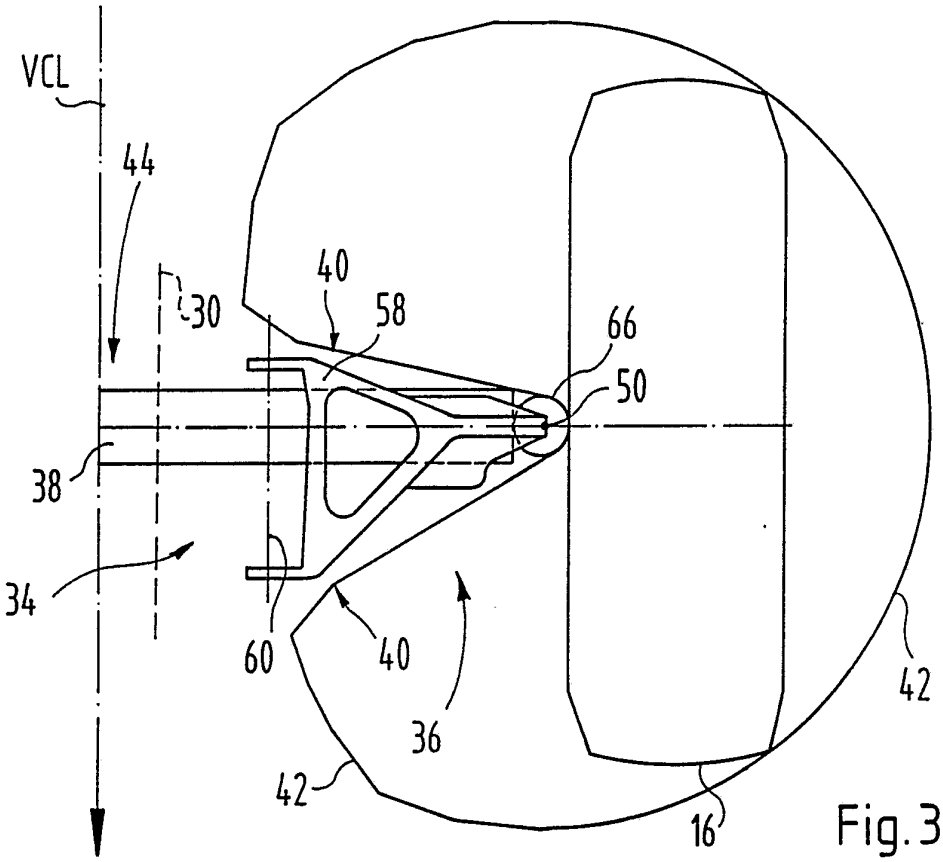
III

Fig. 2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16

Fig. 3

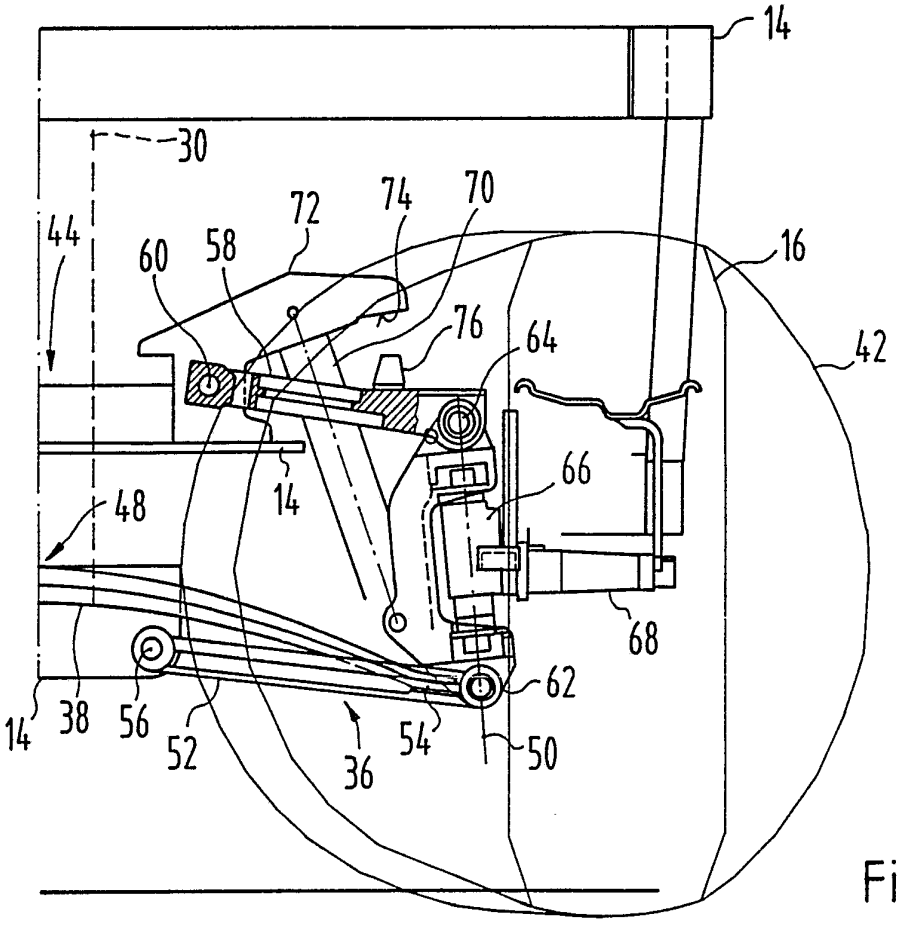
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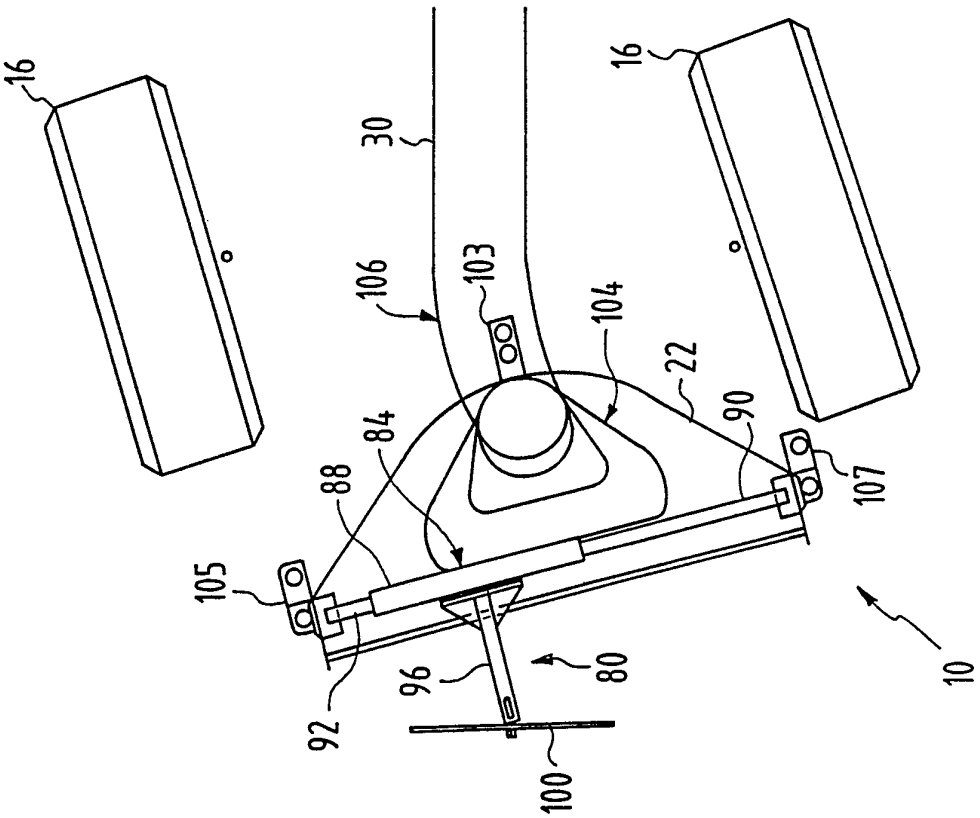
Fig. 4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107
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96
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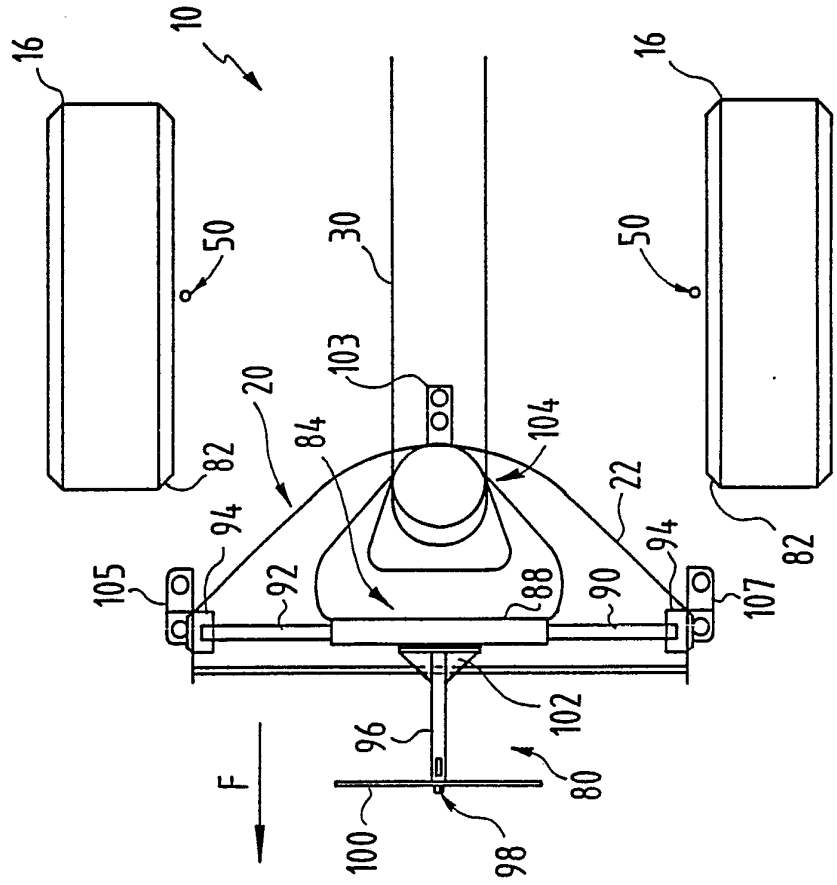
100
10

