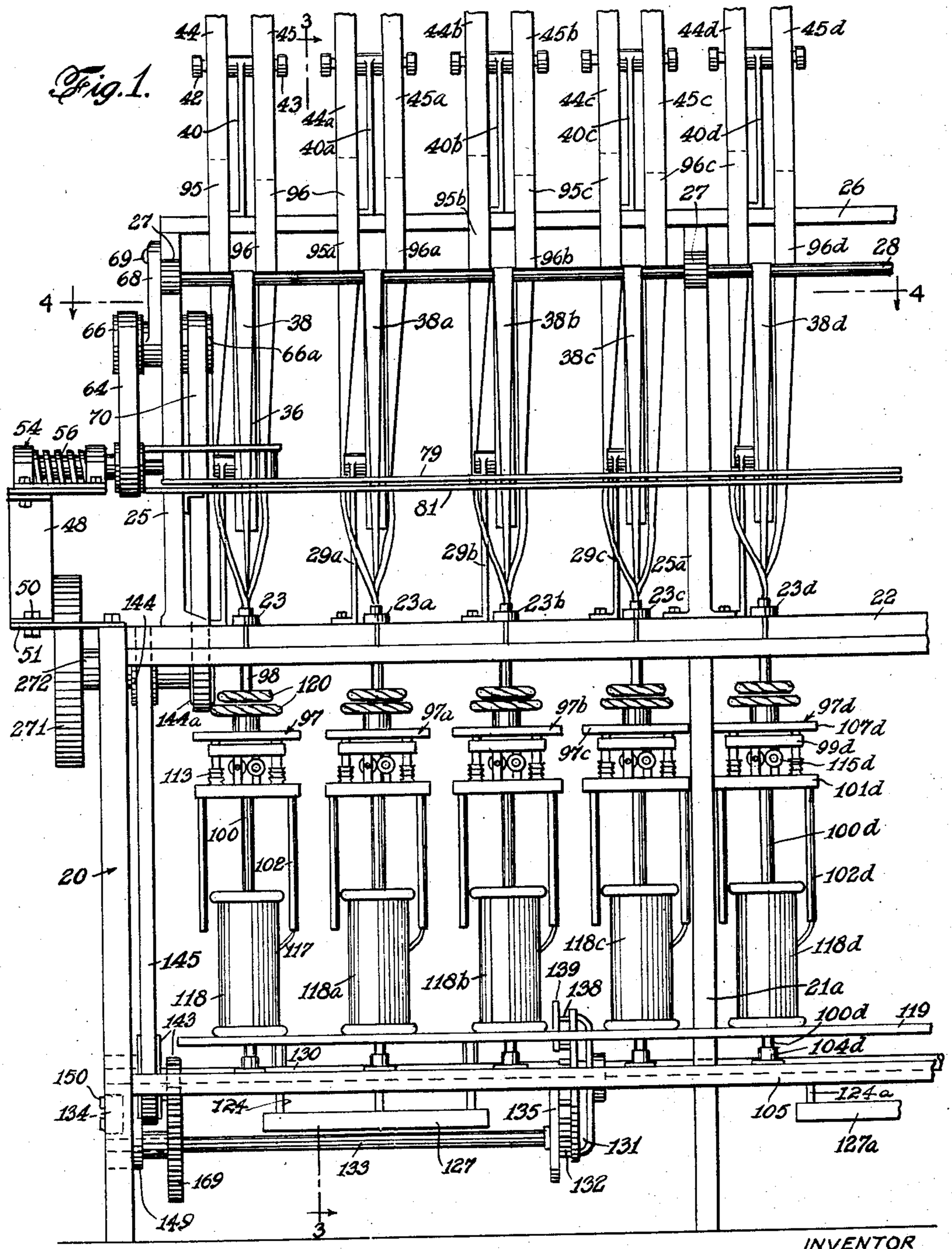
Oct. 25, 1949. E. E. LAMBERT 2,486,037

TWISTED PAPER THREAD AND METHOD OF AND APPARATUS FOR TWISTING THE SAME

Filed Nov. 16, 1946

7 Sheets-Sheet 1

Fig. 1.



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TWISTED PAPER THREAD AND METHOD OF AND APPARATUS FOR TWISTING THE SAME

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Fig. 2.

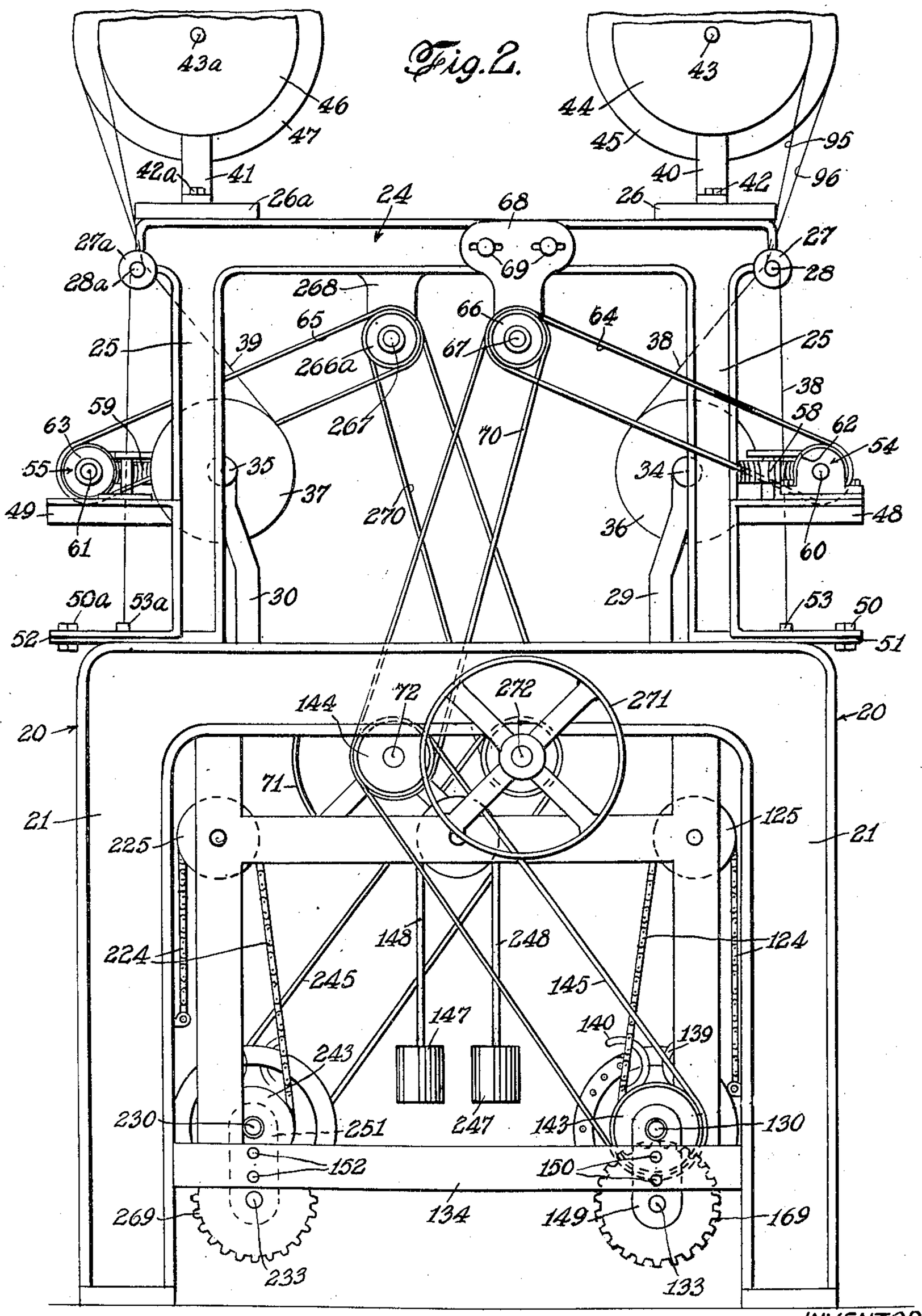

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Fig. 3.

