

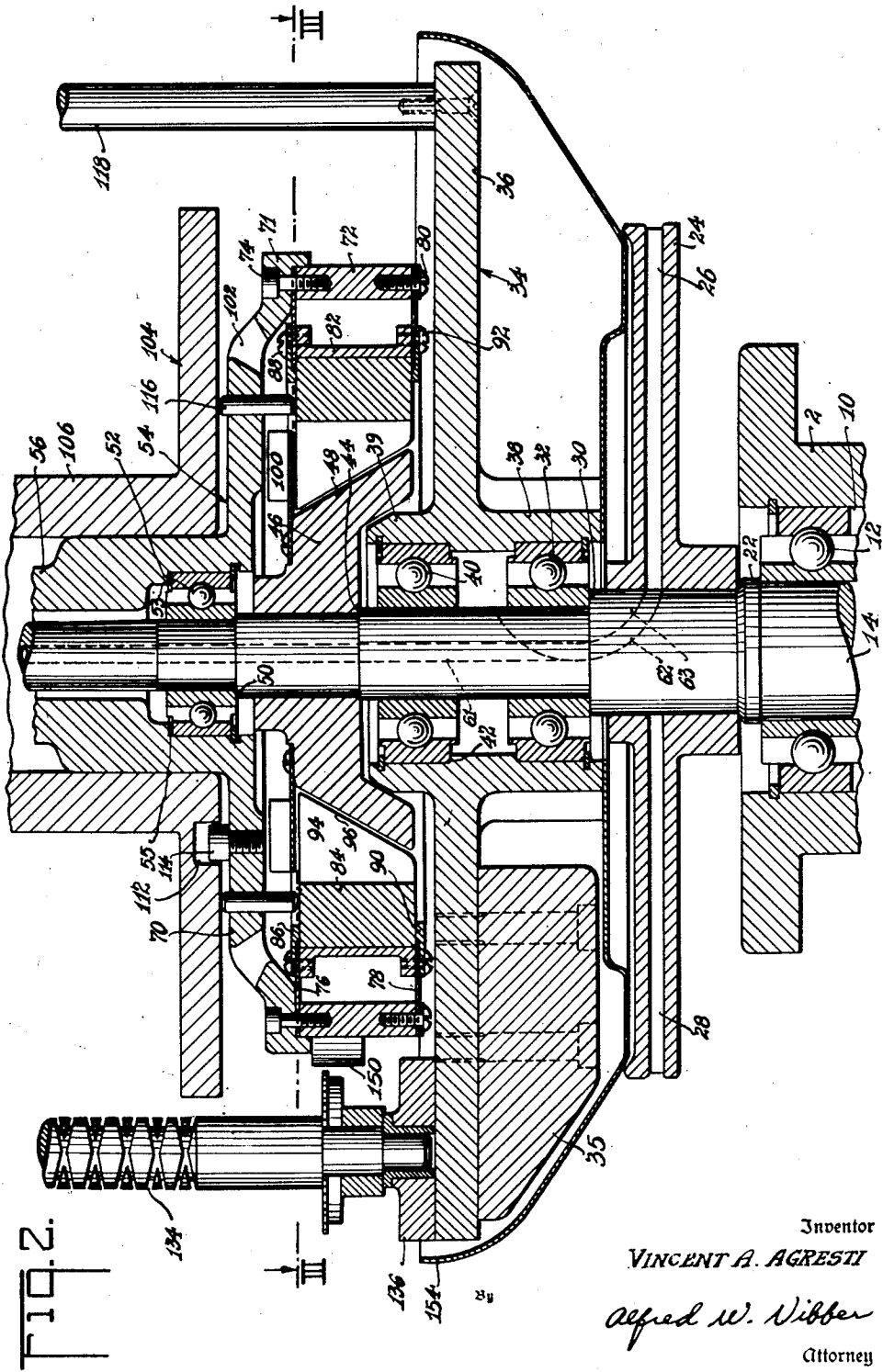
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CONSTANT TENSION ELONGATED MATERIAL
HANDLING MECHANISM

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CONSTANT TENSION ELONGATED MATERIAL HANDLING MECHANISM

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This invention relates to a mechanism for handling or treating elongated material, such handling involving the transfer of such material to or from a reel under substantially constant tension regardless of the diameter of the reel to or from which the material is transferred, respectively.

