

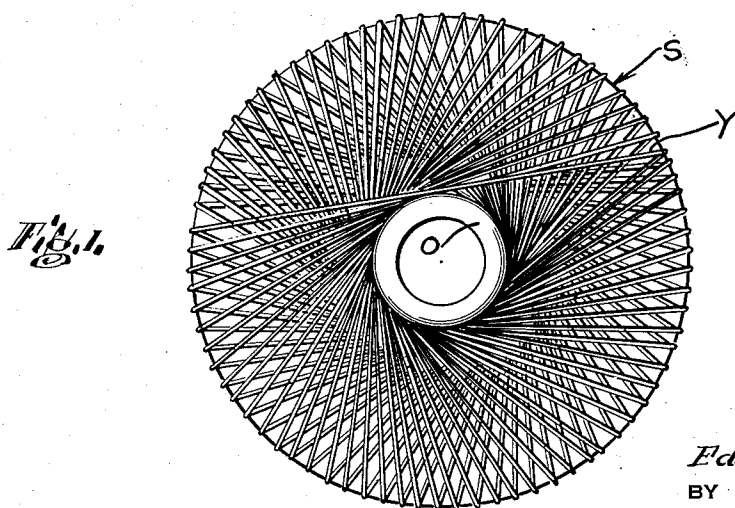
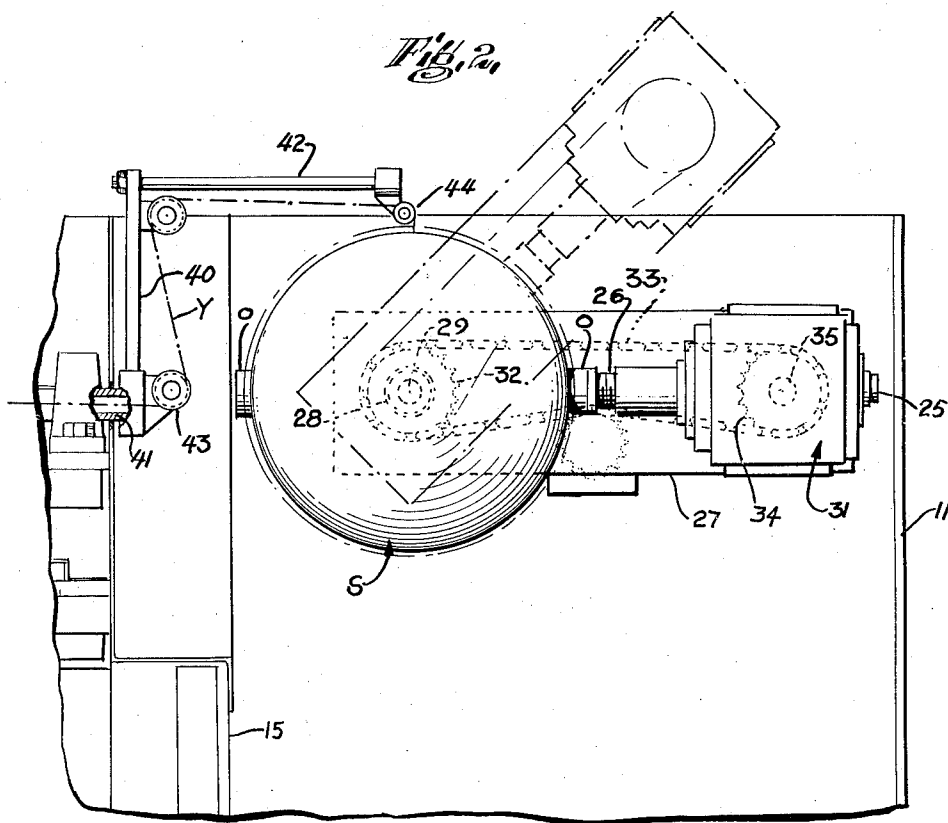
Aug. 25, 1959

