951,450.

A. PETERSEN.

CIRCULAR LOOM.

APPLICATION FILED MAY 12, 1908.

Patented Mar. 8, 1910.

5 SHEETS—SHEET 1.

Fig. 1.

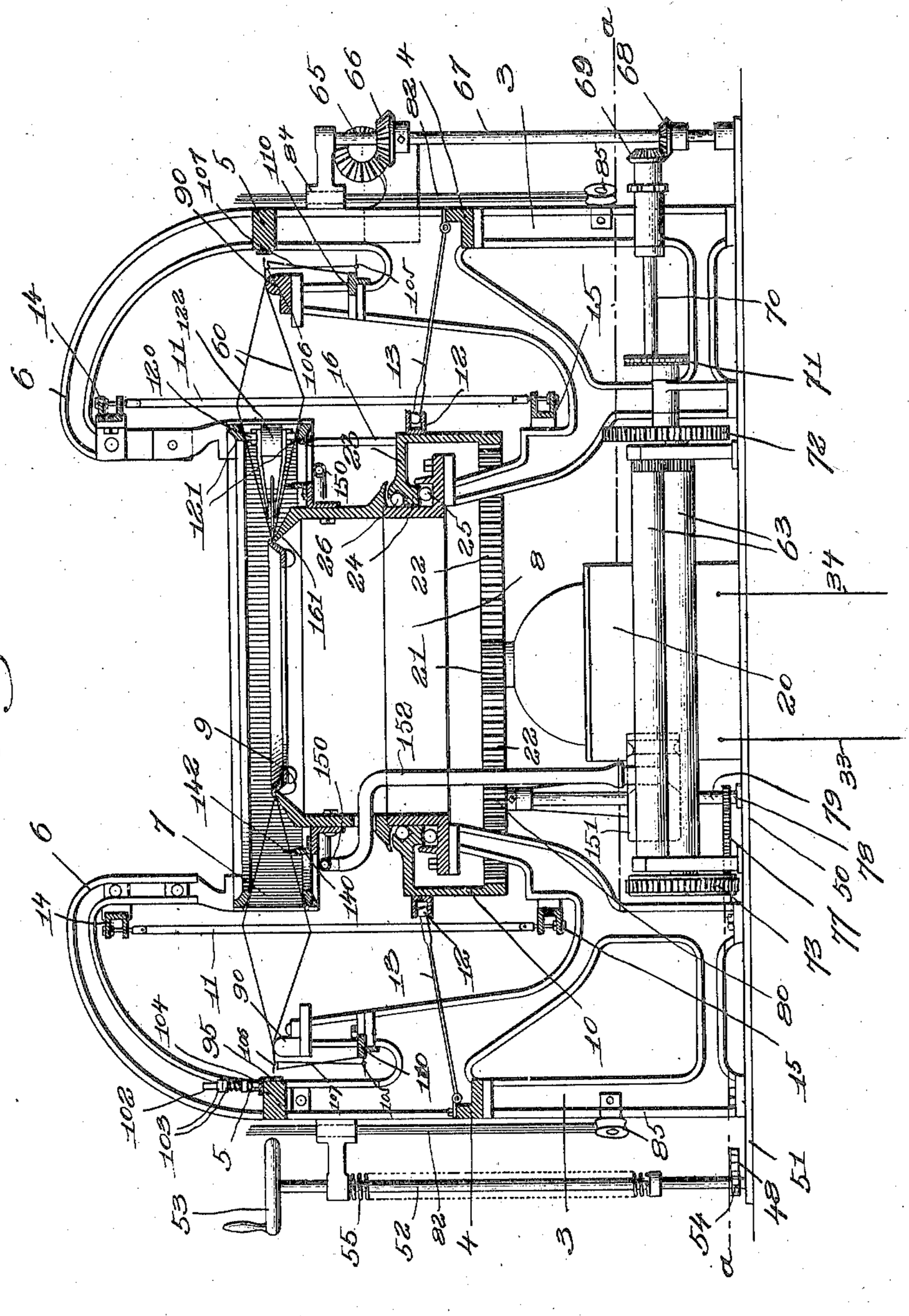
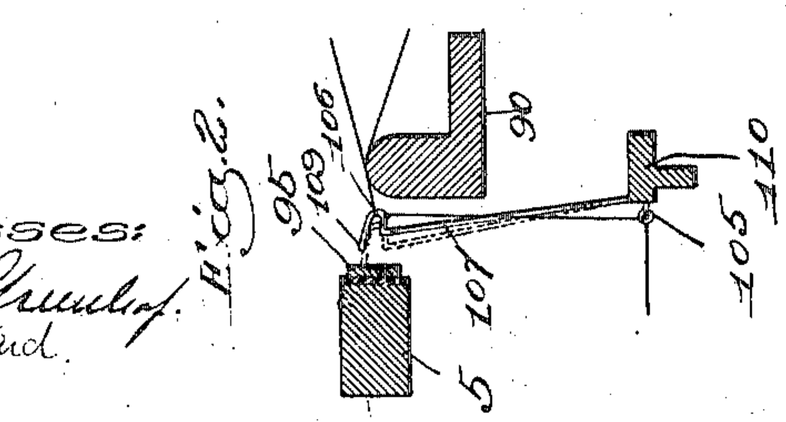


Fig. 2.



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5 SHEETS—SHEET 2.

Fig. 3.

