Nov. 10, 1959 H. D. BOGGS 2,912,041

CORE COMPACTOR

Filed Jan. 28, 1954 4 Sheets-Sheet 1

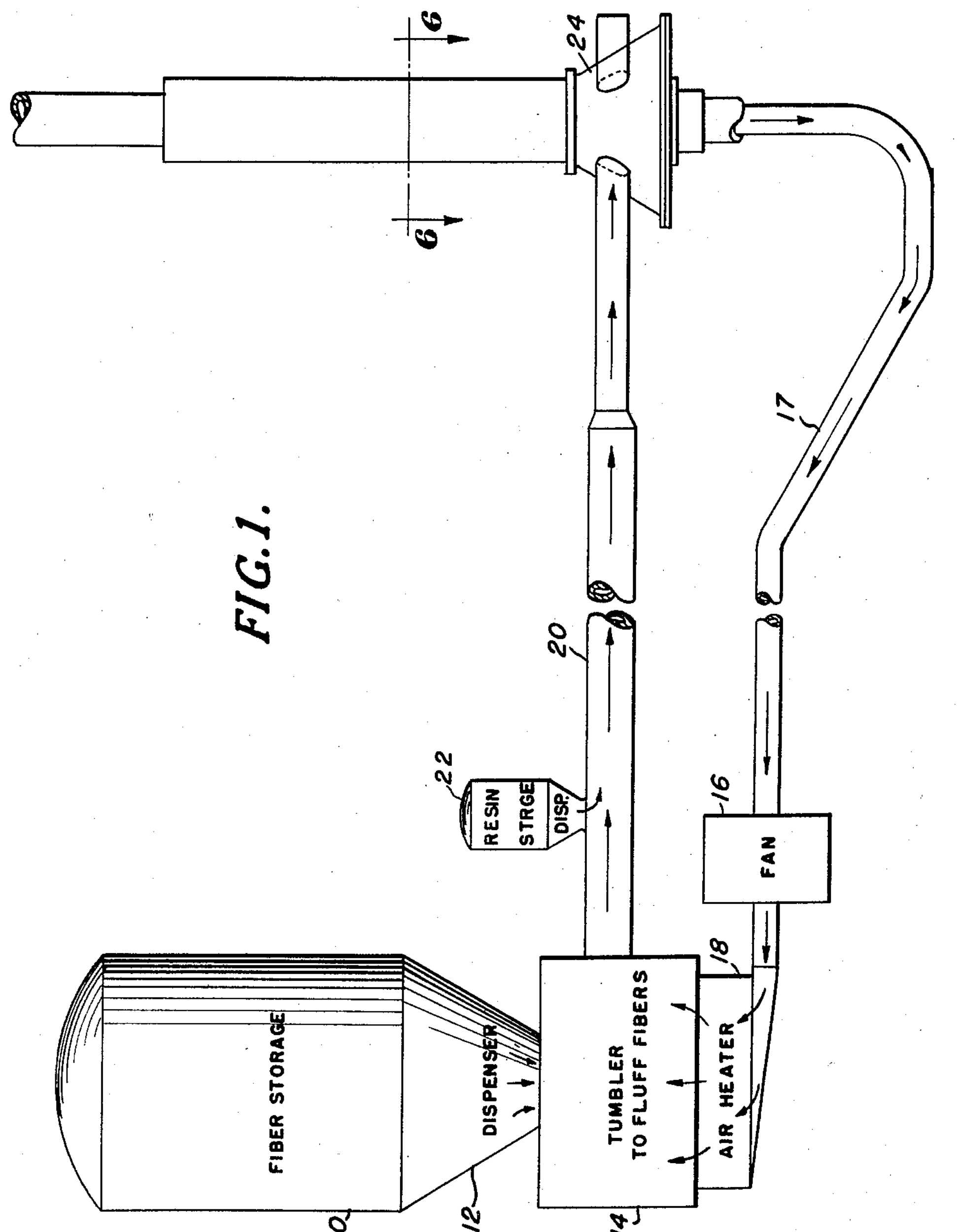

FIG. 1.

INVENTOR
Herbert D. Boggs

BY Cushman, Darby & Cushman
ATTORNEYS

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CORE COMPACTOR

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FIG. 2.

