(12) UK Patent Application (19) GB (11) 2 164 576 A

(43) Application published 26 Mar 1986

(21) Application No **8518560**

(22) Date of filing **23 Jul 1985**

(30) Priority data

(31) **3434114** (32) **17 Sep 1984** (33) **DE**

(51) INT CL^4
B01F 3/04 // 13/02

(52) Domestic classification
B1C 102 202 501 PJA
U1S 1438 B1C

(56) Documents cited

GB A	2041774	GB	1326457
GB A	2033772	WO A1	8000435
GB	1584103	US	4290885
GB	1542301		

(58) Field of search
B1C

(71) Applicant
Ekato Industrieanlagen Verwaltungsgesellschaft mbH & Co. (FR Germany),
Kappelemattweg 2, D—7860 Schopfheim, Federal Republic of Germany

(72) Inventors
Klausdieter Kipke,
Werner Himmelsbach

(74) Agent and/or address for service
Phillips & Leigh, 7 Staple Inn, Holborn, London WC1V 7QF

(54) **Gas injection apparatus**

(57) The apparatus comprises a tubular lance (26) to introduce the gas into the liquid, the mouth (28) of which is disposed in the region of an agitator (24) which disperses the gas in the liquid. The mouth of the lance is preferably on the pressure side of the agitator, as shown.

The apparatus is particularly described in relation to the wet desulphurising of flue gases.

