United States Patent

Fuhring et al.

[15] **3,638,265**

[45] **Feb. 1, 1972**

[54] VEHICLE-SCRUBBING DEVICE

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[73] Assignee: **Bowe, Bohler & Weber**, Augsburg, Germany

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[21] Appl. No.: **881,155**

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **15/21 D**, 15/DIG. 2, B60s/3/06

[58] **Field of Search** ..... 15/DIG. 2, 21 D, 21 E, 53, 15/97, 302

[56] **References Cited**

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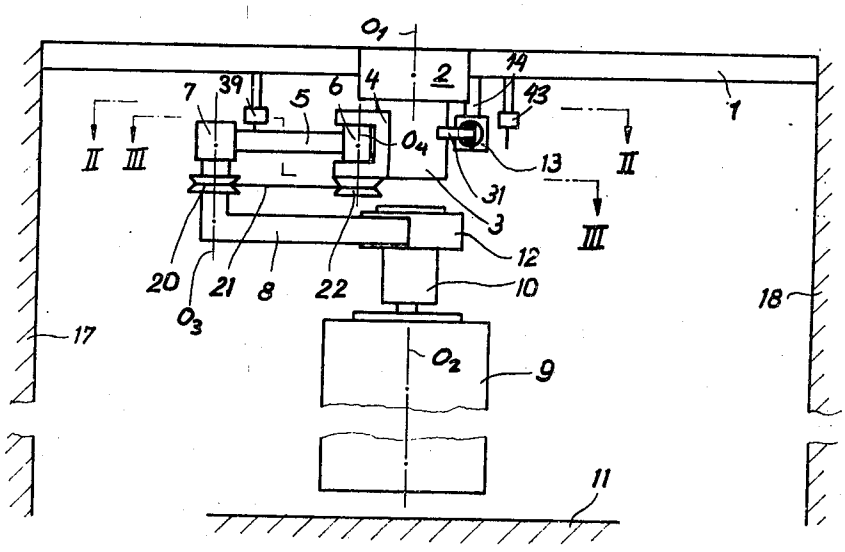
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[57] **ABSTRACT**

A rotary scrubbing brush for cleaning the surface of an automotive vehicle moving relatively to a supporting structure is mounted on that structure through a guidance system, such as an articulated linkage or a guide track, enabling a generally diagonal displacement of the brush from a starting position outwardly or upwardly under the pressure of an oncoming vehicle to sweep and eventually clear the front surface of that vehicle; the guidance system is then swung, through an angle of about 90° or less, into a substantially symmetrical angular position in which a restoring force acting upon the brush holder causes a return sweep along the rear surface of the vehicle.

