(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 707 678 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.10.2006 Bulletin 2006/40

(51) Int Cl.:
E01H 1/08 *(2006.01)*

(21) Application number: **06005728.8**

(22) Date of filing: **21.03.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **30.03.2005 IT PR20050012**

(71) Applicant: **S.A.M. Salute Ambientale S.R.L.**
43013 Langhirano PR (IT)

(72) Inventor: **Saliola, Anna,**
S.A.M. Salute Ambientale S.R.L
43013 Langhirano (Parma) (IT)

(74) Representative: **Guareschi, Antonella**
c/o Ing. Dallaglio S.r.l.
Viale Mentana 92/C
43100 Parma (IT)

(54) Street sweeper having a mechanical vacuum filter system for refuse collection

(57) The invention is applicable in the field of street sweepers and particularly those sweepers having a mechanical vacuum filter system for collecting refuse in a hopper. Namely, the sweeper has a vacuum system comprising a combination of air blowing means located behind a cylindrical rotating brush against the ground and all along the brush, and a fine particulate filter PM10 and PM2.5 through which the intake air is conveyed into a refuse receiving hopper.

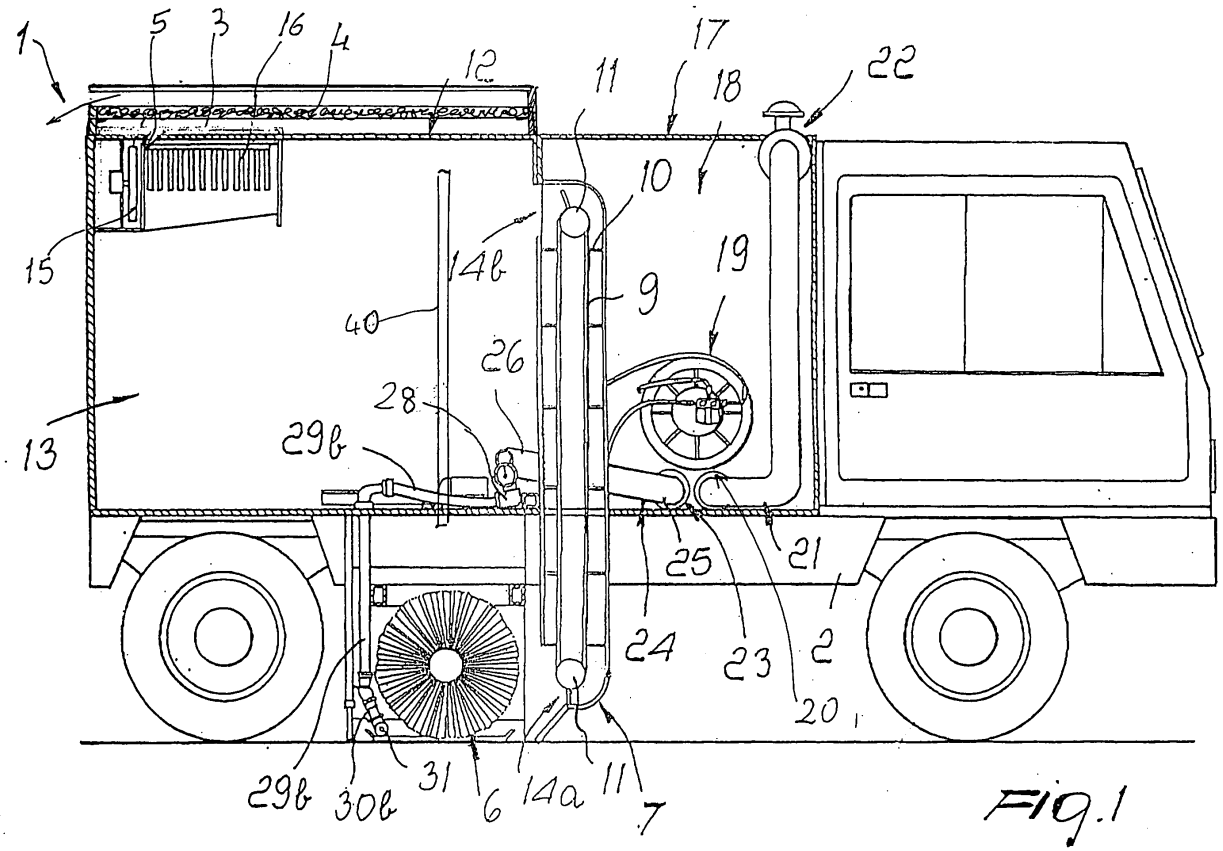

Fig.1

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Description

[0001] The invention relates to a street sweeper having a mechanical vacuum filter system for refuse collection.

[0002] Sweepers are already known, which have a chassis on which a hopper is mounted for receiving refuse, to be conveyed into such hopper through a number of devices, including:

- rotating brushes, including one cylindrical brush disposed transverse to the chassis between the front axis and the rear axis of the sweeper;
- an elevator conveyor device for lifting the material removed by the cylindrical brush;
- means for progressively suctioning the material removed by said cylindrical brush.

[0003] The conveyor device and the suction means cooperate to convey refuse into the receiving hopper, in which a negative pressure is created by one or more centrifugal valves.

[0004] The air sucked in by the hopper is filtered by a filter unit placed in the hopper, before passing through the fans and being discharged to the atmosphere.

[0005] Another type of street sweepers only has a vacuum system for conveying refuse into the receiving hopper.

[0006] This type of sweeper requires a considerable air flow to convey refuse into the receiving hopper, which involves filtering problems.

[0007] It was found that no prior art sweeper solves the problem of collecting ultrafine or fine particulate, named PM10 and PM2.5, from the atmosphere, whereby such particulate deposits on the road surface.

[0008] There are substantially two reasons that prevent prior art sweepers from collecting such particulate matters:

