July 8, 1952 T. T. BUNCH 2,602,281

STRAND-SERVING APPARATUS

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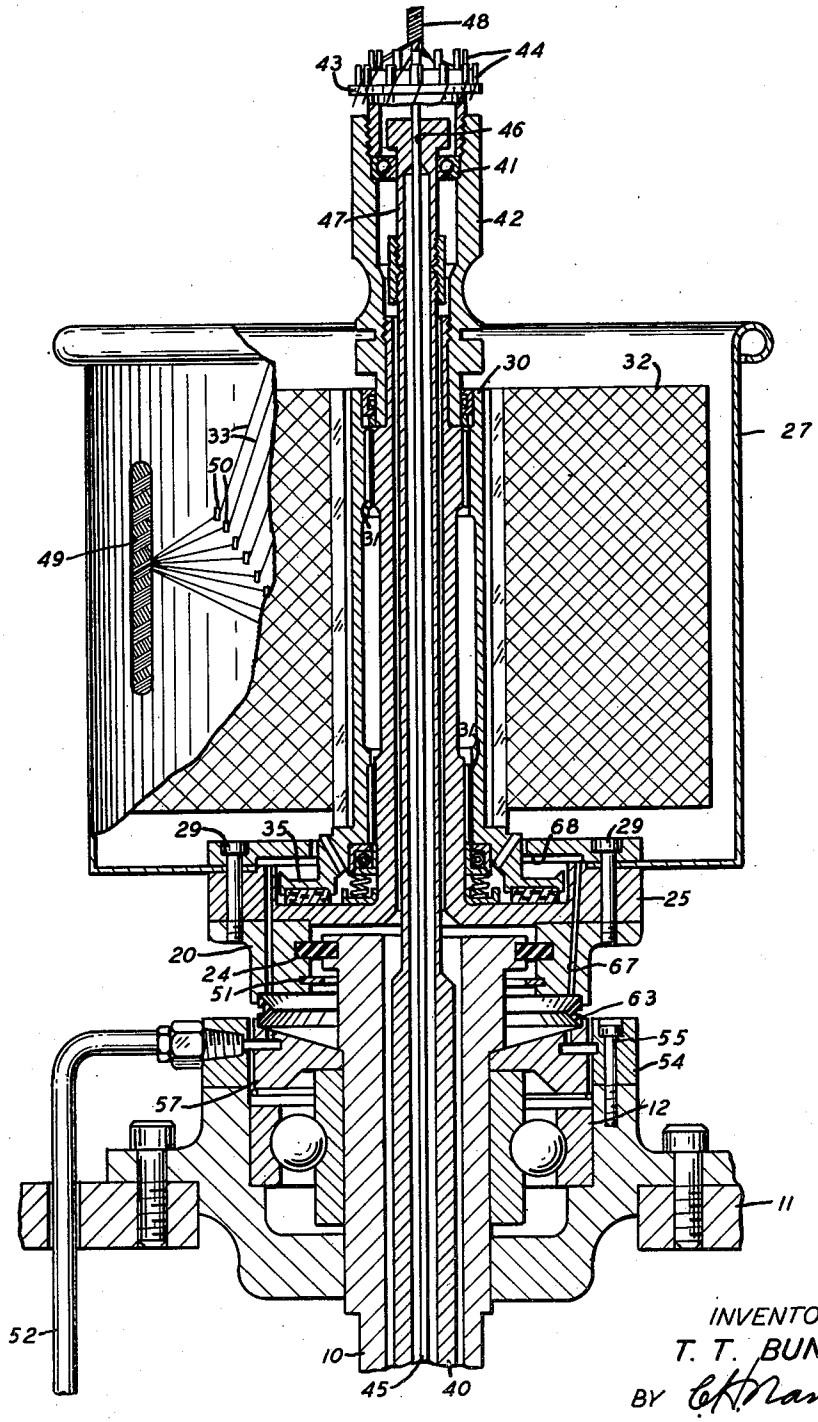