E. A. WENTZ
SPHERE WINDING MACHINE

2,901,190

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4 Sheets-Sheet 1



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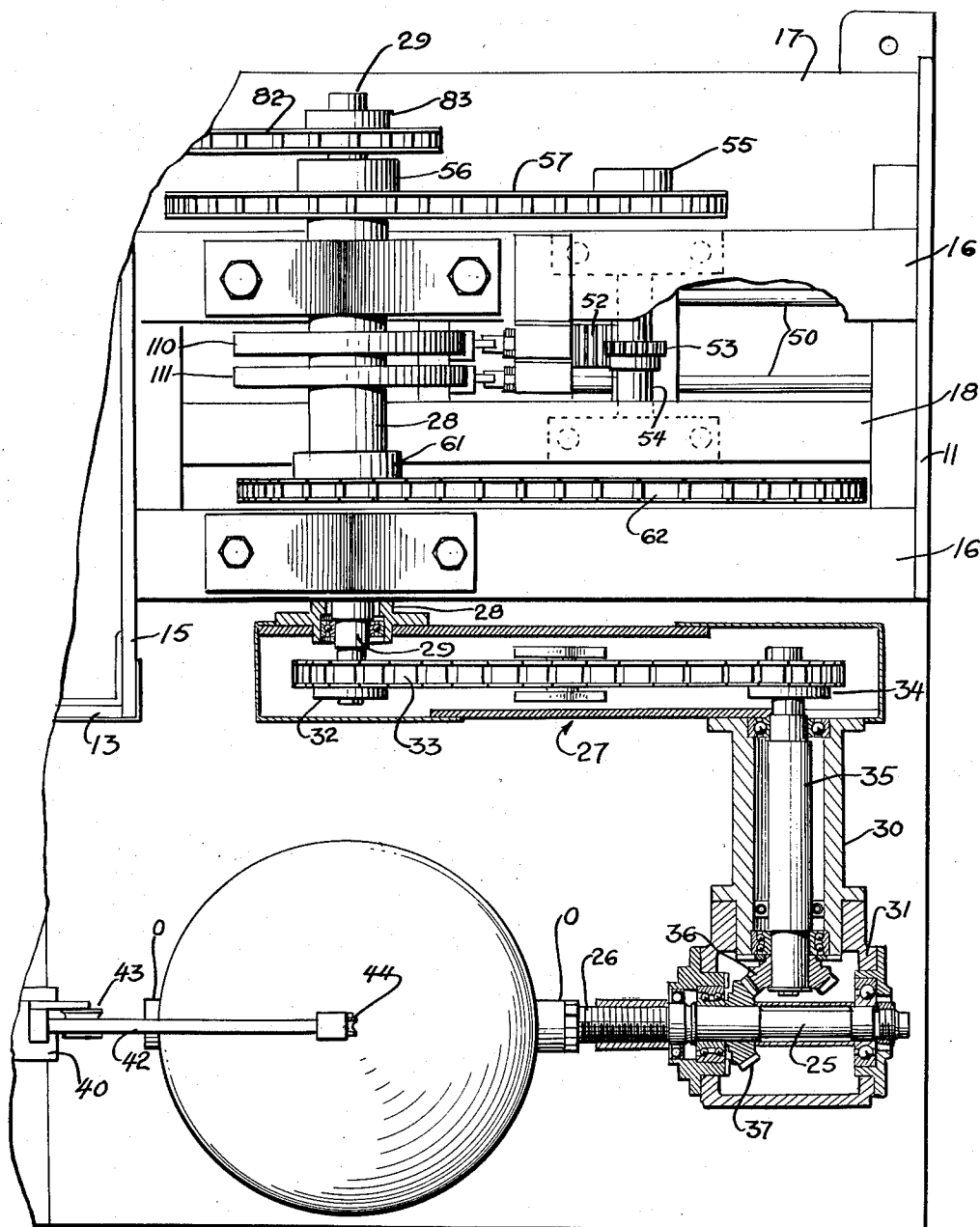


Fig. 3.