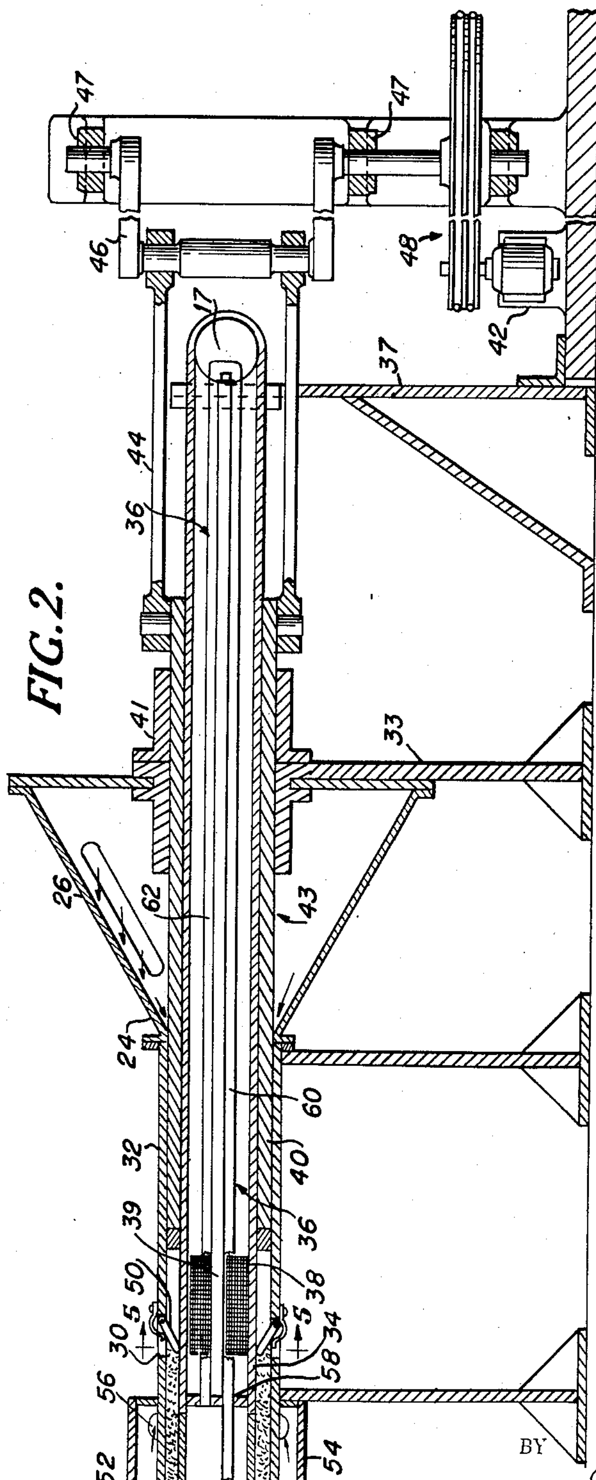
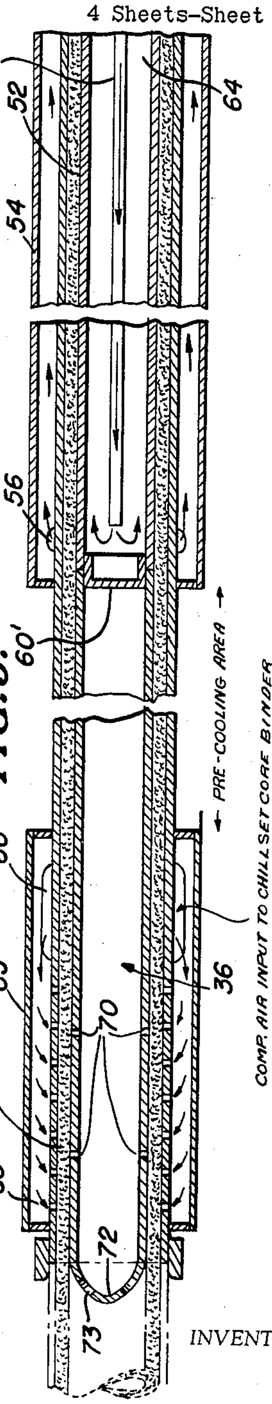


FIG. 3.



