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(11) Publication number:

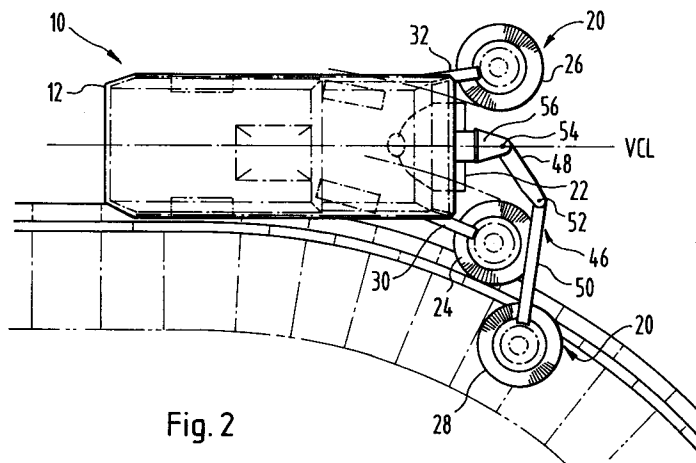
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EUROPEAN PATENT APPLICATION(21) Application number: **91111779.4**(51) Int. Cl.⁵: **E01H 1/08, E01H 1/05**(22) Date of filing: **15.07.91**(30) Priority: **14.07.90 GB 9015529**(43) Date of publication of application:
22.01.92 Bulletin 92/04(84) Designated Contracting States:
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W-8130 Starnberg(DE)(54) **Cleaning vehicles.**

(57) A self-propelled cleaning vehicle (10) comprises matter removal means (18) including primary brushes (24,26) and an additional or third brush (28). The third brush (28) is mounted on a brush mounting arm (46) comprising inner (48) and outer arm (50) portions, pivotally interconnected (52), and controlled by a control linkage (58) interconnecting them and actuated by a remote actuating ram (72) at the inboard end of the assembly. The outer arm portion (50) is of telescopic construction for length-adjustment. The telescoping portion is provided by two parallel rams (98,100). Oil flow to the hydrostatic motor (104) passes through the rams and their pis-

ton rods themselves. The pressure on the piston is used to telescope the rams (98,100). When the third brush (28) is in use, contour-following means enables the inboard primary brush to follow the peripheral contours of a surface it is sweeping without driver intervention. Such automatic contour-following is activated by driver-controlled selection (113) of a contour-following control mode which causes the inboard brush to move outwards until it meets, for example, a gutter profile. Position sensing switches (124A) enable the primary brushes (24,26) to automatically adopt standard sweeping positions when a non-contour following mode is selected.

**Fig. 2****EP 0 467 269 A2**

This invention relates to cleaning vehicles. An example of the application of the invention is to self-propelled cleaning vehicles of the kind used for street and pavement and precinct cleaning operations. Such a vehicle may comprise a pair of sweeping brushes rotating about upwardly extending axes, sweeping matter laterally inwardly towards the centre line of the vehicle, and provided with a suction nozzle to remove swept matter from the region between the brushes. The brushes are mounted on arms extending forwardly from the front region of the vehicle, the arms, and thus the brushes, being position-adjustable by the operator.

In such a cleaning vehicle, we have identified a requirement to increase the versatility of the machine in several important respects. Thus, for example, it would be a useful function to be able to sweep a pavement or side walk simultaneously while the machine is sweeping the adjacent portion of the road. Equally, it would be useful for the sweeping width of the machine to be increased, if desired, at certain times, such as when dealing with relatively large and unencumbered areas to be cleaned. Likewise, a facility to deal with the problem of removing weeds growing in areas swept raises a requirement for further facilities on the cleaning vehicle. In addition, it would be most valuable to be able to reduce the minimum radius of a curved surface (for example a kerb profile) along which the vehicle can sweep.

We have considered the feasibility of adding an additional or third brush to supplement the existing brushes on a cleaning vehicle of this kind. However, such an arrangement leads to technical problems of its own in relation to various aspects of its functions, these including firstly the extent of the reach of the additional brush, secondly the manner of driving it, and thirdly the manner of controlling it and the other brush or brushes.

Considering these in turn, we look firstly at the extent of the reach of the additional brush.

It will be understood that in a cleaning vehicle comprising a pair of primary sweeping brushes mounted in the front region of the vehicle on generally forwardly extending mounting arms, the addition of a third brush, likewise mounted on a forwardly extending mounting arm assembly raises the problem of providing for the third brush a relatively long mounting arm assembly. This is because the matter swept by the third brush necessarily has to pass between the other two brushes in order to be removed by the suction nozzle, and thus the third brush has to be located, in use, generally forwardly of the other two brushes.

A related requirement concerns the locus of movement of the third brush. Cleaning machines of the kind concerned not infrequently are required to sweep into rectangular corners between buildings

or between walls, and thus there is a need for the vehicle to be able to sweep laterally across a road or other surface terminated by a wall, and in which the wall extends laterally across and generally at right angles to the fore/aft axis of the cleaning machine. In addition to this, there is a need for the third brush to be able to adopt a position not only forwardly of either or both of the primary sweeping brushes, but also at least partially laterally outwardly thereof, so as to maximise the sweeping width of the assembly and also to reduce the minimum radius of curved profiles which it is possible to sweep.

These requirements lead to somewhat complex desirable sweeping paths for the third brush, and we have found that these cannot be provided by a simple lengthening of the known brush mounting arms previously proposed for the primary brushes.

Thus, an object of this first aspect of the present invention is to provide a cleaning vehicle having additional brush means, and an associated mounting therefor, in which the additional brush can be position-adjusted relative to the vehicle so as to meet one or more of the sweeping path requirements discussed above, or providing improvements generally in relation to matters discussed herein.

According to this first aspect of the invention there is provided a cleaning vehicle as defined in claim 1 of the accompanying claims.

In a preferred embodiment, a control linkage interconnects the inner and outer arm portions of the brush mounting arm assembly for the additional brush, and actuator means for the linkage is provided to effect relative pivotal movement of the inner and outer arm portions. The actuator means is connected to the linkage and located at the region of the inboard end of the brush mounting arm assembly for the additional brush. In this way, a much more convenient and effective system for control of the mounting of the additional brushes is provided than if, for example, a simple system were provided by means of one or more rams acting directly between the inner and outer brush mounting arm portions. The extent of angular movement between these arm portions, which is needed, exceeds that which can conveniently or possibly be provided by a ram thus positioned, whereby the versatility of the third brush is significantly increased. Effectively, the actuation of the brush mounting arm by means of a remote ram acting through a linkage interconnecting the brush mounting arm portions enables the resultant position-adjusting movement of the brush to be amplified with respect to the movement applied to the linkage by its actuator.