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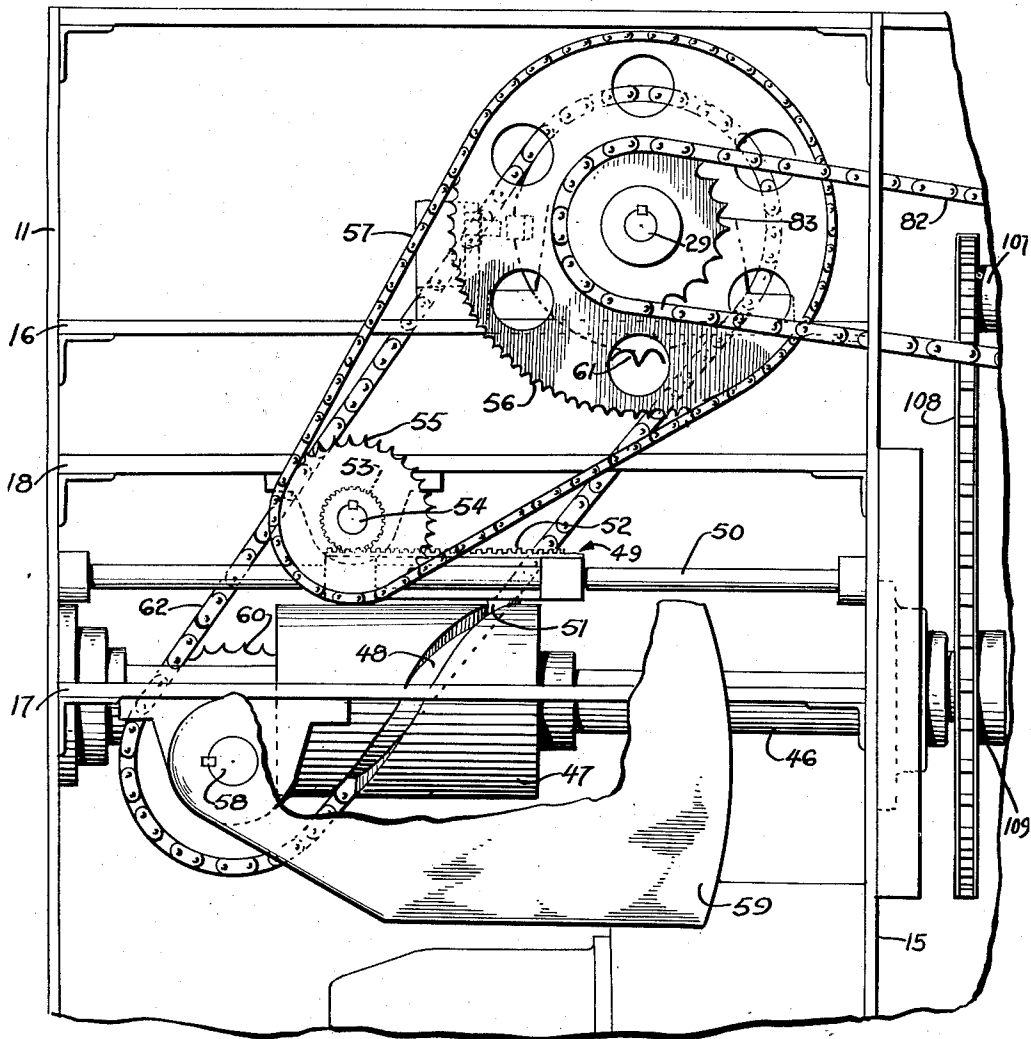


Fig. 4.

