Nov. 4, 1958 E. A. WENTZ 2,858,992

WINDING MACHINE

Filed March 4, 1955 7 Sheets-Sheet 1

Fig. 1

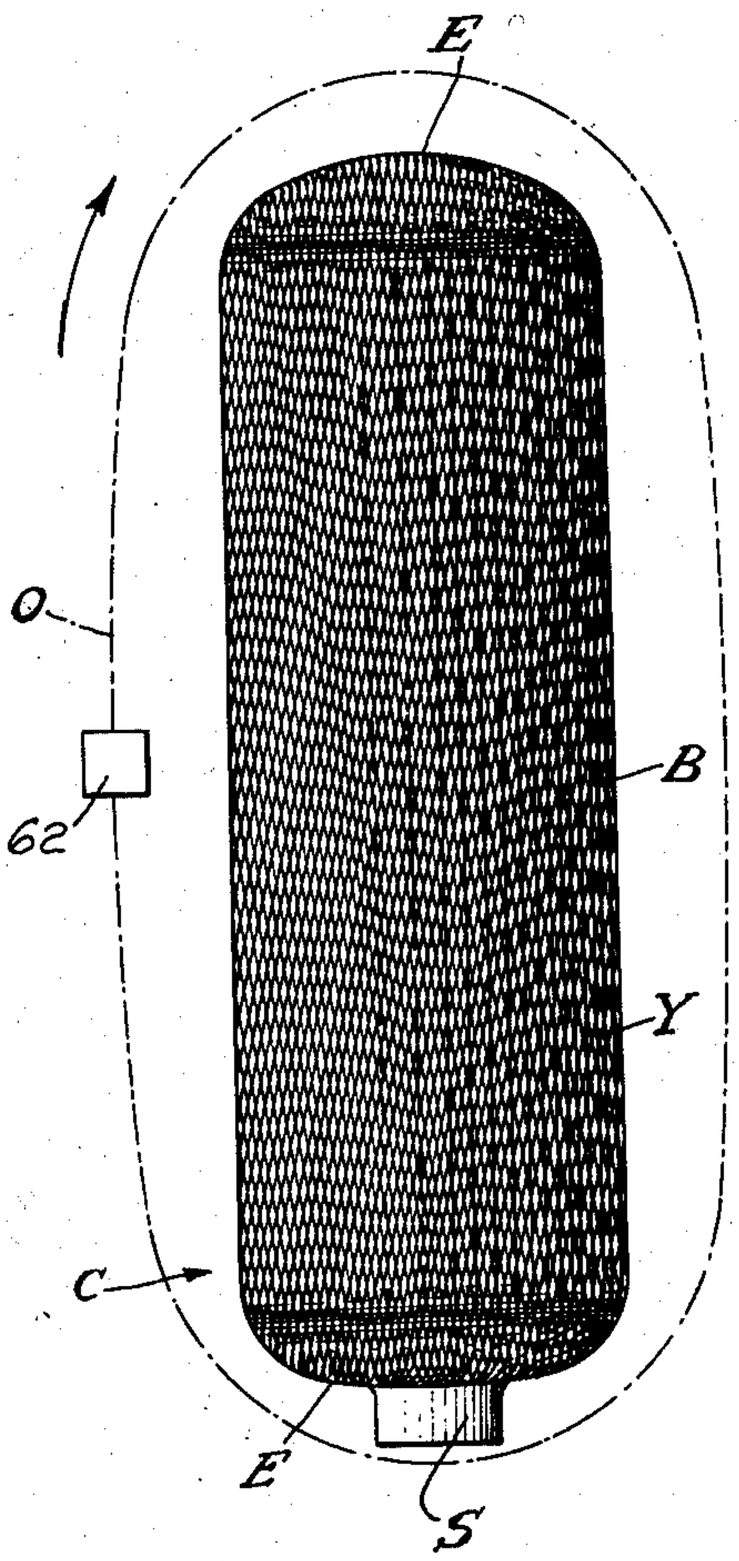
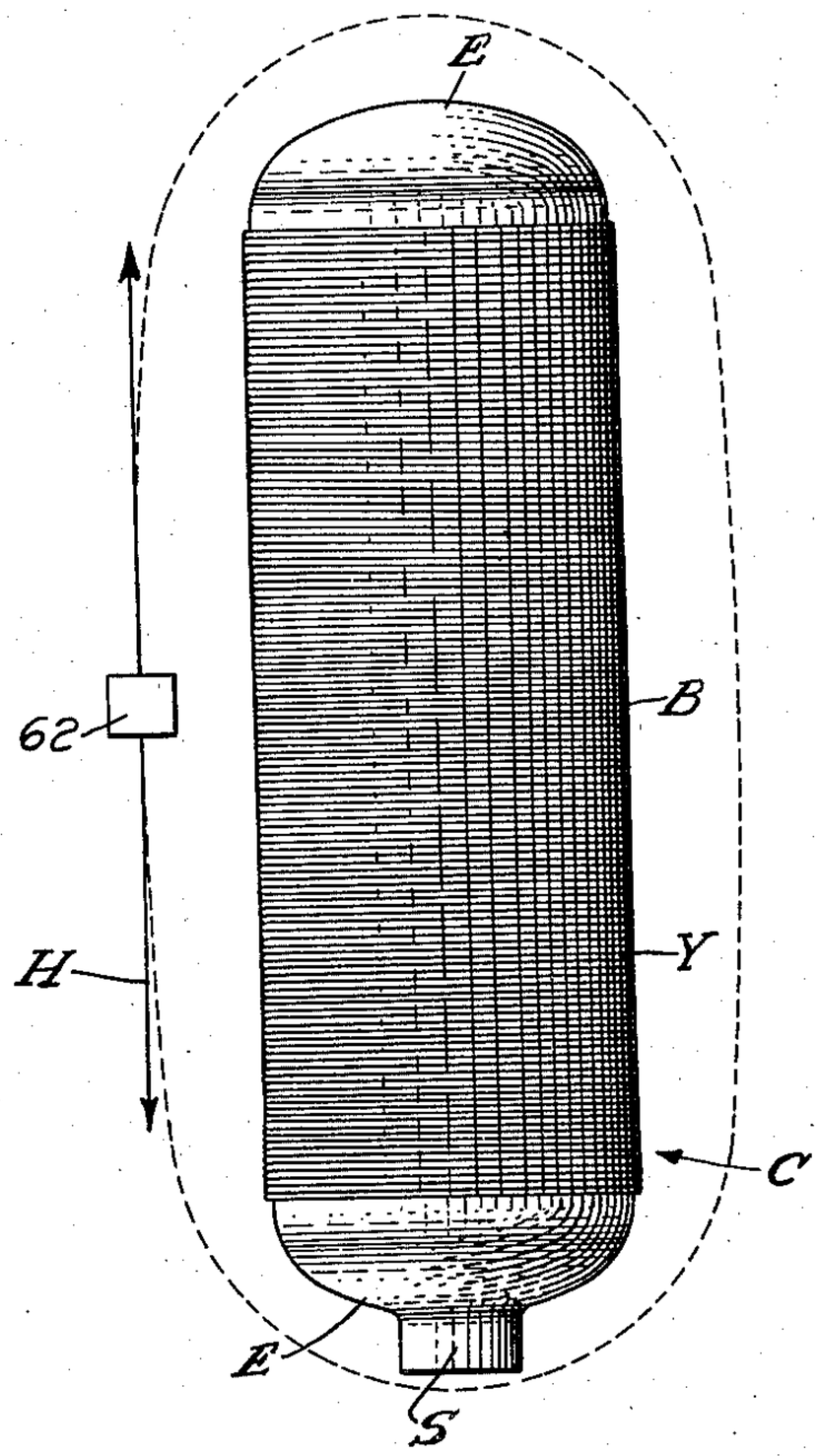


