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(54) Flotation plant

(57) A foam is formed in the upper part 12 of an upwardly diverging separator 10 to which a gasified slurry is fed from gasifying devices 7 fed by a slurry main 5 and a gas main 6. Each device 7 has a row of bubble generators 74 made of resilient and porous plastics material, e.g. high-density polyethylene.

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Fig. 1

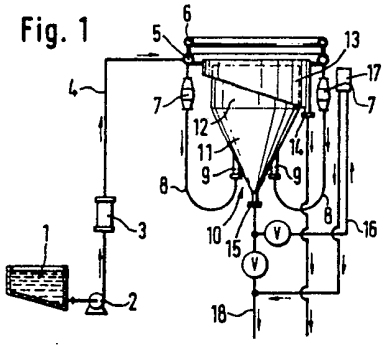

Fig. 4

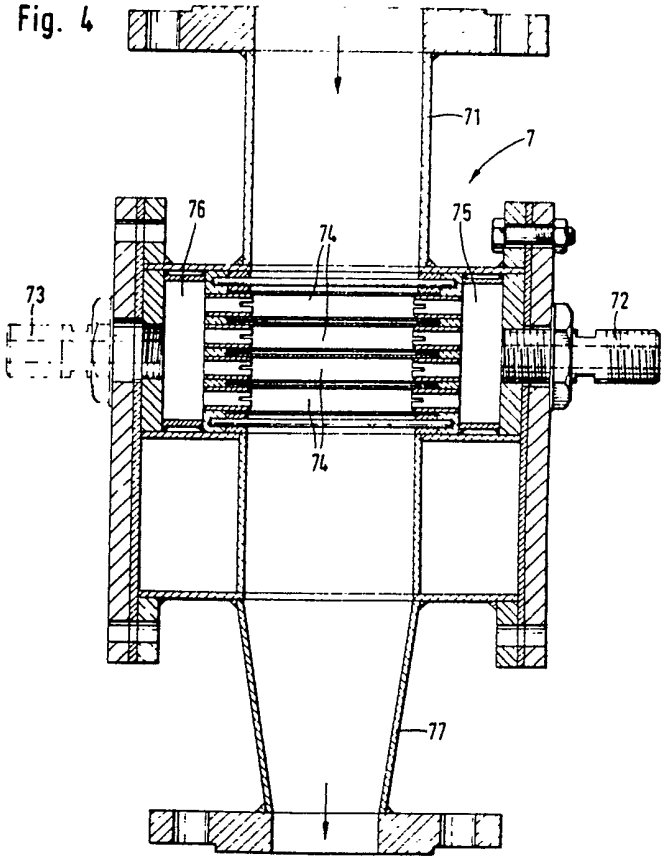

