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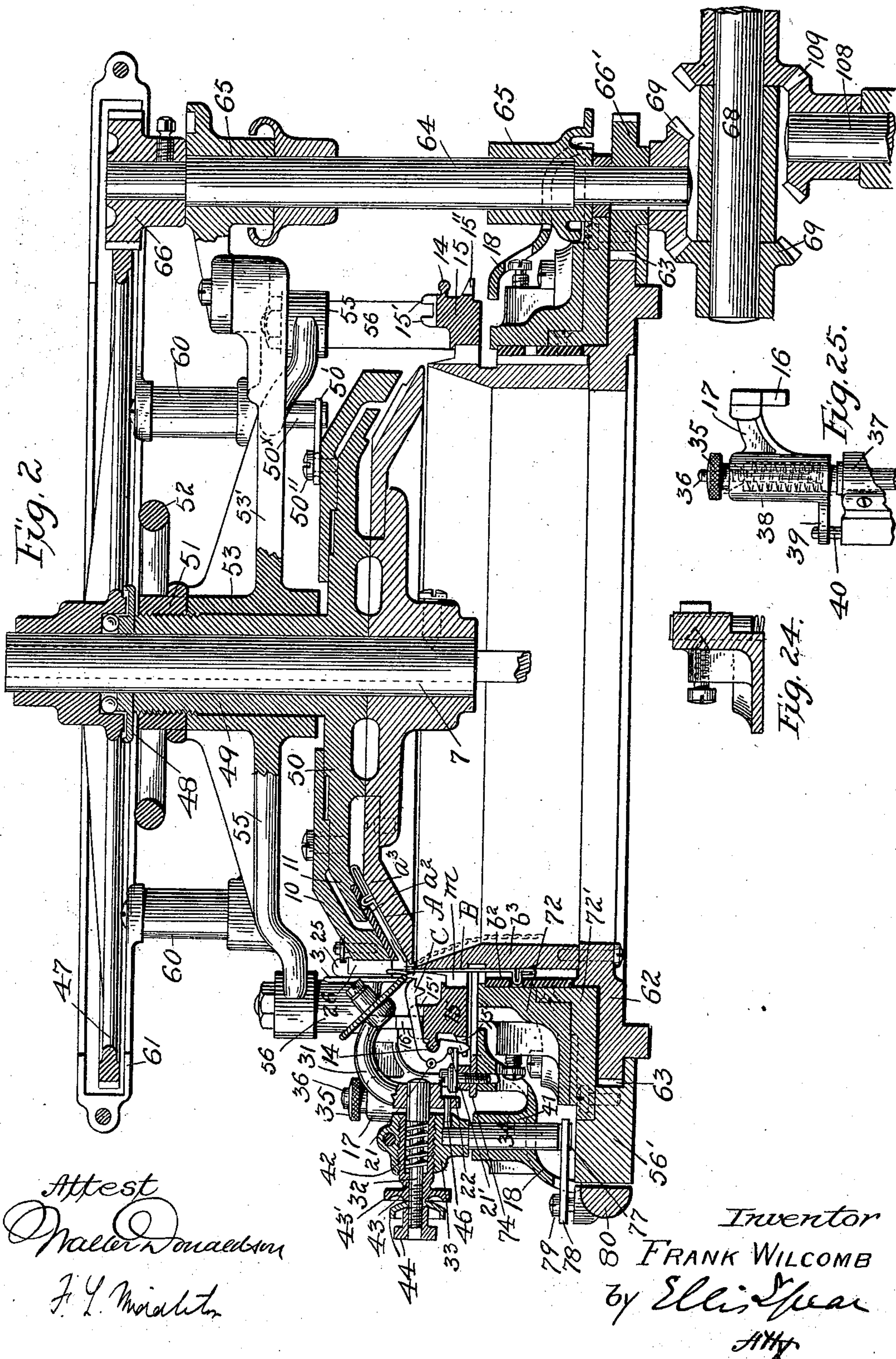
Patented Oct. 22, 1901.

F. WILCOMB.
KNITTING MACHINE.

(Application filed July 27, 1899. Renewed May 1, 1901.)

(No Model.)

6 Sheets—Sheet 2.



No. 685,075.

