United States Patent

Collman

[15] **3,706,257**

[45] **Dec. 19, 1972**

[54] **APPARATUS FOR PACKING A NONFLUENT COMPOSITION**

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[22] Filed: **May 11, 1970**

[21] Appl. No.: **36,295**

[52] **U.S. Cl.**.....**86/20 R**, 86/20 B, 86/20 D, 86/28

[51] **Int. Cl.**.....**C06d 1/08**, F42b 3/00

[58] **Field of Search**.....86/20 R, 20 B, 20 D, 28

[56] **References Cited**

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Assistant Examiner—H. J. Tudor
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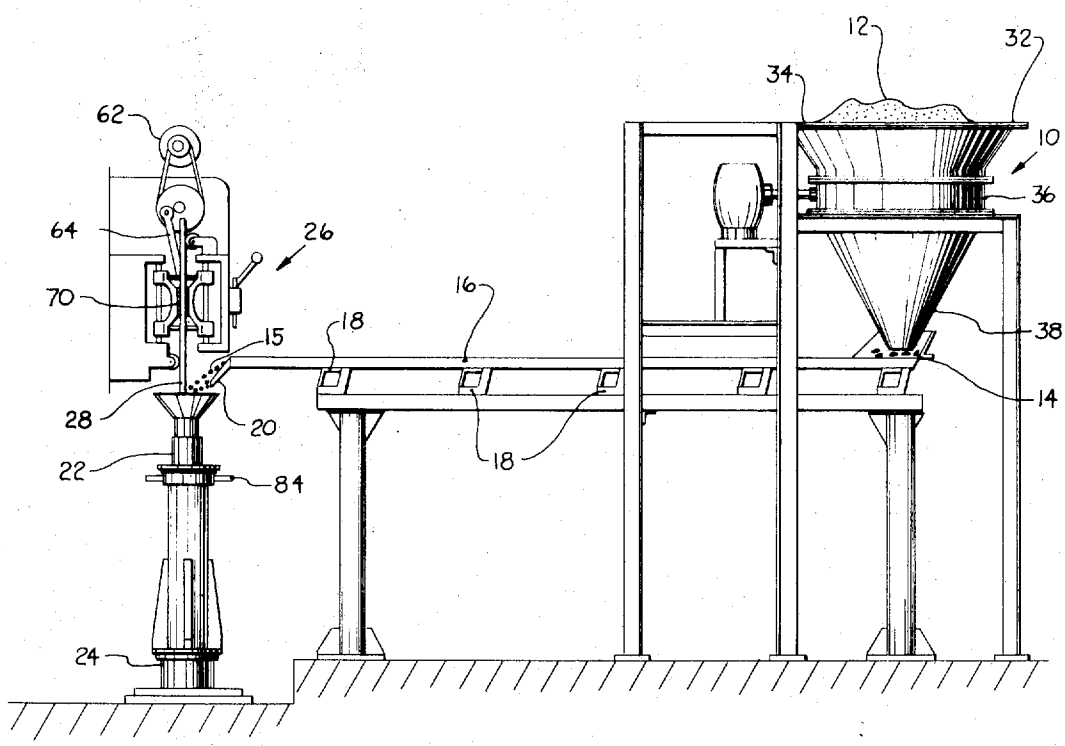
[57] **ABSTRACT**

A crumbly, tacky, nonfluent mass is first separated into small segments by a shredding plate operating against the mass; these segments are then formed into firm, rounded, fluent pellets by a vibrating conveyor and dispensed into a tubular case, where they are tamped into a solid mass by a reciprocating, self-adjusting tamping rod, the case being supported on a rotating table.

