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Facchini

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[54] **DEVICE AND APPARATUS SUITABLE TO PULSED AND CONTROLLED TRANSFER OF SOLIDS IN LIQUID PHASE**

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[51] **Int. Cl.**.....**B65g 53/04**

[58] **Field of Search**.....302/14, 15, 16, 36, 53, 66; 417/137, 138, 139

[56] **References Cited**

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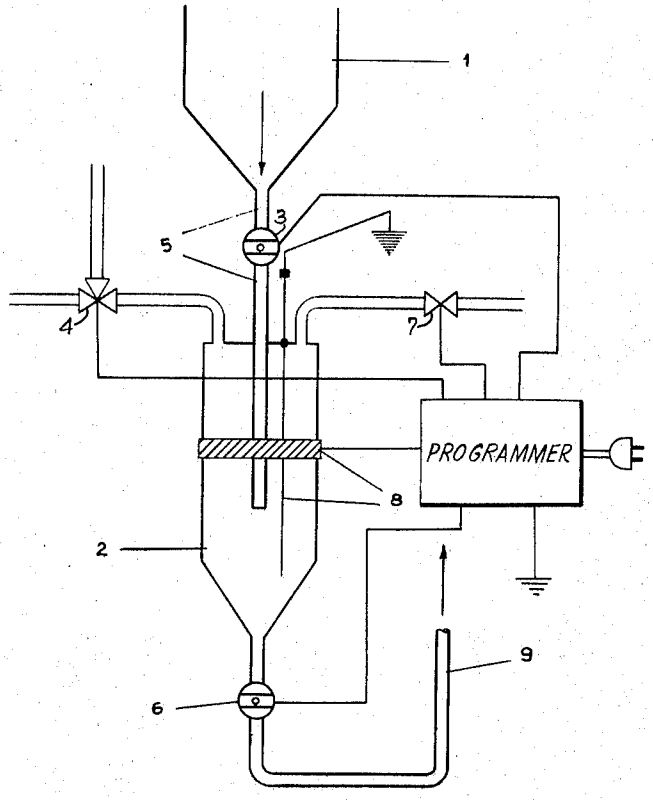
[57] **ABSTRACT**

Finely divided particles of a brittle solid are transported by dispersing them in a transport liquid of lower density in a dispersion chamber and by feeding a series of aliquots of the dispersion from the dispersion chamber to a vessel, equipped with inlet and outlet ducts which are respectively provided with automatic control valves, when the several aliquots are subjected to increased pressure and whence the dispersed particles are expelled for transport through the outlet duct.

3 Claims, 2 Drawing Figures



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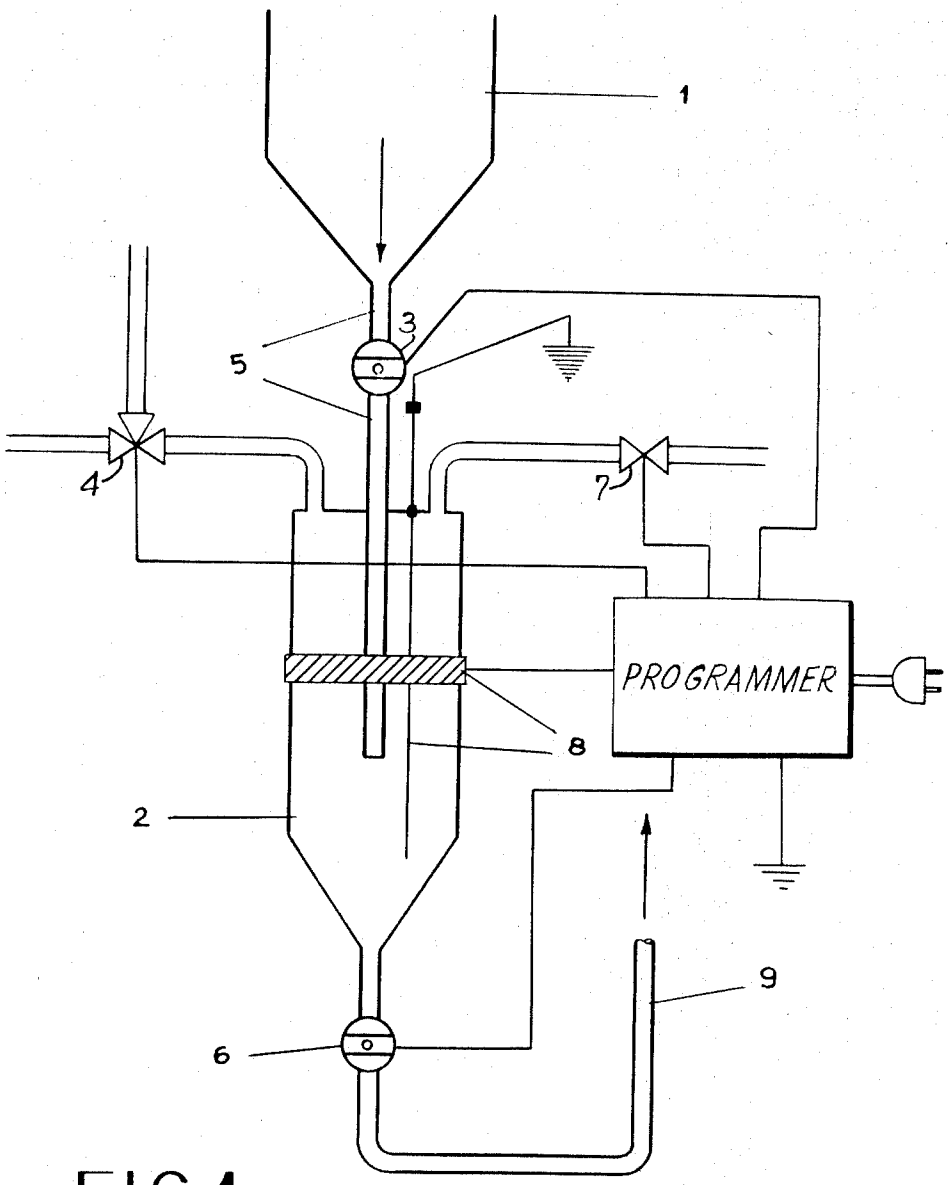