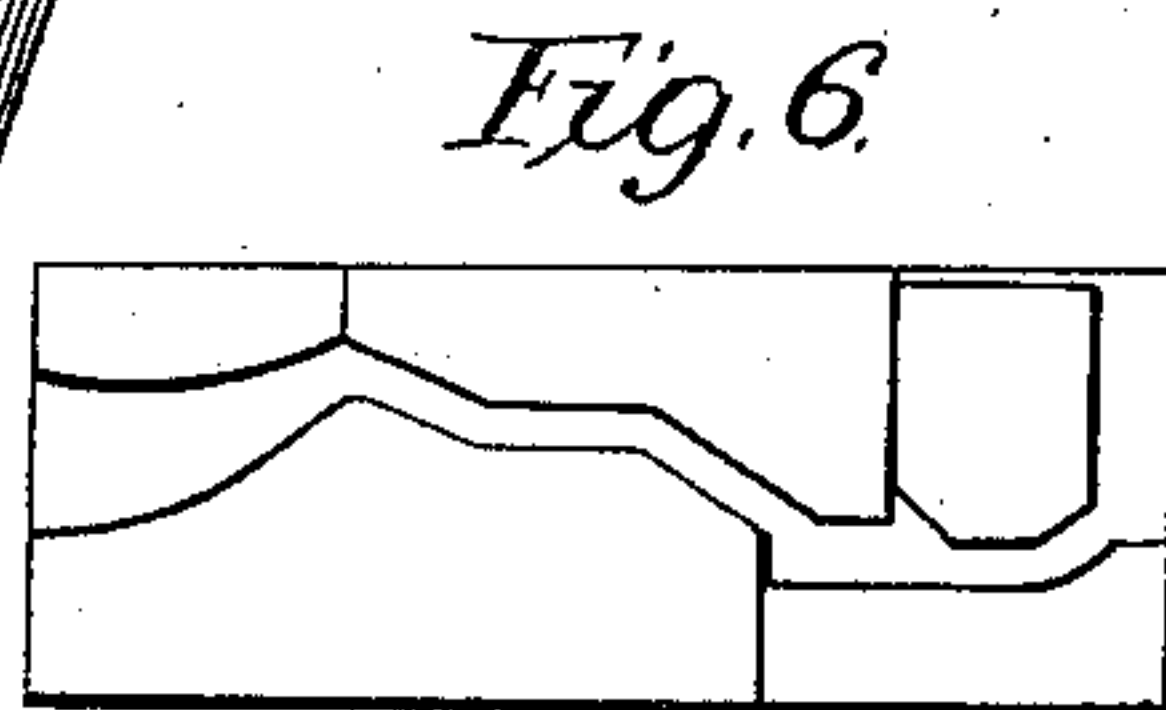
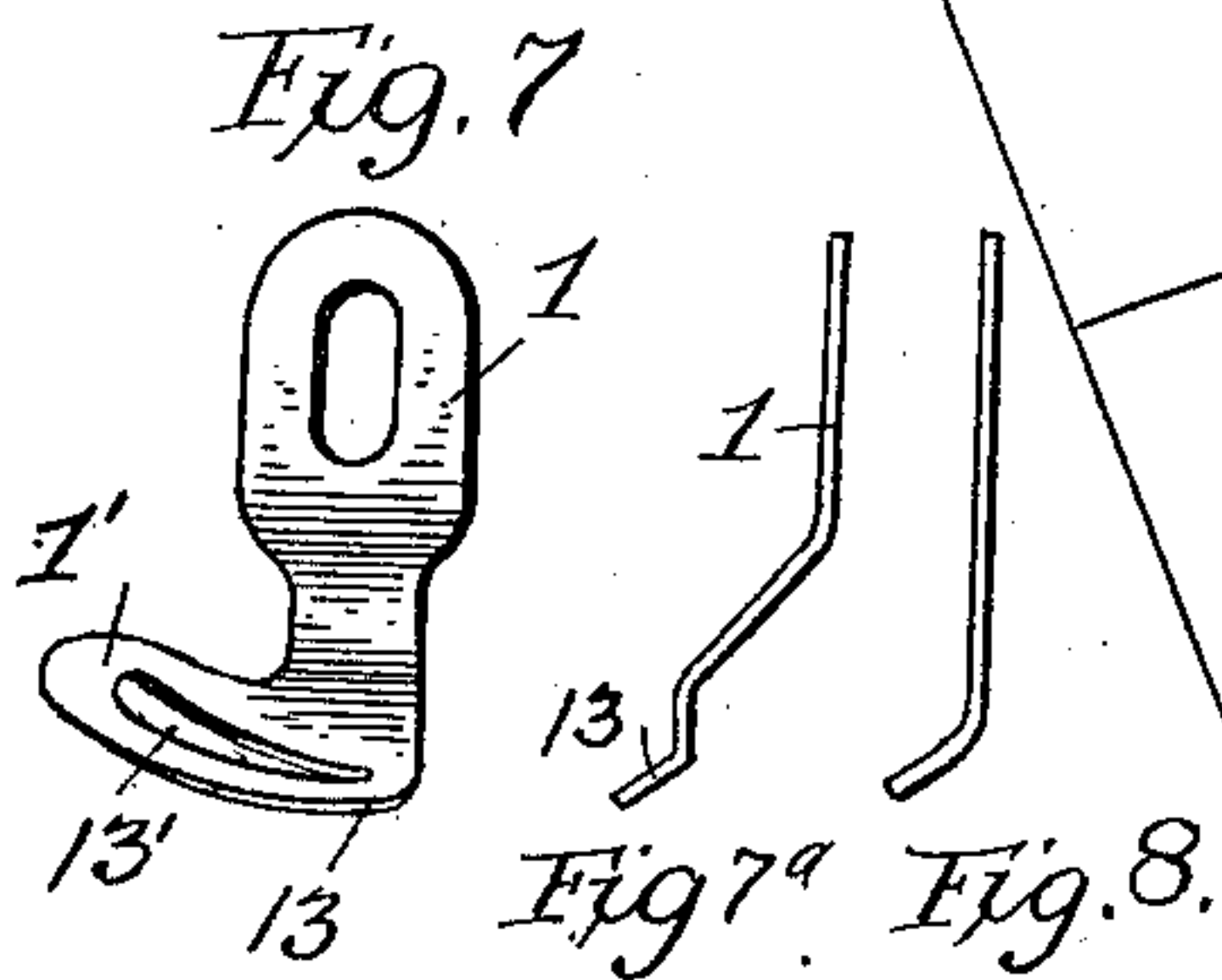