In the preferred embodiment, the control linkage comprises two pivotally connected links which

are themselves connected to the inner and outer brush mounting arm portions so as to form a four bar linkage. The linkage may be a parallelogram linkage. The actuator is connected to, effectively, an extension portion of the inner one of the links of the linkage. This enables the actuating ram to be conveniently positioned with respect to the whole assembly and to make minimum space requirements.

In addition to the angular movement of the brush mounting arm portions produced by the control linkage, the preferred embodiment includes another actuator, or actuators, to move the brush mounting arm assembly and the control linkage laterally with respect to the vehicle body, in a simple swinging movement.

Turning now to the question of further aspects of the reach of the additional or third brush, we have identified a requirement for a means to vary the reach of the brush in a simple and direct way, in order to maximise the reach in certain particular situations. In accordance with a further aspect of the invention we have provided a telescoping facility for the additional brush. However, this telescoping facility itself raises problems in relation to the provision of a supply of hydraulic fluid under pressure for the hydrostatic motor, to the extent that the telescoping of the arm requires the conventional hydraulic supply hoses to accommodate a significant degree of telescoping movement, and this leads to safety and operational problems in terms of excessive amounts of slack hose in the retracted configuration of the telescopic arm portion.

Accordingly, an object of this aspect of the present invention is to provide a cleaning vehicle having a brush mounting assembly for an additional brush, and in which the reach of the additional brush is directly variable, and in which the supply of oil to drive a hydrostatic brush motor mounted on a length-adjustable arm is provided without the problems of excessive amounts of slack hose in the retracted configuration of the arm, or providing improvements generally in relation to matters discussed herein.

According to this aspect of the invention there is provided a cleaning vehicle as defined in claim 7 of the accompanying claims.

In a preferred embodiment, the outer arm portion of the brush mounting arm assembly for the additional brush comprises a telescoping portion providing length adjustment of the brush mounting arm assembly. The telescoping feature provides direct adjustment of the arm length as such so that, in a simple way, the reach of the arm is increased.

The telescoping arm portion is provided by a pair of hydraulic rams which themselves provide the load taking structure of the telescoping arm

portion. In this way, no additional sliding structures are needed. Moreover, the hydraulic supply to the hydrostatic motor of the additional brush passes through either or both of these telescoping rams, whereby the hydraulic supply conduit for the motor itself effectively changes length, and the need for external length-adjustment-accommodating hoses is eliminated. In addition, by utilising the pressure of the hydraulic fluid supply to the motor, to load the pistons of the telescoping rams, it is arranged that telescoping of these can be effected without an additional pressure supply.

Turning now to the question of sensing the brush position in relation to the primary brushes of the cleaning vehicle, we have identified a need, which arises particularly when the third brush is being used, but which also arises in other situations and vehicles when only two brushes are in use, for reducing or eliminating the need for the driver of the vehicle to control the lateral position of the primary sweeping brushes. When the third brush is in use, this in itself makes significant demands on the driver in terms of controlling its position, particularly when it is employed to effect simultaneous pavement sweeping while the primary brushes are sweeping in the adjoining roadway.

Previous proposals in relation to brush steering include arrangements for visual/manual brush positioning, the provision of an impact-sensor to steer the brush with respect to street furniture, and arrangements for steering the brushes in synchronism with the steered wheels of the vehicle.

None of these prior proposals meets the need for a simple means to maintain brush position relative to the vehicle during normal sweeping operations, and an object of the present invention is to provide a cleaning vehicle incorporating such means, or providing improvements in relation to one or more of these or other matters discussed herein.

According to this aspect of the present invention there is provided a cleaning vehicle as defined in claim 13 of the accompanying claims.

In a preferred embodiment, driver-selected automatic contour-following means is provided to enable the primary brush to follow the peripheral contours of a surface it is sweeping, without driver intervention. Thus, for example, the inboard one of the primary brushes will automatically follow varying contours in the gutter profile as a result of the loadings applied to the brush, namely a light outward loading by the hydraulic brush-positioning ram, and the opposite inward loading applied by the gutter profile.

For this purpose, valve means is actuable to interconnect the headside and rodside chambers of a double acting ram (or to interconnect the relevant chambers of two opposed single-acting rams) for

positioning the primary brush, whereby the latter can move more readily inwards under the action of laterally-directed forces, while exerting a light outward loading due to the headside/rodside piston area difference

For driver-selected non contour-following operation, position sensing means is provided to sense the lateral position of the primary brushes, whereby these are automatically returned to standard straight-ahead sweeping positions whenever desired.

Alternatively, resilient means could be provided to permit contour following by the inboard brush, for example in the manner disclosed in our co-pending application (our reference P51482) GB9012780.4.

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 a cleaning vehicle having an additional, third, brush, the vehicle operating on a minimum radius kerb profile;

Fig 2 shows the vehicle operating on a larger radius kerb profile, with the third brush on the pavement;

Fig 3 shows the three brushes arranged for maximum sweeping width;

Fig 4 shows a selection of the ranges of movement available for the third brush;

Figs 5, 6 and 7 illustrate the geometry of the brush mounting arm assembly for the third brush, in a range of lateral movements thereof;

Fig 8 shows the connection of a ram to the control linkage which controls movement of the third brush;

Fig 9 shows a plan view of the vehicle illustrating the two primary brushes, and with associated hydraulic control circuits therefor; and

Fig 10 shows the hydraulic control circuit for the brush control rams, including, in particular, details of the twin rams which provide for telescoping of the outer portion of the third brush mounting arm, and which themselves provide a conduit for the hydraulic supply to the brush drive motor.

As shown in Figs 1 to 4, a self-propelled cleaning vehicle 10 comprises a vehicle body 12, driven rear wheels 14, steerable front wheels 16 and matter removal means 18 comprising brush gear 20 and a suction nozzle 22.

For a fuller description of a vehicle of this kind, reference is hereby directed to the description and drawings in our above-mentioned co-pending application (our reference P51482) GB9012780.4. We hereby incorporate in the present application the entire disclosure in this prior application.

Brush gear 20 comprises primary brushes 24, 26 and an additional or third brush 28. Directions of

rotation of the brushes are indicated by arrows R. The letter F denotes the direction of normal forward movement of vehicle 10 and the letters VCL denote the vehicle centre line.