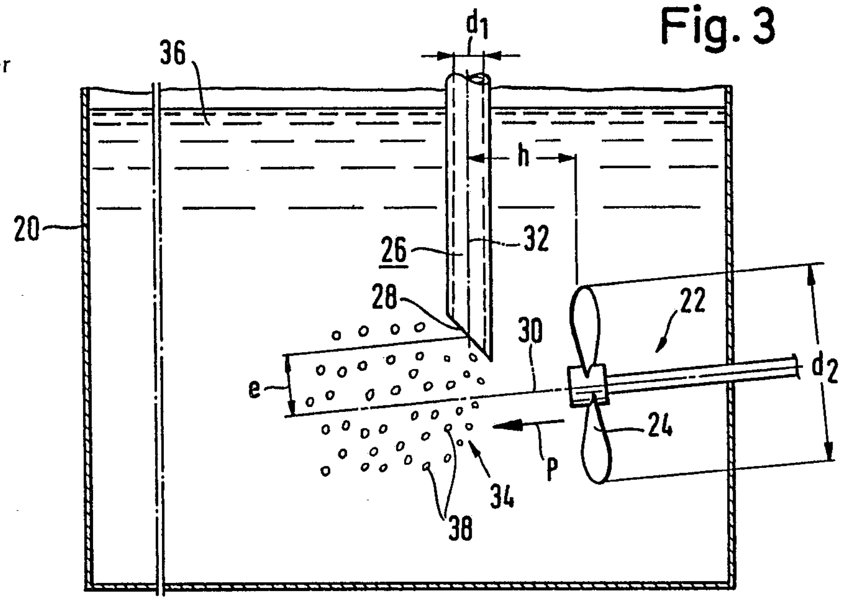

Fig. 3

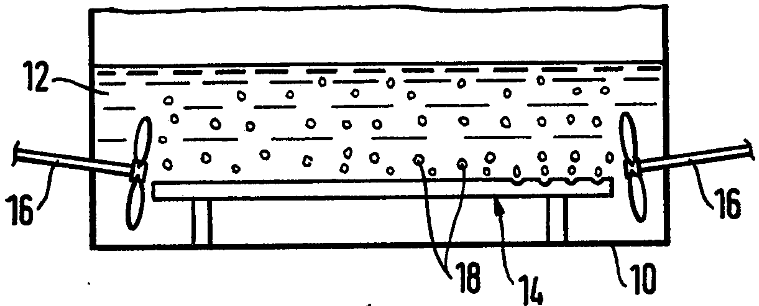

Fig. 1

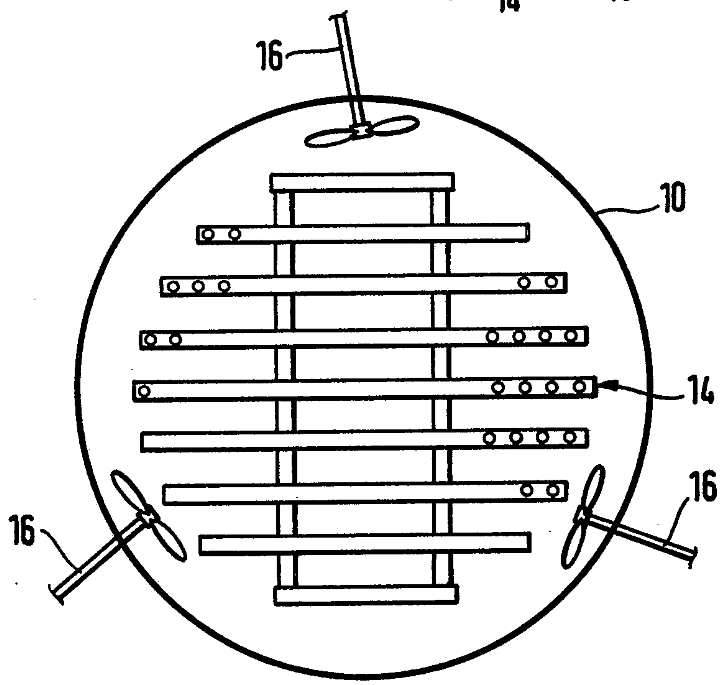

Fig. 2

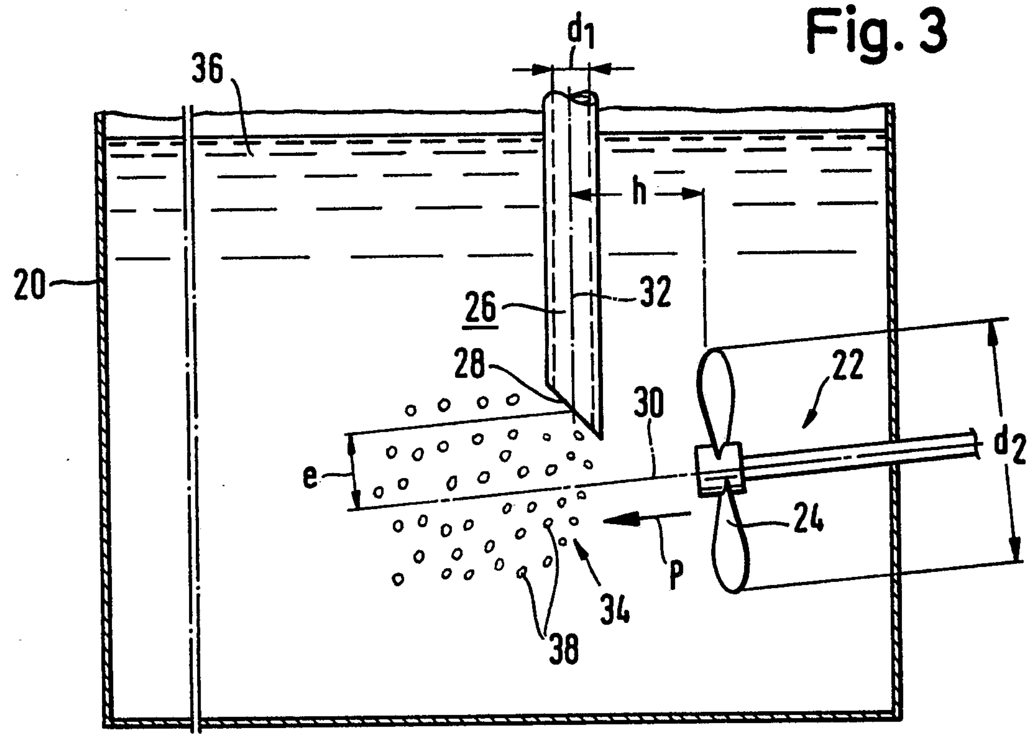

Fig. 3

SPECIFICATION

Gas injection apparatus

This invention relates to gas injection apparatus for introduction of gas into liquid for treatment purposes.

A typical application is in absorber tanks for the wet desulphurising of flue gas, wherein the flue gas is introduced into the absorber tank and sulphur dioxide is bound on lime or calcium hydroxide in water and then oxidised by the addition of air to form calcium sulphate (gypsum) via sulphite, which gypsum is maintained in suspension by agitators in the absorber tank.

In the course of this, the treatment with gas is generally effected via a so-called gas treatment cross which is disposed about 1—3 metres above the bottom of the absorber tank. The gas treatment cross consists of a plurality of tubes which are provided with appropriate holes through which the air supplied emerges in order to achieve a treatment with gas over the whole area of the absorber tank.

For example, three agitators, which are installed laterally, are installed in the tank, which has a diameter of 12—20 metres for example, and serve to suspend the gypsum formed, that is to say to prevent it from settling out.

The arrangement of the agitators, particularly the angular position of their axes in relation to the absorber tank, has a strong influence on the suspension but is not a subject of the invention.

For reasons of corrosion, the gas treatment crosses must consist of high-quality steel, for which reason the costs of such a gas treatment cross are very high (for example about £25,000.00). Furthermore, blowers are necessary, which must deliver gas treatment rates of 8000 m^3/h, as a result of which further relatively high costs are incurred.

