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(54) Device for cleaning runways.

(57) Tire marks on airport runways can form an impenetrable layer which prevents water from draining away when there is heavy rain. To remove this rubber deposit a device is employed comprising one or more nozzles which are connected by means of a pipe to a source for pressurized water, a circulation system which is movable with the nozzles and which is at least provided with a water tank (30), a pump unit (32) connected thereto for raising the water to very high pressure, a hood (5) with suction line (8) fitted round the nozzles, filter means for removing solids from the water extracted from the hood, and a return pipe to the tank (30). In order to get a very effective removing of almost all particles from the water the device is fitted with a cyclone (9) for the extraction of air, a filter (15) for coarse lumps connected to the cyclone, at least one bag-type filter (22, 23) for particles larger than 3 μm and an activated carbon filter (28) for small particles.

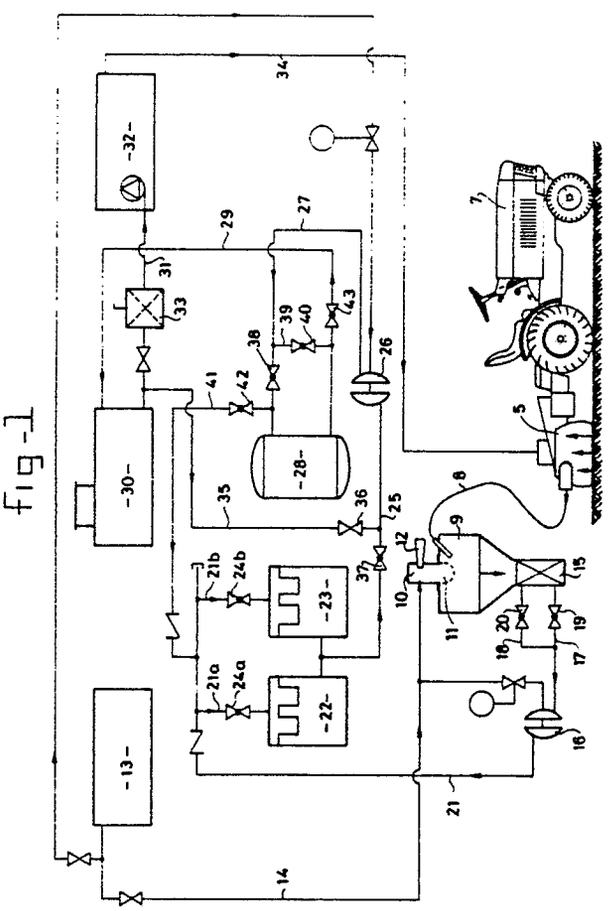

Fig.1

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Device for cleaning runways

The invention relates to a device for cleaning a flat surface with powerful water jets, in particular for removing rubber from runwas, comprising one or more nozzles which are connected by means of a pipe to a source for pressurized water, a circulation system which is movable with the nozzles, said systems being at least provided with a water tank, a pump unit connected thereto for raising the water to high pressure, a hood with suction line fitted around the nozzles, filter means for removing solids from the water extracted from the hood, and a return pipe to the tank.

Such a device is know from DE-B-2,617,635.

It is known that tyre marks on airport runways can form an impenetrable layer which prevents water from draining away when there is heavy rain. There is then a risk of aircraft aquaplaning on landing or take-off. Various methods of removing the rubber layer are know. Using chemicals to dissolve the rubber and water jets to flush the runway clean has the disadvantages that the tyres of aircraft travelling on the runway run the risk of being attacked and the environment is adversely affected. Besides, this method is time-consuming. The runway in question has to be shut down for two days.

Another known method is to remove the rubber deposit using powerful water jets which are directed at the runway from nozzles at a distance of about 60 cm. The pressure used is, for example, about 400 bars and water consumption is 70 to 100 litres of water per minute. The water polluted with rubber particles goes into the environment, so that this method also is harmful to the environment. Other disadvantages are that water consumption is high and control is so imperfect that there is a great risk of the asphalt surface being damaged.

The device disclosed in DE-B-2,617,635 aims to prevent such pollution by removing solids from the water. however, the filtering is not sufficiently effective and therefore there is a risk of clogging of the filter and the risk of solid particles being introduced into the tank.

The object of the invention is to avoid these risks and therefore the device is fitted with a cyclone for the extraction of air, a filter for coarse lumps connected to the cyclone, at least one bag-type filter for particles larger than 3 µm and an activated carbon filter for small particles.