- prior art sweepers cannot remove such thin particulate from the ground because the asphalt behaves like a cavernous surface, and the brushes cannot penetrate its cavities;
- when such particulate is partially detached from the ground and suctioned, the filter systems that are currently mounted on sweepers are not able to hold it, whereby the particulate is discharged back into the atmosphere and increases pollution.

[0009] The object of this invention is to allow fine particulate matter to be collected and held by the sweeper for disposal as special refuse in accordance with applicable standards.

[0010] This object is wholly fulfilled by a street sweeper having a mechanical vacuum filter system for refuse collection, which is characterized as set forth in the annexed claims, and mainly in that it provides a combination of an air blowing system located behind the cylindrical brush against the ground and all along the brush, and a second fine particulate filter through which the air sucked in by the fans placed in series with the first filter in the refuse receiving hopper is conveyed.

[0011] These and other characteristics will be more apparent from the following description of a preferred embodiment, which is shown by way of example and without limitation in the accompanying drawings, in which:

Figure 1 is a schematic side view of the sweeper;
Figure 2 is a perspective view of the air blowing means detail;
Figure 3 is a perspective view of a detail of the second fine particulate filter referring to its connection in the sweeper.

[0012] Referring to Figure 1, a sweeper is generally designated with numeral 1.

[0013] The sweeper has a chassis 2, supporting a cylindrical brush 6, which is placed between the front and rear wheels and rotates transverse to the chassis 2 and parallel to the axes of rotation of the wheels, so that the bristles of said brushes are in contact with the underlying road surface.

[0014] The axis of rotation of the brush 6 is supported in such a manner as to allow height adjustment of the brush relative to the chassis 2, and to further accommodate appropriate vertical settling oscillations upon contact with any asperity or obstacles on the road surface.

[0015] The chassis 2 also has a channel 7 for a belt conveyor-elevator 9 having a plurality of shelves 10 for simultaneously collecting and lifting the particulate matter removed by the brush 6.

[0016] The conveyor belt 9 is driven by well-known drive means.

[0017] The conveyor elevator belt runs within the channel 7 which has, at the lower section of the conveyor, a first aperture 14a adjacent the brush 6 for instant conveyance of the particulate matter removed by the counter-clockwise rotation of the brush.

