May 19, 1964 L. B. SMITH 3,133,563

PROCESS OF BALING FIBERS

Filed June 1, 1960 3 Sheets-Sheet 1

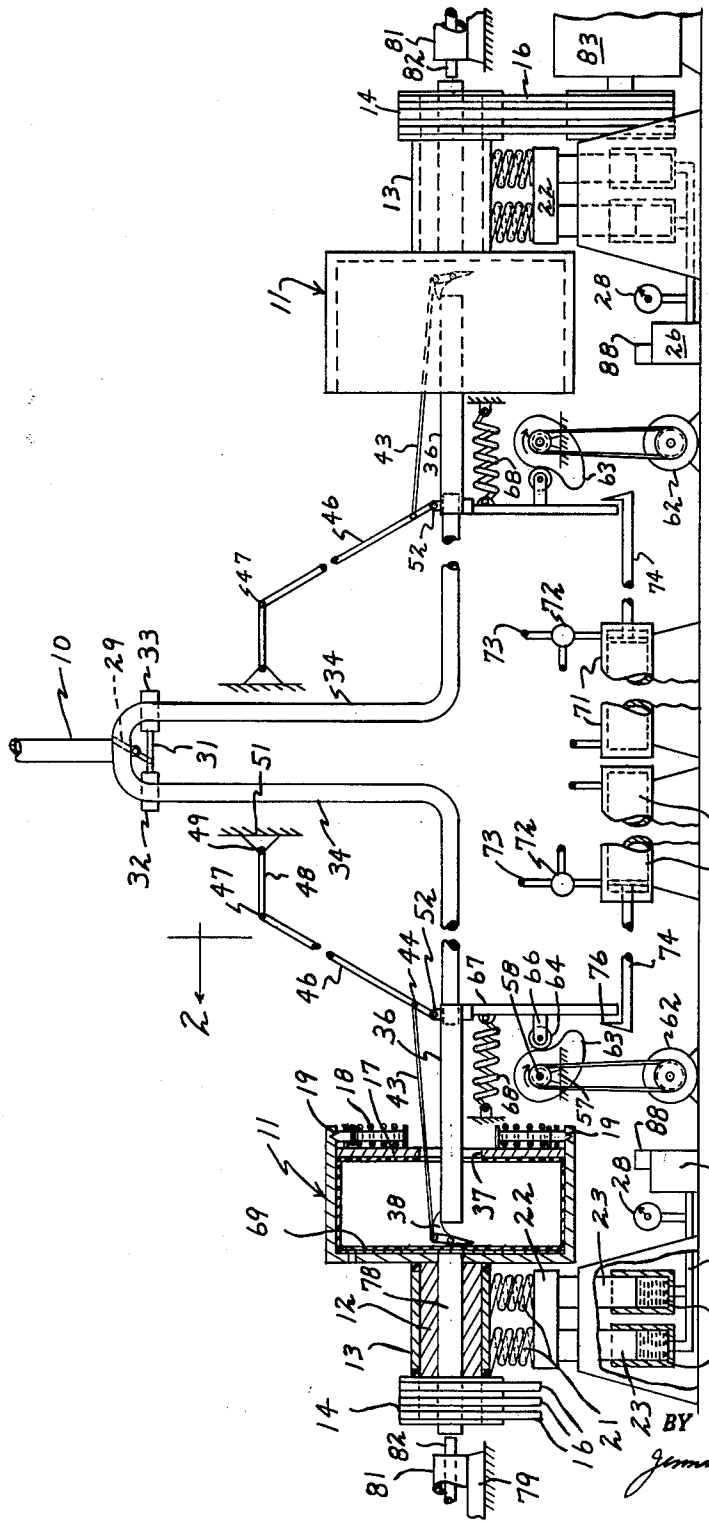


