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2,904,836

CENTRIFUGAL CASTING APPARATUS PARTICULARLY FOR PLASTIC TUBING

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3 Sheets-Sheet 1

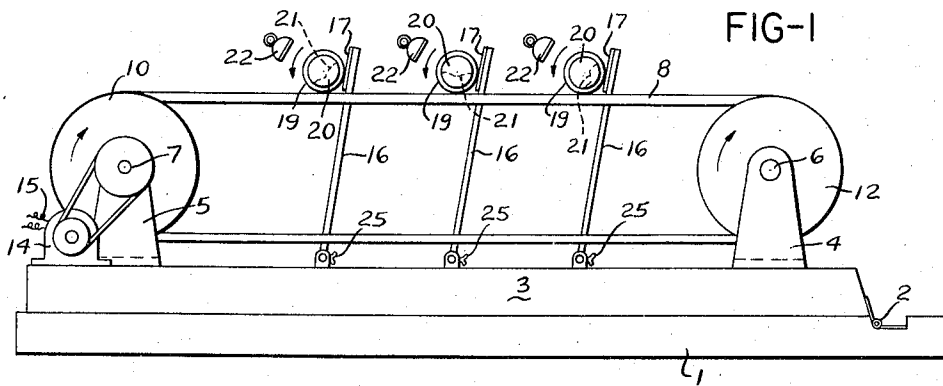
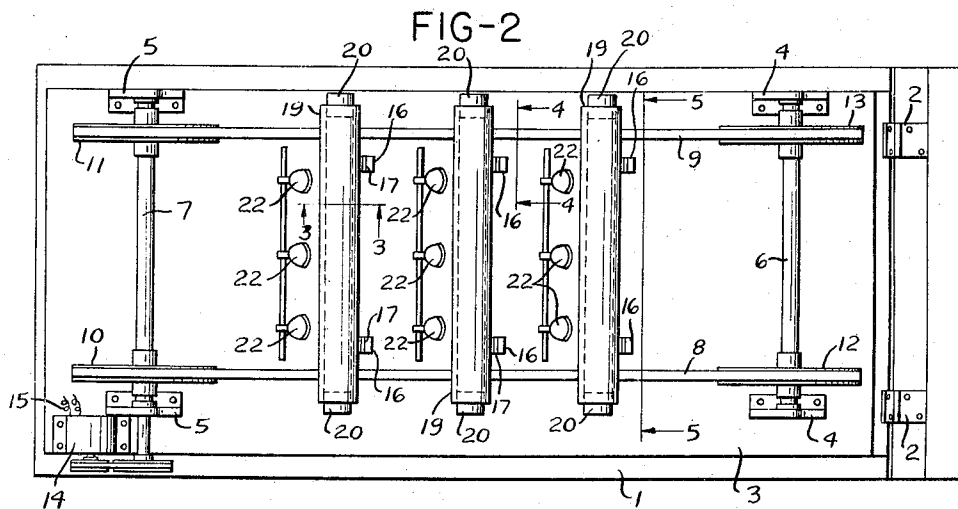
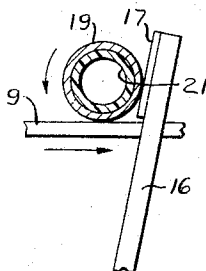
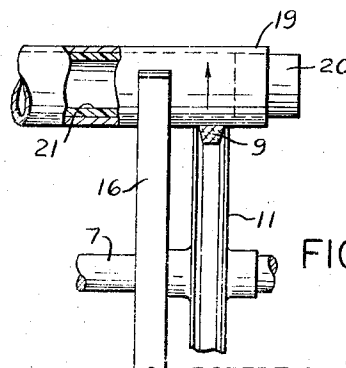


FIG-3

FIG-4.