Primary brushes 24 and 26 are mounted on respective brush mounting arms 30, 32, which are pivotal about upwardly extending axes at their inboard ends - see Fig 9. The upwardly extending axes for such pivotal movement are shown at 34 and 36. The arm movement is controlled by rams 38, 40 connected at their inner ends 42, 44 to vehicle body 12.

Third brush 28 is carried on a brush mounting arm assembly 46 comprising inner and outer arm portions 48, 50 respectively. These are pivotally connected at 52, the pivot axis extending upwardly. Likewise, inner arm portion 48 is pivotally connected at 54 (upward pivot axis) to a bracket 56 project from vehicle body 12, on the vehicle centre line, at a fixed location, directly above nozzle 22.

In order to control the relative attitude of the inner and outer arm portions 48, 50 there is provided a control linkage 58 shown in Figs 5 to 8. For simplicity of illustration, the linkage has been omitted from the other figures. Thus, linkage 58 controls the relative attitude of arm portions 48, 50. For any given setting of linkage 58, the entire brush mounting arm assembly 46 can be pivotally swung about axis 54 by means of a pair of swing rams 60, 62 seen in Fig 10 and indicated diagrammatically in Fig 1 at their location on bracket 56 at the inboard end of brush mounting arm assembly 46. Thus, rams 60, 62 can swing the assembly laterally in the manner to be more fully described below.

Control linkage 58 is shown in Figs 5 to 8. It comprises a control rod 64 extending parallel to inner arm portion 48, and a control bracket 66 disposed generally parallel to outer arm portion 50. Pivot connections 68, 70 to outer arm portion 50, and to each other, respectively, give linkage 58 parallelogram form, or approximately such, whereby the assembly has parallelogram movement characteristics.

An actuator 72 in the form of a ram, for linkage 58 acts between bracket 56 and extension 74 of control bracket 66. Actuation of ram 72 enables linkage 58 to move through the configurations shown in Figs 5, 6 and 7.

As shown in Fig 10, rams 60, 62 and 72 for controlling the brush mounting arm assembly 46 are powered by hydraulic lines 76, 78 and 80 connected, respectively, to the pressure and return lines of the hydraulic supply system of vehicle 10, and to tank. A control manifold 82 comprises a plurality of valves 84 for controlling the rams as described above. It is believed that the hydraulic circuit diagram is self-explanatory and that no further description thereof is needed for present pur-

poses. Likewise, a manifold 86 connected to hydraulic supply lines 88, 90 controls a lift/float ram 92, not described above, for lifting brush mounting arm assembly 46 to a raised transport position, and for decreasing downward low thereon during use.

A corresponding manifold 94 with control valves 96 controls a pair of telescoping rams 98, 100, and a parking ram 102 for raising brush 28 to a parked position.

The hydraulic return from motor 104 is taken to hydraulic line 90 through a conduit 106 from the headside chamber 108 of ram 98. The ram is drilled to connect chamber 108 with the hollow interior 110 of the its piston 112, from whence a line 114 connects to motor 104 through a valve 116. The other side of the motor 104 is connected by a line 118 to the hollow interior 120 of the piston of ram 100, and hence to the rodside chamber of that ram. A line 122 connects the other rodside chamber in parallel, with a line 124 connecting to the hydraulic pressure supply.

In use, valves 96 enable the hydraulic pressure of the supply lines not only to drive motor 104, but to extend and retract the rams 98, 100 and 102.

Turning now to Fig 9, position sensing means 124A is provided for primary brush 26 to detect angular movement of its brush mounting arm 32 from a preset normal working position. The position sensing means 124A is in the form of an electrical switch connected between the arm 32 and the actuating piston of ram 38 and connected through a control 126 to an electrical control valve 128 connected across the lines 130, 132 supplying ram 38. A similar arrangement is provided for brush 24. Control 126 is also connected to and effective to control the valves which control rams 38, 40 when the brushes are in a non contour-following mode.

In use, position sensing means 124A detect whether the brush mounting arms are in their standard working position and when the operator calls (by means of a contour/non-contour switch 133) for a non contour-following sweeping mode, the switches 124A signal to the control system for the rams 38, 40 to position same in their standard working positions as shown in full lines in Fig 9. It will be understood that the brushes may have been manually moved by the operator to any possible position for particular reasons prior to adoption of the non-contour following mode.

When the operator wishes the inboard brush 26 to adopt a contour-following mode, such as to follow a kerb profile while the third brush is under manual control, he operates switch 133 to select the brush gear's contour-following mode. Outboard brush 24 remains unaffected. Inboard brush 26 has valve 128 opened thereby interconnecting the headside and rodside chambers of ram 38. The net difference in area of the piston in these two cham-

bers causes a light outward thrust to be exerted on the brush mounting arm, but which can be easily overcome by slight inward thrust on brush 26 from changes in kerb profile. The brush thus follows the kerb profile.

A manifold 134 comprises valves 136 and controls the operation of rams 38 and 40 from a hydraulic supply 138, with connections to tank at 140 and 142.

Interestingly, the above embodiments provide a cleaning vehicle with a third brush assembly having simple and effective means for providing all necessary third brush positions for the functions required. Fig 4 shows the various third brush positions possible, by means of the brush movement profiles 144, 146, 148 and 150. These represent the swinging movement of the brush under the action of the main swing rams 60, 62, in four different attitudes of the control linkage 58. It can be seen that the arrangement provides the combination of ability to reach right round and outside the brush 24 for pavement operations or extra sweeping width, while having effective control in the straightahead position for entry into corners and weed removal operations. Even greater versatility is provided by the telescopic feature on the outer arm portion, while avoiding the inconvenience and danger arising from slack hydraulic supply hoses for the third brush drive motor. Automatic contour following by the inboard primary brush or automatic adoption of a standard sweeping position by both brushes, modes of sweeping selectable at will, enable the driver to concentrate on manoeuvring the third brush during use.