Fig. 2



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WINDING MACHINE

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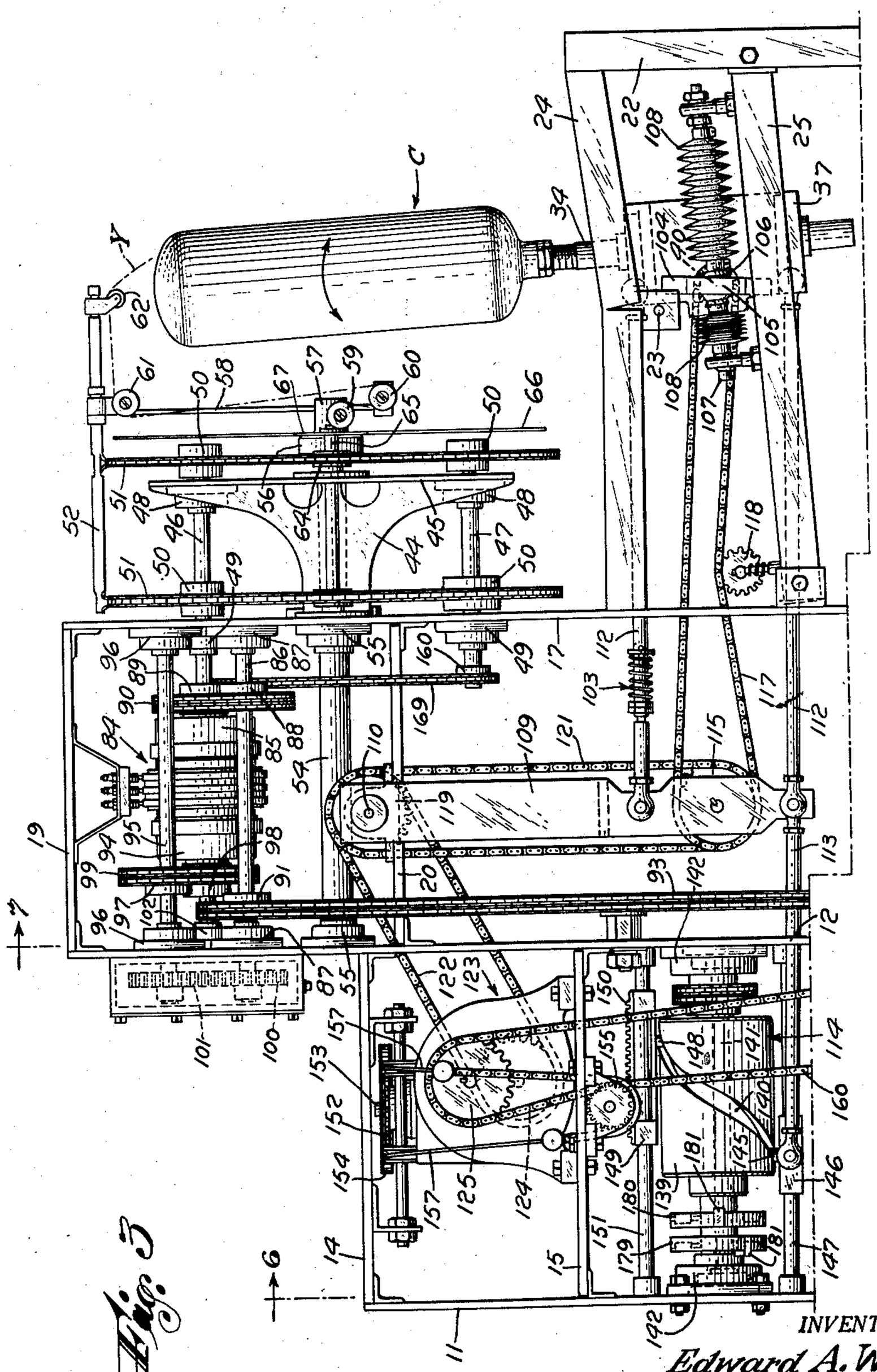

Fig. 3

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WINDING MACHINE

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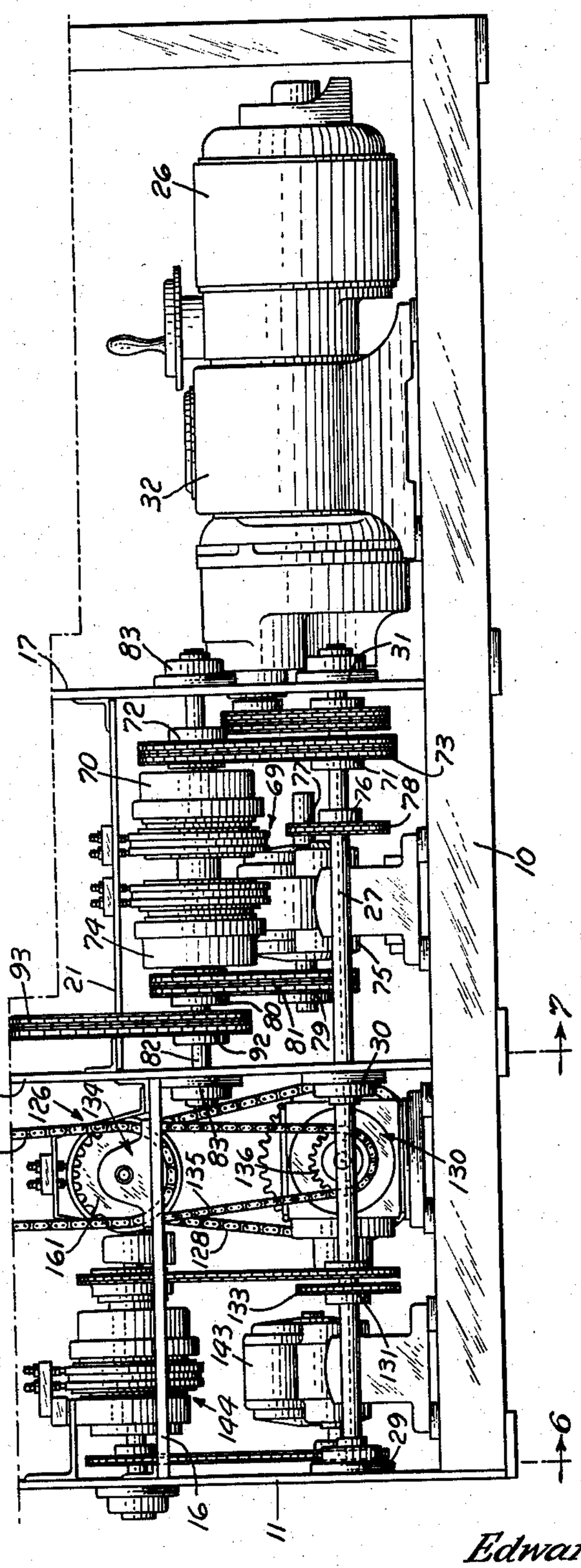
Fig. 3a



