

Nov. 4, 1958

E. A. WENTZ
WINDING MACHINE

2,858,992

Filed March 4, 1955

7 Sheets-Sheet 1

Fig. 1

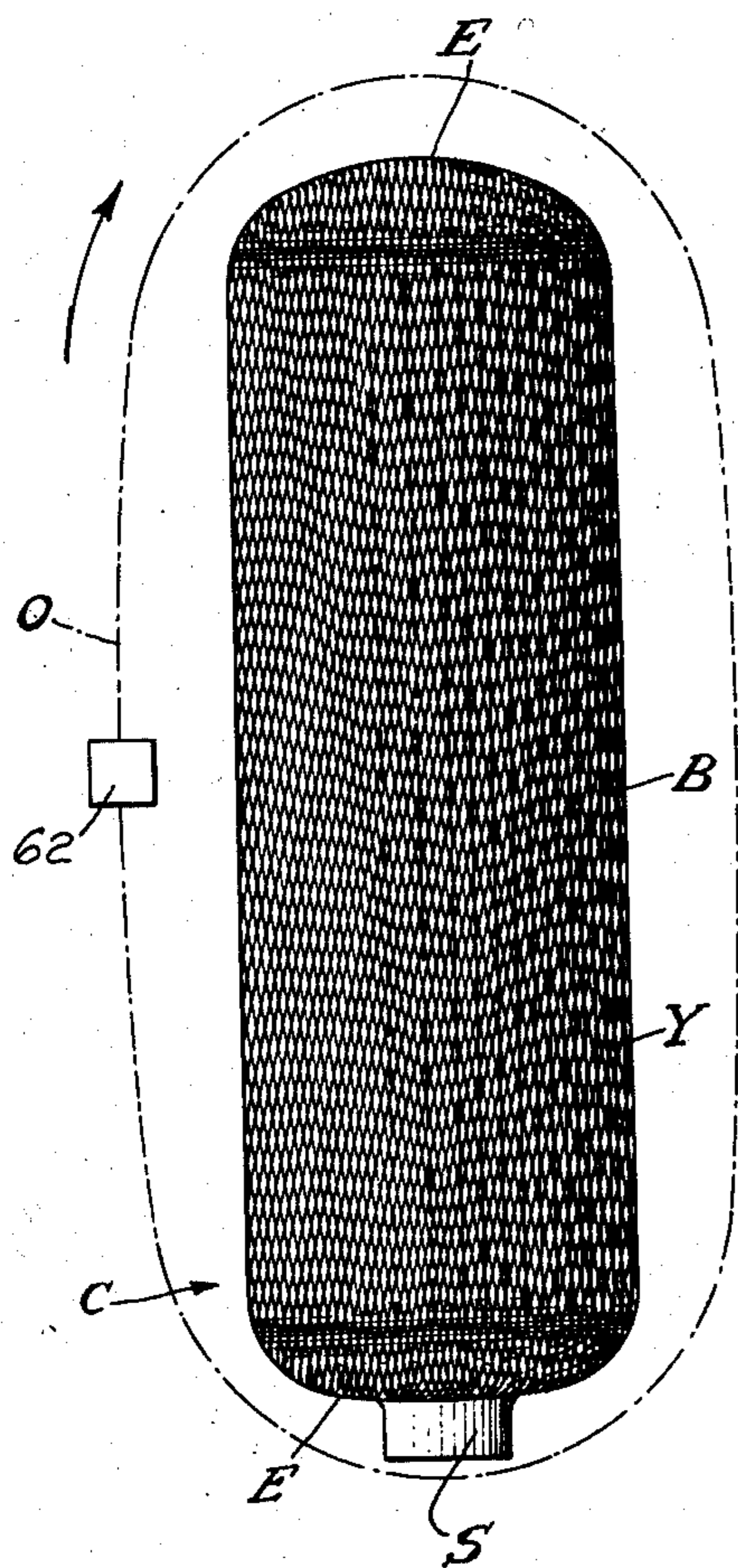
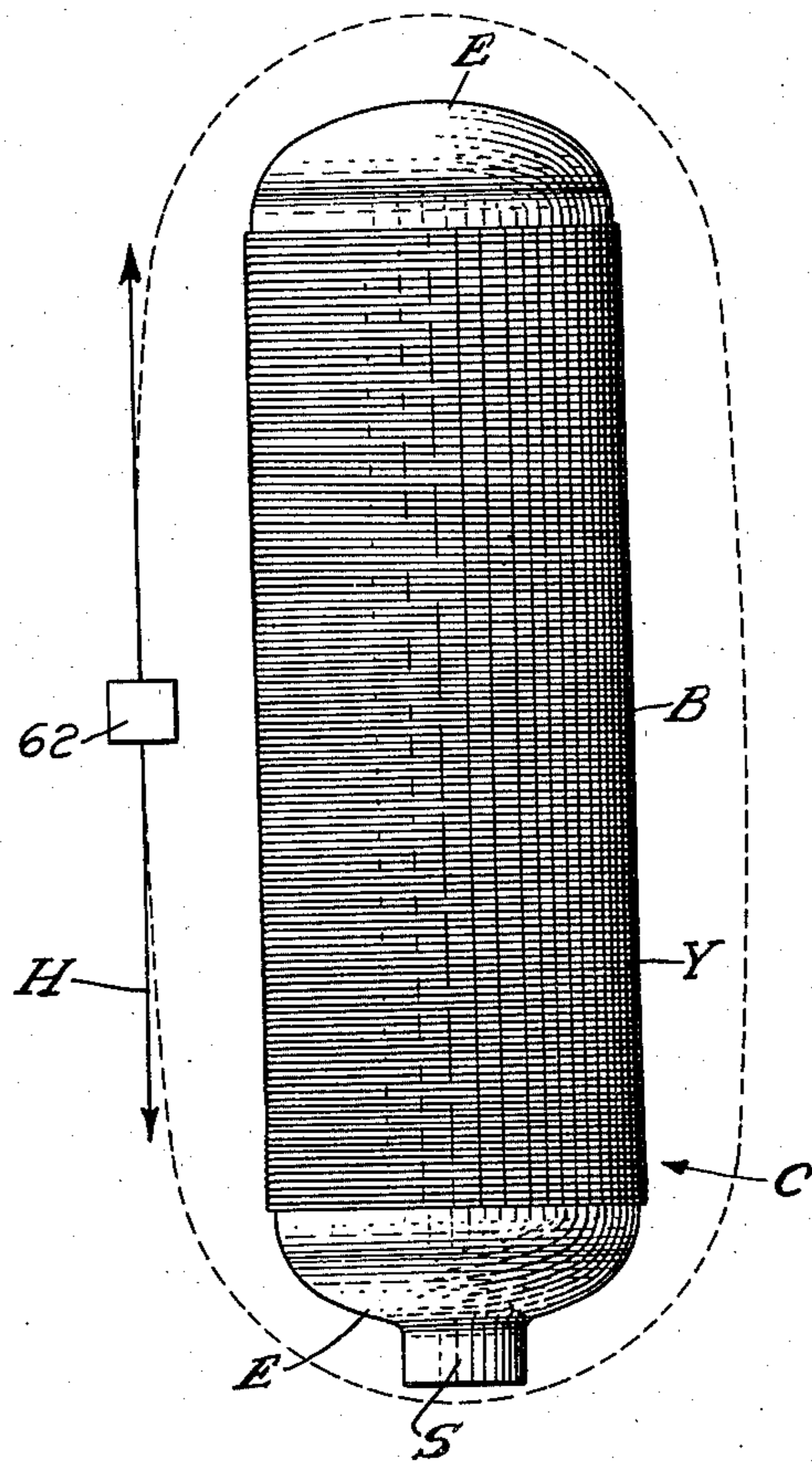


