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

(11) EP 0 690 456 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.01.1996 Bulletin 1996/01

(51) Int Cl.[6]: **G21F 9/02**, G21F 9/06, G21F 9/34

(21) Application number: **95850124.9**

(22) Date of filing: **30.06.1995**

(84) Designated Contracting States:
BE CH DE ES FR LI NL SE

(30) Priority: **01.07.1994 SE 9402336**

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(54) Method and apparatus for the treatment of aerosols

(57) In a method and an apparatus for treatment of aerosols arising during the treatment of materials where liquid is to be found, and in a separator included in the treatment process, whereby a reduced pressure is arranged in said separator to prevent the release of contaminants from the separator, the reduced pressure is arranged by a fluid being pumped out of the separator, a water suction device is driven by the pumped out fluid, and aerosols as well as any of the surrounding atmosphere which may have leaked in are sucked out of the separator by means of said water suction device, whereby the aerosols are taken up in the liquid.

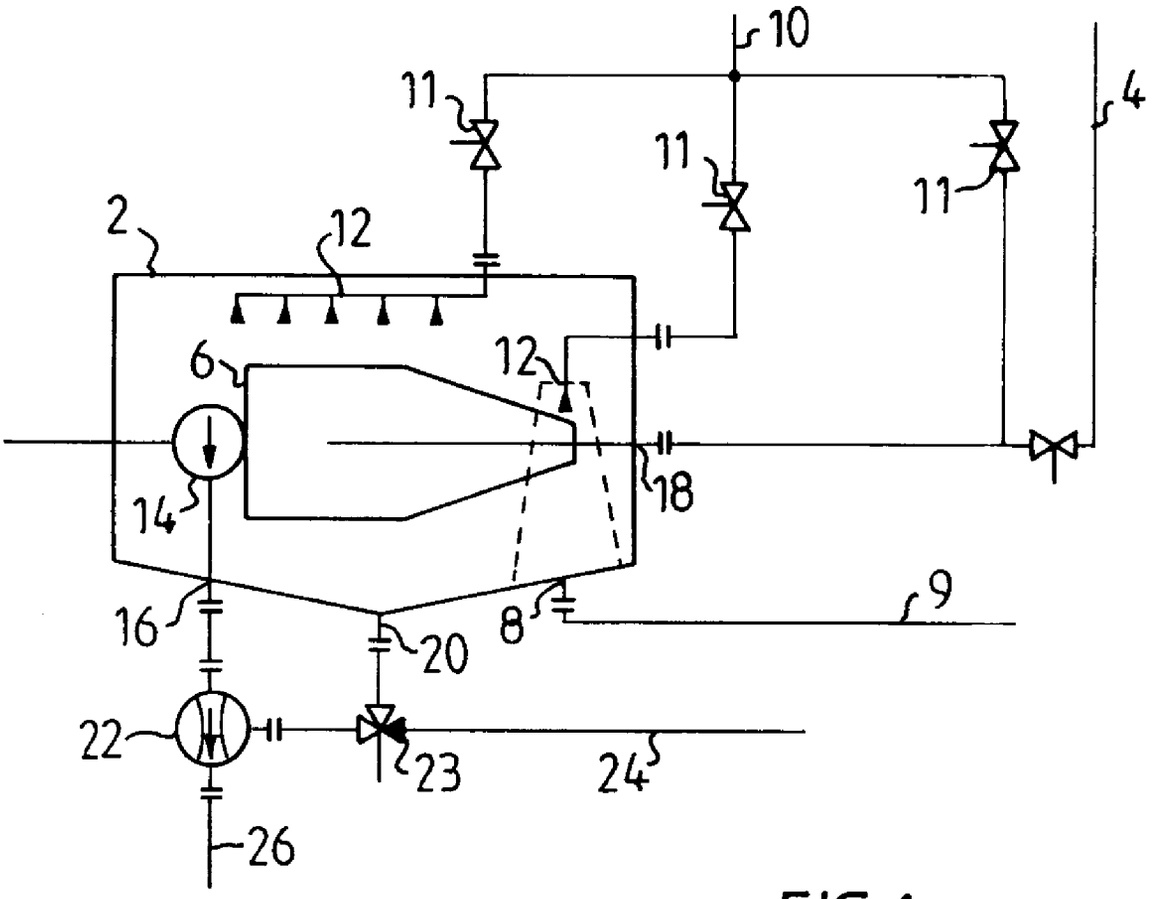

FIG.1

CORRIGENDUM issued on 14.02.96

EP 0 690 456 A1

Description

The present invention concerns a method and an apparatus for the treatment of aerosols, especially aerosols generated during treatment of liquid suspensions or liquid solutions in, for example, a nuclear power station.

