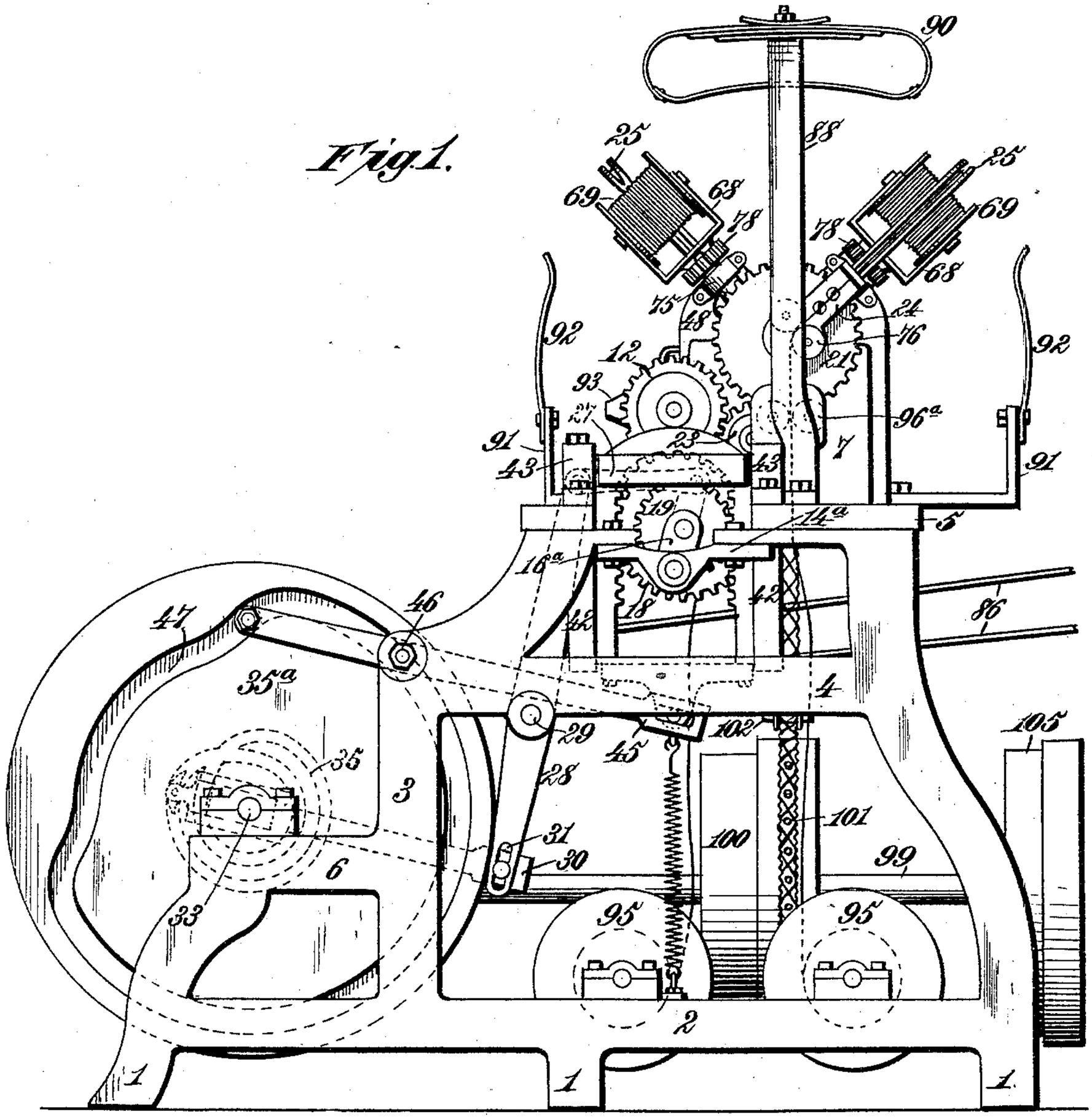
(No Model.) 7 Sheets—Sheet 1.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 1.



Witnesses.
Robert Gnett,
Geo. W. Rea,

Inventor:
George P. Rishel.
By James L. Norris.
Atty.

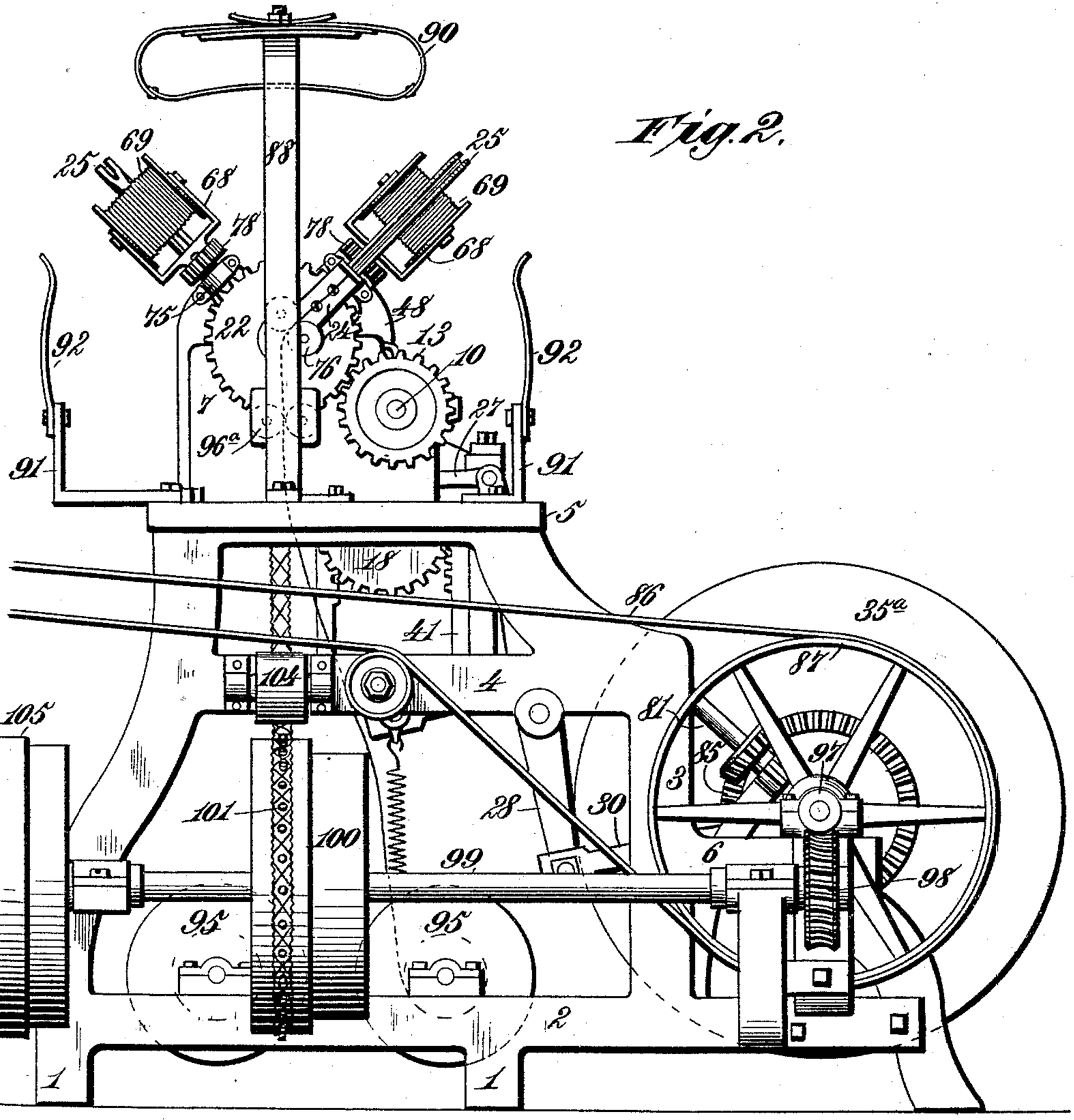
(No Model.) 7 Sheets—Sheet 2.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 2.



Witnesses.
Robt Everett.
Geo. W. Rea.