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WINDING MACHINE

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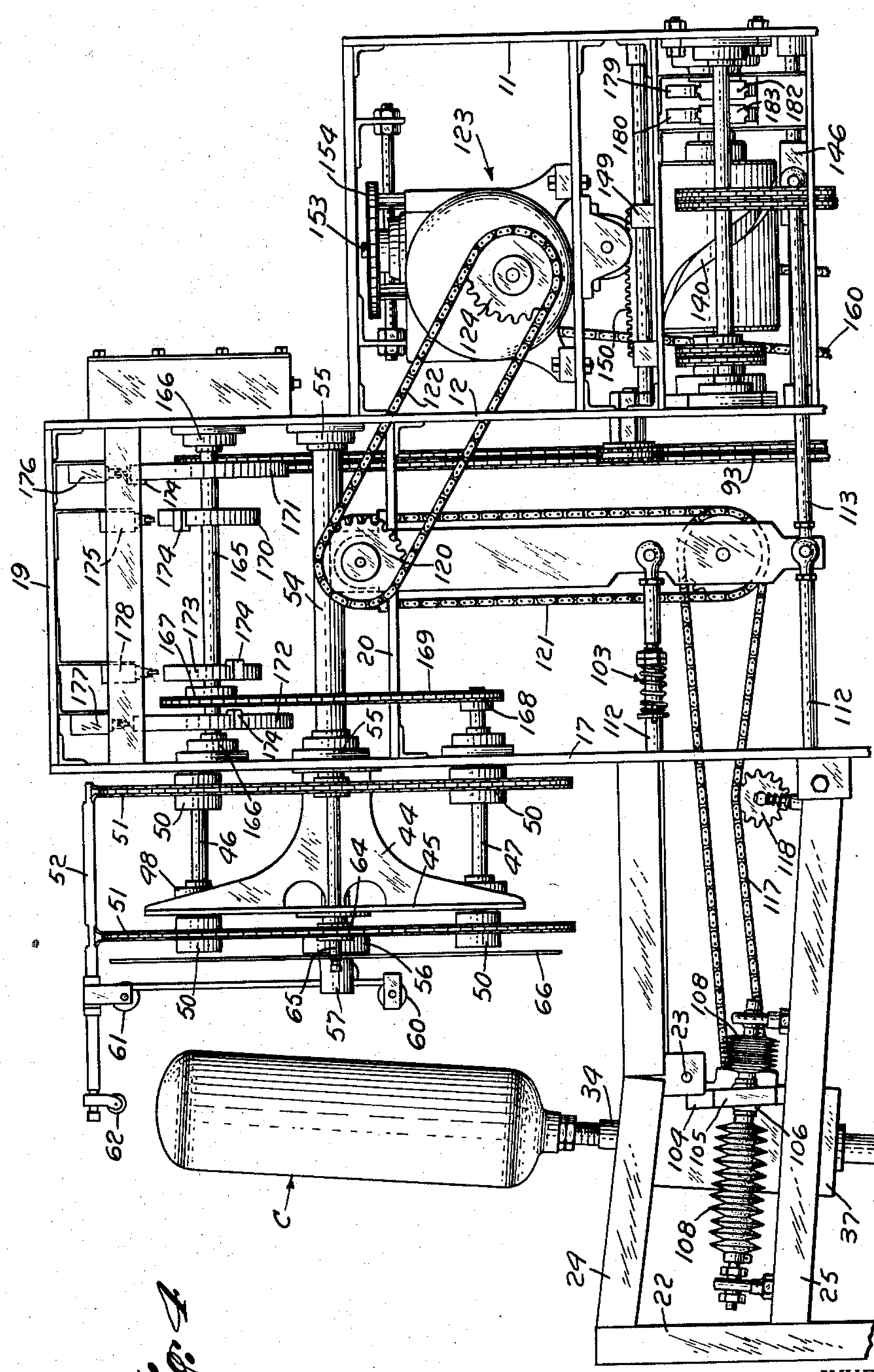

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Nov. 4, 1958 E. A. WENTZ 2,858,992

WINDING MACHINE

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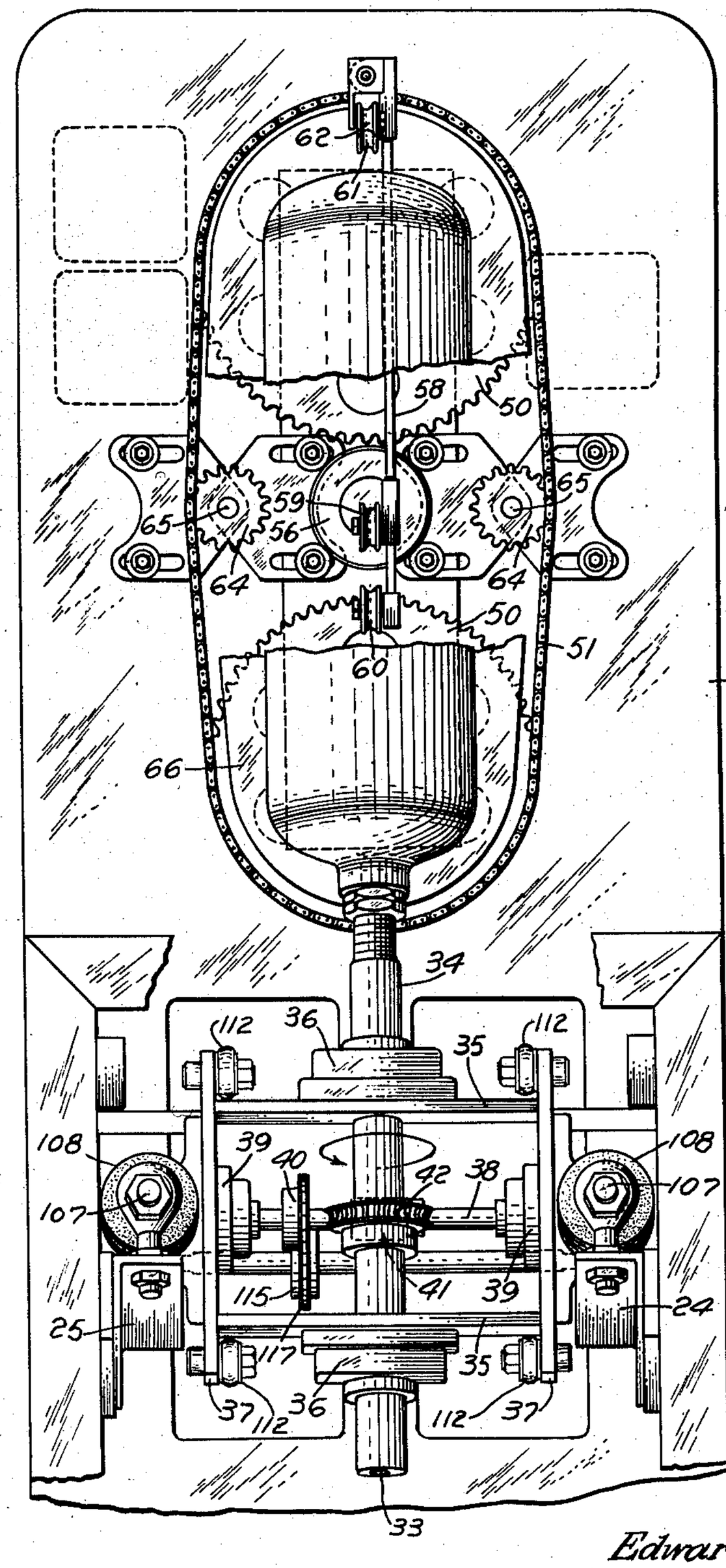
Fig. 5



