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

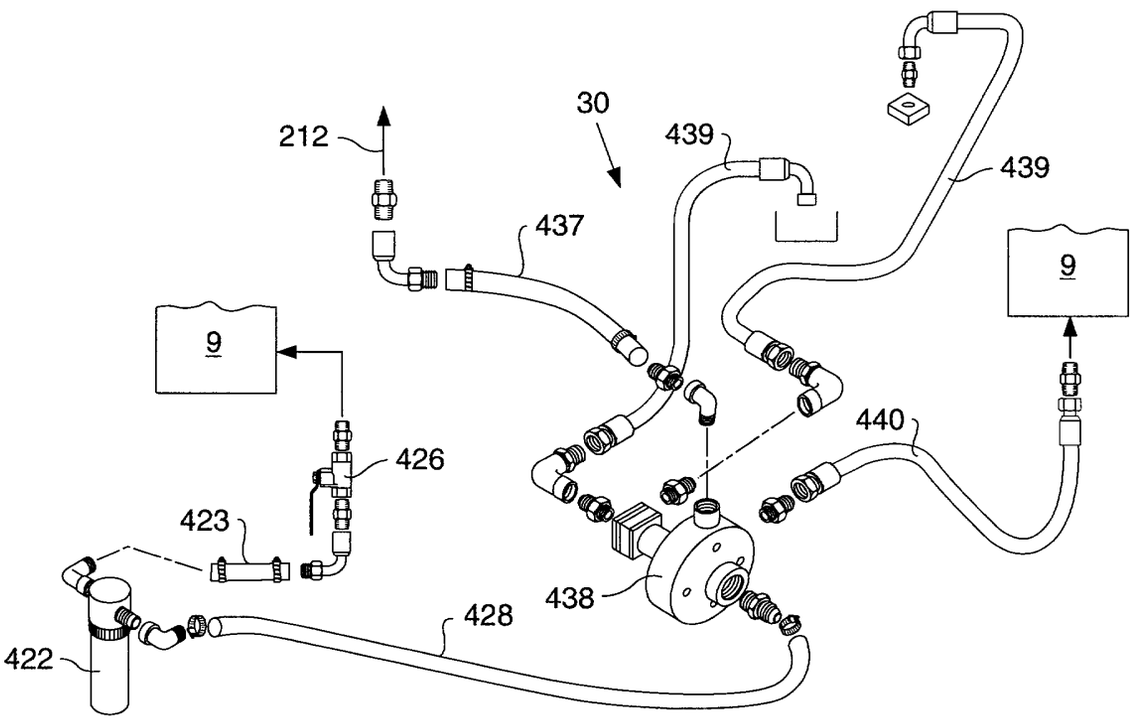
(72) Inventor: **Klaasse, S.H.J.**
2151 HB Nieuw Vennep (NL)

(74) Representative: **Wagner, Karl H., Dipl.-Ing. et al**
Wagner & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

(54) Dust control system for a road working machine

(57) A method and an apparatus for reducing dust is disclosed for the use with a working machine which is adapted to fragment material from a working surface and includes at least one partially confined space in which said dust occurs. In the method a liquid capable of binding dust is provided and the liquid is sprayed into the partially confined space to trap dust particles generated during fragmentation of the material form the working surface.

Fig. 3



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Description

Technical field

[0001] The present invention relates to a method and apparatus for dust handling, in particular for use on a road working machine, like a cold planer.

Background

[0002] Cold planers or road scarifiers comprise a working device, e.g. a milling drum to remove, for example, a surface layer from a road to be repaired. The material to be removed is fragmented or broken up into small pieces by the working device and then transported to another location for collection and/or for reuse. During this fragmentation and transport process the broken up material generates dust particles in a quite high amount. This dust is an undesirable byproduct of the road working process.

[0003] EP 0 971 075 A1 discloses one attempt to handle dust developed during grinding of road surfaces, by providing, on a scarifier, a dust handling device. The dust handling device comprises a housing at least partially enclosing the milling drum and defining a suction area, a suction fan and a suction duct connecting said suction area and said suction fan. The suction fan discharges the dust containing air sucked away from the working space above the milling drum through a filter. The filtered air is then discharged and the collected dust powder is discharged to a different location.