Inventor.
George P. Rishel.
By James L. Norris.
Atty

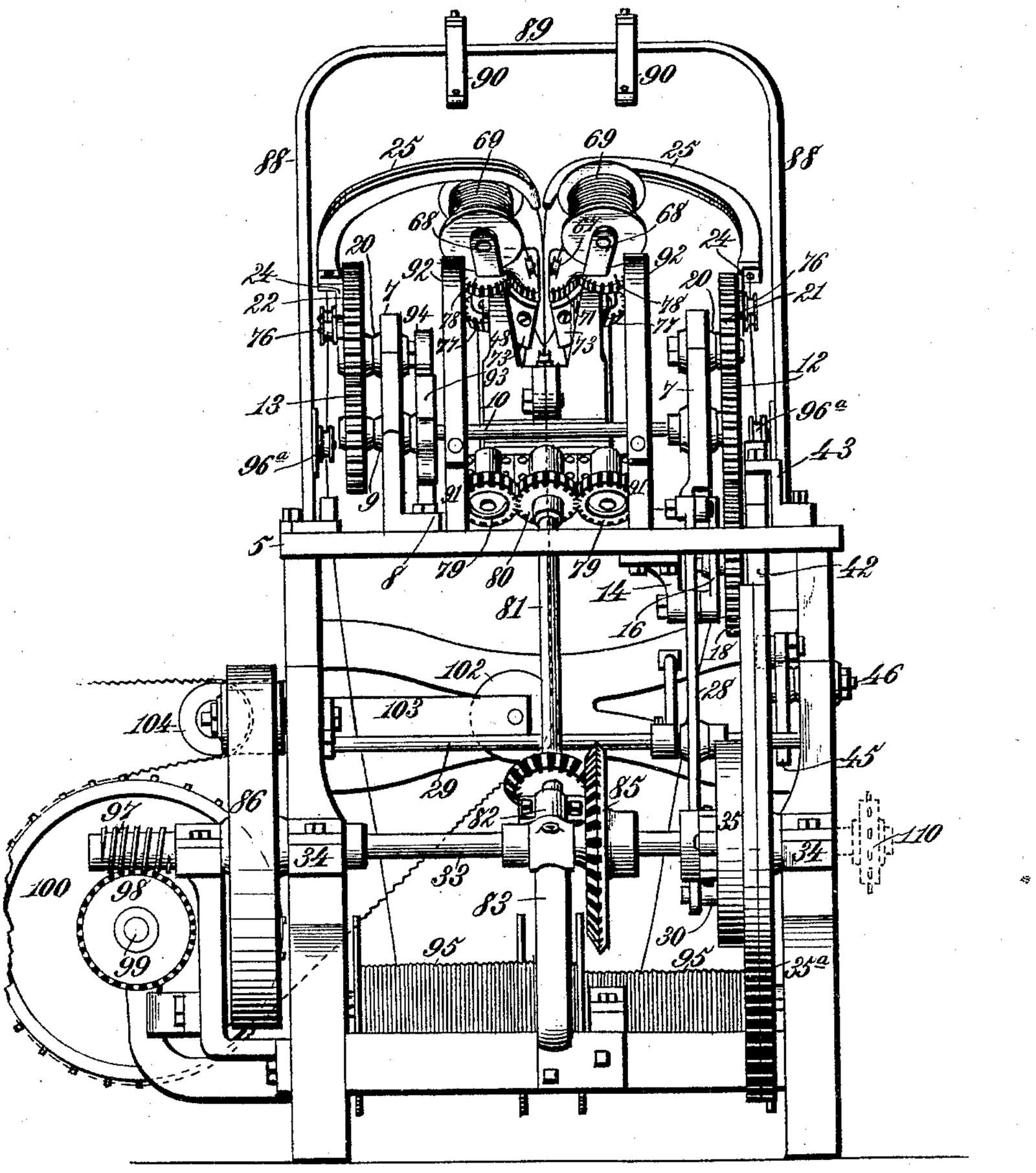
(No Model.) 7 Sheets—Sheet 3.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 3.



Witnesses.
Robt Gruett,
Geo. W. Rea.

Inventor.
George P. Rishel.
By James L. Norris.
Atty

(No Model.) 7 Sheets—Sheet 4.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 4.

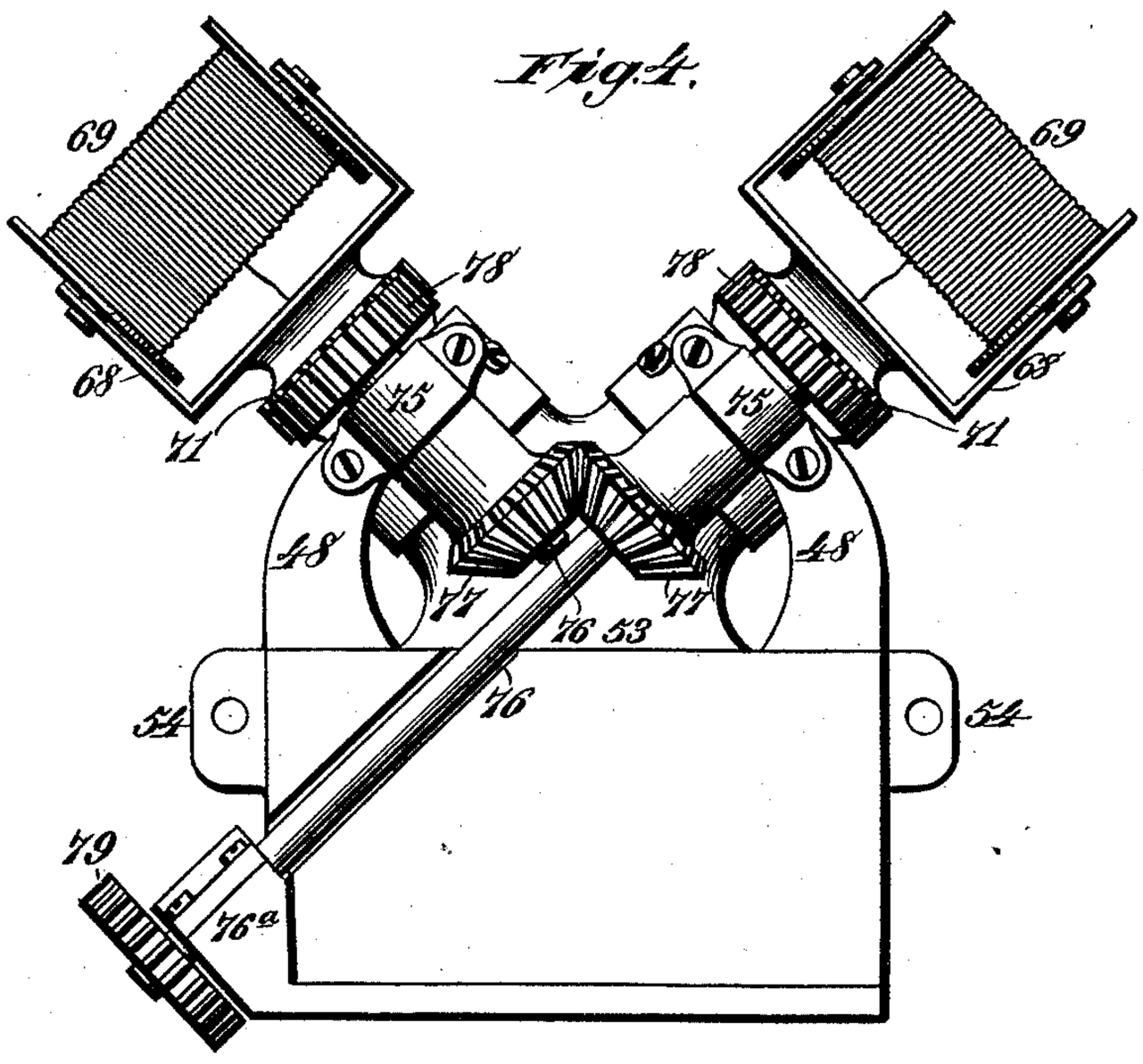


Fig. 5.

Witnesses.
Robt Everett,
Geo. H. Rea

Inventor.
George P. Rishel.
By James L. Norris.
Atty.

(No Model.) 7 Sheets—Sheet 5.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 6.