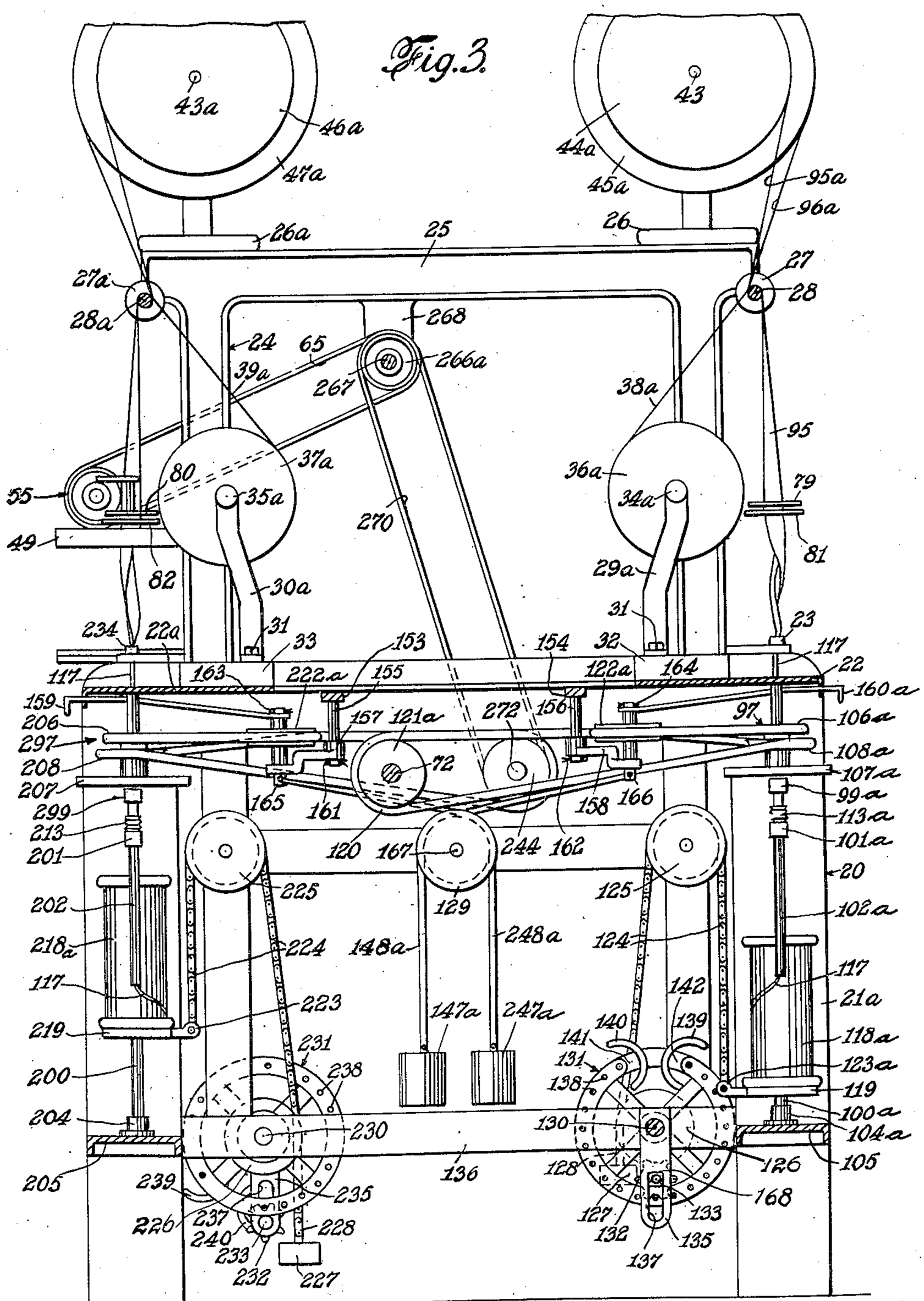

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Fig. 4.

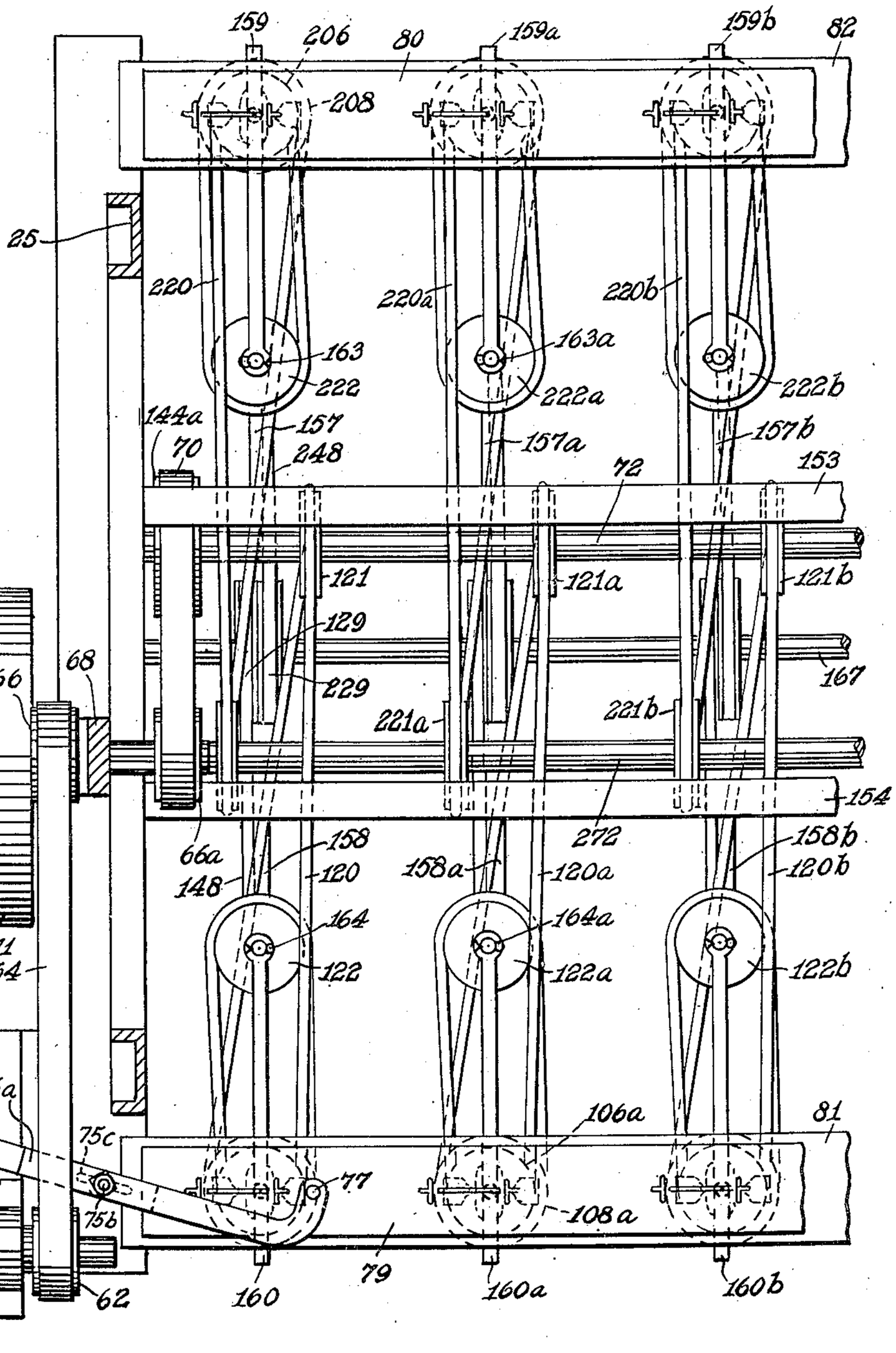

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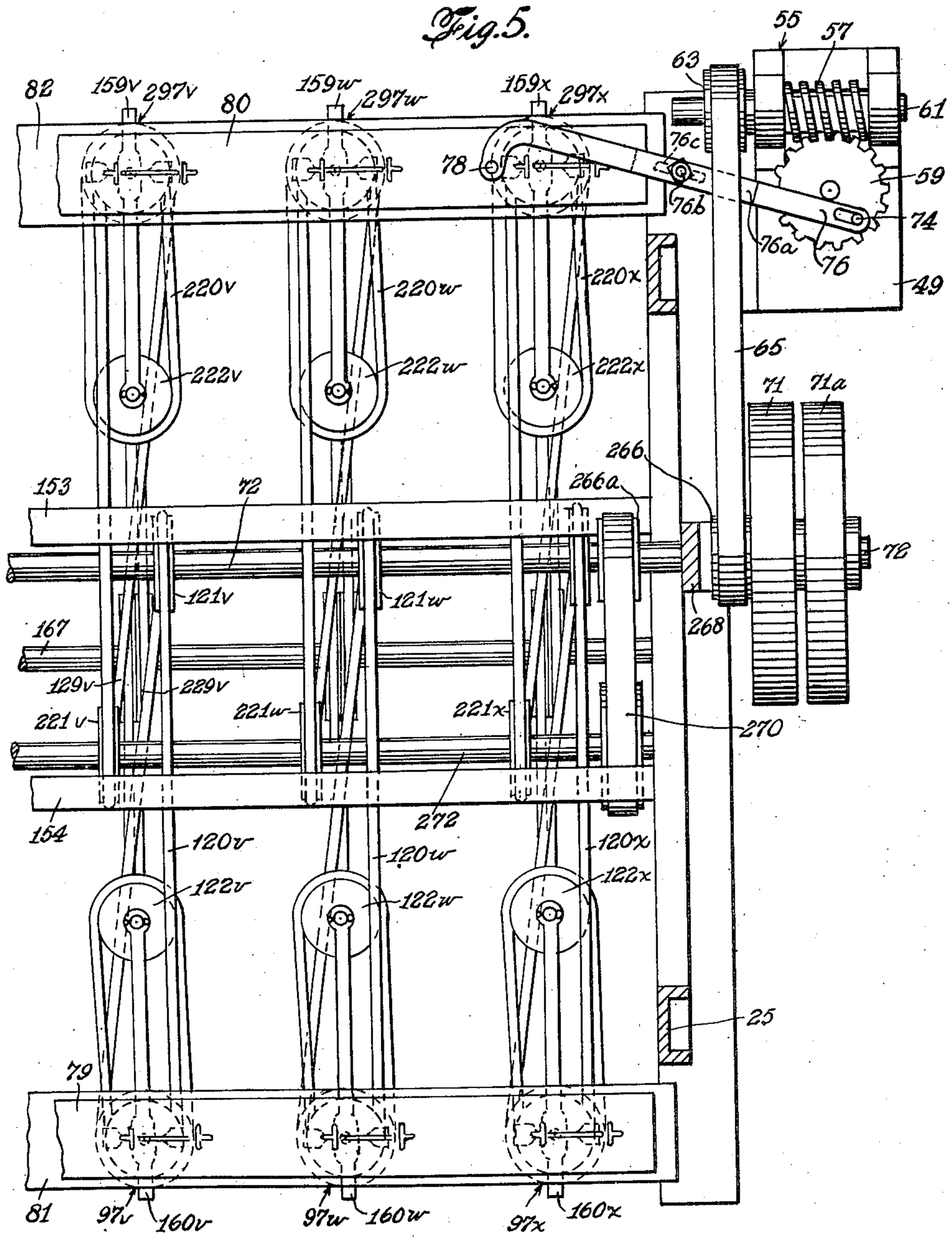
Fig. 5.



