Nov. 21, 1967 V. W. FERGUS 3,353,208

APPARATUS FOR FORMING PELLETS

Filed March 18, 1966

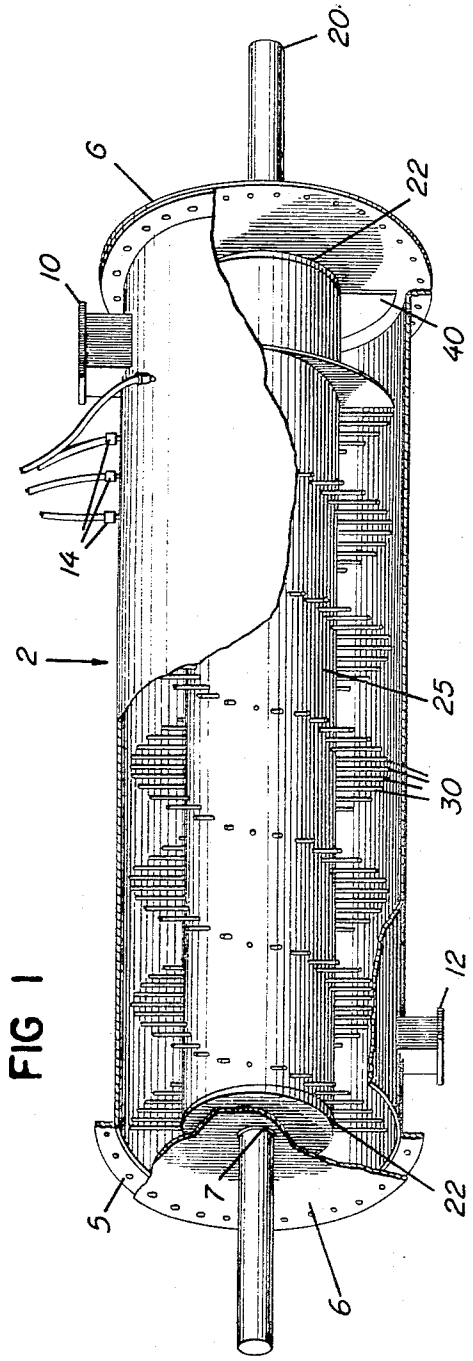


FIG 1

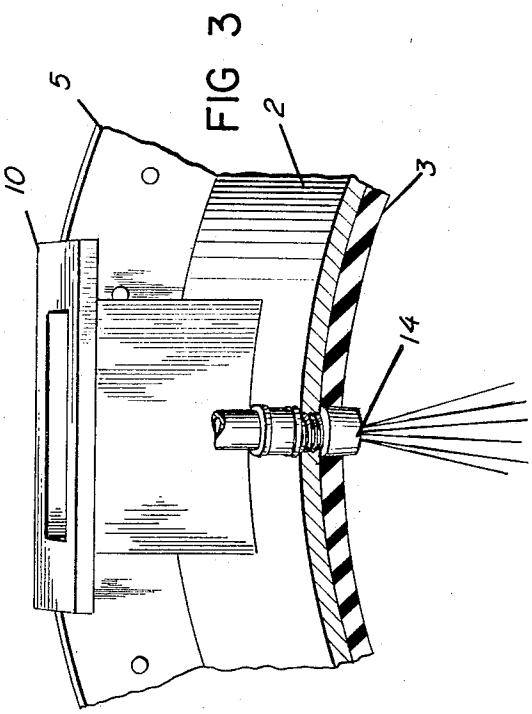


FIG 3

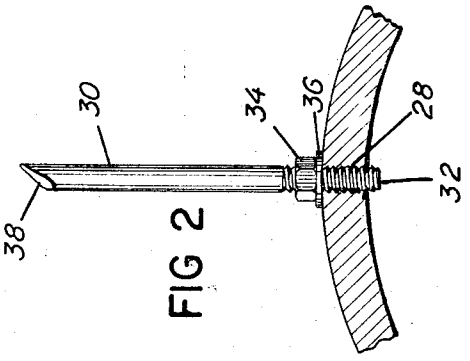


FIG 2

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APPARATUS FOR FORMING PELLETS

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ABSTRACT OF THE DISCLOSURE

A wet pelletizing apparatus for particulate carbon black having the radial pelletizing pins adjustably mounted on an axial rotating drum within the fixed and substantially horizontal housing of the pelletizer, including a black inlet and outlet means and a liquid spray port for said housing.