Background to the invention

During treatment of radioactive waste in suspension in water or as a water solution in a waste disposal plant, certain processes generate aerosols which can contain varying amounts of radioactive products. In waste disposal plants in nuclear power stations, the waste water can come from different processes, for example in the form of system drainage, cleaning water, floor drain drainage, and chemical drainage. Especially in a number of nuclear power stations there occurs a large amount of radioactive filtering substances in water suspension, which before final storage are treated in a special drying process. The process may include many different machines, for example pumps, separators, centrifuges, etc. which because of their construction and function generate larger or smaller amounts of aerosols. From a safety and environmental point of view it is important to prevent the aerosols leaving the process unchecked.

According to prior art certain of such machines can be constructed hermetically sealed. With some types of machines it is however impossible to achieve complete sealing with respect to the surroundings, for example with machines with rotating shafts there is typically shaft seal leakage or other seal leakage. In that case, a reduced pressure is instead arranged in the machine. According to the state of the art the casing of the machine is for this reason connected to a ventilation system with fans which suck out through a filter any air which may have leaked into the machine. The leaks in the machine as a consequence of its construction entail in this case a leakage of air in from the surroundings, and the process atmosphere is prevented from leaking out to the surroundings. A disadvantage with this method is that the filter accumulates aerosols and becomes more and more radioactive. This requires the installation of radiation shields and in general makes the handling and disposal of the filter considerably more difficult.

It is an object of the present invention to accomplish the evacuation of aerosols from machines, which are not gastight, for the treatment of materials where aerosols and liquids occur, in such a manner that the spread of the aerosols to the surroundings and the treatment of such aerosols can be eliminated. It is also an object to eliminate the necessity for filters during the evacuation of the aerosols. A comprehensive object is accordingly to convert aerosols which arise into a solution or suspension in a liquid.

The above mentioned and other objects and advantages are achieved according to the invention by a method of the type mentioned, which shows the characteristic features which are mentioned in the characterising part of claim 1 together with an apparatus according to claim 5.

Summary of the invention

The method according to the invention accordingly concerns the treatment of aerosols occurring during the treatment of materials where liquid is to be found, in a machine included in the treatment process. A reduced pressure is arranged in said machine so that in the case of a possible leakage the surrounding atmosphere can leak into the machine. The method is characterised in that a reduced pressure is arranged through liquid being pumped out of the machine, that a liquid suction device is driven by the pumped out liquid, that aerosols and surrounding atmosphere that may possibly have leaked in are sucked out of the machine by means of said liquid suction device, whereby the aerosols are taken up in said liquid.

Said treatment process can especially be included in the treatment of waste in a waste disposal plant at a nuclear power station in which a large amount of waste can be a suspension of water and radioactive filtered substances. During treatment of the radioactive suspensions radioactive aeosols arise in said machine.

Before the machine is taken out of service it is flushed with pure liquid. During the flushing, process atmosphere is sucked out of the machine until any possible aerosols which could be a danger to the surroundings have been removed. Subsequently extraction is effected by means of a per se known ventilation system and then the machine is taken out of service.

The apparatus, according to the invention for the treatment of aerosols occurring during the treatment of materials where a liquid is present, is applied to a machine which is included in a treatment process. A reduced pressure is arrangable in the device so that in the case of a leak the surrounding atmosphere is able to leak into the device. The apparatus is characterised in that a liquid pump is arranged for pumping out liquid from the said machine. The liquid pump is coupled as a power source to a liquid suction device, so that the liquid suction device's driving pressure is able to be produced by means of the liquid pumped out of the machine. The machine is also coupled to the liquid suction device's suction inlet so that the reduced pressure in the machine is achieved by means of the liquid suction device. Both surrounding atmosphere which may have leaked into the machine and aerosols produced during the treatment are introducable into the liquid suction device for mixing with liquid, so that said aerosols are able to be taken up in the liquid.