FIG. 1

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STRAND-SERVING APPARATUS

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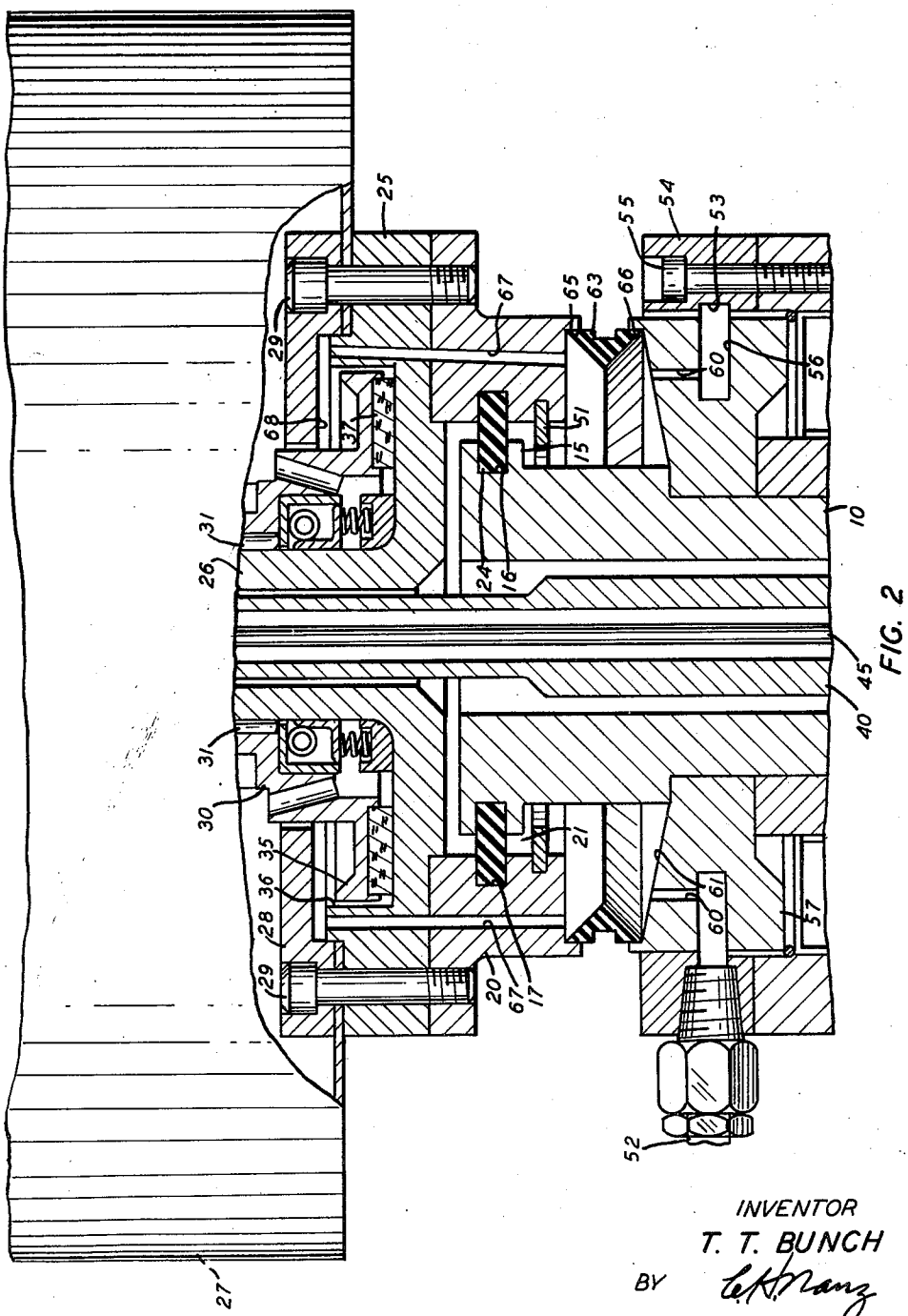


FIG. 2

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UNITED STATES PATENT OFFICE

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STRAND SERVING APPARATUS

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12 Claims. (Cl. 57—18)

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This invention relates to strand serving apparatus, and more particularly to concentric type serving machines designed to serve strands around continuously advancing filamentary articles.