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WINDING MACHINE

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Fig. 6

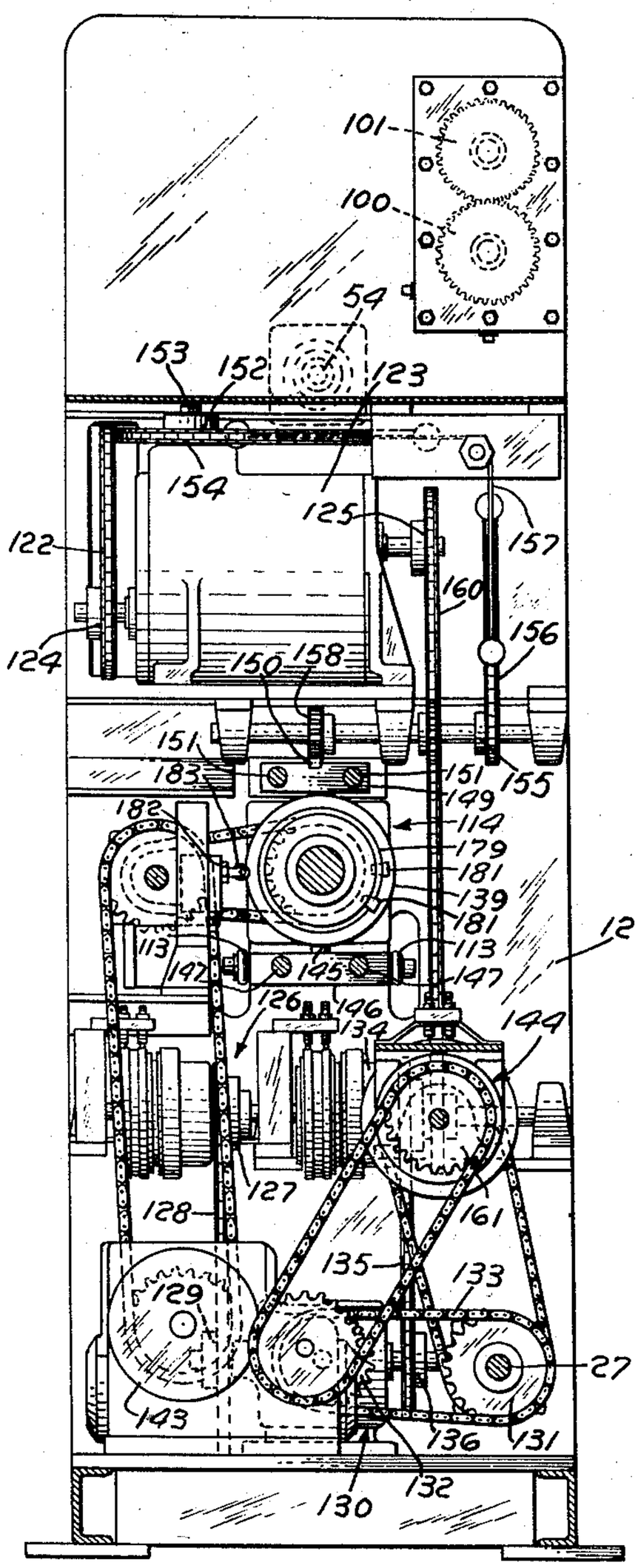
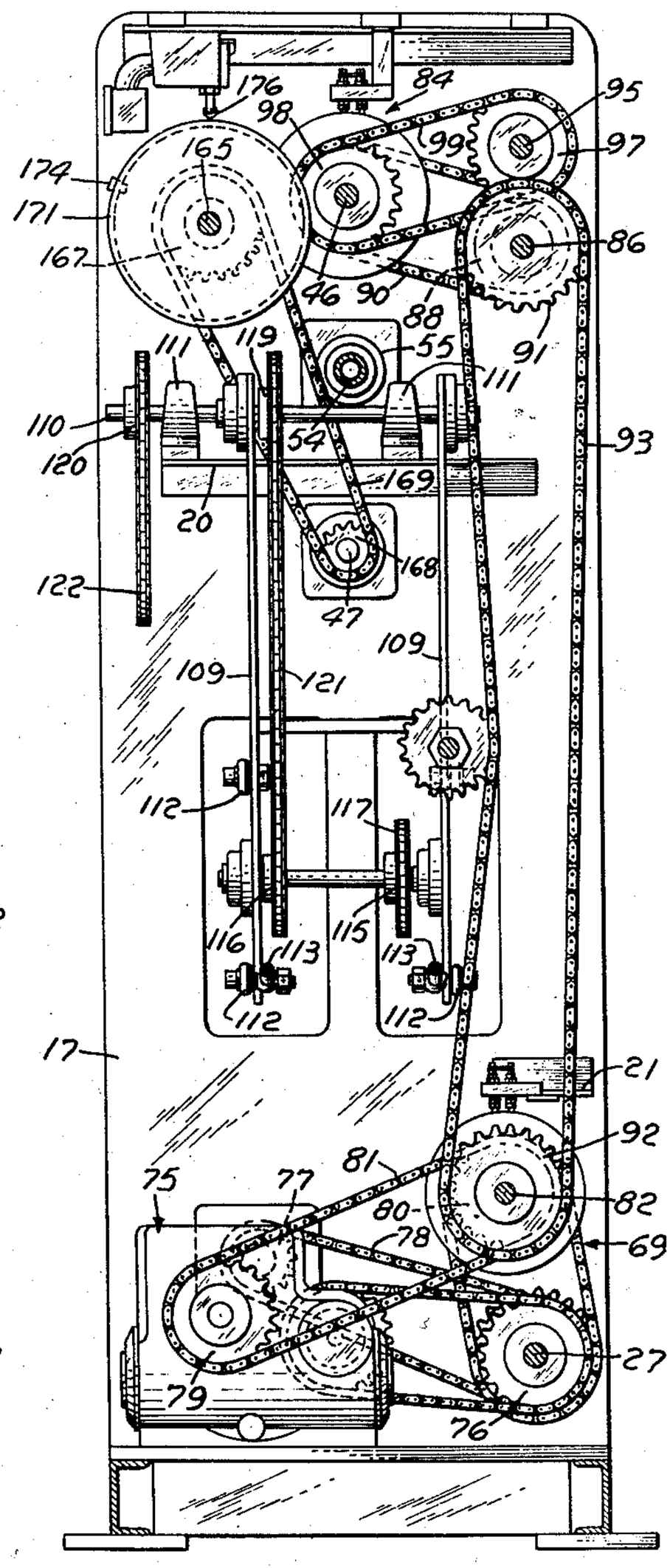