The invention has among its objects the provision of a novel, automatically actuated, mechanism which provides substantially constant tension in elongated flexible material being transferred to or from a reel regardless of the diameter of the package of such material built up on or carried by the reel.

A further object of the invention, in one embodiment thereof, is the provision of a simple, rugged, easily maintained apparatus of the type indicated for reeling or winding up the elongated flexible material.

These and further objects of the invention will be more readily apparent in the following description of a preferred embodiment thereof.

It is frequently necessary in processing elongated flexible material such as textile threads, cords, synthetic fibers, fine wires, and the like, to reel such material to form a compact package. It is desirable during these operations, and in some cases it is necessary, that the elongated material be fed to the spool or bobbin under substantially constant tension. Since the package of the material on the bobbin constantly changes in diameter as the material is wound thereon, it is necessary, where the reeling device is relied upon to provide substantially constant tension in the span of the material adjacent thereto, to provide a drive for the reel or bobbin of the reeling device which will provide a torque which varies in such manner that it compensates for the varying radius of the package. Prior devices of this type have been known, but they have been disadvantageous because of their complexity and unreliability.

The mechanism of the present invention provides an improved simplified drive for elongated flexible material handling mechanism including a bobbin or reel, said mechanism incorporating means to impose a variable torque in a material winding direction on the material containing or holding means such as a reel or bobbin, and means responsive to changes in the total weight of the elongated flexible material present on the material containing means to change the effective torque so transmitted thereto so that the tension in the elongated material in the span thereof adjacent to the material containing means is main-

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tained substantially constant. Although in the embodiment described and illustrated the invention is applied to a winding spindle, it is to be understood that within its broader aspects, the invention is also capable of use on an unwinding spindle. In such latter application the variable torque driving means is employed to impose a variable restraining torque on the supply spindle from which the material is being paid out, the restraining means, the outer rotor in the clutch as shown below, being driven in a direction opposite to that in which the supply spindle is rotated by the material pulled therefrom. In the embodiment presently to be described, however, the variable torque driving means, the outer rotor, rotates in the winding direction and impels the winding means in a material winding direction.

In the embodiment shown, the mechanism of the invention is embodied in a double twist cabling spindle adapted for use in the machine described and illustrated in the prior United States patent application of Henry C. Uhlig, Serial No. 765,577, filed August 1, 1947 now Patent No. 2,487,837 dated November 15, 1949. The apparatus shown herein is designed to replace the center cabling spindle shown specifically in Figs. 12, 13 and 14 in said Uhlig application. It is to be understood, however, that the invention is not limited to such use nor in its broader applications is it limited to a twisting spindle, since it may be applied to advantage, as above explained, in winding and reeling apparatus generally. The invention will be more readily understood by reference to the accompanying drawings, in which

Fig. 1 is a view in axial vertical cross-section through the entire cabling spindle;

Fig. 2 is an enlarged view in vertical cross-section along the same surfaces as that in Fig. 1, showing the mechanism in the vicinity of the variable torque magnetic clutch, the section being taken along the line II—II, in Fig. 3, and

Fig. 3 is a view in section through the spindle transverse to the axis of the spindle, the section being taken along the line III—III in Fig. 2.