Claims

1. A self-propelled cleaning vehicle comprising :-
 - a) a vehicle body;
 - b) ground wheels to drive and support and steer said vehicle body;
 - c) matter removal means positionable in working relation to a surface to be cleaned to remove matter therefrom;
 - d) said matter removal means comprising at least one primary brush rotatable about an upwardly extending axis and carried on a brush mounting arm assembly extending generally forwardly with respect to the normal direction (F) of operative forward motion of said vehicle to sweep matter laterally with respect to said direction;
 - e) said matter removal means further comprising an additional brush likewise rotatable about an upwardly extending axis and carried on a brush mounting arm assembly therefor, the latter extending generally forwardly with respect to said normal direction

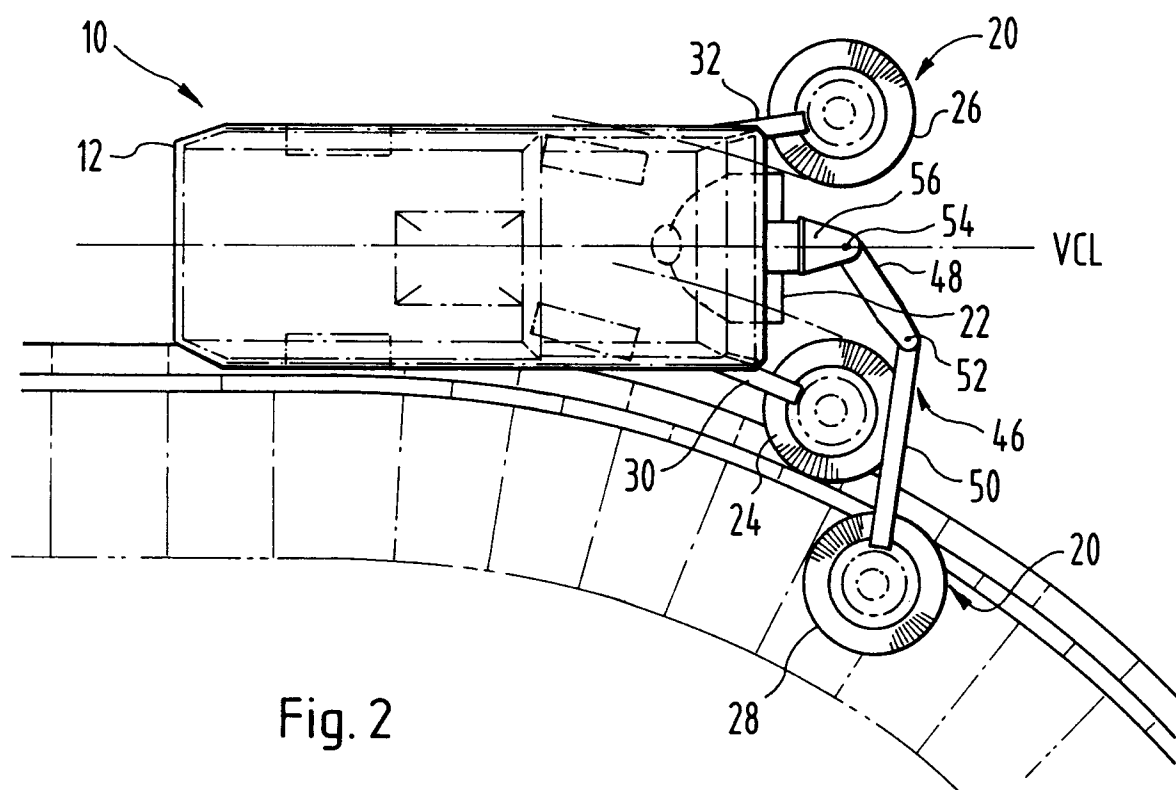
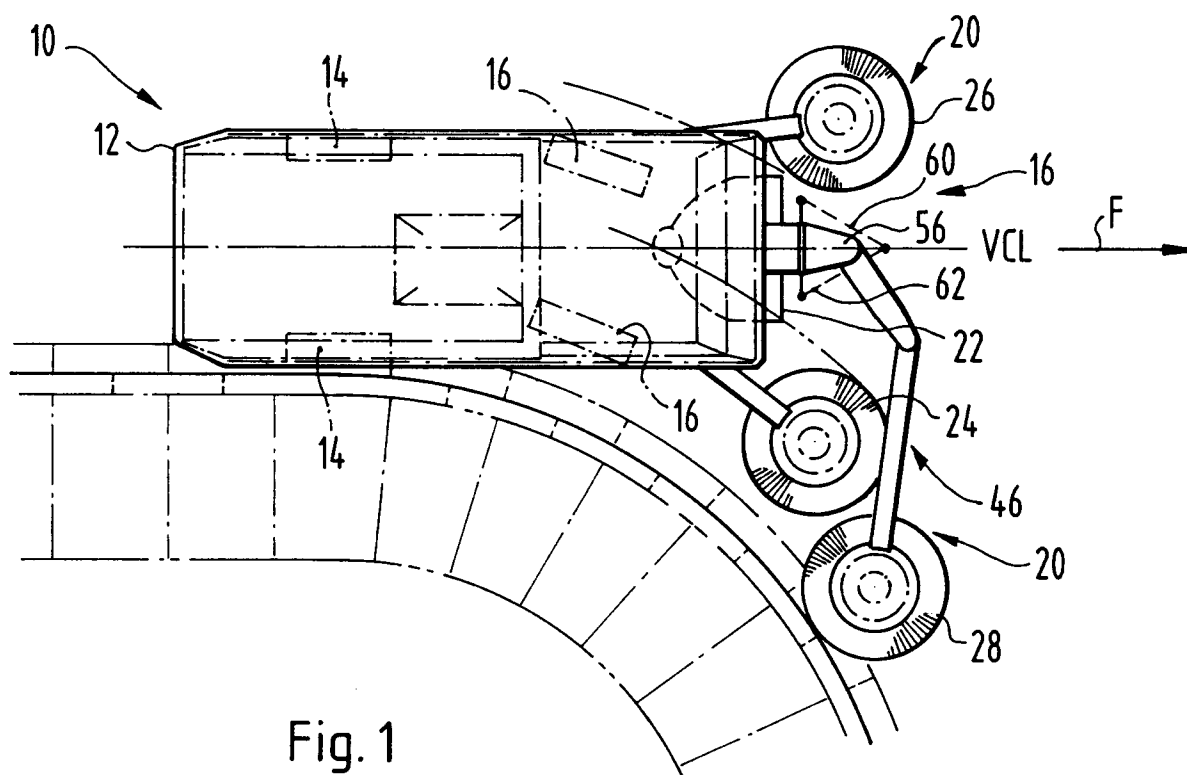
- (F) of operative forward motion of said vehicle, so as to be capable of brushing at locations forwardly and/or laterally outwardly of the normal working position of said primary brush; 5
- f) said brush mounting arm assembly for said additional brush comprising inner and outer arm portions pivotally interconnected; and
- g) means for position-adjusting said additional brush by angular movement of its brush mounting arm with respect to said vehicle body; characterised in that 10
- h) said means for position-adjusting said additional brush comprises a control linkage interconnecting said inner and outer arm portions, and actuator means for said linkage to effect relative pivotal movement of said inner and outer arm portions, said actuator means being connected to said linkage and located at the region of the inboard end of the brush mounting arm assembly for said additional brush. 15
2. A cleaning vehicle characterised in that an additional brush is position-adjustable by a control linkage effecting pivotal movement of its inner and outer brush mounting arm portions by means of a remote actuator. 20
3. A vehicle according to claim 1 or claim 2 characterised in that said control linkage comprises two pivotally connected links which are themselves pivotally connected to said inner and outer brush mounting arm portions and form therewith a four-bar linkage. 25
4. A vehicle according to claim 3 characterised in that said four bar linkage is in the form of a parallelogram linkage. 30
5. A vehicle according to claim 3 or claim 4 characterised in that said actuator is connected to an extension portion of the inner one of said links of said linkage. 35
6. A vehicle according to any one of the preceding claims characterised in that said means for position-adjusting said additional brush further comprises another actuator to move said brush mounting arm assembly and said linkage laterally with respect to said vehicle body in addition to said actuator for said control linkage. 40
7. A self-propelled cleaning vehicle comprising :- 45
- a) a vehicle body;
- b) ground wheels to drive and support and steer said vehicle body;
- c) matter removal means positionable in working relation to a surface to be cleaned to remove matter therefrom;
- d) said matter removal means comprising at least one primary brush rotatable about an upwardly extending axis and carried on a brush mounting arm assembly extending generally forwardly with respect to the normal direction (F) of operative forward motion of said vehicle to sweep matter laterally with respect to said direction;
- e) said matter removal means further comprising an additional brush likewise rotatable about an upwardly extending axis and carried on a brush mounting arm assembly therefor, the latter extending generally forwardly with respect to said normal direction (F) of operative forward motion of said vehicle, so as to be capable of brushing at locations forwardly and/or laterally outwardly of the normal working position of said primary brush;
- f) said brush mounting arm assembly for said additional brush comprising inner and outer arm portions pivotally interconnected; and
- g) means for position-adjusting said additional brush by angular movement of its brush mounting arm with respect to said vehicle body; characterised in that
- h) said outer arm portion of said brush mounting arm assembly for said additional brush comprises a telescoping portion providing length-adjustment of said brush mounting arm assembly. 50
8. A cleaning vehicle characterised by a telescopic brush mounting arm assembly.
9. A vehicle according to claim 7 or claim 8 characterised in that said telescoping portion is provided by at least one hydraulic ram.
10. A vehicle according to claim 9 characterised in that drive means for said additional brush comprises a hydraulic motor and a hydraulic supply conduit for said motor includes said hydraulic ram, or part thereof, as part of the conduit.
11. A vehicle according to claim 10 characterised in that said conduit includes a headside or rodside chamber of said ram and at least part of the piston rod thereof also provides part of said conduit.
12. A vehicle according to claim 11 characterised