[0004] In the mining industry, it is known to spray the mined material with water to avoid the generation of dust while processing and transporting the mined material, e.g. coal. There are also suggestions to add an agent to the sprayed water to reduce the surface tension of the water so it may form smaller droplets during spraying, thus increasing the sprayed surface area. Examples for such agents available on the market are Dustcon™ and Dustclean™ by NALCO Chemical Company, Naperville, Illinois, USA. Dustcon™ and Dustclean™ are so called dust binding agents on an organic lemon or citrus fruit basis and are both biodegradable and not harmful to the environment. In application in coal mines, the dust binding agent is mixed with the water being sprayed on the mined coal to reduce the generation of dust. The amount of required spray water may be remarkably reduced upon addition of the dust binding agent.

Summary of the Invention

[0005] The present invention provides a method and an apparatus for reducing dust during operation of a road working machine like a cold planer. In accordance with the method and the apparatus of the invention, the dust produced by the generation and transport of fragmented material in the road working machine is effectively trapped and removed from the air.

[0006] In one aspect of the invention, a method of reducing dust produced by a work machine which is adapted to fragment material from a working surface and includes at least one partially confined space in which said dust occurs, comprises providing a liquid capable of binding dust and spraying the liquid into said partially confined space. Preferably, the liquid includes a dust binding agent which is mixed with water.

[0007] The invention also provides a road working machine having a working device adapted to fragment a working surface. The road working machine comprises a water source connected to a pump which in turn is connected to at least one outlet, said water source including a dust binding agent, and said outlet being directed at said fragmented material from said working device.

[0008] According to another aspect of the invention, an apparatus for reducing dust is provided. The apparatus is adapted to be mounted on a road working machine having a working device adapted to fragment a working surface. The apparatus comprises a water source connected to a pump which in turn is connected to at least one outlet. The water source includes a dust binding agent and the outlet is adapted to be mounted to a portion of said working machine so as to be directed at said fragmented material from said working device.

Brief Description of the Drawings

[0009]

Fig. 1 shows a schematic side view of a road working machine;

Fig. 2a shows a schematic arrangement of parts of an embodiment of an apparatus for reducing dust in a road working machine in accordance with the invention;

Fig. 2b shows a detail of a part of the apparatus of Fig. 2a in a different view.

Fig. 3 shows another part of an apparatus for reducing dust in a road working machine.

Detailed Description of the preferred embodiments

[0010] Fig. 1 shows schematically a road working machine 1 in a side view. The road working machine 1 includes a machine frame 2 and traction supports 3 for supporting the machine frame 2 and moving it along the driving direction. A drivers seat 4 is located generally above a working device 5 supported at a central position on the machine frame 2 and schematically indicated by dashed lines.

[0011] The working device 5 is adapted to remove material from a working surface 6 and may be a milling drum equipped with grinding tools (not shown) which fragment the surface layer of the working surface 6 when they come in contact therewith. Around the work-

ing device 5, there is provided a housing 7 defining a working space 8 of the working device 5. Dust and other debris material generated during the removal of the surface material, i.e. the fragmentation of the working surface, is generally confined in the working space 8 by the housing 7.

[0012] During operation, the working device 5 gets hot and needs to be cooled. Cooling is typically achieved by spraying cooling water supplied from a water tank 9 carried by the working machine 1 onto the working device 5, e.g. the milling drum. To this end, a spraying means (not shown) is provided inside the housing 7 of the working device. Generally, this spraying means comprises nozzles which are adapted to generate a fan shaped cooling water jet which is directed onto the working device 5.

[0013] Conveyor means 10 in front of the working device 5 are provided to transport the fragmented material produced during operation of the working device 5 away from the working space 8 and to a collecting location, e. g. to a loading platform of a truck (not shown) driving in front of the working machine 1. The conveyor means 10 may consist of a lower conveyor belt 11 and an upper conveyor belt 12. As indicated in Fig. 1, the upper conveyor belt 12 may be moved or pivoted relative to the lower conveyor belt 11 in a vertical and horizontal direction so as to properly adjust the conveyor means 10 with regard to the collection location (not shown). Preferably, the upper conveyor 12 is also foldable so as to reduce its total length during transportation of the working machine 1.