Fig.6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96
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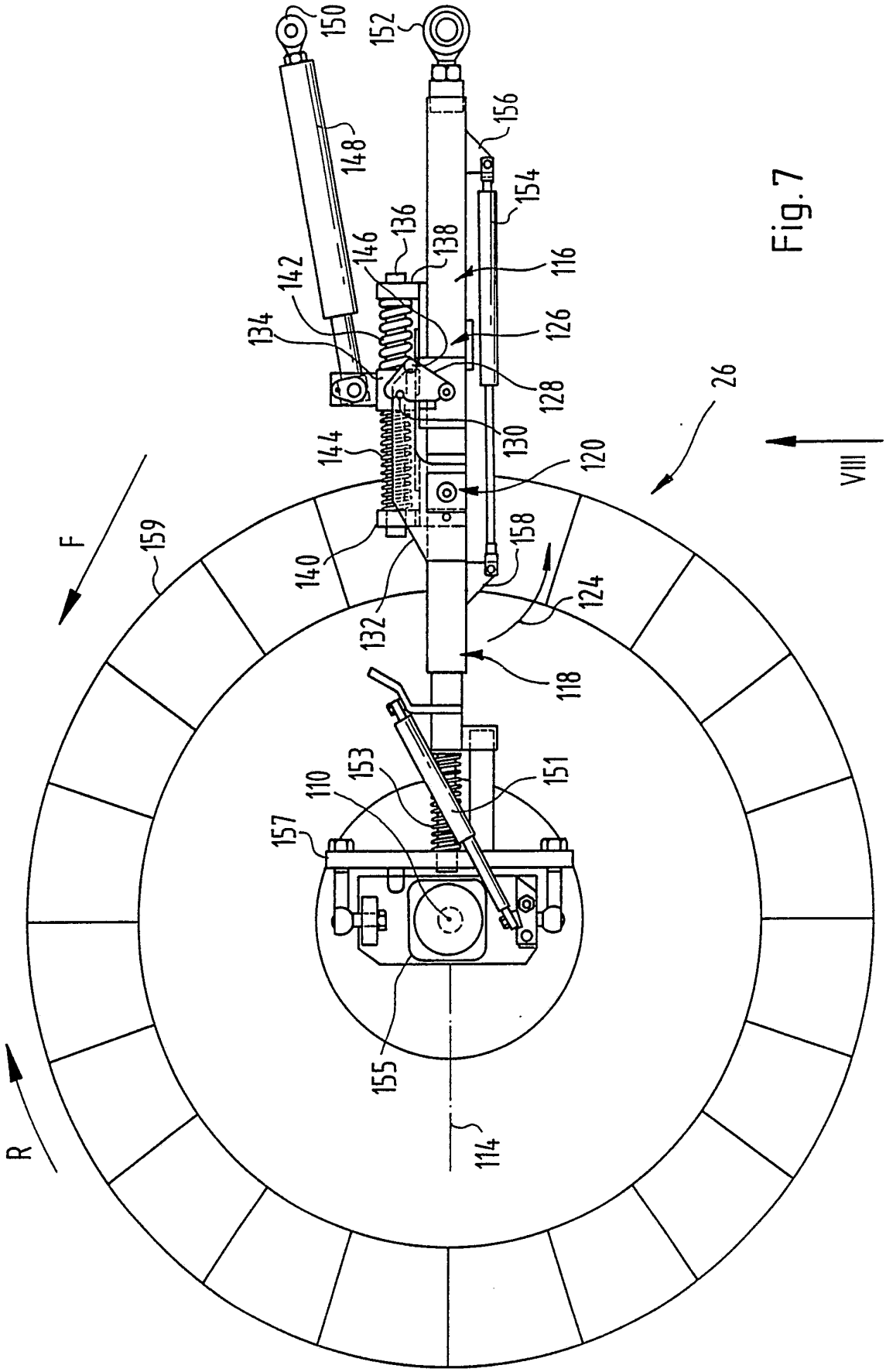
F
100
98

Fig.5


150
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116
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126
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120
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VIII
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159
140
158
132
124
118
153
151
110
157
155
114
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Fig.7