One type of strand apparatus designed to apply a textile covering around a conductor or conductors advancing continuously along the central axis of the machine is generally referred to as a concentric type strand serving machine. This type of machine includes an elongated shaft journalled for rotation about a fixed axis at high speeds. A cup secured for rotation by the shaft withdraws strands from a supply cop positioned on a spindle mounted rotatably on the shaft, and serves them spirally around the advancing conductor.

It has been found that the supply cop and the cup cannot be balanced so that their axis of rotation is in line with the axis of rotation of the shaft. An unbalanced cop and cup assembly has a tendency to deviate laterally from the axis of the shaft, and to make an oscillating movement due to eccentric centrifugal forces acting on the cop and cup. In rigidly journalled, undivided shafts these movements are violently prevented, causing jerks to occur in the strand or strands being withdrawn from the cop and rapid wear of the bearings of the shaft, and imparting excessive vibration to the strand serving machine. To prevent these conditions from occurring, the upper end of the shaft, which supports the cup and the supply cop, must be free to move laterally with respect to the driven portion of the shaft that is rigidly journalled in the serving machine frame so that the rotating cup and supply cop may assume their natural axis of rotation.

An object of the invention is to provide new and improved strand serving apparatus.

Another object of the invention is to provide new and improved concentric machines for serving strands around continuously advancing filamentary articles.

A strand serving apparatus embodying certain features of the invention may include a shaft rigidly journalled for rotation about a fixed axis, a second shaft normally aligned in tandem with the first-mentioned shaft for rotation about said fixed axis, a strand supply mounted rotatably with respect to the second shaft, means secured to the second shaft for withdrawing the strand from the supply and causing rotation thereof, and a resilient member securely bonded to each shaft for coupling the shafts for rotation together and permitting an oscillating movement

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of the second shaft with respect to the fixed axis of rotation when the shafts are rotated so that the rotating cop and strand withdrawing means may assume their natural axis of rotation.

Other objects and advantages of the invention will appear from the following detailed description of an apparatus embodying certain features of the invention, when read in conjunction with the appended drawings, in which:

Fig. 1 is a sectional, side elevation of a portion of a strand serving machine embodying certain features of the invention, and

Fig. 2 is an enlarged, fragmentary sectional view of a portion of the apparatus shown in Fig. 1.

Referring now in detail to the drawings, there is shown the strand serving portion of a high-speed, concentric type serving machine, which includes a tubular shaft 10 arranged to be driven by suitable power means (not shown) at high speed. The shaft 10 is journalled rigidly in the frame of the machine, portions of which are indicated by the numeral 11, by a self-contained ball bearing unit 12. The portion of the shaft 10 extending upwardly beyond the ball bearing unit 12 is provided with an integral flange 15 having a groove 16 in the periphery thereof. A groove 17 is provided in the internal bore of a ring 20, and is of the same width and depth as the groove 16 in the flange 15. An elastomeric compound is molded in the grooves 16 and 17 of the shaft 10 and the ring 20 under sufficient heat and pressure to cure the compound into a tough, elastic coupling 24. The coupling 24 is molded in the grooves 16 and 17 to obtain a strong bond between the coupling and the surfaces of the grooves 16 and 17, and thereby provide a resilient coupling between the shaft 10 and the ring 20. An annular clearance 21 is provided between the periphery of the flange 15 and the internal bore of the ring 20, and the coupling 24 is molded in the grooves so as to secure the ring 20 concentrically with respect to the shaft 10. The surfaces of the grooves may be brass plated or coated with an adhesive to insure a tight bond between the coupling material and the grooves.