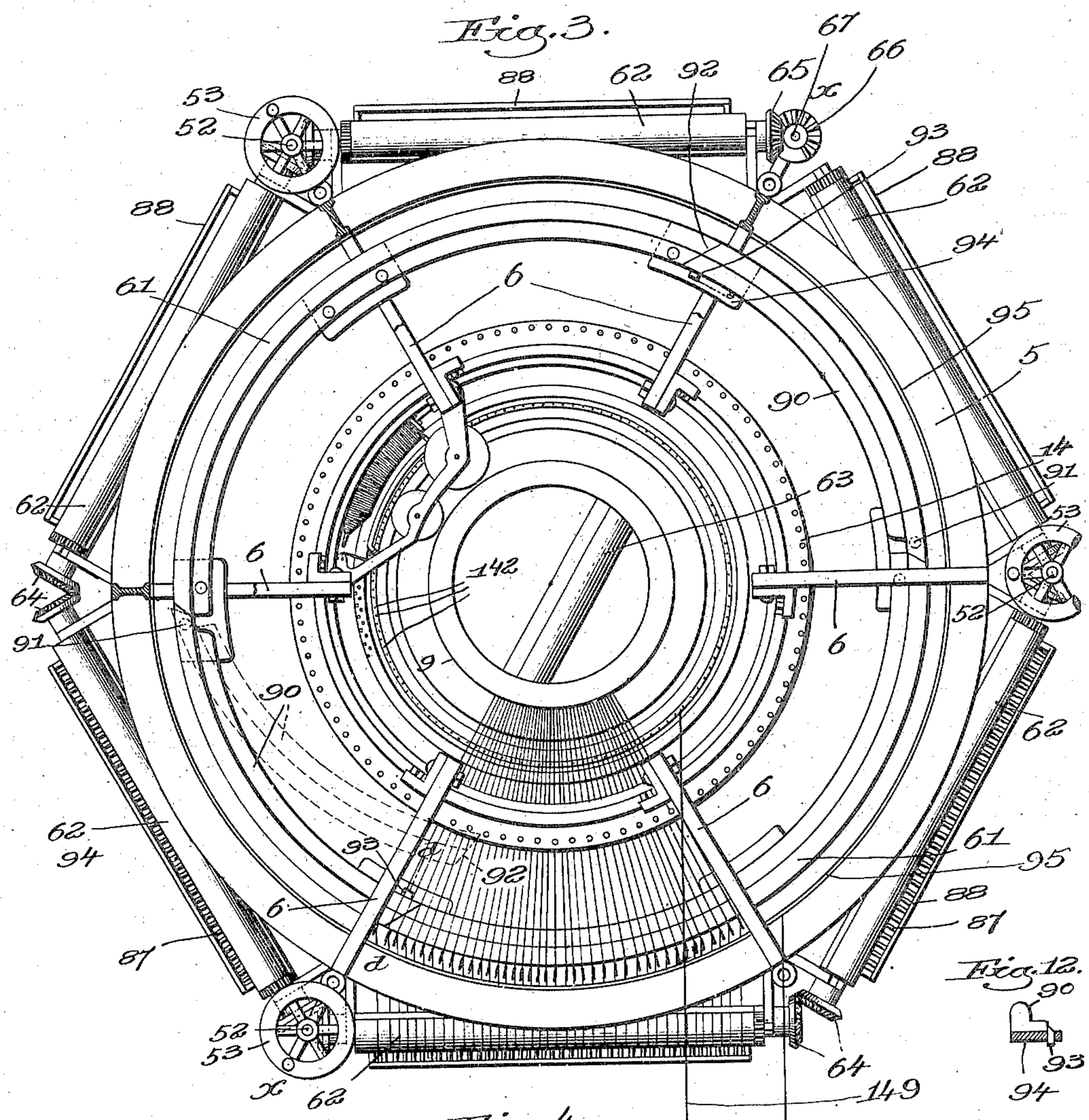
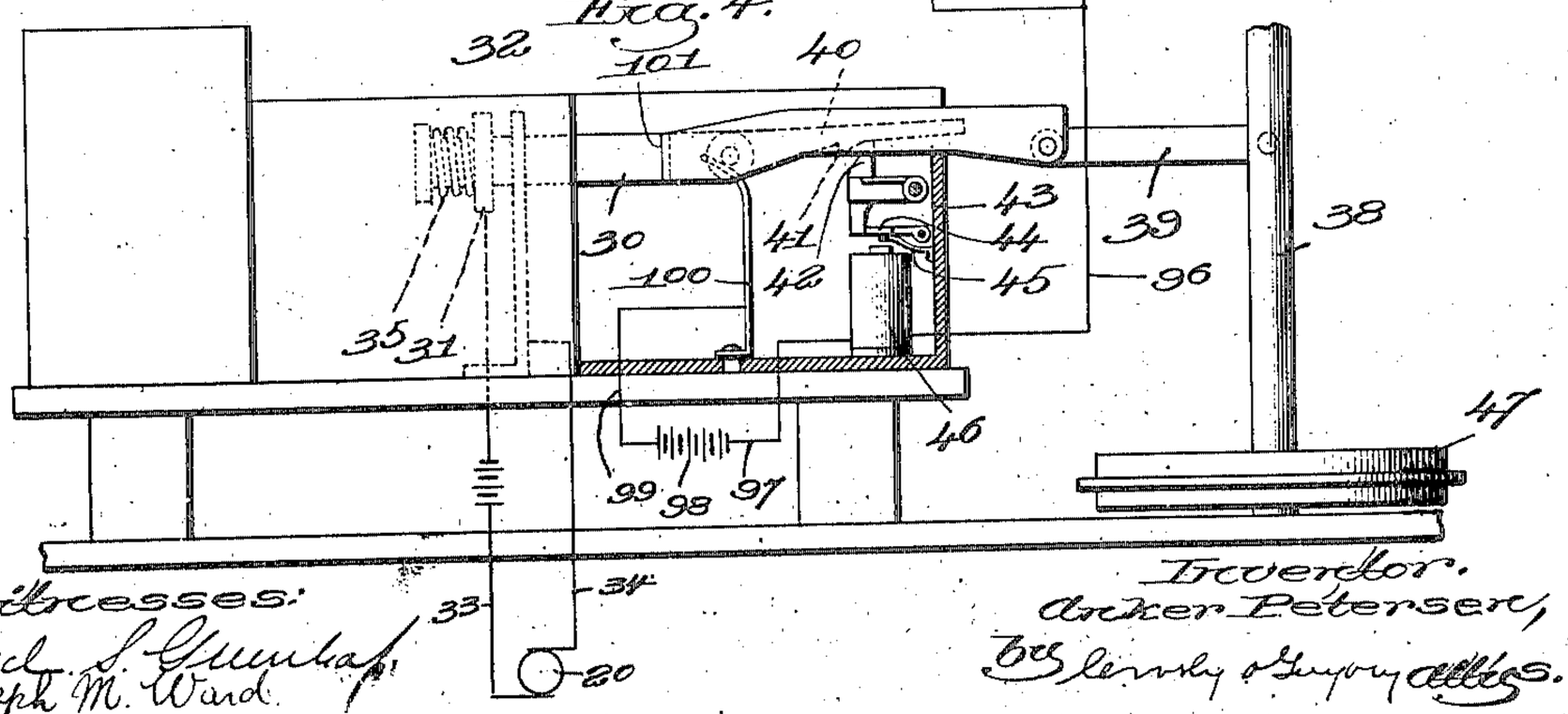


Fig. 12.

Fig. 4.



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5 SHEETS—SHEET 3.

Fig. 5.