INVENTOR

Herbert D. Boggs

BY

Cushman Darby & Cushman

ATTORNEYS

Nov. 10, 1959 H. D. BOGGS **2,912,041**

CORE COMPACTOR

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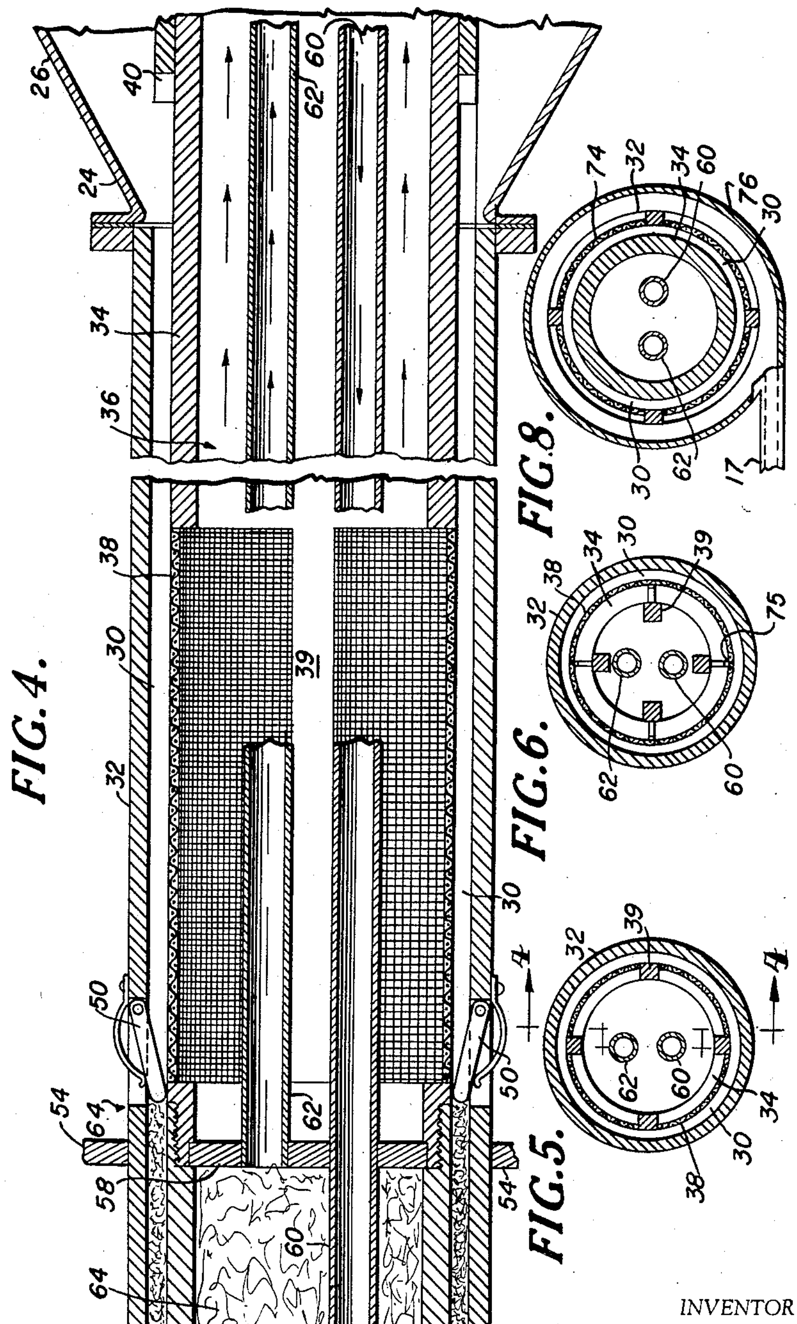

FIG. 4. FIG. 5. FIG. 6. FIG. 8.

