July 16, 1963 G. GRÜN 3,097,828

METHOD AND APPARATUS FOR MIXING PULVERULENT OR FINE-GRAIN MATERIAL

Filed April 28, 1959

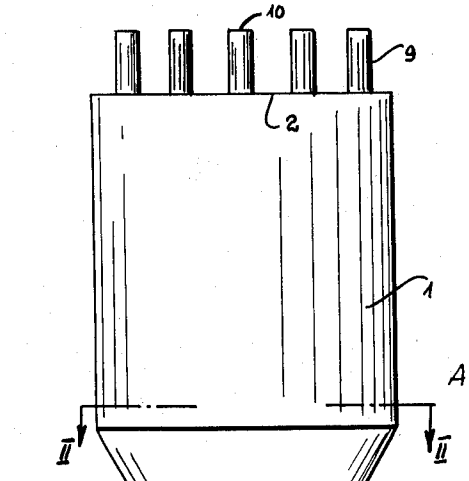


Fig.1

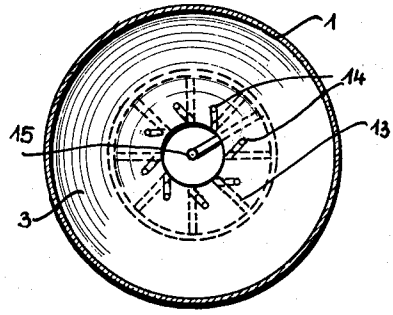
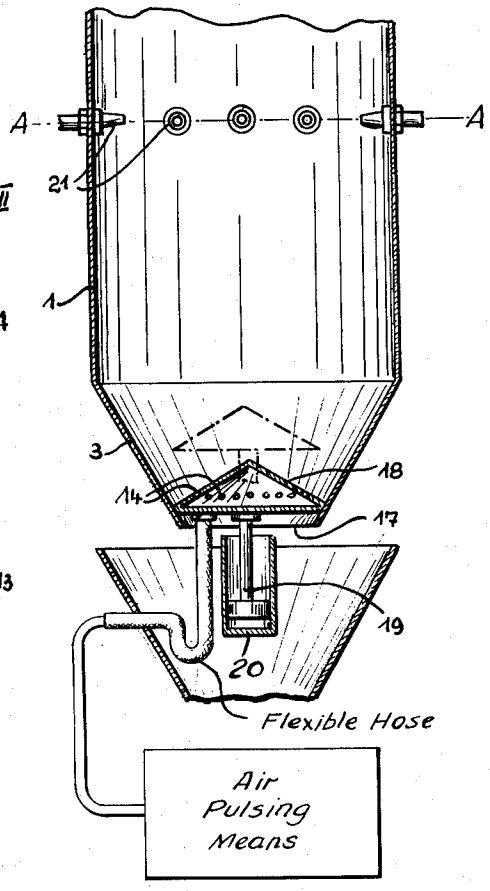


Fig.2

Fig.3



GUSTAV GRÜN

INVENTOR.

BY Emory L. Groff

ATTORNEY

United States Patent Office 3,097,828 Patented July 16, 1963

3,097,828

METHOD AND APPARATUS FOR MIXING PULVERULENT OR FINE-GRAIN MATERIAL

Gustav Grün, 73 Ortenberger Strasse, Lissberg, Germany

Filed Apr. 28, 1959, Ser. No. 809,404
Claims priority, application Germany Apr. 30, 1958
4 Claims. (Cl. 259—4)

For mixing two or more pulverulent or fine-grain materials with one another it is known to introduce the materials into a closed container whose lid has outlet apertures closed by filter elements and in whose bottom portion there are mounted nozzles which can be connected to a source of compressed air, and to blow compressed air or a gas under pressure into this container from the bottom. The pulverulent contents of the container are churned upwards and mixed together by sheer turbulence from a stream of gas under pressure. It may, however, happen that the continual stream of gas under pressure hurls more particularly the materials having a low specific gravity beyond the other materials which have a higher specific gravity, against the container roof and said materials of lower specific gravity are so pressed against the filter elements by the pressure gas streams which escape through the said elements, that the aim of achieving the most uniform mixing is not attained.