FIG. 1

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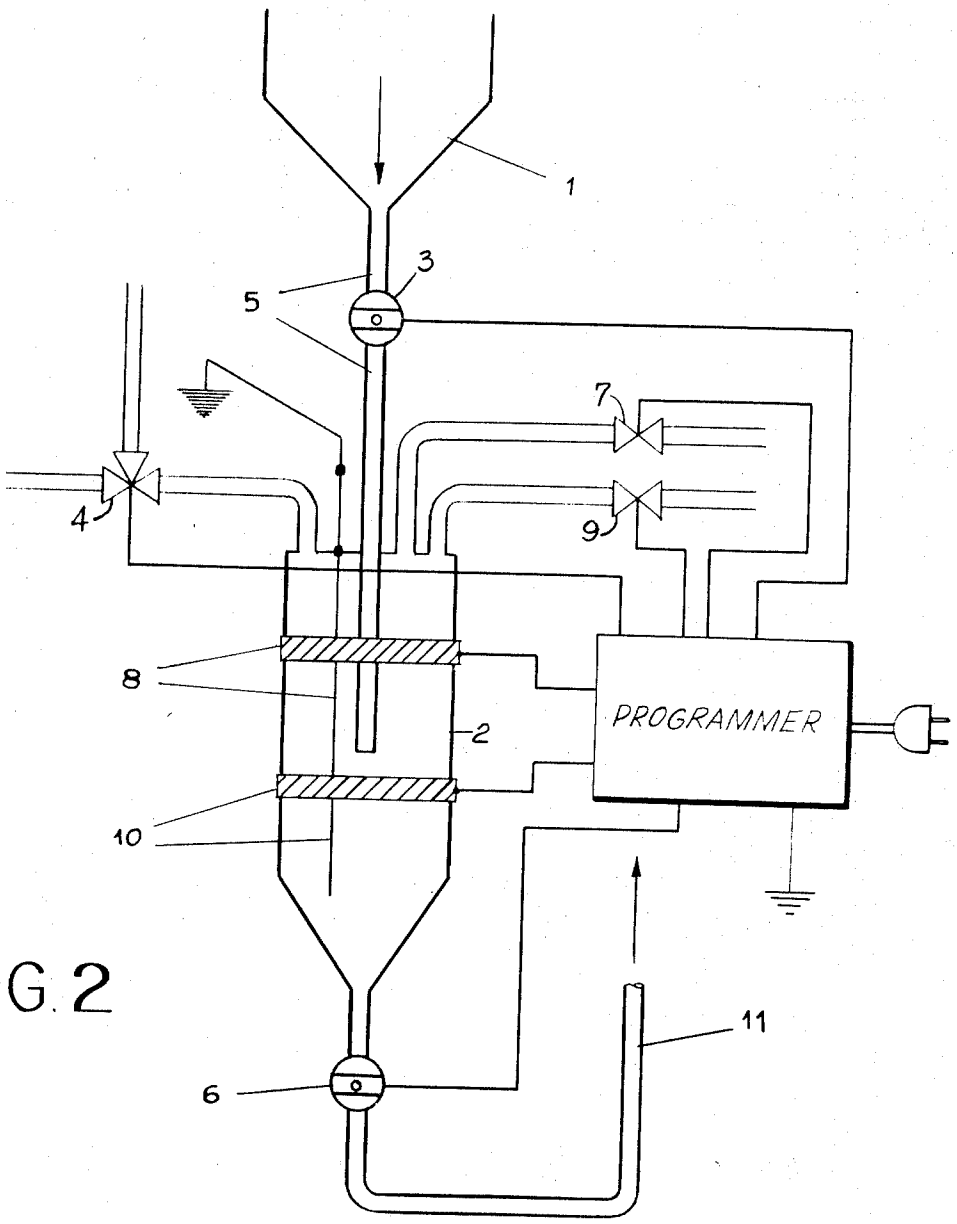