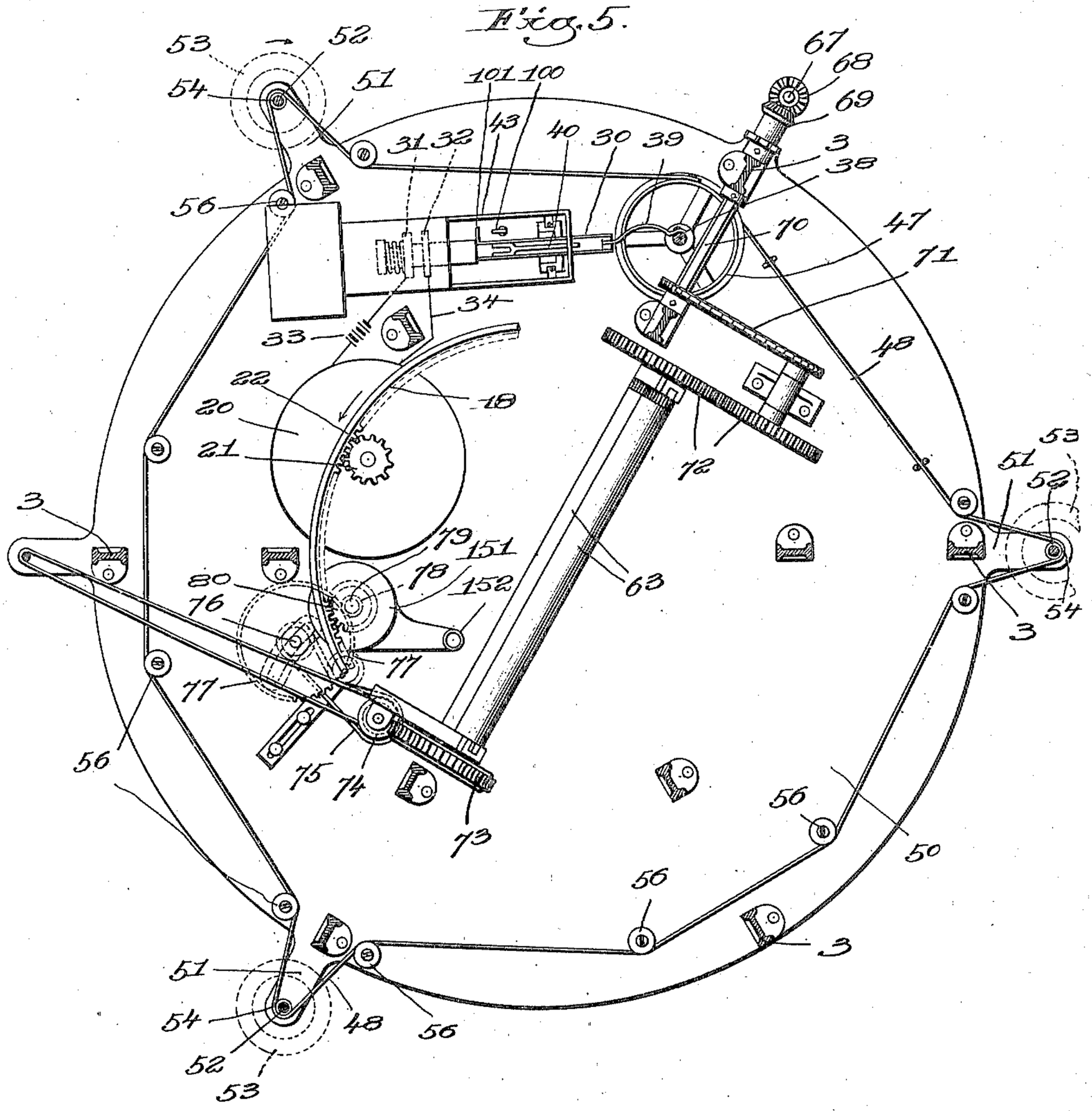


Fig. 7.

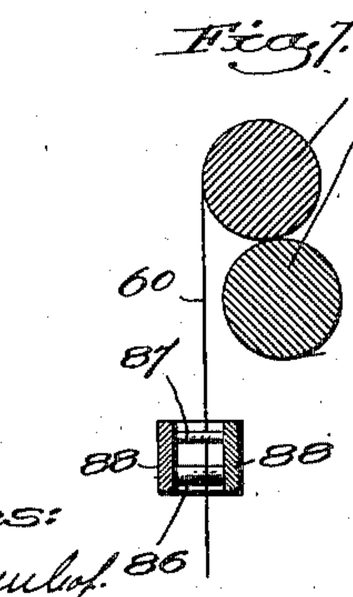
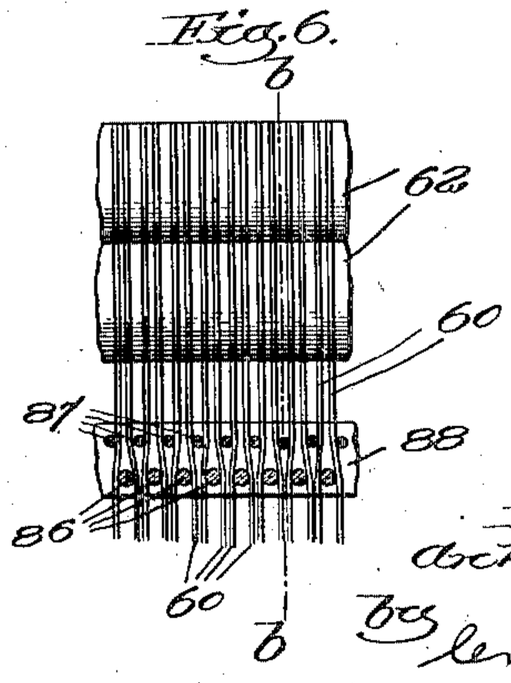


Fig. 6.



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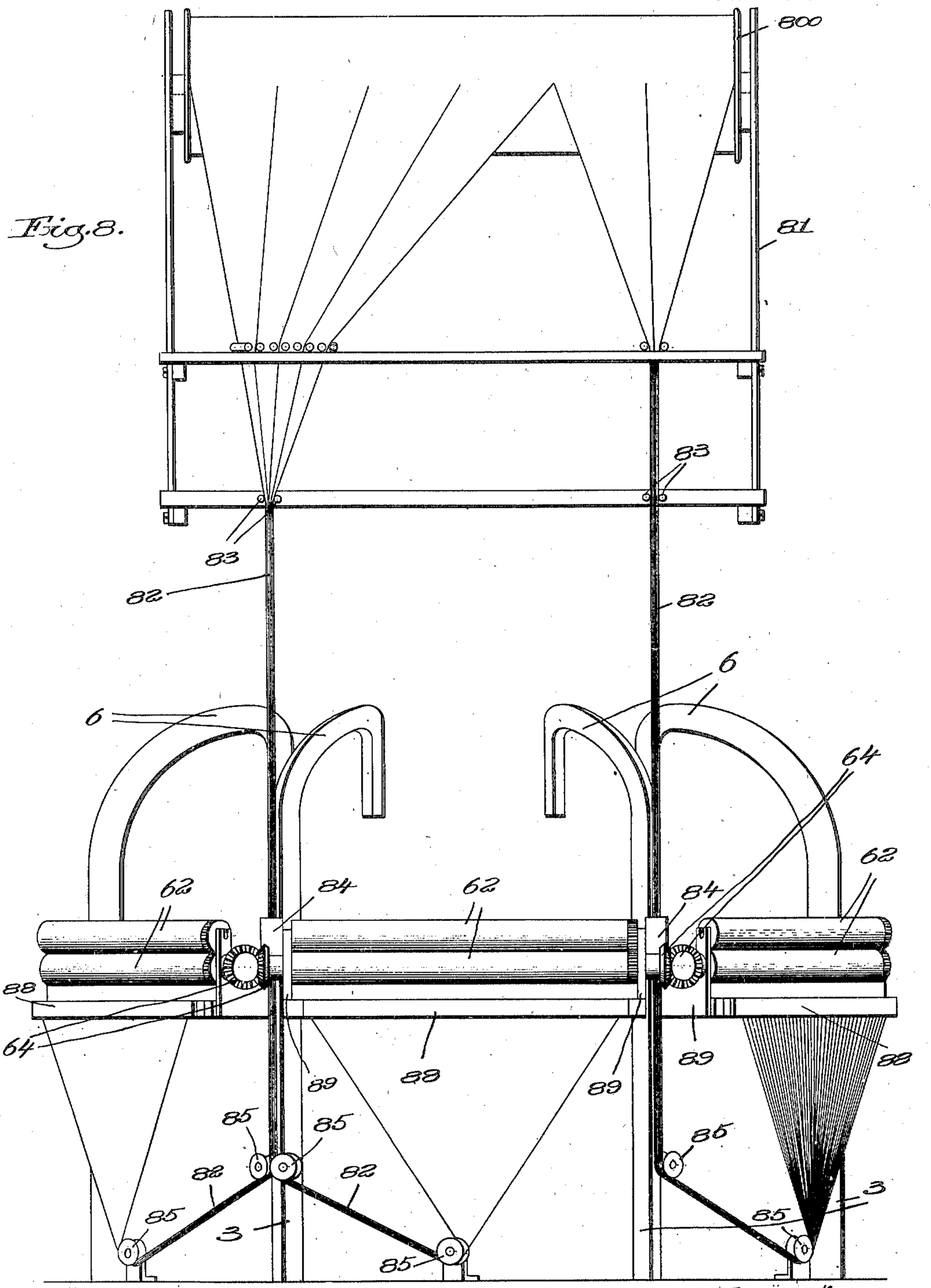
5 SHEETS—SHEET 4.

Fig. 8.



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CIRCULAR LOOM.

APPLICATION FILED MAY 12, 1908.