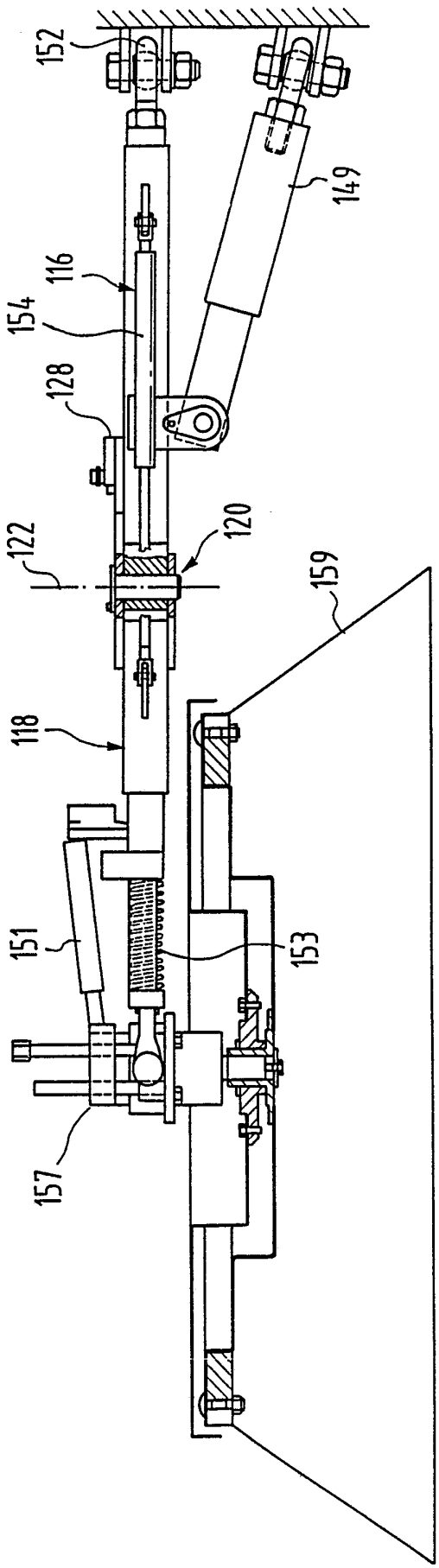


Fig.8

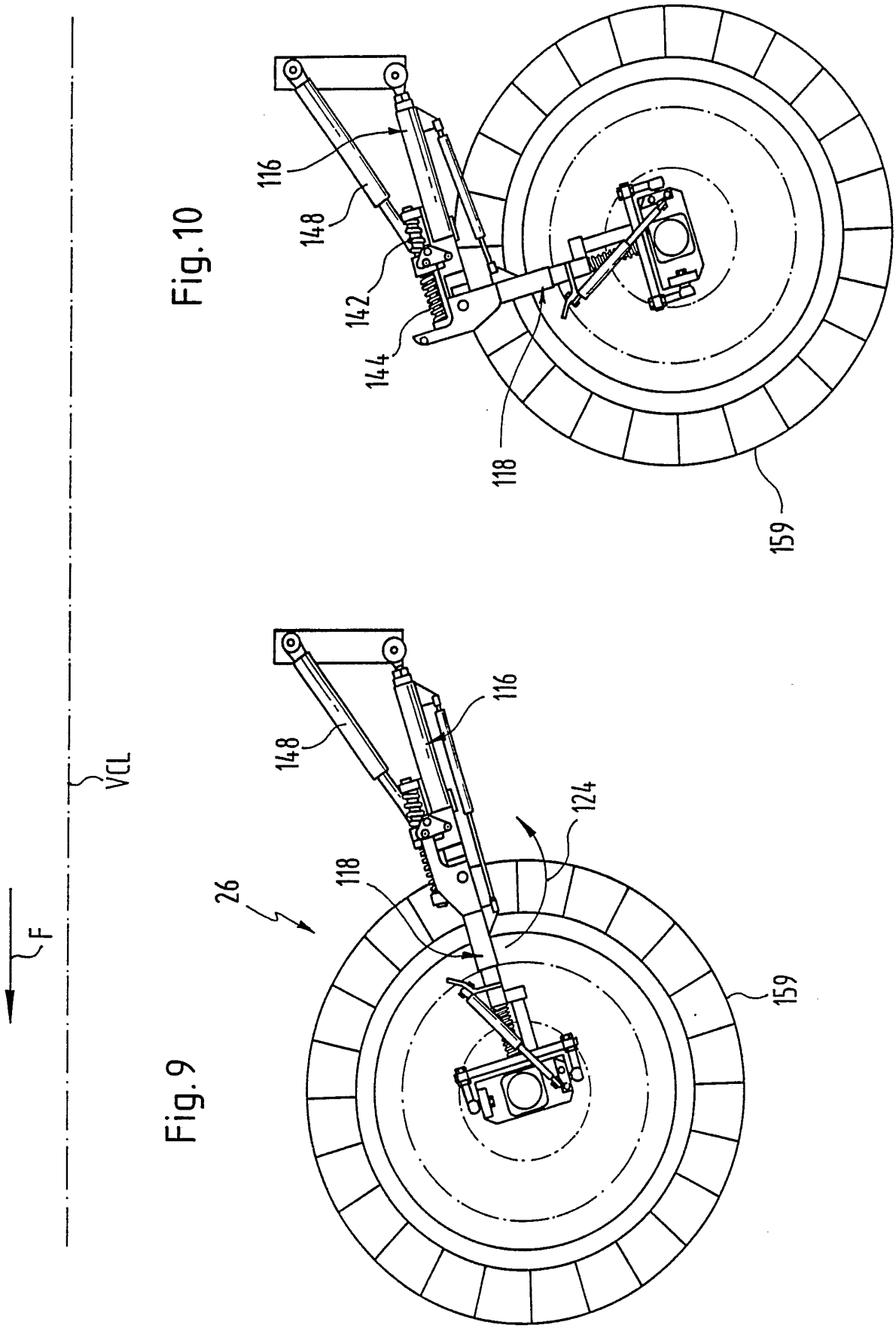


Fig.10

Fig.9

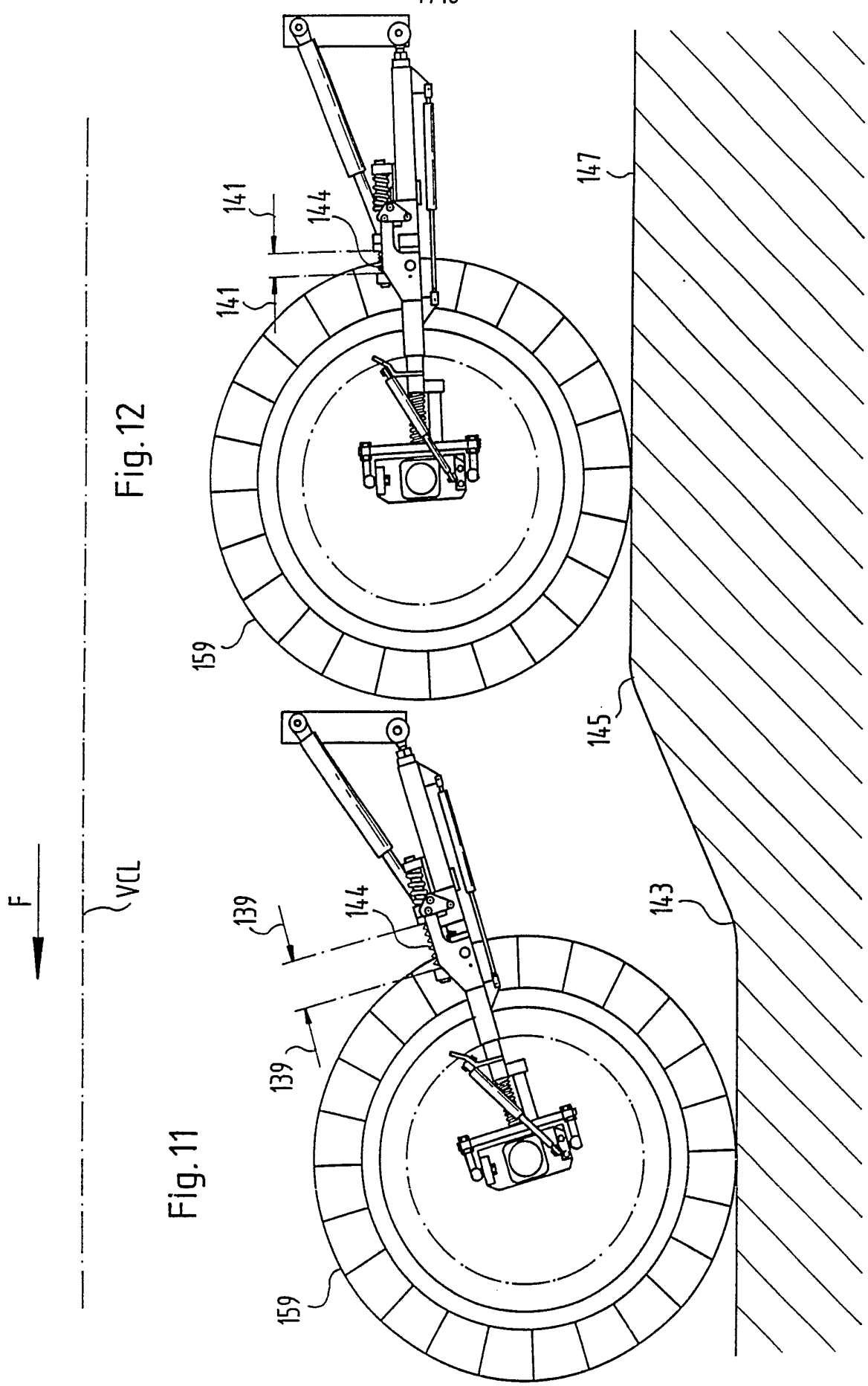


Fig. 11

Fig. 12

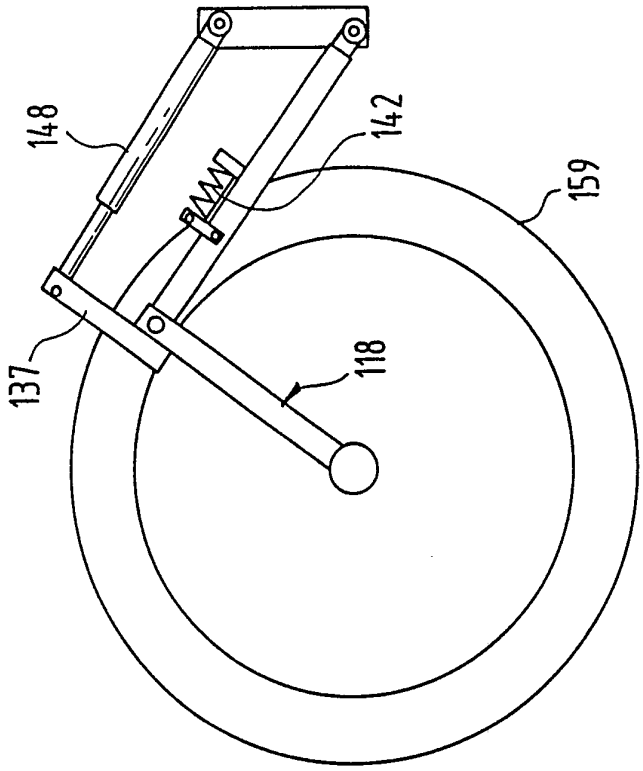
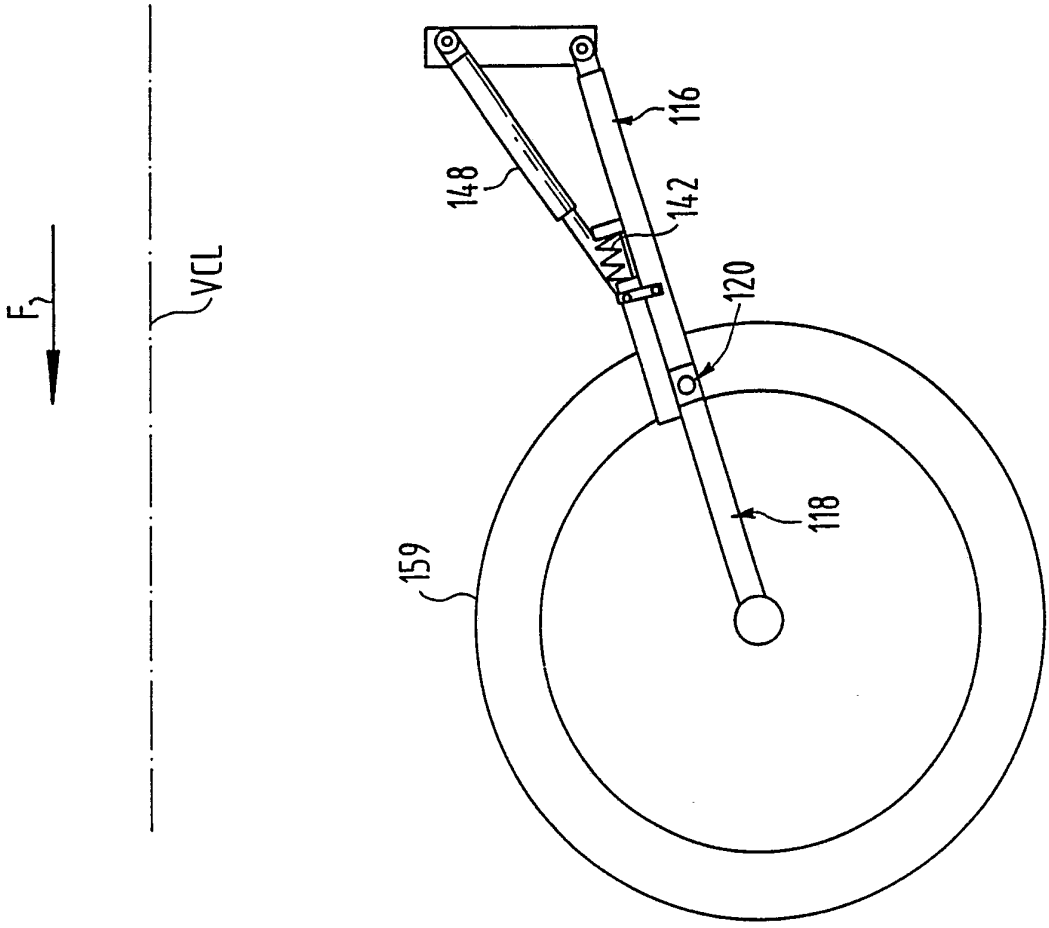


Fig. 14



