Jan. 27, 1959 E. N. MEAKIN 2,870,480

APPARATUS FOR COOLING MATERIAL ADVERSELY AFFECTED BY HEAT OF EXTRUSION

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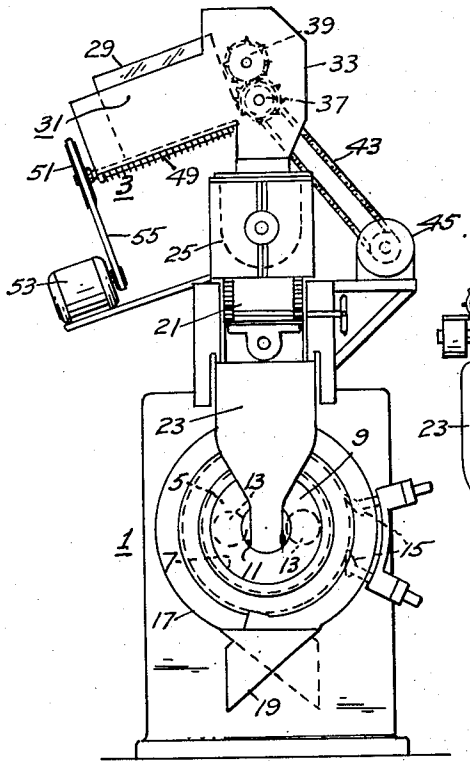


Fig. 1.

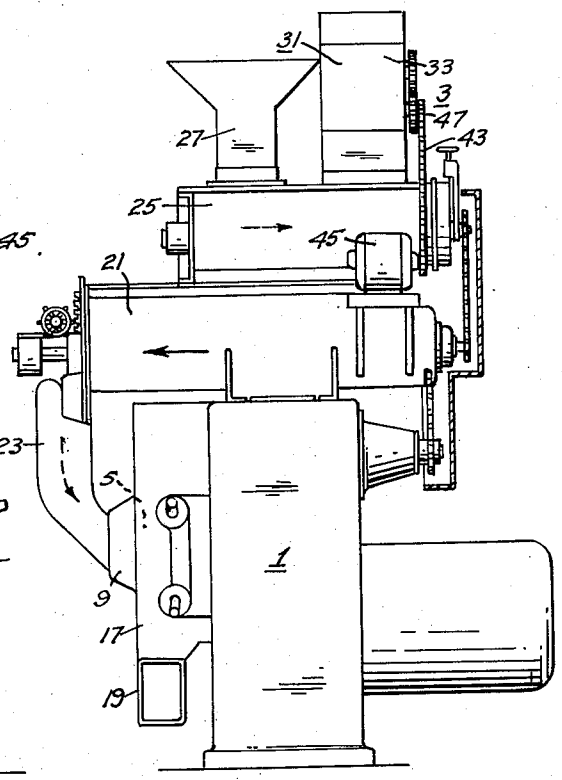


Fig. 2.

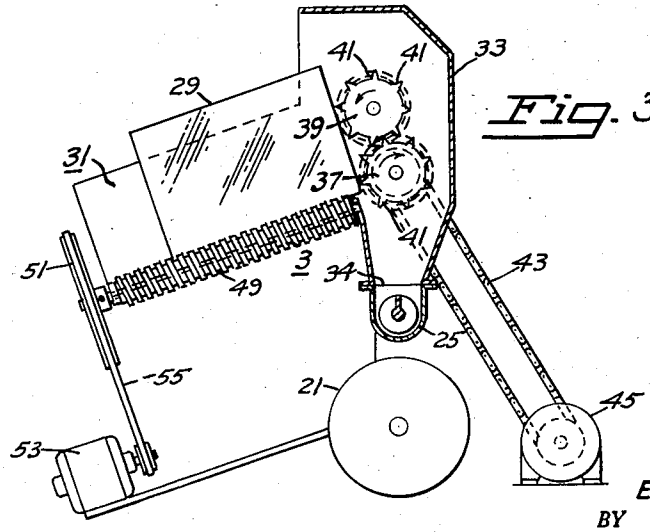


Fig. 3.

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APPARATUS FOR COOLING MATERIAL ADVERSELY AFFECTED BY HEAT OF EXTRUSION

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5 Claims. (Cl. 18—12)

My invention relates to the extrusion of material adversely affected by heat of extrusion, either physically or chemically, and more particularly relates to apparatus for the cooling of such material during extrusion thereof.

In my co-pending application for Method of Extruding Material Which is Adversely Affected by Heat, Serial No. 512,299, filed May 31, 1955, I disclose a method for extruding such materials which method involves a preliminary step of refrigerating such material as by the mixture therewith of a refrigerant such as Dry Ice, and then extruding the material while in its refrigerated condition.