In Fig. 1 there is shown a sleeve member 2 which functions as the support for the spindle as a whole. Such sleeve has an outer downwardly tapered surface 4 adapted to fit within a similarly shaped seat in the frame (not shown) of the machine which, as above stated, may be generally like that of Uhlig. Sleeve 2 has within it at the bottom a bearing seat 6 within which is positioned the ball bearing 8, and at the top a bearing seat 10 in which is retained the upper ball

bearing 12. Within such ball bearings there is rotatably mounted the elongated driven shaft 14. Such shaft will hereafter be referred to as vertical and directions transverse thereto will be referred to as horizontal, although it is to be understood that the spindle as a whole in operative position is mounted at a small angle to the vertical, as for instance 12°, in the same manner as the center cabling spindle of Uhlig. Below the lower ball bearing 8, shaft 14 is provided with a stepped pulley, the lower portion 16 of which slightly exceeds the upper portion 18 in diameter, so that the speed at which the shaft 14 is rotated by the belt (not shown) from the prime mover may be varied by turning the stepped pulley end-for-end on the shaft. The pulley is retained on the shaft by means of the lower nut 20.

Above the upper ball bearing 12 and resting on the inner race thereof there is a flange 22 integral with the shaft 14. Above such flange and fixedly positioned on the shaft to rotate therewith is the lower disc member 24 having a radial cord-receiving opening 26 extending from the outer edge thereof inwardly to the shaft, and a similar balancing bore 28 opposite thereto. Shaft 14 is provided above disc 24 with a shoulder 30 on which rests the inner race of the ball bearing 32, the outer race of such bearing fitting within the depending axial flange 38 on the second upper disc member which is generally designated 34, the radial main body portion of the disc being designated 36. A second upper ball bearing 40 on the shaft 14 and resting on shoulder 42 within the upper axial flange 39 on such disc completes the mounting for the disc 34 on the shaft 14. Disc 34 is thus floatingly mounted on shaft 14. Disc 34 tends to remain in one angular position, when shaft 14 is positioned at an angle to the vertical, by reason of the weight 35 bolted to the bottom of portion 36 at one part thereof, as shown.

Above ball bearing 40 shaft 14 is provided with a further shoulder 44 on which rests a bell-shaped rotor 46 made of magnetic material, such as soft iron, the rotor having an outer upwardly converging conical face 48. Rotor 46 is fixedly mounted for rotation with the shaft. Above such rotor the shaft extends vertically to provide support for the bobbin supporting member 54 which is floatingly mounted therein. Such support is provided by the shoulder 50 on the shaft, the lower ball bearing 52, the inner race of which rests on such shoulder 50, the shoulder 53 on the lower inner surface of the axial tubular portion 56 of the bobbin support, and the upper ball bearing 60 resting on shoulder 58 on shaft 14 and interposed between it and the upper inner surface of part 56 of the bobbin support. In order to allow vertical adjustment of the bobbin support 54 relative to the shaft 14 and thus relative to the rotor 46, to allow initial adjustment or calibration of the magnetic slip clutch, as will appear hereafter, there may be provided one or more annular shims 55 of suitable thickness between shoulder 53 on part 56 of the bobbin support and the outer race of ball bearing 52, the weight of the bobbin support being sustained by the shoulder 53, the shim or shims 55, and the outer race of bearing 52.

The upper portion of shaft 14 has a central bore 61 therein, connected to the inner end of cord receiving bore 26 in disc 24 by a curved passageway 62 as shown. Disc 24 is retained on shaft 14 by means of the key 63, the inner

face of which is concave in cross-section to present a cord guiding surface parallel in vertical section to part 62 of the bore in the shaft. The extreme upper end of shaft 14 is threaded at 64 to receive nut 66 which engages the inner race of bearing 60. A cord guiding extension 68, the bottom end of which fits within the top of the tubular portion 56 of the bobbin holder, is provided to guide the cord to the top of the spindle structure.