INVENTOR

Herbert D. Boggs

BY Cushman, Darby & Cushman

ATTORNEYS

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CORE COMPACTOR

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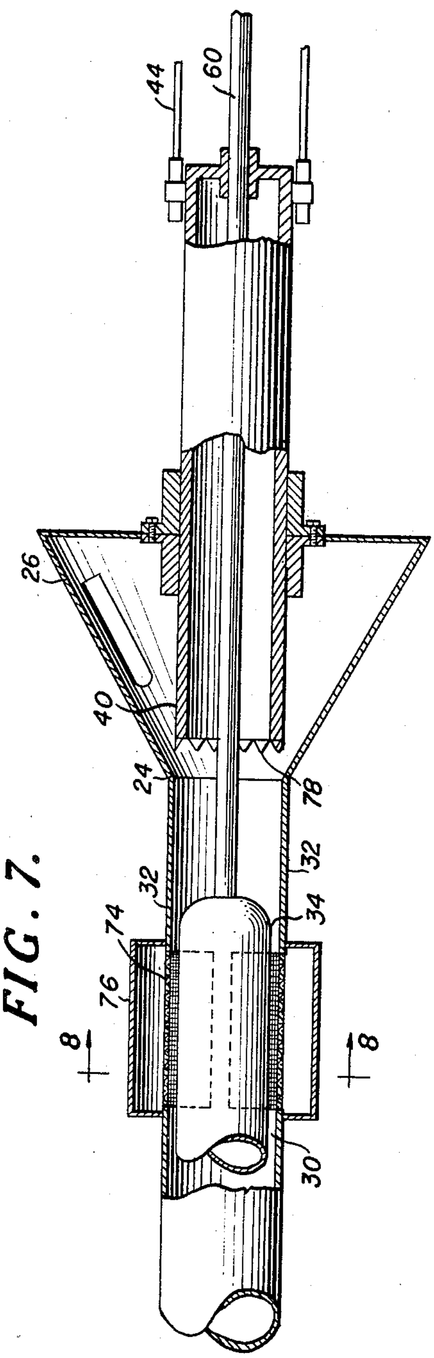

FIG. 7.

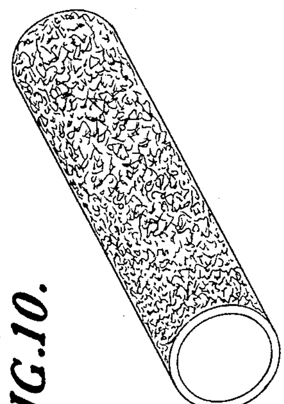

FIG. 10.

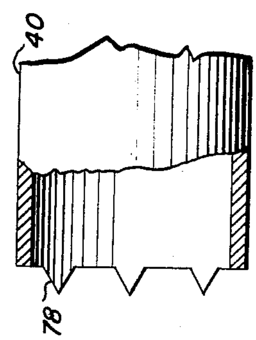

FIG. 9.

INVENTOR

Herbert D. Boggs

BY Cushman, Darby & Cushman

ATTORNEYS

2,912,041

CORE COMPACTOR

Herbert D. Boggs, Tulsa, Okla., assignor to H. D. Boggs Company, Ltd., Omaha, Nebr., a limited partnership

Application January 28, 1954, Serial No. 406,823

15 Claims. (Cl. 154—1)

This invention relates generally to a method and apparatus for making tubular formations of randomly distributed fibers. More particularly, this invention relates to the making of such tubular formations for use, for example, as reinforcing liners or blanks in so-called "plastic" pipe or tubing.

Representative methods and apparatus for producing such articles are disclosed and claimed in the copending applications of H. D. Boggs, Serial No. 200,193, filed December 11, 1950, now Patent No. 2,776,450 and Serial No. 264,976, filed January 4, 1952, now Patent No. 2,785,442 and in the copending application of Lewis Perrault, Serial No. 391,821, filed November 13, 1953, all assigned to the assignee of the present invention. These techniques involve impregnating a fibrous reinforcing liner with a thermo-setting plastic material. It has been proposed to make the initial fibrous reinforcing formation by wrapping sheets of matted fibrous material, such as glass fibers, about a mandrel or other form, inserting the thus-formed liner into a mold, then impregnating the liner of fibrous material with the liquid sealable matter by centrifugal or other forces, and then subjecting the entire mass to sufficient heat to cure the material within a suitable molding apparatus.

It has been determined that a considerable saving in both machinery and labor may be derived by the elimination of the use of material which has to be wound or otherwise formed on the mandrel as discussed above. Rather, it is now proposed to directly prepare tubular blanks or cores of matted fibers to serve as reinforcing liners, although the use of such blanks or cores is by no means so limited. In accordance with the present invention, the fibers are matted into a formation roughly approximating the size and shape, though not necessarily the thickness, of the completed plastic impregnated pipe. These formations are made continuously and may be directly inserted into a mold for casting, or they may be removed and preserved for future use in molds as desired.