10 Claims, 27 Drawing Figures



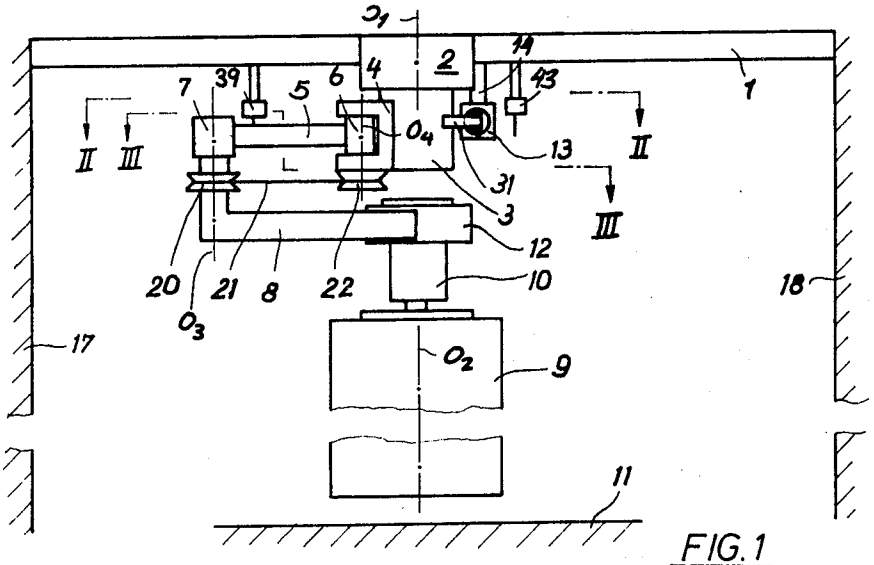


FIG. 1

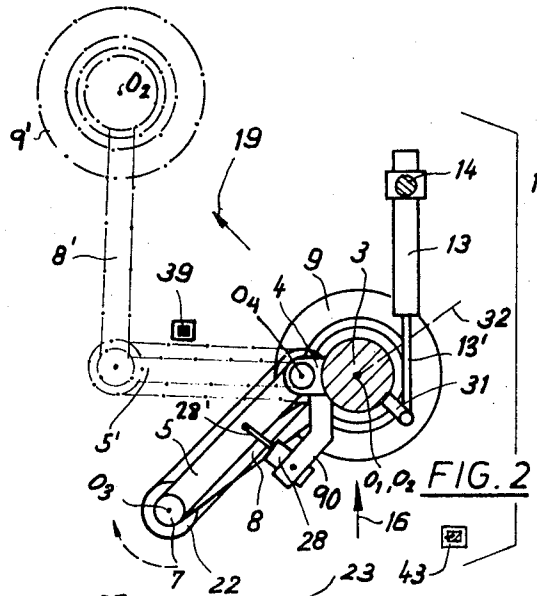


FIG. 2

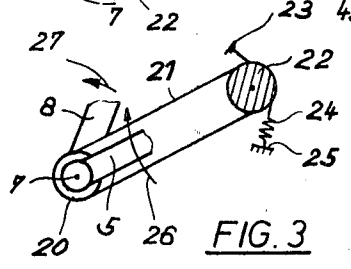


FIG. 3

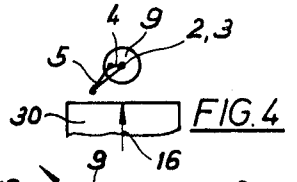


FIG. 4

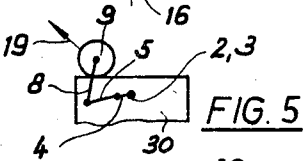


FIG. 5

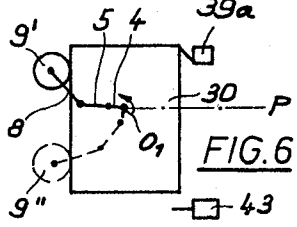


FIG. 6



FIG. 7

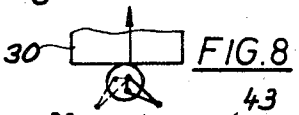


FIG. 8

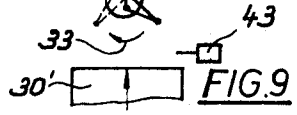


FIG. 9

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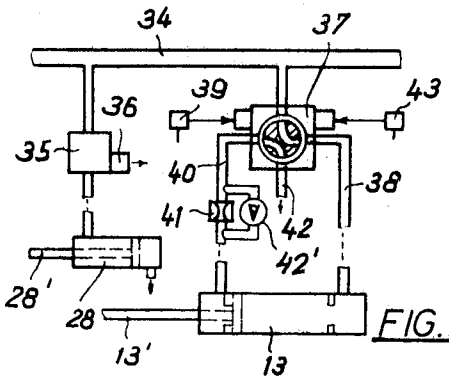