[0014] The upper conveyor belt 12 may be also moved towards the lower conveyor belt 11 so as to properly load the transported material from the lower conveyor belt 11 onto the upper conveyor belt 12. Preferably, the conveyor means 10 are covered by a hood structure 13 on the upper conveyor belt 12 and a cover structure (not shown) connected to the machine frame 2 in the area of the lower conveyor belt 11. The hood structure 13 joins to the cover structure of the lower conveyor belt 11 when a lower end 14 of the upper conveyor belt 12 is moved towards an upper end 15 of the lower conveyor belt 11 and positioned above the same.

[0015] Figs. 2a and 2b show schematically a detail of the conveyor means 10 in the area of the upper end 15 of the lower conveyor belt 11 and the lower end 14 of the upper conveyor belt 12. The hood structure 13, the machine frame 2 and the cover structure of the lower conveyor belt 11 form a space 20 more or less confined to prevent the dust generated by the fragmented material from immediately escaping to the surrounding environment.

[0016] In a preferred embodiment, in the area of the partially confined space 20, a dust handling apparatus 30 is installed on the working machine 1 at the upper end 15 of the lower conveyor belt 11 and at the lower end 14 of the upper conveyor belt 12. The dust handling apparatus 30 includes a liquid supply system 32 and a plurality of outlets 141, 142. The liquid supply system 32 supplies a liquid under pressure to the outlets 141, 142.

[0017] The outlets 141, 142 are realized as nozzels mounted on wall structures around the conveyor belts 11, 12, whereby the wall structures may include side walls extending from the conveyor belts, parts of the cover structure of the lower conveyor belt 11, parts of the hood structure 13 of the upper conveyor belt 12, and/or parts of the machine frame 2. As indicated in Fig. 2a, the outlets 141, 142 direct the liquid onto the fragmented material conveyed on the lower and upper conveyor belts 11 and 12 preferably in the form of a widely dispersed spray, which is, more preferably, conically shaped. The liquid in the preferred embodiment includes water mixed with a dust binding agent, e.g. Dustcon™, in a predetermined mixture ratio.

[0018] The liquid supply system 32 comprises a plurality of hoses or tubings 201 to 210, 216, 219 and 220 forming a network including a first and a second distributor means 211 and 221, a plurality of couplings 315 to 318, and a plurality of T-connectors 314. The hoses 203 and 207 are connected to the first distributor means 211 receiving the water mixed with the dust binding agent as indicated by the arrow 212. The hose 203 distributes the liquid via couplings 316, 315 and T- connectors 314 to the hoses 201, 202 and 204 wherein in turn the hose 201 is connected to an upper one of the outlets 141, hose 202 is connected to a middle one of the outlets 141 and hose 204 is connected to a lower one of the outlets 141 in Fig. 2a. The outlets 141 direct the conically shaped spray of the water mixed with the dust binding agent onto the fragmented material transported on the lower conveyor belt 11.

[0019] The hoses 207 connect the first distributor 211 with the second distributor 221 to which they are coupled on a side surface of the second distributor 221 by couplings 318. On an opposite side surface of the second distributor 221 hoses 205, 216, 219, and 220 are coupled to the second distributor 221 via couplings 317 and T-connectors 314. The hoses 206 and 208 are coupled to the remaining side surfaces of the second distributor 221, and, as shown in Fig. 2b, the hoses 209 and 210 are coupled to a bottom surface of the second distributor 221 by respective couplings 317. The upper surface of the second distributor 221 is mounted to a part of the machine frame 2.

[0020] The hoses 205, 216 and the hoses 206, 209 direct the liquid to respective outlets 142 in the form of nozzles mounted on opposite sides of the lower conveyor belt 11. The hoses 208, 210 provide respective outlets 142 at the upper end 15 of the lower conveyor belt 11 with the liquid consisting of water mixed with the dust binding agent, and the hoses 219, 220 supply this mixture to respective outlets 142 mounted in the area of the lower end 14 of the upper conveyor belt 12. Thus, the water mixed with the dust binding agent is sprayed onto the fragmented material in the area where it is dis-

charged from the lower conveyor belt 11 onto the upper conveyor belt 12, whereby the outlets or nozzles 142 form a conically shaped sprayed mist of fine water droplets which act to trap the dust particles generated by the fragmented material.

