

Aug. 29, 1967

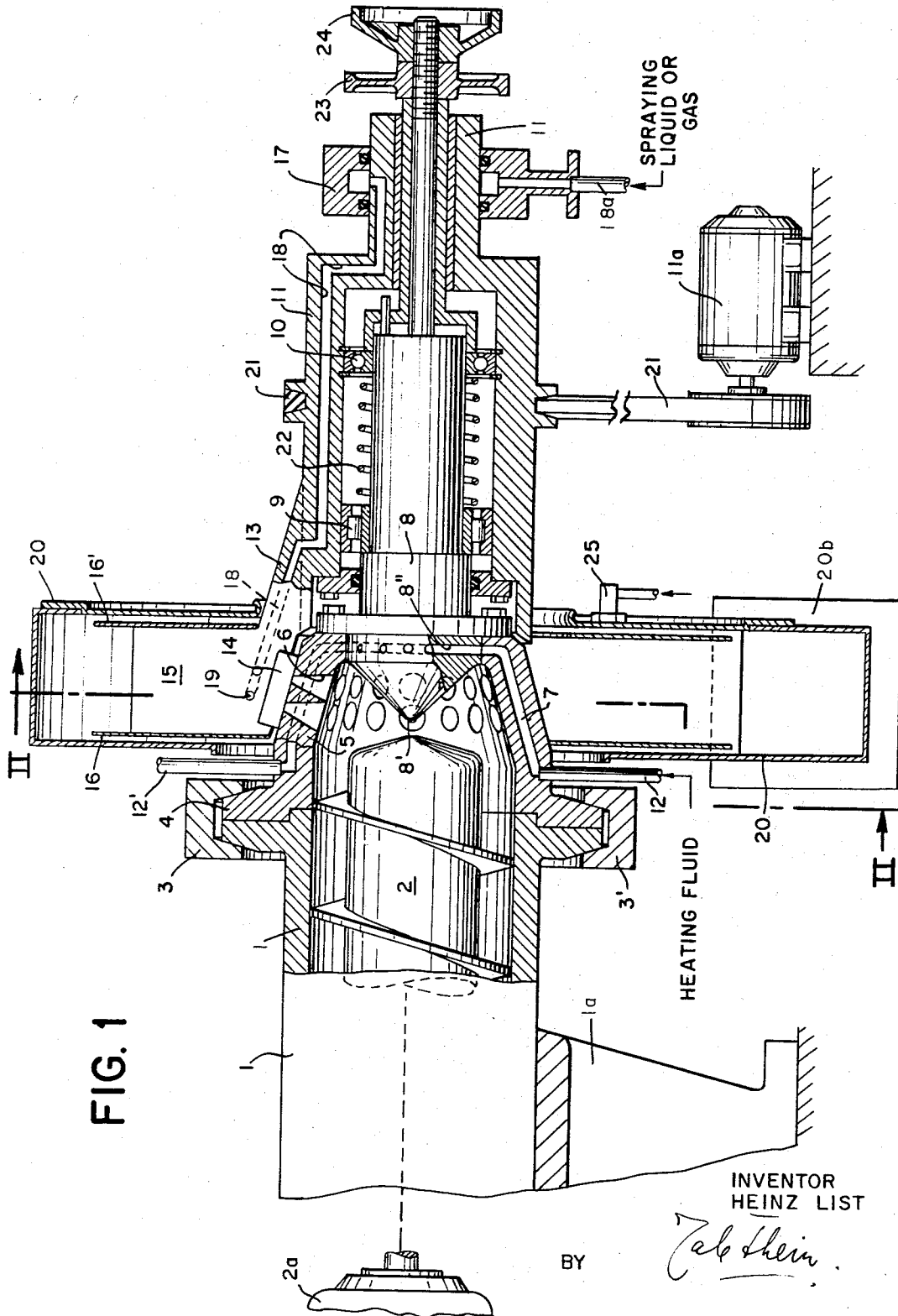
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3,337,913