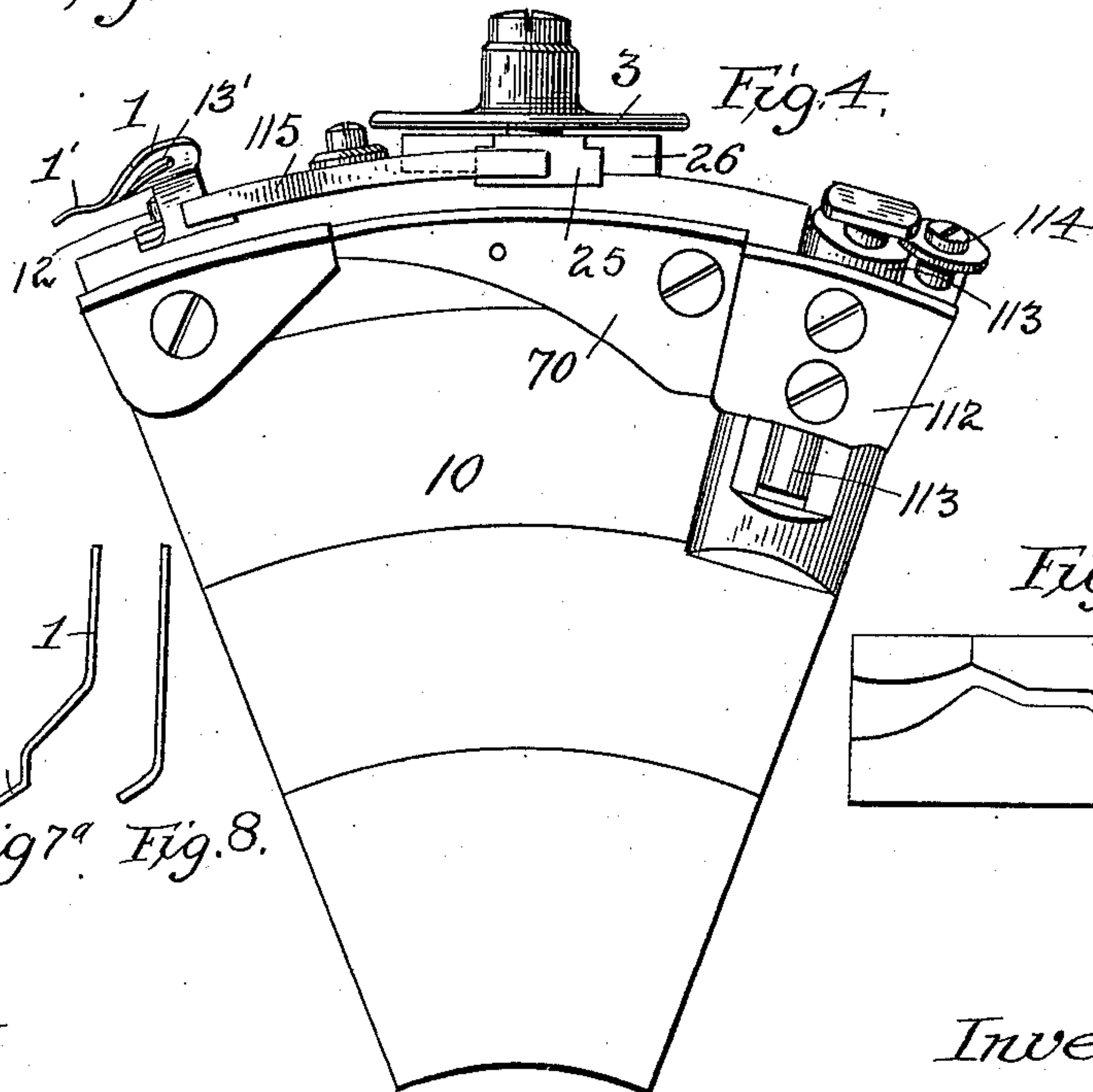