The bobbin support 54 has at its lower end a generally radial flange 70, the outer edge of which is dished downwardly to provide a horizontal annular outer zone 71. Affixed to the bottom of such zone 71 is a depending annular member 72 made of a non-magnetic metal such as brass, the annulus being attached to the flange by cap screws 74. Projecting radially inwardly from the top and bottom edges of annulus 72, respectively, are the two annular diaphragm spring members 76 and 78, respectively, which likewise are made of non-magnetic metal such as brass or bronze. The outer edge of the upper one of such spring members is attached, as shown, by being interposed between portion 71 of flange 70 and annulus 72, and the bottom spring member is attached to the annulus by means of screws 80. The inner ends of such diaphragm spring members are attached to an inner annular member 82, likewise made of non-magnetic material such as brass, by means of the screws 88 and 92, respectively. Member 82 serves as a holder for the outer rotor member of the magnetic slip clutch. The outer rotor member is shown as including the annular magnet generally designated 84 and having radially directed angularly spaced pole pieces 94 attached integrally thereto. The upper and lower annular clamping members 86 and 90, held by screws 88 and 92, respectively, serve to hold the composite outer rotor member in place.

The inner faces 96 of pole pieces 94 lie on a cone converging upwardly, the elements of which are parallel to those on face 48 of the inner rotor. As shown, such elements are disposed at a marked angle to the vertical, in the drawing such angle being shown as 30°. By reason of such angle, vertical movement of magnet 84 in response to increased weight of the bobbin and bobbin support, as a whole, decreases the air gap between the inner and outer rotors of the clutch and thus increases the torque transmitted through the clutch. The pole pieces 94 of magnet 84 are of substantially uniform width, as shown in Fig. 4. Magnet 84 may be made of various well known high permeability magnetic metals of which that composed of an alloy of frame 24 to 30 percent nickel, 9 to 13 percent aluminum, balance iron; and the alloy composed of 24 to 30 percent nickel, 9-13 percent aluminum, 5-10 percent cobalt, balance iron, are typical.

The shaft 14 carrying with it the rotor 46, rotates at a speed many times that of bobbin support 54 and thus the outer rotor of the clutch. Consequently, rotor 46 cuts the lines of force of the magnet 84 and there are induced eddy currents in rotor 46 which in turn have their own magnetic field and cause a slipping magnetic coupling between the two rotor parts. The generation of eddy currents in the inner rotor naturally produces substantial amounts of heat, which are dissipated by a draft of air produced by fan 100 attached to the upper edge of inner rotor 46, air being drawn up through the air gap between the rotors and the spaces between

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pole pieces 94 and impelled outwardly through the series of openings 102 in the flange 70 of the bobbin holder.

The bobbin, generally designated 104, is preferably made of non-magnetic metal. The bobbin has a substantially cylindrical inner core or hub 106, an upper flange 108, and a lower flange 110. The opening through the core 106 is of such size that the bobbin is held accurately on the upper and lower larger diameter portions of part 86, but may slide freely along said portions. The bobbin is held against rotation on the bobbin holder by engagement of the driving pin 114 on the upper surface of flange 70 into the opening 112 in the lower flange of the bobbin.

The weight of the bobbin and of the elongated flexible material 111 wound thereon is sustained by the non-magnetic supporting pins 116, shown here as three in number, equally spaced about the bobbin holder, pins 116 being freely slidable in vertical openings through flange 70. Pins 116 engage magnet 84 of the outer rotor at their bottom ends and the lower surface of the bottom flange of the bobbin at their upper ends. Thus, when the empty bobbin is placed on the bobbin holder it will deflect diaphragm springs 76 and 78 a known amount, since such springs are calibrated and the weight of the various bobbins employed with the device is standardized. Thus, the winding operation will be begun with a maximum known air gap between clutch parts 46 and 84, and thus with a minimum predetermined winding torque imposed on the bobbin. The initial air gap under such conditions may be adjusted by providing shims 55 of desired thicknesses between ball bearing 50 and shoulder 53 on the bobbin holder. As the weight of the system composed of the bobbin and of material 111 increases, the outer rotor will be depressed to decrease the air gap between the rotors. When the bobbin is full there will exist the minimum air gap between the clutch rotors, and thus a maximum torque will be transmitted through the clutch. A suitable choice of diaphragm spring thicknesses and stiffnesses will cause the torque transmitted through the clutch to vary substantially in accordance with the increased weight of the bobbin and material 111 throughout the range of the added weight of the material during a winding operation. Because the bobbin is cylindrical and because successive layers of the elongated material are wound thereon so that each such layer is of substantially constant radius, increased weight of the bobbin material 111 bears a constant relationship to the instantaneous radius of the package upon which the material is being wound. Thus, the variation of the torque through the clutch, by making it responsive to changes in weight of the bobbin and material, results in winding the material upon the bobbin under substantially constant tension regardless of the diameter of the package.