Fig. 1

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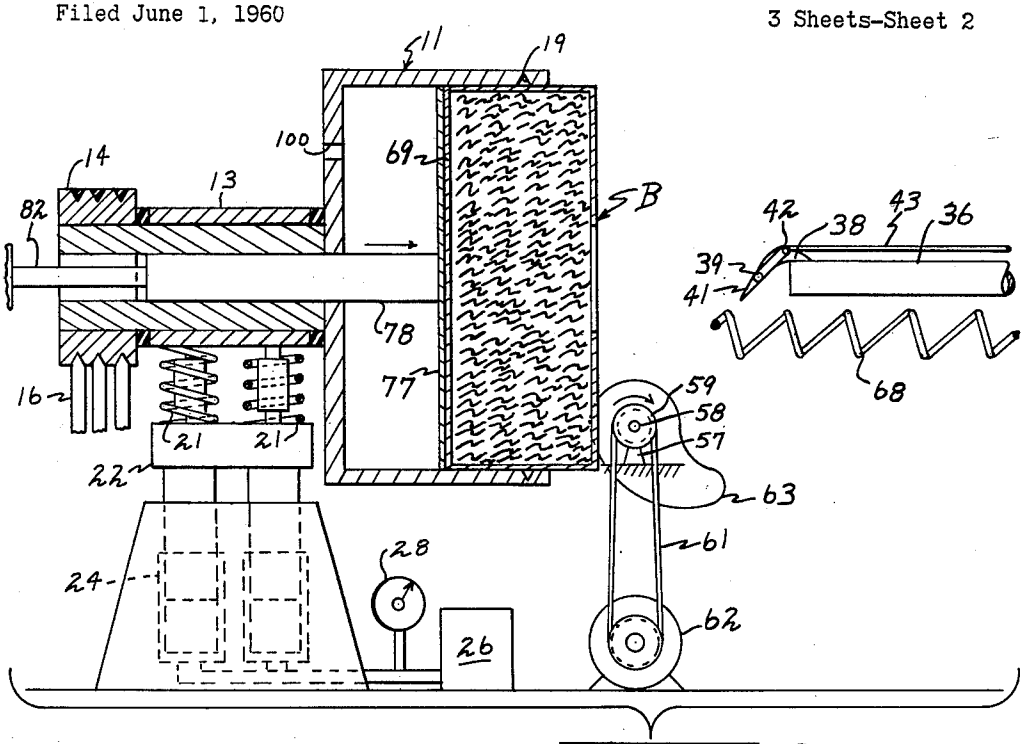


