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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Apparatus for Granulation and Drying Fluid Substances

We, PROGIL, a French Body Corporate of 77, Rue De Miromesnil, Paris 8e, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process of granulation and simultaneously drying of fluid substances such as solutions, pastes and liquids containing dissolved or finely-divided solid material.

It is known to manufacture granules from substances in a fluid state by the fluidisation technique, in which the fluid substance is injected into a rising stream of gas, in a fluidised bed containing a suspension of small solid particles which serve as a support for the granules being formed. The stream of gas is directed at the centre of the lower zone of the fluidised bed, at such a speed that it forces the particles of the bed which are subjected to this stream to move upwards to form what is termed a "spout", whilst the periphery of the channel caused by the stream of gas forms a relatively undisturbed zone, where the granules which are being formed undergo a downward movement and then arrive at the central injection zone where they are recycled in the rising stream. The granulation thus takes place by successive deposition of thin layers of the atomised fluid onto the initial particles of the fluidised bed. The driving of granules being formed is simultaneously achieved by using a hot gas. A particular embodiment of this process is for example described in French Patent Specification No 1,258,497 of 28th April, 1960.

Furthermore, various forms of apparatus have been proposed, which are suitable for this fluidisation technique and based on the principle of simultaneous atomisation of the hot gas stream and the fluid to be granulated

in the central portion of the base of an apparatus of frusto-conical form provided with standard devices, such as overflows and weirs for recovering and grading the granules produced.

One of these devices, shown schematically in British Patent Specification No. 962,265, comprises a granular ending at its base in a steep-angled funnel, which is attached to a gas supply conduit having a constriction where it joins the funnel at the centre of which the nozzle for injecting the fluid to be granulated is arranged. The combination of a funnel and a constriction constitutes a convergent-divergent system which is intended to cause considerable acceleration of the flow of gas.

Apart from the fact that it is limited to the manufacture of granules of diameter at least equal to, and generally greater than, 2 mm, such a device does not prove entirely satisfactory when operated continuously. In effect, the formation of coarse agglomerates and adhering material in the injection zone at the lower part of the funnel frequently causes blockage of the fluidised movement of the granules after 2 to 3 hours running. This type of breakdown requires emptying the bed of granules and cleaning the granulator and frequently makes it necessary to provide a new bed of solid particles. Alternatively sieving of the particles may be necessary, if the bed has been excessively moistened or if numerous granules of large diameter, greater than 8 to 10 mm, have formed.

Furthermore, the use of a simple injection tube, even when well centred in the channel produced in the convergent-divergent system of the bottom of the funnel, does not allow the ascending gas stream to be guided perfectly, since, under these conditions, the stream does not have sufficient uniformity of dynamic pressure at all points of its cross-section. This phenomenon results in an in-

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stability of the rising channel or spout, which passes through the bed of granules, so that the bed is not always uniformly distributed about the periphery of the gas stream. Furthermore, disturbances in the speed of the granules occur in the zone where the fluid to be granulated is injected, and this causes irregularities in the deposition of material onto the base particles.

The defects of the known systems become accentuated if, when attempting to produce fine granules, one is led to reduce the speed of injection of the gas stream by the maximum extent and thus to decide on as large an entry opening as possible for the granulator.

According to the invention, there is provided an apparatus for granulating and drying fluid substances by the fluidised bed technique, such apparatus comprising a vertically extending chamber, having a downwardly converging lower zone, connected directly to an at least partly downwardly diverging gas supply duct, the upper part of the chamber having baffle devices adapted to retain fine particles of solid material, the gas supply duct having co-axially arranged there-within a gas guiding body, the upper portion of which is defined by an upwardly converging wall and the lower part of which is defined by an upwardly diverging wall, to guide the gas stream before it arrives in the lower zone of the chamber.

With the apparatus of the invention, the above-mentioned disadvantages, and especially the blockage of the movement of the granules as well as the irregularities in the speed of the gas stream can be suppressed, and it is possible to obtain granules of very small diameter, for example less than 1 mm.

In order that the invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings, in which:—

FIGURE 1 represents a schematic elevation in axial cross-section, of one embodiment of apparatus of the invention; and

Figure 2 shows an enlarged fragmentary, schematic, detail elevation, in section, of the lower portion of the apparatus of Figure 1.

The apparatus illustrated in Figure 1, consists of a cylindrical chamber 1 having a vertical axis, the height of which may be between 4 and 7 metres, for example. In its upper part it is provided with baffle devices 2 which are shown as consisting of metal sheets folded in zig-zag fashion arranged parallel to one another. In its lower end, the chamber 1 has an overflow 3 for the product granules, and it ends at its base in a downwardly converging frusto-conical funnel 4, which is formed integrally with a hollow assembly 5, forming a gas supply duct. The jacket of this assembly has a downwardly diverging frusto-conical wall 6, an inclined

inlet tube 7 intended for the supply of the gas stream, and a device 8 for emptying out the particles.

The size of the angle of the funnel 4 assumes great importance in the continuous use of the apparatus. Contrary to known forms of apparatus in which it is proposed to provide a very steep angle, it has been found advantageous, in apparatus according to the invention, for this angle to be reduced as much as possible whilst still ensuring uniform flow of the granules to the base of the apparatus. It may be defined as the natural angle of repose of the granules which constitute the fluidised bed. In the most unfavourable limiting case (a very fine bed and particles which are only slightly rounded) it is about 75% of this angle, i.e. the funnel angle is 103°. In practice this angle is reduced by 5 to 7° by way of a safety margin. In this way the granules roll on the walls of the funnel with a minimum of acceleration and reach the edge of the rising gas stream practically without having acquired any speed from their fall. By the same token the formation of deposits of the fluid to be granulated and of granule agglomerates is avoided.