Among the objects of the present invention are:

(1) To provide novel and improved means for adding a refrigerant to material to be extruded;

(2) To provide novel and improved apparatus capable of intimately mixing a refrigerant with material to be extruded;

(3) To provide novel and improved apparatus for uniformly adding a refrigerant in solid form to material as it is supplied to extrusion apparatus;

(4) To provide novel and improved apparatus adapted to comminute solid material such as Dry Ice or the like.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings, wherein,

Figure 1 is a front view in elevation of a pellet mill embodying the features of the present invention;

Figure 2 is a side view in elevation of the pellet mill of Figure 1;

Figure 3 is a fragmentary view in section through that portion of the pellet mill of Figure 1 disclosing the improvement constituting the essence of the present invention.

Referring to the drawings for details of my invention in its preferred form, the same involves the addition to a pellet mill 1 of any conventional type, apparatus 3 adapted to cooperate therewith to the extent of adding to the material to be extruded, a refrigerant capable of intimately mixing with the material, to thereby efficiently refrigerate the same and thus condition it for extrusion without being adversely affected by heat which would otherwise be generated in such material during the extrusion thereof.

The particular pellet mill illustrated is of the type incorporating a horizontal cylindrical extrusion chamber 5 defined by a rotatable cylindrical die 7 which is spanned at the front by a substantially conical cover 9 having a central feed opening 11 therein.

Within the chamber, in a diametrical, horizontal plane, are supported a pair of extrusion rollers 13 which are adjustably positioned with respect to the die. Material supplied to the extrusion chamber is extruded through the die by these rollers as the die rotates. Extruded material emerging from the discharge side of the die is periodically scraped by stationary knives 15 to form pellets.

The extrusion chamber is enclosed in a shroud 17 which terminates at its lower end in a hopper discharge 19 for receiving and guiding the pellets from the machine.

Material to be extruded is fed into the extrusion chamber from a mixer 21 which is supported at the upper end of the mill, and supplies the extrusion chamber through a chute 23 running from the front end of the mixing chamber and into the feed opening in the cover of the extrusion chamber.

The material enters the back end of the mixer from a feeder 25 mounted above and supported by the mixer, and having connection with the mixer at the rear end thereof. Both the feeder and mixer are equipped with feed screws, that in the mixer being adapted to thoroughly mix the ingredients which enter the mixer to produce a homogeneous mixture thereof. Such material is continuously fed into the feeder through a hopper 27 connected to the feeder adjacent the rear end thereof.

The mill as thus far described, is merely representative of the prior art and is adapted to the formation of pellets through the extrusion of material through die holes. During such extrusion, substantial heat may be generated, and such heat can adversely affect certain materials under extrusion. The improvement constituting the present invention, serves to counteract such heat by refrigerating the material through the mixture therewith of a refrigerant in solid form such as Dry Ice, which ultimately vaporizes and disappears without leaving any residue, or otherwise deleteriously affecting the material from which the pellets are formed.

Such improvement broadly involves the apparatus 3 which is the preferred embodiment, gradually comminutes a block 29 of the refrigerant in its solid state and feeds the comminuted refrigerating material to the material to be extruded, and preferably prior to the entrance of such material into the mixer whereby an intimate mixture of the material and the refrigerant will be realized just prior to extrusion of the material. Such intimate mixture places the refrigerant in close contact with the particles of the extrusion material, thereby assuring not only rapid, but uniform refrigeration thereof. This is quite important in that material which is extruded to form the pellets usually possesses high heat insulating characteristics, thereby making it otherwise difficult to refrigerate. For such reason, any prior attempts to refrigerate, which sought to cool from the outside, necessitated high powered refrigerating equipment, proving not only costly in the initial installation thereof, but also expensive in its operation and upkeep.

In the specific embodiment of the invention as illustrated in the drawings, a support in the form of a cradle 31 terminating at one end in a shrouded hopper 33 mounted over an opening 34 in the upper surface of the feeder to one side of the material hopper, is adapted to receive a block of refrigerant such as Dry Ice.

In the shroud portion of the hopper 33, are rotatably supported a pair of comminuting rolls 37 and 39, one above the other and geared to each other. Each roll is provided with a plurality of scraper elements such as pegs 41 extending from the surface thereof. These rolls are preferably rotatable toward each other, as viewed in the drawings, by means of a suitable drive chain 43 connecting a drive motor 45 to a sprocket 47 at one end of one of the rolls and externally of the container.

Means is provided for urging a block of the refrigerant against these rolls, whereby the rolls in picking away at the exposed end of the block of refrigerant, will serve to comminute the same and cause the small particles thus removed, to drop and be guided into the feeder to move with the extrudable material to the mixer. In the mixer, the refrigerating material will become intimately mixed

with the material to be extruded and cause the same to become thoroughly refrigerated.

