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2,428,653

APPARATUS FOR MAKING TUBULAR FIBROUS PRODUCTS

Filed Nov. 6, 1942

3 Sheets-Sheet 1

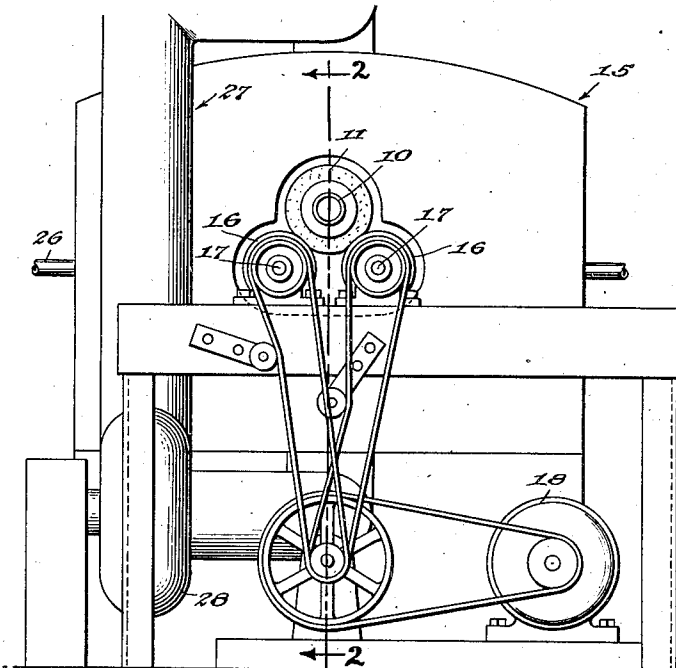


Fig. 1.

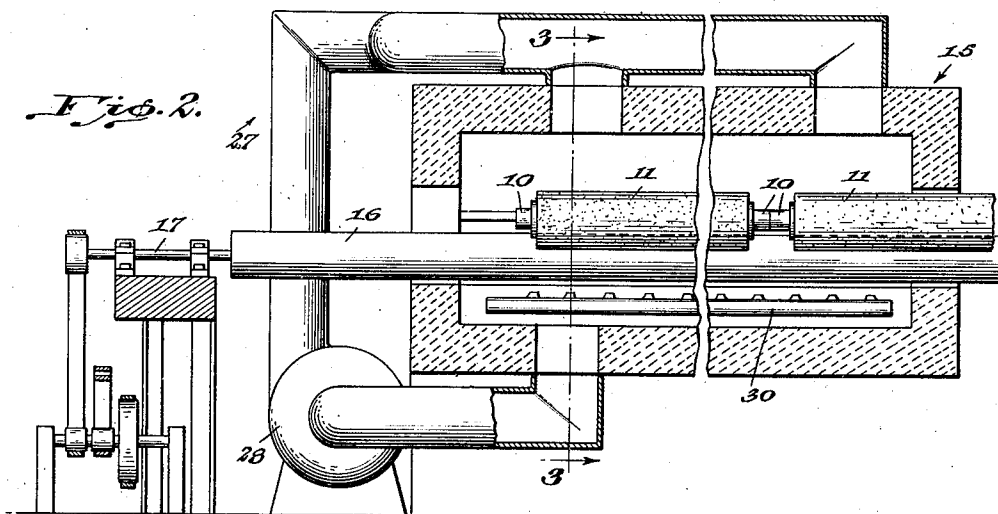


Fig. 2.

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Fig. 3.

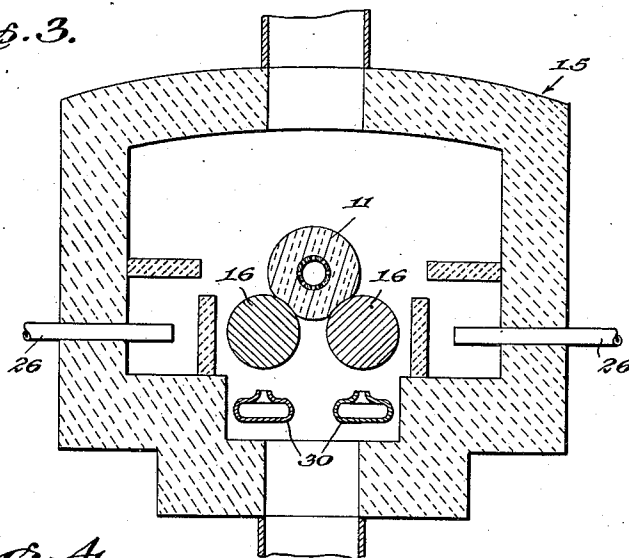


Fig. 4.