FIG. 3

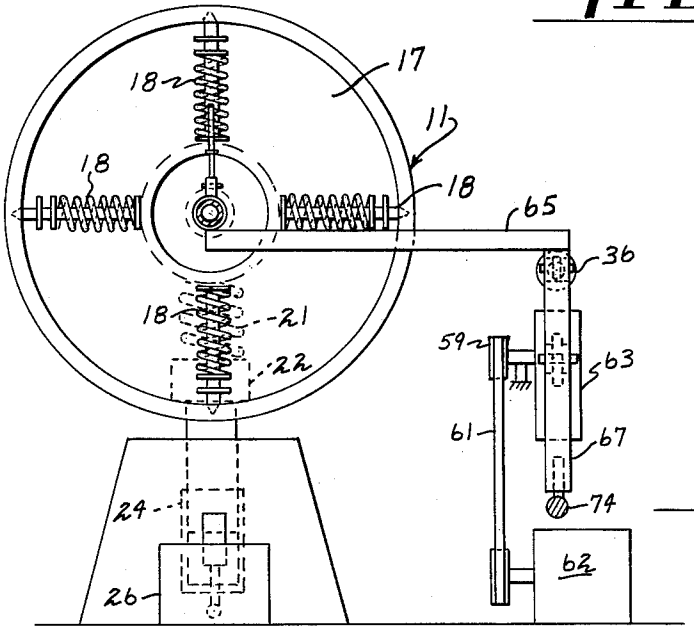


FIG. 2

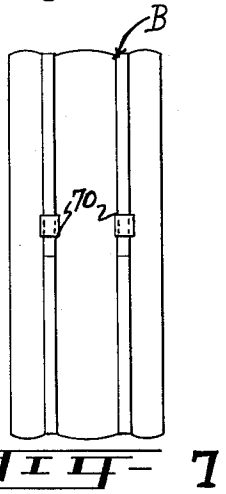


FIG. 7

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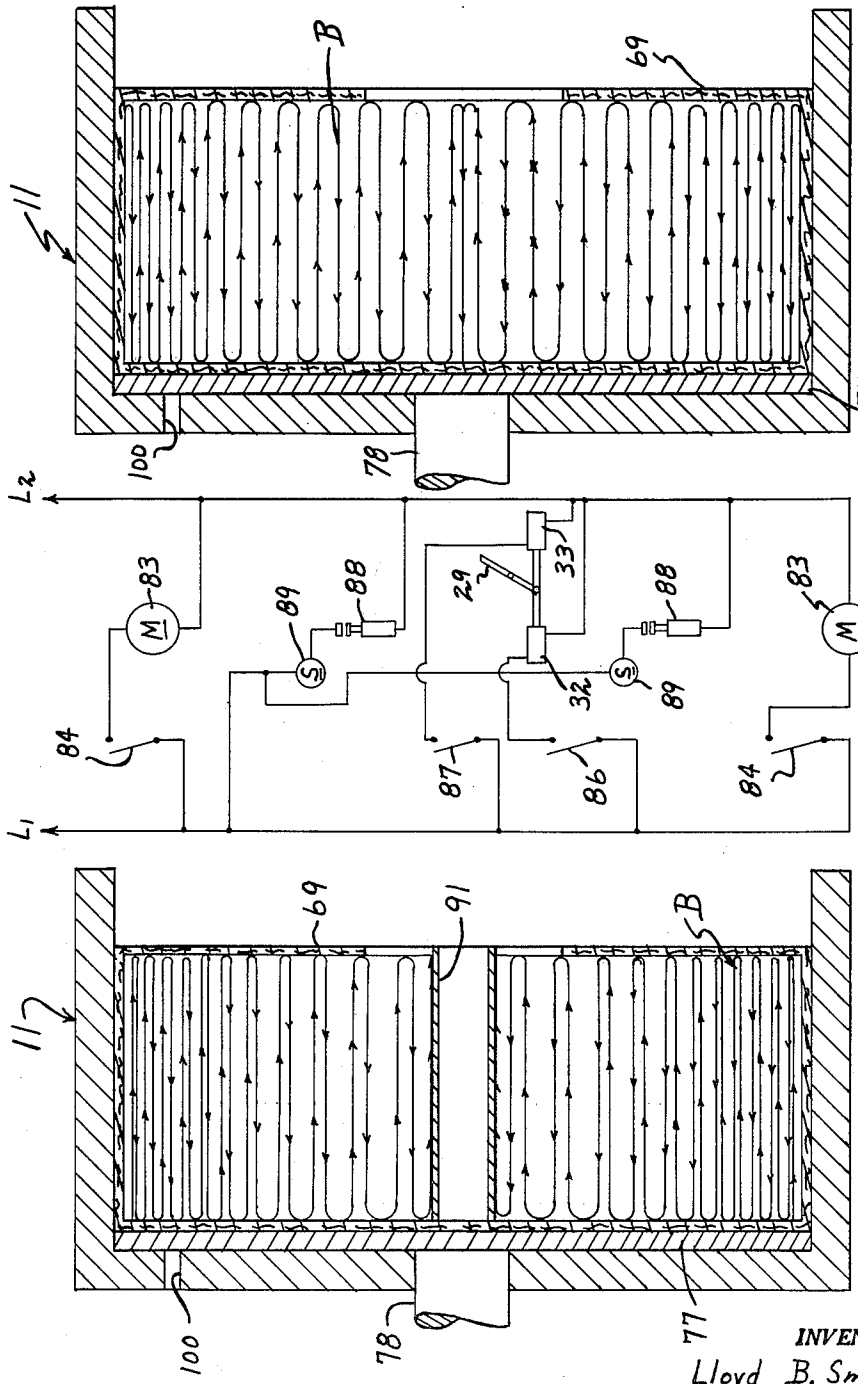


FIG. 5

FIG. 4

FIG. 6

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United States Patent Office 3,133,563 Patented May 19, 1964

3,133,563

PROCESS OF BALING FIBERS

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Filed June 1, 1960, Ser. No. 33,301
3 Claims. (Cl. 141—12)

This application is a continuation-in-part of my co-pending application Serial No. 747,972, filed July 11, 1958, "Method and Apparatus for Collecting Fibrous Materials."