The aim of the invention is to reduce such costs.

Accordingly this invention provides gas injection apparatus for introduction of gas into liquid for treatment purposes, said apparatus comprising one or more agitators in the liquid, characterised in that the apparatus comprises at least one tubular lance to introduce the gas into the liquid, the mouth of the tubular lance being in the region of an agitator.

One tubular lance may appropriately be associated with each agitator, the outlet of the tubular lance being situated at the pressure side of the agitator propeller.

Furthermore, the outlet of the tubular lance may advantageously be disposed above the centre axis of the agitator propeller.

As a result of the use of a simple gas treatment tube for each agitator, the expensive gas treatment cross can be dispensed with as a result of which the necessary investment costs can be reduced considerably. Distinct savings can also be achieved in the operating costs as will be explained with reference to a comparative example.

One form of embodiment of the invention is explained in more detail below, by way of example with reference to the drawing, Figs. 1 and 2 showing an absorber tank with a conventional gas treatment cross, in side view and in plan view.

Fig. 3 shows an absorber tank with an agitator and a tubular lance according to the invention, diagrammatically, in section.

Fig. 1 shows, diagrammatically, the lower portion of an absorber tank 10 such as is used for the wet desulphurising of flue gas.

During this desulphurising, the flue gas is introduced into the absorber tank and the sulphur dioxide is bound on lime, quicklime or calcium hydroxide with the addition of water. It is subsequently oxidised by the addition of air in the lower portion of the absorber tank to form calcium sulphate via sulphite.

In the course of this, a suspension 12 forms in the lower portion of the absorber tank 10, which suspension consists essentially of water and particles of gypsum, the proportion of solids being about 16% by weight. The suspension must be constantly agitated for which purpose agitators 16 are provided which are installed laterally in the absorber tank 10 in order to suspend the particles of gypsum and to prevent settling out.

The supply of air is effected through a so-called gas treatment cross 14, which is disposed at the bottom of the absorber tank 10 and which consists of a plurality of tubes which are connected to one another and provided with holes through which the air supplied to the gas treatment cross can emerge and enter the suspension 12 in order to oxidise the SO_2 bound on lime to form gypsum which is then drawn off in a suitable manner, not illustrated.

Three agitators 16, for example, are used to agitate the suspension 12 and, as Fig. 2 shows, are disposed at angular distances apart of 120° and are installed close to the inner wall of the absorber tank 10. As Fig. 1 shows, the axes of the agitators 16 are inclined downwards at an acute angle and, as Fig. 2 shows, are also set at an acute angle in the circumferential direction, although the arrangement of the agitators is not a subject of the invention, as already mentioned.

The suspension 12 is thoroughly agitated by the agitators 16 while the above-mentioned oxidation is caused by the air bubbles 18 rising from the gas treatment cross 14.

The diameter of the absorber tank may, for example, be between 10 and 20 metres while it may be filled to a height of about 5 metres.

The form of embodiment shown in Fig. 3 shows an apparatus for treating with gas according to the invention.

Three agitators 22, for example, are installed in the absorber tank 20 and disposed as shown in Fig. 2. Only one agitator 22 with an agitator propeller 24 is illustrated in Fig. 3, however.

A tube or a tubular lance 26 is introduced into the absorber tank 20 from above with its mouth 28 in the region of the agitator 22.

The agitator propeller 24 delivers in the direction of the arrow P and the tubular lance 26 is preferably disposed at the pressure side of the propeller 24, as illustrated in Fig. 3.

The arrangement of the tubular lance 26 at the suction side of the agitator propeller 24, which is also possible in itself, may lead to flooding of the propeller 24 by the air bubbles 38 emerging from the mouth 28 of the tubular lance 26 which may have the result that the propeller 24 is working more or less in an air bubble as a result of which its efficiency is impaired. It is therefore preferred to dispose the tubular lance 26 at the pressure side of the propeller 24.

The spacing of the centre axis 32 of the tubular lance 26 from the median plane of the propeller 24 is designated by *h* in Fig. 3 and the diameter of the propeller 24 is designated by d_2.

The ratio h/d_2 is preferably in the range from 0.4—0.5, particularly 0.46.

The mouth 28 of the tubular lance 26 may appropriately be situated somewhat above the centre axis 30 of the agitator 22.

The spacing of the mouth 28 from the centre axis 30 is designated by *e*, and, if the mouth 28 extends obliquely to the longitudinal axis 32 of the tubular lance 26, as illustrated in Fig. 3, then *e* means the spacing of the centre of the mouth 28 from the centre axis 30 of the agitator 22.