FIG.10

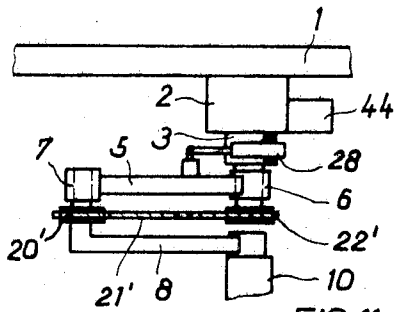


FIG.11

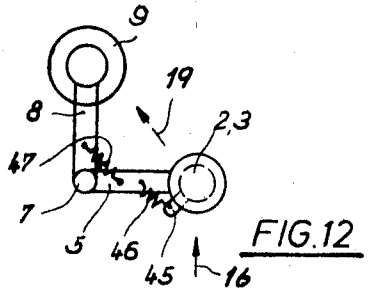


FIG.12

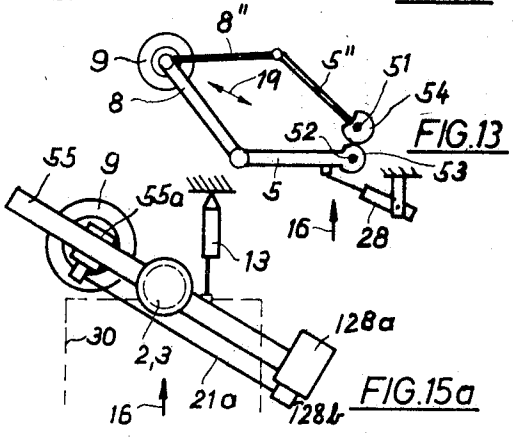


FIG.13 FIG.15a

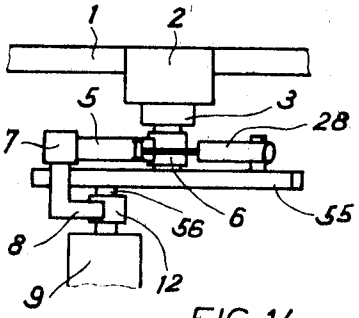


FIG. 14

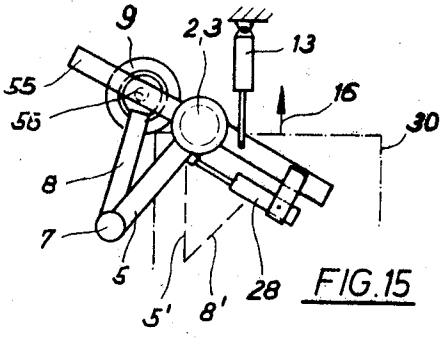


FIG.15

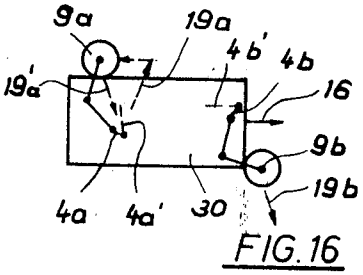


FIG.16

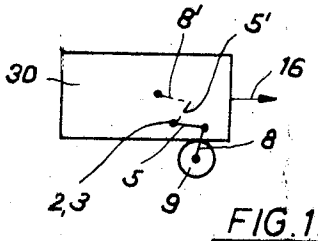


FIG.17

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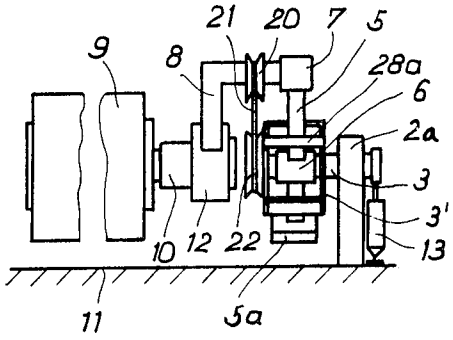