In the collection and baling of fibrous materials such as cotton and other natural fibers and man-made fibers similar to cotton, one of the major problems is to separate the fibers from the large volume of carrier air mixed with the fibers and to bale the fibers to the required bale density without damaging them. In prior mechanical baling processes, it is necessary to exert tremendous pressures on the fibers and then, while holding the compacted bale under pressure, cover the bale and place ties about it to prevent re-expansion. Even in forming the so-called low or standard density cotton bale (15 to 20 pounds per cubic foot) the apparatus required is very heavy and expensive and necessitates much attention for continuous operation. Present baling apparatus for forming the so-called high density (about 25 pounds per cubic foot) and compress bales (about 32 to 36 pounds per cubic foot) are proportionately heavier and more expensive. Further, prior apparatus has necessitated the use of condensers ahead of the baling press to remove the air therefrom and these are expensive and not always trouble-free in operation. Still further, in the high density and compress bales it often is found that the layers of cotton in the bale are sheared along shear planes parallel to the direction of compressive force, thus breaking multitudes of the fibers and lowering the spinnable content of the bale.

In view of all the foregoing an object of my invention is to provide a process and apparatus especially adapted for carrying out the same by which cotton or other similar fibrous material may be baled directly, that is without condensing the fibers, as it comes from the gin (in the case of cotton), or from any other source wherein the fiber is borne along by a carrier air stream.

Another object is to provide a process for baling air-borne fibers which comprises the steps of directing the air-borne stream generally radially into a container rotating at a speed to cause the fibers to collect on the inner surface of the container and pack at the desired density, and in shifting the point of impact of the stream longitudinally of the rotating container, thereby to build up a bale of generally concentric layers of fibers.

Another object is to provide a baling process of the character designated in which the air-borne fiber from a single source is blown alternately into a pair of rotating containers, whereby when one container has been filled and is being removed, the other container is being filled, thus permitting the stream of fibers to flow without substantial interruption.

A further object is to provide baling apparatus embodying an open ended cylinder mounted for rotation and into which may be placed a suitable container for the bale such as a kraftboard container, together with feed means for delivering the air-borne stream of fibers radially into the rotating container and with a reciprocatory movement longitudinally of the container.

Another object is to provide apparatus of the character designated in which the apparatus is provided with means to indicate to the operator when a predetermined bale weight has been reached, facilitating the production of bales of uniform weight.

A still further object is to provide a bale of fibers which

may be more easily opened in the textile mill opening room than present bales, this being accomplished by the aforesaid laying on of the fibers in forming the bale in such manner as to cause the fibers, during the opening operation, to peel off somewhat in concentric layers. My improved bale is distinguished from a press made bale in which the layers of fibers are laid into the press box in somewhat leaf fold manner, and, after compression, oftentimes adhere so closely that in opening the bale it is difficult to feed the fibers uniformly to the blending apparatus.

Yet another object is to provide an improved fiber bale having the foregoing characteristics and which may be generally cylindrical in shape with an open core at the center, whereby such bale may be opened by supporting it on a shaft, mandrel or the like, while the fibers are being removed from its periphery, either with the bale held stationary or while the same is rotating.

Apparatus illustrating the constructional features of my invention and which may be used for carrying out my improved process and for producing my improved bale is illustrated in the accompanying drawings, forming a part of this application, in which:

FIG. 1 is a fragmental side elevational view of a two unit apparatus, partly broken away and in section;

FIG. 2 is an enlarged detail sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical sectional view, partly broken away, and showing a packaged bale in the process of being ejected from the apparatus;

FIG. 4 is a schematic wiring diagram;

FIG. 5 is a diagrammatic cross-sectional view through one form of bale embodying features of my invention and which may be made with my improved process and apparatus;

FIG. 6 is a view substantially like FIG. 5 but showing the bale with a tubular core therein; and,

FIG. 7 is a side elevational view of a bale after it is removed from the apparatus.

Referring now to the drawings for a better understanding of my invention I have illustrated the same as embodying a pair of baling machines which are identical and which are disposed to receive an air-borne stream of fiber from a conduit 10. That is, while one of the machines is being filled the other is having the bale ejected and a new container put in place. In view of the fact that both of the units are identical a description of one will suffice for both.