Horizontal flange 36 of the floatingly mounted disc 34 provides support for the plurality of vertically extending parallel angularly spaced rods 118 which form a cage about the spindle structure. The tops of rods 118 are connected by the horizontally extending annulus 120, the outer edge of which is rounded to serve as a guide for the incoming cord 152. The cage structure is surrounded by a fixed cylindrical guard or can 156 which is supported coaxial of the spindle on the frame of the machine by means not shown. Attached to ring 120 is an angularly disposed

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guide arm 122, on which is positioned a top guide pulley 124 and a lower guide pulley 126.

The mechanism so far described operates as follows: In the method and machine described by Uhlig, the elongated material fed to the cabling spindle consists of two threads themselves twisted but, as yet, untwisted on each other. It will be assumed that cord 152 in this case is of the same character, although it is obvious that use of the apparatus of the invention is not confined thereto. Cord 152 is fed downwardly over the outer edge of ring 120 and within can 156, passing down and around the upwardly dished guard 154 which is secured to the bottom of flange 38. The cord 152 then enters passage 26. In this portion of its run, cord 152 is given one twist by reason of the rotation of disc 24 relative to the fixed guide (not shown) from which the cord is fed to the cabling spindle. The cord then passes upwardly through passageway 61, through the upper guide member 68, and to the top guide pulley 124. In such second portion of its run the cord is given a further twist by reason of the rotation of disc 24 relative to the upper guide pulley 124. The cord is then fed downwardly to guide pulley 126 from which it passes to the guide pulley 130 on the traversing support 128, and thence to the package 111, pulley 130 laying the material helically upon the bobbin in layers, the radius of each layer being constant.

The traverse mechanism is of a generally conventional type in which the support 128 is guided vertically on parallel rod 129, such rods being connected together and to the cage by bottom and top end members 136 and 138, respectively. A right and left threaded worm 134 journaled vertically in the cage parallel to rods 129 cooperates with a conventional swingably mounted nut member (not shown) mounted within support 128 through which the worm extends. The traverse mechanism is provided with conventional mechanism, also not shown, which reverses the position of the nut when the support reaches the top and bottom ends of its traverse, whereby continued rotation of the worm in one direction results in reciprocating motion of support 128.

Worm 134 is rotated in timed relation to the rotation of the bobbin by means of the ratchet wheel 140 affixed to the lower end of the worm and the pawl 142 carried on plate 158 pivotally mounted on the lower end of the worm. Plate 158 carries a vertical stud 160 cooperating with the forked forward end of lever 144 as shown in Fig. 3. Lever 144 is pivotally mounted on vertical pin 146. Oscillation of the lever about its axis is effected by contact between cam lobe 150 positioned on the outer edge of flange 70 and roller 148 on the rear end of the short arm of lever 144. Lever 144 is constantly urged in a counter-clockwise (Fig. 3) direction by spring means (not shown). Thus, worm 134 is rotated one increment upon every passage of cam lobe 150 by roller 148 on lever 144, the oscillation of the lever causing consequent operation of pawl 142 in the manner described.