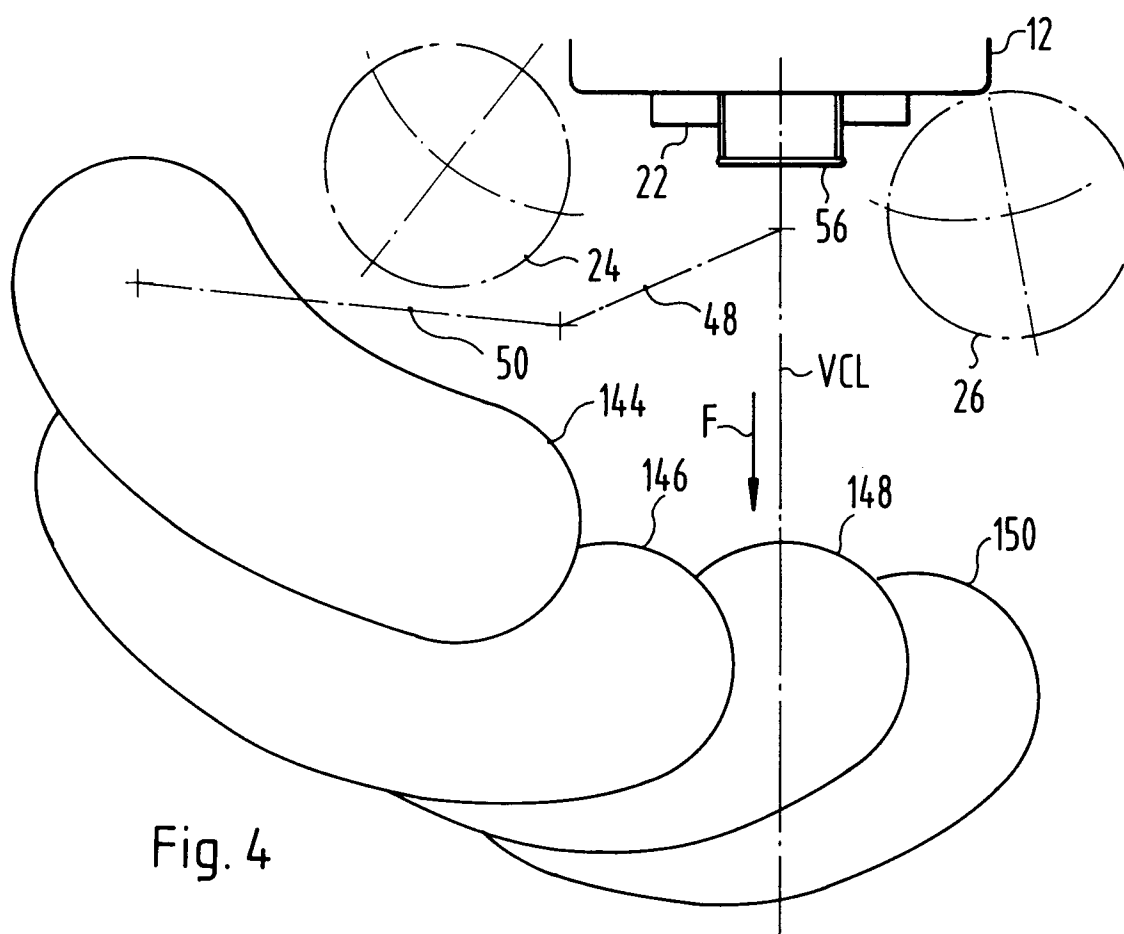
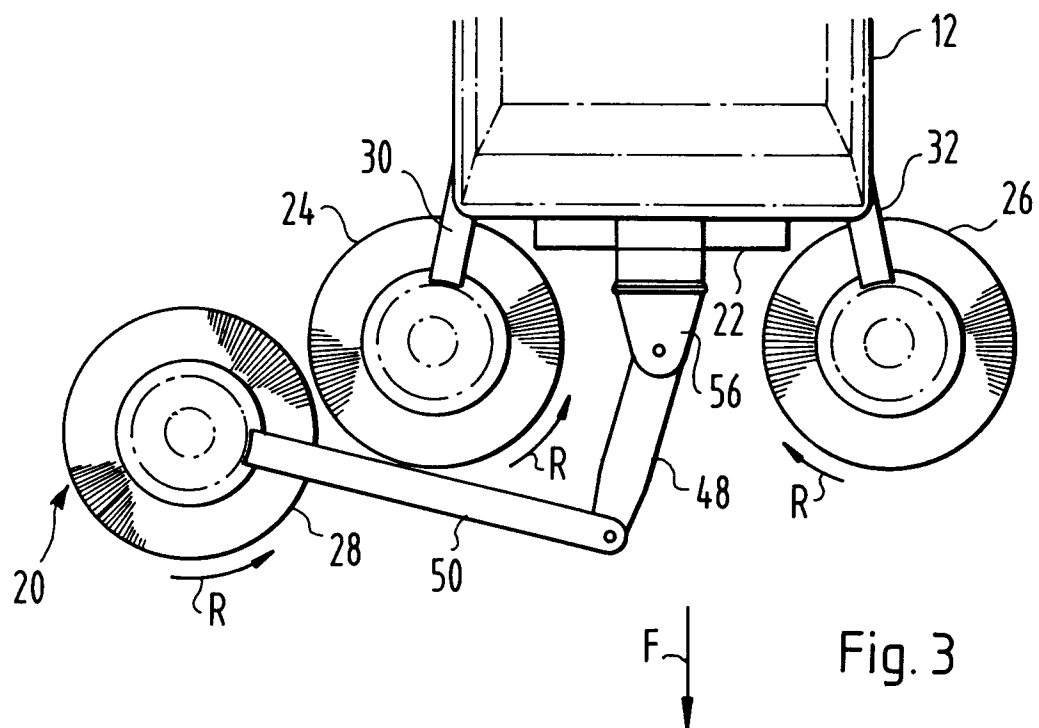
in that fluid pressure generated by the motor supply is used to actuate said ram or rams to telescope said brush mounting arm portion.