My improved apparatus comprises generally a rotating cylinder indicated generally by the numeral 11. Preferably, though not necessarily, the cylinder carries a stub axle 12 mounted in a bearing 13, for rotation on a horizontal axis. The axle 12 carries a pulley 14 and drive means such as multiple V-belts 16 are provided.

It will be noted that the cylinder 11 is open at one end. I provide a closure plate 17 for the open end which may be held in place by means of a plurality of centrifugal latches 18. The latches 18 have pointed ends which engage in holes 19 in the inner surface of the rotating cylinder 11.

The entire apparatus so far described may be supported from a pair of coil springs 21 in turn mounted on a cross head 22. The cross head may be supported on pistons 23 fitting into fluid pressure cylinders 24. The cylinders may be connected to a source of constant fluid pressure, indicated at 26, through a line 27 and the branch lines shown leading to each cylinder. A gauge 28 may be provided.

From what has just been described it will be seen that the entire apparatus more or less floats on the pistons 23 and that the springs 21 prevent undue fluctuations in the gauge 28. Also, and as is understood, this mounting low-

ers the critical speed to a point safely below the operating speed of the parts. Therefore, by observing the gauge **28** the operator can determine the amount of fiber present in the apparatus after it is filled as now will be explained.

In the conduit **10** is a plate-type valve **29**. The valve may be conected to an arm **31** in turn connected to the armatures of solenoids **32** and **33**. The air-borne stream of fiber from the conduit **10** thus may be directed alternately into conduits **34** leading to each baling unit.

Slidably mounted about the exit end of conduit **34** is a tube **36**. The tube **36** extends into the rotating cylinder **11**, projecting through an opening **37** in the cover plate **17**.

On the inner or discharge end of tube **36** is a bracket **38**. See particularly FIG. 3. Mounted for pivotal movement on the bracket **38** as at **39** is a deflecting plate **41**. The plate **41** may be pivotally connected at **42** to a push-pull rod **43**. The rod **43** is pivotally connected at **44** to a link **46** pivotally connected as at **47** to an arm **48** in turn pivotally connected at **49** to a stationary support indicated at **51**. The lower end of arm **46** is pivotally connected at **52** to a bracket carried on the rearmost end of tube **36**.

Mounted in suitable bearings **57** is a shaft **58** carrying a pulley **59** which is driven by a belt **61** in turn driven from an electric motor **62**. Mounted on the shaft **58** is a cam **63**. The cam **63** enages a roller **64** mounted on a bracket **66** carried by a depending arm **67** secured at its upper end to a horizontally extending arm **65** in turn secured to the rearmost end of the sliding tube **36**. A spring **68** anchored as indicated urges the arm **67** to the left as viewed in FIG. 1, thus to hold the roller **64** in contact with the surface of cam **63**. It will thus be seen that as the cam **63** rotates the tube slides back and forth on the horizontal extent of the conduit **34**. At the same time, the baffle plate **41** pivots about the pivot point **39**, thus assuring that the fibers are directed into the front and rear corners of the container, thus to build a bale having dense and fully packed ends. Of course, instead of baling the fibers directly in the cylinder I provide a container for the fibers indicated at **69** and which is removable after the bale is formed. The container may carry circumferential straps **70** or may be otherwise circumferentially reinforced to restrain the bale against radial expansion. See FIG. 7.

In order to withdraw the tube **36** and the plate **41** I provide a double acting hydraulic cylinder **71**. The cylinder is under control of a valve **72** and is supplied with fluid under pressure from a source, not shown, through a line **73**. The piston rod of the cylinder is extended outwardly as at **74** and is provided with a hook **76** which engages behind the arm **67**. Thus, when it is desired to withdraw the tube **36**, pressure is admitted to cylinder **71** in a direction to move the piston rod **74** in the appropriate direction as indicated.

In order to expel a finished bale B from the cylinder, in its package, I may provide a pusher plate **77** mounted on the end of a rod **78**. Mounted on a fixed support **79** is a hydraulic cylinder **81** having a piston rod **82** which, when energized, extends outwardly and pushes the bale from the apparatus as partially illustrated in FIG. 3. It will be noted that piston rod **82** is not connected to the rod **78** as this would interfere with obtaining correct weight reading on the gauge **28**.