This application is a continuation-in-part of application Ser. No. 387,866 filed Aug. 6, 1964, now abandoned.

This invention relates to apparatus for forming pellets from particulate or pulverulent material and more particularly to a pin-type agitator which rotates within a cylindrical drum.

Apparatus of type described is widely used to form wet pellets from a mixture of water and particulate carbon black.

At the present time two methods of pelletizing carbon black are commonly employed. The older and more time consuming of these two methods involves the subjection of the black powder in dry form to a rolling action in a horizontally disposed drum-like container and is referred to in the art as "dry pelletizing."

The other common method is known as "wet pelletizing" and it involves the violent agitation of particulate carbon black in the presence of a suitable wetting agent, usually water.

The apparatus employed in the aforementioned conventional wet pelletizing method comprises a stationary vessel whose configuration is generally that of an elongated cylinder within which rotates an axially disposed solid shaft carrying a plurality of spaced and radially extending pins.

It is well known in the art of manufacturing carbon black that the wet pelletized form is much preferred over the dry pelletized form, being more uniform in pellet size, less dusty to handle and more freely flowable. In pin pelletizers of the type referred to, the length of the individual radially extending pins is usually such so as to provide a clearance of from about ½ to 1½ inches between the inner surface of the stationary elongate cylinder and the tip of the pin. In the operation of the device, beading action does not commence until the space between the tip of the pins and the inner surface of the stationary cylinder is reduced to between about 1/16 and ¼ of an inch. This required degree of clearance is quickly realized in the operation of the apparatus through a build-up of a layer of the aqueous carbon black mixture which rather tenaciously adheres to the inner surface of the stationary cylindrical housing. Concurrently the apparatus realizes a substantial build-up of flocculent black and water about the axial shaft in the zone occupied by the pins and interior of the housing which causes caking about the shaft and subsequent flaking and release of flocculent black deposits deleterious to the pelletizing operation.

According to the prior art, the radially extending pins are securely mounted on the rotatable solid shaft by drilling through the shaft holes which are slightly larger than the pins and welding the same in position. The maximum number of pins for a given length of rotatable shaft is thus limited, i.e., drilling too many holes in the shaft would weaken it to a point which is below its required torque carrying capacity.

The disadvantages of the conventional agitator with pins secured directly to the rotatable solid shaft are as follows:

(1) Disruptive accumulations materialize between the agitator pins and the interior of the stationary cylindrical housing, causing clogging, etc.

(2) The pellets formed (especially with some of the higher grades of carbon black such as GPF) tend to vary widely in pellet size distribution and to have an average pellet size which is too large in diameter.

(3) The radially extending pins cannot be readily changed for replacement or for pins of different size, shape or hardness.

(4) The pins cannot be adjusted for length as the outer ends of the pins wear off.

(5) The practical number of pins per unit length of rotatable solid shaft is limited, due to the hole drilling procedure referred to.

(6) The angle of the leading edges of the pins cannot be adjusted for increased control over pellet formation.

Broadly the present invention comprises an apparatus for pelletizing particulate material in a substantially closed stationary cylindrical housing of sufficient interior processing area to accommodate substantial portions of material and liquid wherein a cylindrical drum axially disposed within said housing mounts pins radially extending to terminate in a spaced relation with the interior of said housing.

It is among the objects of the present invention to overcome all of the immediately aforementioned disadvantages.

Another object is to provide an apparatus which not only possesses the foregoing characteristics but which is also relatively simple and inexpensive to manufacture, install and maintain.

Other objects and advantages will appear from the following description to be read in conjunction with the attached drawing wherein like reference numerals refer to like parts, and wherein:

FIGURE 1 is a perspective illustrating an apparatus which has been constructed in accordance with the teachings of the present invention;

FIGURE 2 is an enlarged fragmentary sectional view illustrating some of the details of the apparatus of FIGURE 1; and

FIGURE 3 is a perspective view showing some of the elements of the apparatus in greater detail.

Referring more particularly to the drawings, the numeral **2** designates the stationary elongate cylinder which was earlier described as constituting the mixing chamber.