FIG. 2

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DEVICE AND APPARATUS SUITABLE TO PULSED AND CONTROLLED TRANSFER OF SOLIDS IN LIQUID PHASE

The present invention relates to a new device and to an apparatus for the pulsed and controlled transfer of solid particles, said particles being finely divided and brittle, dispersed in a liquid phase.

For "pulsed and controlled transfer" is meant the transfer effected in an intermittent way, i.e., at time intervals which may be defined at will, of amounts which may be metered at will.

Among the known systems for the transfer of solids dispersed in a liquid phase, the jet ejectors and the rotating transfer devices have to be mentioned. The first ones are based on the jet of a liquid which drags the solid phase and are formed by a nozzle wherein is injected the dragging liquid surrounded by a suction chamber to which comes the solid phase to be dragged and therefore equipped with an outlet duct in axis with the nozzle and with an inlet duct of the phase to be dragged. Said device is normally utilized for dragging a gaseous or liquid fluid.

When this device is fitted to the dragging of a solid phase, it presents the following drawbacks;

1 It requires a noticeable amount of dragging liquid, sometimes undesired; 2) is prone to flood easily, i.e., the solid phase has the trend to occlude the outlet duct; 3) also when this does not occur, this system has an unstable operation, i.e., the dragged solid flow rate tends, in a random way, to increase or to decrease. The rotating transfer apparatus consists in a fixed chamber, equipped with feeding duct for the solid to be dragged and with suitable discharging and charging ducts for the dragging liquid, wherein a core rotates in which suitable cavities are made. In these cavities the solid phase to be dragged is collected and said solid phase is ejected therefrom after rotation through a suitable angle.

This system too presents some drawbacks among the which we mention:

1°) If the solid to be dragged is brittle it tends to break during the rotation of the core; 2°) if the solid has abrasive characteristics it tends to rifle the fixed chamber with subsequent drawbacks in the seal; 3°) as the jet operates, it has an unstable behavior. The device, which is the subject of the present invention, obviates all the above-mentioned drawbacks as there are no mechanical organs in motion in direct contact with the material to be dragged and its operation is perfectly stable as the amounts transferred at every pulse are quite definite.

Moreover, no dragging liquid is used, but, the liquid itself, wherein the solid is dispersed, moves with it.

The dispersant liquid may be water, any organic or inorganic liquid, benzene, xylene, toluene, etc.

Apparatus for the pulsed and controlled transfer of finely divided solid particles dispersed in a liquid phase in accordance with my invention is illustrated schematically in the accompanying drawing wherein:

FIG. 1 is an elevation of apparatus operated with a single dispersant liquid; and

FIG. 2 is an elevation of modified apparatus operating with two dispersant liquids.

FIG. 1, shown only by way of unrestrictive example, illustrates the device of the present invention. It consists of a hopper 1 wherein the solid phase to be transferred is dispersed in a liquid, of a duct 5 discharging into a vessel 2 having a conic bottom, of two valves 3 and 6 pneumatically or electrically operated, of a three-way pressurization valve 4, of a valve 7 for restoring the liquid level in vessel 2, of a capacitive type probe 8 for regulating the level in vessel 2. Reference numeral 9 indicates the discharging duct of vessel 2.

The operation of the device which is the subject of the present invention, consist in the following phases:

a. discharging the desired amount of solid phase mixed with liquid from hopper 1 into vessel 2, by opening valve 3;
b. pressurization with air or with suitable inert gas, by opening valve 4, of vessel 2 with the return to hopper 1 of the solid remained in discharging duct 5 and decantation of the solid in the conic bottom of vessel 2
c. locking of valve 3 and opening of discharging valve 6 of vessel 2 with transfer from the same, still pressurized, of the solid collected in it through duct 9.
d. depressurization of vessel 2 and locking of discharging valve 6 of the same.
e. restoring of liquid level in vessel 2 through opening of valve 7 of a suitable feeding circuit, operated by a level regulator, preferably of the capacitive type, of which numeral reference 8 indicate the sensitive element.