It further will be noted that the cam **63** is so shaped that it causes the tube **36** to move quickly on one of its strokes and slower on the other. I have found that this action provides better defined layers in the bale. Also in the maximum in and out positions of tube **36** the baffle plate **41** is positioned to direct the airborne stream of fibers into the corners of the container.

Referring now to FIG. 4 I illustrate in diagrammatic manner a wiring diagram for my improved apparatus. The motors for driving the V-belts **16** are indicated at **83**.

The motors are provided with switches **84** and are connected to the lines L^1 and L^2 as illustrated. The solenoids **32** and **33** are under control of manual switches **86** and **87** thereby to shift the valve **29** as desired. Mounted on the pressure sources **26** are pressure switches **88**. The switches **88** are in series with signal lights or other forms of indicating devices **89**, whereby the operator can tell when a certain weight of fiber has been placed in the apparatus.

Referring particularly to FIG. 5 it will be seen that the bale B built up in the operation of my improved process and apparatus consists of a plurality of layers each of which, and the direction of laying on of which, is indicated by the lines and arrows in FIG. 5. It will be noted that near the outer periphery of container **69** the layers are relatively thin and that they progressively increase in thickness toward the center of the bale. This is due to the fact that with the speed of rotation of the cylinder and container maintained constant, and with the speed of motor **62** also maintained constant, and assuming further that the flow of fiber is constant, the layers become thicker because they become smaller in diameter. Further, in view of the fact that the apparatus is operated at a speed high enough to obtain the densities required as hereinafter will be mentioned, the layers near the periphery are somewhat more compressed than the layers near the center since they are being operated upon by greater centrifugal force. My improved bale thus embodies essentially a plurality of concentrically arranged layers of fiber. Due to the laying on of the cotton in layers by means of reciprocating the point of impact of the carrier stream axially of the container, I provide a bale which has almost no tendency to expand axially and which has greatly reduced tendency to expand radially.

In FIG. 6 I show substantially the same bale as in FIG. 5 except that I may provide, as will hereinafter be explained, a central tube-like member **91**.

From the foregoing the method of constructing my improved apparatus, carrying out my improved process, and to produce my improved bale may now be explained and understood. With cotton or other fiber being delivered in an air-borne stream through the conduit **10**, and with the valve in the position shown in FIG. 1, it will be apparent that the air-borne stream is delivered to the left-handmost unit. With a container **69** of kraftboard or the like in place and with the plate **17** installed, the drum **11** may be rotated at a speed sufficient to exert a force on the order of a thousand times gravity on the fibers. By energizing motor **62** the tube **36** is reciprocated back and forth and, in conjunction with the pivoted baffle plate, serves both to turn the cotton 90°, radially, onto the inner periphery of the container and to distribute it axially along the package to be formed. The air is discharged through the enlarged opening **37** surrounding the tube **36**. As soon as the desired weight of cotton is in place in the container the operator gets a signal from one of the signal lamps **89**. Whereupon, he energizes the hydraulic cylinder **71** thus to withdraw the tube **36** from the container, this being done prior to stopping completely the rotation of container **11**. The plate **17** is now removed by pulling out the gravity actuated latches whereupon the cylinder **81** is energized thus to push the entire package out, letting the same fall upon the floor or onto a suitable conveyor, not shown. Of course, as soon as the correct weight of cotton is reached, the operator closes switch **87**, throwing the valve **29** to a position to start discharging into the righthandmost unit of FIG. 1, it being understood that it is now rotating and ready to receive the fiber. As soon as the bale is discharged from the lefthandmost unit a new container **69** is inserted and that unit is ready to commence another cycle.

In my experiments so far conducted with apparatus of this type I have manufactured and tested a machine in which the inner dimensions of the container **69** were 34 inches in diameter by 18 inches long. Using cotton, 1

⅛ inch middling, and by rotating the container at 1400 r.p.m. I have obtained a bale of 131 pounds at a density of 13.8 pounds per cubic foot. Based upon my calculations, the cotton at the inner periphery of the container was subjected to 932 gravities. The power required for rotation of the container was 5.0 H.P. A bale thus produced compares favorably with cotton gin house bales insofar as density is concerned. It was only necessary to provide relatively light strapping around the bale and it had substantially no tendency to expand axially.