In a preferred embodiment of the invention said liquid pump is included in the process machine. Said machine can be a separator, for example a decanting centrifuge, for separating radioactive filter substances which

are suspended in water.

The invention will now be described in more detail with the help of a working example and with reference to the figures. In figure 1 is shown an outline diagram of one embodiment of the invention arranged in a process machine in the form of a decanting centrifuge, in figure 2a a preferred embodiment of a suction arrangement according to the invention, and in figure 2b a side view of the suction arrangement according to figure 2a.

Description of an embodiment

In figure 1 is shown fundamentally the principles of one embodiment of the invention, arranged in a process machine 2, which in this example is an already known decanting centrifuge. The decanting centrifuge is used in the embodying example to separate by sedimenting solid particles and liquid from a pumpable slurry, which divides up into a dry phase and a liquid phase during the centrifuging. The slurry is led in a known manner from a sludge tank into a decanting centrifuge, via a pipe 4, through slurry inlet 18, and is centrifuged in a conical rotor, after which the solid phase of the slurry is removed through a dry phase outlet 8 and is fed, for example, to a drying arrangement via a dry phase pipe 9. The liquid phase is pumped out through a liquid phase outlet 16 by a liquid phase pump 14 built into the decanting centrifuge 2. In the embodiment shown in the figures the liquid phase pump is built in the decanting centrifuge, but in other process machines a corresponding pump can be arranged separately. During treatment of the slurry in the decanting centrifuge aerosols are produced, which are removed through an aerosol outlet 20.

In accordance with the invention a liquid suction device, in this embodiment in the shape of an ejector 22, which can be regarded as being known in principle, is arranged coupled to liquid phase outlet 16 and aerosol outlet 20. During use ejector 22 is driven by the liquid pumped out of the decanting centrifuge, whereby aerosols together with any air which may have leaked into the decanting centrifuge are sucked into the ejector through its suction inlet. In the ejector aerosols are combined with the liquid and returned to the process liquid while at the same time the reduced pressure in the decanting centrifuge is maintained. The liquid is then fed further via pipe 26 to some other process machine, to a chemical tank or back to the slurry tank where it is blended to a homogenous liquid. The aerosols can also be led by means of an adjustable valve 23 to, for example, a fan driven ventilation system. The ventilation system is used to maintain a reduced pressure in the decanting centrifuge when it is not in use and also functions as a reserve evacuating arrangement. There is preferably a non-return valve in the liquid phase outlet. Liquid, which in this embodiment can be deionised water, for cleaning the decanting centrifuge can be led in via pipe 10 and distributed via spray nozzles 12 and can also after being introduced through liquid inlet 18 be flushed through rotor 6. A number of adjustable valves 11 are arranged for controlling the cleaning liquid. After separating has finished the decanting centrifuge 2 is cleaned by means of cleaning liquid until it is free of radioactive aerosols. Valve 23 is then set so that the reduced pressure in the decanting centrifuge is maintained by means of the ventilation system, and subsequently liquid pump 14 and the liquid flow can be switched off.

Ejector

Figure 2a shows a plan view and figure 2b a side view of a preferred embodiment of an, in principle, already known ejector 22, comprising an ejector inlet 28, an ejector outlet 30, a suction inlet 32 as well as a diffuser 34. The process liquid pumped out of a process machine is led into ejector inlet 28 and is dispersed by diffuser 34 in ejector 22 so that a suction effect is produced at the suction inlet. Aerosols which enter through suction inlet 32 are mixed with process liquid in the ejector and are carried further through the ejector outlet. The liquid flow required through the ejector is dependent on the process machines function and size. In this example the liquid flow sometimes reaches 1.5 kg/s. The ejector's suction power can be adjusted by changing the diffusers nozzle diameter and nozzle angle.

According to the preferred embodiment the ejector 22 is very simply designed and gives a weak but controllable reduced pressure in the process machine. By regulating the power of the liquid pump, the ejector's suction power can be controlled and thereby the reduced pressure in the process machine can be regulated. The power of the ejector can also be varied by the use of different diffuser nozzles. The ejector is preferably mounted vertically, with the ejector inlet 28 and the suction inlet 32 in its upper end.