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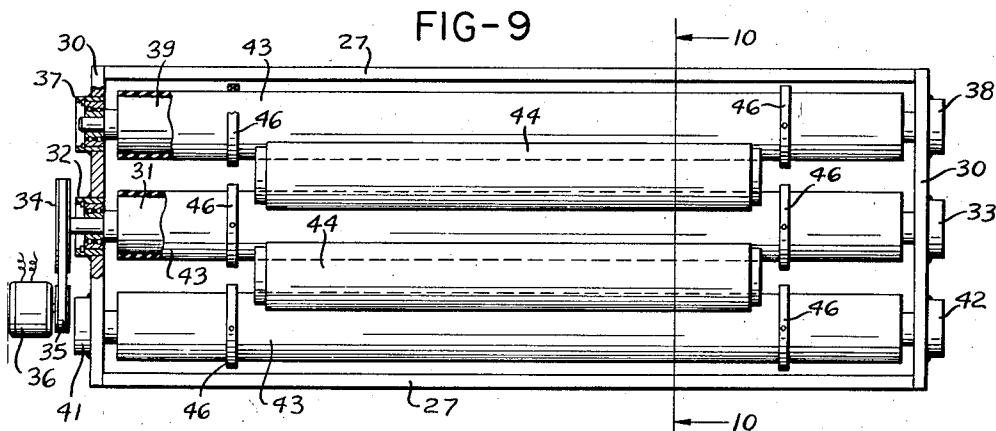
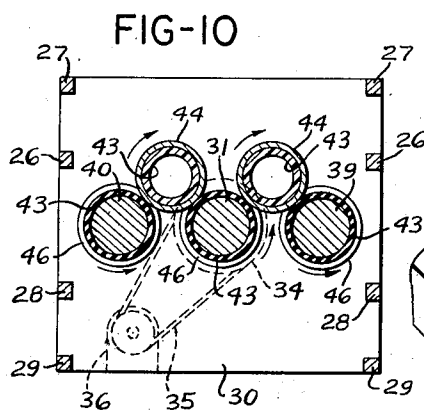
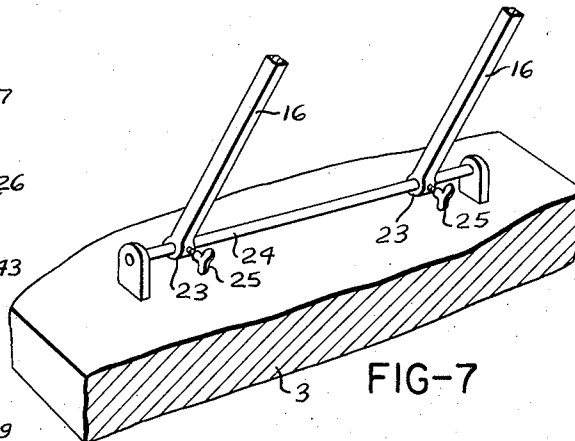
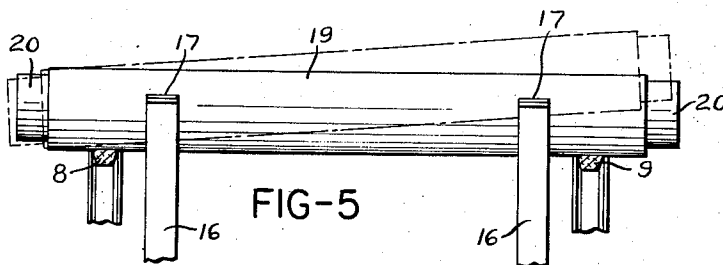
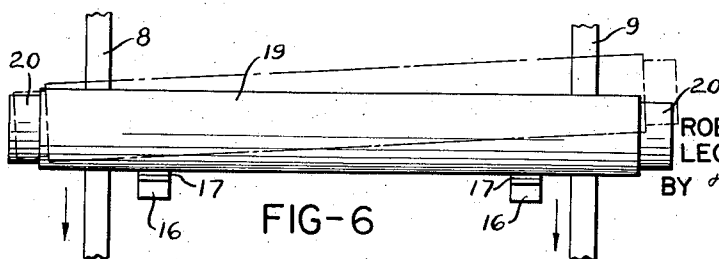
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3 Sheets-Sheet 3