Based upon the foregoing actual experience my calculations indicate that I can obtain densities on the order of 23 pounds per cubic foot by using a container 51 inches in diameter and 18 inches long. This container, rotated at 1800 r.p.m. and giving a force on the cotton of 1818 gravities will produce a bale of 584 pounds in weight and at 23 pounds per cubic foot. The power required for rotating the container will be about 25 H.P.

My experiments so far indicate that bales produced by my improved process and apparatus and which are formed in the concentric layers herein set forth, are much more easily opened than conventional press type bales. That is, by providing the bales such as shown in FIGS. 5, 6 and 7, and using cotton as the fiber, I produce a bale which has a very smooth, dense appearance. This distinguishes from the leaf-fold, mechanical press type bale which has the definite appearance upon opening of the thick, doubled-over layers representative of the bat which came to the baling press from the condenser. My improved bale thus lends itself to more economical packaging in the sense that, having but small tendency to expand or grow in diameter, and relatively no tendency to grow axially, it can be restrained with relatively light securing materials. Further, by providing a kraftboard box or container I provide a bale covered over substantially all of its surface.

In connection with FIG. 6, the tube 91 may be inserted just before the machine stops. In this connection it has been noted that when the machine finally comes to rest the hole in the center of the bale which was present while it was going at full speed, gradually closes as the machine slows down. When at complete rest there is no hole present in the center of the bale and I theorize that it is this inward "growing" which relieves in material manner the tendency of the bale to grow outwardly when it is removed from the machine. It will be apparent that with a bale such as shown in FIG. 6 a shaft or the like can be run through the core and supported in standards, thus facilitating the opening of the bale in the opening room.

In connection with all of the figures, I show a vent hole 100 in the closed end of the cylinder 11 to eliminate the piston effect when the bale is being discharged.

From the foregoing it will be apparent that I have devised an improved process, apparatus and fiber bale. By turning the fibers 90° to their original of entry into the rotating container and reciprocating the point of impact, I am enabled to build up a bale which is entirely different from press made bales and which has all the advantages hereinbefore set out. My improved apparatus is far more economical of manufacture than present standard density presses found in cotton gins. Insofar as I am aware the only limitation on the density obtainable lies in the mechanics involved in the bearings, power requirements, etc. Further, the dimensions of 51 inches

in diameter and 18 inches in length are, from my calculations, the optimum size for bales of fiber on the order of 23 pounds per cubic foot. In other words, the length of the bale should be about 35% to 40% of the diameter thereof, according to the results of my calculations and experiments to date. While my invention may have utility in the baling of other products, it is especially useful in baling "springy" fibers of cotton, nylon, etc.

While I have shown my invention in two forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

I claim:

1. The process of baling fibers which comprises directing the fibers while entrained in a carrier fluid stream radially into a receptacle rotating about its own axis which axis is substantially horizontal and at a speed to subject the fibers to a force in excess of 1000 gravities, and reciprocating the point of impact of the fiber stream back and forth axially of the rotating receptacle as the receptacle is filled, thereby gradually to build up the bale by laying on the fibers in generally concentric layers from the inner periphery of the receptacle toward the axis of rotation thereof throughout the length of the bale.

2. The process of baling fibers which comprises directing a fluid-borne stream of the same into a receptacle rotating about its own axis and at a speed to subject the fibers to forces in excess of 1500 gravities thereby to pack the fibers to a density above 15 pounds per cubic foot, said fiber stream being directed generally radially of the axis of rotation of the receptacle, and shifting the point of impact of the fibers back and forth axially of the rotating receptacle thereby to build up a bale by laying on the fibers in generally concentric layers.

3. The process of baling fibers such as lint cotton which comprises rotating a generally cylindrical shaped container having one open end about its longitudinal axis at a rate of speed in excess of one thousand r.p.m., directing the fibers into the rotating container through the open end thereof and generally axially thereof while entrained in a carrier air stream, turning the stream carrying the fibers generally radially of the container thereby to deposit the fibers onto the inner surface of the container substantially normal to the inner periphery thereof, and reciprocating the point of impact of the fiber stream back and forth longitudinally of the container, thereby to build up a bale from the inner periphery of the container toward the longitudinal axis thereof and which comprises a multiplicity of generally concentric layers of fiber.

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