Fig. 7



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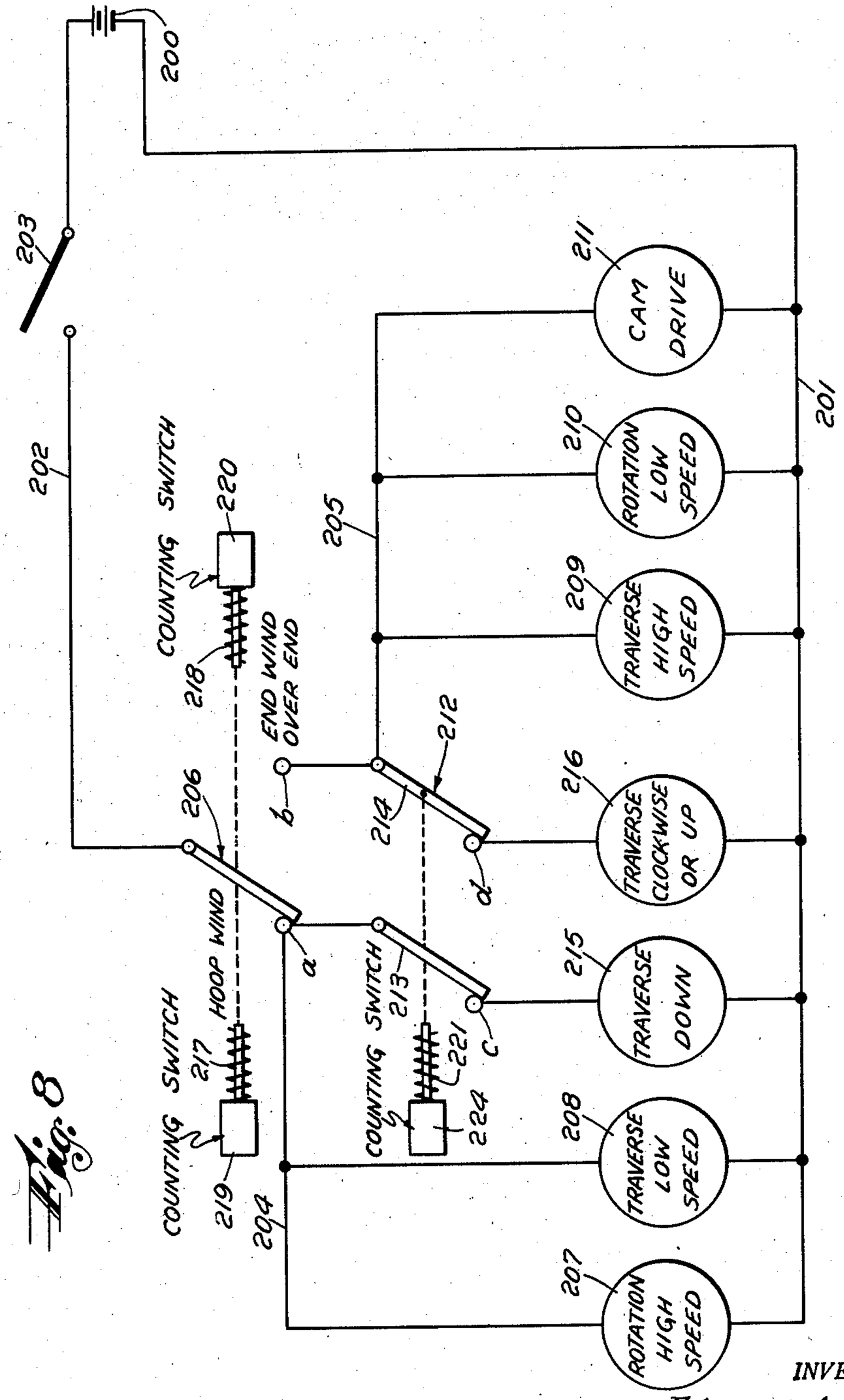

Fig. 8

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United States Patent Office

2,858,992

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2,858,992

WINDING MACHINE

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Application March 4, 1955, Serial No. 492,124

14 Claims. (Cl. 242—7)

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

The present invention is primarily concerned with the manufacture of receptacles, commonly known as cylinders, for storing fluid media under pressure which receptacles comprise a hollow shell having a winding of resin impregnated yarn applied thereto, whereby, in effect, receptacles having walls constructed of resin reinforced with yarn are built up. The machine in accordance with the present invention is particularly adapted for applying such windings but also can be utilized for applying windings of yarn or wire to metallic cylinders 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 in a rapid and economical manner.

Another object is to provide such a machine which is adapted to apply a cylindrical or hoop winding and an end-over-end winding on objects having a cylindrical body and hemispherical ends.

Another object is to provide such a machine which is operable to alternately apply the two types of windings.

A further object is to provide such a machine wherein the change from one type of winding to the other is effected in a rapid and convenient manner and without distrubing the object on which the winding is being applied.

A still 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 cylindrical shell, illustrating the path of the winding applying means while applying an end-over-end winding thereon.

Fig. 2 is a similar view illustrating a cylindrical or hoop winding being applied to the shell.

Fig. 3 is an elevational view of the upper portion of the machine as seen from one side thereof.

Fig. 3*a* is an elevational view of the lower portion of the side of the machine shown in Fig. 3, Figs. 3 and 3*a* when combined constituting a complete side view of the machine.

Fig. 4 is an elevational view of the upper portion of the machine as seen from the other side thereof.

Fig. 5 is a front elevational view of the upper portion of the machine.

Fig. 6 is a sectional view taken along the line 6—6 on Figs. 3 and 3*a*.

Fig. 7 is a sectional view taken along the line 7—7 on Figs. 3 and 3*a*.

Fig. 8 is a schematic wiring diagram of the essential devices for controlling the operation of the machine.

APPLICATION OF THE WINDING

Referring to the drawings in detail and more particularly to Figs. 1 and 2 thereof, there is shown a cylindrical shell C in the course of having a resin-impregnated yarn Y applied thereto. For example, the yarn may be composed of fiber glass threads which are impregnated with any suitable resin adapted to harden to a solid state. The shell C comprises a cylindrical body B, generally hemispherical ends E, and a spud S at one of the ends which provides an inlet and outlet for the receptacle being manufactured.

As shown in Fig. 1, the shell C has an oval or end-over-end winding O applied thereto by moving the winding applying means in a continuous path approximating the outline of the shell while rotating the shell about its longitudinal axis. This path is generally oval, and has semi-circular end zones and has substantially straight or slightly curved side zones between the end zones.

The machine illustrated herein and about to be described is constructed and arranged to provide such windings.

As shown in Fig. 2, the body B has a cylindrical or hoop winding H applied thereto by traversing the winding applying means in a substantially lineal path at one side of the oval path shown in Fig. 1 while rotating the shell.

GENERAL DESCRIPTION OF THE MACHINE

Generally described, the machine shown in Figs. 3, 3*a*, 4, 5, 6 and 7 comprises a frame, a drive mounted on the frame, a support for the object having the winding applied thereon, mechanism operated by the drive for rotating the support, means for applying the winding onto the object, mechanism for moving the applying means in an oval path, mechanism for rocking or tilting the support, mechanism for progressively varying the speed of rotation of the support while being tilted, and mechanism for traversing the applying means. These components will be described in detail hereinafter.

In addition, the machine includes means operable to automatically program the operations of the machine in any desired sequence.