[0021] Fig. 3 shows an embodiment of a part of the supply system 32 (also called water source) which provides the water mixed with the dust binding agent pressurized to the first distributor 211 in Fig. 2a. In this embodiment, the water is directly mixed with the dust binding agent, and this mixture is stored in the water tank 9 of Fig. 1.

[0022] The water tank 9 is provided with an outlet port (not shown) which is connected via a shut off tap or valve 426 and a supply line 423 to a filter 422. The filter 423 in turn is connected via another line 428 to a pump 438. The pump 438 pressurizes the liquid received on line 428. An outlet (not shown) of the pump 438 is connected via line 437 with the first distributor 211, as indicated by the arrow 212.

[0023] The pump 438 is hydraulically driven and to this end the pump 438 is supplied with hydraulic fluid via hydraulic lines 439. The pump 438 is cooled by the liquid being passed therethrough and a bypass line 440 directs the liquid back to the tank 9 in case it is disconnected or shut off from the first distributor 211.

[0024] As mentioned above, also the spraying system provided in the housing 7 around the working device 5 (see Fig. 1) for cooling the working device 5 is connected to the water tank 9 containing the mixture of water and dust binding agent. Thus, in this embodiment, the cooling water sprayed onto the working device 5 has also an improved dust capture capability and helps to reduce the amount of dust generated in the working space 8.

[0025] In a different embodiment, the water and the liquid dust binding agent are stored at separated storing locations, i.e. the water is stored in the tank 9 and the dust binding agent is stored in a dust agent container (not shown). The dust binding agent container is provided with an outlet which is connected to a liquid supply line coming from the water tank 9. This connection can be made wherever convenient, either just after the filter, or just before the pump 438 or even after the pump 438. Preferably, the dust binding agent is fed into the liquid supply line by a metering device (not shown) to control the amount of dust binding agent mixed in the water supplied on the supply line. This arrangement helps to better control the consumption of the dust binding agent and to apply it only to selected locations, e.g., the area where the outlets 141 and 142 of dust handling apparatus 30 are mounted on the working machine 1.

[0026] It is to be understood that also the housing 7 of the working device 5 may be equipped with nozzles connected to the supply system for the water and dust binding agent mixture and capable of generating a widely dispersed spray of the liquid to more effectively trap the dust generated by the fragmentation of material by the working device 5 directly in the working space 8.

Industrial applicability

[0027] In operation of the working machine 1, the material of the working surface 6 is fragmented by the working device 5 and is accompanied by the generation of a high amount of dust particles and smoke. This dust and smoke which is more or less contained in the housing 7 around the working device 5 moves up the lower conveyor belt 11. In case no preventive measure is taken, the dust may just escape to the environment surrounding the working machine 1.

[0028] The liquid mixture of water and dust binding agent sprayed onto the fragmented material has a high capability of entrapping dust particles generated by the fragmented material which in turn is produced by the milling operation of the working device 5 on the working surface 6. In the preferred embodiments described above, the occurence of dust is significantly reduced either in the working space 8, or in the area of the lower conveyor belt 11 where the fragmented material is loaded on the upper conveyor belt 12, or at both locations.

[0029] The widely dispersed spray pattern, which is in the preferred embodiment a conically shaped spray, helps to increase the sprayed area and to generate a fine mist of droplets of the dust binding agent mixture.

[0030] Thus, eventually the dust emerging from the working machine 1, especially at the discharge end of the conveyor means 10, is remarkably reduced and is less of a problem for the operators working on and around the machine 1. The dust binding agent used is preferably biodegradable and environmentally not harmful and thus does not generate any problems in this respect.

[0031] It has to be mentioned, that in accordance with the invention an improvement of the dust handling is achieved by, generally speaking, spraying the water and dust binding agent mixture upon as large a percentage of the generated dust as possible or practical. This is best realized by spraying the mixture onto the fragmented material at a location where the dust can not easily escape to the surrounding environment. In this respect, the meaning of confined space is to be understood as an at least parially confined space or a space in which the dust is channeled. Also, the exact choice of where the outlets or spray heads are located and how many are utilized depends on the particular configuration of the working machine which might vary from case to case and is not necessarily limited to the configuration of the working machine 1 of Fig. 1.