Fig. 2



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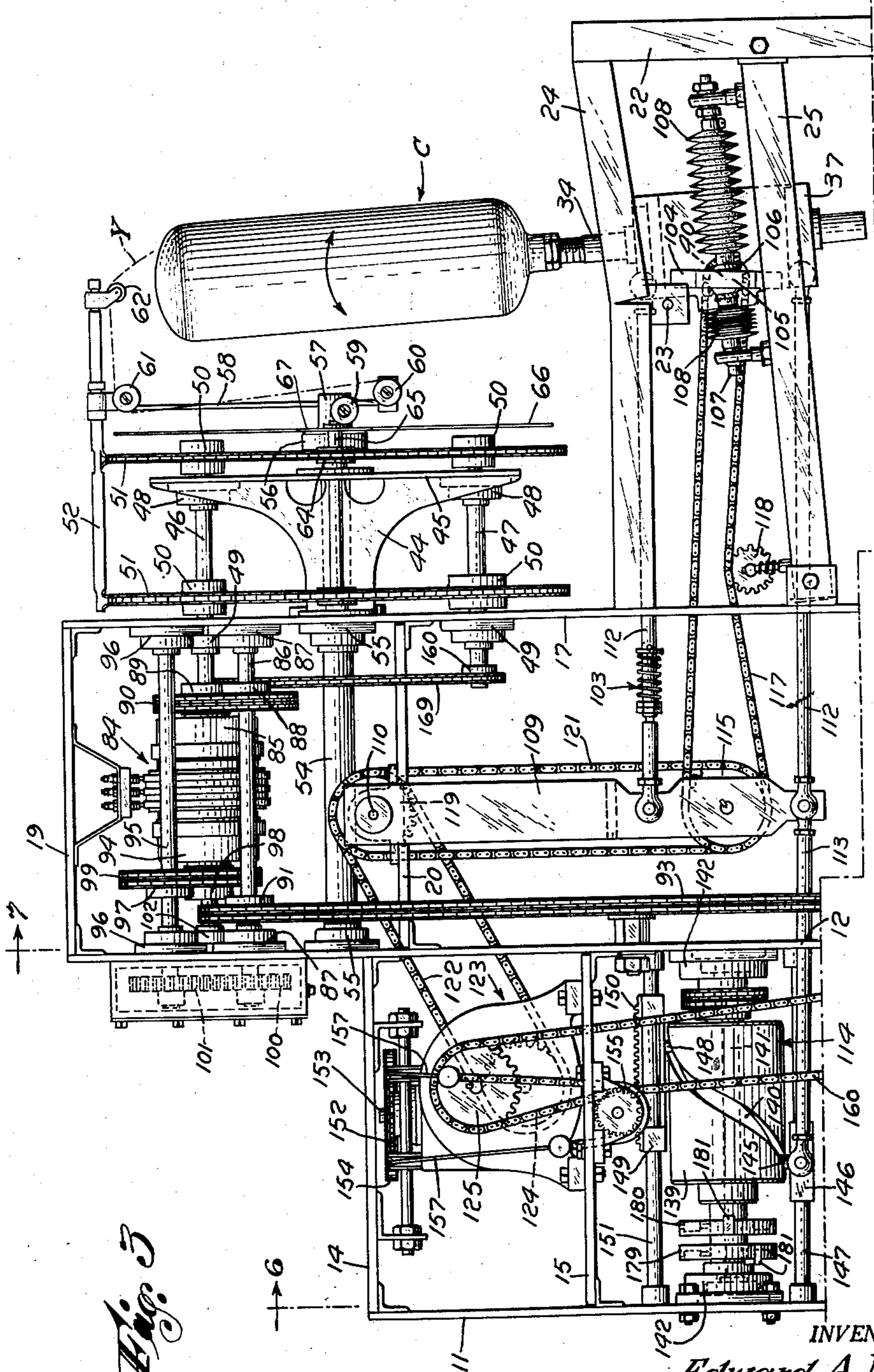