951,450. Patented Mar. 8, 1910.

5 SHEETS—SHEET 5.

Fig. 9.

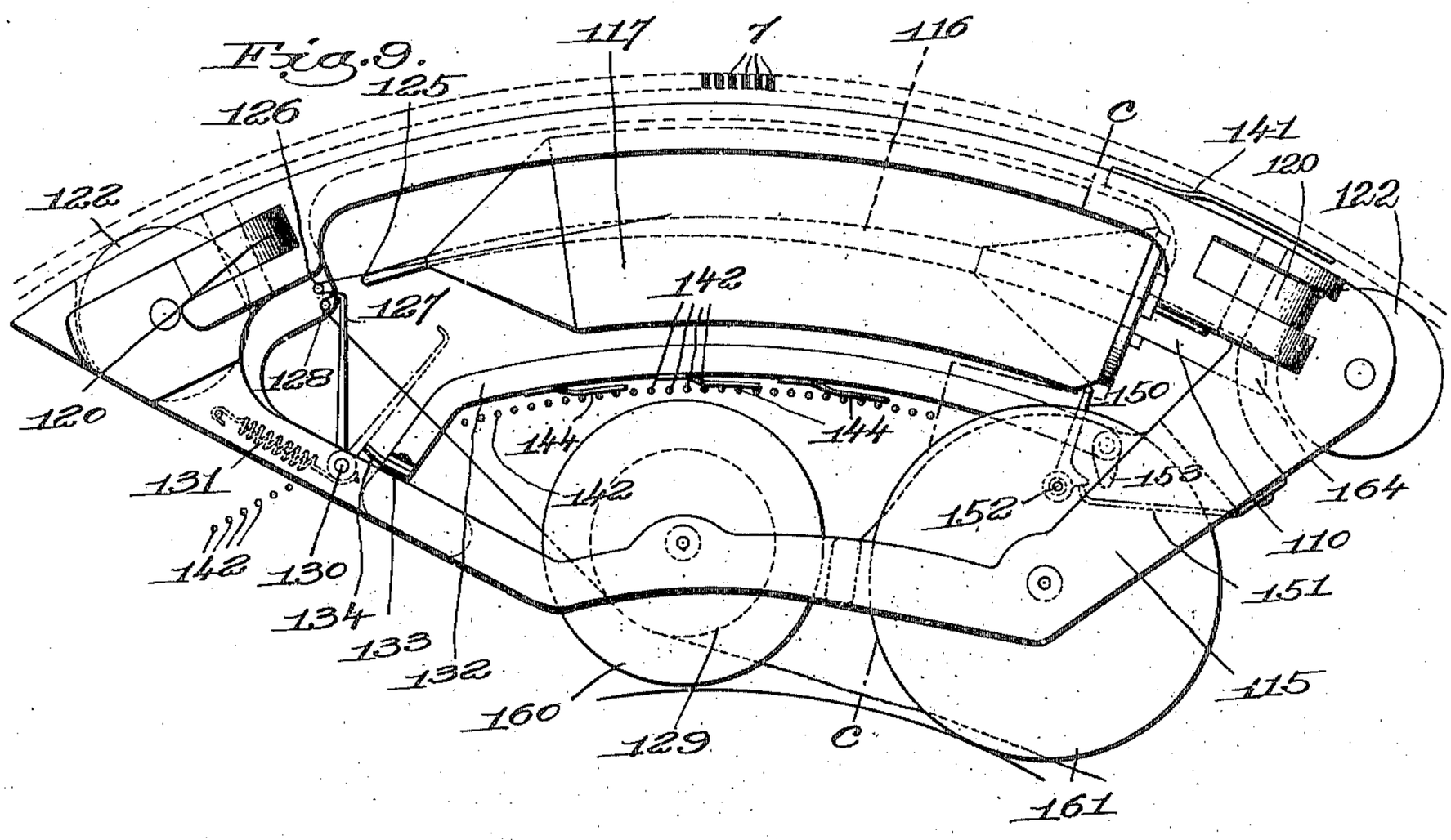


Fig. 10.

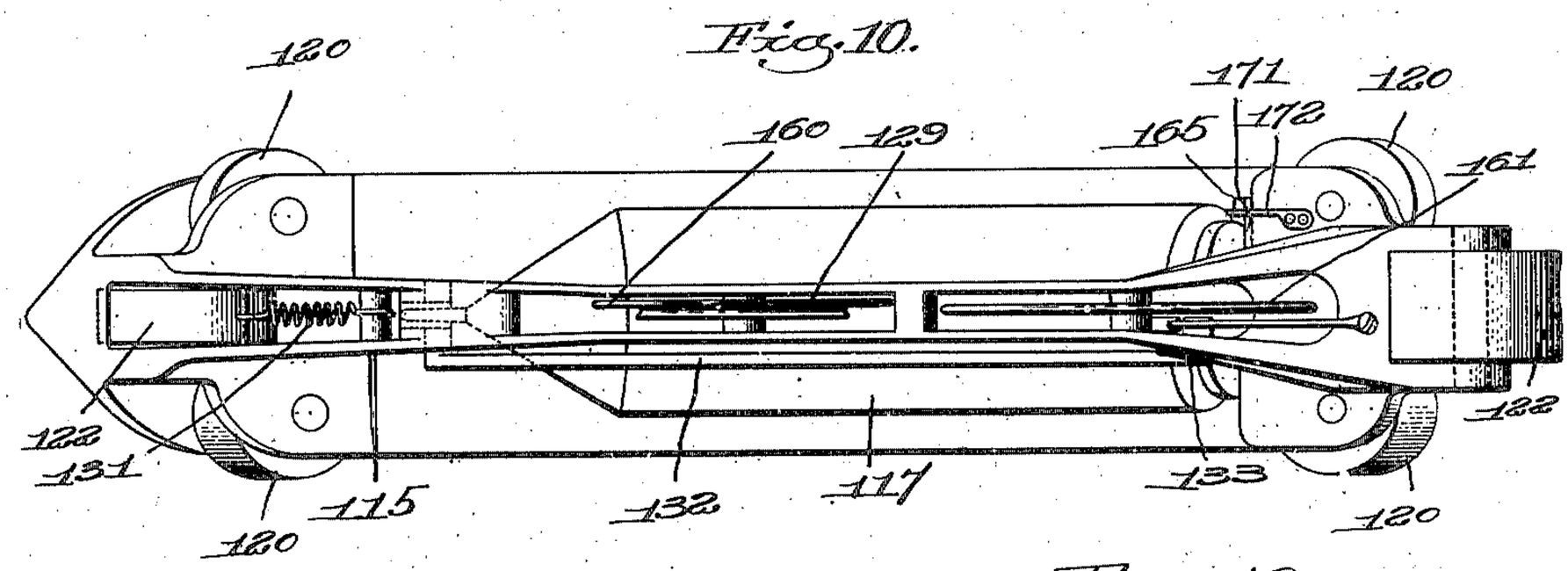


Fig. 11.