[0032] Further, the exisiting spray system for cooling the working device 5 may be also used to spray the water and dust binding agent mixture into the working space 8. In this case, and for an improved dust handling, it is sufficient to simply add the dust binding agent to the water tank 9 of the working machine 1.

[0033] It is clear, that upon reading the foregoing specification, many alternatives, modifications and changes may be realized by the man skilled in the art.

Therefore, the scope of the present invention is not intended to be limited by the embodiments described above in somewhat detail, but it is to be defined by the appended claims and the equivalents thereof.

Claims

1. Method of reducing dust produced by a working machine (1) adapted to fragment material from a working surface (6), said work machine including at least one partially confined space (8; 20) in which said dust occurs, said method includes:

   providing a liquid capable of binding dust, and spraying said liquid into said partially confined space.

2. Method of claim 1, wherein said liquid includes a dust binding agent,
   wherein preferably said dust binding agent is mixed with water; and/or
   wherein said dust binding agent is based on an organic citrus ingredient; and/or
   wherein said dust binding agent is biodegradable; and/or
   wherein said dust binding agent lowers the surface tension of water.

3. Method of claim 2, wherein said water is supplied from a water tank (9) along supply means (30) and said dust binding agent is controllably added to said water at a selected location of said supply means (30); and/or
   said water is preliminary mixed with said dust binding agent, wherein the water and dust binding agent mixture is supplied from a water tank (9) on the working machine; and/or
   wherein preferably said liquid is sprayed in a widely dispersed spray pattern into said partially confined space (8; 20).

4. Method of one of the preceding claims, wherein said partially confined space includes a space (20) above a conveyor means (10) adapted to convey the removed material to a collection location; and/or
   wherein said working machine (1) includes a working device (5) adapted to fragment said working surface (6), and
   wherein preferably said partially confined space includes a working space (8) around said working device (5).

5. A road working machine (1) having a working device (5) adapted to fragment a working surface (6) comprising a water source (9; 30) connected to a pump (438) connected to at least one outlet (141, 142), said water source including a dust binding agent, and said outlet (141, 142) being directed at said fragmented material from said working device (5).

6. Machine (1) of claim 5, wherein said water source includes a water tank (9) and a supply means (30) adapted to connect said water tank (9) and said outlet (141, 142); and wherein said water source further includes a dust binding agent supply means connected to said supply means (30) and adapted to mix a dust binding agent into the water supplied by said supply means (30) from said water tank (9); wherein preferably said dust binding agent supply means includes a metering device adapted to control the amount of said dust binding agent being mixed into the water.

7. Machine (1) of claim 5, wherein said water source includes a tank (9) and a supply means (30) adapted to connect said tank (9) and said outlet (141, 142), said tank (9) containing water mixed with said dust binding agent.

8. Machine (1) of one of the claims 5 to 7, wherein said dust binding agent is based on an organic citrus ingredient; and/or
   wherein said dust binding agent is biodegradable; and/or
   wherein said dust binding agent lowers the surface tension of water.