[0018] The chassis 2 further includes a container, or tipping hopper 12 with a storage chamber 13 formed therein, which is connected to the channel 7 through a second aperture 14b, formed about level with the upper end of the conveyor-elevator belt 9.

[0019] A means is provided in the container 12 for suctioning the particulate matter removed by the brush 6.

[0020] This suction means is an aspirator 15 which generates a negative pressure in the storage chamber 13 to cause the particulate matter to be drawn up toward the conveyor belt 9 and the hopper.

[0021] In more detail, the aspirator 15 is operatively upstream connected to a first coarse filter or pre-filter 16 (about 20 pm) for purification of air from the particulate matter sucked in by the hopper and communicated downstream, through a channel 5, with a chamber 3 that contains a fine particulate filter 4.

[0022] The air that enters the chamber 3 above the hopper is discharged to the atmosphere after passing

through the filter 4.

[0023] Thus, the air that is sucked in near the cylindrical brush is filtered twice: a first filtering or pre-filtering step separates the coarse matter, and a second filtering step separates fine particulate by using a so-called absolute filter, i.e. having an efficiency of 99.99% at 0.3 μm, so that the air discharged to the atmosphere is substantially free of any particulate matter or anyway complying with applicable standards.

[0024] The means for blowing air to the area of the road surface facing the brush 6 consist of a blower, designated with numeral 19, which is upstream connected by a first regulating valve 20 to a first upwardly directed conduit 21, for connection to an overlying filter 22 in communication with the atmosphere.

[0025] Thus, atmospheric air may enter the filter 22 and be conveyed through the conduit 21 to the blower 19.

[0026] The blower is downstream connected by a second regulating valve 23 to a second flexible conduit 24, extending in a substantially horizontal direction.

[0027] A T-fitting 28 is installed in a section 26 of the conduit 24, with two pipes 29a and 29a branching off therefrom, and opening out below the storage chamber 13, behind the underlying brush 6, into an area facing opposite the first aperture 14a of the channel 7.

[0028] The pipes 29a and 29b diverge to define respective sections, designated with numerals 30a and 30b, which open out into an underlying tube 31, which is disposed transverse to the chassis 2, level with the ground or road surface.

[0029] The ends of the tube 31, designated with numerals 32a and 32b, are closed and adjacent to their respective connections with the sections 30a and 30b.

[0030] The tube 31 has a plurality of holes or nozzles 33 on the surface adjacent the ground, which are turned toward the brush and the ground to allow the air delivered by the blower to be blown to the area of the road surface that comes in contact with the brush 6.

[0031] These holes or nozzles are arranged in succession and predeterminedly spaced, preferably all along the tube 31, so that the air is evenly distributed across the area of the ground interacting with the brush 6. The air ejected from the holes 33 shall have such a pressure as to allow that, immediately before the brushing action of the brush 6, particulate matter and residual dirt may be removed from the porous areas of the road surface that are not easily reached by the bristles of the brushes 6.

[0032] The tube 31 is connected to support means for automatic position settling thereof, which consist of two chains 34a and 34b associated to the ends 32a and 32b of the tube 31.

[0033] The invention was found to fulfill the intended objects of lifting fine particulate matter from the road surface and holding it in the filters 4, which may be removed once a predetermined clogging position is reached, as indicated by suitable well-known devices, installed in the sweeper cabin.

[0034] According to a further embodiment, in addition to the above, a tube 40 is provided to allow communication between the operating area of the cylindrical brush 6 and the upper portion of the hopper 12, so that a negative pressure may be also generated in the operating chamber of the brush 6.