It has now been found that an intimate uniform mixing can be achieved in a very short period of time if the gas under pressure is made to act on the materials during several brief periods of time following one another at short intervals.

Thus, the novel method, of mixing two or more pulverulent or fine-grain materials, wherein the materials are whirled upwards within a closed cylindrical chamber by pressure gas introduced into the said chamber from the bottom and issuing through filter elements in the chamber roof, consists in that the gas under pressure is made to act on the materials for mixing in a plurality of pressure waves each lasting for only a short period of time and following one another at short intervals.

Advantageously, the intensity of the pressure waves is so dimensioned that at each pressure wave the coarsest particles or the particles of highest specific gravity are put into a suspended state. The gas under pressure is expediently blown into the advantageously cylindrical chamber through a ring of nozzles in a plurality of obliquely upward directed part-streams so that the part-streams whirl the material in a rotating manner.

The time between the successive pressure waves is advantageously so calculated that the materials whirled upwards by each preceding pressure wave and in so doing mixed with one another have settled again to the bottom of the chamber before the next pressure wave begins or are just completing the settling movement, i.e. the excess pressure built up in the chamber by the preceding pressure wave has approximately reached equilibrium again with the ambient pressure through the filter elements, the intensity and the duration of the successive pressure waves and also the intervals between the individual pressure waves can be varied within a mixing operation.

The novel method results in whirling the materials upwards several times but in each case for only short periods, the degree of mixing being improved with each further pressure wave, and after a few pressure waves a completely uniform mixture has already been achieved, and the relatively rapid homogenisation of the mixture is also substantially promoted by the fact that the materials whirled about in rotary movement during a pressure wave fall down again before the succeeding pressure waves, i.e. are always whirled upwards again with succeeding pressure waves.

Expediently, the novel method is carried out in an upright cylindrical container whose bottom portion has a conical shape, the inlet nozzles being arranged in a circle near the lower extremity of the conical bottom portion about the emptying door which closes the said bottom portion, and being directed obliquely upwards in accordance with generatrices of the conical bottom portion. The conically tapering bottom portion of the container can also be closed by a conically shaped closure which in the closed position bears against the inner wall of the conical bottom portion and which is constructed as a hollow cone, is adapted to be connected to the source of gas under pressure and is provided near its closure edge with nozzle apertures directed towards the conical bottom portion.

The novel method can also be used for mixing liquid substances with pulverulent or fine-grain materials, a circle of nozzles penetrating through the container wall injecting a liquid medium in finely sprayed jets at each pressure wave.

The novel method will be explained in more detail hereinafter with reference to two apparatuses used for carrying it into effect. In the drawings:

FIGURE 1 is a side view of a first form of embodiment,

FIGURE 2 is a cross-sectional view taken on the line II—II of FIGURE 1 and

FIGURE 3 is an axial sectional view of a second form of embodiment.

The mixing apparatus consists of a cylindrical container **1** which is situated in an upright position and is closed at the top by a roof **2** and whose lower edge is connected to a downwardly narrowing conical portion **3**. The end of the conical portion **3** forms an outlet pipe **4** which can be closed by a door **5**. The door **5** can be operated by an operating handle **6**.

The roof **2** has a filling hole closable by means of a door not shown in the drawings, and is provided with a circle of holes into which cylindrical hose pieces **9** made of filter cloth are inserted. The filter hoses **9** are closed at the ends by closure walls **10**.

The conical portion **3** is surrounded at its lower region by an annular pipe **12** which can communicate with a source of compressed air and which is connected by branch pipes **13** to nozzles **14**. The nozzles **14** project through the conical portion **3** and are so arranged therein that their axes follow approximately the inclination of the wall of the conical portion **3**, but are directed obliquely thereto.