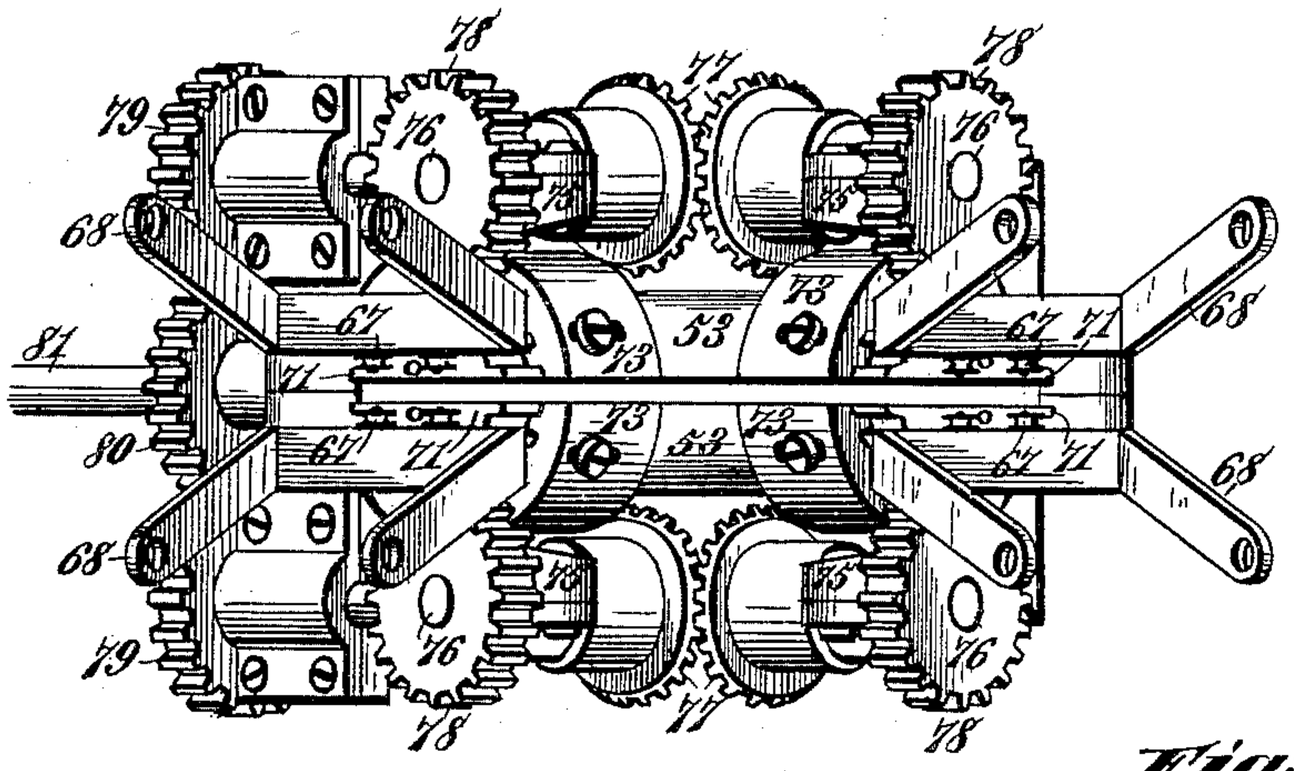


Fig. 7.

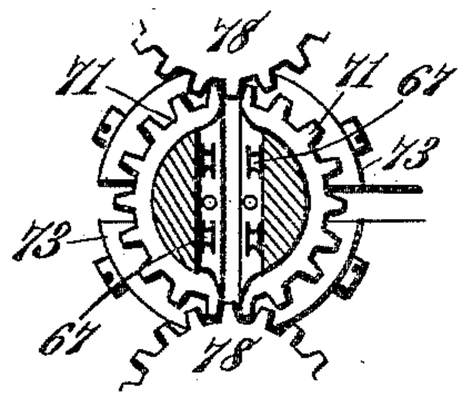


Fig. 8.

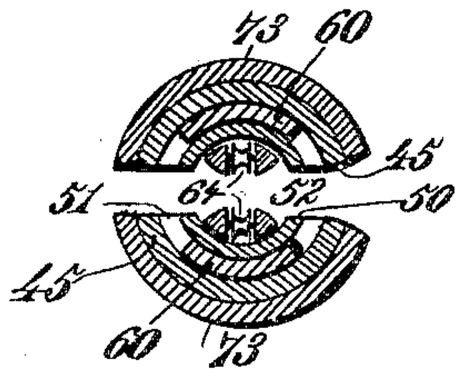


Fig. 9.

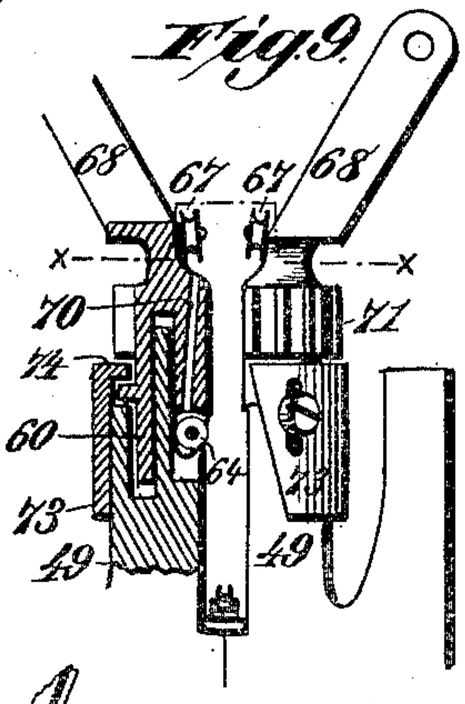


Fig. 10.

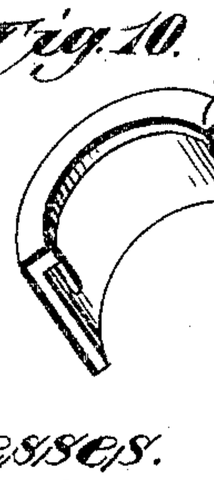


Fig. 11.

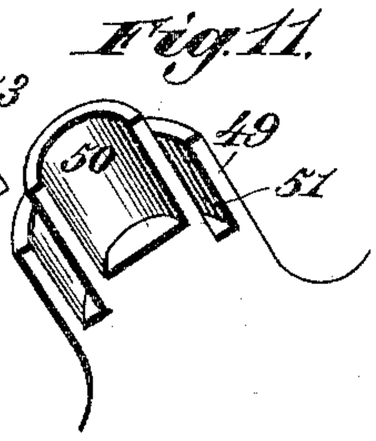
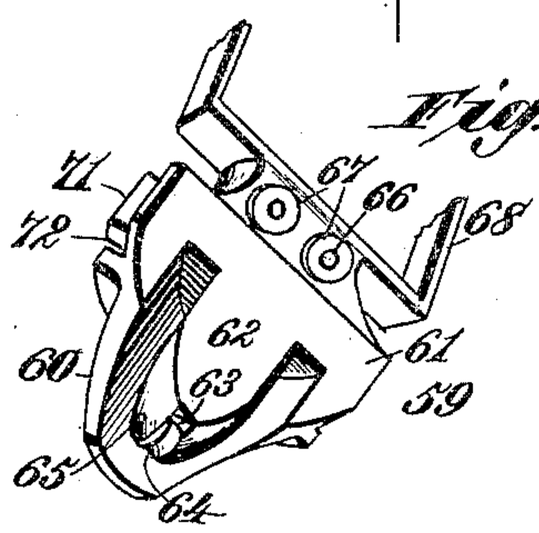


Fig. 12.



Witnesses.
Robert Everett.
Geo. W. Rea.

Inventor.
George P. Rishel.
By James L. Norris.
Atty.

(No Model.) 7 Sheets—Sheet 6.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 13.