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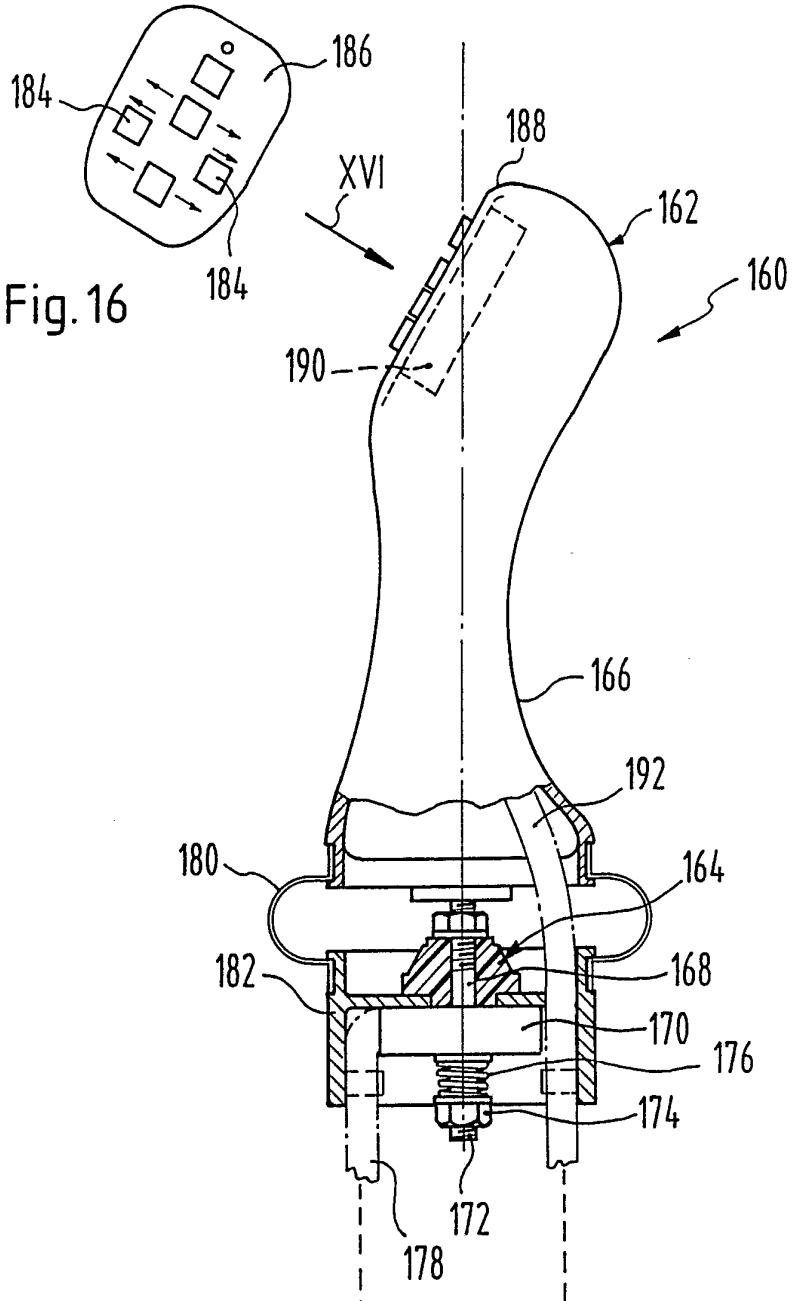
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Fig. 16

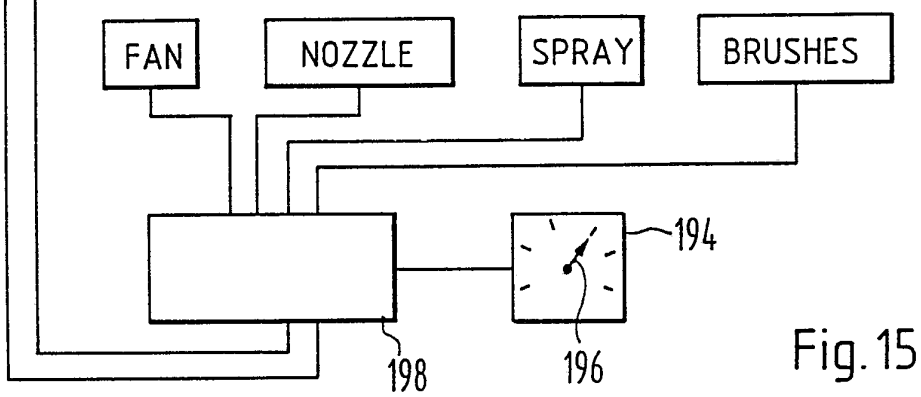
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Fig. 15