6 Claims, 8 Drawing Figures



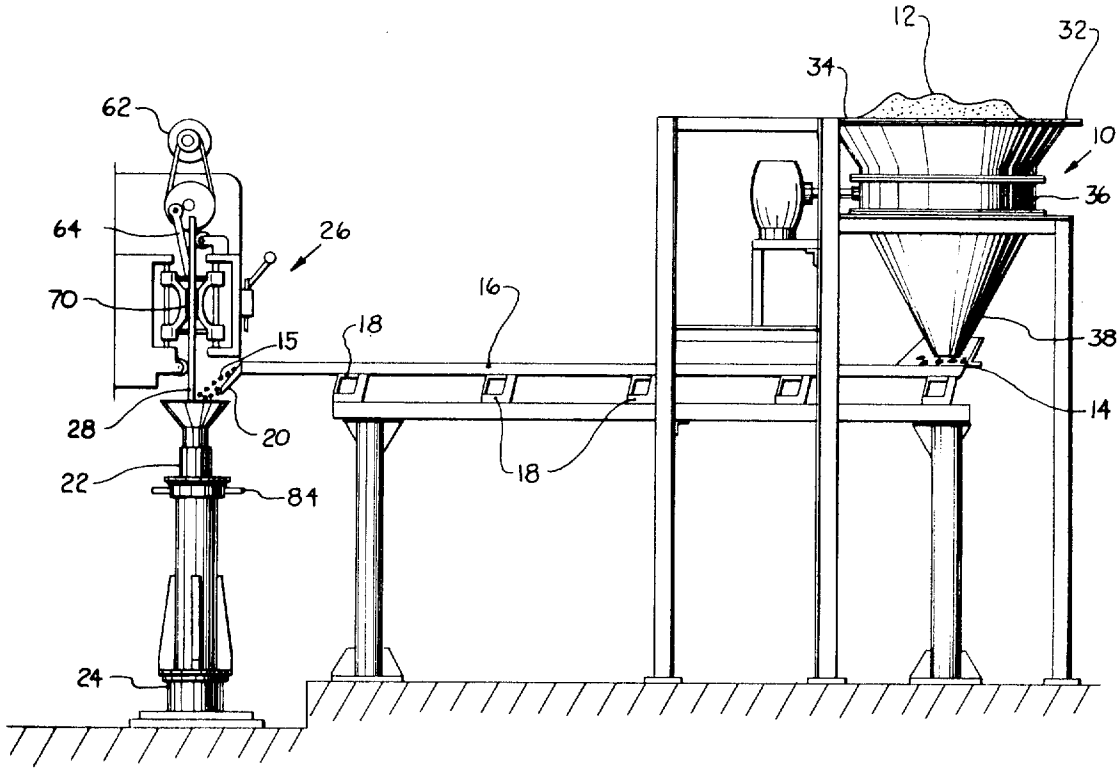


FIG. 1

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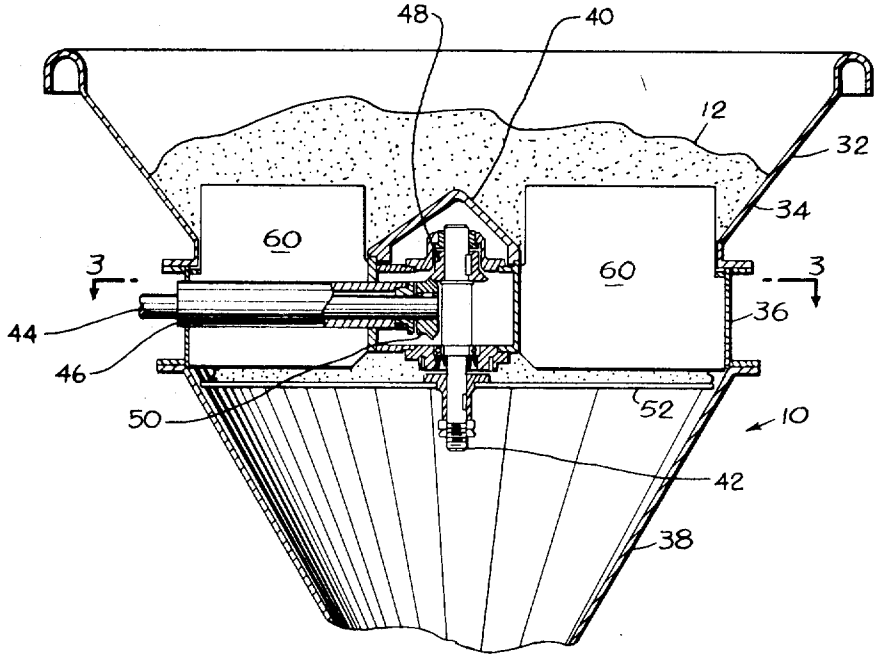