The elastic coupling 24 may be a molded rubber compound, or "neoprene" compound (polymerized chloroprene), or one of the synthetic rubber-like compounds, such as Buna-S (copolymer of butadiene and styrene). The coupling 24 also may be a molded ring or may be cut from a sheet of vulcanized rubber, neoprene, or other rubber-like compounds, and cemented in the

grooves 16 and 17 by any well known rubber adherent compound.

The ring 20 is secured to a flanged portion 25 of a tubular shaft 26 by a plurality of bolts 29—29, which threadedly engage the ring 20. The bolts 29—29 clamp a cup 27 and a cover 28 to the flange portion 25 of the hollow shaft 26. A spindle 30 mounted rotatably on the upper portion of the shaft 26 by needle bearings 31—31 is designed to receive a cop 32 containing a supply of strands 33—33. The spindle 30 has a flanged portion 35 formed integrally on the lower end thereof which fits loosely into a counterbore 36 provided in the flange 25 of the shaft 26. A ring 37, made of cork or other suitable friction material, is secured to the bottom of the flange 35 and rests on the bottom of the counterbore 36. A hollow post 40, having the lower end thereof secured rigidly to the frame of the serving machine, extends upwardly through the bore of the tubular shaft 26. A ball bearing 41 is positioned between the upper end of the post 40 and a hub 42 screwed on the upper end of the shaft 26 to align the upper end of the shaft 26 with the axis of rotation of the shaft 10.

A strand guiding member 43 secured on the end of the hub 42 has a plurality of pins 44—44 for guiding the strands 33—33 to a filamentary core 45 advanced from a suitable supply reel longitudinally through the central opening of the post 40. A bore 46 is provided in a die 47 secured on the end of the post 40 to hold the core 45 concentrically with respect to the guide member 43, and the post 40 keeps the core 45 from coming in contact with the rotating shafts 10 and 26.

The core 45 may be an insulated conductor which is to receive a covering of the strands 33—33, or any type of filamentary article such as bare wire, wire rope, or textile rope which is to receive a covering of the strands 33—33. It is to be understood that the term "filamentary article," as used herein and in the annexed claims, is intended to include all types of wires, cables, ropes and the like, having an indeterminate length. The use of the term "strands" is meant to include textile material, synthetic thread-like materials and all types of metallic threads that may be used as a covering on the core 45.

The strands 33—33 of the supply cop are threaded through a slot 49 in the side of the cup, through hookeyes 50—50 secured spacedly on the outer surface of the cup and between the pins 44—44 of the strand-guiding member 43, and are attached to the core 45. When the cup 27 is rotated by the shaft 26, it withdraws the strands from the cop and serves them spirally around the continuously advancing core 45 in the form of a textile covering 48 as the core emerges from the die. The withdrawal of the strands 33—33 from the cop causes the spindle 30 to rotate about the shaft 26 at a high speed. The ring 37 resting on the bottom of the counterbore 36 retards the rotation of the spindle 30 with a braking force proportional to the weight of the cop 32 positioned on the spindle. This braking arrangement on the spindle 30 provides a constantly decreasing braking force as the unwinding diameter of the cop decreases from a full cop to an empty cop, and thereby maintains a substantially uniform tension in the strands 33—33, as the serving operation proceeds from a full cop to an empty cop.

A snap ring 51 is positioned in a groove provided in the internal bore of the ring 20 so as to provide a clearance between the under side of the flange 15 and the ring 51 which permits only a predetermined tilting movement of the shaft 26 with respect to the axis of the shaft 10. A similar clearance is also provided between the end of the shaft 10 and the adjacent end of the shaft 26 so that when the lower side of the flange contacts the ring 51 at one point, a point diametrically opposed thereto on the upper side of the flange engages the flange 25 of the shaft 26. These clearances are designed to prevent unsafe strain on the coupling 24.