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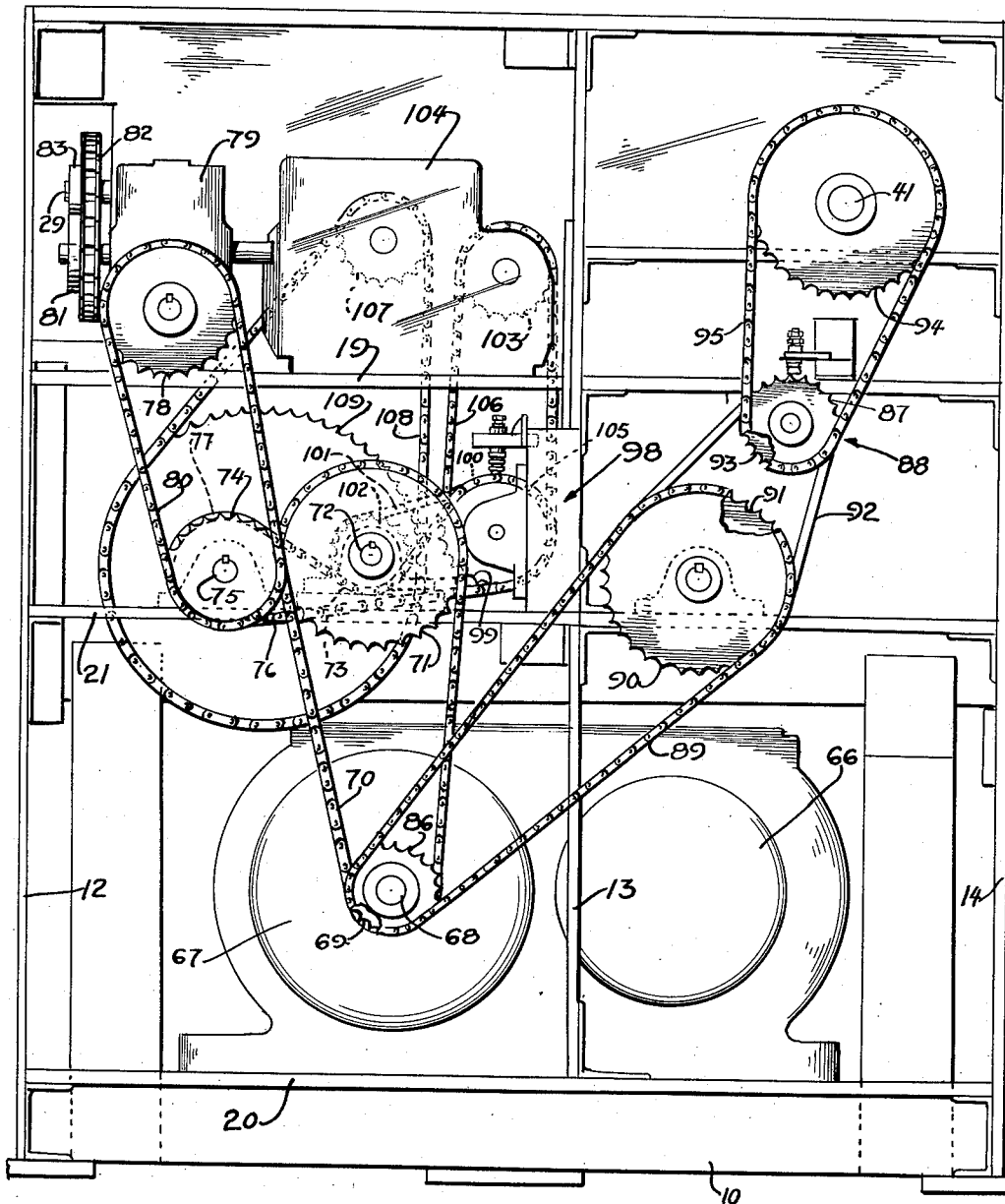


Fig. 5.

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SPHERE WINDING MACHINE

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6 Claims. (Cl. 242—2)

The present invention relates to winding machines, and, more particularly, to a machine for winding yarn or the like on objects having a generally spherical shape.