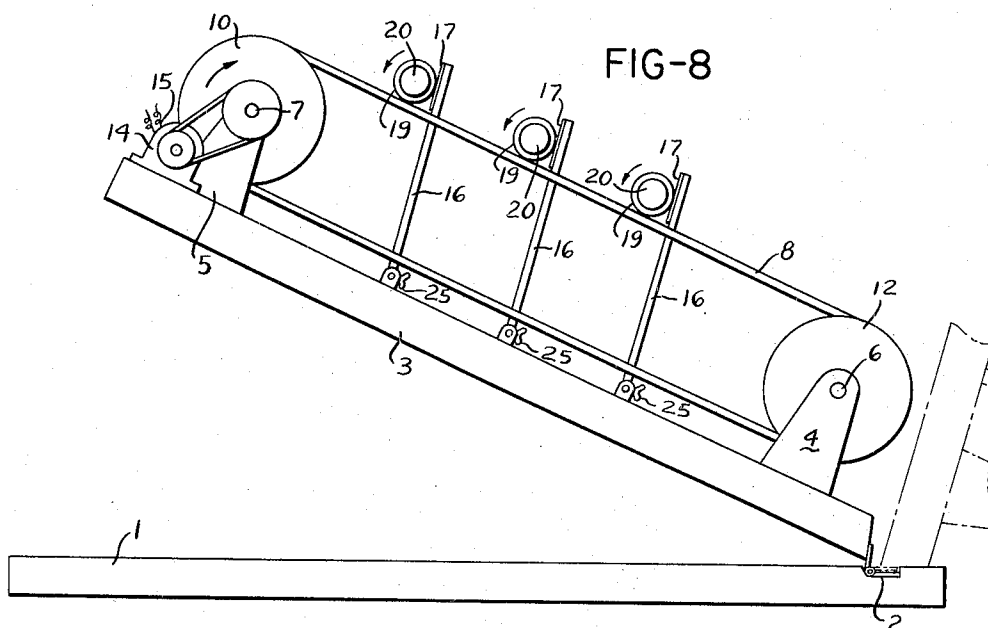
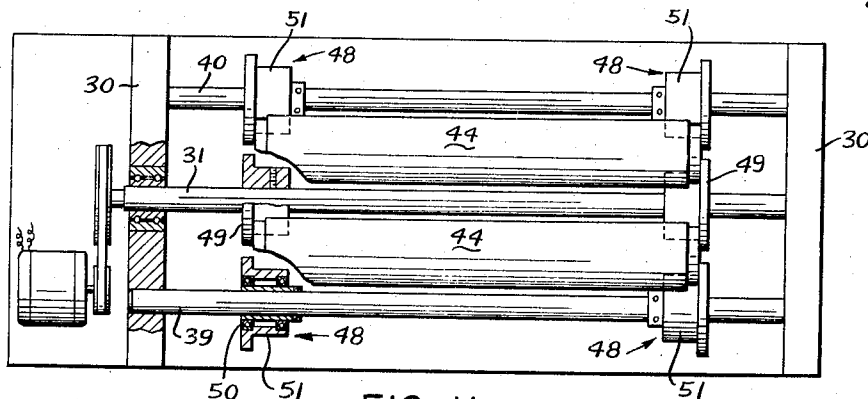


FIG-11

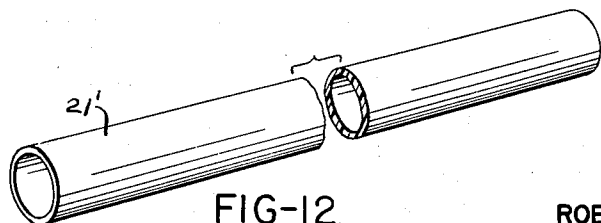


FIG-12

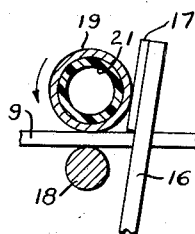


FIG-13

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CENTRIFUGAL CASTING APPARATUS PARTICULARLY FOR PLASTIC TUBING

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Application April 5, 1956, Serial No. 576,278

5 Claims. (Cl. 18—26)

This present invention relates to the production of tubing and to methods and apparatus for the same involving centrifugal casting.

The centrifugal casting of plastic tubing, for example, by the spinning of a tubular member on its own axis with the plastic material therein results in very uniform dimensioned tubing. It is desirable to employ commercially produced tubular members to house and spin the plastic and we have found that while such commercial products are generally satisfactory some tubular members of a commercial lot may vary slightly in characteristics. These variations are such that though not discernible to the eye they may give rise to restrained whipping of the tubular member when the member is spun in the process of manufacturing the tubing. Such may lead to uneven distribution within the tubular member resulting in variation in wall thickness to the product.

We have found that spinning of the tubular member on its axis while freely supporting the tubing for vibratory movement overcomes the above-noted difficulties.