FIG. 2

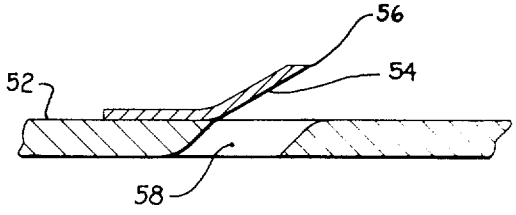

FIG. 4

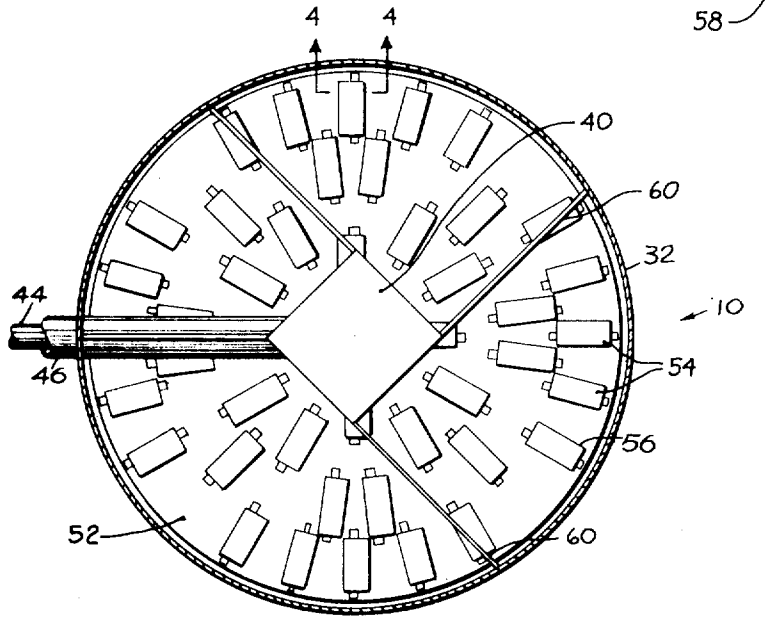

FIG. 3

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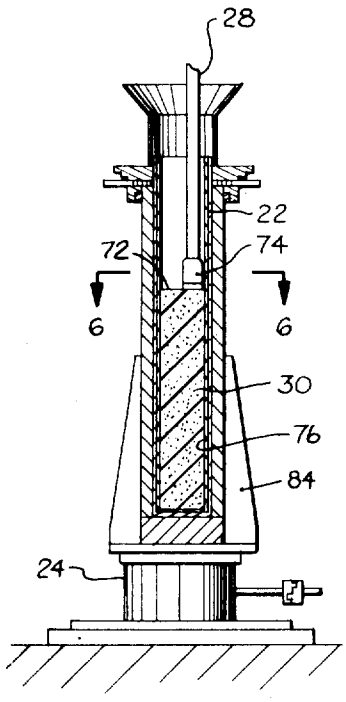