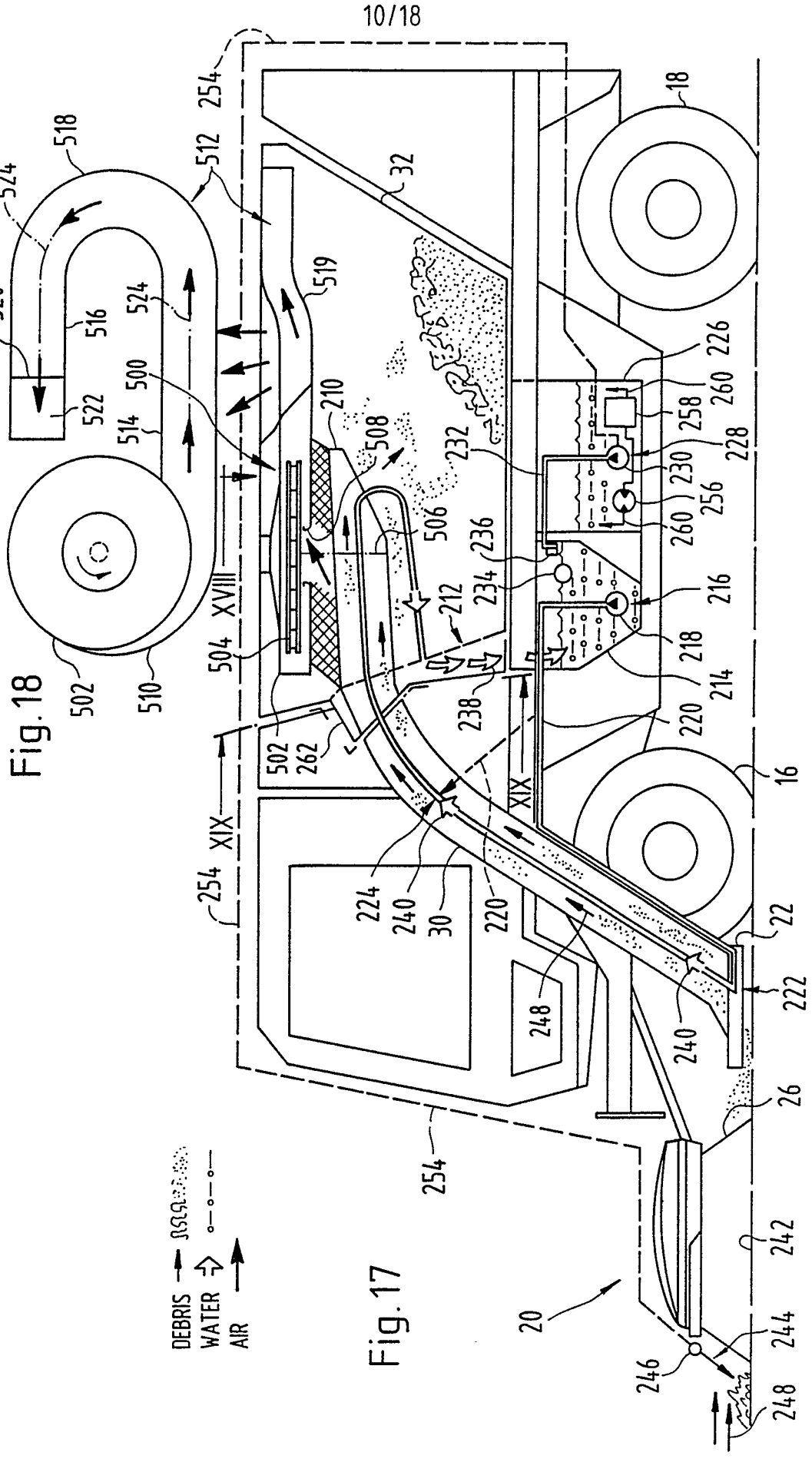

Fig. 18

Fig. 17

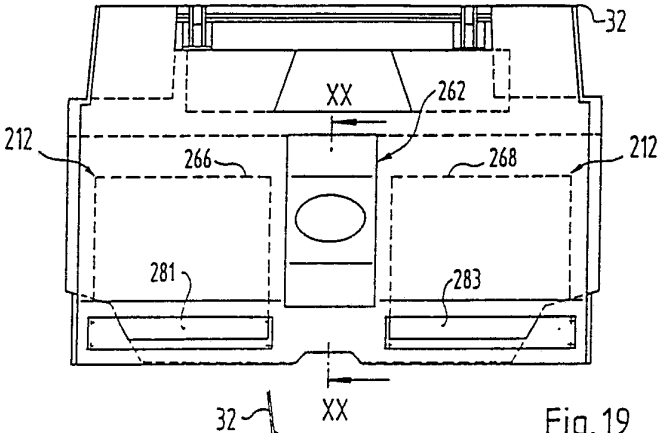

Fig. 19

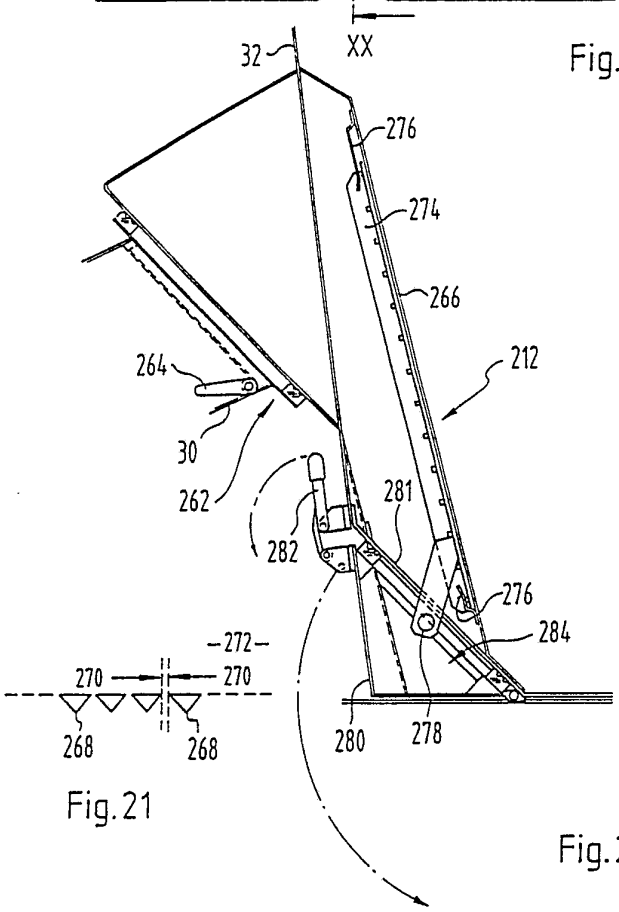

Fig. 21

Fig. 20

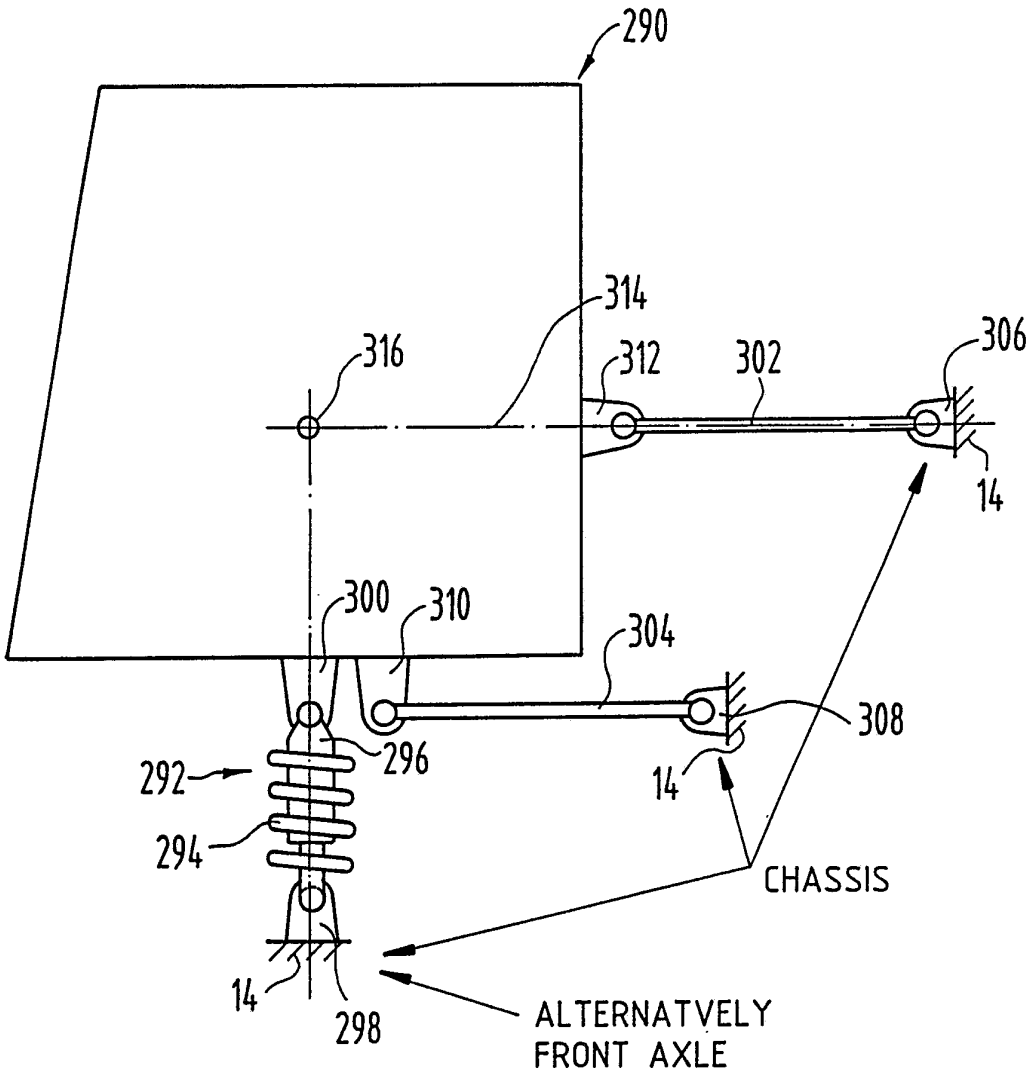
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Fig.22