Also provided in the plane of the nozzles **14** is a central nozzle **15** which is situated in alignment with the axis of the cone **3** and which is also connected to the annular pipe **12**.

In the modified form shown in FIGURE 3, the outlet **17** of the conical portion **3** is closed by a hollow cone **18** whose base surface diameter is somewhat larger than the diameter of the outlet **17**. The closure cone **18** when in the closed position bears on the inner wall of the conical portion **3** near the outlet **17**. For emptying the mixing chamber **1**, the hollow cone **18** is lifted by any desired means. In the example of the embodiment, the hollow-cone **18** is carried by the piston rod **19** of a pressure medium cylinder **20**. The hollow cone **18** is connected to air pulsing means, diagrammatically indicated in FIG. 3, by a flexible feed pipe **23** which follows the up and down movement of the cone. It will also be understood that the annular feed pipe **12** of FIG. 1 may be similarly connected to air pulsing means by a connection **24**.

The wall of the hollow cone **18** is provided near its base surface with a circle of nozzles **14** or apertures for accommodating nozzle elements. These nozzles **14** are directed obliquely upwards and obliquely to the axis of the conical portion **3** so that the gas under pressure issuing

from these nozzles imparts a twisting movement to the material which is to be whirled upwards.

Substantially at the height of the plane A—A representing the suspension zone which is achieved by providing a specific gas pressure in accordance with the material being treated, it is possible to provide in the wall of the chamber **1** radially directed nozzles **21** which spray a liquid medium in a finely divided state into the suspension zone.

I claim:

1. An apparatus for mixing pulverulent materials of different specific gravity, comprising, in combination,

a cylindrical container providing a single mixing chamber,

a roof for said container and having air outlet filter means,

a downwardly narrowing conical portion at the lower end of the container and having an outlet,

an annular series of nozzles disposed in said conical portion, said nozzles discharging obliquely to the axis of the cylindrical container,

and air pulsing means connected to said nozzles to create successive waves of air pressure of short duration with relatively quiescent materials settling intervals therebetween,

whereby, the material in the container is alternately whirled upwardly in the form of a vortex by each pressure wave to mix and distribute the material throughout the cylinder, and the intervals between successive waves cause the material to settle toward the bottom of the container as pressure in the chamber reaches equilibrium due to the pulsing pressure passing through said filter means before the next wave begins.

2. An apparatus according to claim 1, wherein,

a central discharge nozzle is disposed axially of the container and surrounded by said annular series of nozzles.

3. An apparatus according to claim 1 wherein,

an inverted hollow closure cone is disposed within the conical portion of the container,

and pressure responsive lifting means is connected to the inner side of the cone to raise and lower it relative to the said outlet.

4. A process for mixing powdered or finely granulated material containing particles of light and heavy specific gravity, which consists in,

subjecting said material to intermittent blasts of air in the pattern of a vortex to move the material upwardly in a container about its axis,

and interrupting the blasts to provide periods of quiescence to cause the material to settle to the bottom of the container between successive agitating waves.

References Cited in the file of this patent

UNITED STATES PATENTS

1,971,852	Goebels	Aug. 28, 1934
2,528,514	Harvey et al.	Nov. 7, 1950
2,539,847	McGrath	Jan. 30, 1951
2,653,801	Fontein et al.	Sept. 29, 1953
2,688,423	Davis	Sept. 7, 1954
2,724,580	Revallier	Nov. 22, 1955
2,750,681	Berry	June 19, 1956
2,761,769	Elder	Sept. 4, 1956
2,844,361	Dilcher et al.	July 22, 1958
2,884,230	Pyle	Apr. 28, 1959

FOREIGN PATENTS

19,427 of 1907	Great Britain	Aug. 31, 1908