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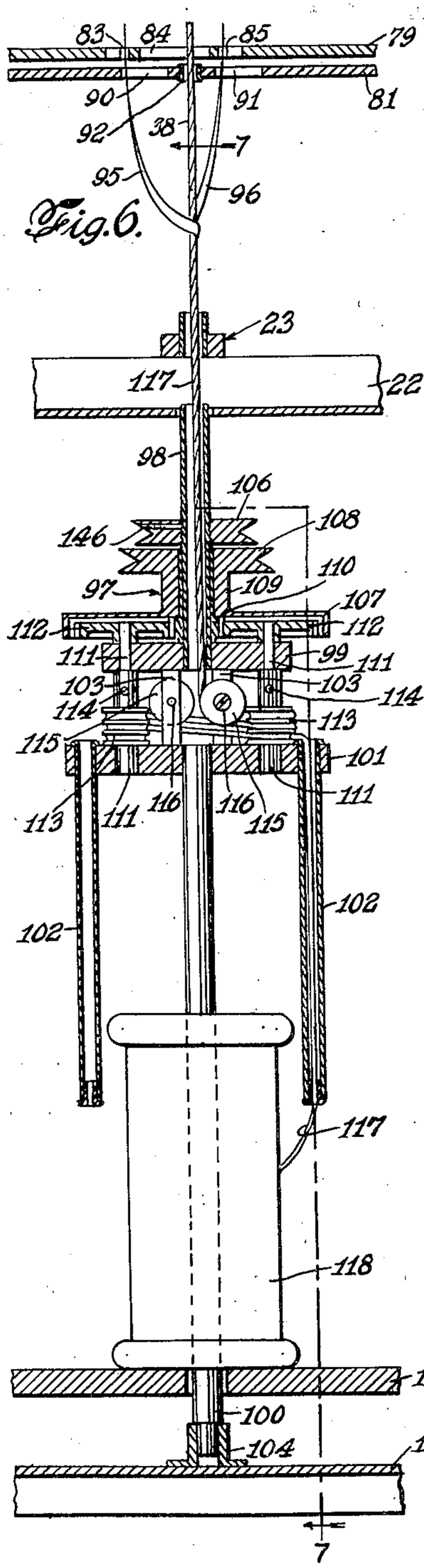

Fig. 6.

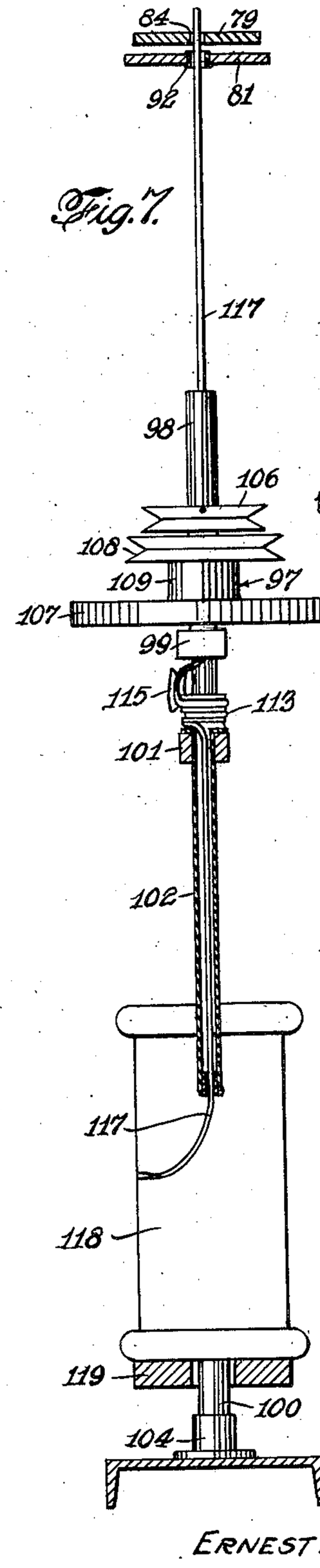

Fig. 7.

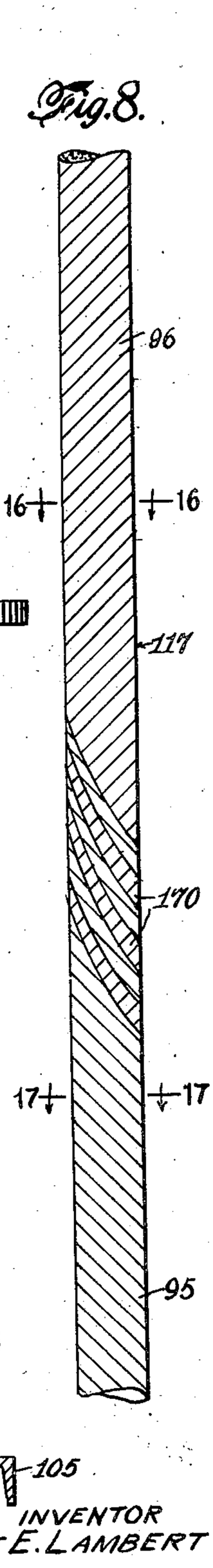

Fig. 8.

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Fig. 9.

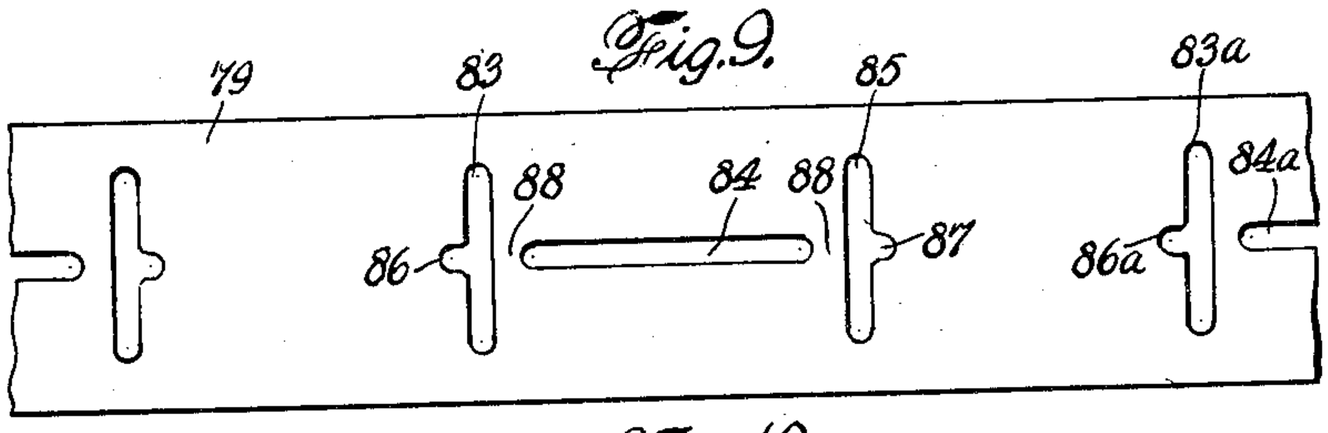


Fig. 10.

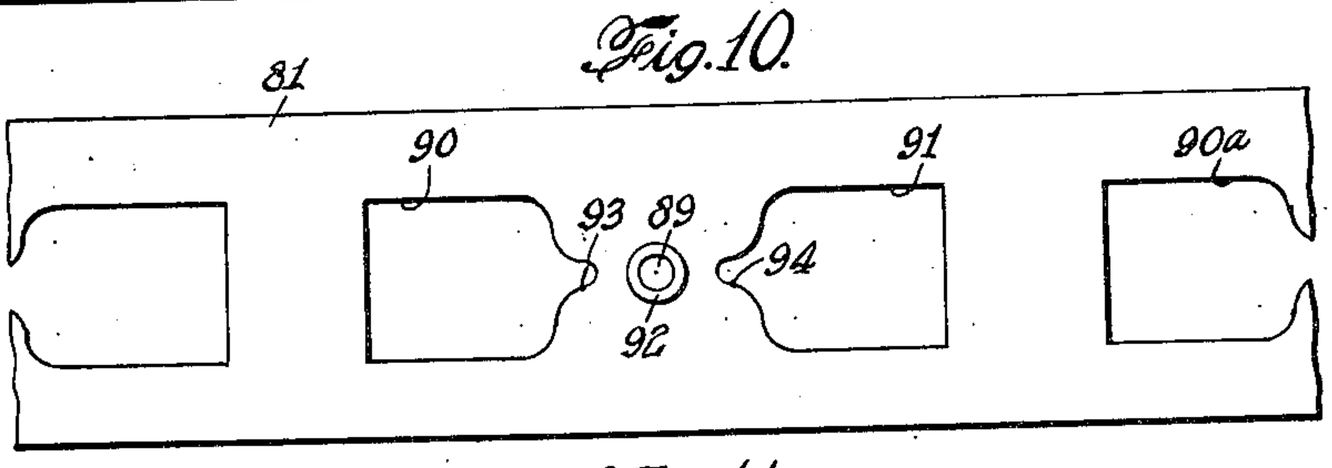


Fig. 11.