It is, therefore, an object of this invention to provide a method of making tubular formations of randomly matted fibers.

It is a further object of this invention to provide a method of forming such a fibrous formation with a light tacking of plastic material.

It is another object of this invention to provide apparatus for forming tubular blanks of randomly matted fibrous material.

It is still another object of this invention to provide apparatus for making tubular formations of randomly matted fibers having a light tacking of plastic material.

These and other objects of my invention will be fully understod from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings in which:

Figure 1 is a schematic flow diagram of the process showing the relative location and arrangement of the various parts of the apparatus;

Figure 2 is an elevational view taken in section of a portion of a collection chamber and apparatus associated therewith;

Figure 3 is an elevational view taken in section of a further portion of the apparatus shown in Figure 2;

Figure 4 is an enlarged view taken in section along the lines 4—4 of Figure 5;

Figure 5 is a section taken along the line 5—5 of Figure 2;

Figure 6 is a section taken along line 6—6 of Figure 1, illustrating a modification of the invention;

Figure 7 is an elevational view taken in section of a modification of the collection chamber and associated apparatus;

Figure 8 is a section taken along line 8—8 of Figure 7;

Figure 9 is an elevational view taken in section of a modification of the face of the reciprocating ram; and

Figure 10 is a perspective view of a core or blank made in accordance with this invention.

Referring generally to Figure 1, a fiber storage container **10** is provided with a depending gravity feed dispenser **12** feeding a tumbler **14**. The tumbler may be of any conventional design suitable for breaking up bundles of short fibers which are received from the dispenser **12**, and may consist of a mechanically energized revolving chamber having interiorly disposed ribs or flukes as in a well-known cement mixer. The tumbler is supplied with a large mass of high velocity air from fan **16**. The air may be preheated by heating unit **18** which may be constructed in any conventional and well-known design. The large volume of air speeding through the tumbler interior will pick up the individual short fibers, for example, glass fibers, and will carry them in a suspended state through conduit **20**.

Disposed adjacent conduit **20** is a resin storage dispenser **22** which is provided with suitable metering means for continuously distributing a small amount of resinous material, in either a liquid or powdered form, into the stream of air and suspended fibrous material passing through the conduit. This material will be further described hereinbelow.

The conduit **20** leads to the compactor collector hood **26**, which is a cone-shaped hood designed to funnel the fiber-laden air stream delivered to its periphery through its apex **24**. The conical construction of the hood, together with the peripherally-disposed entrance of the fiber-laden air stream, will create a whirling or cyclonic action of the air within the hood and will thus create a radial placement of the fibers in the collection chamber, as will be discussed hereinafter.

Referring more particularly to Figure 2, the apex **24** of the conical hood **26** communicates with an annular collection chamber **30** which is formed by an exterior tubular wall **32** and an interiorly-disposed hollow mandrel defining an inner wall **34**. As shown in Figures 2 and 3, the mandrel, indicated generally at **36**, comprises an extended tubular structure, the structural details of which will be discussed hereinafter.

Referring especially to Figure 2, the mandrel **36** is securely fixed to and cantilevered from upstanding structural member **37**, which is securely fixed to the base, or foundation, of the compactor machine. The mandrel may also receive some support from upstanding structural member **33**, fixed to the base or foundation of the machine, which supports sleeve **41** surrounding the mandrel, and ram **40**, as will be discussed hereinafter. The mandrel extends beyond the mouth or first end of the collection chamber **30**, as defined by the outer wall **32**, for substantial distance and has its interior in communication with an evacuating means, which may be the intake **17** of fan **16** (Fig. 1) or any other suitable evacuating means. The walls of the mandrel, that is, the inner walls of the collection chamber, are provided with apertures substantially over the entire circumference thereof, these apertures having fine mesh replaceable screens **38** disposed therein. The provision of such large apertures in the wall **34** of the mandrel may serve to weaken the cantilevered structure, so the remaining portions of the mandrel wall may be built up or thickened to form support beams **39** having sufficient strength to support the weight of the free end of the mandrel. The operation of the evacuating means in communication with the interior of the mandrel will create a partial vacuum effect at the screened mouth of these apertures, and it will be seen that the stream of air entering the conical hood **26** will effect a whirling motion in ever-diminishing circles until its exits the hood and enters into the collection chamber. The suction applied to the surface of the screen will draw the air into the mandrel, from which it is removed by the evacuating mechanism, leaving the short fibers and the plastic impregnating material from dispenser **22** (Figure 1) arrayed on the surface of the mandrel or, more particularly, on or about the screens which act as retaining strainers. The continued straining effect will rapidly build up a substantial layer of fibers and plastic material on the exterior peripheral surface of the mandrel. This layer of fibers will, of course, conform to the tubular shape of the collection chamber which, for example, may be round, and will thus form the initial annular matted formation. Due to the whirling effect of the air passing through the collection chamber the fibers will be randomly oriented when they come to rest upon the screen **38**. However, while these fibers will be randomly oriented, only a negligible number of fibers will come to rest in a radially extending position.