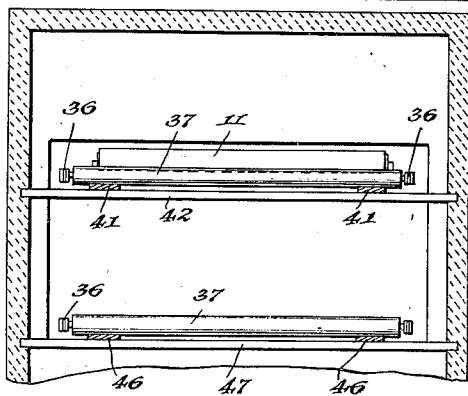
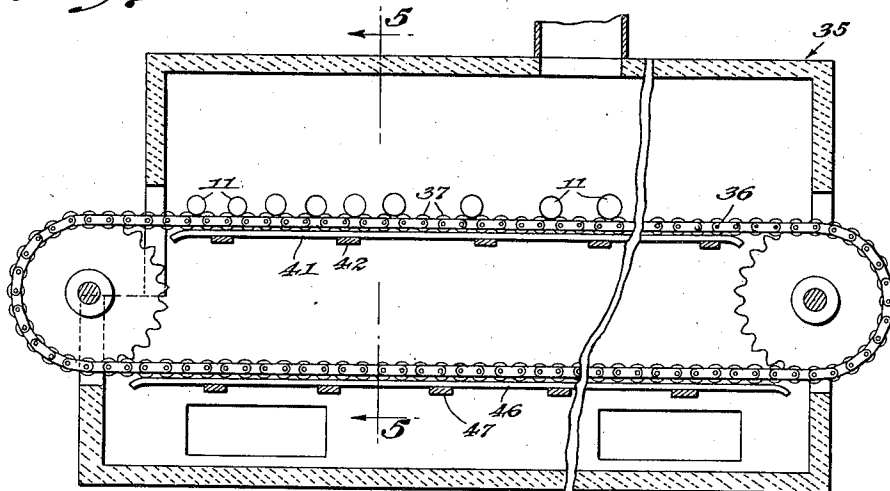


Fig. 5.

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Fig. 6.

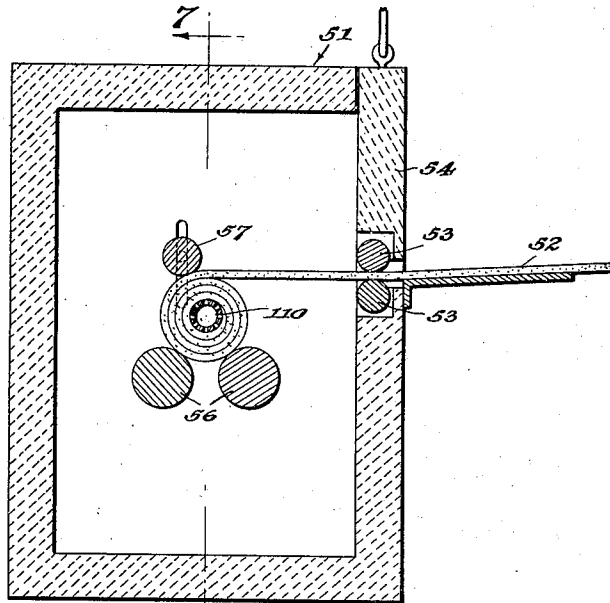


Fig. 7.

