APPARATUS FOR RENDERING PULVERULENT MATERIALS FLUENT

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This invention relates to the treatment of pulverulent materials, such as dry cement, cement raw meal, pulverized coal, pigments and the like, in apparatus for weighing, measuring, transporting, extracting, homogenizing, or the like. In order to render such material fluent so that it may be readily treated in such operations it has been usual hitherto to introduce air into the mass of material to be treated, so as to reduce or eliminate friction between the particles and at the same time to subject the material to the action of mechanical stirrers or agitating devices, the construction, provision and operation of which involve expense. It has been found that the desired result can be accomplished even more effectively and without the expense of mechanical stirrers by a continued introduction of a gaseous medium, such as air, in a continuously and rapidly pulsating current, the interruption or pulsations of which are produced, for example, at intervals of one or two seconds, while the volume introduced at each pulsation is small, travels through the mass, effecting separation of its particles by a film of air, and is quickly followed by other pulsations whereby the entire mass is rendered fluent, and it has been found that the air consumption when the air is introduced in this manner is even less than that required when mechanical stirrers are also used. The air is introduced into the mass of material within a suitable container under the control of suitable valves by which the pulsating effect is produced.

In the accompanying drawing in which are illustrated several embodiments of the invention:

Figure 1 is a somewhat schematic view in vertical section showing one embodiment of the invention, the air reservoir being represented on a somewhat smaller scale than the rest of the apparatus.

Figure 2 is also a view in vertical section, somewhat schematic, showing a form of control valve which might be used in place of that shown in Figure 1, the material container and the air reservoir not being shown.

Figure 3 is a view in vertical section, partly schematic, showing another form of valve which may be used, the air reservoir being represented on a scale smaller than that of the rest of the view while the material container is not shown.

In the embodiment of the invention illustrated in Figure 1 the material container 1, represented as being in its bottom two spring loaded valves 2 opened upward into the container and admitting air under pressure from a header 2 which is supplied with air through a pipe 3 in which is placed a two-way valve 4 which may be rotated at uniform speed by a chain drive 5 from a suitable source of power indicated at 6. The air or other gaseous medium employed may be supplied under pressure from a suitable compressor which may be of any usual construction and need not be shown. It is preferable to interpose in the connection between the compressor and the container an air reservoir 6 to allow for alternate compression and expansion of the air in the operation of the apparatus and to prevent excessive fluctuation. The valve 4 is operated so that the air shall be admitted and cut off at regular intervals, say one or two seconds. When the valve 4 is open the valves 2 are lifted by the air pressure from their seats and air then enters the mass of material within the container. When the valves are thus open the pressure in the reservoir 6 falls somewhat and when the valve 4 closes the valves 2 also close and the pressure is again built up somewhat in the reservoir 6. In this manner the air enters the mass of material in the container in rapidly and continuously successive pulsations and, when the operation is continued for a time, is distributed throughout the mass having its particles separated throughout by a film of air, is thereby rendered so fluent that the material can flow and be subjected to further treatment as a liquid.

Figure 3 of the drawing shows only a valve mechanism which might be introduced between the air reservoir and the material container of Figure 1. In this valve mechanism there are provided two ports 7 and 8 of different sizes with which are arranged to cooperate respectively valve discs 9 and 10 mounted on a spindle 11. The latter carries an armature 12 which is actuated in one direction or the other by electromagnets sufficiently indicated at 13 and 14 and energized alternately from a source of energy through devices of usual character and not necessary to be shown or described herein. The air under pressure is supplied from the air reservoir to the valve chamber and is conducted thence to the container for introduction into the mass of material therein. The armature and the valve discs are loaded by spring 15 which tends normally to hold both valve discs 10 and 11 against the respective ports 7 and 8 to prevent the flow of air. As the pressure in the reservoir rises to a predetermined degree it acts upon the larger valve disc 10 to raise both valve discs from their seats against the pressure of the spring 15 and the action of the magnet 14 on the
armature, which is at the same time moved into the field of the magnet 18, thereby admitting air to the container. As the pressure in the reservoir is reduced by the flow of air the spring 15 overcomes the force of the magnet 13 and the air pressure and both valves 10 and 11 are moved against their respective seats. This action will be repeated indefinitely so long as the supply of compressed air is maintained and a continuously pulsating air current will be produced in the delivery pipe for introduction into the container.

In the construction shown in Figure 3 a lift valve 21, loaded by a spring 22 and opened as hereinafter explained, controls the passage of air from the air reservoir 2& through the valve chamber 21c to the material container, which it is not necessary to show. The valve spindle 21c carries a piston 16 in a cylinder 17, in the lower end of which is a port 23 through which compressed air can enter the cylinder. Air is supplied from a compressor, not shown, to a reservoir 2& from which air is conducted to the valve chamber 21c through a pipe indicated by a dot and dash line 25. Air is also conducted from the air reservoir 2& by a pipe 16, indicated by dot and dash lines, to a spring loaded ball valve 19 and thence to the port 23 at the bottom of the cylinder 17. The valve 19 opens to allow air to pass when the pressure in the reservoir 2& reaches a predetermined degree and closes again automatically when the pressure drops. The air which is allowed by the valve 19 to pass into the cylinder 17 moves upward the piston 16 and so opens the valve 21. When the ball valve 19 closes the valve 21 is closed under the influence of the spring 22, the air then expelled from the cylinder 17 passing back through the pipe 16 to the valve 19 and thence, the ball of the valve being then free from the spring chamber, past the ball into the atmosphere through an opening provided at 24. It will be understood that the opening and closing of the valve 21 proceeds at regular intervals, dependent upon the adjustment of the valves, so that the air passes in successive pulsations from the valve chamber 21c to the material container.

Other mechanical arrangements which will effect the purpose of the invention, that is, the admission of air into the material container in successive pulsations at frequent intervals, will suggest themselves and it will be understood that, except as pointed out in the accompanying claims, the invention is not restricted to the particular constructions shown and described herein.

I claim as my invention:

1. Apparatus for rendering pulverulent material fluent which comprises a container for the material, a source of supply of air under pressure, an air connection from the supply to the container, a spring loaded valve interposed in the connection and opened by air pressure to admit air to the container, a second valve interposed in the connection, and means to open the second valve at rapidly and continuously successive intervals whereby the air is introduced into the material in rapidly and continuously successive pulsations.

2. Apparatus for rendering pulverulent material fluent which comprises a container for the material, a source of supply of air under pressure, an air connection from the supply to the container, a valve chamber interposed in the connection and having aligned ports of unequal size, a spring loaded spindle with valve discs for cooperation with the ports, an armature carried by the spindle, and magnets oppositely ar ranged with respect to the armature.

3. Apparatus for rendering pulverulent material fluent which comprises a container for the material, a source of supply of air under pressure, an air connection from the supply to the container, a valve chamber interposed in the connection, a valve, a valve spindle, a piston connected to the valve spindle, a cylinder, in which the piston is free to move, valve controlled means to admit air to the cylinder to open the first named valve, and means to conduct air from the source of supply through the valve chamber and to the container whereby the first named valve is opened at successive intervals and air is introduced into the material in successive pulsations.

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