Fig. 23

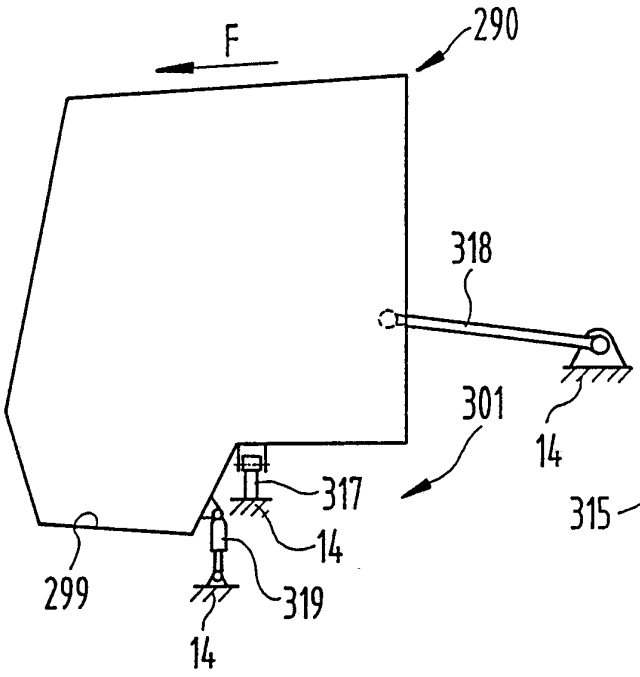


Fig. 24

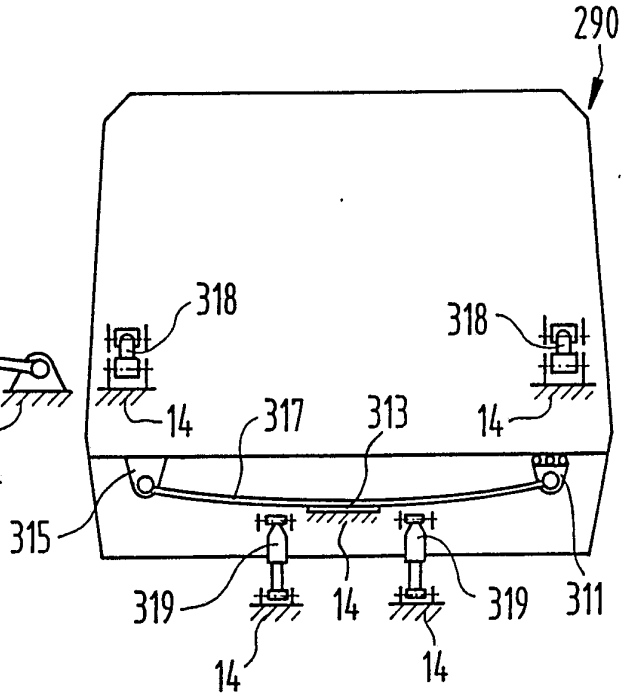


Fig. 25

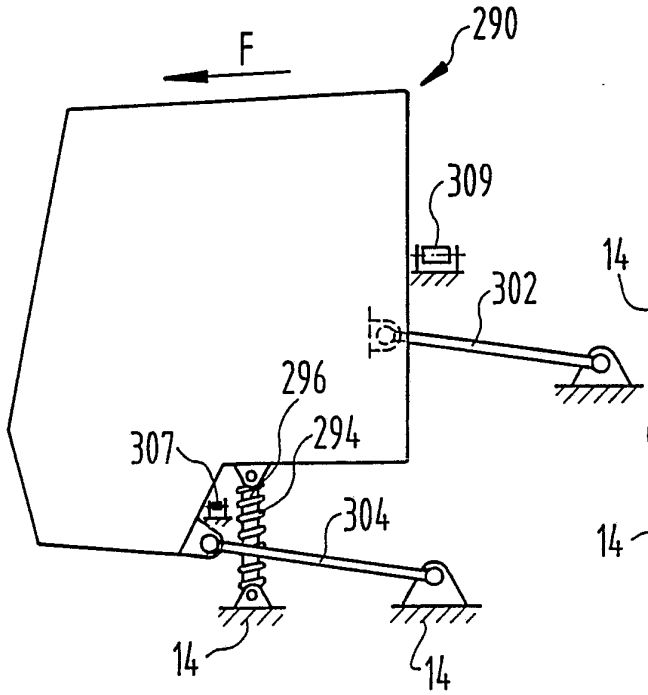


Fig. 26

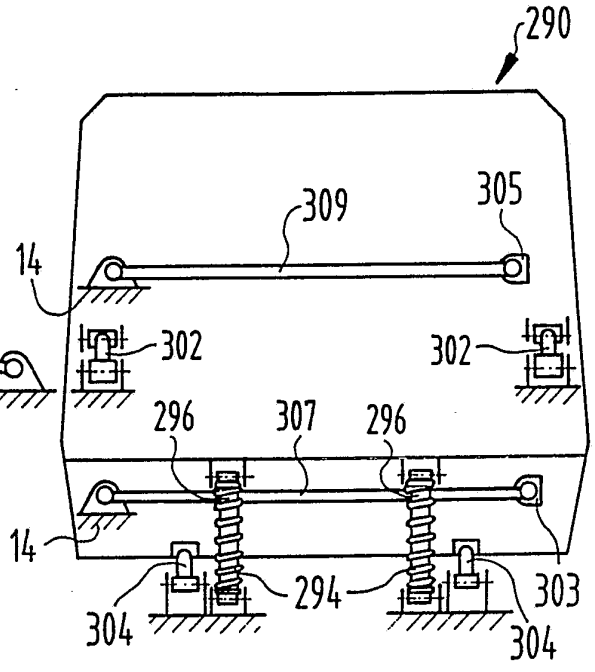


Fig. 28

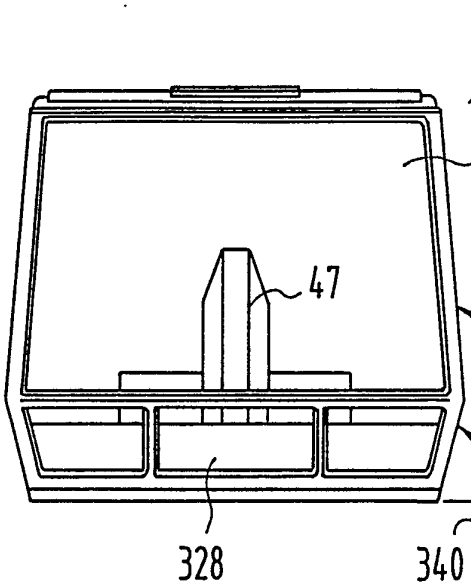


Fig. 29