The present invention is primarily concerned with the manufacture of receptacles, commonly known as spheres, for storing fluid media under pressure. Such receptacles comprise a hollow shell having a winding consisting of layers of resin impregnated yarn applied thereto, whereby, in effect, receptacles having walls composed of resin reinforced with yarn are built up. The machine in accordance with the present invention is particularly adapted for applying such windings to produce spheres, but also can be utilized for applying windings of yarn or wire to metallic spheres solely for the purpose of reinforcing the same or to protect them against shattering when pierced by a projectile.

Accordingly, an object of the present invention is to provide a relatively simple and practical machine for applying such windings on spherical objects in a rapid and economical manner.

Another object is to provide such a machine which includes a novel arrangement for supporting, rotating and tilting the objects while the yarn is applied thereto in a fixed path.

A further object is to provide such a machine which is adapted for automatic, semi-automatic or manual control.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a schematic view of a spherical shell, illustrating the contour of the winding applied thereto by progressively tilting the shell about a fixed axis lying in the plane in which the path of the winding is disposed.

Fig. 2 is a fragmentary front elevational view of the object supporting, rotating and tilting means, and the yarn applying means of the machine.

Fig. 3 is a plan view of the elements shown in Fig. 2, partly in section.

Fig. 4 is a fragmentary back elevational view of the machine illustrating a portion of the support tilting and object rotating drive.

Fig. 5 is an end view, on a reduced scale, of the drive mechanisms and controls of the machine.

Application of the winding

Referring to the drawings in detail and more particularly to Fig. 1 thereof, there is shown a spherical shell S having layers of resin-impregnated yarn Y applied thereto. For example, the yarn may be composed of fiber glass threads which are impregnated with any suit-

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able resin adapted to harden to a solid state. The shell is provided with a spud O at both ends of its polar axis about which the winding convolutions are wrapped, one of these spuds serving for filling and discharging the receptacle. The winding is produced by progressively applying substantially "great-circle" convolutions onto the shell, in the manner made apparent hereinafter.

General description of the machine

Generally described, the machine shown in Figs. 2 to 5 comprises a frame, a drive mounted on the frame, a support for a spherical object having the winding applied thereon, mechanism operated by the drive for rotating the support, means for applying the winding onto the object, and mechanism for tilting the support. These components will be described in detail hereinafter.

In addition, the machine includes means to program the operations of the machine to produce spheres having the desired number of layers of winding.

The frame

The frame, for compactness and economical arrangement of the components of the machine, essentially comprises a rectangular base 10, upright members 11 at one end of the machine (Figs. 2, 3 and 4), upright members 12, 13 and 14 at the other end of the machine (Figs. 3 and 5), an intermediate upright plate member 15 (Figs. 2 and 3), upper, lower and intermediate horizontal members 16, 17 and 18 (Figs. 3 and 4) between the members 11 and 15, and upper, lower and intermediate members 19, 20 and 21 (Fig. 5) between the members 11 and 12.

The work support

As best shown in Figs. 2 and 3, the work or object support for the spherical shell S comprises a spindle 25 having a threaded free end 26 over which a spud O of the shell is adapted to be secured, and spindle mounting structure including an arm 27 in the form of a casing having one end mounted on a hollow shaft 28 through which a shaft 29 extends, an offset tube 30 having one end connected to the other end of the arm, and a gear and bearing box 31 at the other end of the tube 30 for supporting the spindle.

The shaft 28 is supported for rotation on the horizontal members 16. The spindle 25 is rotated by the shaft 29 through a sprocket 32 on the shaft 29 connected by a chain 33 to a sprocket 34 on one end of a shaft 35 extending through the tube 30, and a bevel gear 36 on the other end of the shaft 35 meshing with a bevel gear 37 on the spindle.

The axis of rotation of the spindle 25 and the longitudinal axis of the arm 27 are parallel to each other and are disposed in a common plane, and the tube 30 is perpendicular to the spindle and the arm. The central horizontal axis of the shell, which is perpendicular to the polar axis of rotation of the shell, is in alignment with the axis of the hollow shaft 28 for the purpose made apparent hereinafter.