GRANULATING DEVICE

Filed Jan. 28, 1965

3 Sheets-Sheet 1



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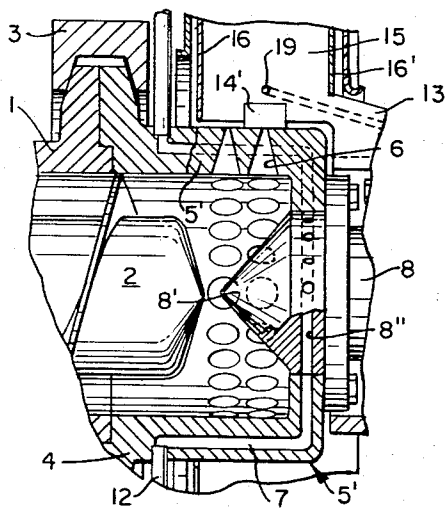


FIG. 1a

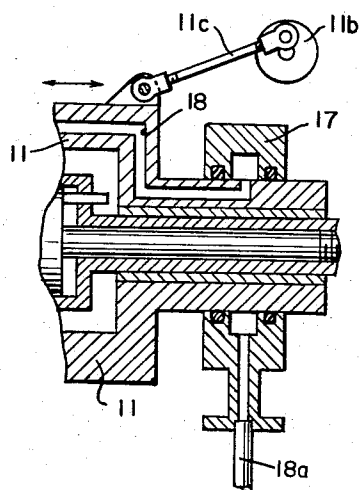


FIG. 1b

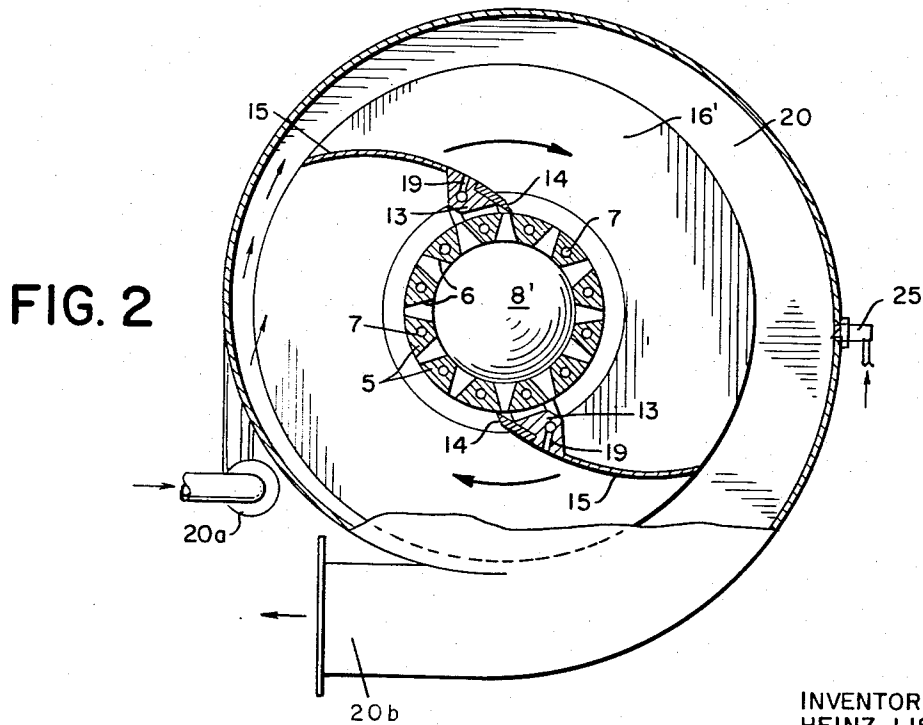


FIG. 2

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FIG. 2a

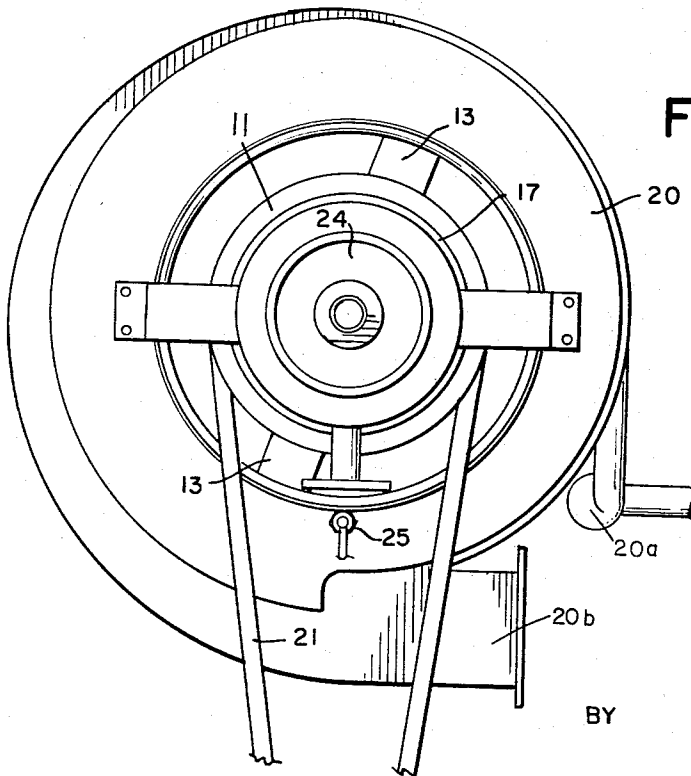
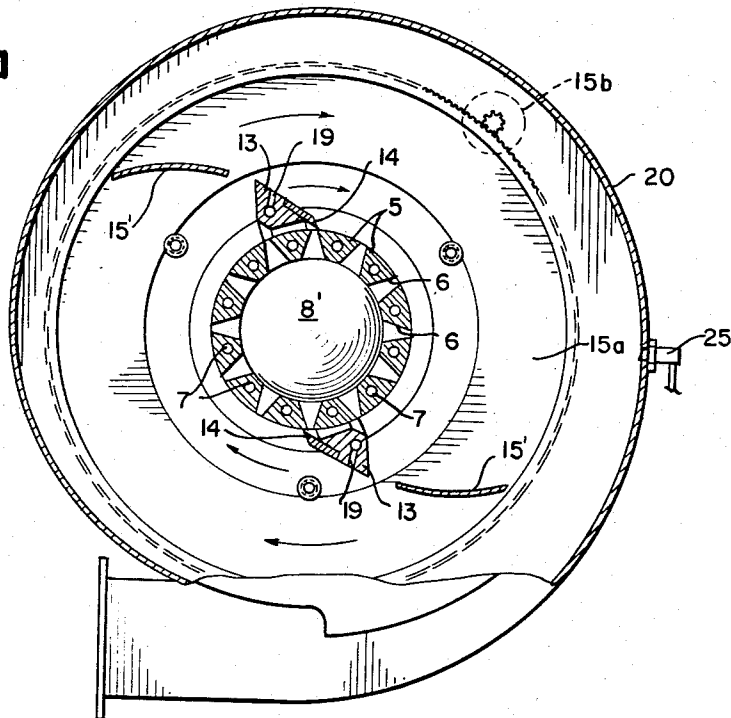


FIG. 3

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GRANULATING DEVICE

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Filed Jan. 28, 1965, Ser. No. 428,808

Claims priority, application Switzerland, Feb. 1, 1964,

1,201/64

9 Claims. (Cl. 18—12)

The present invention concerns a granulating device for reducing a mass of material to granular or particulate form, which has a material-working member, more particularly a continuously operating worm co-operating with radial outlet nozzles of the surrounding housing.