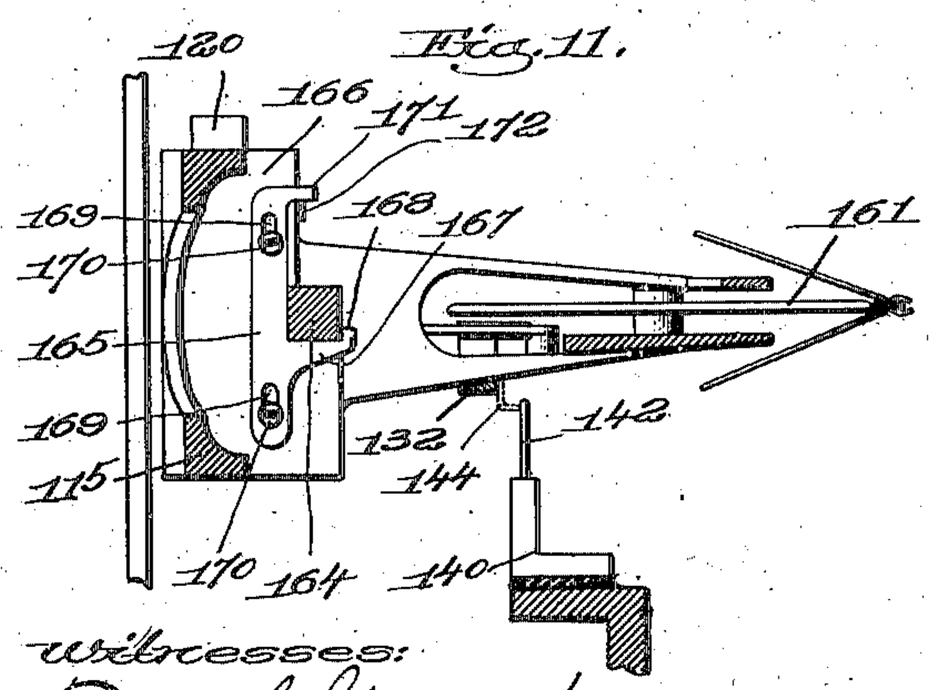
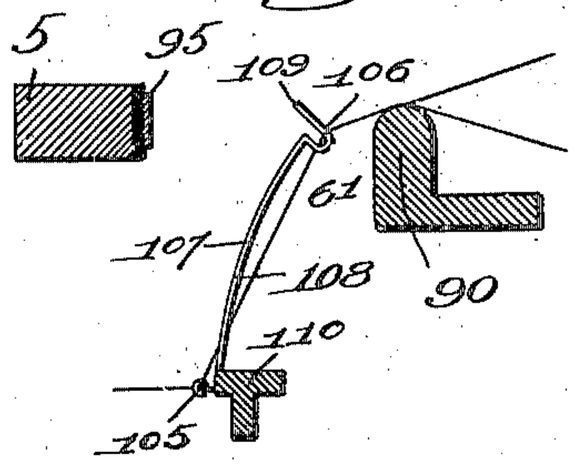


Fig. 13



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UNITED STATES PATENT OFFICE.

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CIRCULAR LOOM.

951,450. Specification of Letters Patent. **Patented Mar. 8, 1910.**

Application filed May 12, 1908. Serial No. 432,489.

To all whom it may concern:

Be it known that I, ANKER PETERSEN, a subject of the King of Denmark, residing at Chelsea, county of Suffolk, and State of Massachusetts, have invented an Improvement in Circular Looms, of which the following description, in connection with the accompanying drawing, is a specification, like numerals on the drawing representing like parts.

This invention relates to circular looms for weaving tubular fabric, and it has for its general object to simplify somewhat the construction of circular looms and to provide a loom of this character which can be run rapidly without danger of producing imperfect fabric.

More specifically the objects of the invention are to provide a novel driving mechanism for operating the cam ring from which the heddles and shuttles are operated; to provide a novel means for controlling this driving mechanism so that it can be readily started from any point on the loom and can be readily stopped either manually or automatically whenever desired or whenever the weft or the warp becomes defective or exhausted; and to provide a novel construction for facilitating the insertion of a fresh bobbin into the shuttle while the latter is in the loom.

These and other objects of my invention will more fully hereinafter appear from the following description.

In order to properly describe the invention I have illustrated in the drawings the preferred embodiment thereof without, however, intending to limit myself to the constructional features herein shown.

In the drawings, Figure 1 is a vertical section through a circular loom embodying my invention, said section being taken on substantially the line *x*—*x*, Fig. 3; Fig. 2 is an enlarged detail view showing part of the warp-stop motion; Fig. 3 is a top plan view of the loom; Fig. 4 is a detail view showing the controlling mechanism for the motor; Fig. 5 is a section on the line *a*—*a*, Fig. 1; Fig. 6 shows in side elevation on an enlarged scale the comb for separating the warp threads as they lead to the let-off rolls; Fig. 7 is a section on the line *b*—*b*, Fig. 6; Fig. 8 is a fragmentary side view of the loom showing the manner of feeding the warp threads thereto; Fig. 9 is a plan view of the shuttle; Fig. 10 is a side view thereof; Fig. 11 is a section on the line *c*—*c*, Fig. 9; Fig. 12 is an enlarged section on the line *d*—*d*, Fig. 3; Fig. 13 shows the manner in which the warp threads are made sufficiently slack to permit the bobbin to be inserted into the shuttle without putting undue strain on any of the warp-threads.

The frame of the loom on which the various parts are supported comprises the uprights or standards 3 which are radially arranged and which support the two rings or annular members 4 and 5 and which are also provided with the overhanging portions 6 that support the annular reed 7. The standards 3 also carry the center ring 8, the upper portion of which constitutes a cloth-supporting member, and the upper edge 9 of which is the annular edge over which the warp threads pass and at which the cloth is made.

The center ring 8 is formed at its lower end to constitute a trackway which supports and around which travels the driving ring 10. This driving ring constitutes the means for driving the shuttle and also the means for operating the harness frames that carry the heddles 11. Said driving ring is formed on its exterior with the cam groove 12 in which is received the ends of harness-actuating levers 13 that are pivoted at their outer ends to the annular member 4 and are pivoted intermediate their ends to the harness frames. The harness frames are supported by the two annular rings 14 and 15 which are carried by the loom frame in any suitable manner. The driving ring 10 has rising therefrom one or more pairs of arms 16 carrying rollers at their upper ends, which rollers engage with and operate to give movement to the shuttle in the raceway as the driving ring rotates. The parts thus far described are or may be all as found in my co-pending application Ser. No. 311,846, filed April 16, 1906, to which reference may be had, and since they form no part of my present invention further description thereof is not necessary herein.

The driving ring 10 is driven from a motor 20 of any suitable or usual construction, but which is herein shown as having the vertically-arranged shaft on which is secured a driving pinion 21 that meshes with the internal gear teeth 22 formed on the interior of the driving ring 10 (see Figs. 1

and 5), said driving ring thus constituting in effect an internal gear. The driving ring is provided at its upper end with the inwardly-directed flange 23 (Fig. 1) which is provided at its interior edge with a bearing 24 that is received and rotates in a raceway formed in the center ring 8. I will preferably provide suitable ball bearings between the bearing 24 and the raceway to lessen friction. In the particular embodiment of the invention herein shown, the ball bearings are adapted to take both vertical thrust and lateral thrust, and to accomplish this the center ring 8 is provided with a ball race in which are located a plurality of balls 25 on which the bearing 24 rests, and said bearing is provided with an annular ball race containing balls 26 which rest against the side of the centering ring 8.

The motor 20 is controlled by a suitable switch or rheostat which in turn may be actuated from a plurality of different points around the loom so that the motor can be started by the attendant from almost any position around the loom.

While the rheostat for starting the motor may be of any suitable kind, I have herein shown one which includes the stem 30 (see Fig. 4) yieldingly carrying thereon one or more contacts 31 which are adapted to engage with fixed contacts 32, the contacts 31 and 32 being in the two sides 33 and 34 of the motor circuit. The stem 30 is normally retracted to maintain the motor circuit broken by a suitable spring 35, but movement of the stem to the right, Fig. 4, will close the contacts 31, 32 thereby closing the motor circuit. This type of switch or rheostat for controlling the motor is old and constitutes no part of my present invention.