Claims

1. A street sweeper having a mechanical vacuum filter system for refuse collection, of the type that comprises a refuse receiving hopper into which refuse is conveyed through:

- at least one cylindrical rotating brush (6) disposed with its axis of rotation transverse to the chassis of the sweeper, between the front wheels and the rear wheels;
- an elevator conveyor device (9) having a refuse inlet in the proximity of the rotating brush and an outlet in the rear portion of the refuse receiving hopper (12);
- means (15) for progressively suctioning the material removed by the cylindrical brush, which convey such material into the hopper, through the conveyor-elevator, wherein said means generate a negative pressure by centrifugal valves, a first coarse filter, or pre-filter (16) being provided in the hopper to filter the air sucked in by the hopper and discharge it into the atmosphere,

characterized in that it further comprises:

air blowing means (19) and (31) located behind the brush (6) against the ground and all along the cylindrical brush;
a second fine particulate filter (4) through which the air sucked in by the centrifugal fans (15) placed in series with the first filter (16) in the hopper (12) is conveyed.

2. A street sweeper as claimed in claim 1, **characterized in that** the air blowing means include at least one blower (19), which is upstream connected, preferably by a first regulating valve, to a filter in communication with the atmosphere, and is connected by pipes to a tube (31) having a plurality of holes or nozzles (33) which are oriented downward or toward the cylindrical brush, so that the air delivered at a predetermined pressure by said blower is blown to the area of said ground or road surface that comes in contact with the rotating cylindrical brush (6).

3. A street sweeper as claimed in claim 1, **characterized in that** the air blowing means include a tube having holes or nozzles arranged in succession and predeterminedly spaced along the whole tube.

4. A street sweeper as claimed in claim 1, **characterized in that** the second fine particulate filter (4) has an efficiency of 99.99% with a 0.3 μm particulate size.

5. A street sweeper as claimed in claim 1, **characterized in that** it has at least one tube (40) for allowing communication between the operating chamber of the cylindrical brush and the upper portion of the chamber (13) of the hopper (12).

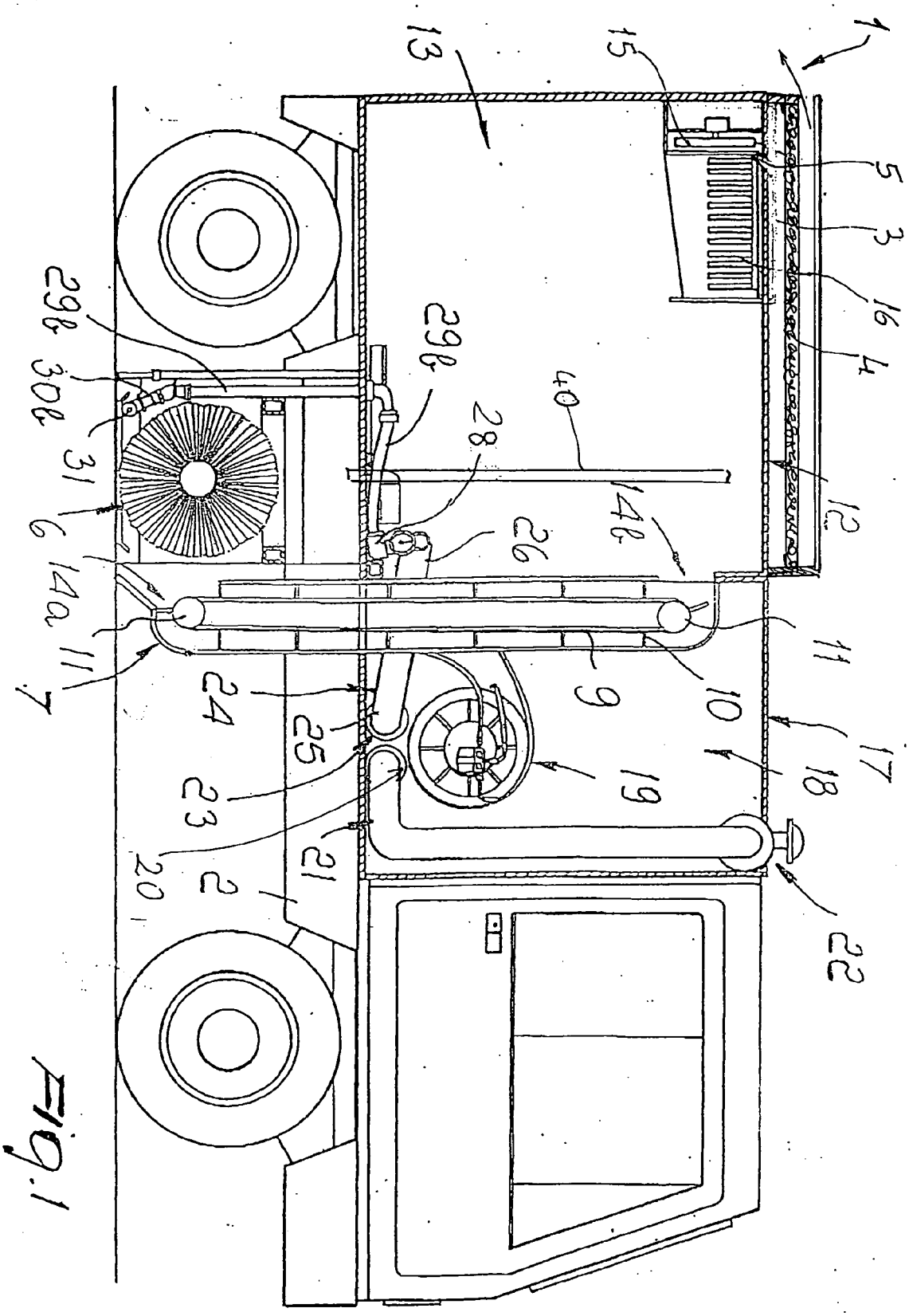
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Fig.1