Preferably a very high water pressure is used which means a pressure of the order of 1,800 to 2,400 bars. Less than 25 litres per minute is sprayed onto the runway. The recirculation means that the rubber passes into filters and quite a considerable quantity of the water sprayed onto the runway is returned to the tank. The water consumption is therefore only about one quarter of the water consumption with the water jet method without recirculation. Since most of the water is removed from the runway, the latter is always available for emergency landings. The tank can be made relatively small and can be carried on a vehicle with the nozzles.

The vacuum required to take the polluted water from the nozzle hood to the cyclone and to separate off and remove the air inside the cyclone could be created by a vacuum pump. It is, however, simpler for a cabinet to be placed on the cyclone connected to the inside thereof and having one or more venturi fittings which are connected to an air compressor.

A diaphragm pump is preferably provided in the liquid line between the cyclone and the filter bag and in the liquid line between the filter bag and the activated carbon filter.

The activated carbon filter has to be cleaned periodically by flushing back. For this purpose, a liquid connection is provided both between the tank and the liquid discharge side of the activated carbon filter and between the liquid infeed side of said filter and the bag-type filter, switchable valves being present in the system to take tank water to the side of the activated carbon filter which is normally the discharge side, for periodic flushing of the activated carbon filter, and for taking flushing water from the normal infeed side of the activated carbon filter to the bag-type filter.

In order to achieve the very high water pressure (about 2,200 bars) which is necessary for the process, the highpressure pump is designed as an intensifier provided with a hydraulically driven plunger system which converts relatively low pressure and high delivery into very high pressure and low delivery.

A high suction output as regards the water in the nozzle hood is achieved if the suction hose opens out tangentially into the hood fitted round the nozzles.

Normally, a number of nozzles will be disposed on a rotary vertical shaft.

The highpressure pump (intensifier) must be protected from solids being washed out of the tank. A duplex filter is therefore provided in the connection between the water tank and the highpressure pump.

The bagtype filters have to be replaced periodically, and in order to do this without interrupting the working of the device, at least two bag-type filters are disposed in parallel, and valves are

present in the pipes to said filters.

The invention will now be explained in greater detail with reference to the figures, in which an embodiment is shown.

Fig. 1 shows a schematic view of the device according to the invention.

Figs. 2, 3 and 4 show a side view, a top view and a cross section respectively of the hood in which the jet nozzles are disposed.

The device shown is intended for cleaning flat surfaces. Its particular object is to remove rubber deposits caused by aircraft tyres on airport runways. Use is made of powerful water jets which are directed towards the ground at a distance of about 15 cm from the ground. The two nozzles are indicated by 1 in Fig. 4. They are each disposed on the end of a pipe 2 which is connectecd to a central hollow shaft 3, which can be rotated by means of a drive mechanism 4. The nozzles are located in a round hood 5 into which a suction line 6 opens tangentially.

The hood 5 with nozzles is disposed on a vehicle 7. Fig. 1 shows schematically the whole device with the pressure generator, filters and recirculation systems. This device is placed on a vehicle which can also carry the hood 5 with nozzles.

This is not necessary, in other words the filter and recirculation system can be placed on a separate vehicle which follows the vehicle 7 on which the hood 5 is mounted.

This suction line 6 of the hood 5 is connected to a suction hose 8 which leads to a cyclone 9. Provision is made on the cyclone for a cabinet 10 which is connected by of a basket 11 to the inside of the cyclone, and to which a number of venturi fittings 12 are connected.

Compressed air produced by a compressor 13 can be conveyed through line 14 to the cabinet 10 opposite the venturi fittings 12, vacuum being created in the top part of the cyclone. The purpose of this vacuum is to carry the soiled water through the hose 78 to the cyclone and in conjunction with the functioning of the cyclone to separate off the soiled water.

On the bottom of the cyclone is a filter 15 for separating off relatively coarse fragments from the deaerated soiled water. A diaphragm pump 16 is connected by means of a line 17 to the discharge side and by means of a line 18 to the inlet side of the filter 15.

A ball valve 19, 20 is provided in each of the lines 17, 18.

The diaphragm pump 16 is connectecd to bag-type filters 22 and 23 by means of line 21 and two branches 21a and 21b. A valve 24a, 24b is fitted in each of the branches.

The soiled water coming from the cyclone is pumped by the pump 16 to one of the bag-type filters 22, 23, in which particles larger than 3 μm are recovered.

A line 25 connects the discharge side of the bag-type filters to a diaphragm pump 26, which is connected by means of line 27 to a sand activated carbon filter 28. The discharge side of said filter is connected by means of a line 29 to a water tank 30.