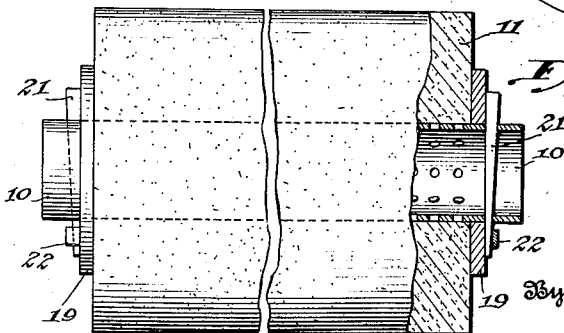
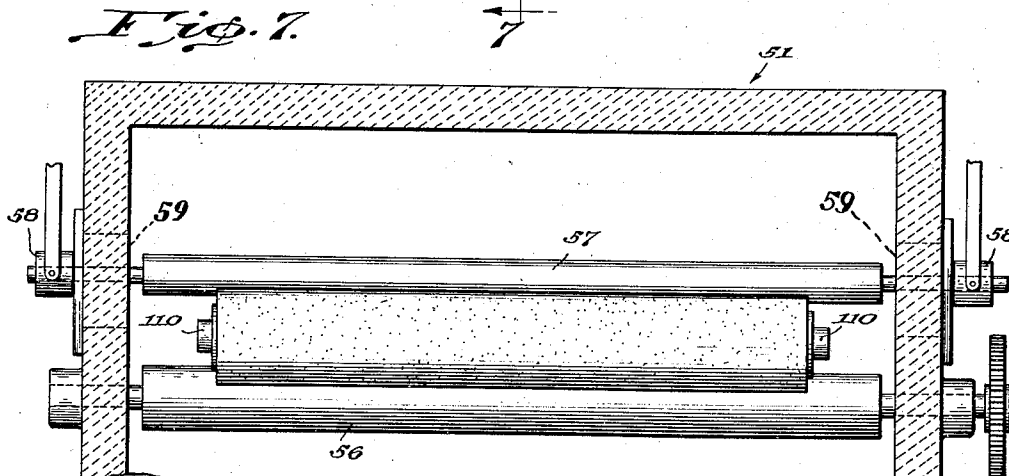


Fig. 8.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR MAKING TUBULAR
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Application November 6, 1942, Serial No. 464,932

3 Claims. (Cl. 49-1)

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This invention relates to tubular insulating members of fibrous material and to apparatus for manufacturing these members. More particularly, it refers to the manufacture of pipe coverings from inorganic fibrous materials such as glass wool.

One of the principal objects of this invention is to provide a pipe covering or other tubular product formed from a fibrous material and having walls which are not only of relatively high density but which possess the desired degree of flexibility and resiliency.

Another object of this invention is to provide a tubular fibrous product having a relatively hard shell-like exterior surface and having the remaining mass of fibrous material comparatively resilient.

A further feature of this invention is to provide a relatively simple, inexpensive apparatus for manufacturing tubular fibrous products possessing the above characteristics. In accordance with this invention the specified fibrous material is distributed around the periphery of a mandrel to form a package having an outside diameter in excess of the outside diameter of the finished product. The fibrous material is then compacted and condensed by applying pressure on the fibrous material in a radially inward direction at the same time heat is applied to soften the fibrous material.

The temperature to which the fibrous material is heated approaches but is preferably just short of the temperature at which all of the fibres in the mass will fuse or partially fuse together. At this temperature the fibers are sufficiently plastic to readily take a permanent set when deformed by the radially applied pressure aforesaid. Since the compacting is done at temperatures below the fusing temperature, a product is obtained wherein the individual fibers are not fused together but are relatively movable to impart resilience and flexibility to the finished product.

Still another object of this invention is to provide a hard shell-like skin on the exterior surface of the product by heating the fibers at the periphery of the product to a temperature sufficient to fuse the fibers. This feature is particularly desirable in the manufacture of pipe covering because it assists materially in retaining the shape of the covering even in the absence of binding material.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

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Figure 1 is an elevational view of a preferred type of apparatus capable of producing a tubular fibrous product in accordance with my improved method of manufacture;

Figure 2 is a fragmentary longitudinal sectional view of the construction shown in Figure 1, and taken substantially on line 2-2 thereof;

Figure 3 is a cross sectional view taken on the line 3-3 of Figure 2;

Figure 4 is a diagrammatic longitudinal sectional view of another embodiment of this invention and having certain parts broken away for the sake of clearness;

Figure 5 is a cross sectional view taken on the line 5-5 of Figure 4;

Figure 6 is a diagrammatic cross sectional view of a further embodiment of this invention;

Figure 7 is a diagrammatic longitudinal sectional view taken in the plane of the line 7-7 of Figure 6; and

Figure 8 is a fragmentary side elevational view, partly in section, of a mandrel having a fibrous material distributed around the periphery.