Occasionally one of the strands 33—33 breaks during the serving operation, and it is necessary to stop the serving machine immediately to prevent the formation of an imperfect covering 48 on the core 45. This is accomplished by increasing the downward pressure on the flange 35 to increase the drag between the ring 37 and the bottom of the counterbore 36. This increased pressure on the ring 37 is obtained by applying air under pressure to the top of the flange 35. Air under pressure is conveyed from a supply source (not shown) through the pipe 52 to a groove 53 in the internal bore of a ring 54 secured on the bearing 12 by a plurality of bolts, one of which is indicated by the numeral 55. The groove 53 in the ring 54 communicates with a groove 56 provided in the periphery of a ring 57 keyed to the shaft 10 for rotation therewith. The air under pressure passes from the groove 56 through a plurality of openings 60—60 into an annular clearance 61 formed between the ring 57 and the ring 20 secured to the upper shaft 26. A ring 63 made of vulcanized rubber or other suitable elastic material is positioned in counterbores 65 and 66 provided in the rings 20 and 57, respectively, to form an air-tight joint between the ring 20 and the ring 57 so that the air entering the annular clearance 61 does not escape into the atmosphere. The ring 63 also permits the upper shaft 26 to move out of alignment with respect to the lower shaft 10 and still holds the air under pressure in the annular clearance 61. The air under pressure passes from the annular clearance 61 through a plurality of openings 67—67 into an annular clearance 68 formed between the underside of the cover 28 and the upper side of the flange 35 of the spindle 30.

The air under pressure is admitted to the pipe 52 only when it is desirable to stop the rotation of the cop and the cup during the serving operation to prevent the cop from overrunning the cup and breaking additional strands and tangling the strands 33—33 whereby a substantial portion of the strand material is wasted. The serving machine is arranged so that when a strand breaks it actuates means (not shown) which de-energizes the means driving the shaft 10 and causes a brake (not shown) to stop the rotation of the shafts 10 and 26 immediately. Air is admitted to the annular clearance 61 simultaneously with the application of the brake to stop the shaft 10 and enters the clearance 68 and applies sufficient downward pressure on the flange 35 to cause the ring 37 to stop the rotation of the spindle and cop thereby preventing the cop from overrunning the cup and damaging the strands of the cop. The control of the air pressure supplied to the annular clearance 68 to increase the braking force on the spindle when a strand breaks is described more fully and claimed in my copending application Serial No. 100,264, filed July 1, 1949 for "Brakes for Strand-Handling Apparatus."

Operation

Let it be assumed that the shaft **10** is being driven by a suitable power means such as an electric motor at a predetermined speed and that the core **45** is being advanced through the post **40** at a linear speed bearing the direct relationship to the rotation of the cup **27** by the shaft **10**. The rotation of the cup draws the strands **33—33** from the cop **32** and serves them spirally around the advancing core **45** in the form of the textile covering **48** and causes rotation of the cop.

In high speed concentric serving machines like that described, it is desirable that the supply cop **32** contain a supply of strands **33—33** sufficient to maintain the serving machine in operation for predetermined reasonable period of time before it is necessary to stop the machine and position another cop on the spindle **30**. This requirement makes it necessary to use cops having a large diameter and mass to obtain a predetermined linear output of the covered core **45** by the serving machine. As a result, the cop **32** and the cup **27** frequently are not balanced so that the axis of rotation of the cop and the cup is not aligned with the fixed axis of rotation of the shaft **10**. During the serving operation of the strand on the core **45**, the cop and the cup become an oscillating mass rotating at a high speed, and they tend to rotate about their natural axis of rotation as a unit due to the eccentric centrifugal forces acting on the cop when it is rotated by the withdrawal of the strands **33—33** therefrom by the cup.

The elastic coupling **24** between the shaft **10** and the shaft **26** together with the clearances between the shafts permits the shaft **26** carrying the cop and cup to oscillate with respect to the fixed axis so that the cop and cup may rotate about their natural axis of rotation, and also permits the shaft **26** to move laterally slightly with respect to the fixed axis of rotation.