The fine particles are removed in the filter 28 from the water from which the coarse material has been removed, and the cleansed water flows back into the tank 30. From this tank water flows through pipe 31 to a hydraulically driven variable displacement pump 32 (intensifier) for the generation of ultrahigh pressure (for example, 2,200 bars), while a duplex filter 33 is placed in the line 31. By means of a plunger system in this pump, oil displacement at relatively low pressure and relatively high delivery is converted into water displacement at relatively high pressure and relatively low delivery. Such an intensifier is known and is marketed, inter alia, under the named JETPAC. The intensifier pump is connected by means of line 34 to the nozzle hood 5.

By means of the recirculation system in which a substantial part of the water sprayed onto the runway or other surface is recirculated to the tank 30, daily water consumption can be limited to 4 to 5 m^3. With known flushing systems it is 20 to 25 m^3. A very considerable part of the rubber removed goes into the filters 15, 22 or 23 and 28, so that there is little or no adverse effect on the environment.

It is extremely important that flushing can be controlled through the ultrahigh pressure and the height setting of the hood 5 above the surface in such a way that there is little or no damage to the asphalt. The quantity of water sprayed on the asphalt is about 24.5 litres per minute. Since the water sprayed onto the runway is removed, the runway is always available for emergency landings.

The recycling ensures that the tank 30 can be relatively small, and is thus transportable on a vehicle.

The sand activated carbon filter has to be flushed clean from time to time. For this purpose, provision is made between the tank 30 and a branch point of the line 25 for a line 35, in which a valve 36 is placed. The flushing system also needs a valve 37 in the line 25, a valve 38 in the line 27, a line 39 connecting the lines 27 and 29 to valve 40, and a line 41 connecting lines 27 and 21 to valve 42, a valve 43 in the line 29, and a valve 42 in the line 27. Through closing of the valves 37, 38, 43 and opening of the valves 36, 40 and 42, the filter 28 can be flushed back, water being conveyed to a bag-type filter 22 or 23.

In normal operation one of the bag-type filters is always in use. Through opertion of the valves 24a, 24b, it is possible to switch over from one bag-type filter to the other, and the used filter can be replaced without the work having to be interrupted.

Various modifications are possible within the scope of the invention. The system described is very kind to the environment, uses little water, and does little or no damage to the surface. The runway is always available for emergency landings. The whole system is mobile.

Claims

1. Device for cleaning a flat surface with powerful water jets, in particular for removing rubber from runways, comprising one or more nozzles (1) which are connected by means of a pipe to a source for pressurized water, a circulation system which is movable with the nozzles, said system being at least provided with a water tank (30), a pump unit (32) connected thereto for raising the water to high pressure, a hood (5) with suction line (8) fitted around the nozzles, filter means for removing solids from the water extracted from the hood (5), and a return pipe to the tank (30), characterized in that the device is fitted with a cyclone (9) for the extraction of air, a filter (15) for coarse lumps connected to the cyclone, at least one bag-type filter (22, 23) for particles larger than 3 µm and an activated carbon filter (28) for small particles.

2. Device according to Claim 1, characterized in that a cabinet (10) is placed on the cyclone (9), connected to the inside thereof and having one or more venturi fittings (12) which are connected to an air compressor (13).

3. Device according to Claim 1 or 2, characterized in that a diaphragm pump (16 resp. 26) is provided in the liquid line (21a, 21b) between the cyclone (12) and the bag-type filter (22, 23) and in the liquid line (25, 27) between the bag-type filter (22, 23) and the activated carbon filter (28).

4. Device according to one of the preceding claims, characterized in that a liquid connection (29 resp. 35) is provided both between the tank (30) and the liquid discharge side of the activated carbon filter (28) and between the liquid infeed side of said filter (28) and the bag-type filter (22, 23) and switchable valves (36, 37, 38, 40, 42, 43) are present in the system to take tank water to the side of the activated carbon filter (28) which is normally the discharge side, for periodic flushing of the activated carbon filter, and for taking flushing water from the normal infeed side of the activated carbon filter to the bag-type filter (22, 23).

5. Device according to one of the preceding claims, characterized in that the high-pressure pump (23) is an intensifier provided with a hydraulically driven plunger system which converts relatively low pressure and high delivery into relatively high pressure and low delivery.

6. Device according to one of the preceding claims, characterized in that the suction hose (8) opens out tangentially into the hood fitted round the nozzles (1).

7. Device according to one of the preceding claims, characterized in that a number of nozzles (1) are provided on a rotary vertical hollow shaft (3).

8. Device according to one of the preceding claims, characterized in that a duplex filter (33) is fitted in the connection between the water tank (30) and the highpressure pump (32).