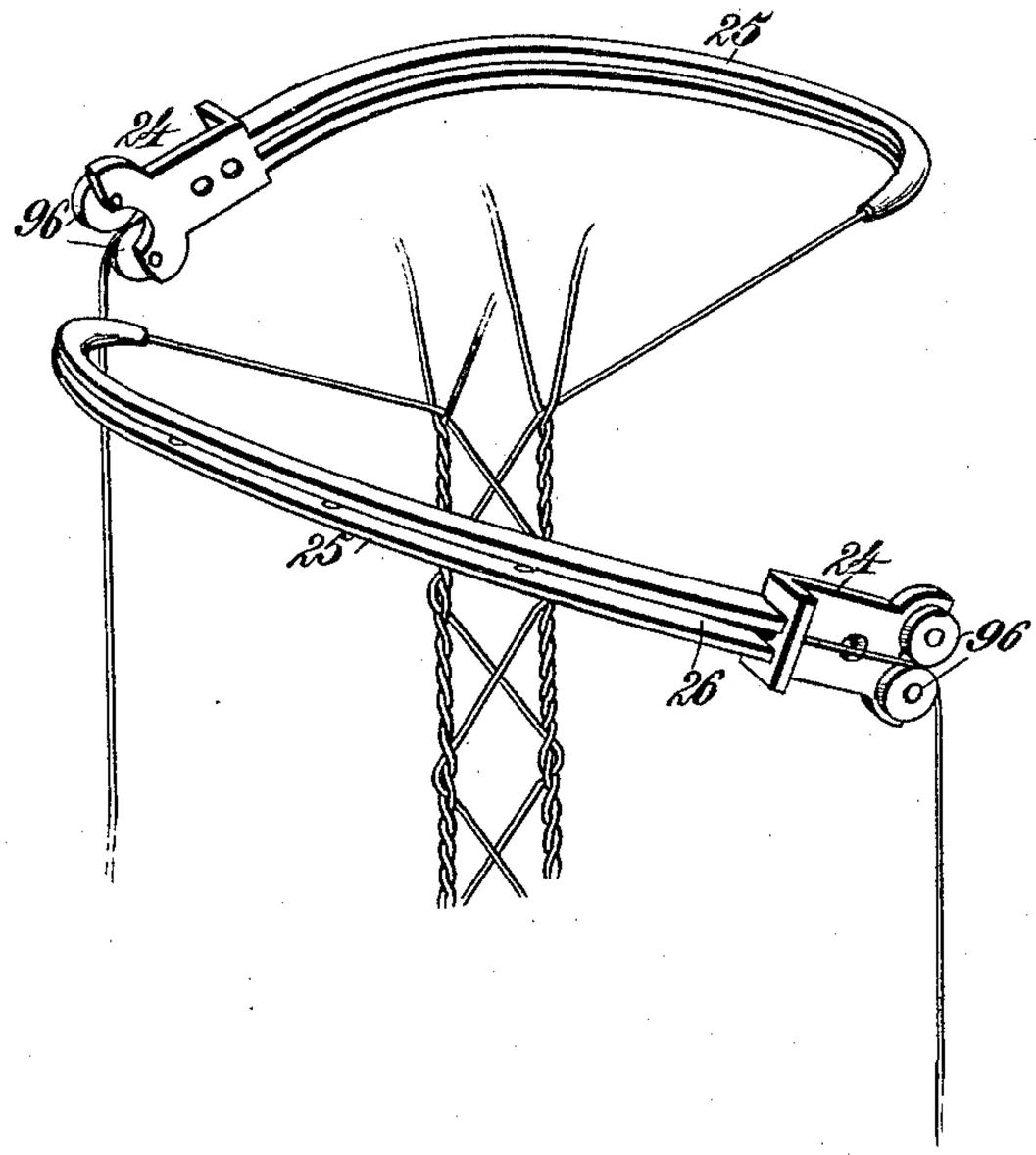


Fig. 14.

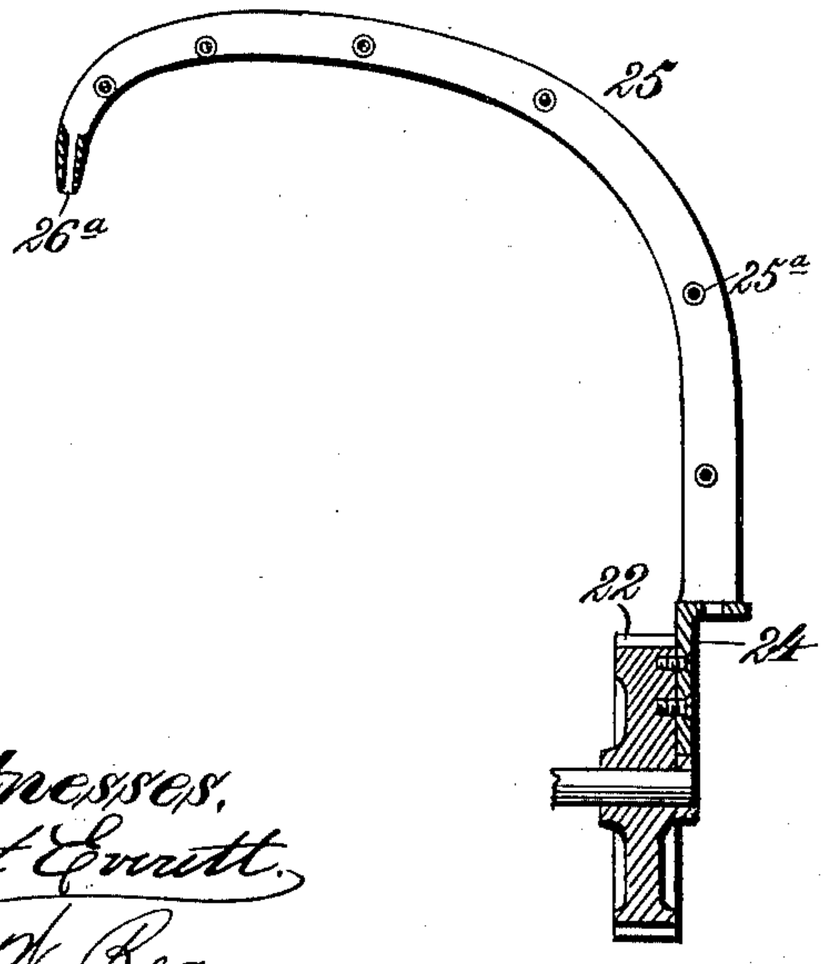
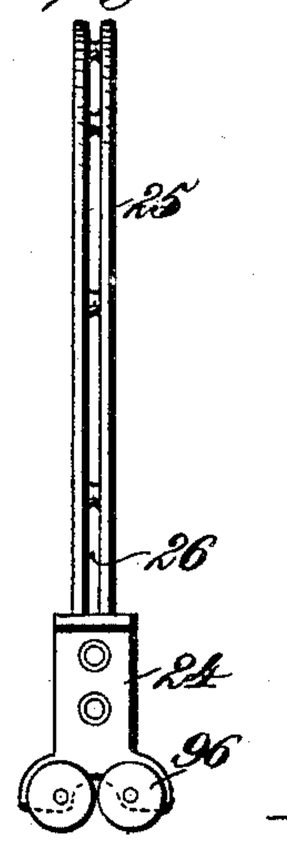


Fig. 15.



Witnesses.
Robt Everett.
Geo. H. Rea.

Inventor.
George P. Rishel.
By James L. Norris.
Atty.

(No Model.) 7 Sheets—Sheet 7.

G. P. RISHEL.

MECHANISM FOR FORMING WIRE STRANDS.

No. 453,066. Patented May 26, 1891.

Fig. 16.

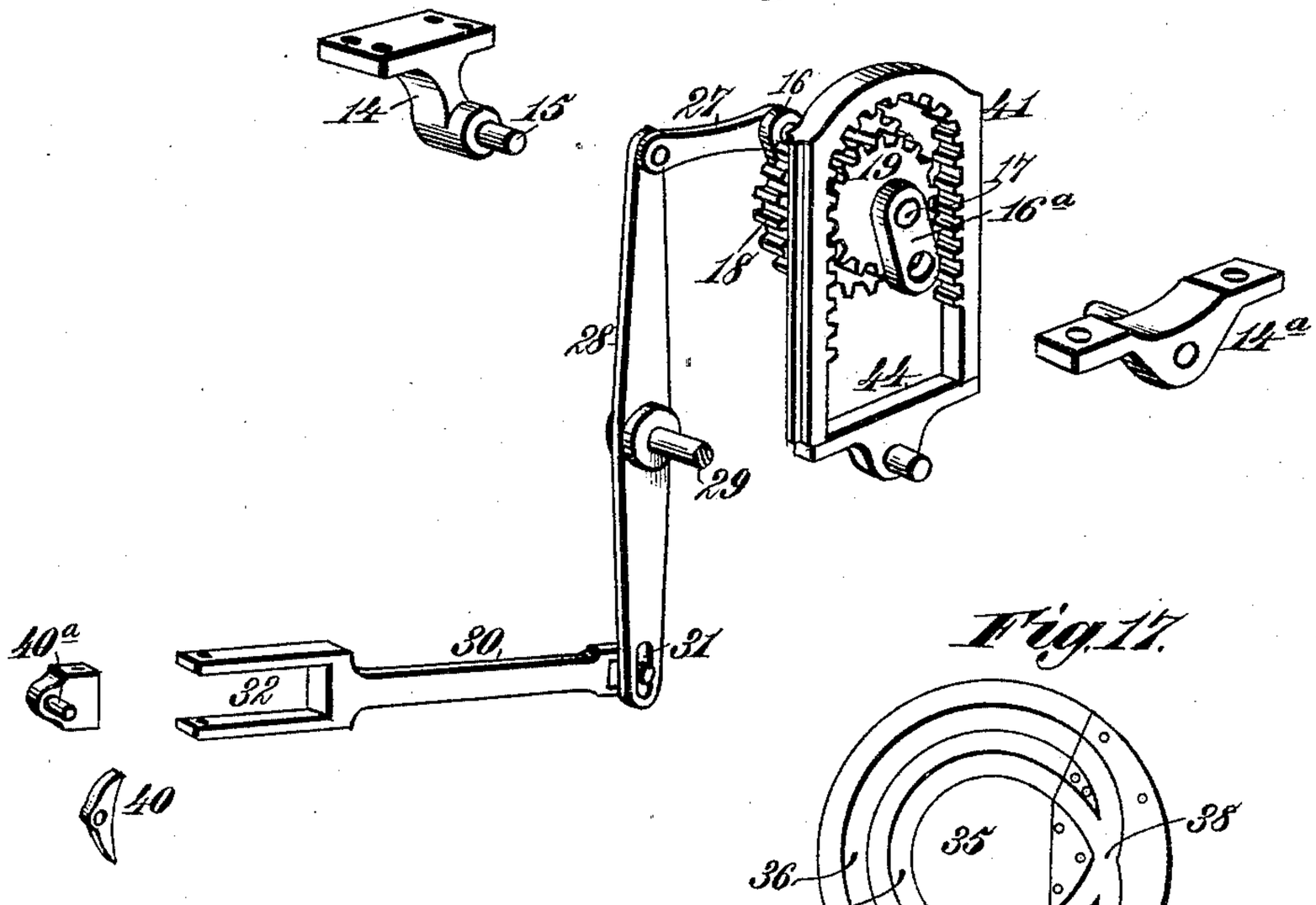


Fig. 17.