This elongate cylinder **2** may acceptably be formed of a suitable grade of stainless, such as S.A.E. 316; or, alternatively, plain carbon steel with a rubber lining **3**, as disclosed and claimed in co-pending application Ser. No. 346,851 filed Feb. 24, 1964. In any event, the stationary elongate cylinder **2** is provided with flanges **5** to which there are affixed centrally apertured end plates, or block-flanges **6**, the latter being provided with centrally disposed packing glands generally indicated at **7**.

The upper side of the periphery of the stationary elongate cylinder **2** is provided, adjacent one of its end flanges, with a box-shaped inlet opening **10**; while a similarly shaped outlet opening **12** is disposed on the lower side of the periphery of said cylinder adjacent its opposite end plate **6**.

Adjacent, but inwardly of, the inlet opening **10** is a series of spray ports **14** which communicate with the interior of the stationary elongate cylinder **2**. For reasons which will appear hereinafter the spray ports **14** should

be flush with the interior of the cylinder **2** or at least project thereinto for a very short distance.

According to the teachings of the present invention, a rotatable cylindrical drum is disposed concentrically within the stationary elongate cylinder or housing **2** in lieu of the hereinbefore-described rotatable solid shaft of the prior art.

This rotatable cylindrical drum of the present invention may acceptably be mounted on a suitably journaled rotatable shaft **20** which is disposed to extend axially of the stationary elongate cylinder **2** and project from the packing glands **7** which are carried by the centrally apertured end plates, or block-flanges **6**.

As will be readily understood, this rotatable shaft **20** may be suitably driven through a belt-and-pulley arrangement by an adjacently positioned electric motor; one of which elements form part of the present invention and, accordingly, are neither shown in the drawings nor specifically described hereinafter.

The aforementioned rotatable cylindrical drum, within the stationary elongate cylinder or housing **2**, may acceptably comprise a pair of widely spaced, circular discs **22** of relatively large diameter which are secured to the rotatable shaft **20**, and which support, and serve as end plates for, a concentric pipe or tube **25**.

This cylindrical drum, which is formed by the pipe or tube **25** and its end closure plates **22**, is provided with a series of drilled and tapped apertures **28**, as shown in FIGURE 2; and, according to a preferred embodiment, extend peripherally of the cylindrical drum in a suitable pattern, such as the helical pattern illustrated. The cylindrical drum may, of course, be composed of stainless steel or the like, although I have discovered that very satisfactory results may be obtained by utilizing a light steel pipe or tube which is covered with a polymeric material, i.e., plastic, rubber or the like, such as used in the lining **3** of the stationary elongate cylinder **2**.

Each of these drilled and tapped apertures **28** carries one of the pins previously described, the latter being shown at **30**, and as provided with threaded inner ends **32**.

According to the immediately aforementioned construction and arrangement, the inner ends **32** of the pins **30** are in screw-threaded engagement with the drilled and tapped apertures **28** and by extending the threaded portions of the inner ends of the pins they become longitudinally adjustable with respect to the cylindrical drum **25**, the proper relationship being securely maintained against rotation, etc., by a lock nut **34** and lock washer **36**.

As also shown in FIGURE 2, the outer ends of the pins **30** are sharpened by providing them with bevelled portions **38**.

Typically, the outer, and sharpened, ends of the pins **30** may be spaced from approximately ⅛ inch to ¼ inch from the inside wall of the stationary elongate cylinder **2**; and while the pins are disclosed as round in cross-section they may, except for their threaded portions, be triangular, rectangular, oval, diamond-shaped, etc.

All pins, except the round ones can be angled so that the leading edge tends to throw the pellets upstream or downstream, as desired. This helps to control the size and hardness of the pellets.

The normal position of the pins **30** with respect to the stationary elongate cylinder **2** is illustrated in FIGURE 2; but they may be quickly adjusted so that their sharpened outer edges lead during rotation of cylindrical drum, instead of following as shown.

Another and important advantage is that by the extension of their threaded inner ends **32** the pins may be readily adjusted longitudinally to compensate for wear, etc.

In FIGURE 1 the most widely used pin arrangement pattern is shown, the pins forming a double helix 180° apart. Up to eight or more of the helical pin patterns may be used; and the pitch of the helix may be changed to obtain the desired effect. The pins **30** can also be arranged in two or more straight rows, or in a zig-zag pattern. Almost an infinite combination of pin shape, pin size, and pin layout pattern can thus be obtained to control pellet average size, pellet size distribution, and pellet hardness. To obtain the desired pellet quality, the arrangement required may vary considerably for the pelletizing of different grades of carbon black.