FIG. 18

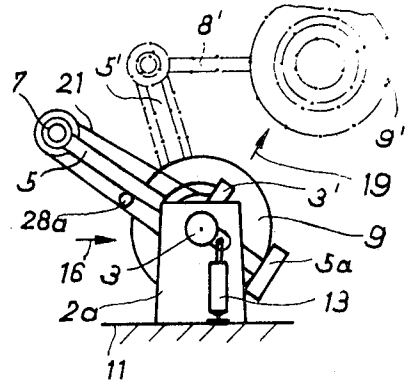


FIG 19

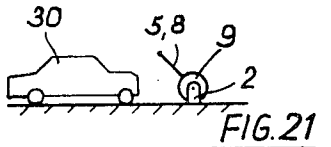


FIG. 21

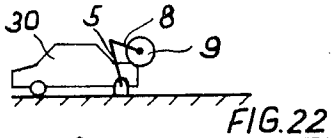


FIG. 22

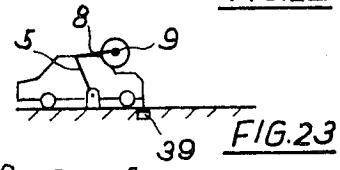


FIG. 23

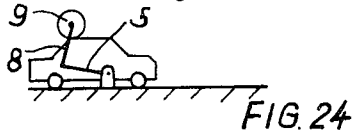


FIG. 24

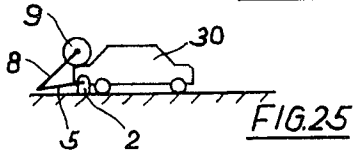


FIG. 25

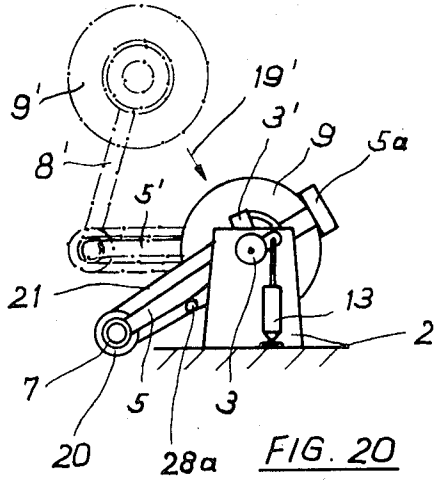


FIG. 20

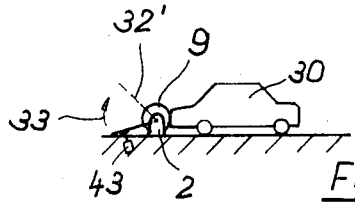


FIG. 26

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VEHICLE-SCRUBBING DEVICE

Our present invention relates to a rotary scrubbing brush for cleaning the surface of an automobile or similar vehicle, as broadly described in commonly owned U.S. Pat. No. 3,466,688 and application Ser. No. 686,025 (now U.S. Pat. No. 3,484,884, filed by H. Führing and R. Fleschhut.

In such an installation a rotary scrubbing brush is vertically suspended or horizontally mounted on a fixed or displaceable structure relatively to which the vehicle moves longitudinally during the scrubbing operation; this structure may be a shed or a portal frame planted astride the path along which the vehicle may be towed or moves under its own power. In the system described and claimed in the aforementioned U.S. Pat. No. 3,466,688, two parallel brushes are mounted on a swingable linkage for sweeping the front and rear surfaces as well as a longitudinal (top or side) surface of a vehicle moving past; in the system of the copending application, a two-arm linkage supporting a single brush is used for the same purpose. When horizontally positioned, the brush or brushes may scrub the complete front and rear surfaces as well as the top; in a vertical arrangement the brush or brushes must be duplicated on opposite sides of the vehicular path for scrubbing respective halves of the end surfaces as well as the corresponding lateral surfaces.

The general object of our present invention is to provide an improved system of this type in which the horizontal or vertical scrubbing brush is guided by simplified means to carry out the desired washing or cleaning operation.

A more particular object is to provide a system of this character adapted to maintain a substantially constant pressure of the brush upon the vehicular surface being scrubbed.

It is also an object of our invention to provide an arrangement of this type wherein the brush, upon completing its sweep of the transverse and longitudinal surfaces of a vehicle, comes to rest in a position of alignment with the vehicular path substantially corresponding to its original starting position so as to be quickly available for the scrubbing of the vehicle next in line.

These objects are realized, pursuant to our present invention, by the provision of guide means securing a brush holder to its supporting structure with freedom of substantially linear motion in a diagonal direction with reference to the vehicular path whereby the brush holder is moved laterally outwardly or upwardly from a starting position to be displaced position under the thrust of the front surface of the vehicle against its brush. As soon as the brush clears that front surface so as to be in line with an adjoining longitudinal surface, the guide means can be swung about a pivotal axis, generally perpendicular to the vehicular path, to sweep that longitudinal surface at a rate greater than the relative speed of the vehicle and the supporting structure. This pivotal axis is codirectional with the axis of rotation of the brush, i.e., is parallel to or in line with the latter axis, so as to be either vertical or horizontal; the swing of the guide means about this pivotal axis is of such extent that the diagonal direction of movement of the brush holder thereafter occupies an angular position substantially symmetrical to its original position with reference to a plane transverse to the vehicular path so that the brush now, after clearing the longitudinal surface, sweeps the rear surface of the vehicle while moving from its displaced position to its starting position in response to a restoring force acting upon its holder.