Granulating devices with worm mechanisms are known which serve for the mixing, kneading and extruding of plastic substances, especially synthetic materials. In these devices the revolving worm works and compresses the product to be granulated in the axial direction through a plate having nozzles, and which is fitted with a rotating knife which cuts the strands of material extruded from the nozzles into granular or particulate form. Many of the newer products cannot be worked without difficulty with such a granulating device as the sticky granulate adheres to the knife and thereby lowers its efficiency.

Furthermore known granulating devices have the additional disadvantage that only a small part of the surface contacted by the knife is utilized and further that the granulate reaches the reception chambers in lumps. Also, the material particles are uneven as a uniform heating of a nozzle plate perforated with axial bores is hardly possible.

The object of the invention is to provide a granulating device in which the disadvantages cited above are avoided. More particularly, satisfactory working of sticky products in continuous operation is to be obtained wherein the material particles do not adhere, neither to the knife nor to the inner wall of the reception chamber.

The granulating device according to the invention has a material-working apparatus, more particularly a continuously operating worm inside a housing having outlet nozzles. These nozzles, arranged at the outlet end of the worm, are disposed in a hollow body provided with substantially radial bores. Revolving cutting members are provided which contact the outer surface of the hollow body with their cutting edges.

The hollow body is preferably of a cylindrical or frusto-conical shape.

According to a preferred embodiment, rotating fan blades are associated with the cutting members, which produce a stream of air which additionally accelerates and cools the particles of material which is outwardly centrifuged by the cutting members.

It is further contemplated to provide substantially axial bores in the hollow body, through which uniform heating is obtained. For this purpose a heating medium may be circulated in the bores or electrical heating means may be arranged therein.

An exemplary, preferred embodiment of the invention is shown in the accompanying drawings in which

FIG. 1 is a partly sectional side elevational view of one embodiment of the granulating device according to the invention;

FIG. 1a is a partial sectional view illustrating a cylindrical apertured member as a modification of the conical member shown in FIG. 1;

FIG. 1b is another partial sectional view showing optional drive means for oscillating the cutting devices together with the bearing case;

FIG. 2 is a partly sectional view of the major inner components, taken along line II—II of FIG. 1, with the knives and the fan blades interconnected;

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FIG. 2a is a view similar to that of FIG. 2 but showing a modification wherein the knives are supported for rotation separate from that of the fan blades, also showing a separate support for the latter; and

FIG. 3 is an end view of the granulating device, taken from the right-hand side of FIG. 1.

The illustrated granulating device has a housing 1 in which a material-working member is disposed in the form of a worm 2 capable of continuous operation. The housing 1 is fixed to the floor or ground in a conventional manner, e.g. by the intermediary of a foundation or base 1a, as shown in FIG. 1. A conventional drive is shown at 2a for the worm 2. A plurality of outlet nozzles is arranged at the right-hand end of the housing 1, as viewed in FIG. 1, being constructed as a hollow body of rotation in the form of an outlet support 4 and a conical apertured member 5 (FIG. 1). Stirrup clamps 3 and 3' are provided to secure the outlet nozzle support 4 onto the housing 1. The apertured member may be given a cylindrical shape, as shown at 5' in FIG. 1a while FIG. 1 shows the conical member 5.

As can be seen from FIG. 1 the conical apertured member 5 is provided with radially aligned apertures 6 to allow passage of the material to be granulated. Longitudinal bores 7 serve to accommodate a heating fluid or medium for the apertured member 5. An extruder 8', forming the extension of a trunnion 8, extends into the interior of the apertured member and has bores 8'' which form extensions of the bores 7.

The trunnion 8 is flanged to the end flange of the nozzle support 4 (e.g. by way of a number of circumferential bolts). Thus the trunnion 8 is arranged coaxially with the worm 2, and it carries a rotatable bearing case 11 by means of bearings 9 and 10. The feed of the heating medium to bores 7, 8'' takes place by means of a pipe 12 attached to the mouth of the bore 7 while a pipe 12' is provided for allowing the heating medium to be discharged therefrom. The heating medium which enters the longitudinal bores 7 through pipe 12, is fed through the bores 8'' of the extruder 8' and flows back into the external heating system through further longitudinal bores 7 and pipe 12'. The heating system is not shown in the drawing.