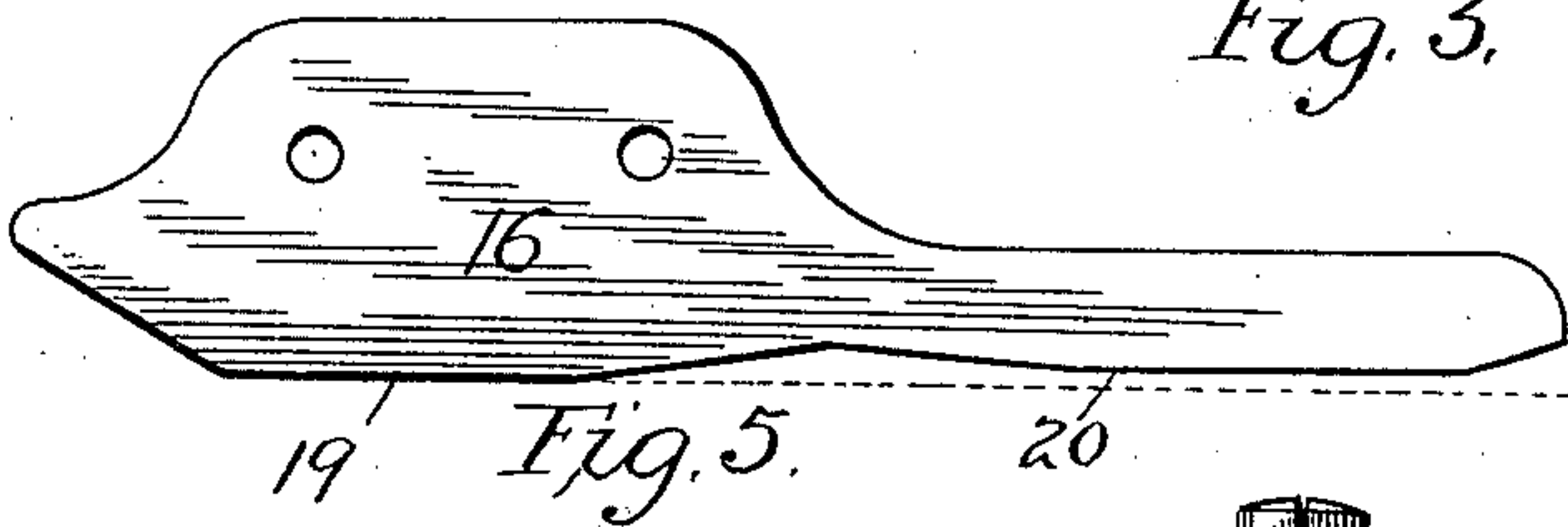
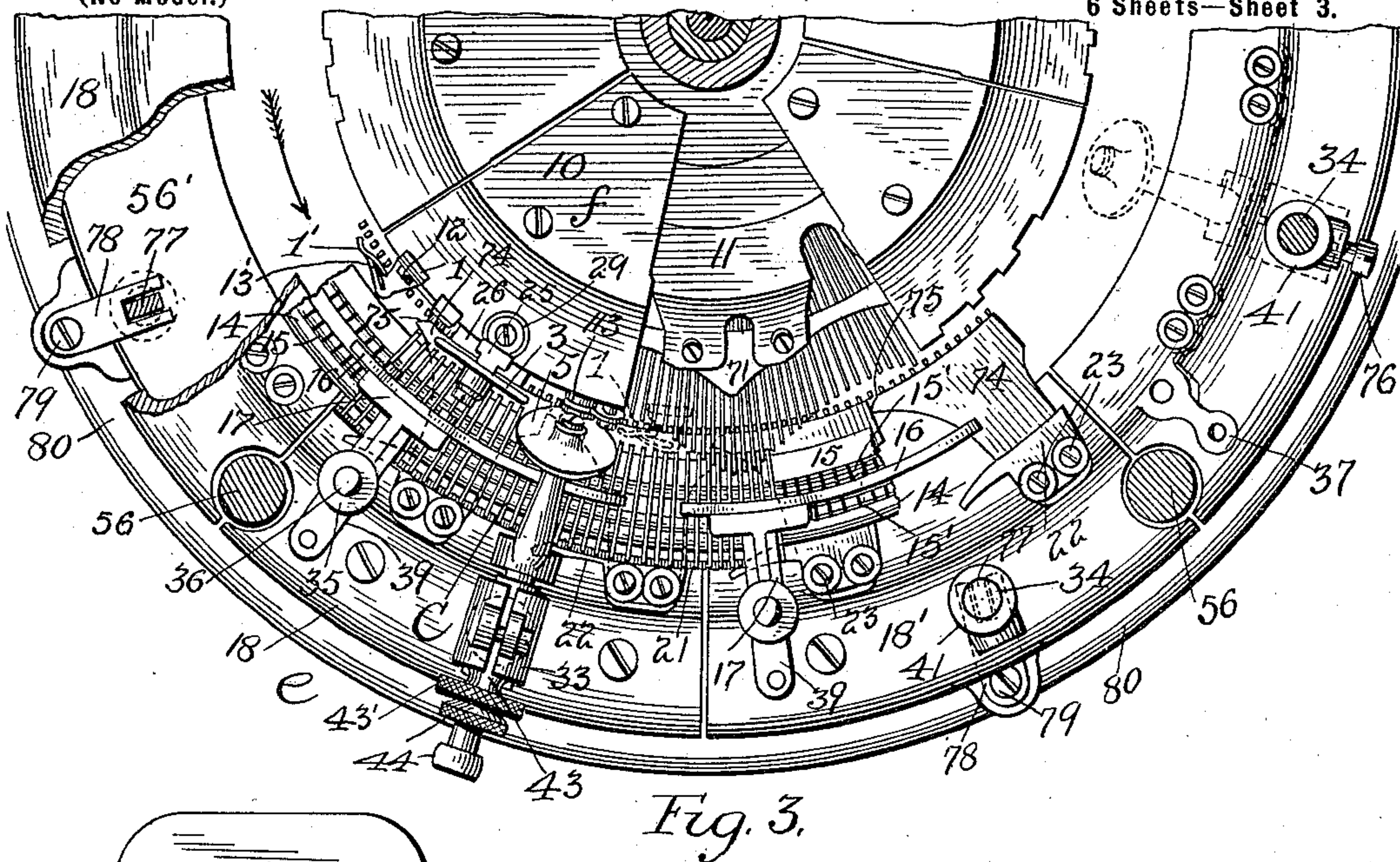
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6 Sheets—Sheet 3.