The method and apparatus according to the invention is used in the preferred embodiment for treating radioactive aerosols during the cleaning of waste water in a nuclear power station. The invention, however, can also be used in any other process where aerosols are present, or condensable or absorbable vapours or gases which one wishes to return to a process liquid. It can, for example, be a matter of mixers, mills or screwfeeds. It is also possible to use a separate circulation flow of liquid as the drive source for the liquid suction device and collecting liquid for the aerosol or the gas. In the case of gases or vapours, these are dissolved or condensed in the fluid which flows through the ejector.

Claims

1. Method for the treatment of aerosols produced during the treatment of materials where liquids are present, in a separator included in the treatment process, wherein a reduced pressure is arranged in said separator to prevent the escape of contami-

nants from the separator, **characterised in** that:

- the reduced pressure is arranged by pumping liquid out of the separator,
- that a liquid suction device is powered by the pumped out liquid,
- aerosols and any of the surrounding atmosphere which may have leaked into the separator, are sucked out of the separator by means of said liquid suction device, whereby the aerosols are absorbed into said liquid.

2. Method according to claim 1, **characterised in** that said treatment process is included in the treatment of waste in a waste treatment plant in a nuclear power station.

3. Method according to claim 1 or 2, **characterised in** that said liquid is a suspension of water and radioactive filtering substances, and that radioactive aerosols are produced in said separator during said material treatment.

4. Method according to any of claims 1-3, **characterised in** that said separator, before it is taken out of service, is flushed with pure liquid, that during flushing aerosols are sucked out of the separator until any possible aerosols which pose a hazard to the surroundings have been removed, that subsequently said sucking out is brought about by an in itself known ventilation system and that then the separator is taken out of service.

5. Apparatus for the treatment of aerosols produced during treatment of materials where a liquid is present, in a separator included in the treatment process, wherein a reduced pressure is able to be arranged in the separator in order to prevent the release of contaminants from the separator, **characterised in** that a liquid pump is arranged for pumping out liquid from said separator, said liquid pump is connected as a power source to a water suction device so that the water suction device's driving pressure is able to be generated by means of the liquid pumped out of the separator, that the separator is coupled to the water suction device's suction inlet so that a reduced pressure is brought about in the separator by means of the liquid suction device, whereby any surrounding atmosphere which has leaked into the separator as well as any aerosols arising from the treatment are able to be introduced into the water suction device for mixing with the liquid, so that said aerosols are able to be taken up in the liquid.

6. Apparatus according to claim 5, **characterised in** that said fluid pump is included in said separator.

7. Apparatus according to claim 5 or claim 6, **characterised in** that said separator is devised for the separating of radioactive filter substances which are suspended in water.