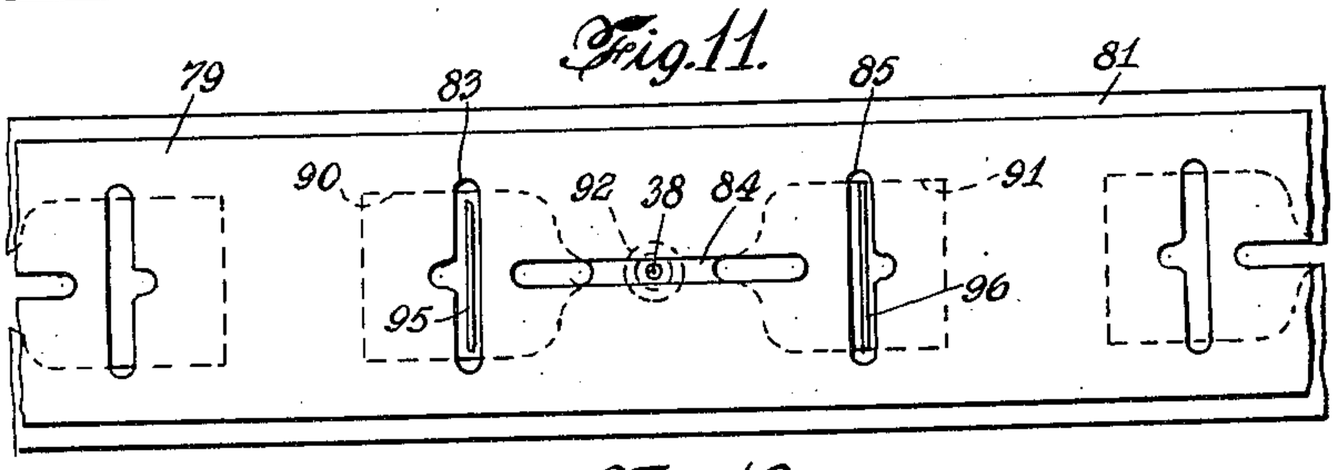


Fig. 12.

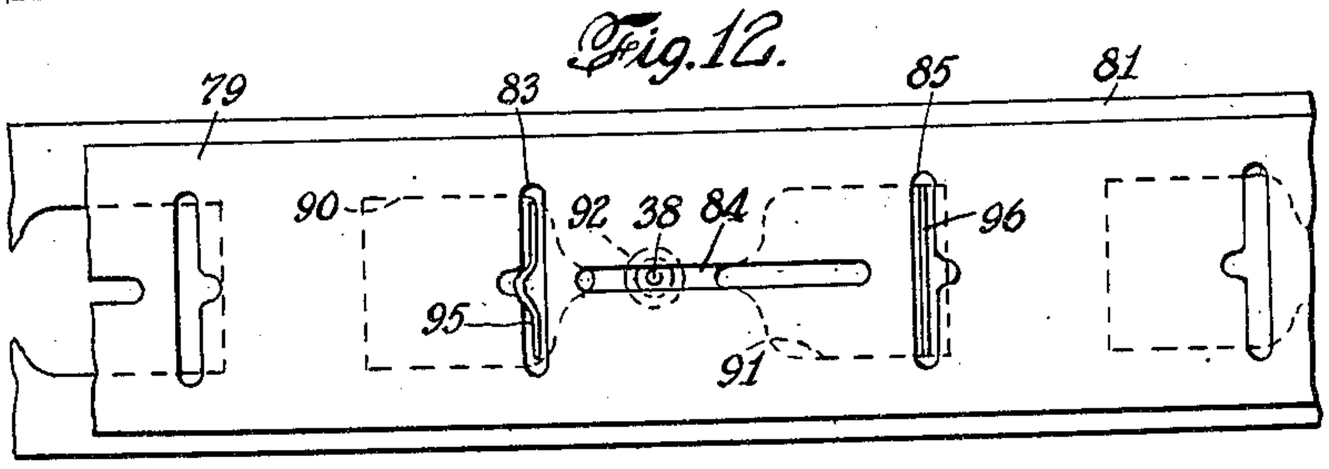


Fig. 13.

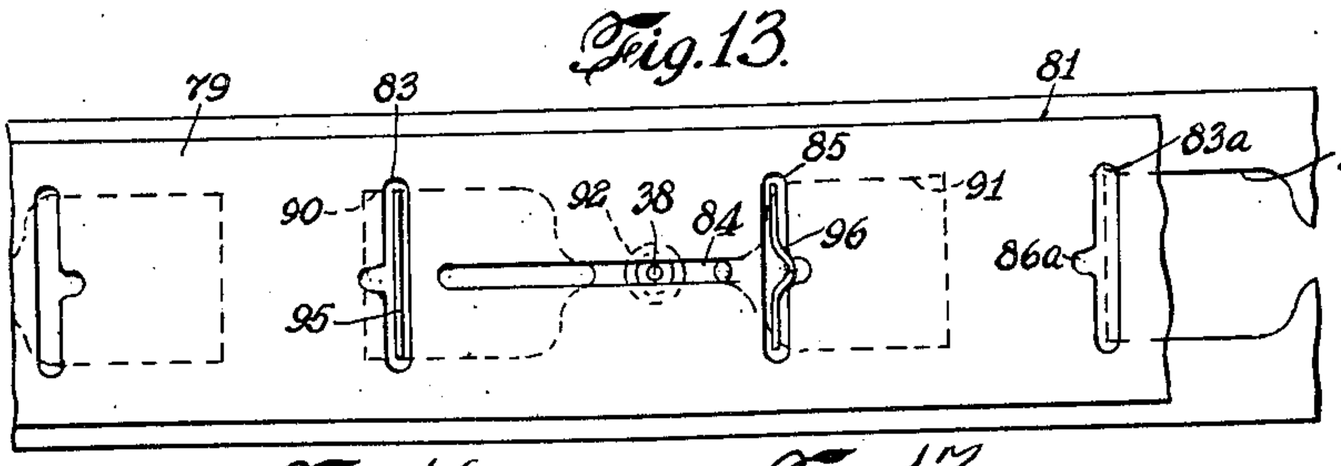


Fig. 14.

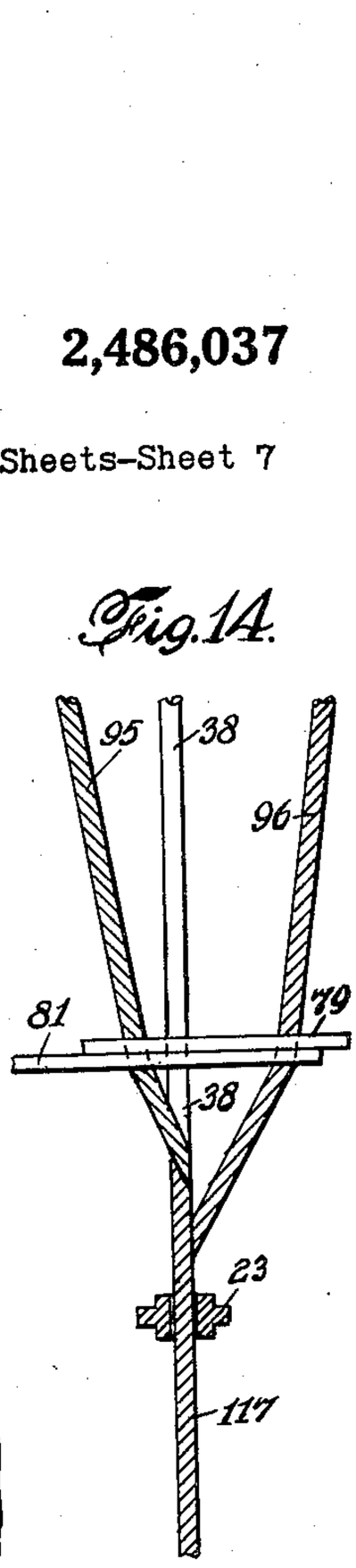


Fig. 15.

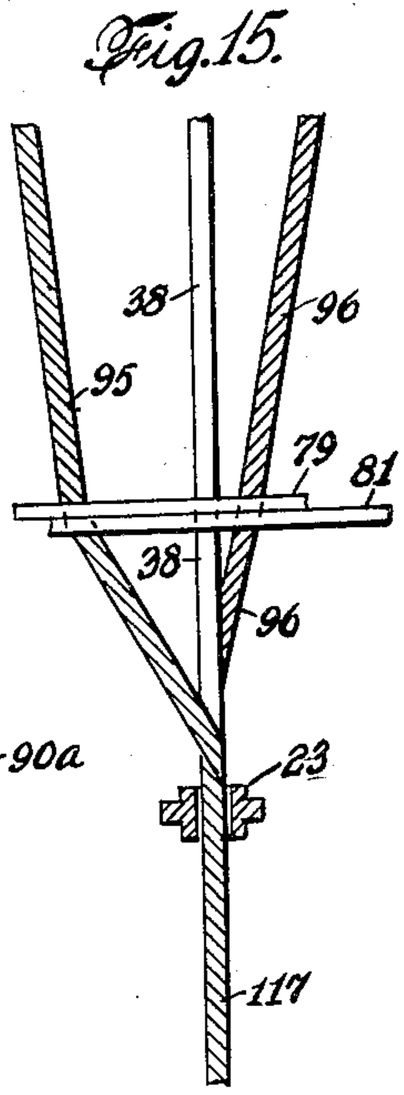


Fig. 16.

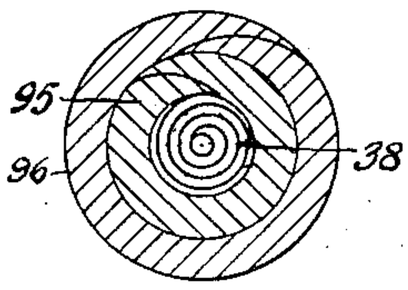
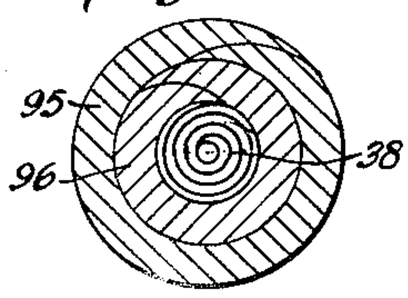


Fig. 17.



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Patented Oct. 25, 1949

2,486,037

UNITED STATES PATENT OFFICE

2,486,037

TWISTED PAPER THREAD AND METHOD OF AND APPARATUS FOR TWISTING THE SAME

Ernest E. Lambert, Springfield, Mass., assignor to Patchogue-Plymouth Mills Corporation, New York, N. Y., a corporation of New York

Application November 16, 1946, Serial No. 710,302

19 Claims. (Cl. 57—31)

This invention relates to twisted paper thread, and to a method of, and apparatus for, twisting the same. The method and apparatus are particularly applicable to the manufacture of variegated threads from paper ribbons of different colors, which threads are subsequently used in the manufacture of textiles, particularly woven paper-fibre rugs, such as are disclosed generally in my co-pending application, now Patent U. S. 2,418,215, issued April 1, 1947.