Fig. 3

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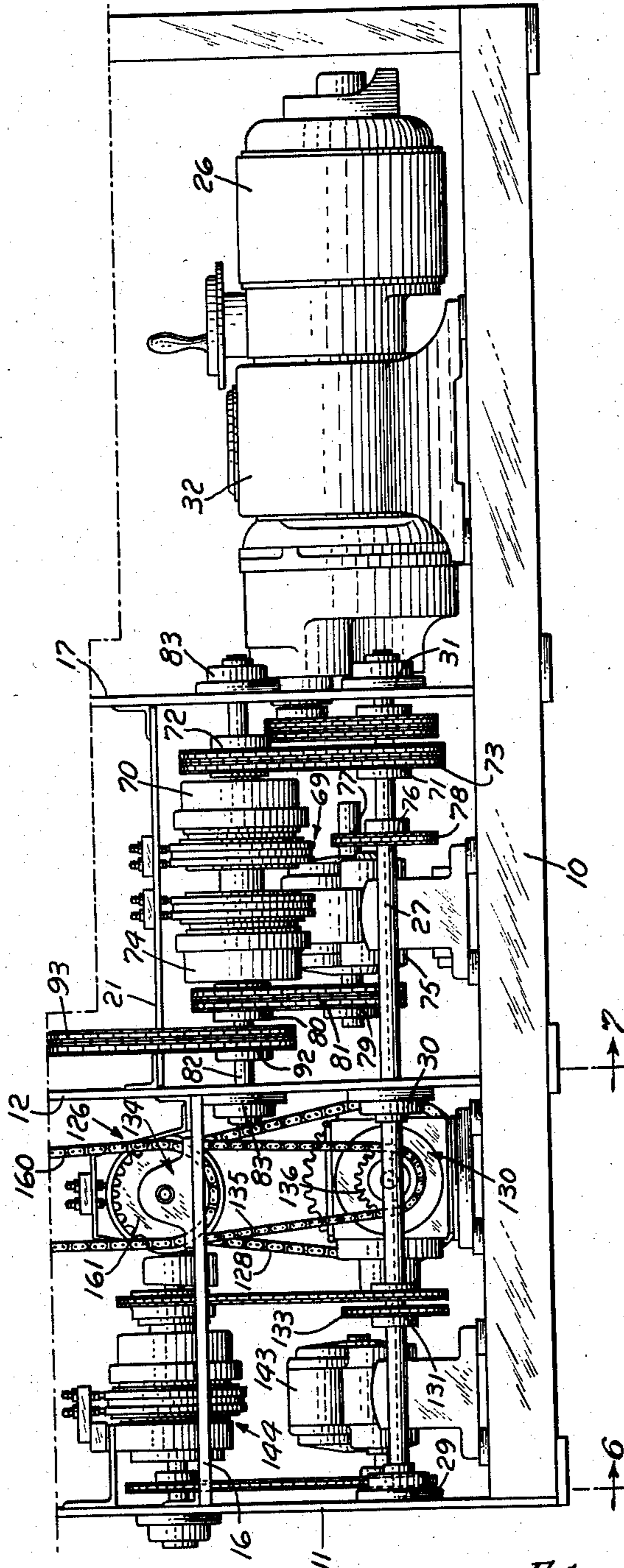
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Fig. 3a