- 13.** A self-propelled cleaning vehicle comprising :-
 a) a vehicle body;
 b) ground wheels to drive and support and steer said vehicle body;
 c) matter removal means positionable in working relation to a surface to be cleaned to remove matter therefrom;
 d) said matter removal means comprising at least one primary brush rotatable about an upwardly extending axis and carried on a brush mounting arm assembly extending generally forwardly with respect to the normal direction (F) of operative forward motion of said vehicle to sweep matter laterally with respect to said direction;
 e) said matter removal means further comprising an additional brush likewise rotatable about an upwardly extending axis and carried on a brush mounting arm assembly therefor, the latter extending generally forwardly with respect to said normal direction (F) of operative forward motion of said vehicle, so as to be capable of brushing at locations forwardly and/or laterally outwardly of the normal working position of said primary brush;
 f) said brush mounting arm assembly for said additional brush comprising inner and outer arm portions pivotally interconnected; and
 g) means for position-adjusting said additional brush by angular movement of its brush mounting arm with respect to said vehicle body; characterised in that
 h) contour-following means is provided to enable said primary brush to follow automatically the peripheral contours of a surface it is sweeping without driver intervention.
- 14.** A cleaning vehicle having primary and additional brush means characterised by contour-following means to enable said primary brush to follow automatically the peripheral contours of a surface it is sweeping, without driver intervention.
- 15.** A cleaning vehicle according to claim 13 or claim 14 characterised in that two laterally spaced apart primary brushes are provided and said contour-following means is effective on the nearside one of these brushes (with respect to the conventional vehicle right or left side of the road position) and the other brush

is held in a standard position with respect to said vehicle body.

- 16.** A vehicle according to claim 13 or claim 14 or claim 15 characterised in that said contour-following means comprises valve means actuatable to interconnect the headside and rod-side chambers of a double acting ram (or to interconnect the relevant ram chambers of two opposed single-acting rams) for positioning said primary brush, whereby it can more readily move inwards under the action of laterally directed external forces, while exerting moderate outward force on the brush, tending to hold it against a kerb or other profile.
- 17.** A vehicle according to any one of claims 13 to 16 characterised by means to define a standard position (with respect to the vehicle body or a suction nozzle) of a primary brush or brushes, said means comprising electrical switch means connected to mounting means for said primary brush, to detect when same is in said standard position.
- 18.** A vehicle according to claim 17 characterised by control means connected to said sensing means and operative to cause actuating means for said primary brush to move same to said standard position when said sensing means detects that the brush position is not in conformity therewith.
- 19.** A cleaning vehicle having brush means and characterised by electrical switch means to detect when the brush means is not in a standard sweeping position, whereby an actuating mechanism can be caused to return the brush means to that position automatically.