Heretofore, paper-fibre threads have been formed by twisting paper ribbons together in a twisting machine to fashion a paper thread. Threads of solid color have been formed by twisting ribbons of colored paper. When two paper ribbons of different colors are twisted together, a pencil striped thread is produced.

The use of paper-fibre threads in solid colors and in pencil stripes, necessarily limits the weaver's art in the fabrication of textile fabrics, and more particularly woven paper-fibre rugs, to conventional patterns and optical effects, thus limiting the character of the designs and patterns of the textile fabrics which can be woven with the said paper-fibre threads.

One object of this invention is to substantially increase the usefulness of paper-fibre threads.

Another object is a variegated paper-fibre thread which can be woven into a large variety of novel design effects.

Another object is a variegated paper-fibre thread which can be so woven as to enhance the appearance of the designs and patterns of the resulting textile fabric.

Another object is an improved construction of colored paper thread.

Another object is a new method of twisting paper ribbons together to produce a paper thread of improved construction.

Another object is an improved method of twisting ribbons of colored paper together to produce a variegated paper thread.

Another object is a machine for carrying out my improved method.

Another object is a machine for manufacturing twisted paper thread embodying my improved construction.

Another object is a paper twisting machine of few and simple parts, which is of simple construction, inexpensive to manufacture, easily assembled, and very efficient and durable in use.

With these and other objects in view, there has been disclosed in the accompanying drawings by way of example, one suggested form in which the invention may be conveniently embodied in practice.

In the drawings consisting of seven sheets of seventeen figures, number Figs. 1 to 17, inclusive:

Fig. 1 is a front view of a portion of one side of a twisting frame showing five separate paper twisting spindles;

Fig. 2 is an end view of a portion of the twisting frame;

Fig. 3 is a vertical cross-sectional view of a twisting frame taken along the line 3—3 of Fig. 1, looking in the direction of the arrows;

Figs. 4 and 5 are horizontal cross-sectional views of the opposite ends of a twisting frame, taken along a line substantially as indicated by the line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 6 is a front view partly in cross section of the thread twisting mechanism;

Fig. 6 is a side view of the mechanism of Fig. 6, also partly in cross section;

Fig. 8 is a blown up longitudinal view of a portion of a twisted thread embodying my improved construction;

Fig. 9 is a plan view of a fragment of a guide bar;

Fig. 10 is a plan view of a fragment of a die carrier bar;

Figs. 11, 12 and 13 are fragmentary views showing the guide bar and the die in various positions;

Figs. 14 and 15 are schematic diagrams of the paper-ribbon twisting operation;

Fig. 16 is a blown up cross-sectional view of the twisted thread taken along the line 16—16 of Fig. 8, looking in the direction of the arrows, and;

Fig. 17 is a blown up cross-sectional view of the twisted thread taken along the line 17—17 of Fig. 8, looking in the direction of the arrows.

Like reference characters designate corresponding parts throughout the several figures of the drawings.

The twisting machine includes the usual twisting frame comprising a lower section or pedestal **20** formed by a series of horizontally spaced lower end castings **21**, **21***a*, etc., which are braced by the die shelves **22**. **22***a* (Figs. 2 and 3). A series of lower dies **23** and **234** are bolted to the top of the die shelves **22** and **22***a* at horizontally spaced intervals. The twisting frame also includes an upper section **24** (Fig. 2) formed by a series of upper end castings **25** (Fig. 1) which are also braced at spaced intervals by the top shelves **26** and **26***a*. As best shown in Figs. 2 to 4, the twisting machine is preferably arranged for dual operation.

The holed ears **27** and **27***a* are cast as an integral part of each upper end casting **25**. The end castings **25** are mounted with their holed ears **27** in horizontal alignment to accommodate the smooth guide rods **28** and **28***a*.

The brackets **29** and **30** are bolted at **31** to, or otherwise mounted upon, suitable braces **32** and **33** (Fig. 3) which extend the length of the twisting frame to further brace the lower end castings **21**, **21***a*, etc., of the pedestal **20**. The upper end

of each bracket **29** and **30** may be provided with a hub for accommodating the spindles **34** and **35** whereon the cheeses or rolls **36** and **37** of paper ribbon are removably mounted for free rotation to allow the rolls **36** and **37** to unwind and feed their paper ribbons **38** and **39** over the guide rods **28—28***a* to the die mechanism and the spinners **97** and **297** of the twisting machine. The spindles **34** and **35** may be screwed together through the hubs of the brackets **29** and **30**, and may be enlarged at their free ends with an annular flange or shoulder to prevent the rolls **36** and **37** from slipping off their spindles.

Similarly, the brackets **40** and **41** may be bolted at **42** and **42***a* (Fig. 2) to the top shelves **26** and **26***a* respectively. These brackets may also be provided with hubs adapted to receive the twin spindles **43—43** and **43***a—43a* which screw into the opposite sides of the hubs of their respective brackets and may be enlarged at their free ends to form annular flanges to prevent the rolls **44**, **45**, **46** and **47** from slipping off their respective spindles.

The number of spindles to be associated with each die mechanism will vary according to the number of paper ribbons to be twisted into the thread. Ordinarily the twisted thread will consist of at least three paper ribbons twisted together, hence brackets having sufficient spindles to accommodate at least three rolls of paper ribbon should be provided for each die mechanism. To insure continuous operation of the twisting mechanism it will be found advantageous to equip each die or spinner position with an extra spindle so that the operator can set up a new roll and be ready to replace a roll which is nearly exhausted before its associated paper ribbon runs out. Such an arrangement also leaves both hands free to splice in new paper ribbon without stopping the machine.

Mounted in any suitable manner upon the top of the lower end castings **21** are the adjustable brackets **48** and **49** (Fig. 2). These brackets may be of any preferred shape, but in the drawings a pair of U-shaped brackets are shown, which may be adjustably secured by the bolts **50** and **50***a* to their respective plates **51** or **52**, which are bolted at **53** and **53***a* to the end casting **21**. The brackets **48** and **49** form a suitable support for the driving heads **54** and **55** (Figs. 2, 4 and 5) which consist of the worm gears **56** and **57** (Figs. 4 and 5) meshing with the toothed gears **58** and **59**. The shafts **60** and **61** of the worm gears **56** and **57** are journalled in suitable bearings. The pulleys **62** and **63** which are keyed to the shafts **60** and **61**, are driven by the endless belts **64** and **65** (Figs. 2, 4 and 5) which pass around the twin pulleys **66—66***a* and **266—266***a* keyed on the common shafts **67** and **267** the ends whereof are respectively journalled in the hubs of suitable bracket bearing **68** and **268** (Fig. 2) which are bolted at **69** and **269** to the front and rear upper end castings **25—25**.

The conventional twisting frame is of the dual type and is equipped with two rows of spinners **97** and **297**, one arranged along the front and the other along the rear of the twisting frame. All of the spinner mechanism may be driven from one common drive shaft, or the front and rear sides or sections may be driven separately, so that one side of the twisting frame may be operated independently of the other. In the drawings a twisting frame of the dual type with each side independently driven is shown. It consists essentially of two independently driven

main drive shafts **72** and **272** (Figs. 2, 4 and 5) extending lengthwise of the machine in parallel spaced relation. Each shaft is journalled at spaced intervals in Babbitt or other suitable bearings carried by the spaced lower end castings **21—21***a*. etc., of the pedestal **20**.

A main drive pulley **71** is keyed to the main drive shaft **72** (Figs. 5 and 2) while a free pulley **71***a* is also carried by the shaft **72**. A suitable main drive belt and belt shifter (not shown) couples the main drive pulley **71** to a suitable main drive shaft which may be of the overhead type. The main drive shaft **72** may (if preferred) be driven by means of an electric motor, or in any other way.

Similarly, a main drive pulley **271** is keyed to the main drive shaft **272** (Figs. 4 and 2) while a free pulley **271***a* is also carried by the shaft **272**. A suitable main drive belt and belt shifter (not shown) may be used to couple the main drive pulley **271** to a suitable main drive shaft which may also be of the overhead type.

For convenience of operation the main drive pulleys **71** and **271** may be keyed to their respective shafts **72** and **272** at opposite ends of the twisting frame (compare Figs. 2, 4 and 5). The twin pulleys **144** and **144***a* are keyed to main shaft **72** (Fig. 4) and the twin pulleys **244** and **244***a* are keyed to main shaft **272** (Fig. 5). One of the twin pulleys **144** (Fig. 4) is coupled to one of the twin pulleys **66** by means of the belt **70** to drive the belt **64** which in turn drives the driving head **54** which actuates guide bar **79** as hereinafter described. Similarly, one of the twin pulleys **244** (Fig. 5) is coupled to one of the twin pulleys **266** by means of the belt **270** to drive the belt **65** which in turn drives the driving head **55** which actuates guide bar **80** as hereinafter described. For convenience of operation the driving heads **54** and **55** may be arranged at diagonally opposite corners of the twisting frame.

Each toothed gear **58** and **59** is fitted with a stud **73** or **74** (Fig. 4), which is set between the center and the circumference of the gear. One end of each adjustable connecting rod **75** or **76** is slotted to fit over one of the studs **73** or **74**, while the opposite bent end of each rod is suitably pivotally connected at **77** or **78** to one of the guide bars **79** or **80** which are slidably supported between the upper end castings **25**, to oscillate lengthwise of the twisting frame relative to their associated upper die carriers **81** and **82**. The connecting rods **75**, **75***a* and **76**, **76***a* are made in two pieces which are relatively movable to effect changes in length adjustment by means of slots **75***c*, **76***c*, and the nuts and bolts **75***b*, **76***b*.