In place of fluid heating, electrical heating could be provided by means of electric heating elements disposed in the bores 7, 8.

Preferably two cutting devices are provided, including knife arms 13 carried by the bearing case 11, radially disposed and extending in the axial direction, each of the arms 13 carrying a knife 14 and a fan blade 15 (see also FIG. 2). For the sake of clarity, FIG. 1 only shows one system of elements 13-15. The knives may be adjustably arranged relative to each other in the axial direction (not shown). The arrangement of the knives 14 is such that during rotation of the bearing case 11 they contact the surface of the radial apertures 6, member 5 in the region of the apertures thereof.

The fan blades 15 produce an air flow which additionally accelerates the granulate particles whirled outwardly by the centrifugal action of the knives 14. At the same time cooling and setting of the material particles takes place.

A reception chamber for the material particles is shown at 20 (see FIGS. 1 to 3). This chamber 20 surrounds the apertured member 5 along with the rotating knives 14 and the fan blades 15. It is suggested to provide lateral rotating walls 16 and 16' attached to the knife arms 13. In FIG. 1, the right-hand side of the chamber 20 is shown with releasable or detachable flanged portions, for cleaning and maintenance purposes of the inner mechanism.

The bearing case 11 is provided with a bore 18 which connects with corresponding bores 18 in the knife arms

13, these bores terminating in outlet openings or spraying nozzles 19 at the outlets and adjacent the respective fan blades 15. Lateral yokes or brackets attached to the outer walls of the reception chamber 20 (see FIG. 3) hold a stuffing box 17 which is thus connected with the conical flange of the nozzle support 4. A liquid or gaseous medium is fed into the stuffing box 17 through an appropriate inlet pipe 18a, thence through the bores 18 of the bearing case, the corresponding bores 18 in the knife arms 13 and to the spraying nozzles 19 adjacent the fan blades 15 so as to form a protective film thereon, as well as on the inner wall of the reception chamber 20, which prevents the material particles from adhering thereto.

The medium should conveniently be guided as near as possible to the cutting edges of the knives 14. In this way the affected surface will be extensive and the cooling of the knives improved.

A V-belt 21 and a conventional drive 11a are provided to drive the bearing case 11 (FIG. 1) together with the attached cutting devices.

As can be seen from the drawing the bearing 10 along with the bearing case 11 supported thereby is subject to the action of a compression spring 22 which urges the bearing case along with the knives 14 towards the right-hand side in FIG. 1.

An adjustment nut 23 with a lock nut 24 (see also FIG. 3) serves as an abutment against this displacement. By adjustment of the nut 23 the play between the knives 14 and the apertured member 5 may be adjusted during operation as desired.

Further nozzles 25 (FIGS. 1, 2 and 3) are provided for additionally spraying the inner walls of the reception chamber 20.

In one preferred embodiment, illustrated in FIG. 1, two diametrically opposed knives 14 are shown, as a matter of example, so that on each revolution of the case 11 each strand of material issuing from the apertures 6 will be cut twice. Should only a single cut be required to take place at a similar cutting speed, the knives can be provided such that their length corresponds to only half the length of the outer conical surface line of the apertured member 5 as shown at 14' in the modified partial view of FIG. 1a. On the other hand, it is also possible to provide additional knife arms, for example four or six (not illustrated.)

It is further possible to use the above-described axial adjustability of the device not only for a change in the play of the knives 14 but to provide an additional oscillating drive in the axial direction. Such a drive is shown, as a matter of example, in FIG. 1b, at 11b, with a linkage 11c connecting the mechanism to the bearing case 11.

In combination with the cylindrical apertured member 5' of FIG. 1a, the oscillatory movement produces a drawing cut which is advantageous with certain products. If the conical apertured member 5 of FIG. 1 is used, the length of the material particles can be varied by the axial oscillating movement of the cutting device. In this way the knife is made to jump over one or more rows of nozzles or apertures 6 before cutting the next row.