The winding applying means

As already indicated in connection with the brief description of Fig. 1, the winding applying means are adapted to progressively wrap "great-circle" convolutions onto the shell, and to accomplish this purpose these means comprise an arm 40 (Fig. 2) having one end mounted on a hollow shaft 41 for rotation in a vertical plane, and an arm 42 extending perpendicularly from the free end of the arm 40 above the shell to about its equator. Yarn is supplied through the shaft 41, and is guided to the shell by a roller 43 on the arm 40 adjacent the shaft 41 and by a roller 44 at the free end of the arm 42.

The spindle 25 and the shaft 41 are disposed in the same vertical plane, and the roller 44 moves in a circular path about the equator of the shell, which path is disposed in a vertical plane perpendicular to the last mentioned plane and intersecting the same at a line coplanar with the axis of the hollow shaft 28, whereby "great-circle" convolutions are applied to the shell regardless of the tilted position of the arm 27 as about to be described.

The work support tilting means

As previously indicated, the work support is arranged to rotate, tilt or revolve the spherical shell about a horizontal central axis perpendicular to the axis of rotation of the spindle and disposed in the plane within which the yarn applying roller 44 moves in its circular path, whereby "great-circle" windings are progressively applied.

This is accomplished by supporting the hollow shaft 28 for rotation on the horizontal member 16 and providing cam mechanism for controlling the rate of rotation of the shaft, whereby the arm 27 is rocked.

As shown in Fig. 4, the cam mechanism comprises a shaft 46 supported for rotation between the upright frame members 11 and 15, a drum-type cam 47 having a cam groove 48 mounted for rotation with the shaft 46, a carriage 49 slidably supported on a pair of spaced horizontal rods 50 extending between the members 11 and 15, and a follower 51 on the carriage extending into the cam groove 48 whereby back and forth movement of the carriage is effected by the cam. This lineal movement of the carriage is utilized to rotate the shaft 28 by providing a gear rack 52 on the carriage, a gear 53 in mesh with the rack mounted on an axle 54 supported by the frame members 18, a sprocket 55 on the axle, a sprocket 56 on the shaft 28, and a chain 57 connecting the sprockets 55 and 56.

The cam mechanism is constructed and arranged to move the arm 27 back and forth, for example through an arc of at least 75°, or as desired.

Preferably, the weight of the work support assembly, including the arm 27 and the elements related thereto as well as the object, is counter-balanced to relieve forces between the gear 53 and its rack 52. This is accomplished by providing an axle 58 supported on the frame member 17 and having a counter-weight 59 and a sprocket 60 secured thereto, a sprocket 61 (Figs. 3 and 4) on the shaft 28 and a chain 62 connecting sprockets 60 and 61.

The drive mechanism

The drive mechanism includes a motor 66, a variable speed drive mechanism 67 driven by the motor having a main drive shaft 68, and means operatively connecting the spindle drive shaft 29, the yarn applying drive shaft 41 and cam shaft 46 for rotation by the shaft 68 as about to be described.

As shown in Fig. 5, the shaft 29 is driven through a sprocket 69 on the shaft 68 connected by a chain 70 to a sprocket 71 on an axle 72, a second sprocket 73 on the axle 72 connected to a sprocket 74 on an axle 75 by a chain 76, a second sprocket 77 on the axle 75 connected to a drive sprocket 78 of a gear box 79 by a chain 80, and a driven sprocket 81 of the gear box connected by a chain 82 to a sprocket 83 on the shaft 29 (Figs. 3 and 4). The shaft 29 effects rotation of the spindle 25 as already described.

The shaft 41 is driven through a second sprocket 86 on the main shaft 68 connected to a drive sprocket 87 of a clutch-brake device 88 by a chain 89, sprockets 90 and 91 and a chain 92, and a driven sprocket 93 of the device 88 connected to a sprocket 94 on the shaft 41 by a chain 95.

The clutch-brake device is a conventional mechanism which can be utilized to stop rotation of the shaft 41 for a short duration each time the shaft 41 completes one

revolution to cause one convolution of yarn to be applied to the shell. As the spindle 25 continues to rotate the shell, yarn is wrapped around the spud O of the shell until the shaft 41 rotates again.