As best shown in Fig. 9, each guide bar **79** or **80**, is provided with a series of sets of elongated slotted openings **83**, **84** and **85**. The number of slotted openings **83** to **85**, in each set of the series will depend upon the number of paper ribbons which are to alternately constitute the covering ribbons of the twisted thread (Fig. 8). Thus if two covering ribbons are used, each set of openings may conveniently consist of three slotted openings. It should be understood however that the number of slotted openings in each set may vary dependent upon the number of paper ribbons to be used as the covering ribbons. The slotted openings **83** and **85** which extend across the guide bar **79** to receive the covering ribbons, are separated by the slotted opening **84** extending lengthwise of the guide bar to accommodate the core or stuffer ribbon. The length of the slot **84** and the spacing between the slots **83** and **85**

may vary according to the extent of relative movement of the guide bar 79 or 80 with respect to its upper die carrier 81 or 82 (Fig. 10). Each slotted opening 83, 84 and 85 is large enough to freely accommodate a paper ribbon. The outer edges of the transverse openings 83 and 85 may be prolonged as indicated at 86 and 87 to curl the covering ribbons as the curling opening 86 or 87 moves towards the die 89 in the die carrier 81 (Fig. 10).

The metal wall or web 88 which separates the slotted opening 84 from the slotted openings 83 and 85 is preferably made very narrow in width thus bringing the covering ribbons closer to the die 89 (Fig. 10) through which the stuffer ribbon is drawn and twisted.

The die carriers 81 and 82 are also provided with a series of sets of openings 89, 90 and 91 (Fig. 10). The number of openings 89 to 91 in each set of the series may equal the number of slotted openings 83 to 85 in each set of openings in the guide bar 79 and 80. The opening 89 conforms substantially to the shape of a cross section of the twisted thread which is generally circular or substantially so. To protect the paper ribbon against injury a porcelain bushing or tubular insert 92 may be fitted into the opening 89. When porcelain inserts are used the opening 89 may be threaded to receive the male threaded stem of the porcelain bushing. The tubular inserts 92 are removable and may be quickly renewed when damaged cr worn. This arrangement is very satisfactory because it increases the useful life of the die carriers indefinitely insofar as erosion due to abrasion occasioned by the passage of the twisting stuffer ribbon is concerned.

The shape of each of the apertures or openings 90 and 91 may be substantially as indicated in Fig. 10. Each opening as shown is substantially square on three sides, but tapers as it approaches the die 89 to form a rounded point 93 or 94 which cooperates to fold and open the covering ribbons 95 and 96 as the slotted openings 83 and 85 (Figs. 12 and 13) move towards and away from the die 89, of the die carrier 81.

The guide bars 79 and 80 are longitudinally slidably mounted upon their associated upper die carriers 81 and 82 so that each set of elongated openings 83 to 85 in the guide bar 79 is in cooperative registry with its corresponding die 89 and the apertures 90 and 91 in the die carrier 81 (compare Figs. 4, 6 and 11). The paper ribbons 95, 38 and 96 of the rolls or cuts 44, 36 and 45 are separately threaded through the slotted openings 83, 84 and 86 respectively, in the guide bar 79, through the corresponding aperture 90, die 89 and aperture 91 in the upper die carrier 81, the ribbons 95, 38 and 96 are then collectively threaded through the lower die 23 which is disposed in vertical alignment beneath the porcelain bushing 92, and finally enter the thread twisting mechanism or spinner head 97 (Figs. 1 and 6).

The spinner 97 (Figs. 6 and 7) for twisting the ribbons into the finished thread, for drawing the finished thread, and for winding it upon the bobbin or spool, may for convenience of description be divided into two parts, the twisting-winding mechanism and the drawing mechanism or capstan assembly.

The twisting and winding mechanism or spinner 97 (Figs. 6 and 7) includes the hollow top spindle 98 which is attached to the hub of the upper capstan bar 99, and the bottom spindle 100 which is attached to the hub of the lower capstan bar 101. The hollow legs 102 are also attached to

the opposite ends of the lower capstan bar 101. The vertical webs 103 join the upper capstan bar 99 to the lower capstan bar 101, so that the top spindle 98 and the bottom spindle 100 which are respectively journalled in the die shelf 22 and the cupped bearing 104 attached to the fixed frame 105, revolve in unison about a vertical axis. The spindles and capstan bars are revolved by the top pulley 106 which may be secured to the top spindle in any suitable way, preferably by a female and a male threaded connection supplemented by the set screw 146 (Fig. 6).

The capstan assembly comprises the flyer top or gear cover 107, the bottom pulley 108 which is press fitted on the hub 109 of the gear cover, and a central gear 110 which is secured within the gear cover in axial alignment with the hub 109. The capstan assembly is mounted to rotate freely about the top spindle 98. The capstan proper includes two spindles 111 which are journalled in the upper and lower capstan bars 99 and 101 and project upwards through the upper capstan bar to receive and mount the spindle gears 112—112 which mesh with the central gear 110 of gear cover 107. The grooved pulleys 113 are pinned at 114 to the spindles 111 so that when the bottom pulley 108 revolves the capstan assembly about the top spindle 98 of the spinner, the central gear 110 revolves both spindle gears 112 in the same direction to rotate their respective grooved pulleys 113. The pulleys 113 are provided with a series of annular grooves which are of sufficient depth to accommodate the twisted thread. The fibre pulleys 115 are rotatably mounted upon the vertical webs 103 by means of the spindle screws 116. The pulleys 115 which are preferably made of fibre or the like, are grooved to receive the twisted thread 117, which is drawn through the axial duct formed in the tubular top spindle 98, through the hubs of the gear cover 107 and of the central gear 110, and around one of the fibre pulleys 115 by the rotary movement of the grooved pulleys 113 around whose annular grooves the finished thread 117 is spirally wound. The finished thread passes off the bottom groove of one of the grooved pulleys 113 into one of the hollow legs 102, thence around the bobbin 118 which rests upon the builder bar 119 and is free to turn on the bottom spindle 100, about a vertical axis.

The friction between the bottom of the bobbin 118 and the builder bar 119 upon which it stands causes the bobbin to turn more slowly than the spinner 97 and its hollow legs 102, thus drawing the finished thread 117 taut around the bobbin 118.

The spinners 97 to 97x on the front side 105 of the twisting frame, and the spinners 297 to 297x on the rear side 205 of the twisting frame (Figs. 3 to 5) are driven from their respective main drive shafts 72 and 272 in the following manner: Keyed to the main drive shaft 72 are a series of grooved pulleys 121 (Fig. 4) through to 121x (Fig. 5). Similarly, a series of grooved pulleys 221 to 221x are keyed to the main drive shaft 272. The grooved pulley 121 keyed to shaft 72, and the grooved pulley 221 keyed to the shaft 272 are arranged in staggered relation to receive their associated endless belts 120 and 220 which may be of cotton rope. The other grooved pulleys of the 121 series which are keyed to the shaft 272 are likewise paired in staggered relation to receive their associated endless belts 120, 220, etc. Each belt 120, 220, etc., is independently tensioned and controlled by means of a separate tension

pulley 122, 222 and its associated counterweight 147, 247, etc.

Extending for the full length of the twisting frame, and suitably supported by the lower end castings 21, 21*a*, etc., are a pair of longitudinally spaced spindle carrier bars 154, 153 (Fig. 3), from which two separate series of spindles 156 and 155 depend in spaced relation, there being one spindle 156 to 156*x* for each spinner 97 to 97*x*, and one spindle 155 to 155*x* for each spinner 297 to 297*x* (Figs. 4 and 5).

A pulley bracket 158 is mounted to swing freely upon each spindle 156, and the spindle of each tension pulley 122 is journalled between the bearing provided by its pulley bracket 158 and its individual releasing rod 160. Each releasing rod 160 is slidably supported through a slotted opening formed in the die shelf 22. A cotter pin 162 retains the pulley bracket 158 upon its spindle 156. Similarly, a cotter pin 164 retains the pulley spindle attached to its releasing rod 160. The lower end of the pulley spindle which extends below bracket 158, contains a hole 166 through which one end of the cable 148 may be suitably anchored. The cable 148 passes over a free pulley 129 which is attached to the counterweight 147. The pulley 129 is mounted to rotate freely upon the common shaft 167 which extends for the entire length of the twisting frame.

The counterweight 147 normally tends to tension the cable 148 to swing the bracket 158 about the spindle 156, thus tending to pull the tension pulley 122 away from the pulleys 106 and 108 of the spinner 97. When the releasing rod 160 is pulled outwards through the slotted opening in the front edge of the die shelf 22, tension pulley 122 swings towards the pulleys 106 and 108 thus drawing up cable 148 to lift counterweight 147.

Upon the rear side 205 of the twisting frame a pulley bracket 157 is mounted to swing freely upon a spindle 155, and the spindle of the tension pulley 222 is journalled between the bearings provided by the pulley bracket 157 and the releasing rod 159 which is slidably supported through a slotted opening in the die shelf 22*a*. Cotter pin 161 retains the pulley bracket 157 upon the spindle 155, and cotter pin 163 retains the pulley spindle attached to its releasing rod 159. The lower end of the spindle of pulley 222 which extends below the pulley bracket 157, contains a hole 165 through which one end of the cable 248 may be suitably anchored. The cable 248 passes over a free pulley 229 and is attached to its associated counterweight 247. The pulley 229 is also mounted to rotate freely on the common shaft 167. The counterweight 247 normally tends to tension the cable 248 to swing the bracket 157 about the spindle 155, thus tending to pull the tension pulley 222 away from the pulleys 206 and 208 of the spinner 297. When the releasing rod 159 is pulled outwards through the slotted opening in the front edge of the die shelf 22*a*, tension pulley 222 swings towards the pulleys 206 and 208 thus drawing up cable 248 to lift counterweight 247.