The frame

The frame, for compactness and economical arrangement of the components of the machine, essentially comprises a rectangular base **10**, an upright end plate **11**, an upright intermediate plate **12**, pairs of the upper, intermediate and lower horizontal bars **14**, **15** and **16** connected between the plates **11** and **12**, a second upright intermediate plate **17**, pairs of upper, intermediate and lower horizontal bars **19**, **20** and **21** connected between the plates **12** and **17**, upright end posts **22**, and pairs of adjacently spaced upper and lower bars **24** and **25** connected between the plate **17** and the posts **22**.

The base and the bars have elements of the machine mounted thereon and the plates have openings through which shafts, chains and the like are adapted to pass and have bearings mounted thereon for the purposes to be described hereinafter.

The main drive

The drive comprises a motor **26** mounted on the base adjacent the posts **22**, a main drive shaft **27** rotatably supported by bearings **29**, **30** and **31** respectively secured to the plates **11**, **12** and **17** (Fig. 3*a*), and a

variable speed drive mechanism **32** driven by the motor for effecting rotation of the drive shaft at a constant predetermined speed.

The main drive shaft powers the various mechanisms of the machine in the manner to be described hereinafter with particular reference to such mechanisms.

The work support

As best shown in Figs. 3 and 5, the work or object support (for the shell C of the illustrative embodiment herein) comprises an upright spindle **34** having means at the upper end thereof for attaching the spud S of the shell to mount the same in inverted position for rotation with the spindle, a pair of spaced apart horizontal bars **35** provided with bearings **36** for rotatably mounting the spindle, a pair of side plates **37** for supporting the bars, a horizontal shaft **38** having its ends rotatably supported by bearings **39** mounted on the plates **37**, a sprocket **40** and a worm gear **41** on the shaft **38**, a worm wheel **42** on the spindle in driving connection with the gear **41**, and means for mounting the plates **37** between the bars **25** and drive mechanism for the sprocket **40** which will be described in connection with the work support rocking or tilting mechanism.

If desired, the spindle may have a bore or passageway **33** extending therethrough adapted for connection to a source fluid under pressure which may thereby be introduced into the shell to pressurize the same and prevent collapse thereof in the event the winding is applied under considerable tension.

The winding applying means

As already indicated in connection with the brief description of Figs. 1 and 2, the winding applying means are adapted to alternately provide an end-over-end winding and a cylindrical or hoop winding, and, to accomplish such purpose, the winding applying means essentially comprise yarn guiding means, mechanism for moving the guiding means in an end-over-end or oval path and for traversing the same, and yarn supply means.

Referring again to Figs. 3 and 5, there is shown a bracket **44** extending outwardly from the plate **17** and including an oblong upright end plate **45**, upper and lower horizontal shafts **46** and **47** each having one end supported by a bearing **48** on the plate **45** and having the other end extending through a bearing **49** on the plate **17**, a pair of spaced apart sprockets **50** secured for rotation on each of the shafts **46** and **47** between the plates **17** and **45**, chains **51** connecting aligned upper and lower sprockets and thereby having an oval path, and a horizontal rod **52** connected to each of the chains **51** for movement therewith in an oval path disposed in a vertical plane and extending outwardly to about the plane in which the spindle **34** rotates for operating the yarn guiding means about to be described.

The yarn is supplied to the yarn guiding means through a horizontal tube **54** mounted for rotation and extending through bearings **55** on the plates **12** and **17** and having an end projecting outwardly through the plate **45** and beyond the outer set of sprockets **50**. This tube is centrally located with respect to the path of the chains **51**.

A ring member **56** is mounted on the projecting end of the tube **54** for rotation therewith and is formed with a centrally and outwardly offset portion or extension **57** having a bore for slideably receiving a rod **58**. One end of this rod is secured to the rod **52** and the other end extends through and is movable with respect to the portion **57**.

In order to guide the yarn supplied through the tube for winding onto the shell, a roller **59** is mounted on the extension **57** facing the tube opening, a roller **60** is mounted on the free end of the rod **58**, a roller **61** is mounted adjacent the fixed end of the rod **58**, and a roller **62** is mounted at the outer end of the rod **52**. As viewed in Figs. 3 and 4, the yarn leaves the tube

54, passes over the roller **59**, under the roller **60** and over rollers **61** and **62**, and is laid on the shell end-over-end as the shell rotates.

With this arrangement, the roller **62** moves in an oval path in close proximity to the shell which path generally approximates the outline of the shell, that is the longitudinal sectional shape thereof.

The chains **51**, in passing from one sprocket **50** to another, may move in a lineal direction, that is, vertically as shown. However, this zone of the chain path may be bowed outwardly slightly by idlers **64** mounted on rods **65** fixed to the plates **17** and **45** midway between the sprockets **50** and extending outwardly beyond the plate **45**.

If desired, a protective plate **66** having a central opening **67** for the ring member extension **57** may be mounted between the path of the rod **58** and the outer sprockets **50** by securing the same to the outer ends of the rods **65**.

The winding applying means drive

The drive for the winding applying means includes gear change means for effecting rotation of the chain operating sprockets **50** at a high speed and a low speed, and gear change means for effecting rotation of these sprockets in either direction.

As shown in Figs. 3, 3*a*, 4 and 5, the speed change drive comprises a conventional solenoid controlled duplex clutch **69** having a high speed input drive **70** driven directly from the main drive shaft **27** by sprockets **71** and **72** and a chain **73**, and having a low speed input drive **74** driven from the main drive shaft through the output shaft of a reducing gear box **75** by sprockets **76** and **77** and a chain **78** and sprockets **79** and **80** and a chain **81** connecting the input shaft thereof to the main drive shaft **27**, and an output shaft **82** rotatable at a high or low speed depending on which input drive is in operative connection therewith, journalled for rotation in bearings **83** on the plates **12** and **17**.

The direction change drive is driven by the speed change drive, and comprises a conventional solenoid controlled clutch **84** having an input drive **85** driven from a shaft **86** journalled for rotation between bearings **87** on the plates **12** and **17** through sprockets **88** and **89** and a chain **90** and a sprocket **91** on the shaft **86** connected to a sprocket **92** on the output shaft **82**, by a chain **93** and having a second input drive **94** driven from a shaft **95** journalled for rotation between bearings **96** on the plates **12** and **17** through sprockets **97** and **98** and a chain **99** and gears **100** and **101** on the shafts **86** and **95** whereby these shafts rotate in opposite directions, and an output shaft herein shown as the upper winding applying means drive shaft **46** which extends through the clutch **84** to a bearing **102** on the plate **12** and which is operable in either direction depending upon which input drive is in operative connection therewith.

The purpose of this drive will be understood more fully from the description of the control circuit including the drive therefore and the operation of the machine.

The work support tilting means

As previously indicated, the work support assembly is mounted in a manner to rock or tilt the same while an end-over-end is applied to the shell, whereby the angle at which such winding is applied is varied with respect to the axis of rotation of the shell.

This is accomplished by providing a trunnion or bearing arrangement at each side of the work support assembly, for example, bearings of the self aligning type known as a "Heim" bearing (Figs. 3, 4 and 5). Such bearings comprise a body member **104** secured to each of the plates **37** and having a generally spherical seat **105**, and an apertured generally spherical member **106** received by the seat. The members **106** are each slidably mounted on a rod **107** which extends through the aper-

ture thereof and is supported in fixed position by the bar **25** at the ends thereof. Contamination of the rods **107** is prevented to maintain the members **106** slideable thereon by suitable means such as accordion pleated sleeves **108** positioned between the ends of the rod **107** and each side of the member **106.**

Rocking or tilting of the work support is effected by an arrangement which comprises a pair of parallel spaced apart members **109** pivotally suspended on a shaft **110** mounted for rotation by bearings **111** (Fig. 7) on the bar **20**, a pair of spaced upper and lower horizontal rods or links **112** having their ends pivotally connected to each of the plates **37** and the members **109**, and a rod **113** pivotally connected to each of the members **109** and operated by cam mechanism **114** (Figs. 3, 4 and 6) to rock the members **109** as described hereinafter, whereby the links **112** rock or tilt the work support assembly.