In an advantageous embodiment, the guide means designed to linearize the motion of the brush holder comprises a pair of articulated arms having a hinge axis parallel to the aforementioned pivotal axis and to the brush axis; these arms may be interconnected by a positive linkage making them rotate in opposite directions about their hinge axis, though such counterrotation may also be achieved by two springs or sets of springs respectively linking one arm with their mounting and with the other arm. An alternate guide may have the form of a linear track member, such as a channel rail, engaged by the brush holder.

The swing of the guide means about its pivotal axis may be carried out by an actuator, such as a fluid-operated jack, tripped by a control switch which responds either directly or through the displacement of the brush holder to the relative motion of the supporting structure and the vehicle.

The above and other features of our invention will be described in greater detail hereinafter with reference to the accompanying drawing in which:

FIG. **1** is a somewhat diagrammatic front view of part of a vehicle-washing station including a scrubbing device embodying our invention;

FIG. **2** and **3** are cross-sectional views respectively taken on lines **11—11** and **111—III** of FIG. **1**;

FIGS. **4–9** are schematic top views of successive positions of the device during the scrubbing of the vehicle;

FIG. **10** is a somewhat diagrammatic view of part of a pneumatic control system for the device of FIGS. **1–3**;

FIG. **11** is an elevational view similar to part of FIG. **1**, illustrating a modification;

FIGS. **12** and **13** are views similar to FIG. **2**, illustrating further modifications;

FIG. **14** is a view similar to FIG. **11**, showing still another variant;

FIG. **15** is another view similar to FIG. **2** but relating to the variant of FIG. **14**;

FIG. **15***a* is a view similar to FIG. **15** but showing yet another modification;

FIG. **16** is a schematic top view illustrating the use of two brush assemblies for scrubbing opposite sides of a vehicle;

FIG. **17** is a schematic view like FIG. **16** but with a modified brush mounting;

FIG. **18** is a front-elevational view of an installation generally similar to that of FIGS. **1–3** but adapted for a horizontal rather than a vertical brush;

FIG. **19** is a side-elevational view of the system of FIG. **18**;

FIG. **20** is a view similar to FIG. **19** but showing the system in alternate positions; and

FIGS. **21–26** are schematic views similar to FIGS. **4–9** but relating to the system of FIGS. **18–20**.

The installation shown in FIGS. **1–3** comprises a supporting structure including an overhead beam or lintel **1** resting on lateral piers or jambs **17**, **18**; the floor **11** of the structure forms a path for a vehicle **30** (FIGS. **4–8**) moving through a washing station of which the structure forms part. Beam **1** is centrally provided with a fixed base **2** in which a depending hub **3** is rotatably mounted; the vertical axis 0_1 of this hub coincides with the axis 0_2 of a cylindrical scrubbing brush **9** in a starting position of that brush illustrated in FIG. **1** and in full lines in FIG. **2**. Brush **9** is suspended on the shaft of an electric motor **10** mounted in an annular holder **12** at the free end of a horizontal arm **8** which is articulated by a joint **7** to another horizontal arm **5**; the latter has an end **6** pivoted to the hub **3** by a frame **4** for rotation about a vertical swing axis 0_4 in the immediate vicinity of pivotal axis 0_1. The hinge axis 0_3 of arms **5**, **8** is parallel to but offset from the axes 0_1, o_2 and 0_4.

The brush-guiding arms **5**, **8** can be jointly swung about axis 0_1 by an actuator here shown as a pneumatic jack **13** which is pivoted to the beam **1** at **14** and whose piston rod **13'** is connected with a lug **31** projecting radially from hub **3**. Another pneumatic jack **28** (illustrated only in FIG. **2**) is pivotally mounted on a bracket **90** rigid with frame **4** and has its piston rod **28** secured to arm **5**, this jack being continuously loaded with a substantially constant fluid pressure to urge the arm **5** to swing counterclockwise about axis 0_4.