Fig. 22.

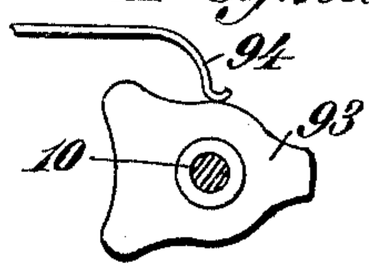


Fig. 18.

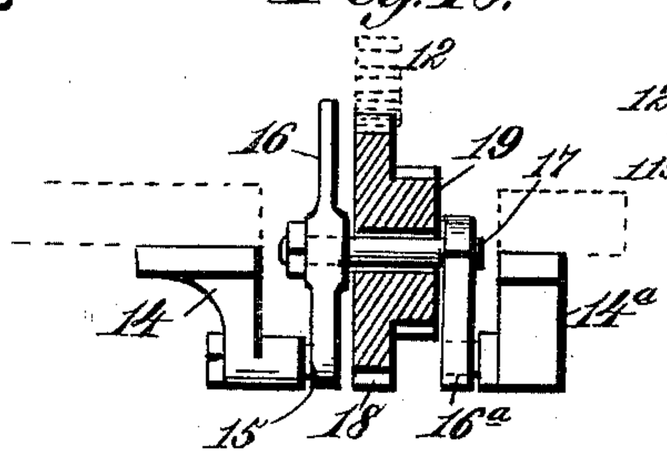


Fig. 19.

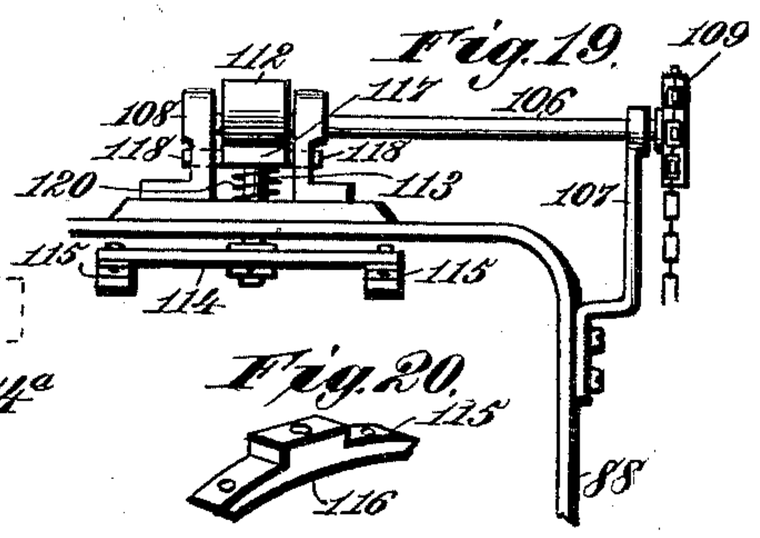
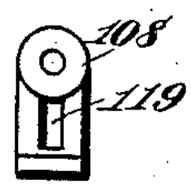


Fig. 20.

Fig. 21.



Witnesses.
Robt Everett,
Geo. W. Rea

Inventor.
George P. Rishel.
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

GEORGE P. RISHEL, OF HORNELLSVILLE, NEW YORK.

MECHANISM FOR FORMING WIRE STRANDS.

SPECIFICATION forming part of Letters Patent No. 453,066, dated May 26, 1891.

Application filed February 7, 1891. Serial No. 380,647. (No model.)

To all whom it may concern:

Be it known that I, GEORGE P. RISHEL, a citizen of the United States, residing at Hornellsville, in the county of Steuben and State of New York, have invented new and useful Improvements in Mechanism for Forming Wire Strands, of which the following is a specification.

My invention relates to certain improvements in mechanism for weaving strands for wire fences, screens, and other structures.

It is the purpose of my said invention to provide automatic machinery whereby strands or webs of any desired width and length may be rapidly and economically produced, the filling-wires of each strand being interlocked with the twisted wires thereof.

It is my further purpose to provide automatic mechanism for the purpose described having means whereby a variety of ornamental forms may be produced in the filling-wires of each strand, and to combine with the twisting mechanism and with the devices laying the filling-wires means whereby the twisted side wires or "warp-wires," as they may be termed, are closed upon the interlocking filling-wires to form a uniform spiral or twist, and to firmly lock the filling-wires and thereby stiffen and strengthen the strand.

To these ends my invention consists in the several novel features of construction and new combinations of parts hereinafter fully set forth, and then more particularly pointed out and defined in the claims concluding this specification.

To enable others skilled in the art to make and use my said invention, I will proceed to describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of a machine embodying my invention. Fig. 2 is a similar elevation of the opposite side of the machine. Fig. 3 is an elevation of the machine, taken from the rear end. Fig. 4 is a detail elevation, upon an enlarged scale, of one part of the bracket supporting the gearing operating the twisting-arms, together with the spools, spool-supports, and gearing driving the twisting-heads. Fig. 5 is a similar view of another part of the two-part bracket, each part carrying one-half of the cleft-bearings for the twisting-heads. Fig. 6 is a plan view of the parts shown in Figs. 4 and 5, the parts of the bracket being united. Fig. 7 is a detail section of one of the cleft-bearings for one pair of the twisting-heads, the section being taken on the line $x\,x$, Fig. 9. Fig. 8 is a detail section of the same parts on the line $y\,y$, Fig. 9. Fig. 9 is a detail section, partly in side elevation, of the cleft-bearing and the pair of twisting-heads mounted therein, one part of said bearing and one of the heads being in section and the other in elevation. Fig. 10 is a detail perspective view of the outer or flanged holding-plate shown in Figs. 8 and 9. Fig. 11 is a detail perspective of one part of the cleft-bearing, the twisting-head and outer plate being removed. Fig. 12 is a detail perspective of one of the twisting-heads and its parts. Fig. 13 is a diagram showing the action of the arms which lay the filling-wires and illustrating the formation of the twist and interlocking of the filling-wires. Fig. 14 is a side elevation of one of the arms carrying the filling-wires, with its supporting-gear and foot-piece in section. Fig. 15 is a rear elevation of the arm and foot-piece. Fig. 16 is a perspective view of the double rack, its operating-lever and pitman, the compound gear driven by said rack, and the brackets supporting the bearings of the rocking lever carrying the compound gear, the parts being separated, but shown in their proper relative positions. Fig. 17 is a face view of the disk having the compound cam-race operating the pitman shown in Fig. 16. Fig. 18 is a detail view of a portion of the machine-table, the brackets, the rocking lever supported thereby, the compound gear carried by said lever, and part of the double rack, the compound gear being in central vertical section. Fig. 19 is a detail elevation of part of the arch and one of the uprights, showing one form of devices for retarding the arms carrying the filling-wires. Fig. 20 is a detail perspective of one of the brake-shoes shown in Fig. 19. Fig. 21 is a detail view of one of the brackets shown in Fig. 19 supporting the cam-shaft. Fig. 22 is a detail elevation of the cam-brake by which the rotation of the gears driving the devices by which the arms laying the filling-wires are operated are alternately retarded and then aided.

The reference-numeral 1 in said drawings

indicates the feet supporting the side frames of the machine. At a short distance from the floor these feet are connected by horizontal portions 2. The rear legs rise with a slight curvature to the machine-table. The front legs are much shorter, being terminated at short horizontal pieces 6, uniting with vertical bars 3, which extend some distance above the piece 6, and are then curved rearward and upward to the front of the table 5. The vertical bars 3 are united with the rear legs by a brace 4, which is horizontal, or substantially so.

Upon the table 5 is detachably mounted a frame composed of two uprights 7, bolted to the table 5. In the uprights 7 are formed bearings 9 for a horizontal shaft 10, the ends of which project beyond the outer faces of said uprights, said ends being provided with spur-gears 12 and 13.

Bolted to the lower face of the table 5, at or near one end of the same, is a hanging bracket 14, which lies in an opening in the table, and mounted by one end upon a stud 15, supported in or formed upon said bracket, is a lever 16, provided with a stud or bolt 17, located between the ends of said lever and projecting outwardly. Upon this stud is mounted a compound gear consisting of two spur-wheels 18 and 19 of different diameters, the larger 18 being arranged to mesh with the spur-gear 12 and through the latter driving the shaft 10 and the gear 13 upon its other end. The stud or bolt 17 receives support at its outer end by means of a bracket 14^a, bolted to the lower face of the table 5, and having a bearing which receives a pin upon a rocking support 16^a, Figs. 16 and 18, lying close to the outer face of the compound gear, and receiving in an opening in its upper end the outer end of the stud 17.