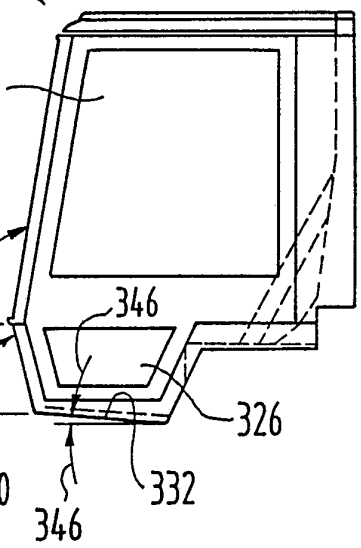
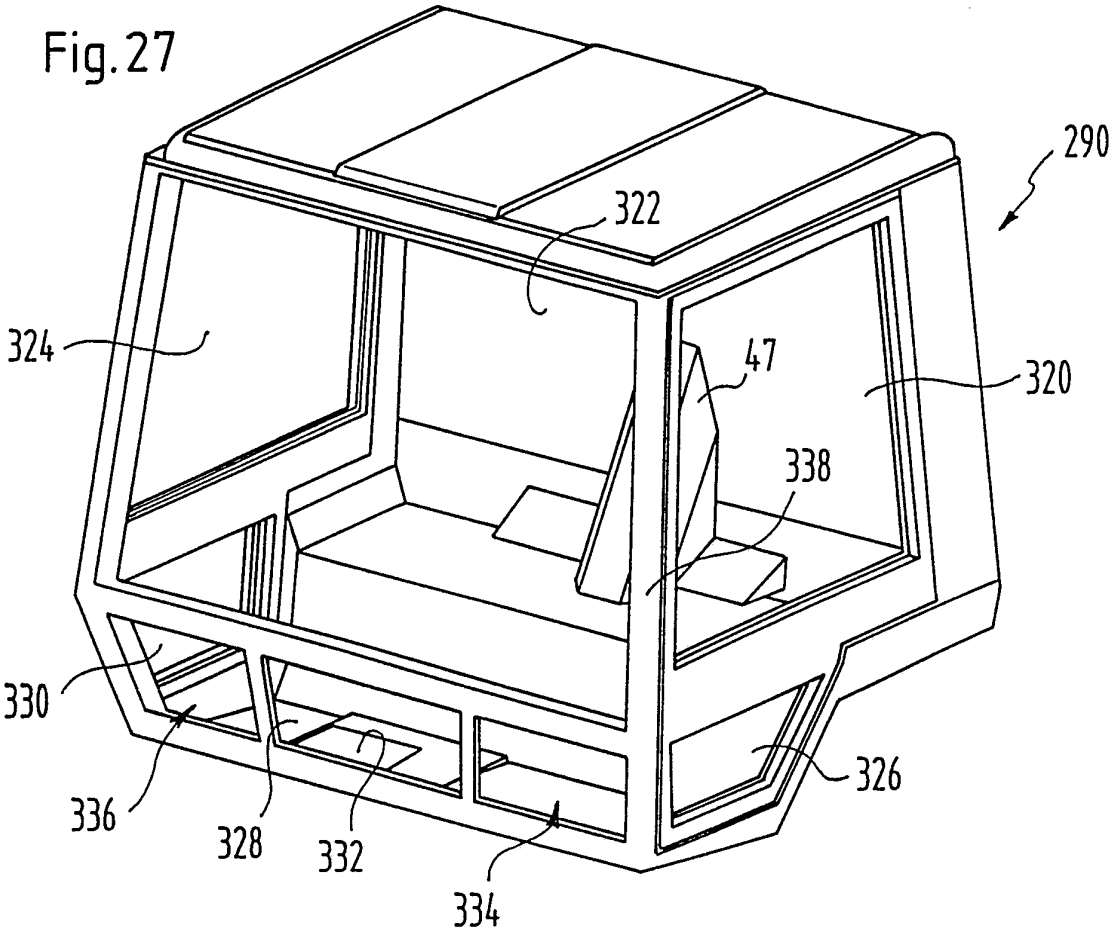


Fig. 27



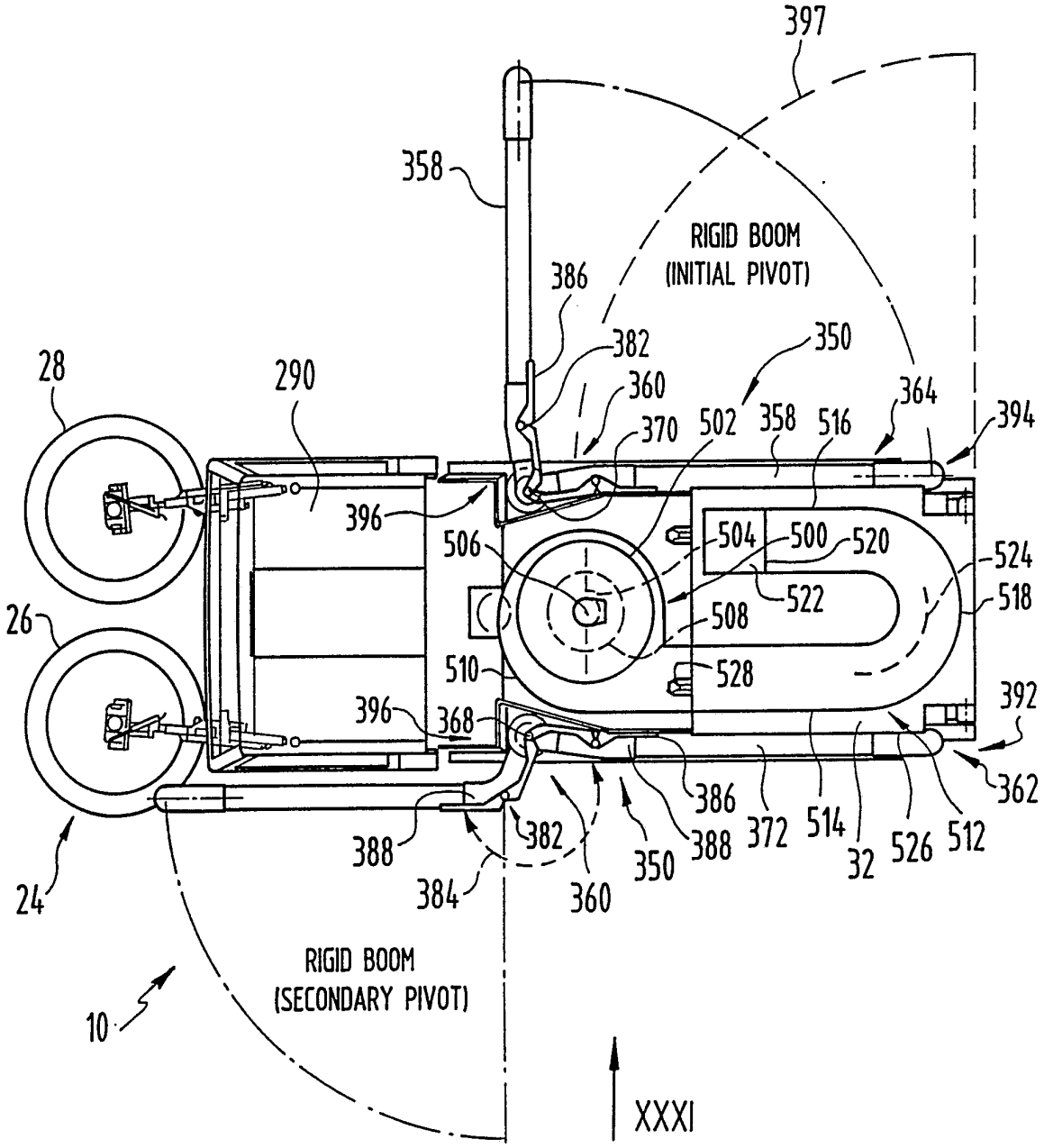

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Fig.30

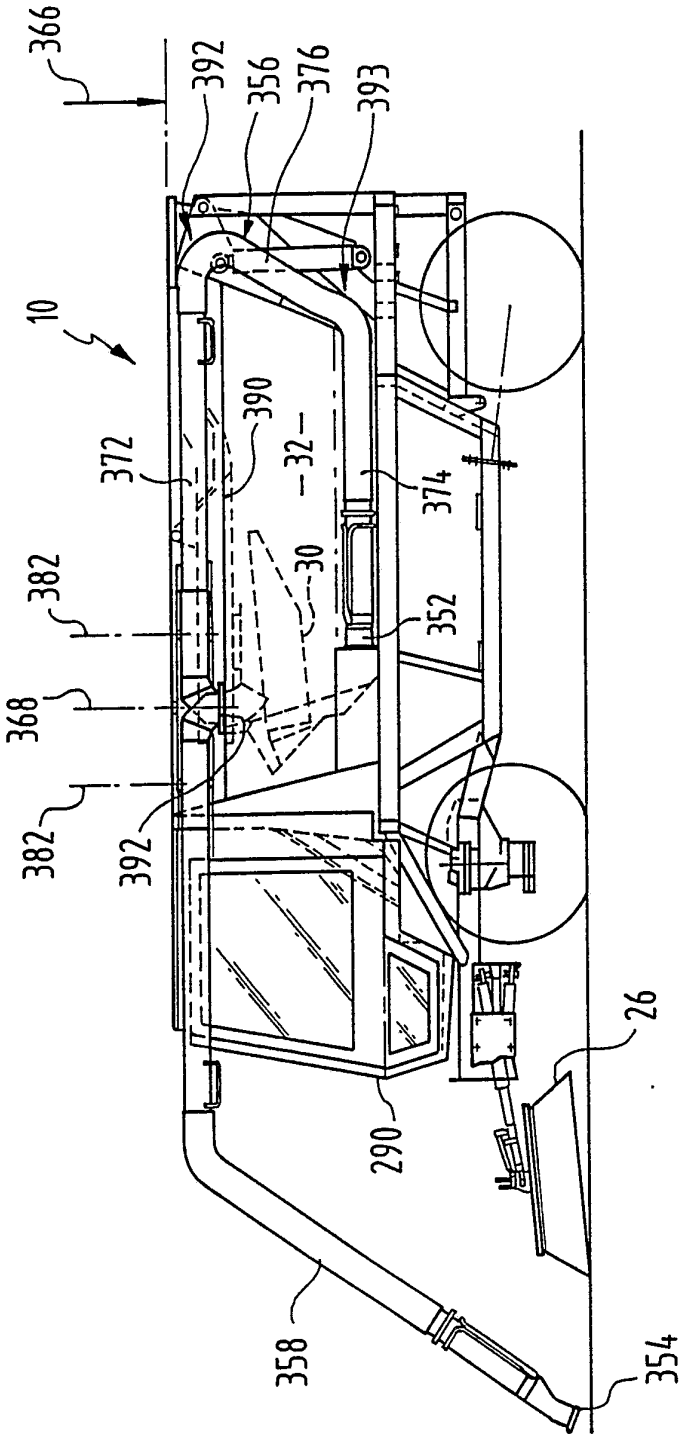
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Fig.31