It is accordingly a primary object of this invention to describe novel tube-spinning apparatus which incorporates means for spinning a tubular member on its own axis while supporting the tube for free vibratory movement; means are provided to engage the periphery of the tubular member to effect rotation of the member and the plastic therein while the tubular member ends are unrestrained and the tubular member may achieve its natural period of vibration while rotating. Such arrangements lead quite unexpectedly to uniform wall dimensions of the finished tubing even in instances where the member vibrates quite violently in the tube-spinning operation.

An important object of the invention is to provide a novel tube-spinning process in which a horizontally supported longitudinally extending tubular member is rotated about its own axis while the member is substantially free over the length thereof for vibratory movement; such method of operation occasions hardenable fluid material within the member to distribute itself uniformly over the interior length of the tubing and the hardened finished tube is provided with a uniform wall thickness over its length even though the tubular member and material therein were subjected to considerable vibration in the spinning process.

The invention will be more fully understood by reference to the following detailed description and accompanying drawings wherein:

Figure 1 is a view illustrating a preferred embodiment of the invention;

Figure 2 is a plan view of the structure of Figure 1;

Figure 3 is a sectional view taken on line 3—3 of Figure 2;

Figure 4 is a fragmentary sectional view taken substantially on line 4—4 of Figure 2;

Figure 5 is a fragmentary view partially in section taken substantially on line 5—5 of Figure 2 but illus-

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trating the apparatus in operation and indicating in dotted line a tubular member in vibration;

Figure 6 is a fragmentary plan view illustrating a portion of the structure of Figure 2 in vibratory movement;

Figure 7 is a fragmentary detail view of a portion of the structure of Figures 1 and 2;

Figure 8 is a side elevational view illustrating the structure of Figures 1 and 2 in other positions of operation;

Figure 9 is a plan view of a further embodiment of the invention;

Figure 10 is a sectional view taken on line 10—10 of Figure 9;

Figure 11 is a plan view of a modification of the structure of Figures 9 and 10;

Figure 12 is a view of a completed tube; and

Figure 13 is a fragmentary view partially in section illustrating a modification of the structure of Figure 1.

Referring to the drawings the numeral 1 designates a fixed support carrying hinges 2 for the mounting of a base 3 for movement with respect to the support 1. Base 3 is provided with forward bearing blocks 4 and rearward bearing blocks 5; shaft 6 is mounted in the bearing blocks 4 and shaft 7 is mounted in the bearing blocks 5.

V-belts 8, 9 pass over pulleys 10, 12 and 11, 13, respectively. Pulleys 10, 11 are suitably keyed to the shaft 7 for rotation therewith, while pulleys 12, 13 are similarly keyed to the shaft 6 (Figure 1).

Motor 14 operably connected with shaft 7 is adapted for driving the pulleys in rotation and suitable leads 15 are provided for connecting the motor to a source of power (not shown).

Referring to Figure 1 the numeral 16 designates vertically extending fingers which are supported on and project upwardly from the base 3 beyond the upper surface of the V-belts, laterally of the V-belts. One surface of the fingers is suitably provided with a plastic block material as indicated at 17.

The numeral 18 (Figure 13) designates a freely rotatable bearing or rod which may be employed in contact with the under surface of the upper strand of the V-belt to assist in supporting of the V-belt in a substantially horizontal plane.

The numeral 19 indicates a plurality of tubular members; each tubular member 19 is closed at its opposed ends by suitable stoppers 20 of rubber or nylon, for example. The members 19 are adapted for housing therein a material to be spun, which material is indicated by the numeral 21.

In the operation of the embodiment of the invention shown in Figure 1, the motor 14 is utilized to drive the belts 8, 9 in the direction indicated by the arrows. The belts 8, 9 pass laterally of the fingers 16. The tubular members 19 which are resiliently supported across the V-belts 8, 9, as shown most clearly in Figure 2, are rotated by the movement of the V-belts in a direction opposed to that of the belts, and as indicated by the arrows in the drawings. This causes the tubular members 19 to rotate and to abut against plastic portions 17 of the fingers.

With many tubes the rotation will take place smoothly and substantially no vibration will appear over the tube from end to end, and accordingly the liquid plastic material 21 will be uniformly coated on the interior of the walls of the tubes 19. In some cases, however, the tube, while being rotated, may assume a rather violent vibration, such as is indicated in Figure 5 in dotted lines. The substantially unrestrained vibration quite unexpectedly results in uniform distribution of the material within the tubular member 19 and occasions the production of a plastic tube of uniform thickness.