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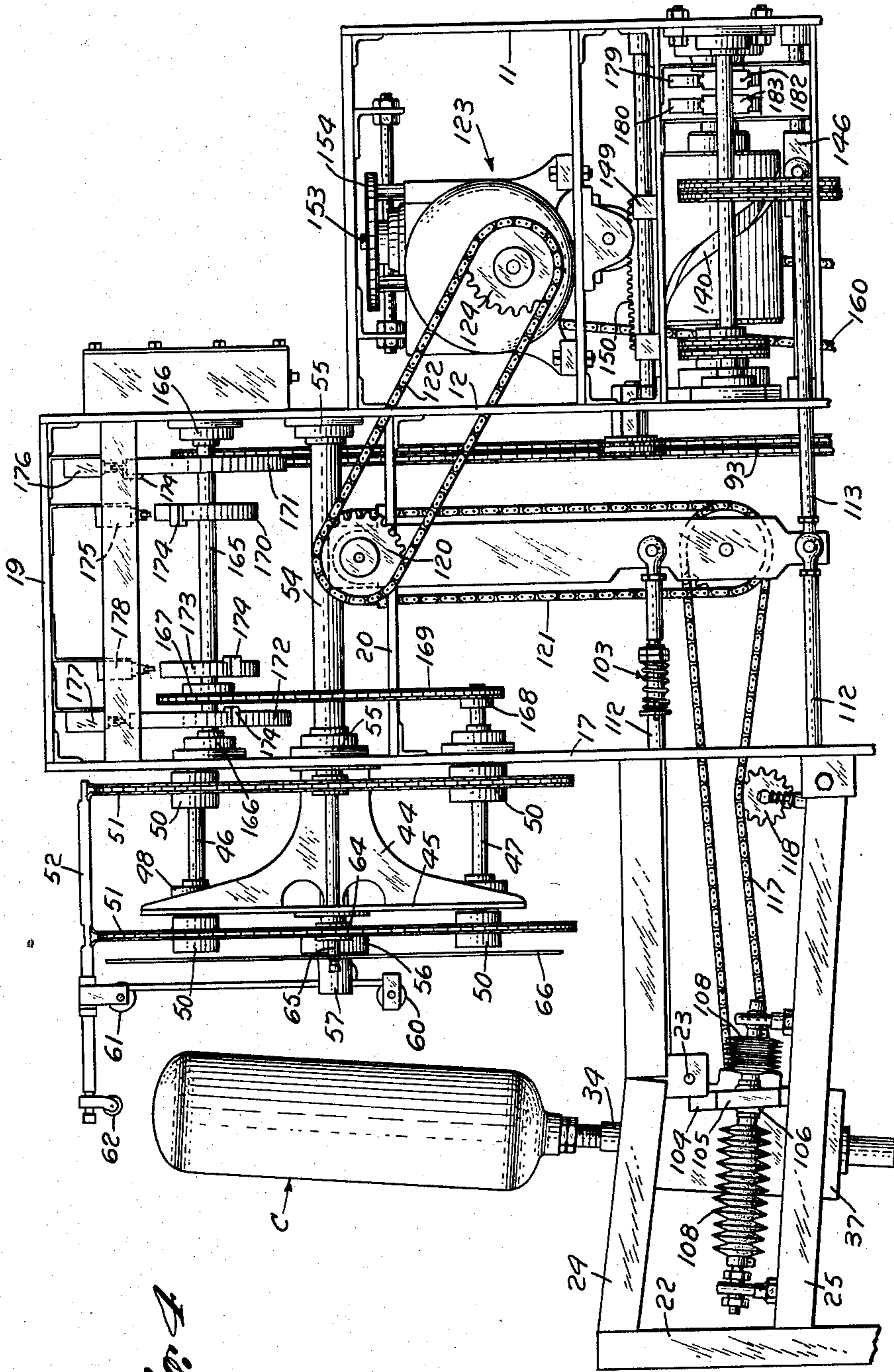


Fig. 4

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