Arms **5** and **8** are synchronized for counterrotation about their common hinge axis 0_3 by a linkage comprising a pair of grooved wheels or V-pulleys **20**, **22** which are peripherally interconnected by a flexible band **21** in the form of a wire or cable. As illustrated in FIG. **3**, band **21** has one end fixedly anchored at **23** and another end connected through a contractile spring **24** with another fixed point **25**, spring **24** exerting sufficient tension upon the band to prevent any substantial slippage between it and the wheels **20**, **22**. With wheel **22** immobilized on frame **4** and wheel **20** rigid with arm **8**, any thrust exerted by an oncoming vehicle upon the brush **9** in the

direction 16 (FIG. 2) disaligns the two originally aligned arms 5 and 8 and causes a swing of arm 5 about axis 0_4 through an angle equal to substantially half the angle of divergence of the two arms. In the displaced position 5', 8', 9' of the arms and the brush illustrated by phantom lines in FIG. 2, for example, the arms have swung 90° apart while arm 5 has rotated through 45° from its starting position. The brush is thereby guided substantially linearly in a diagonal direction represented by an arrow 19 in FIG. 2.

With the brush thus moved out to the left-hand side of the supporting structure, jack 13 may be operated to rotate the hub 3 into its alternate angular position in which the lug 31 lies on the radial line 32 shown in FIG. 2; the extent of the swing of the hub is here shown to be an arc of almost 90°, with the arms 5 and 8 swinging through somewhat lesser arcs as will be apparent from FIG. 6 discussed hereinafter. The rotation of the hub 3 may be controlled by a pair of switches 39 and 43, with switch 43 responding to an approaching vehicle for extending the jack 13 to restore the original starting position whereas switch 39 is triggered by the arm 5 in its displaced position 5' to contract the jack. Alternatively, a switch 39*a* operable directly by the vehicle 30 (FIG. 6) may be provided for the latter purpose. This mode of actuation of jack 13 has been illustrated in FIG. 10 which shows a line 34 carrying a pneumatic fluid (e.g., air) under high pressure, supply line 34 being connected to a four-way valve 37 from which two conduits 38, 40 extend to opposite ends of the pneumatic cylinder while an outlet 42 is open to the atmosphere. The tripping of switch 43 places the valve 37 in its illustrated position in which the high-pressure fluid enters the cylinder 13 behind its piston to extend the rod 13', the front end of the cylinder being then vented via conduits 40 and 42; upon the subsequent operation of switch 39 or (39*a*), the fluid flow is reversed so that piston rod 13' is retracted. Advantageously, the latter motion is retarded by a throttle 41 in conduit 40, this throttle being bypassed by a check valve 41' to permit a rapid return swing upon the approach of the next vehicle.

FIG. 10 also shows the continuous pressurization of restoring jack 28 by fluid from line 34 passing through a pressure-relief valve 35 with an outlet 36. Thus, the gas entering the cylinder of jack 28 (in a direction tending to retract the rod 28') is under substantially constant pressure.

Reference will now be made to FIGS. 4–9 for a description of a complete scrubbing cycle performed with the system of FIGS. 1–3 and 10. FIG. 4 shows the vehicle 30 approaching the brush 9 in the direction of travel 16, the brush and its arms 5, 8 being then in their starting position. FIG. 5 shows the brush 9 partly displaced in the diagonal direction 19 under the thrust of the vehicle, this displacement resulting in a scrubbing of the left-hand half of the vehicular front surface. FIG. 6 gives the position in which the brush 9 has just cleared the left front corner of the vehicle, followed by a swing of bracket 4 through nearly 90° with displacement of the brush from position 9' to its alternate position 9''; these two positions are generally symmetrical with reference to a transverse plan P which includes the pivotal axis 0_1. The rate of displacement from position 9' to position 9'', controlled by the throttle 41 of FIG. 10, is added to the relative velocity of the vehicle 30 and the brush-supporting structure to establish a desired scrubbing speed for the left-hand side of the vehicle. In the position of FIG. 7, the brush 9 has started on its return motion along the line 19' which is substantially symmetrical to line 19 with reference to the plane P of FIG. 6. In FIG. 8 the brush has completed its sweep of the left-hand half of the rear surface of the vehicle preparatorily to a return swing of its supporting arms to the original position (arrow 33) when the switch 43 is tripped by the next vehicle 30' as shown in FIG. 9.

The switch 39 could also be positioned to respond to a predetermined swing of arm 8 relative to arm 5 for contracting the jack 13. Naturally, this operation can in any case take place only after the brush 9 has fully swept its half of the vehicular front surface.