FIG. 5

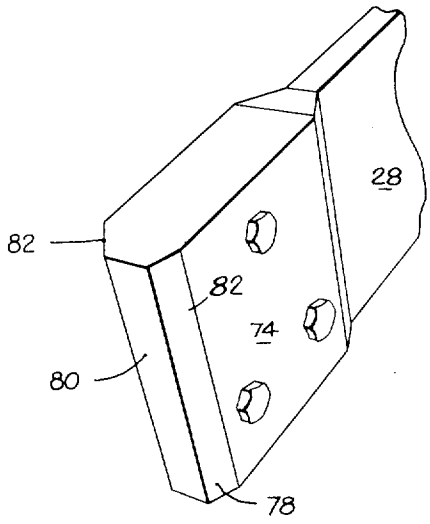

FIG. 7

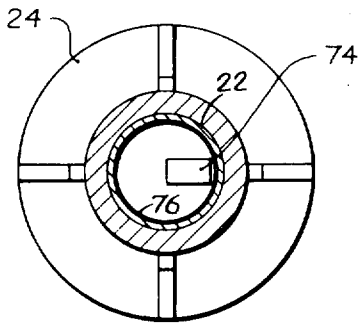

FIG. 6

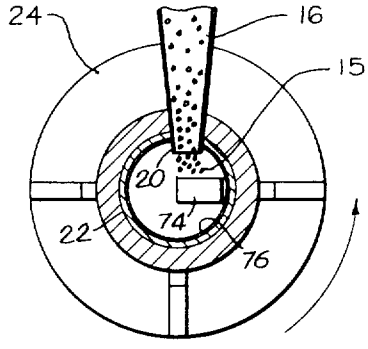

FIG. 8

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APPARATUS FOR PACKING A NONFLUENT COMPOSITION

CROSS REFERENCE TO RELATED APPLICATIONS

The present invention is related to two other inventions owned by the present assignee; "Aerial Flare Parachute Deployment means Therefor," Ser. No. 787,079, filed Dec. 26, 1968, and "Castable Illuminant Flare Composition and Method for Making Flare Body Therewith" Ser. No. 797,906, filed Feb. 10, 1969.

BACKGROUND OF THE INVENTION

This invention relates to methods and apparatus for packing castable compositions into tubular cases. More specifically, it relates to methods and apparatus for packing a crumbly, tacky, nonfluent mass into tubular cases by tamping.

Illuminant compositions for flares have conventionally had a very high solids content, of the order of 95 or 96 percent, mixed with a liquid binder comprising approximately 4 or 5 percent by weight of the composition. Such compositions tended to be dry and granular in their uncured state, and were customarily packed into the flare cases by hydraulic presses that exerted about 10,000 psi on the mixture. To withstand this force, the convolute, cardboard flare cases had to be hard and of substantial thickness. This requirement for thickness of the case was also made mandatory by the fact the illuminant composition was packed into the case in several increments, each requiring a separate press by the hydraulic ram. These excessively thick case walls had a distinctly detrimental effect on the quality and utility of the resulting flares. Since the cases were too thick to be consumed as the illuminating composition burned, the falling flare case constituted a hazard to ground personnel when the flare was deployed from the aircraft. Also, the flare casing tended to obscure a portion of the light output as the illuminant composition burned inside the casing. Another defect resulting from this method of manufacturing flares was that the incremental packing of the illuminant grain imparted a tendency to separate at the interfaces of the increments; and there was also a tendency toward poor adherence to the case wall, which often led to failure when these interfaces within the flare grain and with the case became unintended burning surfaces.

SUMMARY OF THE INVENTION

The present invention, which overcomes these disadvantages of the prior art, provides methods and apparatus for loading a flare case by tamping rather than by use of a hydraulic press. It has been found that illuminant compositions that contain approximately 8 percent binder by weight and employ a somewhat more fluid binder than had been used in prior-art flares, can be successfully used for this purpose. This type of illuminant is a crumbly, tacky, nonfluent mass in its uncured state, resembling sand mixed with a small amount of very thick molasses. Such a mass is first converted into small segments by a special segmenting device, which then dispenses the segments onto a vibrating conveyor that forms them into firm, rounded, fluent pellets and conveys them into the flare case. The flare case is held in a vertical position on a rotating table under an offset, reciprocating, tamping rod that is self-adjusting and that continually tamps the pellets into a solid mass in the flare case until it is filled.

This new method of manufacturing flares not only has manufacturing advantages, but it also produces flares of superior quality. The equipment required is simpler in construction, requires less power, and is less hazardous to use than the prior-art equipment used for making flares. Since the flare case does not have to withstand the high pressures exerted by a hydraulic press, the resulting flare can have a much thinner case, so that there is a higher percentage of illuminant in a flare of a given weight. Also, the illuminant grain has monolithic integrity so that unwanted potential burning surfaces therein are eliminated; the aluminum case is thin enough to be consumed at the same rate as the illuminant grain, so that it neither becomes a hazard to ground personnel nor obscures any of the light output of the burning illuminant; and the special lining composition provides an excellent bond between the illuminant grain and the flare case so that a burning surface at this interface is extremely unlikely.