For operating the stem 30 from various points, I have connected said stem to a shaft 38 by means of a strap or other flexible connection 39 so that by rotating the shaft, the connection 39 will be wound up thereon, thus drawing on the stem 30 and closing the rheostat contacts 31, 32. For maintaining the motor circuit closed, I have attached to the stem 30 a pivoted pawl 40 (see dotted lines Fig. 4) provided with a tooth 41 which is adapted to engage a lock or catch 42 when the rheostat is on. This lock or latch 42 is pivoted to the casing or frame 43 in which the rheostat is contained and is normally held in its operative position by a stop 44 which is also pivoted to the frame or casing, said stop being acted on by a spring 45 which holds it in operative position. The stop 44 is arranged to be released from engagement with the tail of the lock by means of a magnet 46 for which purpose said stop is constructed to act as an armature for the magnet.

The shaft 38 is adapted to be turned from a plurality of different points around the loom, and in the present embodiment, this is accomplished by securing to said shaft a pulley or wheel 47 which has connected to it the two ends of an endless sprocket chain 48 that encircles the loom and can be operated from different points around the loom. The base plate 50 of the loom is herein shown as provided with three arms 51 in which are journaled vertical shafts 52, each shaft carrying at its upper end a hand wheel 53 by which it may be rotated. Each shaft also has fast thereto at its lower end a sprocket wheel 54 which meshes with the sprocket chain 48 so that by turning any one of the shafts 52, the sprocket chain may be drawn on thereby to turn the wheel 47 and close the motor circuit. Each of the shafts 52 is acted on by a suitable spring 55 which is placed under tension when the shaft is turned to close the motor circuit, so that as soon as the shafts are released, said springs act to return the shafts to their normal position, the flexible connection 39 then becoming unwound from the shaft 38, so that when the latch 40 is released from the lock 42, the stem 30 of the rheostat will immediately be shifted to the left Fig. 4 thereby instantly breaking the motor circuit.

The base 50 of the loom is shown as provided with a plurality of direction rolls 56 which are positioned to properly guide the sprocket chain 48.

The means for opening the motor circuit either manually at any time desired or automatically when the weft or the warp becomes defective will be more fully explained hereinafter.

The loom is provided with the let-off rolls 62 which feed the warp threads to the loom, and from the let-off rolls said warp threads pass over the annular warp rest 61 from which they pass to the heddles 11 through the reed 7 and to the cloth support 9, all as shown in my above-mentioned application. The loom is also provided with the cloth take-up rolls 63.

In the embodiment of the invention shown herein, the let-off rolls and take-up rolls are both positively driven and are both connected together so that they rotate at definite speeds relative to each other. The let-off rolls are arranged in pairs as usual, the rolls of each pair being geared together. The adjacent pairs of let-off rolls are connected together by bevel gears 64 so that the rolls all rotate in unison, and the let-off rolls are driven by means of a bevel gear 65 on one of the rolls which meshes with a bevel gear 66 on a vertical shaft 67. Said shaft 67 has thereon a bevel gear 68 which connects with and is driven by a gear 69 on a countershaft 70, said latter shaft being driven from one of the take-up rolls by means of the sprocket chain 71 and the gearing 72 (see Fig. 5). The take-up rolls are

operated positively from the internal gear 10, and to accomplish this one of said rolls has thereon a worm-gear 73 which meshes with and is driven by a worm 74 on a vertically-arranged shaft, said shaft being in turn driven from another shaft 76 by means of the sprocket chain 75. The shaft 76 has thereon a gear 77 meshing with a pinion 78 on a vertically-arranged shaft 79 which carries at its upper end a gear 80 that meshes with and is driven by the internal gear 10 (see Figs. 1 and 5). In this way both the take-up rolls and let-off rolls are positively driven and they each rotate at a definite speed with relation to each other. This manner of operating the let-off and take-up rolls is not herein claimed as it is made the subject of another application filed by me May 12, 1908, Se. No. 432,490.

The let-off rolls act to positively feed the warp threads to the loom and because both the let-off rolls and the take-up rolls are positively driven at a definite speed relative to each other, the tension of the warp threads between the let-off rolls and the cloth is always under control and can be maintained independently of any friction device applied to the warp beams. This permits me to place the warp beams at a distance from the loom and to support them independently of the loom. This in turn is a decided advantage because it permits me to use a much larger warp beam and one containing a greater length of warp threads than would be possible or feasible where the warp beams are carried by the loom.

In the present embodiment, I have shown the warp threads as led to the loom from a distant warp beam in the form of warp chains, there being one warp chain for each of the pairs of take-up rolls. The warp threads in each warp chain are separated by a comb or reed just prior to their delivery to the let-off rolls. The warp beam or warp beams can be situated in any suitable location, and as one possible and convenient location, I have shown them in the drawings as being sustained from the ceiling above the loom, see especially Fig. 8.

In the loom herein shown there are six pairs of take-up rolls, and consequently there are six warp chains. These warp chains may be taken from six separate warp beams or two or more warp chains may be taken from the same warp beam. In Fig. 8 I have shown three warp chains as being taken from one warp beam which would necessitate the presence of two warp beams for the loom arranged as herein shown. One of these warp beams is shown in Fig. 8 at 800 and is supported in suitable framework 81 which in turn may be sustained from the ceiling of the weave room. The warp threads on the warp beam are divided into three warp chains 82 and are led from the warp beam through suitable guides 83 formed on the frame 81 and then down through other guides 84 formed on the loom frame, said warp chains after passing through the guides being led over direction rolls 85 to the comb. In Fig. 8 I have shown two warp chains 82 going through the same guide 84, said warp chains being separated from each other after passing through the guide. This is not essential, however, as the warp chains might be separated at the warp beam and led separately to the loom.

Any suitable comb or warp separator may be employed for separating the warp threads and guiding them to the let-off rolls. The warp separator herein shown is one arranged to separate the warps into groups and then to sub-divide the groups. It comprises a plurality of rows of warp-separating pins 86, 87 (see Figs. 6 and 7) which are sustained by two side pieces 88 that are separated from each other sufficiently to provide the necessary space for the warp threads to pass. There is one such comb or separator for each pair of let-off rolls, and each warp separator may be sustained in any suitable way. I have herein shown each warp separator as sustained by the brackets 89 that support the let-off rolls. In the embodiment herein shown the separating pins are arranged in two rows, those of one row being designated 86 and those of the other row 87. The pins of the two rows are staggered with relation to each other and a group of warp threads, say, for instance, four warp threads, extend between two adjacent pins 86 and the warp threads of each group are then sub-divided by the pins 87, as clearly seen in Fig. 6.

In a circular loom of this character the bobbin is inserted into the shuttle while the latter is in the raceway by forming an opening of sufficient size to receive the bobbin in the web of warp threads between the reed 7 and the cloth-supporting ring 9, this being done by parting the warp threads from each other. It is sometimes rather difficult to thus part the warp threads sufficiently to admit of placing the bobbin in the shuttle without placing so great a strain on the separated threads that they are likely to become broken. To avoid this I have provided in the present invention a means whereby the tension on those warp threads which are to be parted to form the entrance opening for the bobbin may be relieved without disturbing the tension on the remaining warp threads. This may conveniently be done by making the warp rest 61 with movable sections which can be moved inwardly thereby to relieve the tension on the warp threads which pass over such movable sections. I have herein shown the warp rest as having two such movable sections 90. These sec-

tions are shown as pivoted to the other portions of the warp rest, as at 91, and as being adapted to swing inwardly toward the center of the loom. The outward movement of each pivoted portion may be limited by suitable stops or by cutting the end of the portion on the incline, as shown at 92, so that it will fit against the adjacent end of the fixed portion when the pivoted portion is in its operative position. These pivoted portions are each held in their operative position by a suitable lock which is herein shown as a catch 93 carried by the plate 94 on which the pivoted member is sustained. Whenever desired to insert a bobbin in the shuttle, the loom is operated until the shed is open at the point adjacent one of the pivoted portions 90, and said portion is then unlocked and swung inwardly, as shown in dotted lines Fig. 3, and full lines Fig. 13. The inward movement of this pivoted portion 90 obviously relieves the tension on the warp threads which pass over it whereby said warp threads are considerably slacked so that they may be readily parted sufficiently to admit of the shuttle being placed in position between them without putting any unnecessary or undesirable strain on them.