In the upper portion of each of the uprights 7 are mounted outwardly-projecting stud-bearings 20, upon which are journaled spur-gears 21 and 22, the former meshing with an intermediate 23, which is driven by the spur-gear 12, and the latter 22 meshing with the spur-gear 13. By the interposition of the intermediate gear 23 the spur-gears 21 and 22 will have simultaneous rotation in opposite directions whenever rotation is imparted to the shaft 10.

Bolted upon the outer faces of the spur-gears 21 and 22 are foot-pieces 24, arranged radially, and provided at their upper ends, which rise above the gears, with curved arms 25, arched over the uprights 7 and having their free ends brought nearly into contact substantially in the central vertical plane of the bracket-frame supporting the spur-gears. Upon their outer or convex edges these arms are channeled or provided with grooves 26, extending nearly to each end of the arm, where a hole 26^a is formed, for a purpose presently to be shown. The arms may be formed of two parallel curved plates, and the channels 26 may consist simply of the space between said arms, as shown in Figs. 13, 14, and 15, though not the preferred construction. When thus formed cross-pins are inserted at suitable intervals, provided with friction-rolls 25^a, for a purpose presently to be shown. The mounting and function of the grooved rolls shown in the figures mentioned will be explained hereinafter.

To the upper end of the rocking lever 16, carrying the compound gear 18 and 19, is pivotally connected one end of a link 27, the other end thereof being attached to a lever 28, parallel, or substantially so, with the lever 16 and fulcrumed upon a tie-rod 29, which connects the beam 4. To the power end of this lever, which drops below its fulcrum, is connected the end of a pitman 30, adjustable toward and from the fulcrum 29 by means of a slot 31 in the end of the lever, in which the pivotal connection may be set and locked at any desired point. The pitman 30 has an elongated opening 32, through which passes a shaft 33, journaled in bearings 34 upon the short horizontal arms 6 of the machine-frame. This shaft carries a disk 35, having in one of its vertical faces a compound or duplex cam-race composed of outer and inner parallel channels 36 and 37, which meet or intersect at a common point 38, as shown in Fig. 17, whereby one of the ends of the outer channels 36 passes into the opposite end of the inner channel 37 upon the same curve.

Upon the forked end of the pitman 30 is a centrally-pivoted dog 40, mounted upon a head or block 40^a, bolted between the arms of the fork, said dog lying in one of the channels of the cam-race in the disk 35. As the latter revolves, the dog passes from one channel to the other, and vice versa, thereby giving longitudinal movement to the pitman operating the lever 28 and swinging the lever 16, by which motion the compound gear 18 and 19 is vibrated in a short arc of a circle of which the stud 17 is the center. This arc is very short, and the subtended chord is substantially a horizontal line. As the gear 18 meshes with the lower edge of the gear 12, the engagement of said gears is for this reason little affected by the movement described. The lower end of the lever 28 is slotted to provide an adjustable attachment for the end of the bar 30, whereby the throw of the lever 16 may be accurately adjusted to mesh the gear 19 in the manner about to be described.

Outside the gears 12 and 18, but in the same vertical plane with the gear 19, is a yoke-shaped rack 41, which passes vertically through the table 5, being mounted in a frame 42, which is sustained by two brackets 43, arranged upon opposite sides of the opening in the table in which the compound gear and its supports are arranged. The inner edges of the parallel arms of this rack are provided with teeth, the arms being separated by such an interval that when the gear 19, which lies between them, is in mesh with the teeth on one arm it is entirely disengaged from those

upon the other. The lower ends of the toothed arms of the yoke are connected by a cross-bar 44, to which is pivotally connected the end of a lever 45, having its fulcrum 46 upon the frame of the machine. Upon the power end of the lever is a bearing having a friction-roll which lies in a cam-race 47, formed in the outer face of a disk 35^a upon the same shaft with the disk 35. For a considerable part of the circumference of the disk near which it lies this cam-race is concentric, or nearly so, with said disk, and at the ends of this concentric portion the race is sharply curved and crosses the face of the disk nearly in the line of a chord subtending an arc of about one hundred and twenty degrees. These proportions, however, while only stated approximately, are subject to very wide variations, as will be seen hereinafter. The revolution of the disk 35^a will operate the lever 45 in such manner as to raise the toothed yoke in its frame 42, which is channeled to receive the feathered edges of the rack, hold it for a short interval, and then return it to its original position, where it is held during the time the roll on the end of the lever 45 remains in the concentric portion of the cam-race. The action of the lever 16 and gear 19, together with that of the other parts described, will be fully explained and "timed" hereinafter.

Upon the table 5, between the upright 7 and upon one side of the shaft 10, is arranged a two-part bracket-frame, Figs. 4 and 5, each part having two substantially semicircular bearings, Figs. 7 to 11, inclusive, each consisting of outer and inner concentric nearly semicircular plates 49 and 50, separated from each other to form an intermediate channel 51, which is nearly semicircular. The inner semicircular plate 50 rises somewhat above the outer, and when the other portion of the bracket is in place the two similar half-bearings thereon form, in connection with those already described, two substantially circular bearings, each divided by a diametrical channel 52, which lies in a vertical plane transverse to the shaft 10. These circular bearings are arranged when the bracket is in place upon opposite sides of a vertical plane lying parallel with the shaft 10, with which plane their axes form angles of about forty-five degrees, more or less. Each half-bearing is supported upon each part of the bracket by a central base-piece 53, and the two parts of said bracket are fastened together, when in place, by bolts engaging with lugs 54 upon the ends of the bracket-sections. The channel 52 between the half-bearings lies in the same plane with an opening extending below said bearings to a horizontal shelf 55. This shelf is provided with an opening at or near its central point, and upon the ends of the shelf, adjacent to said opening, are mounted adjustable brackets 56, (see Fig. 5,) having forked ends extending over said opening and provided with grooved wheels or rolls 57, the other ends of said brackets being provided with slots 58 to receive bolts fastening said brackets to the shelf.

The numeral 59 designates one of the twisting-heads, consisting, substantially, of a metallic plate 60, curved to lie in the channel 51, and provided with a head or top 61, which is somewhat less than a semicircle and is adapted to rest upon the upper edge of the inner plate 50 of the half-bearing. Depending from this head or top is a central or substantially central guide-point 62, having a flat face which is flush with the wall of the diametrical channel 52, its curved face being concentric with the plate 60, and the space between the two being such that the inner curved plate 50 of the half-bearing is received therein, Figs. 9 to 12, the central guide-point lying within the concave face of the inner plate 50, as shown in Figs. 8 and 9. In the lower end of the depending guide-point 62 is formed a slot 63, in which is arranged a grooved roll 64, mounted upon a cross-pin 65. Upon the upper portion of the twisting-head are mounted studs or pins 66, which project beyond the flat face of the same. Upon these pins or studs are mounted grooved rolls 67, for a purpose which will be explained hereinafter.

Upon the head or top 61 I mount a bracket 68, having ears or lugs which constitute supports for the spindle of a spool or bobbin 69, mounted upon each semicircular twisting-head. These bobbins or spools are filled with wire of suitable size, which is carried from the spool under and then over the grooved roll 67, thence under and over the second roll, thence downward through an opening 70 in the central guide-point 62, and after traversing the longitudinal passage or channel it passes over the grooved roll 64. The edges of the curved plate 60 are cut away or beveled off toward each other, and the lower end of the central guide-point is also rounded off to remove the sharp edges, the purposes of these features being explained hereinafter.

Upon the outer or convex face of the plate 60, at its top, is formed a series of gear-teeth 71, the lower ends thereof resting upon the upper edge of the outer plate 49 of the semicircular half-bearing. A little above the ends of the teeth 71 is a channel 72, cut from end to end of the series of teeth to or nearly to the exterior face of the curved plate 60. Screwed or otherwise attached to the outer face of the plate 49 is a similarly-curved plate 73, having an inwardly-turned flange 74, which is inserted in the channel 72, thereby holding the twisting-head within the half-bearing, but permitting its rotary movement, the curved plate 60 and the central guide-point 62 sliding in the concentric channel 51 and against the concave face of the inner plate 50 when the two semicircular half-bearings are in place. This movement is produced in the following manner: Upon the outer faces of the arms 48, curving slightly and rising from the ends of each section of the bracket supporting the semicircular