FIG. 11 shows a modification of the means interconnecting the arms 5 and 8 for mutually opposite rotation. The wheels rigid with arm 8 and hub 3 are here shown as a pair of sprockets 20', 22' engaged by a chain 21', the operation of this linkage being the same as in the system of FIGS. 1–3. Also, the pivoted extremity 6 of arm 5 has been mounted coaxially with hub 3, sprocket wheel 22' being centered on the same axis.

FIG. 12 shows a simplified brush-guiding system wherein the arms 5 and 8 are interconnected by a contractile spring 47, another such spring 46 linking the arm 5 with a lug 45 on hub 3. With suitable dimensioning and positioning of springs 46 and 47, as by making the latter twice as stiff as the former, the aforedescribed angular relationship between the two arms and the hub 3 can be maintained so that a thrust upon the brush 9 by a vehicle traveling in the direction of arrow 16 causes a substantially linear brush displacement in the direction of the diagonal arrow 19.

The modification shown in FIG. 13 comprises a pair of articulated members 5'', 8'', similar to arms 5 and 8, which complement these arms to a generally parallelogrammatic linkage. Adjoining ends of arms 5 and 5'' are pivotable about respective axes 52, 51 and are provided with meshing gears or gear sectors 53, 54 centered on these axes so as to rotate in mutually opposite directions in response to a vehicular thrust (arrow 16) or to the restoring force of jack 28. Again, therefore, the brush 9 is constrained to move diagonally along line 19.

In FIGS. 14 and 15 the guidance system of the preceding embodiments has been replaced by a track 55 of inverted-U shape receiving the top of the shaft 56 of brush motor 12. At 5' and 8' we have shown in FIG. 15 a displaced position in which the arm 8 is swung past its position of alignment with arm 5.

In FIG. 15*a* the same track 55 is used but the jack 28 has been replaced by a cable 21*a* which can be wound on a capstan 128*b* driven by a motor 128*a* to recall the brush 9 after it has been displaced from its normal position by the thrust of vehicle 30. Motor 128*a*, coupled with capstan 128*b* through a slipping clutch not shown, again exerts a constant biasing force upon the brush 9, tending to restore it to its starting position.

If the arm 8 is free to swing past its position of alignment with arm 5, the operation of the system described with reference to FIGS. 4–9 may be modified by allowing the assembly to remain in the position of FIG. 8 until the arrival of the next vehicle 30' (FIG. 9), instead of restoring it to its starting position as indicated by arrow 33, whereby the thrust of vehicle 30' displaces the brush forwardly and to the right, rather than to the left as indicated by arrow 19. When the brush reaches the right-hand side of vehicle 30', the actuator 13 is tripped to rotate the assembly in the reverse sense (i.e., clockwise) whereby the brush sweeps the right side of the vehicle in the manner illustrated in FIG. 6 for the left side. After the vehicle 30' has passed, the next vehicle again finds the brush mounting in the position of FIG. 4 so as to be scrubbed on the left, and so forth.

Thus, a combination of two longitudinally offset brush carries 4*a*, 4*b* may be operated in staggered relationship, as illustrated in FIG. 16, to let their brushes 9*a*, 9*b* sweep respective halves of a vehicle 30 traveling in the direction 16. Depending on the mode of operation, the two brushes either stay on opposite sides of the vehicular path or work alternately to the right and to the left of that path as described above.

FIG. 16 also shows the alternate positions 4*a*', 4*b*' of the supporting frames 4*a* and 4*b*. The arc of swing of these frames and of the associated hubs is here somewhat less than in FIGS. 4–9, with a corresponding increase in the angle included between the diagonal directions 19*a*, 19*b* (as well as their mirror images indicated at 19*a*' for brush 9*a*) and the longitudinal direction 16. Because of this steeper angle, the brushes move more rapidly across the front and rear surfaces of the vehicle; also, the length of the arms may be reduced as this angle in-

creases. The rate of swing of the hub, on the other hand, ought to be reduced (or the relative motion between the vehicle and the brush support correspondingly increased) in order to provide a substantially uniform rate of displacement of the brush from the front to the rear of the corresponding lateral vehicle surface. FIG. **16** further shows the two hub axes laterally offset from the longitudinal centerline of the vehicle so that each brush sweeps slightly more than half of the front and rear surfaces.