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The resilient support by the belts 8, 9 in combination with the support of the tubular members for substantially free vibratory movement in their rotation apparently permits the flow of the liquid material within the tubing in such manner that the interior of the tubing is covered with plastic of uniform thickness, and this is so even when the free ends of the tubes oscillate in a vertical plane along the members 16 through an amplitude of as much as 3 or 4 inches with a 1/2 inch tubing.

It is to be noted that one tubular member may be rotating smoothly in contact with the V-belts as indicated in Figure 3, while another tubular member vibrates rather violently as indicated in Figure 5, and that both will produce a uniform plastic tube. This is in direct contrast to the result attained when a commercial tube vibrates violently if the tube is supported endwise for rotation.

In one embodiment of the apparatus of invention the tubular members rolling in contact with the belts are 26 inches long and 1/2 inch in diameter. The speed of rotation is about 3500 r.p.m. The plastic material was epoxy resin having a silica-quartz filler and a viscosity of about 800-1000 cps. at 140° F. The resin was a condensation of epichlorhydrin and bisphenol, and the filler constituted approximately 47 percent by weight of the total, while about 5 1/2 parts by weight of an amine catalyst were used to 100 parts by weight of the combined resin and filler.

A plurality of infra-red lamps designated by the numeral 22 in Figure 1 were utilized to heat the stainless steel tubular members as they are rotated, and the temperature of the tubular members during the rotation over the length thereof was about 140° F.

Such a mode of operation is consistently used for the production of plastic tubes of about 1/2 inch outside diameter with a wall thickness as low as .030 inch. However, it is to be noted that the resin, the filler, and the catalyst employed may be varied, as may be the viscosity of the material, to achieve particular results.

In general, epoxy resins, by which is meant a class of synthetic organic resins, sometimes called ethoxyline and epoxy resins, are entirely suitable for the centrifugal casting procedure of invention. Tubes have been spun with tubular members having as large an I.D. as 11 inches, and tubes have been spun with an I.D. as low as 1/8 of an inch; in fact, solid plastic items may be produced should such be desired.

Suitable rotation rates may be from about 2000 r.p.m. to about 4000 r.p.m., the higher speeds being used with more viscous materials.

The operation may be performed at room temperature with the kind of resinous materials described hereinafter when activated by a catalyst; but heating is preferable to shorten the time of operation.

The tubular members 19 should extend in a horizontal plane while being rotated; however, as indicated in Figure 8, for example, the base 3 may be pivoted to a very considerable angle, in excess of 90 degrees, and for this purpose the fingers 16 are pivotally mounted as shown in Figure 7 in order that the fingers will adequately retain the tubular members during the rotation and possible vibration thereof. Thus, as shown in Figure 7, portion 23 cooperates with portion 24 and the wing nut 25 is utilized to provide for adjustment of the position of the fingers 16. The adjusting device is suitably supported on the base 3.

Referring now to Figure 9 wherein a further embodiment of the structure of invention is illustrated, a frame is shown having intermediate, longitudinally extending side bars, 26, upper side bars 27, lower intermediate side bars 28, lower side bars 29, and vertical plate supports 30. The numeral 31 designates a shaft which is supported in bearings 32, 33 mounted in the plates 30. Shaft 31 has keyed thereto a pulley 34 over which a V-belt 35 passes to drive the pulley of a motor 36.

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Bearings 37, 38 mounted in the plates 30 rotatably support a solid shaft 39 to one side of the shaft 31; shafts 39 and 31 define a hollow therebetween. Shaft 40 is rotatably supported in bearings 41, 42 and likewise spaced from the shaft 31 to define a hollow therewith. Preferably each of the shafts 31, 39 and 40 are provided with a rubber cover as indicated at 43.

Tubular members 44 closed at their ends by stoppers are supported in the hollows between the shafts. Stop members 46 secured to the shafts by set screws or other suitable means are adjustably provided in pairs on the shafts 31, 39 and provided in loosely spaced relation with the tubular members 44 and are adapted to restrict movement of the tubular members 44 lengthwise of the shafts and the frame.

When shaft 31 is driven to suitable energization of motor 36 the tubular members 44 are rotated in the direction indicated by the arrows in Figure 10. A resin material within the tubular members will be spun to form a plastic tube.