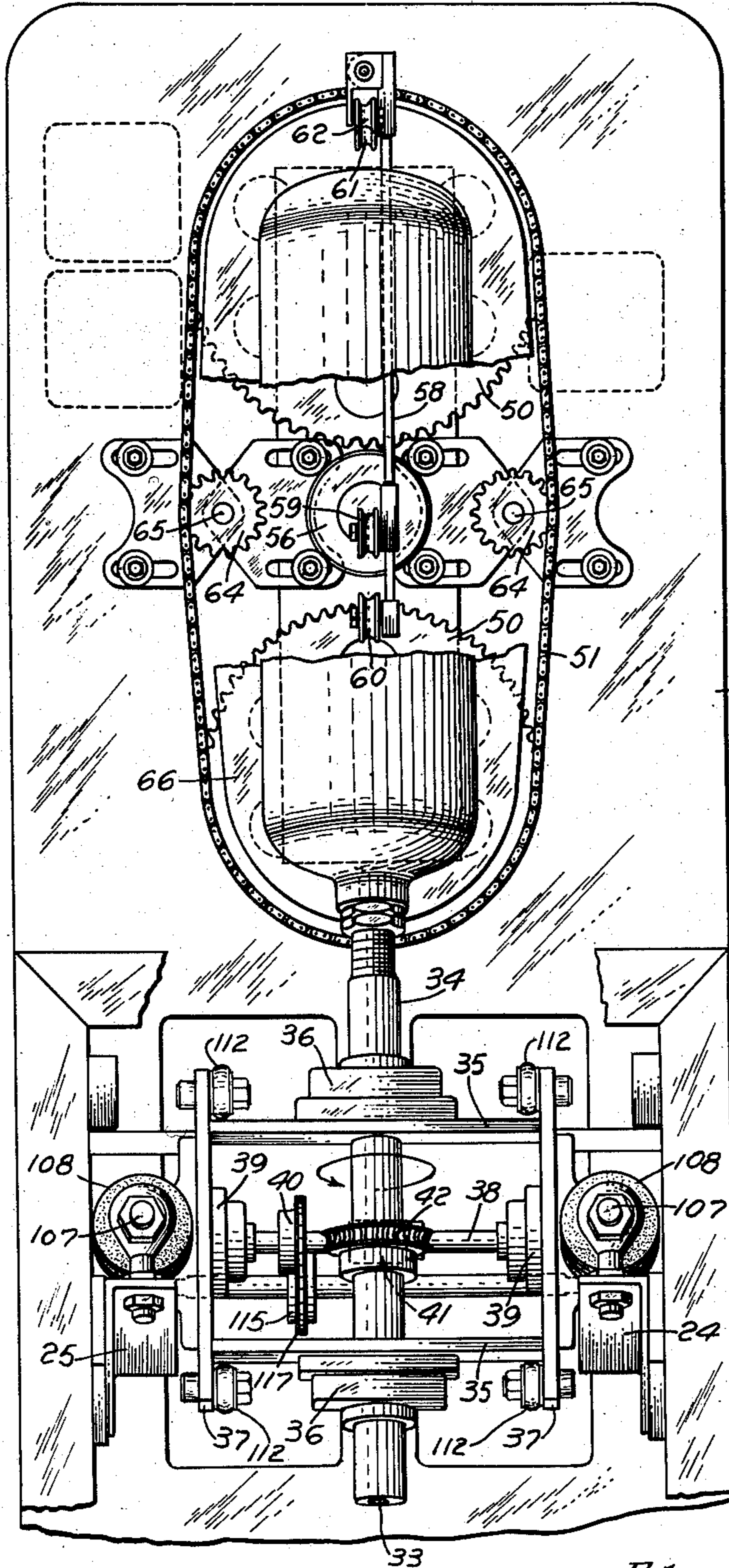
E. A. WENTZ
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Fig. 5