FIG. **17** illustrates the possibility that the base **2** and the hub **3** of the brush mount may be offset from the centerline toward the side to be scrubbed, provided the arms **5**, **8** are swingable past their position of alignment as described above. In this case, the starting position of the linkage is the one shown at **5'**, **8'** (compare also FIG. **15**), with the brush **9** moving laterally outwardly past the coincidence position of the arms into the extreme position in which the brush rests against the lateral surface of the vehicle **30**. This arrangement, which can be realized with any of the aforedescribed constructions except that of FIG. **12**, permits a still further reduction in the length of the arms.

FIGS. **18–26** illustrate how the system described above, and particularly the embodiment of FIGS. **1–3**, can be converted for use with a horizontal rather than a vertical brush **9**. Although FIG. **18** shows only one pair of arms **5**, **8** with the brush **9** cantilevered thereto, these arms and their mount **2***a* rising from floor **11** may be duplicated on the opposite side of the brush shaft (i.e., at the left in FIG. **18**) to support the brush at both ends. In this instance the jack **28** of the preceding Figures may be omitted, the restoring force being here furnished by gravity with the aid of a counterweight **5***a* on an extension of arm **5** which in the normal or starting position (full lines, FIG. **19**) comes to rest against an abutment **28***a* on a frame **3'** rigid with hub **3**. The diagonal displacement of the brush **9** into an off-normal position **9'**, in the direction **19**, has been illustrated in phantom lines in FIG. **19**. FIG. **20** shows the alternate hub position, established here by the extension of jack **13**, with the arms **5** and **8** in their coincidence position (full lines) and in their diverging position **5'**, **8'** (phantom lines); the arrow **19'** indicates again the diagonal displacement of the brush from its off-normal, i.e., raised, position **9'**.

FIGS. **21–26** illustrate the successive stages of the brush movement in sweeping the front, top and rear surfaces of a vehicle **30**. In FIG. **26** the line **32'** denotes the position of the aligned arms upon their return swing in the direction of arrow **33**, e.g., in response to the tripping of switch **43** by the next-following vehicle.

We claim:

1. A scrubbing device for a vehicle moving along a predetermined path relatively to a supporting Structure, comprising:

a brush holder forming a rotatable mounting;

a rotary brush journaled in said mounting with an axis of rotation generally perpendicular to said path;

a rotatable hub on said structure centered on a pivotal axis codirectional with said axis of rotation;

guide means on said hub supporting said brush holder for substantially linear displacement thereof in a first diagonal direction from the centerline of said path outwardly under the thrust of the front surface of an advancing vehicle against said brush, said guide means being swingable with said hub about said pivotal axis into an alternate position to enable displacement of said brush holder in a second diagonal direction generally symmetrical to said first diagonal direction relative to a plane transverse to said path;

actuating means for so swinging said guide means upon alignment of said brush with a longitudinal surface of said vehicle;

and restoring means coupled with said brush holder for returning same to said centerline in said second diagonal direction along the rear surface of the advancing vehicle.

2. A device as defined in claim **1** wherein said guide means comprises a pair of articulated arms with a hinge axis parallel to said pivotal axis and said axis of rotation, one of said arms having an end remote from said hinge axis pivoted to said hub for turning about a swing axis parallel to and in the vicinity of said pivotal axis, the other of said arms having a free end remote from said hinge axis carrying said brush holder.

3. A device as defined in claim **2** wherein said guide means further comprises a linkage positively interconnecting said arms for relative counterrotation about said hinge axis.

4. A device as defined in claim **3** wherein said linkage comprises a wheel centered on said swing axis and rigid with said hub, a wheel rigid with said other of said arms centered on said hinge axis, and a flexible band peripherally interconnecting said wheels.

5. A device as defined in claim **3** wherein said linkage comprises a pair of articulated members complementing said arms to a generally parallelogrammatic framework.

6. A device as defined in claim **3** wherein said linkage further comprises first spring means linking said one of said arms with said hub and second spring means interlinking said arms.

7. A device as defined in claim **2** wherein said restoring means comprises a source of gas pressure acting upon said one of said arms.

8. A device as defined in claim **1** wherein said guide means comprises a linear track member engaged by said brush holder.

9. A device as defined in claim **1** wherein said actuating means comprises a fluid-operated jack connected between said structure and said hub.

10. A device as defined in claim **1**, further comprising switch means responsive to relative motion of said structure and said vehicle for tripping said actuating means.

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