9. Device according to one of Claims 1 to 8, characterized in that at least two bag-type filters (22, 23) are disposed in parallel and valves (242a, 24b) are present in the pipes to said filters.

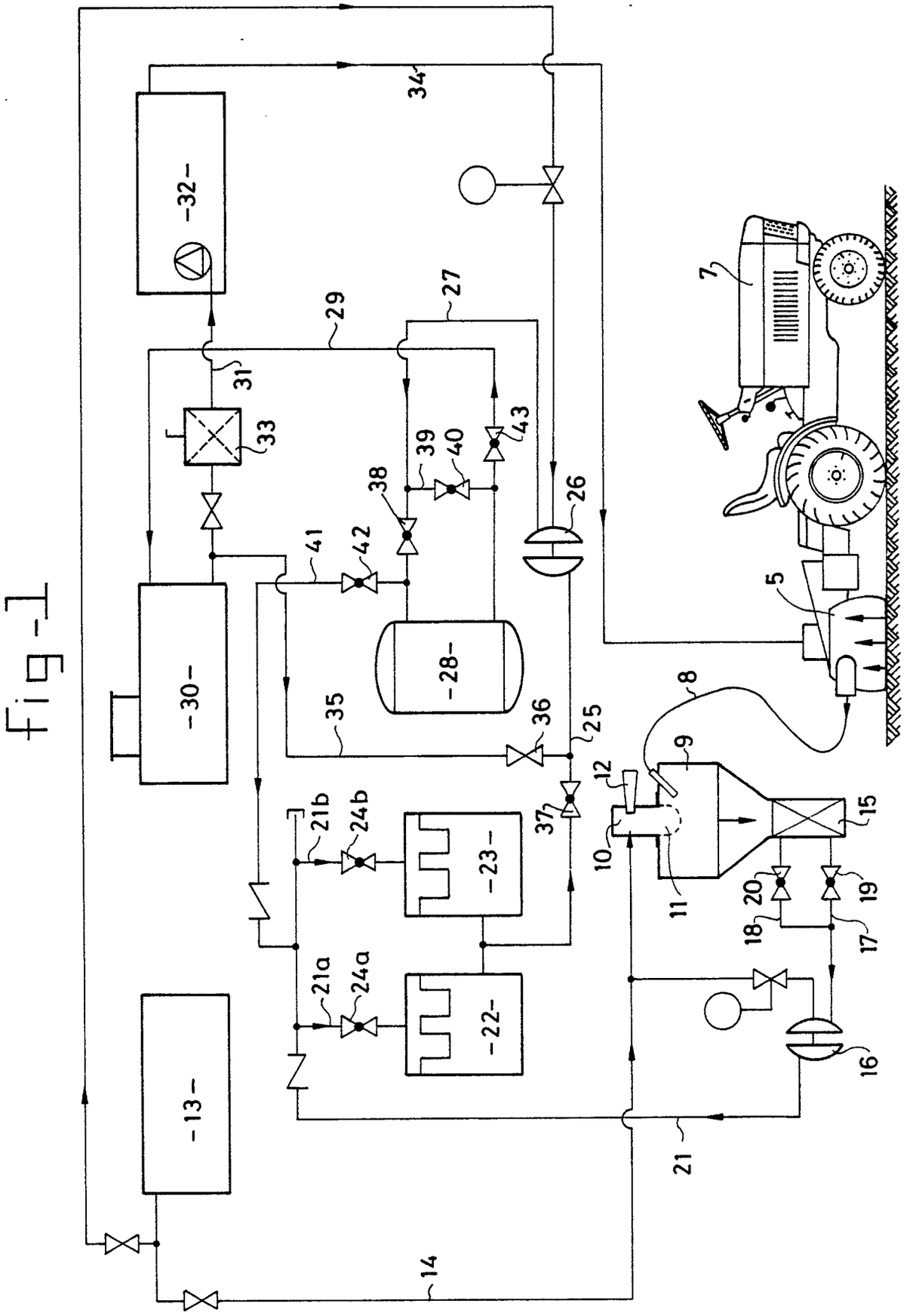
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fig-1