half-bearings, are journal-bearings 75, in which are mounted shafts 76, arranged parallel with the axes of the half-bearings and having upon their lower ends miter-gears 77, which are intermeshed, while upon their upper ends are spur-gears 78, meshing with the gear-teeth 71 upon the upper ends of the bobbin-supports. By examining Fig. 7 it will be seen that the teeth 71 upon each twisting-head are so formed that the interval between the teeth on one twisting-head and those on the other is just sufficient to admit one of the teeth of either spur-gear 78, thus preserving the parallelism between the flat faces of the twisting-heads and retaining them at all times in such relative position that the space between said flat faces will coincide at each half-revolution with the diametrical channel 52 between the semicircular heads and form an uninterrupted vertical passage, as shown in Fig. 9. One of the shafts 76 upon each half of the bracket is prolonged nearly to the foot of the bracket, where it catches a second bearing in a bracket-lug 76ª, the end projecting beyond said lug receiving a spur-gear 79. Between these two spur-gears and meshing with both is a gear 80, carried by a shaft 81, which extends through the table 5, where it has bearing in a box 82, and is prolonged until its end reaches nearly to the shaft 33, where it receives bearing in a bracket 83, rising from the skeleton platform. This shaft 33 carries the disks 35 and 35ª, having the cam-races already described, and upon said shaft is mounted a miter-gear 85, meshing with a similar gear upon the shaft 81. The shaft 33 is driven by a belt 86 and pulley 87, the latter being mounted on said shaft. Rising from the sides of the table 5 are uprights 88, which extend above the curved arms 25 and are connected by a cross-bar 89. Mounted upon the latter transversely thereto are springs 90, slightly resembling the ordinary elliptical spring and arranged over the arched portions of the arms 25 in such position that as the latter rise toward a vertical position they will engage the lower members of said springs and have frictional movement thereon, the maximum resistance being exerted at the point where the arms 25 reach a vertical position. Upon the opposite ends of the table 5 are also placed brackets 91, carrying springs 92, which act, in conjunction with the springs 89, to prevent excessive vibration of the arms 25 at the end of the stroke. In addition to those devices I mount upon the shaft 10 a triple cam 93, consisting, substantially, of a disk having three cam-points, two of which project in radial lines at an angle with each other of about ninety degrees and the third points from the opposite side of the same disk in a diametrical line passing between the two arms first mentioned. A spring 94 has a bent point resting upon the edge of this cam, and as the shaft 10 revolves this spring will be lifted by these cam-arms, thereby tending to retard the movement of the shaft at certain points, and then as the point of the spring descends upon the other edge of the cam-arm expediting the revolution of the shaft. These devices constitute a cam brake and accelerator, alternately aiding the movements of the arms 25 as they pass from one to the other of the positions shown in Fig. 2 and retarding their further movement, which is checked by the springs 91.

Upon the horizontal pieces 2, supported in any suitable bearings, are reels 95, from which the filling-wires are taken. These wires are led between grooved rolls 96, mounted on the foot-pieces of the arms 25, first, however, passing between or over rolls 96ª, journaled on plates upon the uprights 88, and then, after traversing the channels in the curved arms, being passed through eyes or openings at the lower free ends of the curved arms 25. In traversing these grooves or channels 26 the wire may pass over and under the friction-rolls to give it tension upon the convex edges of said arms and is then passed through eyes or openings in the extremities of said arms and carried downward to the intersections of the wires taken from the spools or bobbins carried by the supports 59. The end of the shaft 33 projects beyond the pulley and is provided with a worm 97, meshing with a worm-gear 98 upon a shaft 99 at right angles with the shaft 33. Upon the shaft 99 is mounted a reel 100, having a series of steel pins 101 driven into its periphery at regular intervals, forming a kind of sprocket. The manufactured strand is carried over an idler-pulley 102 on a bracket 103, and then received upon this reel and conveyed over an idler 104 to the take-up reel, which is not shown in the drawings, but is driven by a belt from a pulley 105 on the shaft 99.

Instead of using the brake-springs 90 shown in Figs. 1 and 2, I prefer to employ the brake shown in Figs. 19, 20, and 21, in which the numeral 106 indicates a shaft journaled in a bracket 107 on one of the uprights 88, and also having bearing in small brackets 108 on the central portion of the arch. The end of the shaft is provided with a sprocket 109, driven by a similar sprocket 110 on the prolonged end of the shaft 33. Between the brackets 108 a cam 112 is mounted on the shaft 106, and beneath the cam is a spring-raised plunger 113, passing down through the arch, and on its lower end carrying a bar 114, upon the ends of which are mounted brake-shoes 115, formed of metal and faced with rubber 116 or other suitable material. The head 117 of the plunger is provided with guide-pins 118, running in slots 119 in the brackets 108. At each revolution of the main shaft 33 the same speed is imparted to the shaft 106 and its cam 112, and when the arms 25, which carry the filling-wires, are about to move from their outward to their central position the cam causes a downward movement of the piston, whereby the rubber-covered shoes are brought into position to receive the stroke of

the arms. An instant later the cam passes off the plunger, which is raised by a spring 120, coiled on its stem, to release the arms before the next outward stroke of the same. By inclining the axes of the circular bearings in which the twisting-heads move so that they converge downwardly, as shown upon an enlarged scale in Figs. 4 and 5 of the drawings, the delivery ends of the guide-points 62 are brought more closely together, and a narrow strand may be formed, while ample space is provided by this arrangement for the motion of the spools and spool-brackets 68. When strands of greater width are to be formed, this axial inclination is not necessary. It may nevertheless be employed, if preferred.

I have described the filling-wires as passing between or over the rolls 96ª and between the rolls 96 and being thence laid in the grooves or channels 26 of the arms 25, where they may pass over and then, to give them tension, under the rolls 25ª. I prefer, however, to merely groove the arms and dispense with the cross-pins and friction-rolls.

I may employ any suitable tension device; but I may also carry the wires over the rolls 96ª in the form of a recumbent figure **8**, and, if necessary, a similar course may be followed with the rolls 96.

The operation of the machine, which is clearly shown in Figs. 5 and 13, is substantially as follows: The wire from the spools carried upon the divided twisting-heads being carried over the pulleys or wheels 66 and 67, Figs. 5 and 12, to give the proper tension, it is passed from each spool through channel 70 and over the roll 64, and, being united to the corresponding wire on the other part of the twisting-head, the two are drawn downward over one of the guide-rolls 57, Fig. 5, and the same disposition is made of the two wires carried by the other twisting-head, the latter wires being laid in the groove of the other roll 57. These rolls are so adjusted as to give the necessary interval between the pairs of wires and regulate the width of the completed strand. The filling-wires are brought up from spools beneath the table, carried over the rolls 96ª for giving suitable tension, and then passed between the rolls 96 on the foot-pieces 24 and into the channels 26 in the curved arms 25. From the apertures 26ª in the ends of these arms the filling-wires pass downward, as shown in Fig. 5, and, a few twists being given to each pair of wires carried by the twisting-heads, the filling-wires are laid in the intersections of said wires, and the ends of the wires are fastened to any suitable feeding device below the rolls 57 to feed the strand as it is formed until a sufficient length is formed to permit it to be carried over the guide-roll 102 and around the sprocket 100. The machine being now set in motion, continuous revolution is given to the twisting-heads, whereby a uniform twist is imparted to the side wires, which are fed downward as rapidly as said twist is formed. During this formation the curved arms 25 stand vertically, or nearly so, so that the filling-wires lie between the side wires, being retained in this position during the time the roll on the end of the lever 45 is traveling in the concentric portion of the race 47, Fig. 1. When a predetermined length of twist has been formed, the lever 45 is vibrated, and movement is given to the rack 41, and thence, through the compound gear 18 19, to the two trains of gearing which include the gears 21 and 22, thereby throwing or turning the arms 25 outward, as shown in Fig. 13, and crossing the filling-wires between the twisted side wires and laying said filling-wires into the intersections of the side wires immediately above the twisted portions. A single turn of the twisting-heads closes the side wires upon the filling-wires, and as the revolution continues the arms 25 rise to their former position, drawing the filling-wires between the side wires again and holding them in that position during the formation of a second length of twist of the side wires. Upon the completion of the latter the curved arms again move outward, but in the direction opposite to that taken in their first outward movement, again crossing the filling-wires between the side wires and laying them in the intersections above the twist, where they are secured in the manner already described. The subsequent operation is a mere repetition of that described. The action of the curved arms 25 may perhaps be better described by stating that they move simultaneously in opposite directions through an arc of nearly one hundred and eighty degrees, said movement being arrested temporarily when the arms are vertical or so nearly vertical as to bring the filling-wires between the side wires.

What I claim is—

1. In a mechanism for forming wire strands, the combination, with centrally-cleft circular bearings having permanent diametrical channels, of divided twisting-heads adapted to move in said bearings, each part of said twisting-heads carrying one of the wires, substantially as described.

2. In a mechanism for forming wire strands, the combination, with centrally-cleft circular bearings having permanent diametrical channels, of divided twisting-heads arranged and turning in said bearings and provided with depending guide-points through which the wires are carried, substantially as described.

3. In mechanism for forming wire strands, the combination, with centrally-cleft circular bearings, of divided twisting-heads having curved guide-plates lying and moving in outer channels in the cleft-bearings and provided with central depending guide-points lying and moving in central concentric portions of the cleft-bearings and having openings to conduct the wires, and means, substantially as described, for operating the twisting-heads, substantially as described.