The ratio e/d_2 is preferably in the range from 0.08—0.18, particularly 0.13.

The air blown into the suspension 36 through the tubular lance 26 is dispersed by the propeller 24 as a result of the shearing forces emerging in the propeller jet and is carried away by the agitator 22, 24, forming air bubbles 38.

The system is non-coalescent, that is to say the air bubbles formed remain small and stable; large bubbles are not formed and flooding of the agitator is thus ruled out.

Therefore, not only is the air blown in through the tubular lances 26 dissipated into small bubbles in the region of the shearing zones 34 of each individual agitator by the shearing forces arising there, but also the suspension 36 is thoroughly agitated and the particles of gypsum formed are kept in suspension by the agitators 22.

As already mentioned, at least one tubular lance 26 is associated with each agitator 22, 24.

The known form of construction as shown in Fig. 1 and Fig. 2 will now be compared below with the form of embodiment according to the invention shown in Fig. 3, with reference to an example.

The basis for the comparison was the same material transition factor k_La of $70h^{-1}$ in both experiments. ("Material transition factor" is equivalent to the term "oxygen transition factor" which is a measure of transfer of oxygen from gaseous to dissolved form.)

The plants used had the following dimensions:

Diameter of the absorber tank	D=13.6 m
Filling height	H= 6.5 m
Propeller diameter	d_2= 1 m

Three agitators were used.

In the case of the experiment with the known gas treatment cross shown in Figs. 1 and 2, the specific agitator output is lower because the agitators serve only for the suspension. Their power consumption was 3×8.5 kW=25.5 kW. The air throughput of the gas treatment cross was Q=8200 m^3/h. The blower power was P=193 kW.

Thus the total power of agitators and blowers in the experiment with the known gas treatment cross shown in Figs. 1 and 2 is 218.5 kW.

If, on the other hand, according to the invention, tubular lances are used instead of the known gas treatment cross shown in Figs. 1 and 2, as illustrated in Fig. 3, then the specific agitator power rises to 3×18.7 = 56.1 kW, because the agitators are used both for the suspension and for the treatment with gas, that is to say, in addition to the suspension, energy must be provided by the agitators in order to disperse the air blown in through the tubular lances 26.

With the method according to the invention, however, only an air throughput of 3100 m^3/h is necessary so that the corresponding blower power can be reduced to 74 kW. Thus the total power necessary when using the invention is 130.1 kW in comparison with a total power of 218.5 kW when using the conventional installation.

This means that distinct savings result not only on the investment side but also in the operating costs.

The mouth 28 may possibly be provided with a perforated cover in order to improve the bubble formation.

The above description is couched in terms of a liquid being treated with a gas (air) but it will be appreciated that similarly a gas may be treated with a liquid and such usage falls within the present invention.

CLAIMS

1. Gas injection apparatus for introduction of gas into liquid for treatment purposes, said apparatus comprising one or more agitators in the liquid, characterised in that the apparatus comprises at least one tubular lance to introduce the gas into the liquid, the mouth of the tubular lance being in the region of an agitator.

2. Gas injection apparatus as claimed in claim 1 in which two or more agitators are provided and at least one tubular lance is associated with each agitator.

3. Gas injection apparatus as claimed in claim 1 or claim 2 in which the agitator has a pressure side and a suction side and the mouth of the tubular lance is disposed at the pressure side of the agitator.

4. Gas injection apparatus as claimed in claim 3 in which the agitator is of the propeller type and the ratio (h/d_2) of the distance of the tubular lance from the median plane of the propeller (h) to the diameter of the propeller (d_2) is in the range 0.4—0.5.

5. Gas injection apparatus as claimed in any preceding claim in which the mouth of the tubular lance is situated above the centre axis of the agitator.

6. Gas injection apparatus as claimed in claim 5 in which the agitator is of the propeller type and the ratio (e/d_2) of the spacing of the mouth of the tubular lance from the axis of the propeller (e) to the diameter of the propeller (d_2) is in the range 0.08—0.18.

7. Gas injection apparatus as claimed in any

preceding claim characterised in that the tubular lance is disposed in a plane which passes through the centre axis of the agitator.

8. Gas injection apparatus as claimed in claim 7 in which the tubular lance is disposed in the vertical plane passing through the centre axis of the agitator.

9. Gas injection apparatus as claimed in claim 1 substantially as described with reference to Fig. 3.

10. Absorber tank for the wet desulphurising of flue gas, comprising a tank in which sulphur dioxide reacts with lime and water and is oxidised by air to form gypsum, the gypsum being maintained in suspension by agitators, characterised in that tubular lances are used to supply the air to the region of the agitators.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa. 3/1986. Demand No. 8817443.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.