8. Apparatus according to any of claims 5-7, **characterised in** that said separator is a decanting centrifuge.

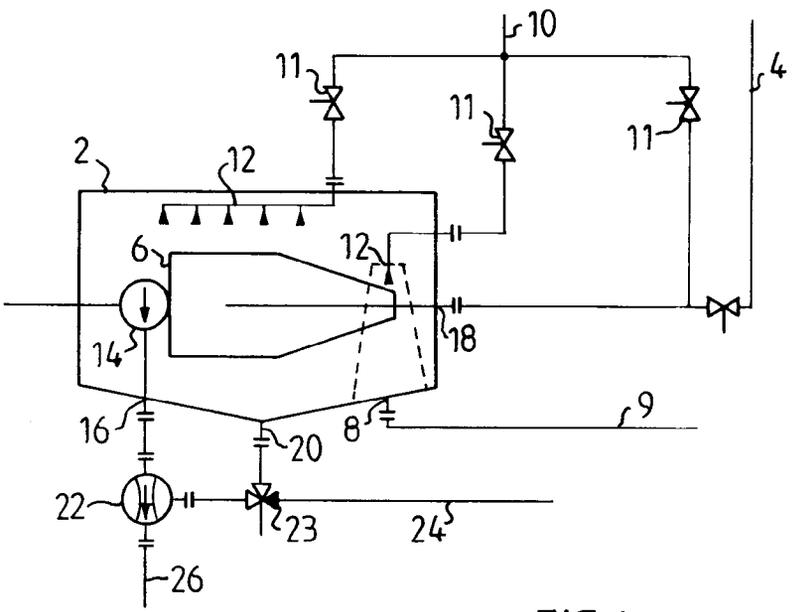

FIG.1

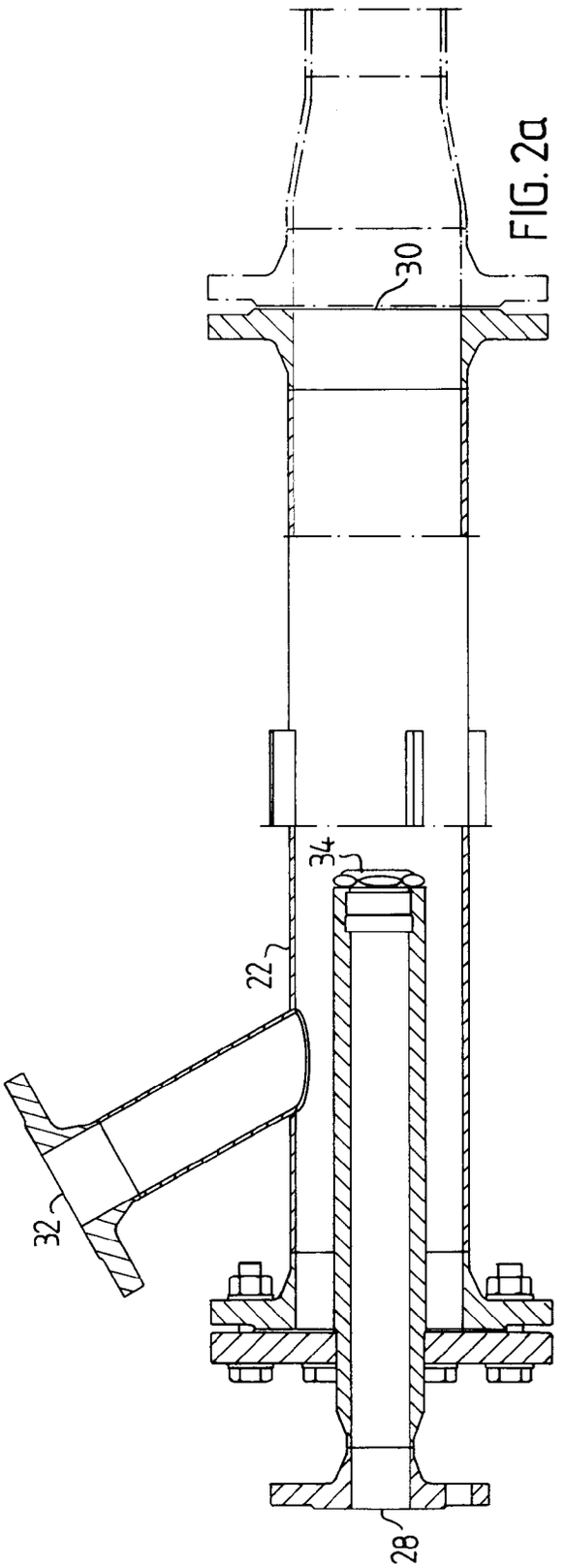

FIG. 2a

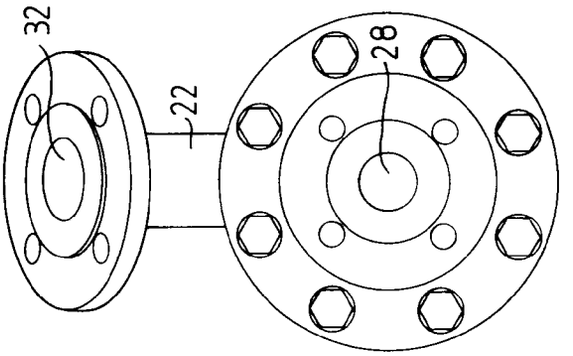

FIG. 2b

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EUROPEAN SEARCH REPORT

Application Number
EP 95 85 0124

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.6)
A	WO-A-94 09904 (ABB ATOM) * abstract; claims 1,2,8; figure *	1-8	G21F9/02 G21F9/06 G21F9/34
A,P	EP-A-0 628 970 (ROBATEL) * claims 1-8; figures 1-5 *	1-8	
A	GB-A-1 276 082 (LICENTIA PATENT VERWALTUNG) * claims 1,2,6 *	1-8	
A	FR-A-2 576 525 (COMMISSARIAT A L'ENERGIE ATOMIQUE) * abstract; claims 1-3; figure 1 *	1-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 October 1995	Nicolas, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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EPO FORM 1503 03.82 (P04C01)