Objects of the invention, therefore, are to produce a flare having an illuminant grain of greater structural integrity than was previously possible; that will have a greater percentage of illuminant relative to that of inert parts; and that will have a case that will be consumed at the same rate as the illuminant grain, thereby eliminating the danger of falling debris and producing a flare of greater total light output relative to its weight. Important features of the invention are that the mechanisms necessary to manufacture these superior flares are simpler, less hazardous, and require less power than those of the prior art.

Although the method of loading the cylindrical cases by tamping is not known by the applicant to have been used in the manufacturer of illuminating flares before the present invention, it has been known in the explosive art, such as in the manufacture of dynamite sticks and the loading of artillery shells. For example, U.S. Pat. No. 2,395,898 to John C. Mohr discloses a tamping apparatus for "Loading Explosive Powders into Shell Casings," and U.S. Pat. No. 3,033,069 to W.S. Bohlman et al discloses a similar apparatus for "Packing Granular and Semigelantinous Explosive Materials into Containers." However, none of these prior art apparatus appears to have solved the problem of uniformly feeding a mass having the nonfluent consistency of uncured flare illuminant into cylindrical cases in a manner to produce an illuminant grain of the desired uniform density. This problem is solved in the present invention by a special segmenting device that carves small chunks or segments off the mass and dispenses them into a vibrating conveyor that forms the segments into firm, round, fluent pellets and dispenses them into the cases. Cooperative functions of the segmenting device to produce segments of illuminant, the vibrating conveyor to form them into fluent pellets, and a special tamping head are combined in the present invention to produce this new result. The tamping head of the present invention is made of a special plastic material having a high degree of surface lubricity, and of a special configuration for uniformly packing material of this particular consistency. Other refinements,

such as serial time delays between stoppages of the segmenting device, the vibrating conveyor, and the tamping mechanism when loading of a case is completed (to insure uniform density of the illuminant at the end of the illuminant grain) render the apparatus uniquely suitable for the manufacture of illuminating flares.

Other objects, features, and advantages of the present invention will become apparent as the following description is read with reference to the accompanying drawings, wherein the same parts are designated by identical characters throughout the disclosure.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a general arrangement of the entire apparatus in side elevation;

FIG. 2 is an enlarged, fragmentary, sectional view of the segmenting apparatus;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged, detailed section taken on line 4—4 of FIG. 3;

FIG. 5 is a sectional view in side elevation of a typical flare case mounted on the rotating table together with the tamping device;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5;

FIG. 7 is a perspective view of the tamping head; and

FIG. 8 is a top view of the flare case showing the manner in which the discharge end of the vibrating tray delivers the pellets to the interior of the flare case.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A typical arrangement of the apparatus is shown in FIG. 1. A segment former 10 reduces the tacky, nonfluent mass 12 of uncured illuminant composition to small segments 14 that fall into a long, vibrated tray 16. The tray or conveyor 16 is of a type well-known in the art for conveying loose materials, and is typically oscillated by a vibrating means 18 in a principally-longitudinal direction with a small vertical component of motion, so that loose material thereon is continually urged forwardly. This action also forms the segments 14 into firm rounded, fluent pellets 15. The pellets 15 of uncured illuminant composition then drop from the open end 20 of the vibrated tray 16 so that they fall into the tubular case 22, supported on a rotating table 24. Tamping mechanism 26 is positioned above the flare case 22, so that tamping rod 28 may compact the illuminant pellets into a solid mass in the flare case 22.