The cam shaft 46 is driven through a duplex or reversing clutch 98 having two drive sprockets 99 and 100 one of which is driven by the chain 76 in one direction and the other of which is driven in the other direction by a chain 101 connected to a third sprocket 102 on the axle 72, a drive sprocket 103 of the gear box 104 connected to a driven sprocket 105 of the clutch 98 by a chain 106, and a driven sprocket 107 of the gear box 104 connected by a chain 108 to a sprocket 109 on the cam shaft 46 (Figs. 4 and 5).

The clutch 98 is a conventional mechanism adapted for reversing rotation of the cam shaft and is controlled by elements 110 and 111 on the shaft 28 (Fig. 3) to alternately render the drive sprockets 99 and 100 effective when the arm 27 reaches its extreme positions, to provide for return of the arm. By tilting the sphere in this manner, a predetermined number of convolutions are applied in each cycle, and the number of tilting cycles determines the number of layers of winding.

From the foregoing description, it will be seen that the present invention provides a novel and improved winding machine which is useful in producing spherical objects.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. In a winding machine of the class described, the combination of a spindle adapted to support a spherical object on which a winding is to be applied, yarn applying means adapted to move in a substantially circular path about the object within a given plane passing through approximately the center of the object, said spindle having means thereon for threadedly securing the object thereon whereby the object can be adjusted longitudinally with respect to said spindle to position its center in the plane wherein the circular path of the yarn applying means lies, means for tilting said spindle in a plane passing substantially diametrically through the circular path and substantially perpendicular to the first mentioned plane and being constructed and arranged to tilt the object about an axis lying within the first mentioned plane and passing diametrically through the object, and means for rotating said spindle to rotate the object about an axis perpendicularly intersecting the first mentioned axis.

2. In a winding machine of the class described, the combination of a spindle adapted to support a spherical object on which a winding is to be applied, yarn applying means adapted to move in a substantially circular path about the object within a given plane passing through approximately the center of the object, means for tilting said spindle in a plane passing substantially diametrically through the circular path and substantially perpendicular to the first mentioned plane and being constructed and arranged to tilt the object about an axis lying within the first mentioned plane and passing diametrically through the object, said tilting means including a pivoted arm parallel to said spindle having a pivot point at one end in alignment with the aforementioned axis and means for mounting said spindle at the other end of said arm, and means for rotating said spindle to rotate the object about an axis perpendicularly intersecting the first mentioned axis, said spindle rotating means including drive mechanism carried by said arm and said spindle mounting means.

3. In a winding machine of the class described the combination of an arm, means for pivotally mounting

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said arm at one end thereof, a spindle having a free end adapted to support a spherical object on which a winding is to be applied, means for mounting the other end of said spindle on the other end of said arm and parallel thereto and spaced therefrom with the free end of said spindle extending in the direction of the pivoted end of said arm whereby the object is adapted to be supported on said spindle with a central axis in alignment with the pivot point of said arm, yarn applying means adapted to move in a circular path about the object within a plane in which the aforementioned axis is disposed and perpendicular to the plane in which the axis of said spindle is disposed, and means for rotating said spindle.

4. A machine according to claim 3, wherein said spindle rotating means includes drive mechanism carried by said arm and said mounting means.

5. In a winding machine of the class described, a rotatably mounted sleeve, an arm having one end thereof secured to said sleeve for movement therewith, a second sleeve having one end secured to the other end

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of said arm, a spindle, means for rotatably mounting said spindle on the other end of said second sleeve parallel to said arm, a shaft extending through said first sleeve, a second shaft extending through said second sleeve, means rotatably connecting said shaft, means for rotatably connecting said second shaft and said spindle, and mechanism for rocking said first sleeve.

6. In a machine according to claim 5, including a counterweight mechanism operatively connected to said first sleeve for counterbalancing the weight of said arm and of the elements carried by said arm.

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