The hollow assembly 5 has within it a central channel 9 intended to feed the fluid substance which is to be dried and granulated, and ending in an injection nozzle 10.

Also within the assembly 5, is a central body 12 which is shown arranged coaxially within the converging section 6 and having essentially the same height as the latter. The body 12 is defined by an upwardly converging wall 13, closed at its base by an upwardly diverging wall 14 which ensures that the gas stream slips towards the convergent channels defined between the walls 6 and 13. The body 12 causes streamlining and progressive acceleration of the gas stream fed in through the tube 7, before it reaches the opening 11 where it enters the bed of granules. A tubular support 15 is integral with body 12 and has, at its centre, the injection tube 9. In order to ensure the dynamic equilibrium of the gas stream without excessively lengthening the vertical assembly 5, a baffle 16 having inclined walls is positioned below the divergent section 6, and has an orifice the cross-section of which is approximately equal to 1.5 times the cross-section 11.

The assembly of the central body 12, the tube 15 and the channel 9 can be moved within the guide tube 17, by means of a pinion 18, engaging a rack on the tube 15. Thus the position of the body 12 relative to the assembly 5 can be varied, to alter the cross-section 11 of the orifice through which the gas stream enters the chamber 1, so that the speed of the injected air can be regulated at any time.

In case of trouble in the system for atomising the fluid which is to be granulated, the

channel 9 may be easily withdrawn from its support guide 15 without at the same time changing the stream of carrier gas fed in through inlet 7. The positioning of this channel along the axis of the body 12 automatically ensures that it is perfectly centered.

According to a variant, the walls of the central body 12 may, instead of being truncated cones, to be given a frusto-pyramidal shape, if the bottom of the funnel has this latter configuration, as is for example shown in French Patent Specification No: 1,328,974 of 24th April, 1962.

In carrying out a granulation and drying process, the fluid substance fed in through channel 9 is atomised at the same time that the carrier gas stream, which will control the speed of fluidisation in the bed of particles in the chamber 1, is passed in through the inlet 7 and then successively streamlined and progressively accelerated due to the presence of the baffle 16 and body 12. The granules of the desired size, whose diameter generally is less than 2 mm, are expelled through the overflow 3 of the granulator, whilst the very fine particles (0.1 to 0.2 mm) are stopped by the baffles 2 and recycled in the fluidised bed. Dust is removed at 19 through the top of the chamber 1 and is passed into standard devices for dust removal (which are not shown).

It is to be understood that the general installation for granulating and drying comprises a series of attached components of apparatus such as systems for charging, sieving, possibly grinding and recycling particles into the chamber, as well as a combustion chamber, if the fluidisation gas stream has to be heated before being introduced into the inlet tube 7. These well-known devices have not been shown in the drawings.

The apparatus of the invention makes it possible continuously to manufacture regular granules of spherical appearance from substances which are liquid or pasty or even in the form of fine crystals. Thus, for example it is possible to obtain granules of products such as fertilisers, pharmaceutical substances, synthetic zeolites (i.e. ion exchanges), and various pesticides. This apparatus is particularly advantageous for the manufacture of granules of diameter equal to or less than 2 mm, because of the precision and flexibility with which it may be regulated.

By way of a non-limiting example, 35 tons of granules of sodium pentachlorophenate whose diameter, which was very uniform, was about 1 m, were continuously manufactured for 13 days in a granulator according to the invention having a volume of 2.5 m³, by

feeding the fluid channel 9 with 420 kg/hr of an aqueous solution containing 350 g/l of pentachlorophenate and passing 2000 m³/hr of air heated to about 380° C into the inlet tube 7.

WHAT WE CLAIM IS:—

1. An apparatus for granulating and drying fluid substances by the fluidised bed technique, such apparatus comprising a vertically extending chamber, having a downwardly converging lower zone, connected directly to an at least partly downwardly diverging gas supply duct, the upper part of the chamber having baffle devices adapted to retain fine particles of solid material, the gas supply duct having co-axially arranged therein, a gas guiding body, the upper portion of which is defined by an upwardly diverging wall, to guide the gas stream before it arrives in the lower zone of the chamber.

2. Apparatus according to claim 1, in which the gas guiding body is integral with a vertical tubular support at the centre of which is arranged a channel for injecting the fluid to be granulated.

3. Apparatus according to claim 2, wherein the tubular support is slidable in a guide tube and means are provided to move the tubular support to adjust the position of the gas guiding body.

4. Apparatus according to claim 1, 2 or 3, in which the gas supply duct has a cylindrical wall located below the downwardly diverging portion thereof, this cylindrical portion enclosing a downwardly converging annular frusto-conical baffle, to ensure dynamic equilibrium of the gas stream.

5. Apparatus according to any preceding claim, in which the chamber is cylindrical and the lower zone thereof, the downwardly diverging gas supply duct and the walls of the gas guiding body are frusto-conical.

6. Apparatus according to any preceding claim, wherein the upwardly converging walls of the gas guiding body lie wholly within that part of the gas supply duct having downwardly diverging walls.

7. Apparatus for granulating and drying fluid substances by the fluidised bed technique, such apparatus being constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

J. A. KEMP & CO.,
Chartered Patent Agents,
14, South Square,
Gray's Inn,
London, W.C.1.

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