The segment former 10 is built into a large, downwardly-convergent hopper 32 having an upwardly-diverging section 34 for receiving loose material, that adjoins a cylindrical section 36 at its lower end, that in turn adjoins a downwardly-convergent section 38. The mechanism of the segment former 10 is housed in the cylindrical section 36 of the hopper 32. This mechanism is shown in detail in FIGS. 2 and 3. A hollow, central hub 40 houses a vertical shaft 42 and its geared engagement with a horizontal driving shaft 44. A sleeve 46 that adjoins the hub 40 surrounds the shaft 44 and extends through the wall of the hopper 32, so that the rotating, driving shaft 44 cannot be exposed to flammable material such as the flare illuminant composition 12. Beveled worm gears 48 and 50 on the shafts 42 and 44 transfer rotary motion from the horizontal, driving shaft 44 to the vertical, driven shaft 42. A large shredding disk 52 is concentrically fixed on the vertical shaft 42 to be rotated thereby. As shown in FIG. 3 and detailed in FIG. 4, small upwardly-extending scoops 54, having knife edges 56, are positioned over corresponding holes 58 in the disk 52. A plurality of vertically positioned baffle plates 60 extend substantially radially between the hub 40 and the inner wall of the cylindrical section 36 of the hopper 32, to which they are fixed. These baffles 60 extend downwardly, but clear the scoops 54 of the shredding disk 52.

In practice, the illuminant composition 12 is dumped into the hopper 32 and comes to rest on the shredding disk 52 as an amorphous, nonfluent mass having a consistency similar to that of sand mixed with a small quantity of very viscous molasses. The shredding disk 52 is very slowly rotated, at about 0.2 rpm, so that excessive heat will not be generated at the interface of the shredding disk 52 and the base of the illuminant composition 12, which is prevented from rotating with the disk 52 by the baffles 60. As the shredding disk 52 is rotated, the scoops 54, being oriented in the direction of rotation, carve off circular strips from the underside of the illuminant mass 12 that break off and fall in small segments into the vibrating tray 16. The scoops 54 and their corresponding holes 58 are positioned in radially-staggered, slightly-overlapping relationship on the shredding disk 52 so that there are no uncarved lands on the underside of the illuminant mass between the circular strips carved off by adjacent scoops 54. As the small segments of illuminant composition strike the vibrating tray 16, any edges or irregularities that they may have had are immediately rounded off by the motion of the tray, to contribute to their flowability thereon.

The tamping mechanism 26 is of a type well-known in the art and is commercially available. Salient features are a rotary driving means 62, a crank 64 for converting the rotary motion to longitudinal, reciprocating motion, a clutch 70 driven thereby, and a tamping rod 28 retained therein. The clutch 70 is any one of several types that automatically adjust the functional length of the tamping rod 28 as the upper surface 72 of illuminant composition rises in the flare case 22. Although the tamping mechanism 26 is a commercial device, several modifications had to be made to make it adaptable for compaction of the flare illuminant composition. The tamping head 74, for example, was specially made of Teflon (polytetrafluoroethylene) to avoid adhesion to the illuminant composition, possible damage to the uncured liner 76 on the inside surface of the flare cases 22, and to minimize the danger of accidental ignition of the illuminant composition. The tamping head 74 is somewhat wedge-shaped on the bottom surface of 78, so that the relatively small, flat surface 80 between the two bevels 82 may exert greater pressure on the upper surface of the illuminant composition 30.

The tamping head 74 is positioned relative to the flare case 22 so that the flat surface 80 extends from the center of the flare case to the wall thereof, allowing a suitable clearance to avoid damage to the liner 76, and to avoid pinching the illuminant composition

between tamping head 74 and the flare case 22. As the flare case 22 is rotated concentrically about a fixer center by a rotating table 24, the illuminant composition, which is dropped into the flare case immediately in front of the tamping head (relative to the rotation) is firmly tamped into a solid mass in the flare case 22. The flare case 22 is fixed to the rotating table 24 by a clamp 84, of a type well-known in the art. The rotating table 24, being offset relative to the tamping head 74, constitutes lateral-motion means to insure uniform compaction of the entire upper-surface area of the illuminant 30.