From my work I have discovered that the pelletization of particulate matter in a wet pelletizing process occurs only in the limited zone at the inner periphery of the stationary cylindrical housing where the body of carbon black and liquid at the inner housing is contacted by the ends of the radial pins. This limited zone of effective pelletizing is due to greater speed of the pins at this point and the ability of the pins to impart work to the material as confined against itself and the interior wall of the housing. Further, it has been determined that a conventional mixing box with an axial shaft mounting the radial pins provides a substantial inner zone about the shaft and the base and intermediate portion of the pins wherein no effective pelletizing action occurs. Therefore, the black and liquid accumulate about the shaft in this zone, which has no value in forming pellets, causing the black and liquid to build up as an uneven deposit of substantial amounts of cake in said zone. The black and liquid cake becomes dislodged releasing large pieces of the same into the outer pelletizing zone to disrupt uniform pelletization operations, and frequently the cake build-up is sufficient to unbalance the shaft causing vibration and interruption of operations.

The present invention essentially eliminates the above inner zone with its disadvantages and provides an apparatus whereby the black and liquid are directed to and confined in the actual zone of pelletizing, together with the mechanical advantages described herein. The apparatus provides an operation resulting in pellets of more uniform configuration and sizing, together with ability to adjust sizing, and reduced fines production.

In operation the loose fluffy carbon black enters the inlet **10** and is propelled by helical screw vanes **40** which are secured to the cylindrical drum defined by tube **25** and closure plates **22** and which advance the particles toward the outlet **12**. This drum fills the space about shaft **20** and within housing **2**, the latter being of sufficient size to provide adequate interior area to process particles in volumes desired, and thereby causes the particles to be displaced into the pelletizing area adjacent the interior periphery of the housing and in contact with pins **30**. The pelletizing water is added through one or more of the spray ports **14**; and the rotation of the pins **30** thoroughly mixes the carbon black and the water immediately downstream from the spray ports. The wet carbon black mixture rotates with the pins and is held against the inside wall of the stationary elongate cylinder **2** by centrifugal force; and the rolling action of this mixture on the wall causes formation of the wet pellets, the latter subsequently being discharged through the outlet **12** which communicates with a drying drum (not shown).

It is essential to the practice of the present invention that the outside diameter of the rotatable cylindrical drum be such as to provide an annular space between it and the interior surface of the stationary elongate cylinder or housing **2** which is much smaller in cross-sectional area than would be the case if a conventional pin-carrying solid rotatable shaft were employed.

The most desirable ratio between the outside diameter of the rotatable cylindrical drum and the inside diameter of the stationary elongate cylinder or housing **2** will, of course, depend upon a number of factors including the type and particle size of the carbon black or similar material to be pelletized.

However, the invention contemplates a rotatable cylindrical drum whose outside diameter is as much as 75% of the inside diameter of the stationary elongate cylinder

or housing **2**. On the other hand the outside diameter of the rotatable cylindrical drum **25** should be not less than 25% of the inside diameter of the stationary elongate cylinder or housing **2**.

While I have shown and described certain specific embodiments, it will be understood that various changes and modifications may be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. Apparatus for wet pelletizing particulate carbon black comprising:

a stationary cylindrical housing disposed in a substantially horizontal position having centrally apertured end plates affixed to each end thereof;

an inlet opening in the upper side of said housing near one end thereof;

an outlet opening in the lower side of said housing near the other end thereof;

at least one liquid spray port extending through the upper side of said housing substantially flush with the interior surface of said housing;

a rotatable shaft extending axially through said housing and said centrally apertured end plates;

a cylindrical drum affixed to said shaft and disposed to rotate within said housing, said drum having an

outside diameter not less than 25 percent nor more than 75 percent of the inside diameter of said housing; and,

pin means affixed to and extending radially from said drum in a pattern suitable to move said black through said housing, said means terminating adjacent the inner surface of said housing.

2. The apparatus of claim **1** wherein the pin means terminate from one-eighth to one-quarter of an inch from the inner surface of said housing.

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