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Fig. 1

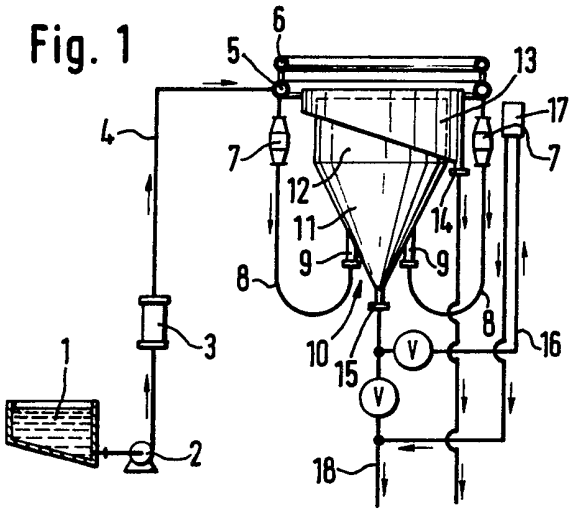


Fig. 2

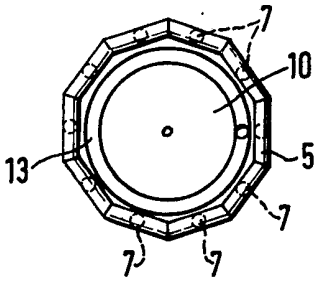


Fig. 3

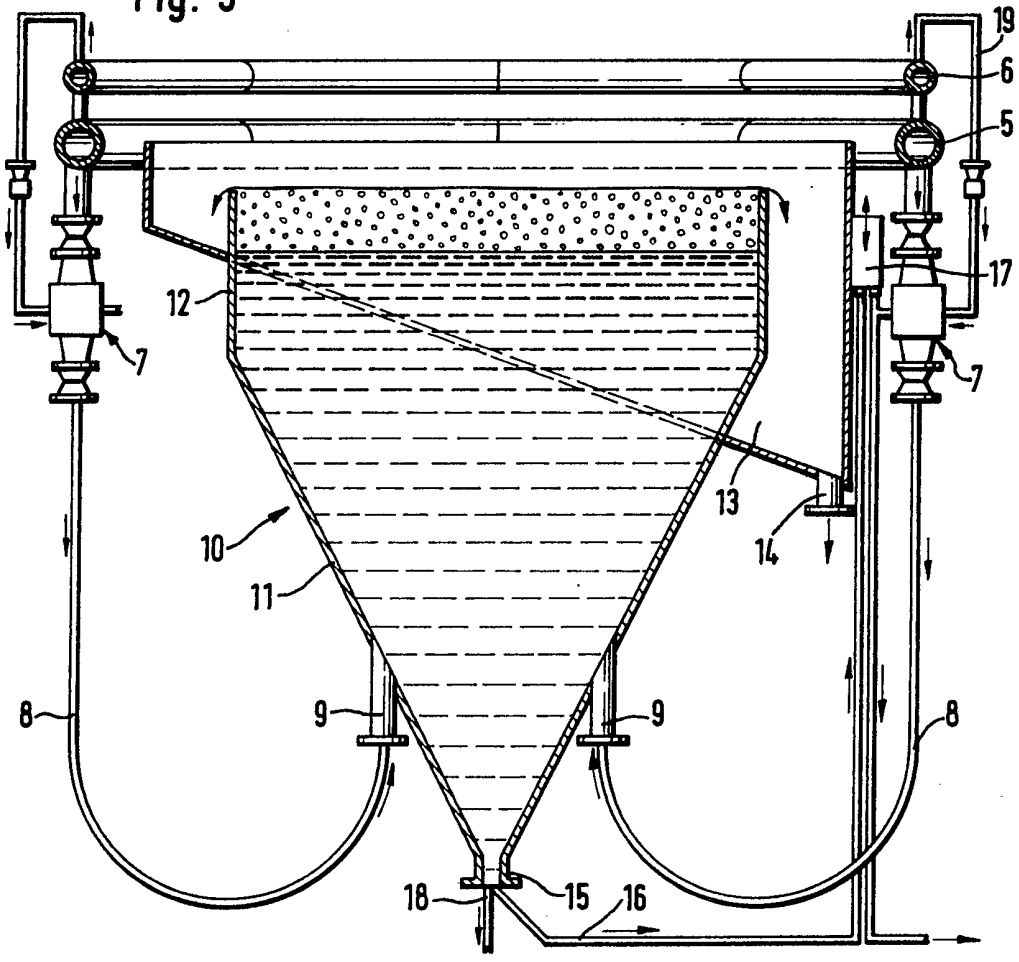
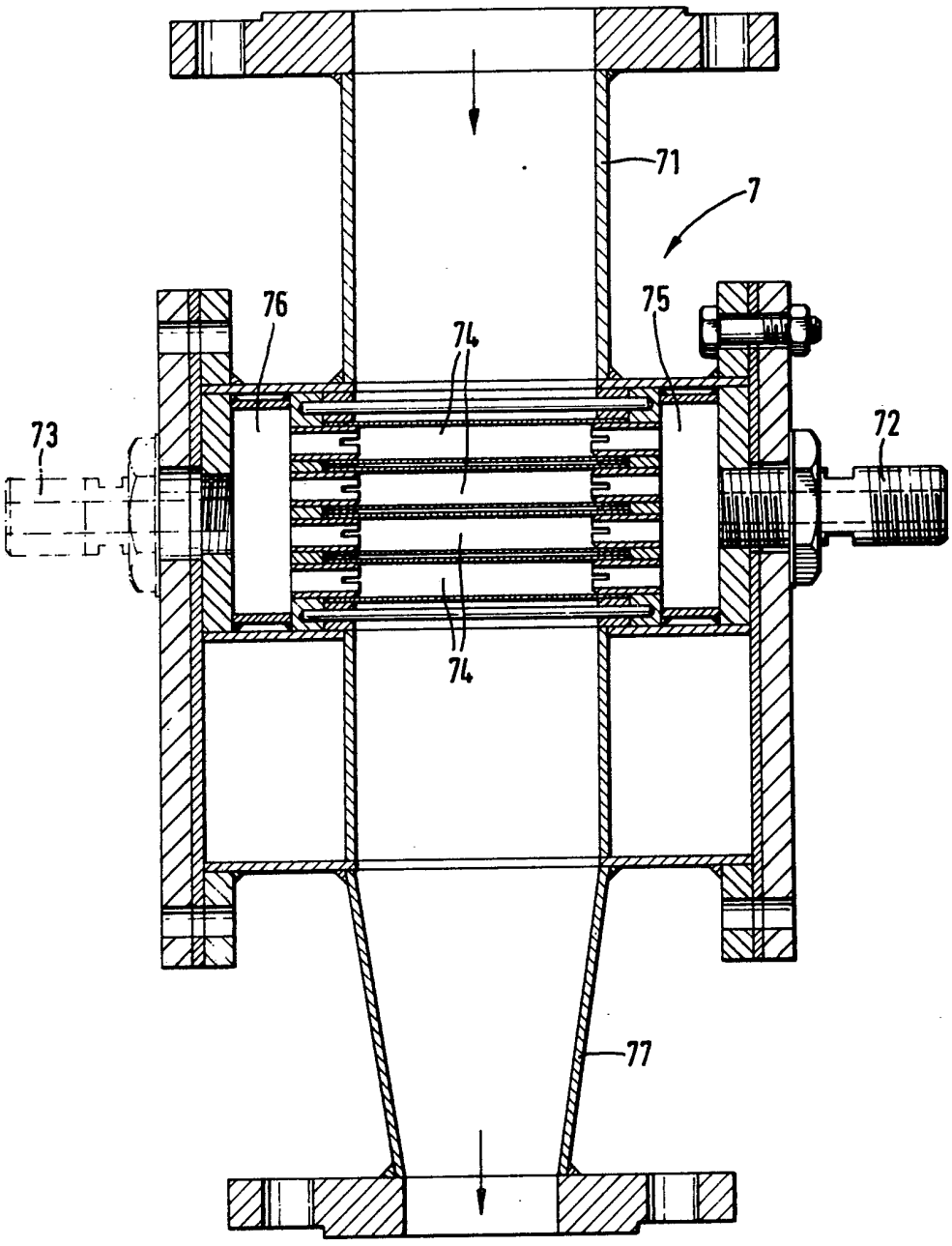