The means for continually urging the block of refrigerating material against the comminuting rolls preferably takes the form of a feed screw 49 disposed longitudinally of the cradle and partially submerged in the floor thereof. This feed screw is connected externally of the container to a sprocket or pulley 51 which is driven from a motor 53 by means of a connecting sprocket chain or belt 55.

The block refrigerant being much colder than the drive screw, will melt down over the exposed portion of the screw to form a screw drive connection therewith, whereby rotation of the screw will force the block of refrigerant in the direction of the comminuting rolls.

To permit of positive and accurate control of the forward movement of the refrigerant, the supporting cradle is preferably mounted in a tilted position with the roll end at a slightly higher elevation than the opposite end. Such manner of mounting, completely eliminates any probability of a gravitational component of force urging the block in the direction of the rolls, as the movement of the block would then be somewhat difficult to control accurately. Thus such forward movement becomes exclusively the function of the screw drive.

In connection with the problem of refrigerating the material to be extruded, it is desirable to adjust the rate of refrigeration to both the particular material passing through the machine, and the rate at which such material is supplied. Such adjustability is made possible by utilizing as the screw drive motor, one capable of having its speed adjusted, whereby the rate of movement of the block of refrigerant may be accurately controlled, and thereby accurately adjusted to the requirements of the particular material to be extruded.

It will be apparent from the foregoing description of my invention in its preferred form, that the same fulfills all the objects attributed thereto, and while I have illustrated and described the invention in its preferred form and in considerable detail, it is apparent that the same is subject to alteration and modification without departing from the underlying principles involved. I accordingly do not desire to be limited in my protection to the specific details so illustrated and described except as may be necessitated by the appended claims.

I claim:

1. In combination with a machine having an extrusion chamber means for feeding material to said extrusion chamber for extrusion, means for adding a refrigerant to said material prior to extrusion, said means comprising a support for a refrigerant in a solid tate, and means for comminuting such refrigerant, said means including at least one roll mounted adjacent an end of said support, having a plurality of pegs extending from the surface thereof, means for driving said roll and means for urging a block of such refrigerant toward said roll, said last means including a drive screw disposed longitudinally of said support and being at least partially exposed thereby to permit such block of refrigerant when positioned on the drive screw to settle down thereon and to effect a screw drive engagement therewith, and means for rotating said drive screw at a speed which is adjustable to the requirements of the particular material being extruded.

2. In combination with a machine having an extrusion chamber, and means for continuously feeding material to said extrusion chamber for extrusion, means for adding a refrigerant to said material prior to extrusion, said means comprising a support for a refrigerant in a solid state, means for comminuting such refrigerant, said means including a pair of rolls mounted adjacent an end of said support, each of said rolls having a plurality of pegs extending from the surface thereof, means for driving said rolls in opposite directions, and means for continually urging a block of such refrigerant toward said rolls, said last means including a drive screw disposed longitudinally of said support and being at least partially exposed thereby to permit the block of refrigerant to settle down thereon and to effect a screw drive engagement therewith, and means for rotating said drive screw, said means being adjustable to alter the rotational speed of said drive screw, and means for guiding said comminuted refrigerant to said material for mixing therewith prior to the extrusion thereof.

3. In combination with a machine having an extrusion chamber, and means for continuously feeding material to said extrusion chamber for extrusion, means for adding a refrigerant to said material prior to extrusion, said means comprising a support for a refrigerant in a solid state, said support being tilted, means for comminuting such refrigerant, said means including a pair of rolls mounted adjacent the higher end of said support, each of said rolls having a plurality of pegs extending from the surface thereof, means for driving said rolls in opposite directions, and means for continually urging a block of such refrigerant upwardly toward said rolls, said means including a drive screw disposed longitudinally of said support and being at least partially exposed thereby to permit the block of refrigerant to settle down thereon and to effect a screw drive engagement therewith, and means for rotating said drive screw, said means being adjustable to alter the rotational speed of said drive screw, and means for guiding said comminuted refrigerant to said material for mixing therewith prior to the extrustion thereof.

4. Apparatus for comminuting material such as Dry Ice in solid state, comprising a support for a block of such material, at least one roll mounted adjacent an end of said support, said roll having scraper means on the surface thereof, and means for positively and controllably urging such block of material toward said roll, said means including a drive screw disposed longitudinally of and being at least partially exposed relative to said support thereby to be engaged by such block and to effect a screw engagement therewith, and means for rotating said drive screw.

5. Apparatus for comminuting material such as Dry Ice in solid state, comprising a support for a block of such material, a pair of rolls mounted adjacent an end of said support, said rolls each having scraper means on the surface thereof, means for rotating said rolls toward each other, and means for urging such block of material toward said rolls, said means including a drive screw disposed longitudinally of and being at least partially exposed relative to said support thereby to be engaged by such block and to effect a screw drive engagement therewith, and means for rotating said drive screw at a speed which is adjustable to a desired refrigerating effect.

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