When the mechanism has been initially adjusted and calibrated as described, and when bobbins of substantially uniform weight are employed with it, it will operate substantially free from attention for long periods, automatically maintaining substantially uniform tension in the span of flexible material approaching the spindle.

Although I have described and illustrated a preferred embodiment of the mechanism for

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handling or treating elongated material under constant tension in accordance with my invention, it is to be understood that the invention is not confined to such described embodiment, since it is capable, as indicated, of considerable variation as to its manner of application and as to details of its construction.

I claim as new the following:

1. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, means to lay the elongated flexible material on a substantially cylindrical bobbin slidingly mounted for vertical movement on the bobbin support in a plurality of superimposed layers each of substantially constant radius, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a driving part connected to the shaft and a driven part connected to the bobbin support, such parts being magnetically coupled together and being of such configuration and so mounted that the air gap between them may be varied, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, to maintain the tension in the material being wound substantially constant, said last named means comprising spring means connecting one of the aforesaid parts of the clutch to the respective member to which it is attached, and means to transmit the weight of the bobbin and the material wound thereon to the spring mounted part of the clutch.

2. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, means to lay the elongated flexible material on a substantially cylindrical bobbin slidingly mounted for vertical movement on the bobbin support in a plurality of superimposed layers each of substantially constant radius, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first part connected to the shaft and a second part connected to the bobbin support, one of the parts being in the form of an annulus and the other in the form of a disc within the annulus, confronting faces of the parts being spaced by an air gap and lying on cones the elements of which are parallel, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support to maintain the tension in the material being wound substantially constant, said last named means comprising spring means connecting one of the aforesaid parts of the clutch to the respective member to which it is attached, and means to transmit the weight of the bobbin and the material wound thereon to the spring mounted part of the clutch in such manner that as the weight of the material on the bobbin increases the air gap between clutch parts is decreased.

3. In a device for reeling elongated flexible ma-

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terial, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support floatingly mounted on and indirectly driven by the shaft, means to lay the elongated flexible material on a substantially cylindrical bobbin slidingly mounted for vertical movement on the bobbin support in a plurality of superimposed layers each of substantially constant radius, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support and surrounding the first rotor, the two rotors having conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support to maintain the tension in the material being wound substantially constant, said last named means comprising spring means connecting the second rotor to the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

4. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support floatingly mounted on and indirectly driven by the shaft, the bobbin support having a transverse bottom flange, means to lay the elongated flexible material on a substantially cylindrical bobbin slidingly mounted for vertical movement on the bobbin support above the flange in a plurality of superimposed layers each of substantially constant radius, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support parallel to and below the flange thereof and surrounding the first rotor, the two rotors having conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support to maintain the tension in the material being wound substantially constant, said last named means comprising two vertically spaced parallel annular leaf springs connecting the second rotor to the flange on the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

5. A variable torque magnetic clutch for coupling together a driving member and a driven member, comprising a first, disc shaped, rotor fixedly positioned on the driving member, a second, annular, rotor surrounding the first rotor, drivingly mounted on the driven member, and located in magnetically coupled relation to the

first rotor, at least one of said rotors including a magnet of substantially constant flux strength, the two rotors constituting a magnetic system of substantially constant flux strength, the two rotors having parallel conical confronting faces spaced by a narrow air gap, the second rotor being mounted for movement toward and away from the first rotor to vary the degree of coupling between the rotors, and means for positioning the second rotor relative to the first rotor, said last named means comprising a supporting structure surrounding the second rotor and fixedly positioned on the driven member, and spring means interposed between the supporting structure and the second rotor, said spring means comprising at least one annular spring member attached at its outer edge to the supporting structure and at its inner edge to the second rotor, the spring means stably supporting the second rotor of the clutch from said supporting structure the spring means and the clutch rotors being so constructed and arranged that when the second rotor is thrust toward the first rotor with a first predetermined force the clutch transmits a first predetermined torque and that when forces are added to the first force the clutch transmits other greater predetermined torques proportional to the total applied force.

6. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, a bobbin mounted on the bobbin support, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a driving part connected to the shaft and a driven part connected to the bobbin support, such parts being magnetically coupled together and being of such configuration and so mounted that the air gap between them may be varied, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting one of the aforesaid parts of the clutch to the respective member to which it is attached, and means to transmit the weight of the bobbin and the material wound thereon to the part of the clutch mounted on the resilient means.

7. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, the bobbin being slidable longitudinally of the shaft, a bobbin mounted on the bobbin support, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a driving part connected to the shaft and a driven part connected to the bobbin support, the driven part sustaining the weight of the bobbin, such parts being magnetically coupled together and being of such configuration and so mounted that the air gap between them may be varied, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the

air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting the driven part of the clutch to the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon to the part of the clutch mounted on the resilient means.

8. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, a bobbin, means slidingly to mount the bobbin for vertical movement on the bobbin support, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a driving part connected to the shaft and a driven part connected to the bobbin support, such parts being magnetically coupled together and being of such configuration and so mounted that the air gap between them may be varied, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting one of the aforesaid parts of the clutch to the respective member to which it is attached, and means to transmit the weight of the bobbin and the material wound thereon to the part of the clutch mounted on the resilient means.

9. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, a bobbin, means slidingly to mount the bobbin for vertical movement on the bobbin support, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first part connected to the shaft and a second part connected to the bobbin support, one of the parts being in the form of an annulus and the other in the form of a disc within the annulus, confronting faces of the parts being spaced by an air gap and lying on cones the elements of which are parallel, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting one of the aforesaid parts of the clutch to the respective member to which it is attached, and means to transmit the weight of the bobbin and the material wound thereon to the part of the clutch mounted on the resilient means in such manner that as the weight of the material on the bobbin increases the air gap between the clutch parts is decreased.

10. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, a bobbin, means slidingly to mount the bobbin for vertical movement on the bobbin support, means to lay

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the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first part connected to the shaft and a second part in the form of an annulus connected to the bobbin support, the second part sustaining the weight of the bobbin, the first part being in the form of a disc within the annulus, confronting faces of the parts being spaced by an air gap and lying on cones the apices of which lie upwardly and the elements of which are parallel, the two parts together constituting a magnetic system of substantially constant strength, and means responsive to changes in the total weight of the elongated flexible material present on the bobbin to vary the air gap between said parts of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting the second part of the clutch to the bobbin support and means to transmit the weight of the bobbin and the material wound thereon to the second part of the clutch in such manner that as the weight of the material on the bobbin increases the air gap between the clutch parts is decreased.

11. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, a bobbin, means slidably to mount the bobbin on the bobbin support for vertical movement with respect thereto, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support and surrounding the first rotor, the two rotors having parallel conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising resilient means connecting the second rotor to the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

12. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, said bobbin support having a transverse bottom flange thereon, a bobbin, means slidably to mount the bobbin on the bobbin support for vertical movement with respect thereto, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support parallel to and below the flange thereof and surrounding the first rotor, the second rotor sustaining the weight of the bobbin, the two rotors

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having conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch on the shaft of the bobbin support, said last named means comprising at least one annular leaf spring stably connecting the second rotor to the flange on the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

13. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support mounted on and driven by the shaft, said bobbin support having a transverse bottom flange thereon, a bobbin, means slidably to mount the bobbin on the bobbin support for vertical movement with respect thereto, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support parallel to and below the flange thereof and surrounding the first rotor, the second rotor sustaining the weight of the bobbin, the two rotors having parallel conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch on the shaft to the bobbin support, said last named means comprising two vertically spaced parallel annular leaf springs stably connecting the second rotor to the flange on the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

14. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support coaxial with the shaft mounted on and driven by the shaft, said bobbin support having a transverse bottom flange thereon, a bobbin, means slidably to mount the bobbin on the bobbin support for vertical movement with respect thereto, means keying the bobbin and bobbin support together to prevent relative rotation therebetween while allowing the recited sliding movement therebetween, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support parallel to and below the flange thereof and surrounding the first rotor, the second rotor sustaining the weight of the bobbin, the two rotors having conical confronting faces spaced from each other by a narrow upwardly converging conical air gap, and means responsive to changes in the total weight of the elongated flexible ma-

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terial on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch on the shaft to the bobbin support, said last named means comprising two vertically spaced parallel annular leaf springs stably connecting the second rotor to the flange on the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases.

15. In a device for reeling elongated flexible material, a substantially vertical rotary shaft, driving means for such shaft, a bobbin support coaxial with the shaft, floatingly mounted on, and indirectly driven by, the shaft, the bobbin support having a transverse bottom flange, a bobbin, means slidably to mount the bobbin on the bobbin support for vertical movement with respect thereto, means keying the bobbin and bobbin support together to prevent relative rotation therebetween while allowing the recited sliding movement therebetween, means to lay the elongated flexible material on the bobbin, a variable torque slip clutch drivingly interposed between the shaft and the bobbin support, said clutch comprising a first rotor in the form of a disc of magnetic metal fixedly connected to the shaft coaxially thereof, a second rotor in the form of an annular permanent magnet connected to the bobbin support parallel to and below the flange thereof and surrounding the first rotor, the second rotor sustaining the weight of the bobbin, the two rotors having parallel upwardly converging conical confronting faces spaced from each other by a narrow air gap, and means responsive to changes in the total weight of the elongated flexible material on the bobbin to vary the air gap between the rotors of the clutch thereby to vary the effective torque transmitted by the clutch from the shaft to the bobbin support, said last named means comprising two vertically spaced parallel annular leaf springs stably connecting the second rotor to the bobbin support, and means to transmit the weight of the bobbin and the material wound thereon vertically to the second rotor, whereby as the weight of the material on the bobbin increases the air gap between the rotors decreases, said last named means comprising a plurality of pins parallel to the shaft, said pins being slidably mounted in the bottom flange of the bobbin support, angularly spaced about the shaft, and contacting the bottom surface of the bobbin with their upper ends and the top surface of the second rotor with their bottom ends.

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16. A variable torque magnetic clutch for coupling together a driving member and a driven member, comprising a first, disc shaped, rotor fixedly positioned on the driving member, a second, annular, rotor surrounding the first rotor, drivingly mounted on the driven member, and located in magnetically coupled relation to the first rotor, at least one of said rotors including a magnet of substantially constant flux strength, the two rotors constituting a magnetic system of substantially constant flux strength, the two rotors having parallel conical confronting faces spaced by a narrow air gap, the second rotor being mounted for movement toward and away from the first rotor to vary the degree of coupling between the rotors, and means for positioning the second rotor relative to the first rotor, said last named means comprising a supporting structure surrounding the second rotor and fixedly positioned on the driven member, and spring means interposed between the supporting structure and the second rotor, said spring means comprising two spaced parallel annular leaf springs attached at their outer edges to the supporting structure and at their inner edges to the second rotor, the annular leaf springs stably supporting the second rotor of the clutch from said supporting structure, the leaf springs and the clutch rotors being so constructed and arranged that when the second rotor is thrust toward the first rotor with a first predetermined force the clutch transmits a first predetermined torque and that when forces are added to the first force the clutch transmits other greater predetermined torques proportional to the total applied force.

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Certificate of Correction**Patent No. 2,534,496****December 19, 1950****VINCENT A. AGRETI**

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 51, for the word "therein" read *thereon*; column 4, line 58, for "frame" read *from*; column 6, line 33, for "rod" read *rods*; column 12, line 8, for "of the" read *to the*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of February, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.