Fig. 4



SPECIFICATION
Flotation plant

The invention relates to a plant for separating solids from a liquid-solids mixture, for example from waste water, by flotation, more particularly for the separation of coal from conditioned slurry.

Solid particles in a conditioned slurry are selectively rendered hydrophobic by means of organic or inorganic reagents. Gasifying devices are then used to produce gas bubbles on which the solids to be separated accumulate under specific conditions. Gas-bubble/solids complexes are therefore produced in the slurry, which is made to foam in a downstream separator of the flotation plant. The principle of this kind of flotation is adequately described in the German Patent Specification 24 20 482.

Bubble generators of ceramic or metallic material are used in the gasifying device of the known flotation system. In performing tests it was found that during operation, in particular during interruptions of the operation, the bubble generators give rise to sedimentation malfunctioning due to blockage of the bubble generator and on continuing operation it is no longer possible to ensure the presence of a uniform gas-bubble/solids mixture in the separator.

Furthermore, the known flotation system suffers from the disadvantage that the kind and arrangement of the gasifying device does not permit an adequate throughput for the separator.

It would therefore be desirable to avoid the existing disadvantages and, by means of homogeneous gasifying, to achieve complete accumulation of all solids particles for flotation in the gas bubbles of the slurry and a quantitatively large output without operational breakdown.

The present invention provides a flotation plant in which gasifying devices are disposed in annular configuration about an upwardly diverging separator and are connected to a slurry and a gas ring main, each gasifying device being provided with at least one bubble generator of resilient and porous plastics material, for example high density polyethylene.

It has been found advantageous if in the presence of large quantities of air and slurry, the bubble generators, which are provided in the gasifying devices, are constructed as hoses arranged in a plurality of rows one beneath the other, transversely to the flow direction. This arrangement results in the formation of a plurality of streams which flow along the rows of hoses which present gasifying surfaces extending parallel with the flow direction of the slurry.

Both end regions of the bubble generators can be connected to gas supply ducts to ensure an improved and more uniform introduction of gas into the plurality of hoses.

The technological progress of the invention is due mainly to the fact that the resilient construction of the bubble generators make possible co-oscillation or co-movement of the bubble generators due to flow and vortex formation, more particularly in the radial and axial direction, so that the sedimentations on the surface of the hoses resulting from interruptions of operation are detached and foreign bodies which have penetrated into the pores are removed so that complete homogeneous gasification without operational breakdown is thus made possible. Furthermore, the gasifying devices, arranged around the separating device, ensure a high throughput of gas-bubble/solids complexes, which in turn makes possible a large output from the separator.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a flotation plant, in which details not required to understand the invention are not shown;

Figure 2 is a plan view of a separator with a ring of gasifying devices around it;

Figure 3 is a section through the separator and the ring of gasifying devices; and

Figure 4 is a section through one embodiment of a gasifying device.

Slurry is conditioned in a conditioning vessel 1 with agitators, i.e. chemicals are added to the slurry so that the solids to be separated are rendered hydrophobic. Fine oil can be used for the flotation of coal.

The conditioned slurry is transferred by means of a pump 2 and a positive mixer 3, which is not absolutely essential, *via* a duct 4 into a slurry ring main 5 through which the slurry is supplied to gasifying devices 7 arranged in a ring around a separator 10.

The gasifying devices 7 are supplied with gas, for example air, *via* a gas ring main 6 and by means of individual ducts 19 (Figure 3). In a manner to be described subsequently, gas bubbles of suitable diameter are formed by the gasifying devices 7 in the flowing slurry. Solids which have been rendered hydrophobic are simultaneously deposited on the said gas bubbles. The slurry, laden with the gas bubbles or the gas-bubble/solids complexes, is supplied *via* a duct 8 to the separator 10.

The separator 10 comprises a conically converging lower part 11 and a cylindrical upper part 12. Foam formation takes place in the separator 10. The foam, formed in the upper part 12, passes with or without the aid of a stripper into an overflow trough 13 with a discharge port 14. The lean slurry passes, together with any solids particles which have not been rendered hydrophobic, through a port 15 into a drain 18 which extends to a clarifying system. A level-regulating vessel 17 is disposed laterally of the separator 10 and is vertically adjustable. For the purpose of adaptation to the slurry in the separator 10, the vessel 17 communicates *via* a duct 16 with the separator 10 and communicates *via* an additional duct with the drain 18.

The number of gasifying devices 7 can be varied as desired and depends on the size of the

entire flotation plant. The slurry is supplied from the ring main 5 to the gasifying devices 7 from above through individual ducts, while the gas is supplied from the gas ring main 6 *via* separate ducts 19 to the gasifying devices 7 from one or both sides. The slurry, flowing through the gasifying devices 7, passes *via* the ducts 8 in a large arc to a ring of inlets 9 in the bottom region of the lower part 11 of the separator 10. The inlets 9 are arranged substantially in the deepest region of the lower part 11 so as to ensure settlement within the flow when the gas-bubble/solids complex rises.