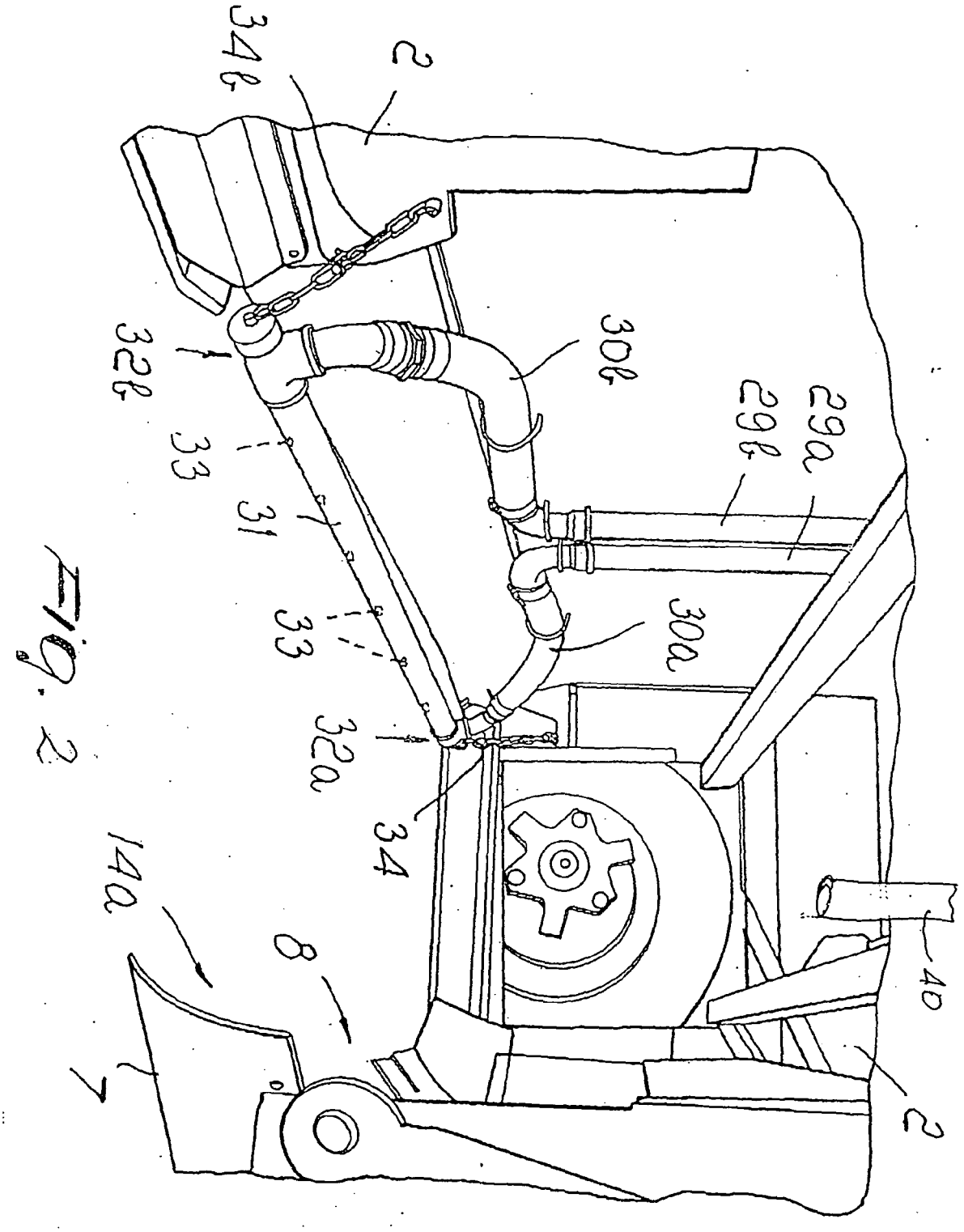

Fig. 2