The upper links **112** may be formed in two sections connected by an extension joint **103** including a spring, whereby, when the work support assembly contacts a stop **23** on the frame, the work is rocked or tilted about a pivot point closer to the work than that of the bearing body **104** and thus enabling the work to be tilted at a greater angle than otherwise possible. This arrangement is desirable for applying certain types of end-over-end windings.

The work support drive and tilting means operating mechanism

The portion of this drive more directly associated with the work support is arranged to cooperate with the tilting means just described so that tilting of the work support does not disturb its operation.

As shown in Figs. 3, 4 and 7, this portion of the work support drive comprises a pair of spaced sprockets **115** and **116** mounted on and for rotation with a shaft supported between the pivotally suspended members **109** at the lower ends thereof, a chain **117** connecting the sprocket **40** of the work support assembly and the sprocket **115**, a spring urged idler **118** for taking up slack in the chain **117** due to sliding movement of the work support assembly on the rods **107**, a pair of spaced sprockets **119** and **120** mounted on and for rotation with the shaft **110**, a chain **121** connecting the sprockets **116** and **119**, and a chain **122** connecting the sprocket **120** to drive means about to be described.

Since it is desirable to rotate the shell at a high speed when applying a cylindrical or hoop winding to speed up production and it is required to rotate the shell at a predetermined low speed in order to lay the end-over-end winding thereon, provision is made for driving the chain **122** at such speeds. Also, since, under certain operating conditions, it is desirable to progressively vary the speed of rotation of the shell while driven at a low speed for end-over-end winding in relation to the angle at which the axis of rotation of the shell is tilted to its normal vertical position, provision is made for so coordinating the speed varying means and the tilting operating means through the cam mechanism **114.**

This is accomplished by a conventional variable speed drive **123** having an output sprocket **124** connected to the sprocket **120** by the chain **122** and having an input sprocket **125**, and a conventional solenoid controlled duplex clutch **126** (Fig. 3*a* and 6) having a high speed input drive **127** driven by a chain **128** connected to a sprocket **129** of the high speed output shaft of a high and low speed gear box **130**, driven from the main drive shaft **27** by sprockets **131** and **132** and a chain **133**, and having a low input speed drive **134** driven by a chain **135** connected to a sprocket **136** of the low speed output drive shaft of the gear box **130.**

The cam mechanism **114** which controls speed change of the variable drive **123** and the operation of the work support tilting rods **113**, as previously mentioned, comprises a cam drum **139** having a continuous helical groove **140**, a shaft **141** for mounting the cam drum for rotation therewith journalled for rotation between bearings **142** on the plates **11** and **12**, means for rotating the shaft **141** including sprockets and chains and a gear box **143** driven from the main drive shaft **27** through a clutch-brake **144** (Fig. 3*a*), a cam follower **145** in the cam groove and mounted on a slide **146** having the rods **113** linked thereto and being supported on a pair of rods **147** secured between the plates **11** and **12**, a second cam follower **148** in the cam groove diametrically opposite the follower **145** and mounted on a slide **149** having a gear rack **150** opposite the follower **148** and being supported on a pair of rods **151** similar to the rods **147**, and a speed control device for the variable drive **123** including a sprocket **152** on a control shaft **153**, a chain **154** on the sprocket **152**, a second sprocket **155**, a chain **156** on the sprocket **155**, flexible strands **157** connecting the ends of the chains **154** and **156**, and a gear **158** meshing with the rack **150** and connected for rotating the sprocket **155** to operate the control shaft **153** (Figs. 3 and 6).

The input sprocket **125** of the variable speed drive **123** is driven by a chain **160** connected to a sprocket **161** driven by the output of the clutch **126.**

The clutch-brake **144** serves to connect the cam drum **139** for rotation by the main drive shaft when in one position and serves as a brake when in its other position to prevent rotative movement of the cam drum due to the thrust of the rods **113** on the follower **145.**

The timing mechanism

In applying windings to the shell, it is desirable to alternately apply one or more windings of one kind and one or more windings of the other kind until sufficient windings have been applied to produce a container having a desired wall thickness. This is generally accomplished by operating the clutches **69**, **84** and **126**, and the clutch-brake **144** in a predetermined sequence and under the control of an electrical circuit, about to be described, which in turn is controlled by rotation counting or timing mechanism associated with the machine.

In general, such mechanism comprises a shaft **165** supported by bearings **166** between the plates **12** and **17** (Figs. 4 and 7), a sprocket **167** on the shaft **165**, a sprocket **168** on the winding applying means drive shaft **47**, a chain **169** connecting the sprockets **167** and **168** whereby the shaft **165** rotates in a predetermined relation with the shaft **47** four wheels **170**, **171**, **172** and **173** mounted for rotation with the shaft and each having a dog or extension **174** thereon, and four switches **175**, **176**, **177** and **178**, one for each wheel and adjacent thereto to enable the dog of its wheel to operate the same upon the completion of one revolution of the shaft **165**. The switches supply impulses to conventional counters of type which open and/or close control switches for the solenoids of the clutches as described hereinafter.

The timing mechanism further includes wheels **179** and **180** (Figs. 3, 4 and 6) on the cam drum shaft **141** each having a dog **181** for respectively operating a switch **182** and a switch **183** (directly in back of the switch **182**, as viewed in Fig. 6) which in conjunction with the other timing mechanism controls the operation of the cam.

The control circuit

Referring now to Fig. 8 of the drawings, a control circuit is shown which essentially comprises a source of electrical energy **200**; a main conductor **201** and a main conductor **202** having a master switch **203** connected therein; a sub-conductor **204**, a sub-conductor **205** and a single-pole-double-throw switch **206** having contacts *a* and *b* for alternately connecting the sub-conductors **204** and **205** to the main conductor **202**; solenoids **207** and **208** connected across the conductors **201** and **204** for respectively moving the clutch **126** into position for effecting high speed rotation of the work supporting spindle **34** and

moving the clutch **69** into position for effecting low speed operation winding applying means; solenoids **209**, **210** and **211** connected across the conductors **201** and **205** for respectively moving the clutch **69** into position for effecting high speed operation of the winding applying means, moving the clutch **126** into position for effecting low speed rotation of the spindle **34** and moving the clutch **144** into position for effecting rotation of the cam drum **139**; a switch **212** having contacts *c* and *d*, and arms **213** and **214** respectively connected to the contacts *a* and *b* and constructed and arranged so that the arms **213** and **214**, in the position shown, respectively engage the contacts *c* and *d*, and, in another position, the arm **213** engages the contact *d*; a solenoid **215** connected across the conductor **201** and the contact *c* for moving the clutch **84** into a position for effecting operation of the winding applying means in one direction (e. g. downwardly); and a solenoid **216** connected across the conductor **201** and the contact *d* for moving the clutch **84** into a position for effecting operation of the winding applying means in the opposite direction (e. g. clockwise or upwardly).