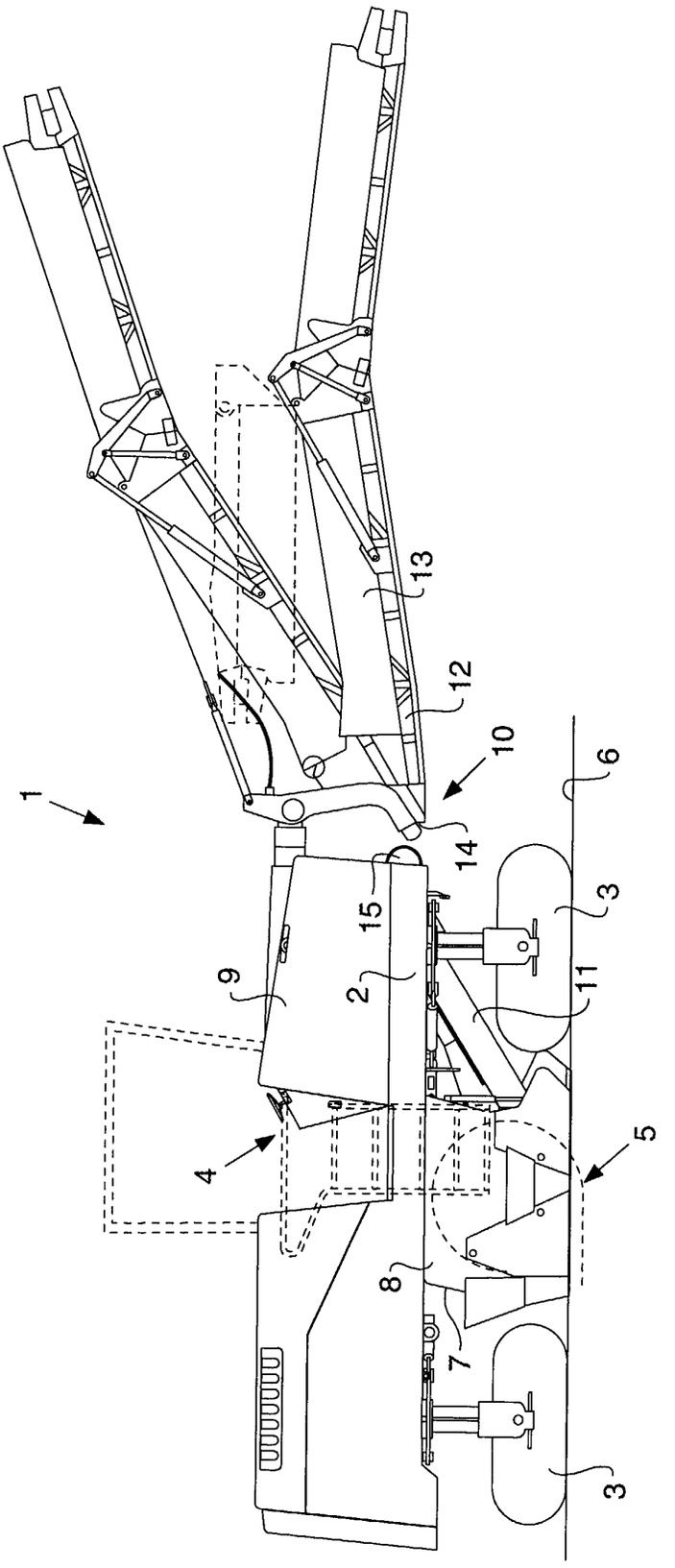
9. Machine (1) of one of the claims 5 to 8, wherein said outlet (141, 142) is directed into a partially confined space (20) of said working machine containing said fragmented material;
   and
   wherein preferably said partially confined space includes a space (20) above a conveyor means adapted to convey the fragmented material to a collection location; and/or
   wherein said partially confined space includes a work space (8) around said working device (5); and/or
   wherein preferably said outlet (141, 142) includes at least a nozzle adapted to generate a widely dispersed spray of said water mixed with said dust binding agent and directed onto said fragmented material.

10. An apparatus for reducing dust, said apparatus (30) being adapted to be mounted on a road working machine (1) having a working device (5) adapted to fragment a working surface (6), said apparatus comprising a water source connected to a pump (438) connected to at least one outlet, said water source including a dust binding agent and said outlet being adapted to be mounted to a portion of said working machine so as to be directed at said fragmented material from said working device.

11. Apparatus (30) of claim 10, wherein said water source includes a water tank (9) and a supply means (32) adapted to connect said water tank (9) and said outlet (141, 142); and wherein said water source further includes a dust binding agent supply means connected to said supply means (32) and adapted to mix said dust binding agent into the water supplied by said supply means from said water tank (9); wherein preferably said dust binding agent supply means includes a metering device adapted to control the amount of said dust binding agent being mixed into the water.

12. Apparatus (30) of claim 10, wherein said water source includes a supply means (32) adapted to connect a tank (9) provided on said road working machine (1) and said outlet (141, 142); said tank (9) containing water mixed with said dust binding agent.