It will be noted that in the structure of Figure 9 the apparatus supports the tubular members over substantially the whole length thereof in contrast with the structure of Figure 1 wherein the periphery of the tubular members engages the belts at spaced points along the periphery.

The structure of Figure 9 is particularly suitable for very large diameter tubular members and the provision of the resilient material 43 permits free vibratory movement of the tubular members as they are driven in rotation.

The structure shown in Figure 11 is a modification of the structure set forth in Figure 9 and differs principally in that in the structure of Figure 11 the tubular members 44 are supported on their periphery adjacent the ends only. For this purpose shaft 39 carries a combination bearing and stop member designated by the numeral 48. Two of these stop members are provided on the shaft 39 in spaced relation. The shaft 40 is similarly provided with a pair of stop members 48. The shaft 31 is provided with stop members 49 which are securely fixed to and rotate with the shaft.

The stop members 48 are provided in two portions, a bearing portion designated by the numeral 50 and a portion rotatable with respect to the bearing portion designated by the numeral 51. The portion 51 engages the tubular members 44 on the peripheries thereof and adjacent the ends thereof as clearly shown in the figure.

When the shaft 31 is driven the tubular members 44 are driven also, as are the portions 51 of the stop members 48; but the shafts 39 and 40 are not rotated and accordingly are fixed in the plates 30. Otherwise the operation of the structure of Figure 11 is similar to that of the structure of Figure 9.

The finished plastic tube 21' shown in Figure 12 may be removed from the tubular members 19 and 44 in any suitable manner; the structure shown in the co-pending applications of Douglas W. Howenstine and Bernard F. Forrest, Serial No. 348,246, filed April 13, 1953, now Patent No. 2,856,639, and Serial No. 566,485, filed February 20, 1956, now abandoned, and assigned to the same assignee as the present invention, being particularly suitable for the purpose.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

We claim:

1. In combination, in tube-spinning apparatus, a tubular member closed at the longitudinal ends thereof and adapted for housing therein a material to be spun, and rotatable means resiliently supporting and engaging the tubular member for driving the same in rotation, the tubular member being so supported as to be rectilinearly

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movable while rotating and the rotatable means being mounted for tilting thereof in a vertical direction.

2. Tube-spinning apparatus which comprises in combination, rotatable driving means, resilient support means which are tiltably mounted for providing the support means at an angle to the horizontal, and a tubular member closed at its ends adapted to house therein material to be spun, the driving means being positioned between the tubular member ends and peripherally engaged with the tubular member, the member being mounted for rectilineal movement while being rotated.

3. Tube-spinning apparatus which comprises, in combination, resilient, flexible, rotatably mounted power transmission belting, tiltably mounted supporting means for the belting finger means laterally of the belting projecting beyond a surface of the belting, a tubular member closed at its ends and adapted to house therein material to be spun, the tubular member having the longitudinal periphery thereof in contact with the belting surface and being supported by the belting, and the tubular member being in contact with and retained in position on the belting by the finger means, and means for driving the belting to thereby rotate the tubular member, the tubular member being free for movement rectilineally with respect to the finger means in the tiltable position of the belting and support means.

4. Tube-spinning apparatus which comprises, in combination, substantially rigid finger means in spaced lateral alignment, spaced power transmission belts arranged to have aligned strands thereof pass laterally of and transversely to the aligned finger means, means to actuate the power transmission belts, means to tilt the belts at an angle to the horizontal in their activated condition, and a tubular member closed at its ends and adapted for housing therein a material to be spun, the tubular member having the longitudinal axis thereof extending transversely of the belts and the periphery of the member being in contact with the belts and the finger means, the finger means retaining the tubular member against rectilineal

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movement along the belts in a downward direction in the tilted position of the belts, the tubular member being otherwise free for movement whereby actuation of the belts drives the tubular member in rotation.

5. Tube-spinning apparatus which comprises, in combination, flexible power transmission belting, power transmission equipment rotatably supporting the belting, a support for the power transmission equipment, means pivotally mounting the support for varying the degree of tilt thereof, aligned finger means carried by the support and projecting laterally of and beyond the belting transversely, a tubular member closed at the ends thereof and adapted to house therein material to be spun, the tubular member having the periphery thereof in contact with the belting and being supported by the belting, and the tubular member being in contact with and retained on the belting by the finger means, the tubular member being free for movement, and the finger means being adjustably supported for mounting the same in a position transverse to the belting.

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