My improved loom is adapted to use comparatively large bobbins in the shuttle, and by the construction above described such large bobbins can be introduced into the shuttle without any danger of breaking any warp threads.

For stopping the loom manually I have herein provided the following mechanism: The ring 5 supports on its inner face a metal contact ring 95 which is a good conductor of electricity and which is connected by a wire 96 with the magnet 46. Said magnet is also connected by a wire 97 with a battery or other source of electricity 98, and said battery is connected by a wire 99 with a contact 100 which is sustained by the casing 43, but which is insulated therefrom. The stem 30 has extending therefrom a contact 101 which is situated to engage the contact 100 when the motor circuit is closed by the rheostat. This contact 101 is electrically connected with the loom frame and the latter has thereon one or more spring-pressed manually-operated contacts 102 which are adapted to be forced into contact with the contact ring 95. Any desired number of these manually-operated contacts may be employed, and they may be situated at different points around the loom. I find it convenient to mount them on the overhanging arms 6, each contact being sustained in suitable bearings 103 on said arm and being situated to be pressed into contact with a lip or finger 104 formed on the contact ring 95, but insulated from the ring 5 of the loom frame. So long as the motor circuit is closed at the rheostat, the circuit including the contact member 95, wire 96, magnet 46, wire 97, battery 98, wire 99, contacts 100, 101 and loom frame, is closed at the rheostat by reason of the engagement of the contacts 100 and 101. Said circuit, however, is normally open at the points between the contact ring 95 and various manually-operated contacts 102. By depressing any one of these contacts 102 the circuit is closed, thus energizing the magnet 46. When said magnet is energized, it draws the stop 44 downwardly, thus releasing the lock 42 and permitting the latter to become disengaged from the catch or latch 40. When this occurs, the spring 35 operates to shift the stem 30 thereby to open the motor circuit at the rheostat, as will be obvious, and stop the loom.

I have provided means co-acting with the contact ring 95 for stopping the loom whenever any of the warp threads become unduly slack or become broken. To accomplish this purpose each warp thread is led from the let-off roll through a guide-eye 105 and into the open eye 106 of a contact member 107, said warp threads all passing from the eyes 106 over the warp rest 61. The contact members are preferably made from resilient wire bent into the shape shown in Fig. 2, each having a resilient stem 108 which terminates in the eye 106, one side of the eye being extended to form the contact point 109 which extends nearly at right angles to the stem and extends outwardly beyond the latter. The contact members 107 are shown as being sustained by an annular member 110 and the position of each member is such that when it is not subjected to tension, the contact end 109 thereof will engage the contact ring 95, as shown in dotted lines Fig. 2. The tension on the warp threads, however, is so adjusted that under normal conditions this tension is sufficient to flex the resilient stems of the contact members, thus holding them away from the contact ring 95, as shown in full lines Fig. 2. If any warp thread becomes unduly slack or becomes broken, the corresponding contact member will by the resiliency of its stem be thrown against the contact ring 95, and since the contact members are all connected with the loom frame, the engagement of any contact member with the contact ring 95 will establish the circuit of the magnet 46 and thus stop the loom. These contact members 107 also act in a measure to take up any small amount of slack in the warp threads and thus they help maintain a uniform tension on the warp threads.

For stopping the loom when the weft thread breaks or becomes exhausted, I have provided a contact device in connection with the shuttle which is adapted to make the circuit through the magnet 46 if the weft breaks or becomes exhausted. The shuttle

is shown best in Figs. 9 to 11, and it comprises the shuttle frame 115 which supports a spindle 116 on which the bobbin or cop 117 is mounted. The shuttle frame is provided with the guide rollers 120 which run on the two rings 121 forming a trackway, and also with the guide rolls 122 which roll over the dents of the reed 7, all as shown and illustrated in my co-pending application Se. No. 311,846. The weft thread 125 passes from the bobbin 117 around the guide pin 126, thence through the eye of a spring-pressed contact arm 127, thence around another guide pin 128, and thence around a guide roll 129. The contact member 127 is shown as pivoted to the shuttle frame at 130 and as being acted on by a spring 131 which tends to carry it away from the guide pins 126, 128. The tension on the weft thread 125, however, normally tends to keep the contact arm in the full line position Fig. 9. The shuttle has secured thereto a contact-carrying bar 132 which is insulated from the body of the shuttle, as shown at 133. This contact-carrying bar has secured thereto a contact 134 situated to be engaged by the contact 127 when the latter swings into the dotted line position Fig. 9. The shuttle body is constantly in electrical connection with the loom frame, and the contact-carrying bar is constantly in electrical connection with a contact ring 140 also carried by the loom frame, but insulated therefrom. The electrical connection between the shuttle and the loom frame may conveniently be provided for by securing to the shuttle one or more flexible contact strips 141 which bear against and wipe over the dents of the reed 7 as the shuttle moves. The electrical connection between the bar 132 and the insulated ring 140 is secured by providing the ring 140 with a plurality of upwardly-extending pins 142, said pins being of a length to project into the shed when the latter is formed, as shown in Figs. 1 and 11, and by providing the contact-carrying bar 132 with one or more contact strips 144 which have contact with and wipe over the pins 142 as the shuttle moves.

The contact ring 140 is connected by a wire 149 with the magnet 46 or the wire 96 leading thereto, and the circuit for the magnet which is controlled by the shuttle includes the wire 149, contact ring 140, pins 142, contact strips 144, contact-carrying bar 132, contacts 134 and 127, the shuttle frame, contact strip 141, the loom frame, contacts 101 and 100, wire 99, battery 98 and wire 97 and magnet 46. Under normal conditions when the loom is running, this circuit is broken between the contacts 127 and 134 and therefore the magnet is deënergized. If, however, the weft breaks or becomes unduly slack, the contact 127 is thrown into the dotted line position Fig. 9 thereby closing the circuit, energizing the magnet 46, and stopping the loom. In addition to this mechanism I have provided a device for stopping the loom when the weft is exhausted. Such mechanism comprises a feeler 150 pivoted to the shuttle body at 152 and provided with a heel which is acted on by a spring contact 151 carried by the shuttle body. The resiliency of the spring contact 151 keeps the feeler normally against the weft on the bobbin near the base thereof. The contact-carrying bar 132 has extending therefrom a contact 153 which is situated to be engaged by the spring contact 151 when the feeler moves to the left Fig. 9. When the weft is exhausted, the resiliency of the spring arm 151 throws the feeler 150 to the left, thus permitting said contact 151 to meet and engage the fixed contact 153, thus establishing the circuit through the magnet 46 and stopping the loom. As the shuttle moves around in the shed the weft thread is beat into the warp threads by means of two weft packing wheels 160, 161, both of these wheels acting on the previously laid weft thread and firmly placing the latter in position.