Briefly, a quantity of fibrous glass in bat form is wound on a mandrel 10 to provide a package 11 having an outside diameter in excess of the specified outside diameter of the finished product. In the present instance, the finished product is in the form of a pipe covering, although many other types of tubular products may be manufactured by employing the teachings of this invention. In the case of pipe covering, the mandrel is of a diameter equal to the outside diameter of the pipe to be covered with the tubular insulating sections.

The fibrous material on the mandrel is heated and is subjected to a compacting pressure to reduce the outside diameter of the material to the specified diameter of the finished product and thus increase the density of the fibrous material. The temperature to which the fibrous material is heated is sufficient to cause the fibers in the mass to take a permanent set when subjected to the compacting pressure. Particularly satisfactory results are obtained by heating the fibrous material to a temperature which is just below the temperature at which all of the fibers in the mass will fuse or partially fuse together. At this temperature the fibers become sufficiently plastic to enable the same to be readily reduced to the proper density with the application of a relatively small compacting pressure but remain mutually free so as to retain the desired flexibility and resiliency in the product.

Although the temperature is controlled to avoid

fusing of the fibers throughout the mass or material, nevertheless, in the manufacture of pipe coverings and analogous products it is desired to form a hard shell-like coating on the exterior surface of the material. This result is obtained by heating the peripheral portions of the material on the mandrel to a temperature sufficiently high to fuse the fibers lying at or adjacent to the peripheral surface of the material.

In the manufacture of certain products it is desirable to embody a small quantity of binding material in the mass. Such materials as asphalt, bentonite, phenol formaldehyde, and the like, are particularly satisfactory in case the material is formed of glass wool or the like. Regardless of the binder employed, only a small quantity is needed to bind the compacted fibers at their points of contact so that the required strength and coherence is imparted to the material without noticeably effecting the porosity of the mass.

Referring now more in detail to Figures 1 to 3, inclusive, of the drawings, it will be noted that the reference character 15 indicates an elongated heating chamber or oven having openings in the opposite ends thereof for receiving a pair of rolls 16. The rolls 16 extend lengthwise of the chamber in lateral spaced parallel relationship and are suitably journaled on fixed supports at the outside of the heating chamber for rotation about their respective axes. Each of the rolls 16 is provided with a shaft 17 which projects beyond the ends of the rolls and is operatively connected to a suitable motor or prime mover 18 in such a manner that both rolls are revolved in the same direction.

The package 11 or, in other words, the mandrel 10 with the fibrous material thereon is supported on the rolls in such a manner that the exterior surface of the fibrous material is engaged by the peripheral portions of the rolls along circumferentially spaced lines throughout the length of the package 11. The arrangement is such that the weight of the package 11 including the mandrel is carried directly by the rolls 16 and the reactive force applies a radial pressure on the fibrous material in an inward direction. Inasmuch as the two rolls 16 are rotated in the same direction, this pressure is progressively applied throughout the circumference of the material and, as a result, the fibers are compacted or, in other words, the diameter of the package 11 is reduced. The extent of reduction in the diameter of the fibrous material is determined in the present instance by a pair of flanges 19 extending radially outwardly from opposite ends of the mandrel and having an outside diameter equal to the specified outside diameter of the finished product. With the above construction the fibers are compacted until the peripheral surfaces of the flanges 19 abut the rolls 16 whereupon continued compacting of the fibers is positively prevented, providing accurate dimensions in the finished product.

The flanges 19 are preferably releasable from the mandrel to facilitate removal of the cylindrical body of compacted fibrous glass either by slitting the body lengthwise or in any other way. For this purpose the flanges may be in the form of collars slidably fitted over the mandrel. Tapered pins 21 are passed through diametrically opposed holes in the mandrel to hold the collars against outward displacement. The smaller ends of the tapered pins are received in loops 22 fixed to the collars, preventing undue inward movement of the flanges 19 while the fibrous glass is being applied to the mandrel.