Each belt 120 to 120*x*, and 220 to 220*x*, is connected in a similar manner to drive its associated spinner 97, 297, etc., so that the description of one of these belt connections applies to all of them. For example, the belt 120 (Figs. 3 and 4) passes around its grooved pulley 121 keyed to main drive shaft 72, then around top pulley 106 of its associated spinner 97, then around the tension pulley 122 and bottom pulley 108, and back to grooved pulley 121, thus transmitting motion from main

drive shaft 72, to drive the spinner 97. When the releasing rod 160 is pulled outwards, tension is released from the belt which may be removed from grooved pulley 121 manually, to shut down spinner 97 without interfering with the continued operation of any other spinner in the twisting frame.

Thus the spinner 97 is operated by one endless belt 120 which drives the top pulley 106 to spin the capstan bars 99 and 101 and to twist and wind the finished thread 117 around the bobbin 118 and also drives the bottom pulley 108 to rotate the grooved pulleys 113—113 thus drawing the finished thread 117 by the capstan motion through the spinner 97 and feeding it into the hollow leg 102.

The builder bar 119 is common to a number of bobbins. In dual operation one builder bar 119 may be common to all bobbins disposed along one side 105 of the twisting frame, and another builder bar 219 may be common to all bobbins disposed along the opposite side 205 of the frame (Fig. 3). To wind the finished thread 117 at each position evenly upon its associated bobbin, the bobbins must be raised and lowered upon their associated bottom spindles 100 to move bobbins relative to the free end of the hollow legs 102 of the capstan unit. When the builder bar is supporting a series of bobbins, to lift the dead weight represented by the builder bar and its associated row of bobbins, may require a substantial amount of power. By counterbalancing the weight of the builder bar and its associated row of bobbins with a suitable counterweight, a relatively negligible amount of power is required to initiate the movement of either builder bar 119 or 219.

Referring to Fig. 3, the builder bars 119 and 219 are respectively provided at suitably spaced intervals with lugs or ears 123, 223 for receiving one end of one of the chain cables 124 or 224 which pass upwards and around one of the free pulleys 125 or 225 which are suitably mounted on the twisting frame, and then downwards and are wound around and anchored to one of the grooved pulleys 126 or 226 which are keyed to the shafts 130 and 230. The counterweights 127 and 227 are suspended from suitable chain cables 128 and 228 which are wound around and anchored to the grooved pulleys 126*a* and 226*a* which are also keyed to the shafts 130 and 230. The rack wheels 131 and 231 are also keyed to the shafts 130 and 230 respectively. Thus when the shafts 130 and 230 are rocked in one direction under control of their associated rack wheels 131 or 231 one of the chain cables 124 or 224 is wound around its grooved pulley 126 or 226 to raise its associated builder bar 119 or 219, and the other chain cable 128 or 228 is unwound from its grooved pulley 126*a* or 226*a* to lower its associated counterweight 127 or 227. When the shafts 130 and 230 are rotated under control of their associated rack wheels 131 and 231 in the opposite direction, the chain cables 124 and 224 are unwound from their grooved pulleys 126 or 226 to lower the builder bars while the chain cables 128 and 228 are wound around their associated grooved pulleys 126*a* and 226*a* to raise their counterweights 127 and 227. Thus by designing the counterweights 127 and 227 so that they counterbalance the builder bars 119 and 219 and their bobbin load, a relatively small amount of power applied to either of the shafts 130 and 230 will rock said shafts in one direction to lower builder bars 119 and 219 and their load of bobbins and simultaneously wind up the counter-

weights 127 and 227, or in the opposite direction to lower the counterweights 127 and 227 and simultaneously lift the builder bars 119 and 219 and their load of bobbins 118 and 218.

The rack wheels 131 and 231 mesh with the sprocket gears 132 and 232 which are keyed to the swing shafts 133 and 233 respectively which are indirectly driven from the main drive shafts 72 and 272 as hereinafter more fully described.

Referring to Figs. 1, 2 and 3, the shafts 130 and 230 which extend lengthwise from end to end of the twisting frame are journalled upon the pedestal 20 in any suitable manner. Since shafts 130 and 230 and their respective swing shafts 133 and 233 are constructed alike and function in the same manner, only one of these assemblies, for example shaft assembly 130—133 and its associated parts, which operate the front side 105 of the twisting frame, need be described in detail, it being understood that shaft assembly 230—233 and its associated parts which operate the rear side 205 of the twisting frame are constructed and function in like manner.

A cross brace 134 is attached to each of the lower end castings 21 (one of which is shown in Fig. 2) at opposite ends of the pedestal 20 of the twisting frame. A pillow block 149 is bolted by the bolts 150 to the cross brace 134 at the near end of the twisting frame, and a pillow block (not shown) but similar to the pillow block 251 shown in Fig. 2, is bolted to a cross brace (similar to the cross brace 134 of Fig. 2) at the far end of the twisting frame in alignment with pillow block 149. The shaft 130 is journalled in the pillow block 149 and in its aligned pillow block (not shown). Each intermediate casting 21*a* (Fig. 3) includes a cross brace 136 whereon the shaft 130 is provided with an intermediate supporting journal.

Adjacent the pillow block 149, the end of the shaft 130 is reduced in diameter to form an axle whereon the toothed pulley (or combined pillow and toothed wheel) 143 (Figs. 1 and 2) is independently rotatable being driven from pulley 144*a* of main drive shaft 72, by means of the belt 145.

The swing shaft 133 is also journalled at its near end in the pillow block 149, and at its opposite end (Fig. 3) swing shaft 133 is alternately supported either in a bearing block 168 slidably supported in the elongated slot 137 formed in bracket 135, or by a sprocket gear 132 (which is keyed to swing shaft 133) in mesh with the pins 138 of the rack wheel 131, depending upon the radial position of the sprocket gear 132 relative to the rack wheel 131. A reduction gear 169 (Fig. 2) is keyed to the near end of the swing shaft 133. Reduction gear 169 meshes with the gear teeth of the toothed pulley 143, so that when the toothed pulley 143 driven by belt 145 rotates, it in turn rotates reduction gear 169 to drive swing shaft 133 and its sprocket gear 132 at a reduced speed to operate rack wheel 131.

The bracket 135 is provided with an elongated slot 137 in which the bearing block 168, which carries the end of the swinging shaft 133 and its sprocket gear 132, rides up and down, thus transferring the bearing for the swing shaft 133 from the bottom of the elongated slot 137 to the inside rim of the rack wheel pins 138 and back again, each time the rack wheel 131 whose pins 138 mesh with the sprocket gear 132, is rocked by the rotation of said sprocket gear to one or the other of its extreme positions.

The pins 138 of the rack wheel 131 are spaced

to mesh with the teeth of the sprocket gear 132, so that while the swing shaft 133 and its associated sprocket gear 132 revolves continuously in one direction, its associated rack wheel 131 is turned by the sprocket gear 132 until the free end of the swing shaft 133 engages the concave edge of one of the reversing shoes 139 or 140, whereupon the free end of swing shaft 133 is deflected through one of the raceways 141, 142, from the inner to the outer rim (or vice versa) of the rack wheel 131. The elongated slot 137 allows the bearing block 168 which supports the free end of swing shaft 133 the necessary freedom to rise or fall in its slotted bracket 135, thus allowing the free end of the swing shaft 133 to travel inwards or outwards through the raceways 141 and 142.

For example assume that the rack wheel 131 and sprocket gear 132 are in the position shown in Fig. 3 and that the swing shaft 133 is rotating clockwise. The sprocket gear 132 will be resting upon and in mesh with the pins 138 of the rack wheel 131, hence swing shaft 133 will be raised towards the upper end of the elongated slot 137. Since the sprocket gear 132 is in mesh with the inner face of the pins 138 of rack wheel 131, shaft 130 will rock in a clockwise direction until the reversing shoe 139 engages the free end of swing shaft 133 and guides it radially outwards and downwards through the raceway 142 thus moving the bearing block 168 downwards in the elongated slot 137 of swing bracket 135. The shaft 133 moves sprocket gear 132 around the last pin 138 of rack wheel 131 until the sprocket gear 132 engages the inner edge of the said pin thus causing the rack wheel 131 to reverse its direction of rotation and rock shaft 130 counterclockwise until the edge of reversing shoe 140 engages the free end of the swing shaft 133 and guides it radially inwards and upwards through the raceway 141 to lift the bearing block 168 in the elongated slot 137. Swing shaft 133 again carries sprocket gear 132 around the last pin 138 of the rack wheel 131 until the sprocket gear engages the inner edge of said pin thus causing the rack wheel 131 to again reverse its direction of rotation and rock shaft 130 clockwise until it again passes through the position shown in Fig. 3, and the cycle of operations is repeated. The raceways 141 and 142 accordingly allow the necessary freedom to the free end of swing shaft 133 to allow the sprocket gear 132 to swing up and down and around the teeth 138 of rack wheel 131 to adapt itself to the different positions required to effect a reversal in direction of the rocking motion of the rack wheel, and swing its bearing from the bottom of the elongated slot 137 to the inner face of the teeth 138 of the rack wheel 131 and back again.

The rocking motion imparted to the shafts 130 and 230 by the reversing motion of the rack wheels 131 and 231 effects the rise and fall of their associated builder bars 119 and 219 to raise and lower the bobbins 118 and 218 relative to the hollow legs 102 and 202 which revolve around the bobbins to wind up the twisted thread 117.

Operation

The various sets of paper ribbons 95, 38, 96; 95*a*, 38*a*, 96*a*, etc., of the various sets of rolls or cuts 44, 36, 45; 36*a*, 45*a*; etc., are respectively threaded through the slotted openings 83, 84, 85, in the guide bar 79, and then through aperture 90, die 89 and aperture 91 in the upper die carrier 81. Each set of ribbons is then threaded

collectively through the corresponding lower die 23 and hollow spindle 98 (Fig. 6), around one of the fibre pulleys 115, around the grooves in the grooved pulleys 113, through one of the hollow legs 102, and around the bobbin 118.