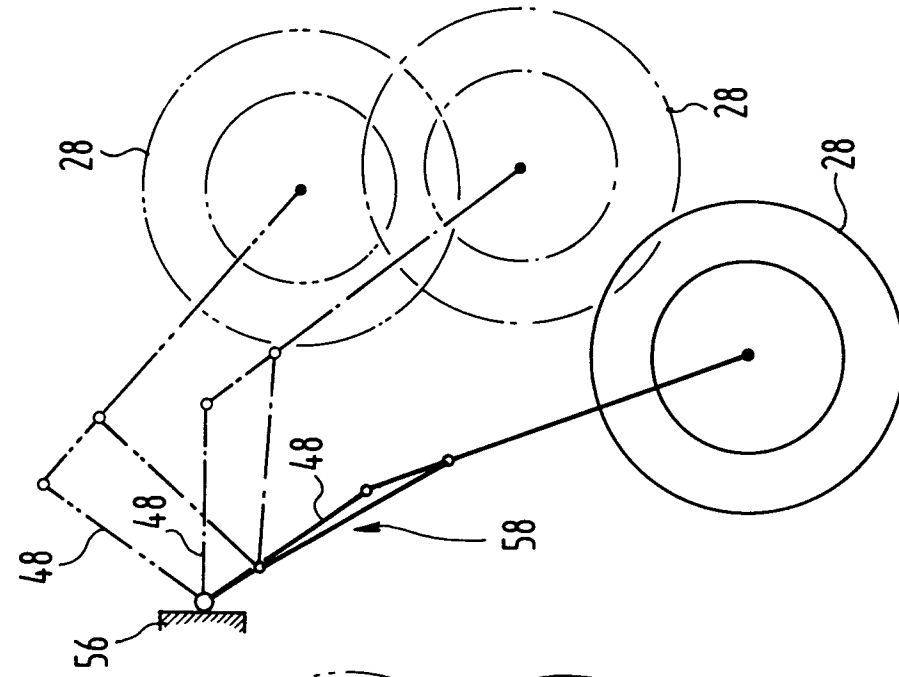


Fig. 5

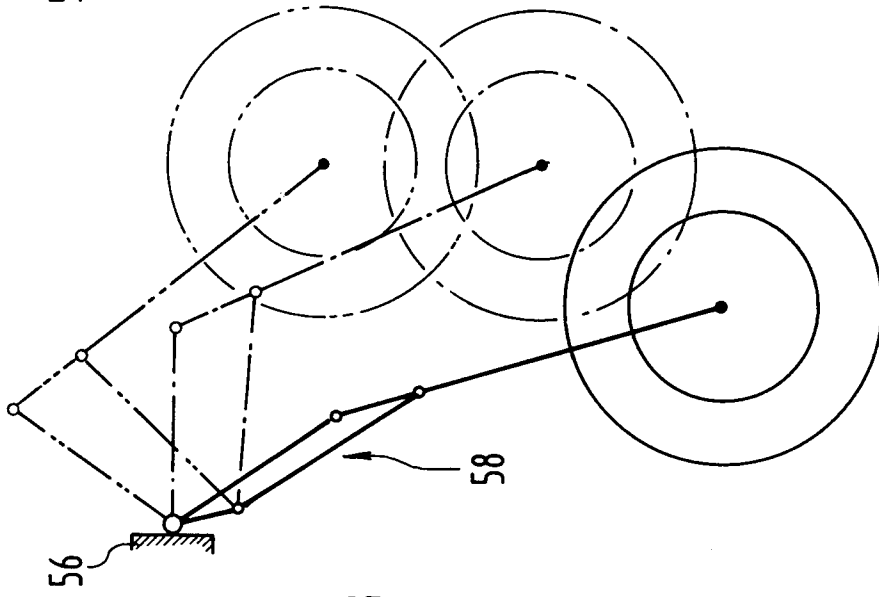


Fig. 6

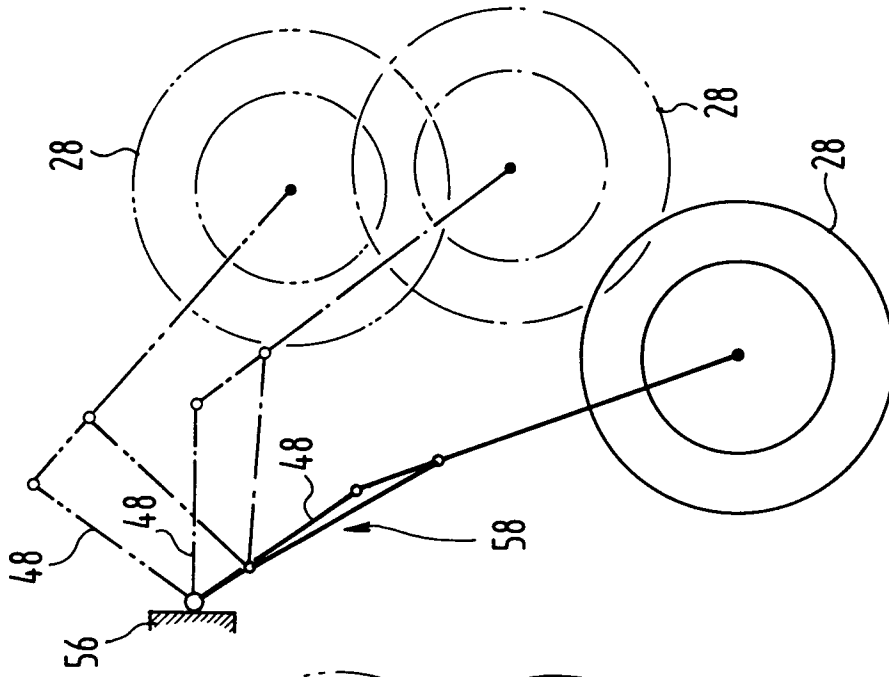
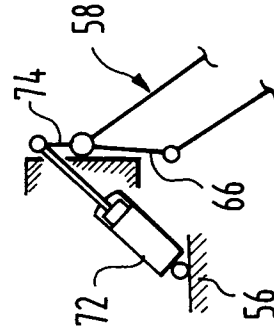
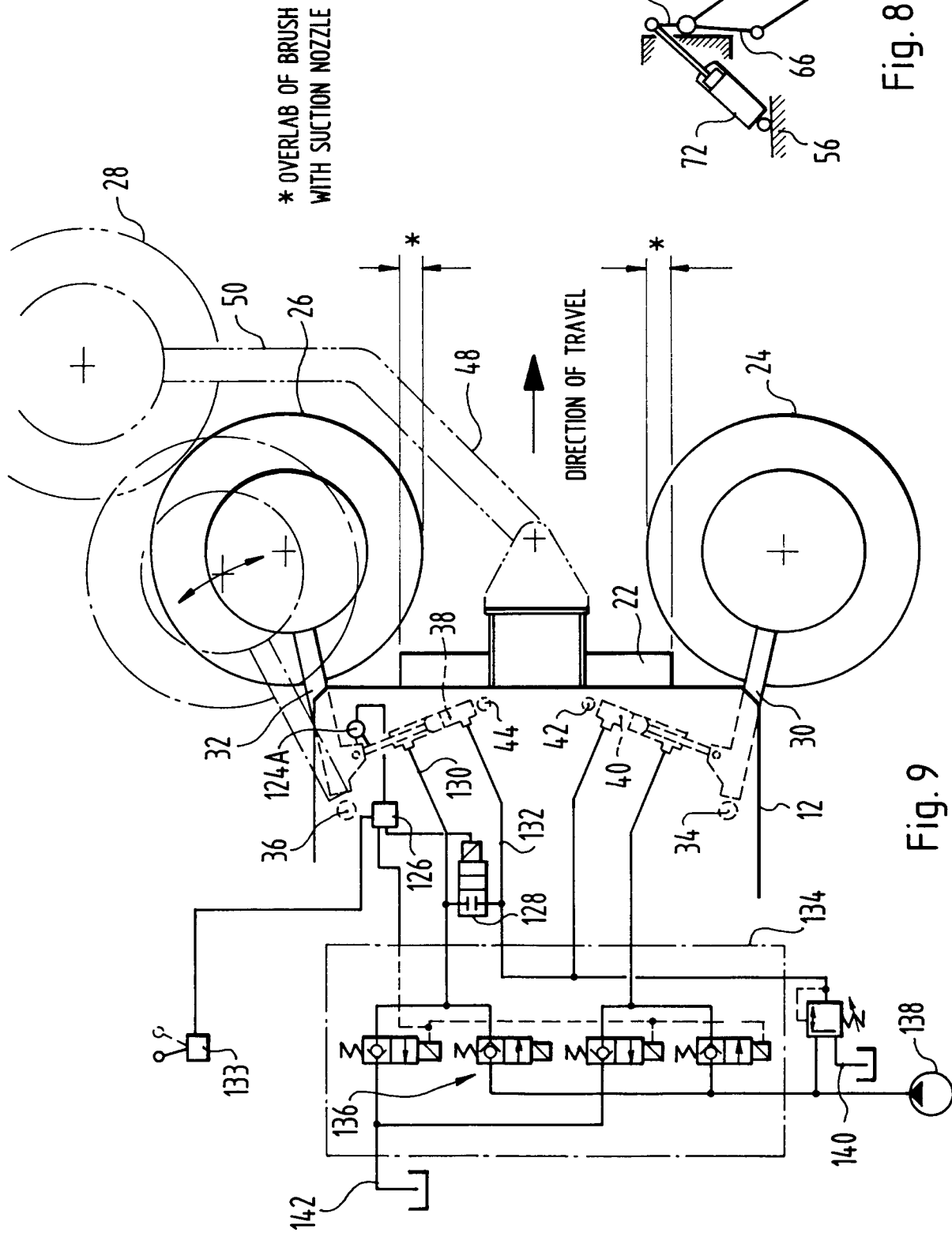