The compacting pressure applied to the fibrous material is relatively light in the present case because the compacting of the fibrous material is assisted by applying heat to the fibers. Referring again to Figures 1 to 3, inclusive, a plurality of burners 26 are mounted at opposite sides of the heating chamber in spaced relation to each other longitudinally of the chamber and these burners extend into the chamber through openings provided therefor. In addition, air is circulated through the chamber by a closed circuit 27 including a blower 28 having the exhaust side communicating with the interior of the chamber through the top wall of the latter and having the intake side communicating with the interior of the chamber through the bottom wall thereof. The temperature within the chamber is controlled and is sufficient to reduce the fibers to a plastic state but is less than the fusing temperature of the fibers. With common kinds of fibrous glass, particularly good results are obtained by providing a temperature of approximately 1100° F. to 1300° F. within the chamber. These temperatures are not extremely critical and may be varied as desired to suit the particular glass composition of the fibers undergoing treatment.

The above temperatures serve to reduce the fibers to a sufficiently plastic state to enable the mass to be condensed to the proper diameter by the application of a relatively light compacting pressure. However, these temperatures will not fuse the fibers throughout the mass and, as a result, the product is both flexible and resilient. In the event it is desired to provide a hard-shell-like coating over the product, the rolls 16 may be directly heated in any suitable manner, for example, by means of burners 30 beneath the rolls, to a temperature which is sufficient to fuse the fibers at the periphery of the package. The resulting product is then cooled in the absence of excessive moisture and is preferably treated with any one of the binders previously set forth.

In operation fibrous glass in the form of a mat usually several inches thick and of 1 to 2 pounds per cubic foot density is wrapped about a mandrel fitted with flanges as previously described. The wrapping is done by hand, or by machine, as disclosed for example, in the Slayter Patent No. 2,206,059 of July 2, 1940. The density of the fibrous glass is increased somewhat by the pressure exerted on the fibrous material during wrapping and the cylindrical body of fibers on the mandrel may have a density of from 2 to 4 pounds per cubic foot. The fibrous glass on the mandrel after wrapping is about 2 to 3 times the specified thickness of the finished pipe covering section so that when it is compacted during further processing the final density of the product is from 6 to 12 pounds per cubic foot. These figures are given merely as examples and not as limitations of the present invention.

Prior to the present invention, it had been found very difficult to compact the fluffy resilient fibrous glass the extent required to obtain densities in the finished product of the order just mentioned. Very high compacting pressures were required and, in the case of pipe covering, it was difficult to apply pressure evenly to the cylindrical body to obtain the uniform increase in density required. In the present instance the wrapped mandrels are slid endwise on the rolls 16 into the oven and heated to the degree necessary to permit the weight of the wrapped mandrel to compact the fibrous glass as the rolls rotate the cylindrical body. Each new wrapped

mandrel is slid on the rolls into the oven, pushing the preceding wrapped mandrel endwise through the oven. Feeding of the bodies through the oven is readily effected by hand in this manner but mechanical feeding means may be employed if desired. The rate at which the newly wrapped mandrels are introduced into the oven regulates the length of time the mandrels previously placed therein are subjected to rolling and heating, thus establishing a rate of movement through the oven. This results in an intermittent longitudinal movement of the mandrels through the oven at substantially regular intervals so that each time a new mandrel is introduced at one end a completed mandrel is ejected from the other.

The invention also includes employing a plurality of pairs of rolls similar to the pair of rolls 16. These rolls may be arranged in a horizontal row or in tiers and extend through an elongated heating chamber in the direction of the length thereof. Each roll of each pair of rolls may be rotated about its respective axis with all the rolls rotating in the same direction by any suitable power means. A mandrel having the fibrous material thereon is supported on each pair of rolls and the latter progressively apply pressure on the material throughout the circumference of the latter in the same manner previously described.

The modification illustrated in Figures 4 and 5 comprises an elongated heating chamber 35 similar in construction to the heating chamber 15 described in connection with the first embodiment of this invention. Located within the heating chamber 35 is a pair of endless conveyor chains 36 which extend the full length of the heating chamber and are driven by any suitable mechanism not shown herein. The two chains carry rolls 37 through the heating chamber from one end of the latter to the other. The rolls are provided with stub shafts which are received as pintles in the links of the chains 36 so that the rolls are free to rotate.