The switches **206** and **212** may be arranged for manual operation, but, as already indicated, these switches may be under the control of the timing mechanism. This may be accomplished providing mechanism for shifting each of these switches from one position to another at desired intervals determined by counting the number of various operations the machine has performed.

For example, the switch **206** may be controlled by a pair of solenoids **217** and **218** which respectively are energized by counting switches **219** and **220** under the control of the timing mechanism switches **175** and **178**, respectively. Likewise, the switch **212** may be controlled by a solenoid **221** which is energized by counting switches under the control of the timing mechanism switches **176** and **177** for alternately closing and opening the solenoid switch **224**, the armature of this solenoid controlling the arms **213** and **214** being spring urged into the position shown when the solenoid is de-energized.

Operation

In operation, with the master switch **203** closed, and with the switches **206** and **212** in the positions shown in Fig. 8, the machine is set up for applying a cylindrical or hoop winding such as shown in Fig. 2. In such operation, the spindle **34** is rotated at high speed and the winding applying means is traversed in a downward direction along its substantially straight vertical path until it reaches the lower limit of the hoop winding, whereupon the switch **224** energizes the solenoid **221** to move the switch arm **213** into engagement with the contact *d* to energize the solenoid **216**. The winding applying means is then traversed in an upward direction in the same path until it reaches the upper limit of the hoop winding, whereupon the switch **224** is opened and this solenoid is de-energized to cause the switch arm **213** to move into the first mentioned and illustrated position. Alternate closing and opening of the switch **224** under the control of the timing mechanism effects traversing of the winding applying means.

After a predetermined number of layers of hoop windings have been applied, the switch **219** is caused to energize the solenoid **217** which moves the arm of the switch **206** into engagement with the contact *b* to set up the machine for applying an end-over-end winding such as shown in Fig. 1. In such operation, the spindle **34** is rotated at low speed, the winding applying means are operated at high speed to move the yarn guiding elements in an oval clockwise path, and the cam drum is rotated to effect tilting of the spindle and to progressively vary the speed at which the spindle is rotated in small increments. During such operation, the arm **214** engages the contact *d* to maintain the clutch solenoid **216** energized and effect clockwise movement of the yarn applying means. This operation continues until the switch **220** is caused to energize the solenoid **218** to reverse the switch **206** to the position shown herein.

Conclusion

From the foregoing description, it will be seen that the present invention provides a relatively simple, practical and efficient machine for applying hoop and end-over-end windings on shells to either build up a container structure or to reinforce the same, provision being made for rapidly switching from one type of winding to another. The machine is sufficiently rugged in construction to withstand any rough usuage to which it may be normally subjected, but yet is compact and requires only a small working area.

The term "yarn" is used in its broadest sense herein and is intended to include strands, filaments, strips, ribbons, wires, threads and the like formed of any material which is sufficiently flexible to enable the same to be wound in the manner described herein.

While chains and sprockets have been disclosed as drive connecting means for various shafts herein, it will be undertsood that belt and pulley drives or their equivalents could be utilized, and, that the invention is in no way limited thereto.

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 support for an object adapted to have yarn wound thereon, means for rotating said support, means for guiding the yarn to be wound on the object, endless flexible conveyor means for moving said yarn guiding means about the object in a continuous path disposed in a given plane and approximating the outline of the object to wind the yarn on the object, means for rocking said support in a plane substantially perpendicular to the plane in which the continuous path is disposed, and means for progressively changing the speed of said support rotating means in synchronism with said support rocking means.

2. A winding machine according to claim 1, wherein said speed changing means are constructed and arranged to cause said support rotating means to be operated at its lowest speed when said support is in its intermediate position and at its highest speed when in its end positions.

3. A winding machine according to claim 1, including mechanism for controlling said speed changing means and said support rocking means, said mechanism comprising a cam having a continuous helical dwell, follower means in said dwell operatively connected to said speed changing means, follower means in said dwell opposite said first mentioned follower means and operatively connected to said support rocking means, and means for rotating said cam.

4. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a pivotally suspended member, a pair of spaced upper and lower parallel rods pivotally connected to said member and said mounting means, means for rocking said member to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object.

5. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a member pivotally suspended adjacent one end thereof, a pair of spaced

upper and lower parallel rods pivotally connected to said member and said mounting means, means for rocking said member to effect tilting of said mounting means and the object on said support, means for winding yarn on the object, and drive means for said rotating means including a drive sprocket on said member adjacent its pivotally suspended end, a driven sprocket on said member adjacent its other end, a chain connecting said drive and driven sprockets, a drive sprocket mounted on said member for rotation with said driven sprocket, a driven sprocket on said mounting means, and a chain connecting said last mentioned drive and driven sprockets.

6. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a pivotally suspended member, a pair of spaced upper and lower parallel rods pivotally connected to said member and said mounting means, means for rocking said member to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object, said mounting means including bearing means and means for slideably supporting said bearing means.

7. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a pivotally suspended member, a pair of spaced upper and lower parallel rods pivotally connected to said member and said mounting means, means for rocking said member to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object, said mounting means including bearing means and means for slideably supporting said bearing means and flexible sleeves for enclosing said bearing supporting means.

8. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a pair of parallel pivotally suspended members, a pair of spaced upper and lower parallel rods pivotally connected to each of said members and said mounting means, means for rocking said members to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object.

9. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, a pair of parallel pivotally suspended members, a pair of spaced upper and lower parallel rods pivotally connected to each of said members and said mounting means, means for rocking said members to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object, said mounting means including a pair of bearings for pivotally supporting the same and means for slideably supporting each of said bearings.

10. In a winding machine of the class described, the combination of a support for an object on which yarn

is adapted to be wound, means for mounting said support for tilting movement including means for rotating said support and the object thereon, means for varying the speed of said support rotating means including a cam, a pivotally suspended member, a pair of spaced upper and lower parallel rods pivotally connected to said member and said mounting means, means operated by said cam for rocking said member to effect tilting of said mounting means and the object on said support, and means for winding yarn on the object.

11. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for rotation, means for rotating said support, means for winding yarn on the object, and drive means for said winding means including reversing means and speed change means for driving said winding means at a high speed and a low speed through said reversing means.

12. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for rotation, means for rotating said support, means for winding yarn on the object, drive means for said winding means including reversing means and speed change means for driving said winding means at a high speed and a low speed through said reversing means, and means for progressively varying the speed of said support rotating means.

13. In a winding machine of the class described, the combination of a support for an object on which yarn is adapted to be wound, means for mounting said support for rotation, means for rotating said support, means for winding yarn on the object, drive means for said winding means including reversing means and speed change means for driving said winding means at a high speed and a low speed through said reversing means, means for progressively varying the speed of said support rotating means, means for rocking said support mounting means, and a cam for controlling said last mentioned means and said speed varying means.

14. In a winding machine of the class described, the combination of a support for an object adapted to have yarn wound thereon, means for rotating said support, means for guiding the yarn to be wound on the object, mechanism for selectively moving said yarn guiding means to apply an end-over-end winding on the object and to apply a hoop winding on the object, drive mechanism for said support rotating means, and automatic control means for said drive mechanism for effecting rotation of said object at a low speed while an end-over-end winding is being applied and at a high speed while a hoop winding is being applied.

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