Figure 4 shows a gasifying device 7 which comprises a box-shaped, enclosed construction in which hose-like resilient and porous bubble generators 74 of high-density polyethylene or some comparable plastics are arranged transversely to the flow direction. The flow direction of the slurry is represented by the arrows in the region of sockets 71 and 77 for respective connection to the duct from the slurry ring main 5 and to the duct 8 which extends into the separating device 10. The gasifying device 7 is supplied with gas (air or an inert gas) for the bubble generators 74 *via* connections 72 or 73 from the gas ring main. (The connection 73 may be omitted.)

In the embodiment shown in Figure 4, four hose-like bubble generators 74 are arranged transversely to the flow direction, and plenum chambers 75, 76 are provided between the connections 72, 73 and the bubble generators 74, which are correspondingly retained on the side. The purpose of plenum chamber 75, 76 is to avoid pressure surges in the gas supply. The hose-like bubble generators 74 of resilient and porous plastics material, such as high-density polyethylene, are arranged in one or more rows one behind the other and one beneath the other, as shown in the exemplified embodiment of Figure 4, to form gasifying surfaces parallel with the slurry flow. The number of bubble generators 74 disposed one above the other and in rows adjacent to each other depends on the throughput of slurry and gas.

According to another embodiment (not shown) it is feasible to arrange the bubble generator 74 in the form of one or more bundles of hoses extending parallel with the flow, thus again producing a gasifying surface or surfaces extending parallel with the flow. The bubble generators 74 need not necessarily be of hose configuration; it is feasible for the bubble generators 74 to be constructed as plate-like chambers, disposed parallel with each other in the flow direction.

The bubble generators 74, in the embodiment of Figure 4, have an internal diameter of at least 3 mm and a pore distribution around a means value between 2 and 50 μm. These values result in a gasified thickness of liquid or slurry (flow velocity at least 0.5 m/s) of between 2 and 10 mm thus ensuring completely homogeneous gasifying over the entire cross-section. The gasified thickness of 2 to 10 mm necessarily defines the distance between the individual bubble generators 74 as a minimum of 4 mm and a maximum of 20 mm. On flowing through the gasifying devices 7, the slurry produces vibrations of the flexible bubble generator 74 so that blockage of the non-rigid and porous plastics material is avoided.

According to another embodiment (not shown) it is feasible to allow the slurry to flow through the resilient porous hoses (bubble generators 74) and at the same time to allow the gas to enter the hoses under pressure from the outside to the inside, so that the gas bubbles are formed on the internal wall of the hoses.

CLAIMS

1. A plant for separating solids from a liquids-solids mixture by flotation, the plant comprising gasifying apparatus for introducing gas into the mixture, and a separator which diverges upwards and to which the gasified mixture is supplied by the gasifying apparatus so that a foam is formed in the upper part of the separator, the gasifying apparatus comprising a ring of gasifying devices arranged around the separator and connected to a ring main for the mixture and a ring main for the gas, each gasifying device having a gasifying surface which extends substantially parallel with the flow of the mixture through the device and which is defined by at least one bubble generator of resilient and porous plastics material.

2. A plant as claimed in claim 1, in which the or each bubble generator comprises hoses disposed transversely to the flow direction.

3. A plant as claimed in claim 1, in which the or each bubble generator comprises a bundle of adjacent hoses extending parallel with the flow.

4. A plant as claimed in claim 1, in which the or each bubble generator comprises a plate-like chamber extending parallel with the flow direction.

5. Apparatus as claimed in claim 1, in which the or each bubble generator has two ends, each end being connected to the gas ring main.

6. Apparatus as claimed in any of claims 1 to 5, in which the plastics material has a mean pore diameter of 2 to 5 μm.

7. A plant as claimed in any of claims 1 to 6, in which the distance between adjacent bubble generators is 4 to 20 mm.

8. A plant as claimed in any of claims 1 to 7, including plenum chambers disposed between the gas ring main and the bubble generators.

9. A plant as claimed in claim 1, in which at least one gasifying device comprises one or more hoses through which the mixture passes, the hose(s) being of resilient and porous plastics material, means being provided for supplying the gas from the gas ring main to the exterior of the hose(s).

10. A plant as claimed in any of claims 1 to 9,

in which the plastics material is high-density polyethylene.

11. A plant for separating solids from a liquid-solids mixture, substantially as described with reference to, and as shown in, the accompanying drawings.

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