The eccentric centrifugal forces acting on the cop and the cup are resolved into many multiple and strongly acting divided impulses which are absorbed by the resilient coupling **24** because the coupling is placed in direct contact with the driving shaft **10** and the driven shaft **26**. Since these eccentric centrifugal forces acting on the shaft **26** are absorbed directly by the coupling **24** they are not transmitted to the frame **11** or other parts of the serving machine. The coupling **24** permits the shaft **26** to move axially without losing parallelism between their respective axes of rotation because the gyroscopic co-efficient of inertia of the upper shaft carrying the cup and the cop and rotating at a very high speed is powerful enough and the elastic coupling **24** between the two shafts is flexible enough to permit relative displacement between the two shafts while permitting the shaft **26** to retain its true plane of rotation.

The amount of lateral movement of the shaft **26** is determined by the cross-section of the coupling **24**, therefore the coupling **24** is designed to limit the lateral movement of the shaft within safe operating values at predetermined operating speeds of the shaft **26**. The lateral displacement and the oscillating movement of the shaft **26** also are restricted by the clearance between the flanges **15** and **25** of the shafts **10** and **26**, respectively, and between the flange **15** and the snap ring **51** so that bending of the post **40** and flexing of the coupling **24** in shear is restricted within safe limits. The coupling **24** is located at a point substantially close to the point on the shaft

26 where the eccentric centrifugal forces are most prominent, therefore the coupling absorbs the shocks due to oscillating movement and the lateral displacement of the shaft **26** and prevents these movements from being referred to the frame of the serving machine and the bearing **12** in the form of excessive vibration. When the shaft **26** oscillates about its axis of rotation, the resulting movement acts in shear on the coupling **24**. The apparatus is designed so that the oscillating movement of the shaft **26** will act in shear on the elastic coupling **24** because the uniformity of the resilience of the elastic material, such as rubber, due to forces acting in shear thereon is substantially greater than when the elastic material is used under compression or tension.

While the above-described flexible coupling between a driving shaft and a driven shaft in a centrifugal machine is particularly well adapted for centrifugal concentric type serving machines, it is to be understood that it may be readily modified to suit various types of machines in which the centrifugal loading on a portion of the shaft is unbalanced and tends to create serious vibrations and jerks in the machine without departing from the spirit and scope of the invention.

What is claimed is:

1. Strand serving apparatus, which comprises a shaft rigidly journalled for rotation about a fixed axis, a second shaft normally aligned for rotation about said fixed axis, a strand supply mounted rotatably with respect to the second shaft, means secured to said second shaft for withdrawing strands from the strand supply and causing rotation thereof, and a resilient member bonded to the shafts for coupling the shafts for rotation together and permitting an oscillating movement of the second shaft with respect to the fixed axis so that the strand supply and the withdrawing means may assume their natural axis of rotation.

2. Strand serving apparatus, which comprises a driving shaft rigidly journalled for rotation about a fixed axis and driven at a predetermined speed, a driven shaft normally aligned in tandem with the driving shaft for rotation about said fixed axis, a supply of strand material rotatably mounted with respect to the driven shaft, means secured to the driven shaft for withdrawing the strand from the strand supply and causing rotation thereof, and an elastic ring molded to the shafts to couple them for rotation together and permit an oscillating movement of the driven shaft with respect to the fixed axis so that the strand supply and the strand withdrawing means may assume their natural axis of rotation, and means for restricting the oscillation of the driven shaft within predetermined limits to prevent excessive displacement of the driven shaft with respect to the axis of the driving shaft.

3. Strand serving apparatus, which comprises a driving shaft rigidly journalled for rotation about a fixed axis and driven at a predetermined speed, a driven shaft aligned for rotation about said fixed axis, a supply of strand material mounted rotatably with respect to the driven shaft, means secured to the driven shaft for withdrawing the strand from the strand supply and causing rotation of the strand supply, a vulcanized rubber ring molded to the shafts for coupling the driving shaft and the driven shaft for rotation together so that the driven shaft may oscillate with respect to the driving shaft due to any eccentric centrifugal forces acting on the strand withdrawing means and the rotating strand

supply, and means for restricting the movement of the driven shaft with respect to the fixed axis within predetermined limits.