When each set of ribbons in the twisting frame has been similarly threaded, the electric motor or other prime mover is set in motion to operate main drive shafts 72 and 272, thus driving: the grooved pulleys 121 and 221 to drive the rope belts 120, 120*a*, etc., and 220, 220*a*, etc., to rotate the spinners 97, 97*a*, etc., and 297, 297*a*, etc.; the shafts 60 and 61 to oscillate the guide bars 79 and 80; the swing shafts 133 and 233 to rock the rack wheels 131 and 231 thus raising and lowering the counterbalanced builder bars 119 and 219.

The rotary movement of the spinner twists the stuffer ribbon 38 to form a core, and twists the covering ribbons axially around the said core to form an inner and an outer layer (Figs. 16 and 17).

Each time the guide bar 79 or 80 oscillates, it intermittently changes the position of the elongated slotted openings 83 and 85 with respect to the die 89 in the upper die carrier 81 or 82, thus intermittently changing the positions of the covering ribbons 95 and 96 relative to the core or stuffer ribbon 38 (Figs. 14 and 15), thus producing the variegated or intermittently colored twisted thread 117 (Fig. 8), having sections of finished thread the color of paper ribbon 96, alternating with other sections of finished thread the color of paper ribbon 95. Each time the guide bar 79 or 80 passes through the position shown in Fig. 11, both covering ribbons 95 and 96 are momentarily equidistant from the die 89 in the upper die carrier 81 or 82 and therefore from the stuffer ribbon 38, and during this short interval the covering ribbons 95 and 96 are intertwined to make a relatively short piece of pencil striped thread 170 (Fig. 8). This pencil striped section 170 is so short that it is hardly noticeable and will not affect the eye appearance of a textile fabric wherein the intermittently colored thread 117 is utilized as a part of the pattern of the woven fabric.

The rotary movement of the gear cover 107 (Fig. 6), operates the grooved pulleys 113, to draw the thread towards the hollow leg 102, and the rotary movement of the spinner 97 revolves the hollow leg 102 around the bobbin 118, thus winding the finished thread 117 upon the bobbin 118 which also turns around the bottom spindle 100. Due to the friction between the face of the bobbin and the builder bar 119, the bobbin 118 will turn about the bottom spindle 100 more slowly than the hollow leg 102 revolves around the bobbin 118 hence the finished thread 117 is wound tightly upon the bobbin.

The rise and fall of the counterbalanced builder bar 119 controlled by rocking shaft 130, continuously changes the level of the delivery end of the hollow leg 102 relative to the bobbin 118, hence the finished thread 117 is wound in even layers upon the bobbin.

The operation is continuous. When a cut or roll of paper ribbon is running out, the operator may mount a new cut or roll upon a spare spindle and splice the end of the new ribbon to the end of the old ribbon before the cut runs out. In this way continuous and uninterrupted operation of the machine is assured.

What is claimed is:

1. A twisted paper fibre thread comprising a twisted core, a plurality of ribbons of differently colored paper twisted around said core in two concentric layers, and said ribbons alternating from the inner layer to the outer layer of said thread and back again to expose substantial lengths of each ribbon separately and in succession as the covering layer.

2. A twisted paper fibre thread comprising a central ribbon, said ribbon being twisted to form a continuous core, a plurality of separate paper ribbons twisted around said core in separate and concentric layers, and each of said ribbons alternately forming an inner layer enclosing a substantial length of core and then the outer layer or covering of a substantial length of the thread.

3. The method of forming a twisted paper thread which includes the step of continuously twisting three separate paper ribbons in three separate and concentric layers to complete a substantial length of thread, and then reversing the relative positions of the two ribbons which form the intermediate and outer layers while continuously twisting them so that the positions of these two ribbons in said intermediate and outer layers is reversed for a substantial length of the twisted thread.

4. The method of forming a twisted paper thread which includes the step of continuously twisting a stuffer ribbon and a plurality of other ribbons of two differently colored papers in separate layers around said stuffer ribbon to form a section of thread having a covering the color of only one of said differently colored papers for a substantial length thereof, and then reversing the positions of said other ribbons relative to the stuffer ribbon and to each other while turning them continuously as before to form the succeeding section of thread having a cover the color of the other differently colored paper only for a substantial length of thread.

5. The method of forming a twisted paper thread which comprises continuously twisting a plurality of ribbons of differently colored paper around a continuously twisting core at different radial distances therefrom, and alternately reversing the radial distances between said ribbons of differently colored paper and said core without interrupting any of said twisting motions.

6. A machine for making thread by drawing ribbons while simultaneously twisting them together, comprising a guide bar having slotted openings formed therein through which said ribbons may be separately threaded, a die disposed beneath said guide bar through which said formed thread is adapted to be drawn, and said guide bar being mounted to reciprocate relative to said die to displace certain of said drawn ribbons laterally with respect to another ribbon.

7. A machine for making thread by drawing ribbons while simultaneously twisting them together, comprising means for continuously separating and guiding each of said ribbons towards a common die, and means operable to automatically and intermittently move said separating and guiding means laterally relative to said common die to variously and intermittently displace certain of said drawn ribbons relative to each other and to the direction of movement of the formed thread.

8. A machine for twisting paper ribbons together to form a twisted paper thread, comprising a die, means for continuously twisting the paper ribbons together and drawing them through said die in the form of a finished thread, means for continuously separating each of the ribbons and for guiding them towards the die, said sepa-

rating means being laterally slidable back and forth relative to said die to variously displace certain of said ribbons with respect to another ribbon, and means automatically operable to impart back and forth movement to said guiding means.

9. A machine for twisting ribbon paper into thread, comprising mechanism for twisting a series of paper ribbons together to form the finished thread, means for separating each paper ribbon in the series and for continuously guiding them towards the twisting mechanism, and an eccentric operable to automatically rock said separating means back and forth across said twisting mechanism to variously displace at least two ribbons in the series with respect to a third ribbon.

10. A machine for making thread by drawing ribbons while twisting them together, comprising an upper guide bar having slotted openings formed therein through which said ribbons may be separately threaded, a lower guide bar having openings formed therein cooperating with said slotted openings through which said ribbons may likewise be threaded, and said upper guide bar being mounted to reciprocate relative to said lower guide bar to displace certain of said drawn ribbons laterally with respect to another ribbon.

11. A machine for making a plurality of separate threads simultaneously by drawing ribbons while twisting them together in groups, comprising an upper guide bar having groups of slotted openings formed therein through which said ribbons may be separately threaded, a lower guide bar having groups of openings formed therein, each of the openings in the lower guide bar cooperating with one of said slotted openings to threadably receive its associated ribbon, said upper guide bar being mounted to reciprocate relative to said lower guide bar to displace certain of the drawn ribbons in each group laterally with respect to another ribbon of the same group, and means for reciprocating the upper guide bar.

12. A machine for making paper thread by drawing paper ribbons while twisting them together, comprising two bars disposed one above the other, each of said bars having openings formed therein through which said paper ribbons may be separately threaded, each opening constituting means for guiding the paper ribbon threaded therethrough, one of said bars being mounted to reciprocate relative to the other bar to displace certain of said drawn ribbons laterally with respect to a third ribbon, and means for reciprocating said bar.

13. A machine for simultaneously making a plurality of separate threads by drawing ribbons while twisting them in groups comprising two bars disposed one above the other, each of said bars having a plurality of groups of openings formed therein through which said ribbons may be separately threaded, said openings constituting means for independently guiding the ribbon threaded therethrough, and one of said bars being mounted to reciprocate relative to the other bar to displace certain of the drawn ribbons in each group laterally with respect to another ribbon of the same group.

14. A machine for making a number of separate threads simultaneously by drawing ribbons while twisting them in groups comprising two bars disposed one above the other, each of said bars having a plurality of groups of openings formed therein through which said ribbons may be separately threaded, said openings constituting means

threaded therethrough, one of said bars being mounted to reciprocate relative to the other to displace certain of the drawn ribbons in each group laterally with respect to a third ribbon of the same group, and means for reciprocating said bar.

15. A machine for making thread by drawing ribbons while simultaneously twisting them together, comprising a common die through which the ribbons are simultaneously drawn, a plate through which said ribbons are fed, said plate being movable back and forth crosswise relative to said common die, one of said ribbons feeding through said plate substantially in axial alignment with said common die unaffected by the crosswise movement of the plate, the crosswise movement of the plate moving the remaining ribbons laterally relative to said axially aligned ribbon, and means for automatically effecting the back and forth movement of said plate.

16. A machine for making thread by drawing ribbons while simultaneously twisting them together, comprising a common die through which the ribbons may be simultaneously drawn, a plate through which said ribbons feed towards said common die, one of said ribbons passing through said plate substantially in axial alignment with said common die, and means for moving the remaining ribbons back and forth in said plate to vary their feeding positions relative to said common die.

17. A machine for making thread by drawing ribbons while simultaneously twisting them together, comprising a common die through which the ribbons may be simultaneously drawn, a plate through which said ribbons feed freely towards said common die, one of said ribbons feeding through said plate substantially in axial alignment with said common die, and means automatically operable to move the remaining ribbons back and forth in said plate to vary their feeding positions relative to said common die.

18. A machine for making thread by drawing three or more ribbons while simultaneously twisting them together, a plate through which said ribbons are drawn in spaced relation to each other, one of said ribbons being positioned between said other ribbons, a common die through which the formed thread is drawn, and said plate being movable back and forth above said common die to variously move said other ribbons with respect to said between-positioned ribbon.

19. A machine for making thread by drawing three or more ribbons while simultaneously twisting them together, comprising a common die through which said twisted thread is drawn, a plate, said ribbons feeding through said plate in parallel spaced relation to each other, one of said ribbons being positioned intermediate said other ribbons, said plate being movable back and forth above said common die to vary the positions of said other ribbons with respect to the intermediate ribbon, and means for automatically initiating the back and forth movement of said plate.

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