The density of the illuminant composition 30 as it is packed into the flare case 22 may be precisely determined and regulated with high quality control by optimizing the relations between (1) the speed at which the case 22 is rotated; (2) the pressure at which the tamping head 74 is impressed upon the upper surface of the illuminant composition; (3) the rate at which the illuminant composition is fed into the flare case 22 from the vibrating tray 16; and (4) the tamping frequency. When the case 22 has been filled to a predetermined level with an illuminant composition, a photoelectric limit switch, operated by the tamping rod 28, stops, in sequence the operation of the (1) segment former 10, (2) vibrating conveyor 16, (3) tamping mechanism 26, and (4), the rotating table 24, with approximately a 10-second delay between each switch off. This insures that the upper end portion of the illuminant grain will be of the same uniform density as the remainder thereof, without any loose illuminant remaining when the apparatus is turned off—contributing not only to the structural integrity of the illuminant grain, but also to the safety of its manufacture. In order to minimize adherence of the nonfluent composition to the mechanical surfaces of the apparatus with which it comes in contact, these surfaces are desirably made of or preferably coated with polytetrafluoroethylene.

The lining composition 76, which is used to insure a tight bond between the illuminant composition and the inner wall of the flare case 22, is described in the cited, pending application for patent titled "Castable Illuminant Flare Composition and Method for Making Flare Body Therewith," Ser. No. 797,906, by V.T. Dinsdale. The manner in which the lining composition 76 is used in the manufacture of flare bodies is described in the same application. Also, a typical illuminant composition suitable for use in the present invention is described in this application.

An invention has been described that constitutes an advance in the art of manufacturing illuminating flares. Although the description has been specific in regard to detail. It should be understood that equivalent means may be employed in many instances without departing from the scope of the invention.

The invention claimed is:

1. Apparatus for packing a crumbly, tacky, nonfluent composition into a tubular case, comprising:

a segment former comprising a downwardly-convergent hopper to receive the composition, a plurality of vertical baffles each fixed to the inner wall of the hopper and extending inwardly thereof to prevent angular motion of the nonfluent composition in the hopper, a horizontally-disposed, rotatable, shredding disk having scoops, each extending upwardly over a corresponding hole in the disk, which is positioned intermediately in the hopper below the baffles, for supporting the nonfluent mass therein and whereby strips may be carved off the bottom of the nonfluent mass of the composition, to fall in small segments therefrom;

a vibrating conveyor to form the segments into firm, rounded, fluent pellets and to convey the pellets into the tubular case;

reciprocating tamping means, for tamping the pellets into a solid mass in the tubular case, having a tamping head of smaller cross-sectional area than that of the case, the tamping head also having surface lubricity to prevent adhesion to the pellets; and

lateral motion means operatively connected to the tamping head and case combination to effect relative lateral motion therebetween, whereby the entire cross-sectional surface area of the composition in the case may be tamped uniformly.

2. The apparatus of claim 1 wherein all surfaces that normally contact the nonfluent composition are at least coated with polytetrafluoroethylene.

3. The apparatus of claim 1 wherein the tamping head is made of polytetrafluoroethylene and tapers to a flat, elongated surface that is aligned, relative to the tubular case, to extend from the center thereof to the case wall, with ample clearance therefrom, and wherein the lateral-motion means is a rotating table to which the tubular case is concentrically clamped.

4. Apparatus for dividing a mass of crumbly, tacky, nonfluent composition into small segments, comprising;

a downwardly-convergent hopper;

a horizontally-disposed, rotatable, shredding disk having scoops, each extending upwardly over a corresponding hole in the disk and oriented in the direction of rotation of the disk, which is positioned intermediately of the hopper for supporting the nonfluent mass therein, and whereby circular strips may be carved off the bottom of the mass, to fall in small segments therefrom;

vertically-disposed baffles, fixed to the inside of the hopper above the shredding disk to prevent motion of the nonfluent mass, as the shredding disk rotates; and

rotating means for rotating the disk, wherein all moving parts are shielded from contact with the nonfluent composition.

5. The apparatus of claim 4 wherein the scoops and their corresponding holes are positioned in radially staggered, slightly overlapping relationship in the shredding disk, so that, as the disk rotates, no uncarved lands are formed on the bottom of the nonfluent mass between strips carved off by the scoops.

6. The apparatus of claim 4 wherein ample clearance is provided between the shredding disk and adjacent parts, to avoid pinching the nonfluent composition therebetween, and wherein all surfaces that contact the composition are coated with polytetrafluoroethylene.

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