4. In mechanism for forming wire strands,

the combination, with centrally-cleft circular bearings having their axes converging, of divided twisting-heads having supports for spools carrying the wires and provided with gear-teeth at or near their upper ends, shafts parallel with the axes of the circular bearings and having intermeshed miter-gears at their converging ends and spur-gears at the other ends meshing with the gear-teeth on the divided twisting-heads, one of said shafts on each half-bearing being prolonged and provided with a spur-gear, and a shaft having a driving-gear meshing with both spur-gears, substantially as described.

5. In mechanism for forming wire strands, the combination, with centrally-cleft circular bearings, of divided twisting-heads having supports for spools containing the wire, means for imparting circular movement to said divided heads, and curved arms overhanging the same and carrying the wires forming the filling, the extremities of said arms having opposite periodical movement in the line of the channel dividing the bearings, substantially as described.

6. In a machine for forming wire strands, the combination, with centrally-cleft circular bearings and divided twisting-heads having spool-supports and provided with tension devices from which the wires pass through central depending guide-points, of spur-gears meshing with gear-teeth formed upon the outer faces of the divided twisting-heads, and curved arms mounted on oppositely-turning gears to throw the arms periodically in opposite directions in the line of the channel dividing the bearings, said arms having grooves for the filling-wires, substantially as described.

7. In mechanism for forming wire strands, the combination, with centrally-cleft circular bearings, each half being composed of curved concentric portions curving through less than a semicircle, of divided twisting-heads having spool-supports and provided with plates lying and moving between the concentric portion of the bearings and having also depending guide-points moving on the concave face of the inner portion of the bearing, the slots or channels dividing the twisting-heads and the bearings being brought into coincidence twice during each revolution of the twisting-heads, and curved arms carrying the filling-wires, their points overhanging the channel between the cleft-bearings, said curved arms having a periodical movement in opposite directions in the line of the channel dividing the bearings, substantially as described.

8. In mechanism for forming wire strands, the combination, with a bearing divided diametrically by a vertical channel or slot, of twisting-heads arranged in said bearings and composed of separate similar parts, each part having a spool-support and being divided or separated from the opposite part by a channel which coincides periodically with the vertical channel of the bearings, curved arms having channels for the filling-wires, their extremities overhanging the channels dividing the bearings, gears on which the ends of said arms are mounted, and means for automatically producing a periodic opposite and partial revolution of the said gears to throw the arms periodically in opposite directions in the line of the channel dividing the bearings, substantially as described.

9. In mechanism for forming wire strands, the combination, with cleft circular bearings, of centrally-divided twisting-heads having spool-supports, gears meshing with gear-teeth on the outer faces of the twisting-heads, means for continuously operating said gears, curved arms laying the filling-wires and carried by oppositely-revolving gears, a compound gear driving the same by one of its members, a yoke-shaped rack engaging the other member, a vibrating lever supporting the journal of the compound gear, a bar vibrating said lever, and a disk having a cam-race in which lies a roll on the end of the bar, substantially as described.

10. In mechanism for forming wire strands, the combination, with cleft-bearings and divided twisting-heads moving therein to twist or spin the cables of the strand, of curved arms carrying the filling-wires and mounted upon oppositely, periodically, and partially rotating spur-gears, a compound gear from which the motion of said spur-gears is derived, a yoke-shaped rack, between the toothed arms of which the other member of the compound gear lies, a lever raising and lowering the rack, a disk having a cam-race operating said lever, a movable bearing supporting the compound gear, and a lever actuated by a cam-race on the opposite side of the disk actuating the rack-lever, substantially as described.

11. In mechanism for forming wire strands, the combination, with bearings divided by central or diametrical channels and having their axes inclined, of twisting-heads each divided diametrically into two similar independent parts, each having a spool-support and provided with a series of teeth upon the outer surface, gears meshing with said teeth and driving the twisting-heads, and adjustable guide-rolls over which the wires run as they come from the twisting-heads, substantially as described.

12. In a machine for forming wire strands, the combination, with circular bearings, each composed of circular plates inclosing an annular channel and a central circular space, the whole divided by a central channel into two equal parts, of twisting-heads each consisting of a curved plate running in the annular channel and a central guide-point lying in the central opening of the bearing and conducting the wire from a spool mounted on

the head of each part, and guide-rolls journaled on adjustable brackets beneath the twisting-heads, substantially as described.

13. In a machine for forming wire strands, the combination, with circular bearings, each composed of an inner and outer plate inclosing an annular channel and a central concentric opening, the whole divided into two equal parts by a diametrical channel, of twisting-heads, each consisting of a plate moving in the divided annular channel and a central guide-point having a passage for the wire, each point having a flat face which substantially coincides with the adjacent walls of the channel in the bearing when turned in the latter, spur-gears meshing with teeth on said twisting-heads, adjustable guide-rolls arranged beneath the latter to regulate the width of the strand, curved arms carrying filling-wires and having their ends from which the wires pass overhanging the diametrical channels in the bearings, and means for sweeping said arms in opposite directions at stated intervals to carry the wires through the channeled bearings and into the intersections of the cables, the edges of the curved plates on the twisting-heads being beveled or converged, substantially as described.

14. In a machine for forming wire strands, the combination, with two circular bearings having a common central channel, of two nearly semicircular twisting-heads traveling in each circular bearing, each semicircular part having a spool-support and being provided with a guide-point for the wire from said spool, curved arms having ways for wires forming the filling of the strand, gearing actuating the twisting-heads, and means for sweeping the curved arms in opposite directions at stated intervals to carry the filling-wires between the twisting-heads and through the channel in the bearings, substantially as described.

15. In a machine for making wire strands, the combination, with circular bearings centrally divided by a vertical channel common to both, of twisting-heads, two of which move in each bearing, gearing driving said heads continuously, curved arms having their ends overhanging the channel in the bearings and having the filling-wires laid in grooves in said arms, gears upon which said arms are mounted, means for giving a partial rotation to said gears in opposite directions to throw the arms periodically in opposite directions in the line of the channel dividing the bearings, a cam-brake consisting of a disk on the driving-shaft provided with arms at intervals, and a spring having its end resting on the edge of said disk, substantially as described.

16. In a mechanism for forming wire strands consisting of parallel twisted cables and filling-wires, the combination, with the twisting devices and with the vibrating arms carrying the filling wires, of brake-shoes mounted on a support carried by a spring-raised plunger, a cam acting on said plunger, and a cam-shaft geared to the main shaft of the machine to revolve therewith, whereby said brake-shoes are lowered and raised to arrest and release the said vibrating arms, substantially as described.

17. In a mechanism for forming wire strands, the combination, with circular bearings having their axes inclined relatively to each other, of two divided or separate twisting-heads arranged in each bearing, and gears arranged upon opposite sides of the bearings and meshing with external teeth formed upon said twisting-heads, substantially as described.

18. In a mechanism for forming wire strands, the combination, with centrally-cleft circular bearings having their axes converging downwardly, of divided twisting-heads adapted to move in said bearings, and gearing meshing with teeth upon the parts of the divided heads and having shafts arranged in parallelism with the inclined axes of the circular bearings, the lower ends of said shafts being provided with intermeshing miter-gears, substantially as described.

19. In a mechanism for forming wire strands, the combination, with centrally-cleft circular bearings, of divided twisting-heads adapted to move in said bearings and having their axes inclined to converge downwardly, each part of the divided twisting-heads being provided with a spool-bracket, and gearing meshing with teeth upon the parts of the twisting-heads, substantially as described.

20. In a mechanism for forming wire strands, the combination, with centrally-cleft circular bearings, of divided twisting-heads, each composed of a curved plate having a head or top and a substantially central guide-point depending from said head, both the plate and the guide-point having their edges beveled or cut away, curved plates detachably mounted upon the cleft-bearings and having inwardly-turned flanges engaging slots in the parts of the divided twisting-heads, and gearing meshing with teeth upon said parts, substantially as described.

21. In a mechanism for forming wire strands, the combination, with circular bearings, of twisting-heads moving therein to form the parallel twisted cables of the strand, and means for carrying filling wires in opposite directions between the wires forming each cable at the points where said wires intersect to form the twist, substantially as described.

22. In a mechanism for forming wire strands, the combination, with circular bearings, of twisting-heads carrying two wires in each bearing and having their axes inclined to bring the points where the two parallel twisted strands are formed into suitable proximity, and means for continuously feeding said strands in substantial parallelism as they are twisted, substantially as described.

23. In a mechanism for forming wire

strands, the combination, with circular bearings, of twisting-heads carrying and intertwisting two wires in each bearing, means for feeding said strands continuously in substantial parallelism as they are twisted, and adjustable guide-rolls by which the interval between said strands may be still further diminished, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

GEORGE P. RISHEL. [L. S.]

Witnesses:
M. C. CRANE,
C. F. KEYSER.