Fig. 1



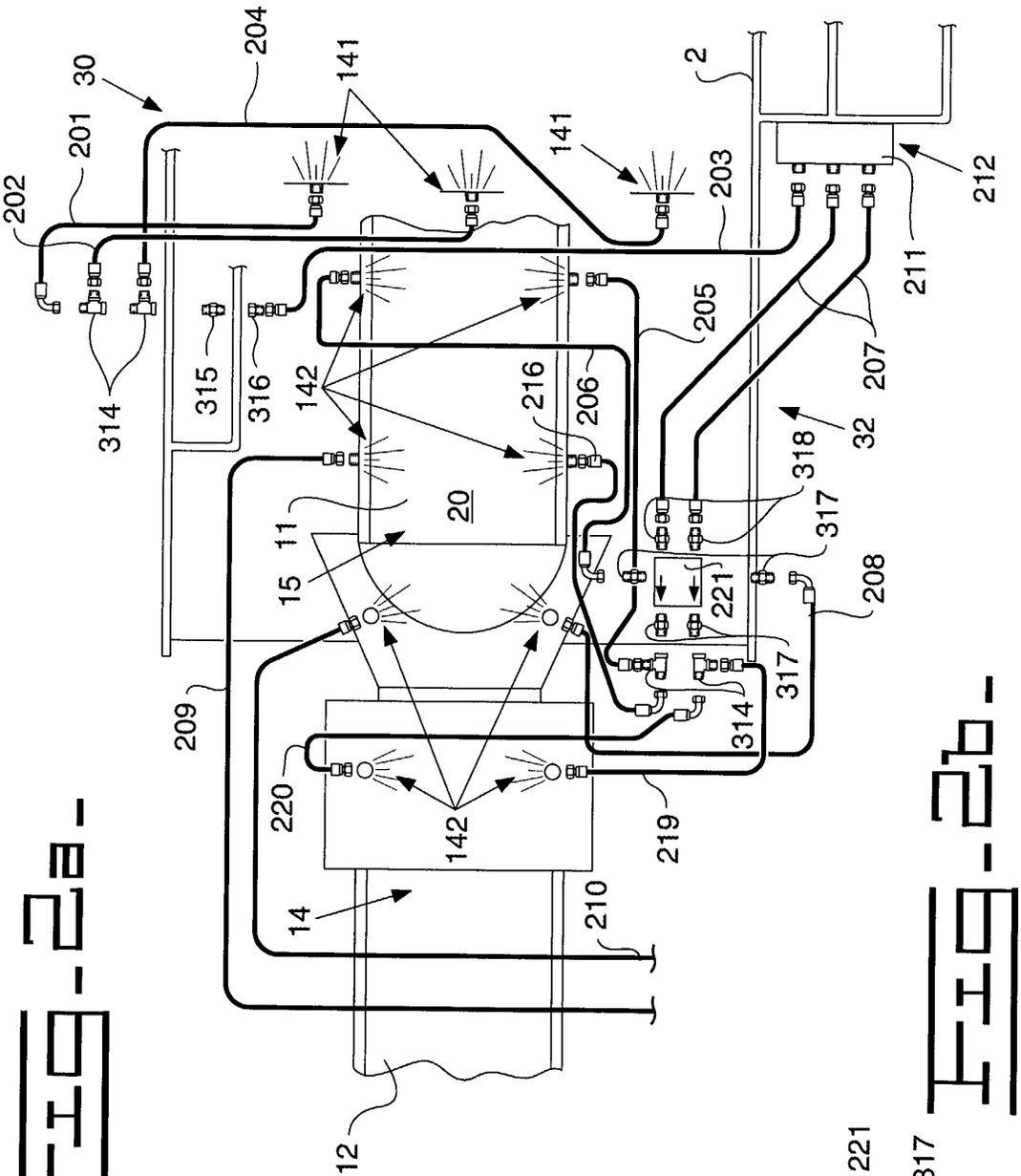

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Fig-2a-

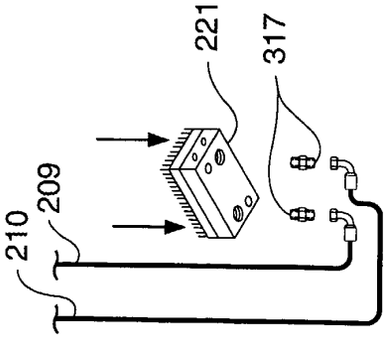
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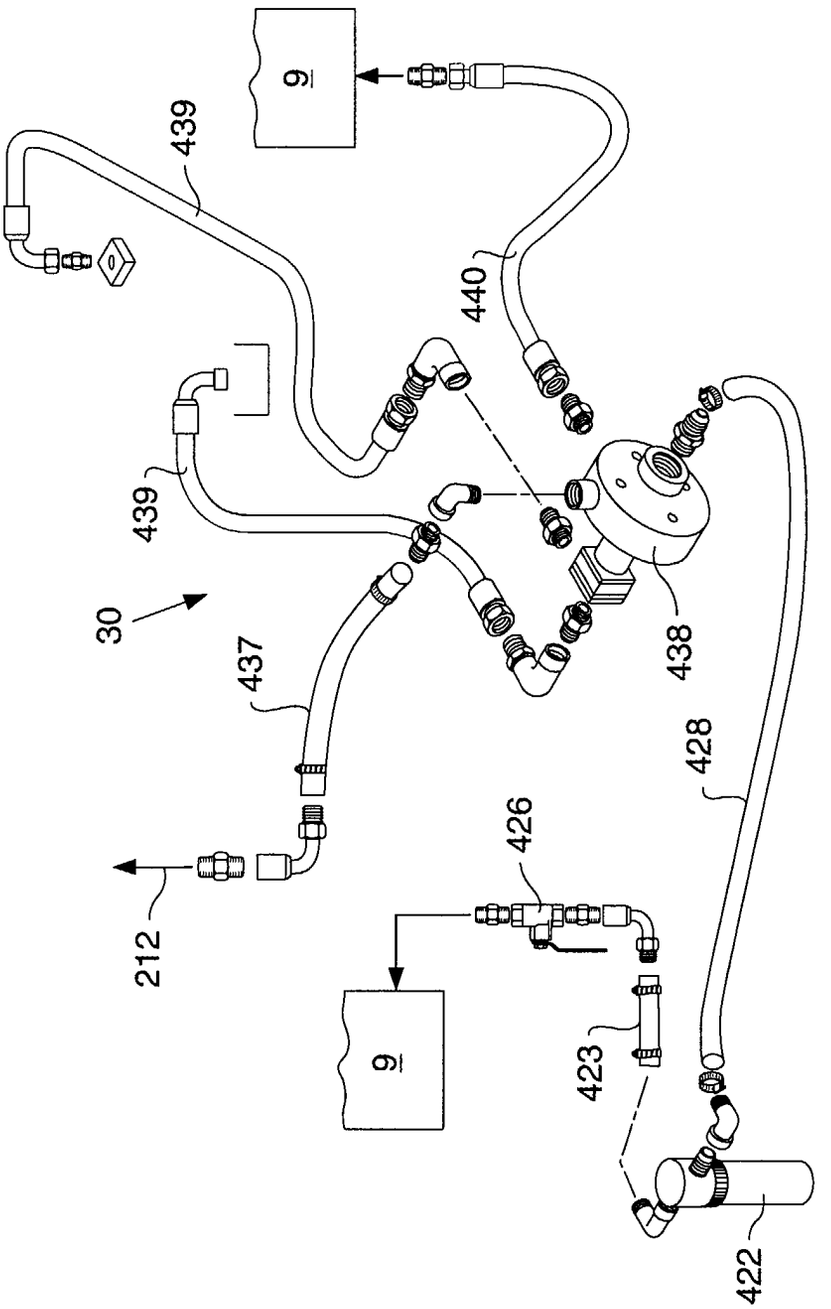
Fig-2b-

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 1273

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	US 4 325 580 A (SWISHER JR GEORGE W ET AL) 20 April 1982 (1982-04-20) * column 24, line 61 - column 26, line 25; figures 1-3,7,10 *	1,4,5, 7-10,12 2,3,6,11	E01C23/088 E21C35/22
Y	US 6 124 366 A (PULLEN CAROL ET AL) 26 September 2000 (2000-09-26) * column 4, line 1 - line 15 * * column 5, line 59 - column 6, line 8 *	2,3,6,11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E01C E21C C09K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 October 2002	Movadat, R

CATEGORY OF CITED DOCUMENTS

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23-10-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4325580 A	20-04-1982	NONE	
US 6124366 A	26-09-2000	AU 715910 B2	10-02-2000
		AU 3649997 A	21-01-1998
		BR 9710070 A	11-01-2000
		WO 9800472 A1	08-01-1998

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