Fig. 7



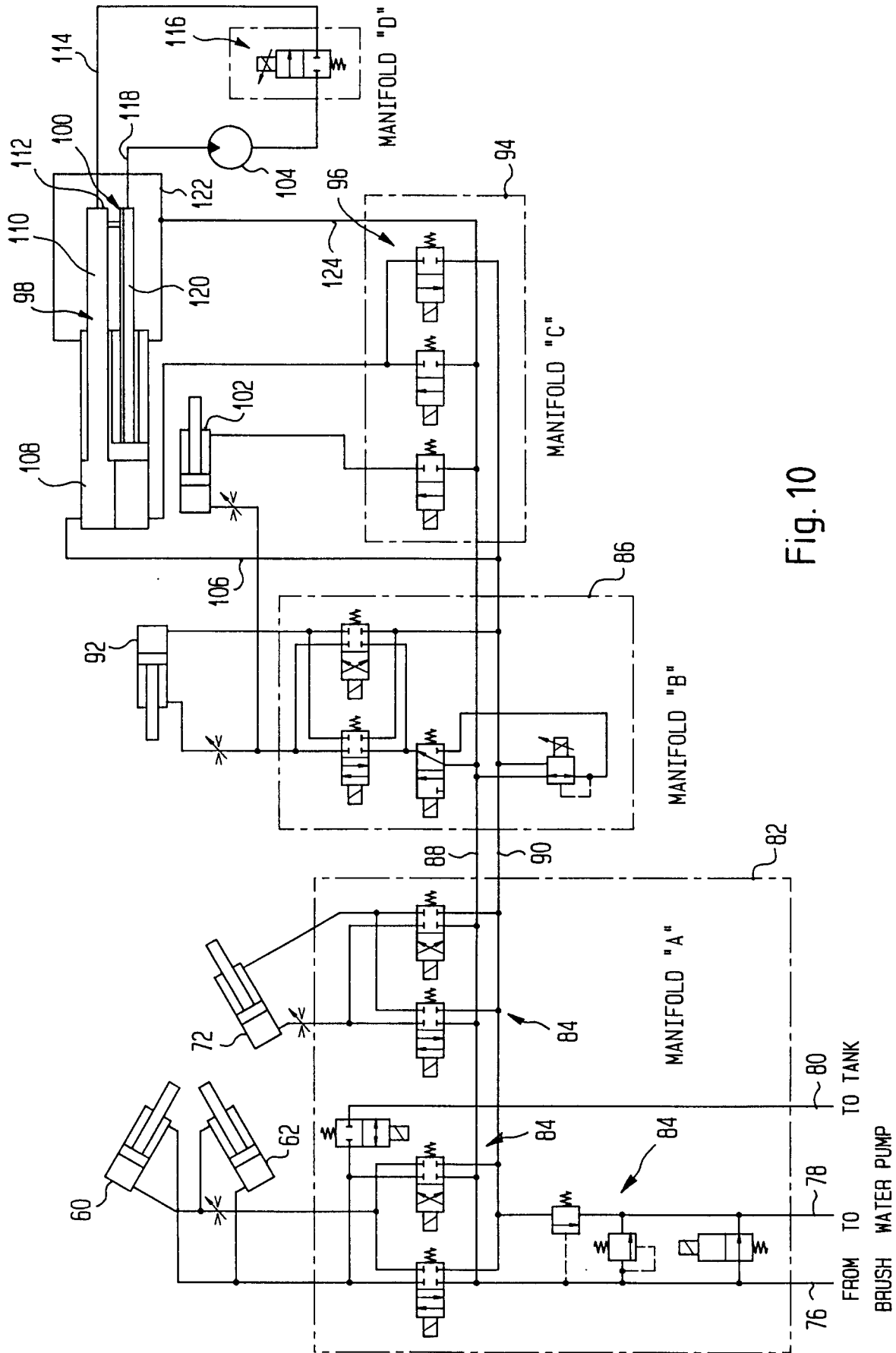


Fig. 10