Fig-2

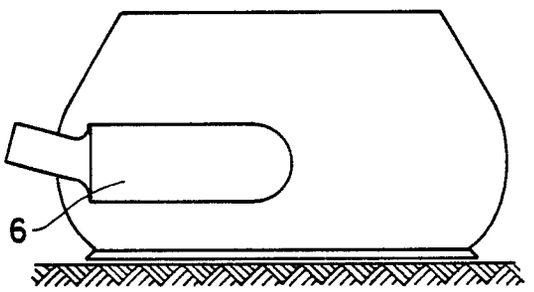


Fig-3

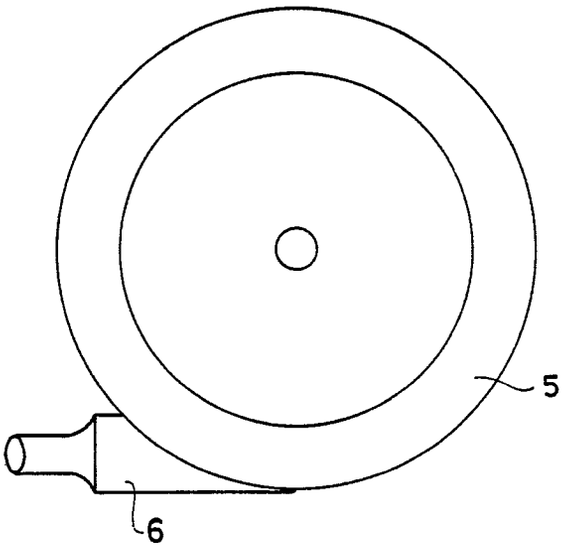
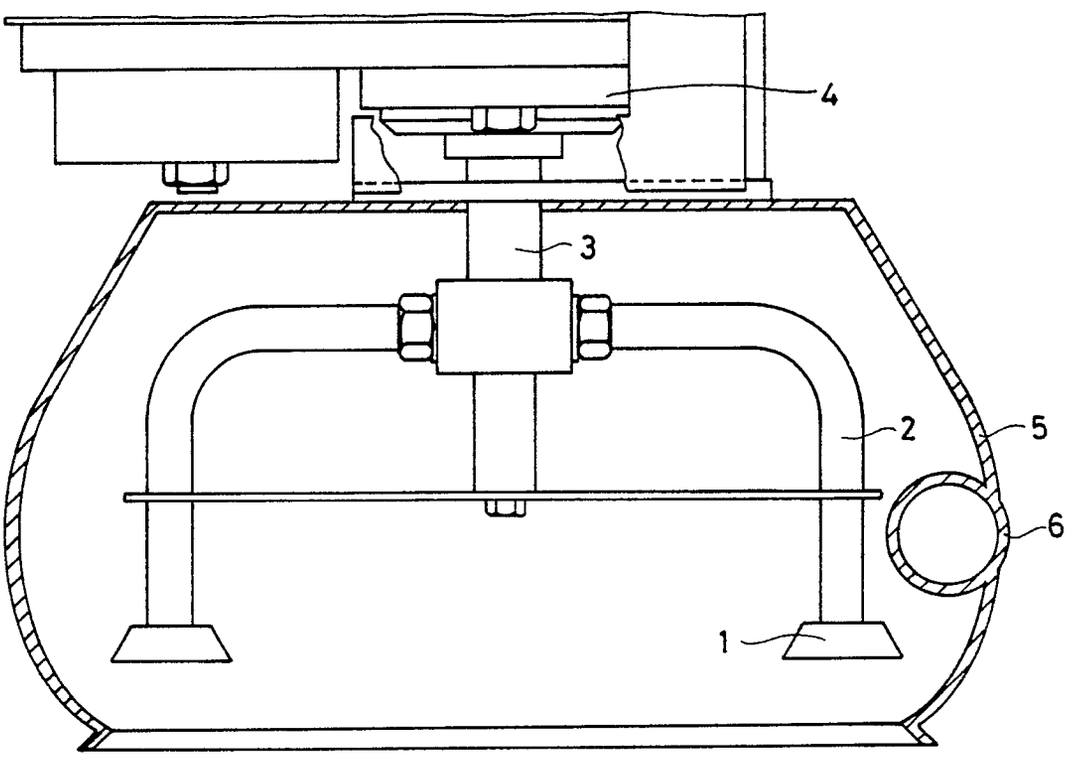


Fig-4



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EUROPEAN SEARCH REPORT

Application Number

EP 88 20 2385

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.4)
A	DE-B-2 617 635 (WOMA APPARATEBAU WOLFGANG MAASBERG & CO. GmbH) * Whole document *	1	E 01 H 1/10
A	FR-A-2 515 536 (PINAY) * Whole document *	1,7	
A	US-A-3 959 010 (THOMPSON) * Column 3, lines 28-36 *	1	
A	EP-A-0 121 511 (NOLTE) * Page 10, lines 9-27; figure 7 *	1,2	
A	US-A-3 848 804 (PRESTWICH) * Whole document *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 01 H
A 47 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-02-1989	DIJKSTRA G.

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