4. Strand serving apparatus, which comprises a shaft rigidly journalled for rotation about a fixed axis and driven at a predetermined speed, a second shaft normally aligned in tandem with the first-mentioned shaft for rotation about said fixed axis, a strand supply cop mounted rotatably with respect to the second shaft, means secured to the second shaft for withdrawing the strand from the supply cop and causing rotation of the supply cop, and an elastic ring molded to the adjacent ends of the shafts so as to couple the shafts for rotation together so that the second shaft may oscillate with respect to the fixed axis of rotation and permit the strand withdrawing means and the strand supply to rotate about their natural axis of rotation, said ring of elastic material being positioned between the shafts so that the movement of the second shaft with respect to the fixed axis tends to shear the elastic coupling.

5. Strand serving apparatus, which comprises a shaft rigidly journalled for rotation about a fixed axis and having an annular depression in one end thereof, a second shaft having an annular depression in the end thereof adjacent to the first-mentioned shaft and normally aligned in tandem therewith for rotation about said fixed axis, a strand supply cop mounted rotatably with respect to the second shaft, means secured to the second shaft for withdrawing the strand from the supply cop and causing rotation of the supply cop, and an elastic ring molded to the adjacent ends of the shafts so that annular portions of the ring are embedded in and adhere to the depressions in the shafts to couple the shafts for rotation together, said elastic coupling allowing the second shaft to oscillate with respect to the fixed axis of rotation so that the strand withdrawing means and the rotating strand supply may rotate about their natural axis of rotation.

6. Strand serving apparatus, which comprises a shaft rigidly journalled for rotation about a fixed axis and having an annular depression in one end thereof, a second shaft normally aligned in tandem with the first-mentioned shaft for rotation about said fixed axis and having an annular depression in the end thereof adjacent to the first-mentioned shaft, a strand supply cop mounted rotatably with respect to the second shaft, means secured to the second shaft for withdrawing the strand from the supply cop and causing rotation of the supply cop, and an elastic ring molded to the adjacent ends of the shafts so that annular portions of the ring are embedded in and adhere to the depressions in the shafts and thereby couple the shafts for rotation together, said elastic coupling allowing the second shaft to oscillate with respect to the fixed axis so that the strand withdrawing means and the rotating strand supply may rotate about their natural axis of rotation, said elastic ring being embedded in the depressions of the shafts so that the oscillating movement of the second shaft tends to shear the elastic coupling transversely to its cross-sectional area.

7. Strand serving apparatus, which comprises a shaft rigidly journalled for rotation about a fixed axis and driven at a predetermined speed, a second shaft normally aligned in tandem with the driven shaft for rotation about said fixed axis, a strand supply mounted rotatably with respect to the driven shaft, means secured on the driven shaft for withdrawing the strand from the strand supply when the shaft is rotated and causing rotation of the strand supply, an elastic ring bonded tightly to the adjacent portions of the shafts to couple the shafts for rotation together in such a manner that the second shaft may oscillate with respect to the fixed axis of the driving shaft so that the strand supply and the strand withdrawing means carried by the second shaft may rotate about their natural axis of rotation.

8. Strand serving apparatus, which comprises a driving shaft rigidly journalled for rotation about a fixed axis and having a groove in one end thereof, a driven shaft normally aligned in tandem with the driving shaft for rotation about said fixed axis and having a groove therein aligned with the groove in the driving shaft, a strand supply mounted rotatably with respect to the driven shaft for withdrawing the strand from the strand supply and causing rotation of the strand supply, a ring of elastic material molded in the grooves of the shafts for resiliently coupling the shafts for rotation together so that the strand withdrawing means and strand supply carried by the driven shaft may rotate about their natural axis of rotation with respect to eccentric centrifugal forces occurring in the rotating strand withdrawing means and the rotating strand supply.