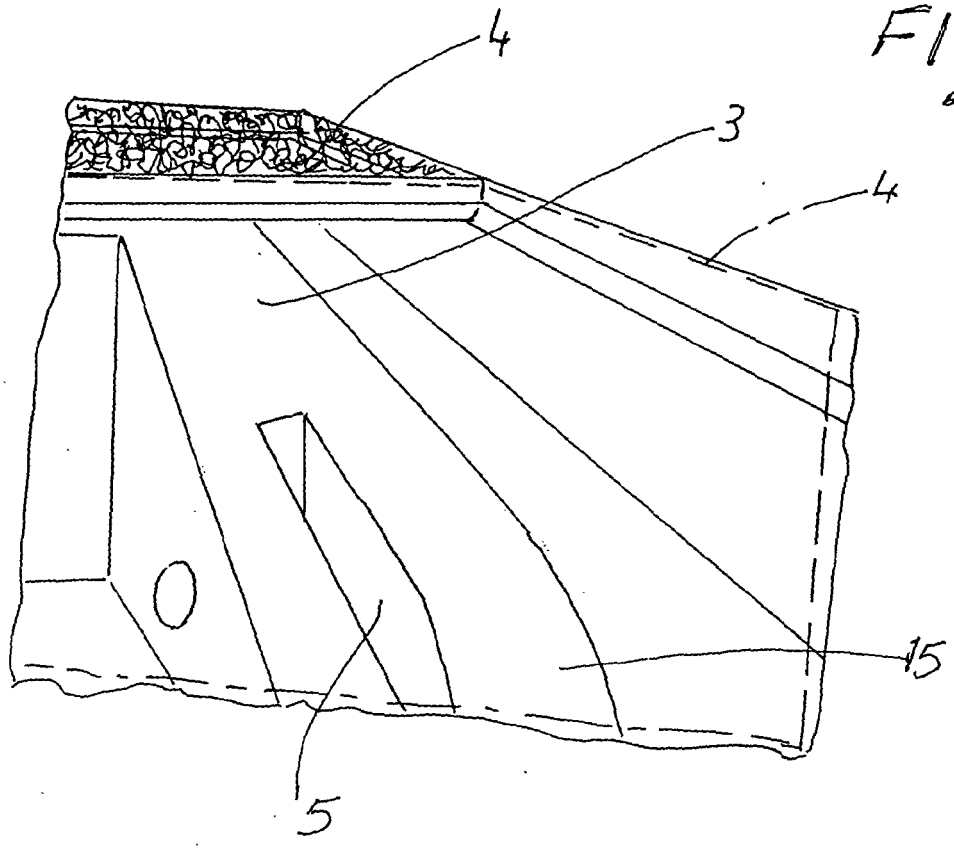

Fig 3