Operations *a*, *b*, *c*, *d*, are effected in a pneumatic or electric way be a simple programmer.

By regulating the operations time, the flow rate of the solid phase transfer is varied with continuity and once the operations time is fixed, said flow rate remains quite stable in the course of time.

By varying the pressure of gas introduced into vessel 2, by means of valve 4, it is possible to transfer the material at a certain distance and/or at noticeable heights.

A substantial variant of the present invention is represented by the possibility of realizing in above described tank 2, the change of the liquid in which the solid phase is dispersed initially, with another one, subject to choice, which has a density higher than that of the initial liquid and lower than that of the solid.

As examples of materials utilized in the present invention we mention: as solid phase, spherules (of about 1.3 of density) based on hydroxides of thorium, plutonium or ammonium uranates and so on; as initial liquid phase water (density 1) and as substituting liquid, a mixture of carbon tetrachloride or of n-heptane (or n-hexane or cycloexane and so on), having density of about 1.15.

The device, according to the present invention, may be used to transfer not only spherules of compounds based on uranium, thorium and plutonium, but also any type of solid in liquid phase.

With this variant, it is not only the possible to carry the solid phase, but also to disperse the same with a new liquid to be subsequently subjected to other processes.

In the case of the mentioned example, it is possible to realize the dispersion of the spherules of thorium or plutonium hydroxide or ammonium uranate in the above-mentioned organic mixture and their transfer in an apparatus in which the drying of the spherules may be effected by means of azeotropic distillation.

Said variant is illustrated in the device of FIG. 2, which may be used when the new liquid in which the solid phase is dispersed has a density higher than that of the initial liquid and lower than that of the solid phase to be transferred.

In FIG. 2, the following reference numerals signify:

1. collecting hopper of the solid phase dispersed into the initial liquid which has to be transferred;
2. transfer vessel;
3. discharging valve from 1) to 2);
4. pressurization valve of vessel 2;
5. discharging duct from 1) to 2) of the material to be transferred;
6. discharging valve of the material;
7. valve for restoring the level in 2) of initial liquid;
8. sensitive element for regulating the level in 2) of said liquid;
9. valve for restoring the level in 2) of the new liquid in which the solid phase is dispersed;
10. sensitive element for regulating the level in 2) of said liquid;
11. discharging duct of the solid phase dispersed in the new liquid.

The operation of the device of FIG. 2 coincides with the one of FIG. 1 up to the above-mentioned phase d), whereas the subsequent phases are as follows:

e. restoration of the level of the new liquid in vessel 2 by opening valve 9 of a suitable feeding circuit, operated by a level regulator, preferably of capacitive type, whose sensitive element is indicated by reference numeral 10;

f. restoration of the initial liquid level in vessel 2 by opening valve 7 of a suitable feeding circuit, operated by a level regulator, preferably of capacitive type, whose sensitive element is indicated by reference numeral 8.

From the above description, it is evident that the demixing of the solid phase from the initial liquid in the new liquid, occurs because of their different density values. As a matter of fact the solid phase collects in vessel 2 within the new liquid as its density is higher than that of the same, whereas the initial liquid separates, always in vessel 2 from the new liquid, as its density is lower than that of the same.

Although the present invention has been described in connection with a particular embodiment illustrated in the drawing, the inventive concept is susceptible of numerous other applications which will occur to people skilled in the art. In addition, without departing from the scope of the invention, many variations may be brought to the present invention, all these variations being comprised in the above-mentioned main concepts.

What I claim is:

1. Apparatus for the pulsed and controlled transfer of finely divided solid particles dispersed in a liquid phase, comprising

a hopper adapted to hold a quantity of said dispersion,

a closed transfer vessel having a conic lower end and adapted to receive dispersion from said hopper,

a feed duct leading from the bottom of the hopper to the interior of the transfer vessel,

a valve located in said feed duct,

means for pressurizing said transfer vessel,

a discharge duct leading from said conic bottom,

a valve located in said discharge duct,

means for actuating said valves in timed sequence,

a conduit communicating with said transfer vessel and

adapted to supply a liquid thereto,

a third valve located in said conduit, and

a level regulator located in said transfer vessel adapted to actuate said third valve so that said liquid is maintained at a predetermined level in the transfer vessel.

2. Apparatus for the pulsed and controlled transfer of finely divided solid particles dispersed in a liquid phase as claimed in claim 1 wherein the pressurizing means communicate with the transfer vessel at its top.

3. Apparatus for the pulsed and controlled transfer of finely divided solid particles dispersed in a liquid phase as claimed in claim 1 and including a second conduit communicating with the transfer vessel and adapted to supply a second liquid thereto so that said second liquid is maintained at a predetermined level in the transfer vessel.

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