Slidably disposed upon the mandrel is a tubular ram **40** which is adapted to be reciprocated axially along the mandrel by electrically energized prime mover **42**. The free end of the ram is provided with pivoted connecting arms **44** which are in turn pivotally mounted upon the crank shaft **46** which is mechanically engaged to the motor **42** by any suitable means, such as the belt and pulley arrangement shown generally at **48**. The crank may be off center, that is, its axis at bearings **47** may be below or above the path of travel of the ram **40**, the choice depending upon the selected directional rotation of the crank shaft, the arrangement being such that the ram will have a prolonged period of forward motion and a shortened period of retracting motion. The effect of this arrangement will be that the ramming action will be considerably slower than the relatively rapid withdrawal or retractional movement. The face of the ram **40** comprises a pliable sleeve slidably disposed on the mandrel and has an exterior diameter slightly smaller than the interior diameter of the outer wall **32** of the collection chamber. During a portion of its reciprocating period, it will slide into the collection chamber for a substantial distance, and, during another portion of its reciprocating period, it will be withdrawn clear of the mouth of the chamber as indicated by arrow **43**.

When the ram moves axially into the collection chamber, it will compress and pack the randomly-matted fibers which have collected on its surface adjacent the screens. This compression will form a much denser fibrous formation which will be forced to conform exactly with the predetermined shape of an annular collector chamber.

Each stroke of the ram will not only compress the fibers collected within the collection chamber, but will move the matted formation toward the exit or second end of the chamber. As this apparatus is operated continuously, the ram effects a continuous, though periodic, ejection of a compacted mat from this end of the collection chamber. Due to the natural resiliency of the short fibers, the mats will have a tendency to expand or slip back into the collection chamber upon removal of the pressure of the ram when it moves back for a new stroke. Therefore, the outer wall **32** is provided with a plurality of depending uni-directional stop dogs **50**, which may be spring-biased to project into the end of the collection chamber and thus engage and prevent any re-expansion of the compacted fibers.

Referring to Figures 2, 3, and 4, the collection chamber exits into a congruent and coaxial heating chamber **52** which is defined by the enclosing of the exterior wall **32** with a steam chest **54**. The steam chest is provided with entrance ports **56** for the introduction of live steam, hot water, or some other heating medium, as may be appropriate. The mandrel **36** is provided with an interiorly-disposed plug **58** which further defines the location of the heating chamber **52**. The hollow mandrel acts as an evacuating air conduit, as discussed hereinbefore, but a small portion of its interior is utilized to carry steam entrance pipe **60** and steam exit pipe **62**, which extend through the evacuating air portions of the mandrel, through the plug, and into the heating portion of the mandrel **64**. The heating area of the mandrel is terminated adjacent the end of the heating chest **54** by interiorly-disposed plug **60'**.

The outer wall **32** and inner walls **34** continue to form a precooling area which may be of any suitable length, and then enter a portion of the apparatus utilized as a cooling or chilling area. This area or portion **63** of the annular passage is defined by a peripheral cooling chest **65** surrounding the outer wall **32**. A supply of compressed air is introduced into the chilling chest through apertures **66** which may be arranged in communication with any suitable compressed air-supplying means. The portion of the outer wall **32** circumscribed by the cooling chest **65** is perforated (at **68**) as is the exterior wall of the mandrel, that is, the inner wall of the passage (at **70**). The free end **72** of the mandrel **36** is provided with large apertures **73** allowing the free exhaust of the compressed air through the end of the tubular fibrous formation (not shown).