It is shown in the modification of FIG. 2a that it is also possible to mount shorter fan blades 15' on a separate support or crown 15a surrounding and radially spaced from the cutting knives 14, and to drive the crown independently therefrom the drive for the knives. In this case the fan blades 15' rotate in the same plane as the knives 14, the volume traversed by the blades being concentric with and surrounding the volume traversed by the cutting device constituted by the knives. FIG. 2a shows, in an exemplary manner, drive means 15b, in the form of a motor-driven pinion, acting upon a toothed outer rim of the support or crown 15a. The latter may be supported by inner bearings, as shown.

It should also be explained that under certain conditions it may be convenient to build in additional fan blades between the blades 15 associated with the cutting

members 14, which are disposed and driven independently from the knife arms 13.

Finally it should further be pointed out that when working sticky material, the surfaces of the blades 15, 15' should be kept as small as possible. An additional air stream should be produced in this case by the provision of an additional fan which is arranged outside the reception chamber 20 and effects exhaustion as well as cooling of the material particles. As a matter of example, FIGS. 2 and 3 show such a fan at 20a, for producing the additional air stream for the material particles. Again as a matter of example, an outlet or discharge 20b has been shown in the drawings for the material particles.

What I claim is:

1. A granulating device comprising, in combination, a material-working apparatus in the form of a rotatable worm having outlet means arranged at the outlet end of said apparatus, said outlet means being in the form of a channeled and apertured member having substantially radial bores for the passage of the material upon rotation of said worm, at least one rotatable cutting member supported substantially coaxially with respect to said apparatus and on the side of said apertured member facing away therefrom, each cutting member having a cutting edge in linear contact with a portion of the outer surface of said apertured member, and at least one rotatable fan blade connectable with a respective cutting member, said cutting members and said fan blades when aligned presenting a unitary curved profile tangentially contacting said outer surface of the apertured member.

2. The granulating device as defined in claim 1, wherein said apertured member has therein substantially axial bores intermediate said radial bores, spaced apart and independent therefrom, and adapted for operative association with heating means for the material by the intermediary of the wall of said apertured member.

3. The granulating device as defined in claim 1, further comprising first drive means for rotating said worm, a rotatably journaled bearing case supporting said cutting members and said fan blades, and second drive means for rotating said bearing case independently from said first drive means.

4. The granulating device as defined in claim 3, wherein said bearing case is mounted coaxially with respect to said worm, further comprising adjustable abutment means in operative connection with a portion of said bearing case, and biasing means for urging said bearing case toward said abutment means and for urging said cutting members axially away from said worm, so as to adjust the play between said cutting members and said outer surface of the apertured member.

5. The granulating device as defined in claim 3, further comprising third drive means for axially oscillating said bearing case and cyclically altering the play between said cutting members and said outer surface of the apertured member.

6. The granulating device as defined in claim 3, further comprising a housing for said apparatus, said apertured member forming the outlet end of said housing intermediate said worm and said bearing case, said cutting members having therein outlet apertures facing away from said apertured member, a conduit system operatively connected with said outlet apertures for allowing spraying fluid to be fed to the vicinity of said fan blades, and a reception chamber for the material, surrounding and spaced away from said cutting members.

7. The granulating device as defined in claim 6, wherein said apertured member has at least two substantially concentric rows of said radial bores, and the length of at least one of said cutting edges, contacting said outer surface of the apertured member, is shorter than the linear length of two adjoining rows of radial bores so that said one cutting edge will pass over only one of said two rows.

8. The granulating device as defined in claim 1, further comprising first drive means for rotating said worm, a

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rotatable crown surrounding and radially spaced from said cutting members, for supporting said fan blades separately from said cutting members, second drive means for rotating said cutting members alone, and third drive means for rotating said crown independently from said second drive means.

9. The granulating device as defined in claim 8, further comprising fan means for producing an air stream in the vicinity of said cutting members.

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