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Fig. 6

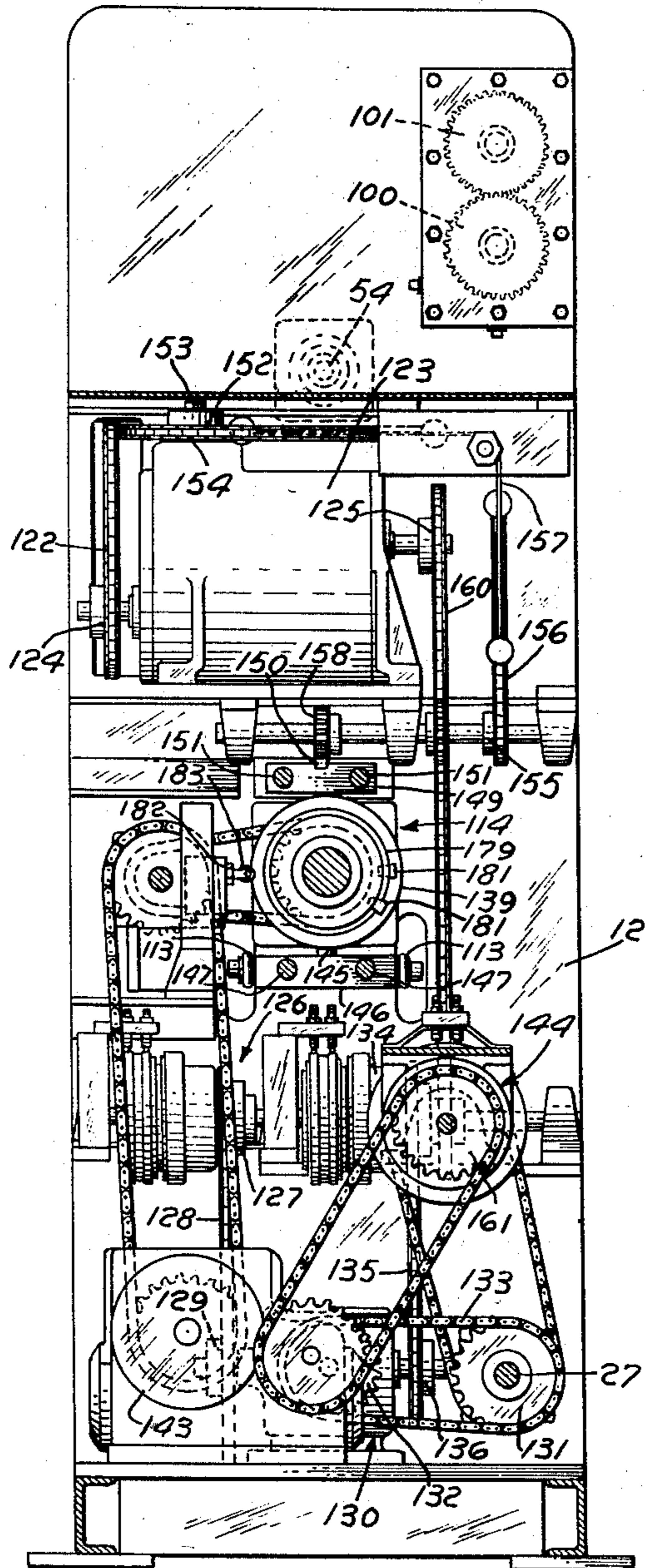
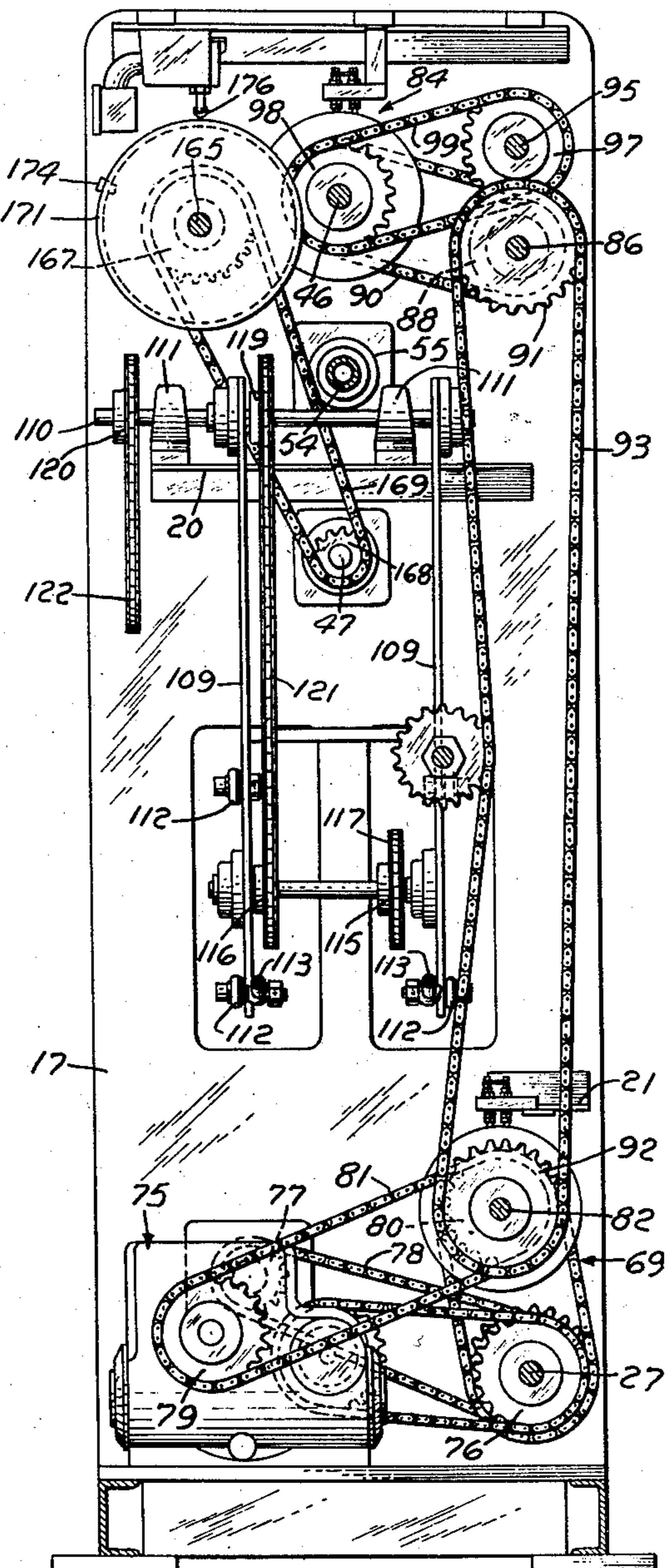