The object of employing two weft-packing wheels is to beat the weft in firmly. The advance weft-packing wheel 160 acts to place the previously-laid weft thread closely against the crossed warps at the fell of the cloth, and the rear weft-packing wheel 161 acts on the weft thus placed and serves to firmly beat it into place.

It will be noted that the advance weft-packing wheel 160 is smaller in diameter than the rear weft-packing wheel 161, and because of this fact the rear packing wheel will act with greater pressure on the weft than the advance wheel. It is within my invention to place more than two weft-packing wheels on the shuttle if it is found necessary to beat the weft up more firmly.

The shuttle is of such a construction that it cannot be removed from the shuttle race without cutting the warp threads. The mass of weft yarn 117, however, is detachably sustained by the shuttle so that when the weft becomes exhausted a fresh supply of weft can be placed in the shuttle. As herein shown the weft mass is sustained on a spindle 116 and the spindle is detachably sustained in the shuttle. For this purpose the shuttle is provided with a socket into which the end 164 of the spindle is inserted, said end of the spindle being non-circular and the socket also being non-circular. The spindle is sustained in its proper position by a holder 165 which is sustained on the face 166 of the body of the shuttle, as shown in Fig. 11, and which is provided with an arm 167 having its end turned up to form a lip 168. The holder 165 is mounted for

vertical movement on the face 166, said holder having for this purpose the two slots 169 therein through which pass two screws 170. The upper end of the holder is provided with the offset 171 which is normally engaged by a spring 172 that tends to raise the holder. When it is desired to place the spindle in the shuttle or remove it therefrom, the holder is depressed thereby releasing the spindle from the grasp of the arm 167 and the spindle is then withdrawn from the socket and removed from the shuttle. In placing a new spindle in the shuttle the end of the spindle is placed in the socket while the holder 165 is lowered, and thereafter the holder is permitted to rise under the influence of the spring 172, thereby to cause the arm 167 to embrace the squared end of the spindle. Said arm thus serves to support the spindle and keep it in proper position.

The device herein shown is provided with race free from lint, and this is accomplished herein by means adapted to deliver a blast of air against or into the shuttle race. While it is feasible to accomplish this object in a variety of ways, I have herein shown a pipe 150 situated directly beneath the shuttle race and provided with a plurality of jet apertures directed upwardly. This pipe 150 is connected to a suitable blower 151 by means of a pipe 152 so that when the blower is operated, the air will be delivered from the jet pipe and thus blow any lint from the shuttle race. The blower may be operated in any suitable way and I have herein shown it as being operated from the shaft 79.

I have attempted to show herein only one form of the invention, and it will be obvious that many changes in the constructional details may be made without departing from the invention.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a circular loom, the combination with a cylindrical frame down through which the woven cloth is delivered, of a combined harness-actuating and shuttle-driving ring exterior to the frame and rotatably sustained thereby, said ring having internal gear teeth, harness mechanism situated exterior to the ring, means to actuate the harness mechanism by rotation of the ring, a shuttle raceway, a shuttle therein, means carried by said ring for directly engaging and driving said shuttle, and a vertical driving shaft having a pinion meshing with the internal gear teeth of said ring.

2. In a circular loom, the combination with warp-feeding means for positively feeding the warp threads to the loom, of harness mechanism, an annular warp rest over which the warp threads pass to the harness mechanism, said warp rest having a section mounted to be moved toward the harness mechanism thereby to relieve the tension of all the warp threads that pass over it.

3. In a circular loom, the combination with warp-feeding means for positively feeding warp threads to the loom, of harness mechanism, and an annular warp rest between said warp-feeding means and said harness mechanism, said warp rest having a movable section arranged to move in a direction to relieve the tension on the warp threads which pass over it.

4. In a circular loom, the combination with harness mechanism, of positively driven let-off rolls for feeding the warp threads to the harness mechanism, and an annular warp rest situated between the let-off rolls and the harness mechanism, said warp rest having an inwardly movable section.

5. In a circular loom, the combination with a plurality of pairs of positively-driven let-off rolls, of a warp beam, means to sustain the latter above the loom and independently therefrom, and means to guide the warp threads from the warp beam to the let-off rolls in the form of warp chains.

6. In a circular loom, the combination with a plurality of pairs of positively-driven let-off rolls, of a warp beam sustained independently of and at a distance from the loom, and guides on the loom for guiding the warp threads in the form of warp chains as they pass from the beam to the let-off rolls.

7. In a circular loom, the combination with a plurality of pairs of positively-driven let-off rolls, of a warp beam sustained independently from the loom, means to guide the warp threads from the warp beam to the let-off rolls in the form of warp chains, and a separating comb for each pair of let-off rolls to separate the warp threads of the warp chain before said warp threads are delivered to the let-off rolls.

8. In a circular loom, the combination with loom-operating mechanism, of a controlling device therefor, a plurality of manually-operated starting shafts, and means connecting all said shafts to the controlling device.

9. In a circular loom, the combination with loom-operating mechanism, of a controlling device therefor, a plurality of connected manually-operated shafts situated at different points around the loom, and means connecting said shafts to the controlling device.

10. In a circular loom, the combination with loom-operating mechanism, of a controlling device therefor, a plurality of starting shafts situated at different positions around the loom, a sprocket chain connecting all of said shafts, and means connecting

said chains to the controlling device whereby the controlling device may be operated from any one of said shafts.

11. In a circular loom, the combination with an annular contact ring, of a plurality of vertically-arranged resilient contact members situated in a circle within said ring, each member being bent at its upper end into a goose-neck shape thereby to form an open eye, the end of said member projecting beyond the body and forming a contact point adapted to engage the contact ring, each contact point being normally held out of engagement with said contact ring by the tension of a warp thread passing through said open eye, and means to stop the loom when any contact member engages a contact ring.

12. In a circular loom, the combination with a loom frame having a raceway, of a shuttle in the raceway having continuous electrical connection with the loom frame, a movable weft controlled contact carried by the shuttle, a fixed contact also carried by the shuttle but insulated therefrom, and means to stop the loom when said contacts are brought into engagement.

13. In a circular loom, the combination with a loom frame having a contact ring insulated therefrom, of a shuttle in continuous electrical contact with the loom frame, a weft-controlled contact carried by the shuttle, a fixed contact also carried by the shuttle and continuously in electrical contact with said contact ring, and means to stop the loom when the weft-controlled contact engages the fixed contact.

14. In a circular loom, the combination with an annular shuttle raceway, of an insulated contact ring situated beneath the raceway and having contact pins projecting into the shed, a shuttle to traverse the raceway, said shuttle having an insulated contact, means to provide electrical connection between said contact and the contact ring as the shuttle moves, a weft-controlled contact also carried by the shuttle but normally held out of engagement with the insulated contact by the weft, and means to stop the loom when said contacts meet.

15. In a circular loom, the combination with a raceway for a shuttle, of a shuttle in said raceway, said shuttle having a plurality of weft-packing wheels arranged to act on the crossed warps at the fell of the cloth, the front one of said wheels having associated therewith an annular weft guide and said shuttle also having means to deliver weft thread to said guide and thence to the cloth in the rear of the shuttle.

16. In a circular loom, the combination with a loom frame having a shuttle raceway comprising upper and lower tracks connected by an annular reed, of a shuttle in said raceway having permanent electrical contact with said reed, a movable weft-controlled contact carried by the shuttle, a contact fixedly carried by the shuttle but insulated therefrom, and means to stop the loom when said contacts come into engagement.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

ANKER PETERSEN.

Witnesses:
LOUIS C. SMITH,
THOMAS J. DRUMMOND.