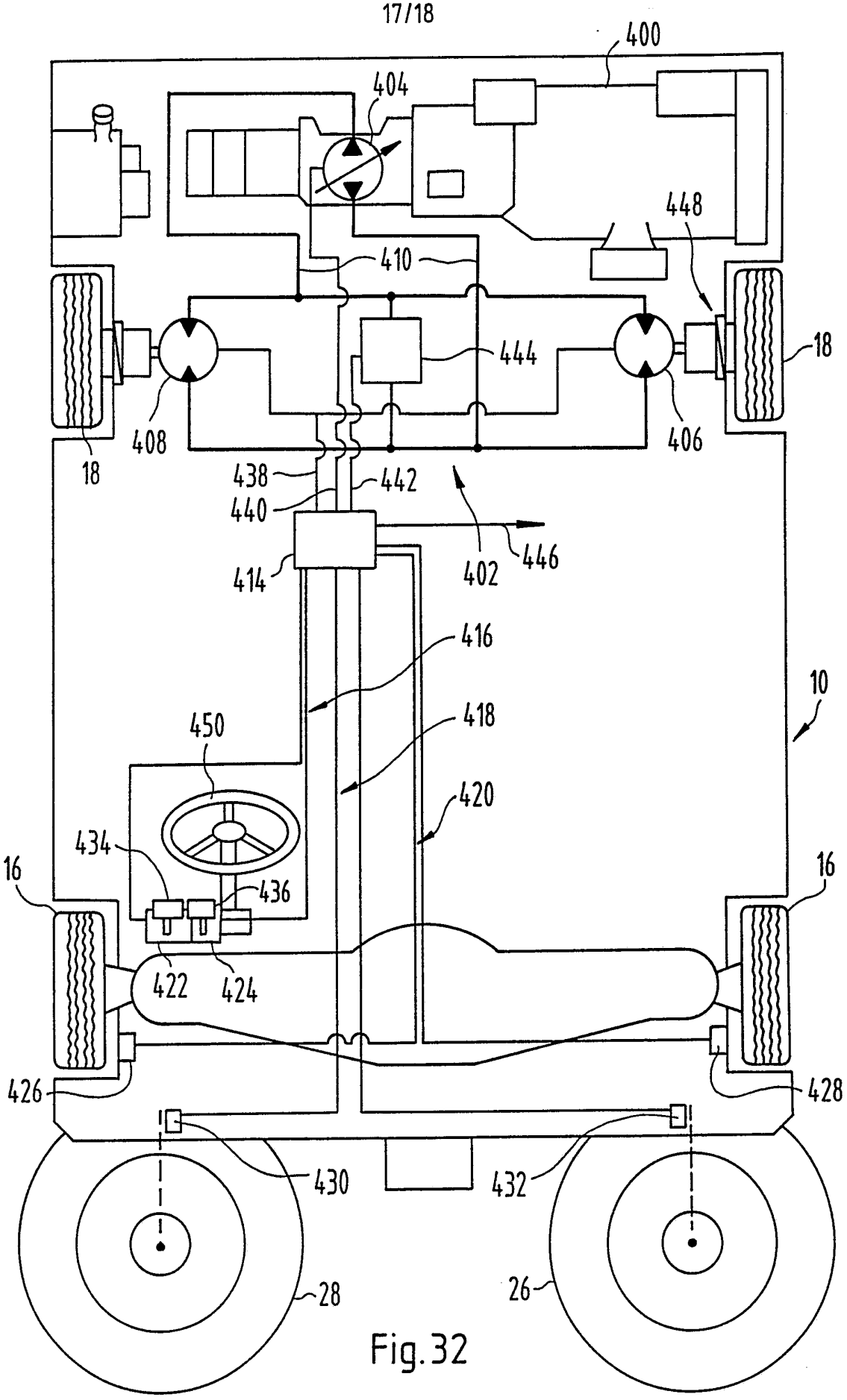
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Fig.32

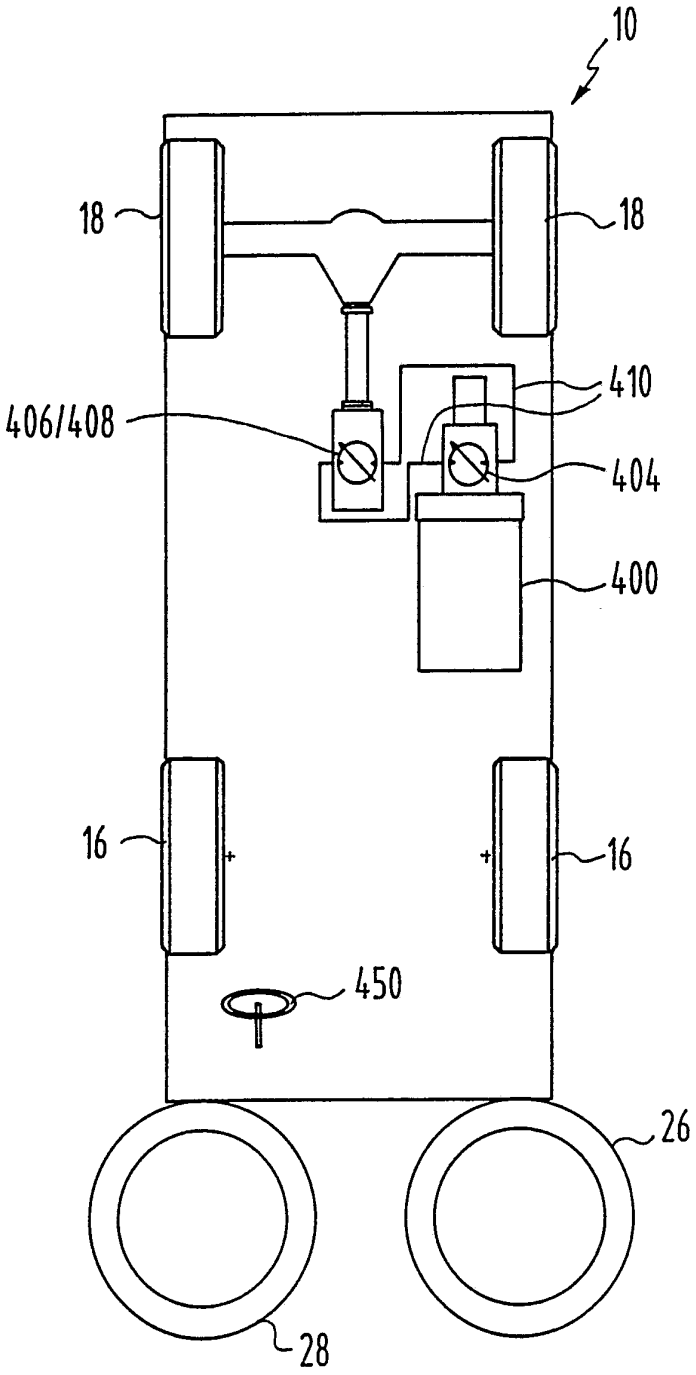

Fig.33

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 91/01063

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E01H1/00 ; G05G9/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E01H ; G05G ; B62D ; E01C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	CH,A,570 751 (MULAG-FAHRZEUGWERK HEINZ WÖSSNER) December 31, 1975 see column 1, line 22 - line 52 see column 4, line 10 - line 63; figures ---	1,2,4-8
Y	GB,A,2 178 143 (TOKYO KEIKI CO.) February 4, 1987 see page 1, line 111 - page 2, line 68 see page 3, line 11 - line 85 see page 4, line 32 - line 42; figures 1-4 ---	1,2,4-8
A	EP,A,0 164 315 (KONRAD PETER AG.) December 11, 1985 ---	
A	US,A,4 237 629 (A. SCHMIDT) December 9, 1980 cited in the application ---	

° Special categories of cited documents : [10]

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
05 SEPTEMBER 1991	04. 10. 91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VERVEER D.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9101063
SA 47945

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05/09/91

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		AT-B-	369814	10-02-83
		CA-A-	1074995	08-04-80
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		JP-A-	54031930	09-03-79
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