Fig. 7



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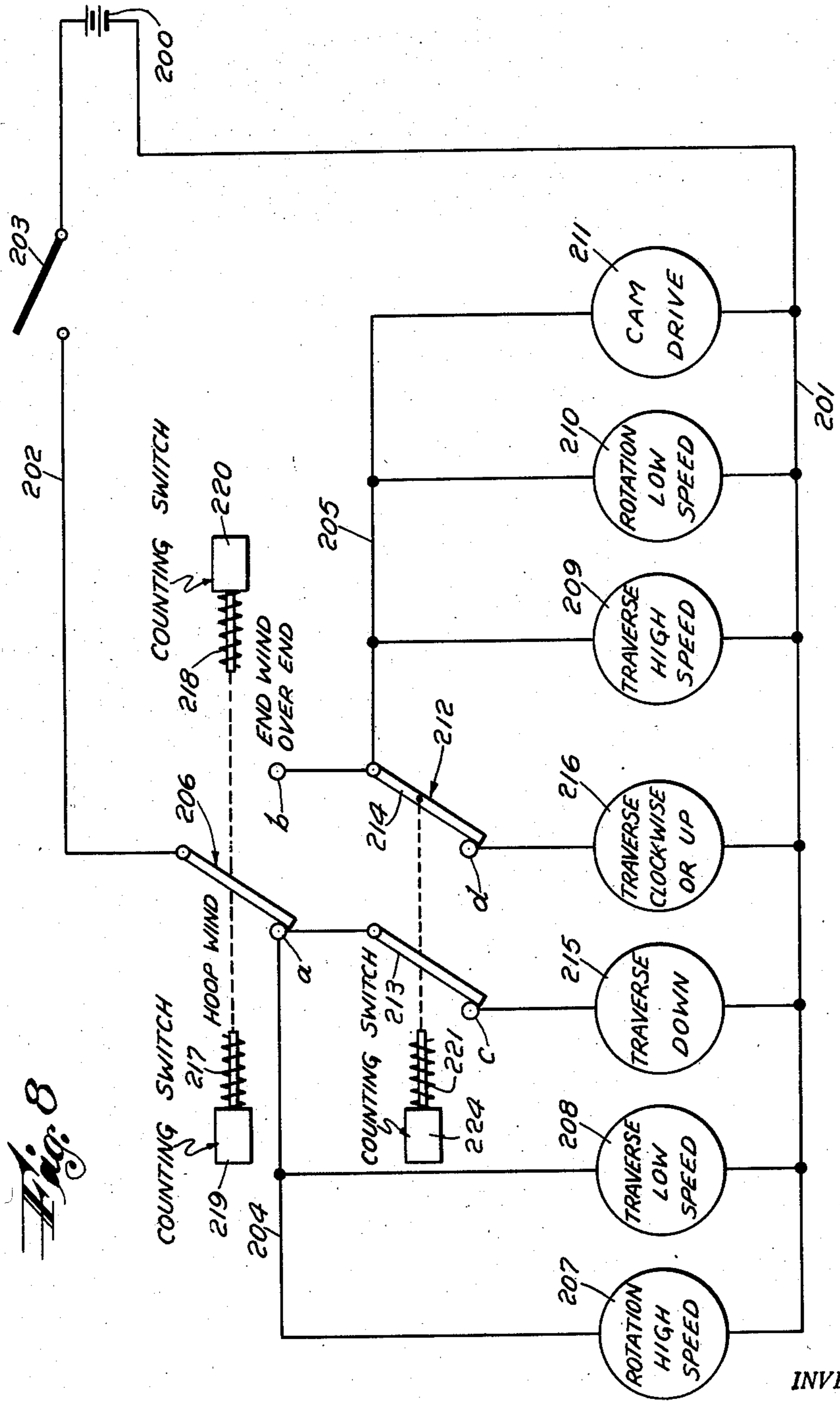


Fig. 8

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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 disturbing 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. 3a is an elevational view of the lower portion of the side of the machine shown in Fig. 3, Figs. 3 and 3a 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.

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

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

5 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, 3a, 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. 3a), 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 passage-way 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, 3a, 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 herein-after, 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. 3a 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, com-

prises a cam drum 139 having a continuous helical groove 140, a shaft 141 for mounting the cam drum for rotation therewith journaled 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. 3a), 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 usage 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 understood 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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