The periodic reciprocation of the ram compacts the fiber in the collection chamber and slowly forces the tubular formation through the annular passage **30, 52,** and **63**. As the matted core or blank passes through the heating area **52** defined by the steam heating chambers, the thermosetting resin previously introduced into the fibrous material will react to form a light tack or binder which will be distributed through the fibrous mass. Further movement of the blank or core through the precooling and thence the chilling area **63** will permanently set such a plastic material so that the blank is permanently formed in a semi-rigid tubular shape, as shown in Figure 10.

As the blank is extruded from the end of the chilling area **63**, it may be cut off into suitable lengths (by means not shown). As hereinabove mentioned, one use of such blanks or cores is as reinforcing lines for centrifugally-cast "plastic" pipe as defined, for example, in the copending application of Lewis Perrault, Serial No. 391,821.

Referring to Figure 6, there is shown a modification of the invention in which the beams **39** converge slightly to define a circle having a diameter somewhat smaller than that of the mandrel wall **34**. Each beam carries radially-projecting pins **75**. In this modification the air-straining means comprises a tubular sleeve of fine mesh screening material which encompasses the beams **39** and pins **75**, and which may be fixed to the latter by suitable bolts or other detent means. This tubular sleeve will have a diameter equal to or somewhat smaller than that of the exterior wall **34** of the mandrel **36**. The effect of this arrangement will be that the entire circumference of this portion of the mandrel, excluding the negligible area of the heads of the bolts, will define an air-straining surface.

Referring to Figures 7 and 8, I have shown a modification of the invention in which the air strainer is placed on the outer periphery of the collection chamber **30**. In such a case, the fine mesh screens **74** will be disposed within apertures in the outer wall **32**. The screened area is provided with a circumscribing hood **76** which is placed in communication with evacuating mechanism as described hereinabove.

In Figures 7 and 9, there is shown a modification of the ram **40**. The free end of the sleeve of the compactor ram **40** may have an irregular face with lugs or knobs **78** projecting therefrom. Such knobs apparently have a circumferental packing effect on those fibers immediately adjacent the face of the ram, tending to prevent slippage of loose fibers on the end of the matted formation. Moreover, this arrangement permits the quantities of fibers picked up by each pass of the ram to be interengaged with those already compacted into the tubular formation.

Referring to Figure 1, it should be noted that the dispenser **22** is arranged to dispense a very small amount of the thermo-setting material into the stream of air and suspended fibrous material passing through conduit **20**. This resin is utilized to tack together some of the individual fibers forming the finished fibrous core or blank. It is well known that the expression "tacking" connotates a light adhesive effect, and it is not intended that the fibers be saturated or impregnated with the plastic material. This tacking operation only uses enough of the thermo-setting material to lend some rigidity to the core or blank, as it is a purpose of this invention to form a liner which may be thereafter submitted to a saturating or completely impregnating bath of plastic material to form the finished "plastic" pipe. It has also been determined that, unless the tacking material is used rather sparingly, the tacking material may serve to impede the subsequent saturation or impregnation of the liner when it is being utilized in the process of making plastic pipe as discussed hereinabove.

While reference has been made to short fibers, it is with the contemplation of this invention to use longer fibers when circumstances so dictate. It has been found that spun glass fibers make a particularly suitable reinforcing material, but the invention should not be restricted to fibers of any particular composition.

Having described only a typical preferred form and application of the invention, it is not to be limited or restricted to specific details herein set forth, but I wish to reserve to myself any variations or modifications that may appear to those skilled in the art and falling within the scope of the following claims.

I claim:

1. Apparatus for making an elongated annular formation of randomly matted fibres comrising an elongated annular collection chamber, means for whirlingly introducing a supply of fibrous material suspended in an air stream into said collection chamber, said collection chamber having a first open end to receive the air and the fibrous material, strainer means forming a portion of the structure of said collection chamber, and evacuation means juxtaposed to said collection chamber in communication with said strainer means, the arrangement being such that the fibrous material is collected against the strainer means, and ram means disposed for axial movement into said first end of said collection chamber for removing collected fibrous material from the strainer means.