Adjacent rolls cooperate to support the wrapped mandrels 11 and the rolls are rotated in the same direction by frictional contact with spaced stationary supporting bars 41 mounted in the heating chamber on cross bars 42. As a result, the fibrous material on the mandrels is compacted by the rolling pressure applied by the rollers and is heated during the application of this pressure in the same manner hereinbefore described in connection with the embodiment shown in Figures 1 to 3. During the return movement of the conveyor chains 36, the rolls 37 may be supported on bars 46 mounted on cross bars 47 secured in the heating chamber.

In Figures 6 and 7 of the drawings I have shown a further embodiment of this invention. In these figures the reference character 51 designates a heating chamber which may be somewhat smaller than the heating chambers previously described but which performs the same function.

In detail, a web 52 of loosely matted fibers is introduced into the heating chamber 51 by a pair of cooperating feed rolls 53 suitably journaled at the entrant end of the chamber and driven in any suitable manner, not shown herein. One of the feed rolls, preferably the upper one, is mounted on a slide 54 and is adapted to be moved upwardly therewith for the introduction and removal of a mandrel 110 similar to the previously described mandrel 10 into and from the heating chamber. The mandrel is received centrally above a pair of rolls 56 rotatably mounted and driven in suit-

able manner. As the web 52 leaves the feed rolls 53, it is wound on the mandrel 110 and is compacted by a roll 57. The roll is supported in bearings 58 suitably mounted for vertical sliding movement in slots 59 in the walls of the chamber 51. The roll 57 under the influence of gravity thus compresses the web on the mandrel and also aids in holding the wrapped mandrel in place on the rolls 56.

When the mandrel 110 contains the desired quantity of fibrous material, the bat is severed at the outside of the heating chamber and the rotation of the mandrel is continued until the desired compacting has been accomplished. When processing has been completed, the mandrel 110 is removed and a new mandrel put in its place, the new mandrel having preferably first been wrapped with one or more turns of the fibrous web.

I claim:

1. Apparatus for manufacturing tubular fibrous products comprising a weighted mandrel adapted to have a fibrous material loosely distributed thereon to form a package with a substantially cylindrical exterior surface of a diameter in excess of the specified finished diameter of the product, means on said mandrel for controlling the finished diameter of the product, means for rotatably supporting said mandrel and coacting therewith to progressively apply pressure in a radially inward direction against the fibrous material, means for heating the fibrous material during the application of said pressure to a temperature which is less than the fusing temperature of the fibrous material but which is sufficiently high to condense the fibrous material under the action of said pressure to the specified finished diameter, and heating means for said mandrel supporting means for heating the exterior surface of the fibrous material to a temperature sufficient to fuse the fibers at the periphery of the material.

2. Apparatus for manufacturing tubular fibrous products comprising an elongated heating chamber, means for supplying heat to the chamber, a pair of heated rolls extending longitudinally through said chamber and projecting from either end thereof, said rolls supported in parallel relationship for rotation about their respective axes and arranged to support between them a weighted mandrel covered with fibrous glass with the axis of the mandrel extending in the general direction of the axes of the rolls, means for rotating the rolls in the same direction about their respective axes to coact with said mandrel for compacting the fibrous material on the mandrel as it softens by heat within the chamber, and means for heating said rolls individual to each of said rolls and separate from the means for supplying heat to the chamber.

3. Apparatus for manufacturing tubular fibrous products comprising an elongated heating chamber, means for heating said chamber, a pair of rolls extending longitudinally through said chamber and projecting from either end thereof, means for rotating said rolls in the same direction, a weighted mandrel adapted to have a fibrous material distributed around the periphery thereof to form a package having an outside diameter in excess of the specified finished outside diameter of the product and having radially extending flanges at opposite ends of an outside diameter approximating the specified finished outside diameter of the product, said rolls and mandrel when disposed thereon coacting to progres-

sively apply pressure in a radially inward direction against the fibrous material throughout its circumference to condense the fibrous material to the specified finished diameter as it softens by the heat within said chamber upon reaching a temperature approaching but less than the fusing temperature of the fibrous material, and separate heating means individual to said rolls for heating the rolls to a temperature sufficiently high to fuse the fibers at the periphery of the package.

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