9. Strand serving apparatus, which comprises a driving shaft rigidly journalled for rotation about a fixed axis and having an enlarged flanged portion on one end thereof, a driven shaft normally aligned in tandem with the driving shaft for rotation about said fixed axis and having a flanged portion provided with a counterbore for loosely receiving the flange of the driving shaft, means rotatably mounted with respect to the driven shaft for receiving a strand supply cop, means secured to the driven shaft for withdrawing the strand from the cop and causing rotation of the cop, an annular elastic member molded in position between the periphery of the flange of the driving shaft and the adjacent wall of the counterbore of the driven shaft so as to couple the shafts for rotation together, said elastic member being designed to permit the driven shaft to oscillate with respect to the fixed axis of the driving shaft in accordance with any eccentric centrifugal forces occurring in the strand supply and strand withdrawing means when they are rotated, and means for restricting the oscillation of the driven shaft within predetermined limits with respect to the fixed axis.

10. Strand serving apparatus, which comprises a driving shaft rigidly journalled for rotation about a fixed axis and having an enlarged flange on one end thereof provided with a peripheral groove, a driven shaft normally aligned in tandem with the driving shaft for rotation about the fixed axis and having an enlarged flanged portion provided with a counterbore for receiving the flange of the driving shaft and a groove in the internal wall of the counterbore aligned with the groove in the flange of the driving shaft, means rotatably mounted with respect to the driven shaft for receiving a strand supply cop, means secured for rotation with the driven shaft for withdrawing the strand from the supply cop and causing rotation of the cop, and an elastic material molded in the grooves of the driving shaft and the driven shaft under sufficient heat and pressure to bond the surfaces of the grooves and form an elastic coupling between the shafts, said elastic coupling permitting the driven shaft

to oscillate with respect to the fixed axis so that the strand withdrawing means of the cop may rotate about their natural axis of rotation and thereby prevent any eccentric centrifugal forces occurring in the strand supply from causing excessive vibration in the driving shaft.

11. Strand serving apparatus, which comprises a driving shaft journalled for rotation about a fixed axis and having an enlarged flanged portion on one end thereof provided with a groove in the periphery thereof, a driven shaft normally aligned in tandem with the driving shaft for rotation about said fixed axis and having an enlarged flanged portion on the end thereof, an annular member secured to the flange of the driven shaft so that it loosely surrounds the flange of the driving shaft and having a groove provided in the inner wall thereof and aligned with the groove in the flange of the driving shaft, a rubber ring molded in said grooves under sufficient heat and pressure to cause the rubber to adhere to the surfaces of the grooves and couple the shafts for rotation together, said rubber ring being designed to permit the driven shaft to oscillate with respect to the driving shaft so that the rotating strand withdrawing means and strand supply cop may rotate about their natural axis of rotation with respect to the fixed axis, and a snap ring fitted in the annular member adjacent to the underside of the flange on the driving shaft, said elastic ring coupling the shafts together so as to provide predetermined clearance between the adjacent surfaces of the shaft, whereby the clearance between the shafts and the clearance between the snap ring and the flange of the driven shaft restricts the oscillating movement of the driven shaft within predetermined limits.

12. An apparatus for serving strand material around an advancing core, which comprises a shaft for supporting rotatably a supply of strand material adjacent to the advancing core, means secured to the shaft for withdrawing the strand material from the strand supply and serving it around the core and causing rotation of the strand supply, means aligned in tandem with the shaft and rotatable about a fixed axis for driving the shaft, and an elastic member molded and bonded to the driving means and to the shaft so that portions thereof are imbedded in the shaft and the driving means to couple them for rotation together, said elastic coupling permitting the shaft to oscillate with respect to the fixed axis so that the strand supply and the strand withdrawing means may rotate about their natural axis of rotation, whereby the strand is served uniformly on the advancing core.

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