2. The apparatus defined in claim 1, a second open end of said collection chamber, means for introducing a tacking resinous material into said supply of air and fibrous material, and fibrous formation heating means communicating with a second end.

3. In the apparatus defined in claim 2, fibrous formation cooling means communicating with said heating means.

4. Apparatus as defined in claim 1, wherein said collection chamber is formed by an exterior wall and an interior wall, said interior wall extending beyond the first end of said chamber, said ram means comprising a sleeve slidably disposed about said interior wall, said ram means being eccentrically engaged with rotational

means, whereby said sleeve spends a relatively small portion of each cycle within said collection chamber.

5. In the apparatus defined in claim 1, said collection chamber comprising an exterior wall, and an inner wall extending beyond the first end of said collection chamber, said strainer means forming a portion of the said inner wall of said collection chamber.

6. In the apparatus defined in claim 1, said collection chamber comprising an exterior wall, and an inner wall extending beyond the first end of said collection chamber, said strainer means forming a portion of the said exterior wall of said collection chamber.

7. In the apparatus defined in claim 4, a second open end of said chamber, unidirectional stop means depending into said collection chamber between a second end and said strainer means to prevent re-expansion of the formation of fibrous material compressed by said ram means.

8. The process of making annular fibrous formations comprising suspending fibrous material in an air stream, whirlingly delivering said stream to a collection chamber, straining said stream through a forming strainer, compacting said material within a forming mold, and extruding the compacted material from said mold.

9. A process of making annular fibrous formations comprising suspending fibrous material in an air stream, dispensing a resinous material into said air stream, whirlingly delivering said stream into a collection chamber, straining said stream through a forming strainer, compacting said fibrous material and said resin retained by the strainer within a forming mold, heating said compacted material while it is enclosed in said mold, cooling said material while still confined within said mold and extruding said material from said mold.

10. The process for making annular fibrous formations comprising suspending fibrous material in an air stream, dispensing a resinous thermosetting material into said air stream, delivering said stream to an annular collection chamber, straining said stream through interiorly disposed forming strainers compacting the material retained by said strainers within an annular forming mold, periodically conveying said material through a steam heated portion of said mold, periodically conveying said material through an air cooled portion of said mold, and periodically extruding said material from said mold.

11. The process of forming an annular fibrous formation comprising whirlingly depositing fibrous material and thermosetting resinous material in a collection chamber, collecting said material by the application of vacuum to foraminous strainers forming a portion of the collection chamber, compacting the fibrous material retained by the strainers and resinous material within an annular mold, forcing said material through a heated portion of said mold, forcing said material through a chilled portion of said mold and extruding said material from said mold.

12. Apparatus for making a substantially continuous elongated annular formation of randomly matter fibres comprising an elongated annular collection chamber, strainer means forming a portion of the structure of said collection chamber, evacuation means juxtaposed to said chamber in communication with said strainer means, and means for whirlingly introducing a supply of fibrous material suspended in an air stream into said chamber, said last-mentioned means comprising fan means, tumbler means, and vortex conduit means, said collection chamber having a first end open to said vortex conduit means to receive the whirling air and fibrous material, and ram means disposed for periodical axial movement into said first end of said collection chamber for compressing and removing fibrous material collected against said strainer means.

13. Apparatus defined in claim 12 wherein said collection chamber is formed by an exterior wall and an in-

terior wall, said interior wall extending beyond the first end of said chamber, said ram means comprising a sleeve slidably disposed about said interior wall, said ram means being eccentrically engaged with rotational means whereby said ram spends a relatively small portion of each cycle within said collection chamber.

14. In the apparatus defined in claim 13 a unidirectional stop means depending into said collection chamber between a second end and said strainer means, to prevent re-expansion of the formation of fibrous material compressed by said ram means.

15. Apparatus for making a substantially continuous elongated annular formation of randomly matted fibers comprising an elongated annular chamber, means for whirlingly introducing a supply of fibrous material suspended in an air-stream into one end of said collection chamber in a direction generally axially thereto, fixed strainer means forming a portion of the structure of said collection chamber, evacuation means juxtaposed to said collection chamber in communication with said strainer means, the arrangement being such that the fibrous material is collected against the strainer means, and means for removing the annular formation formed in said annular collection chamber from a second end thereof by causing movement of the formation in a direction axially thereto and away from the first end of said collection chamber.

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