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No. 685,075.

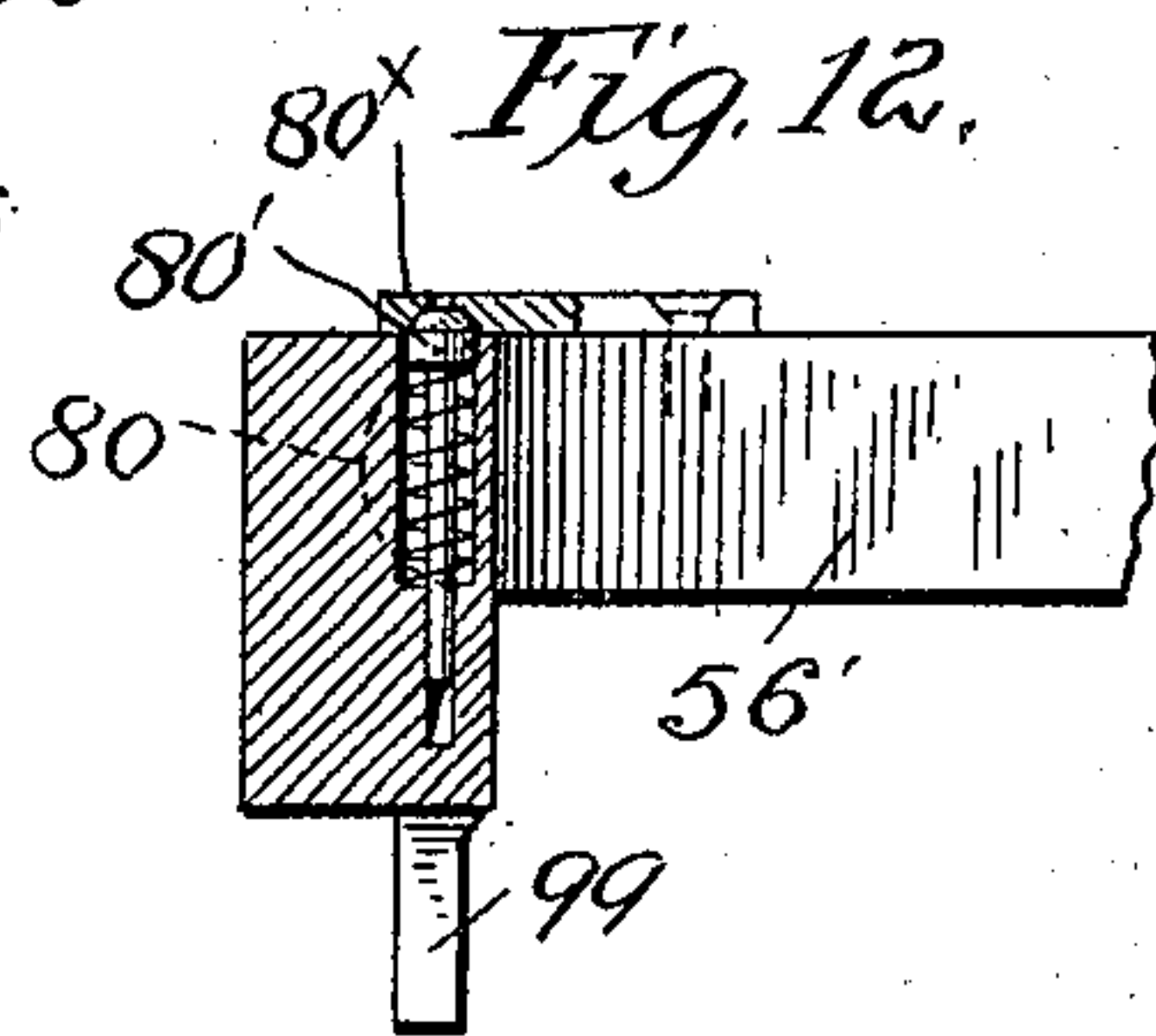
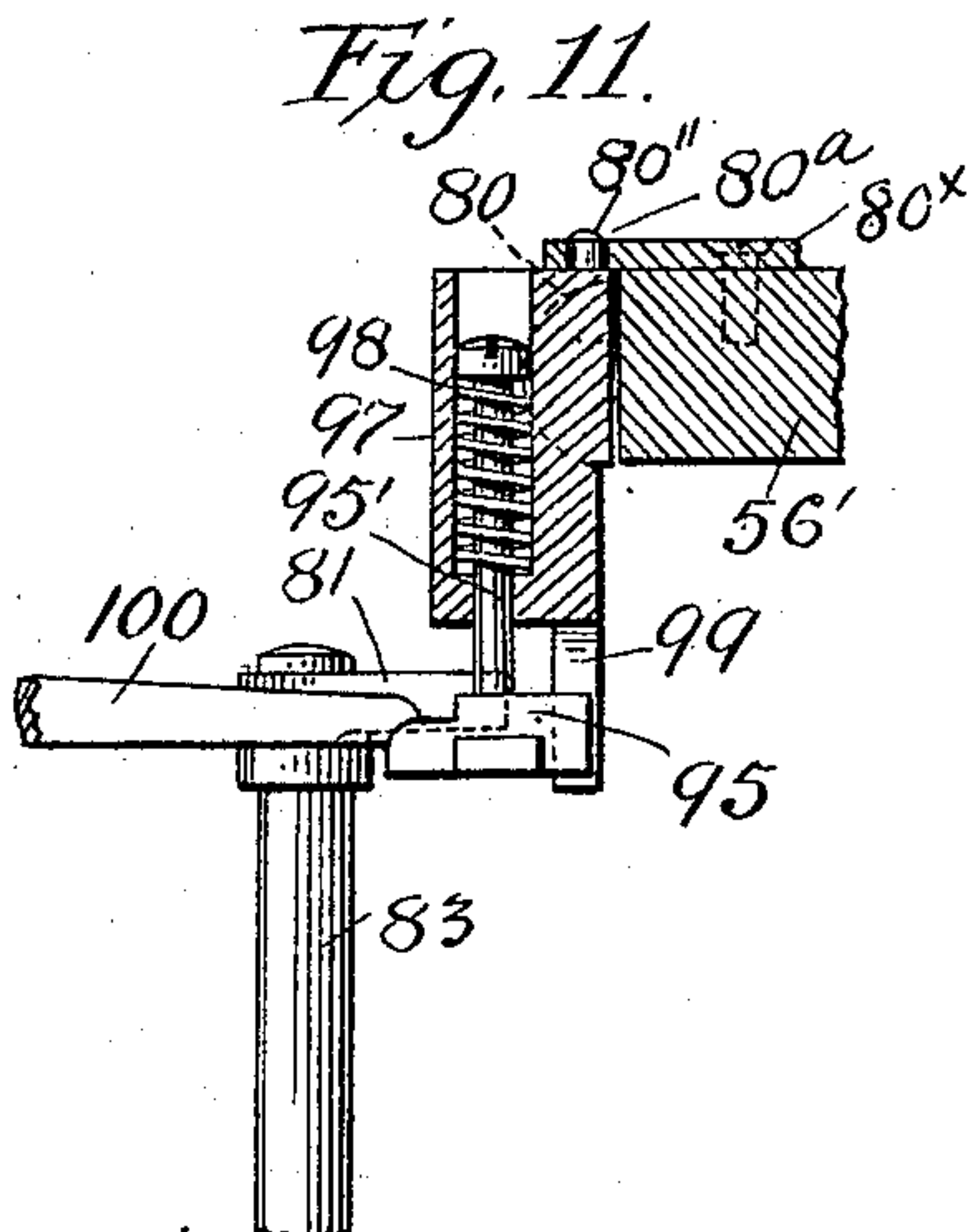
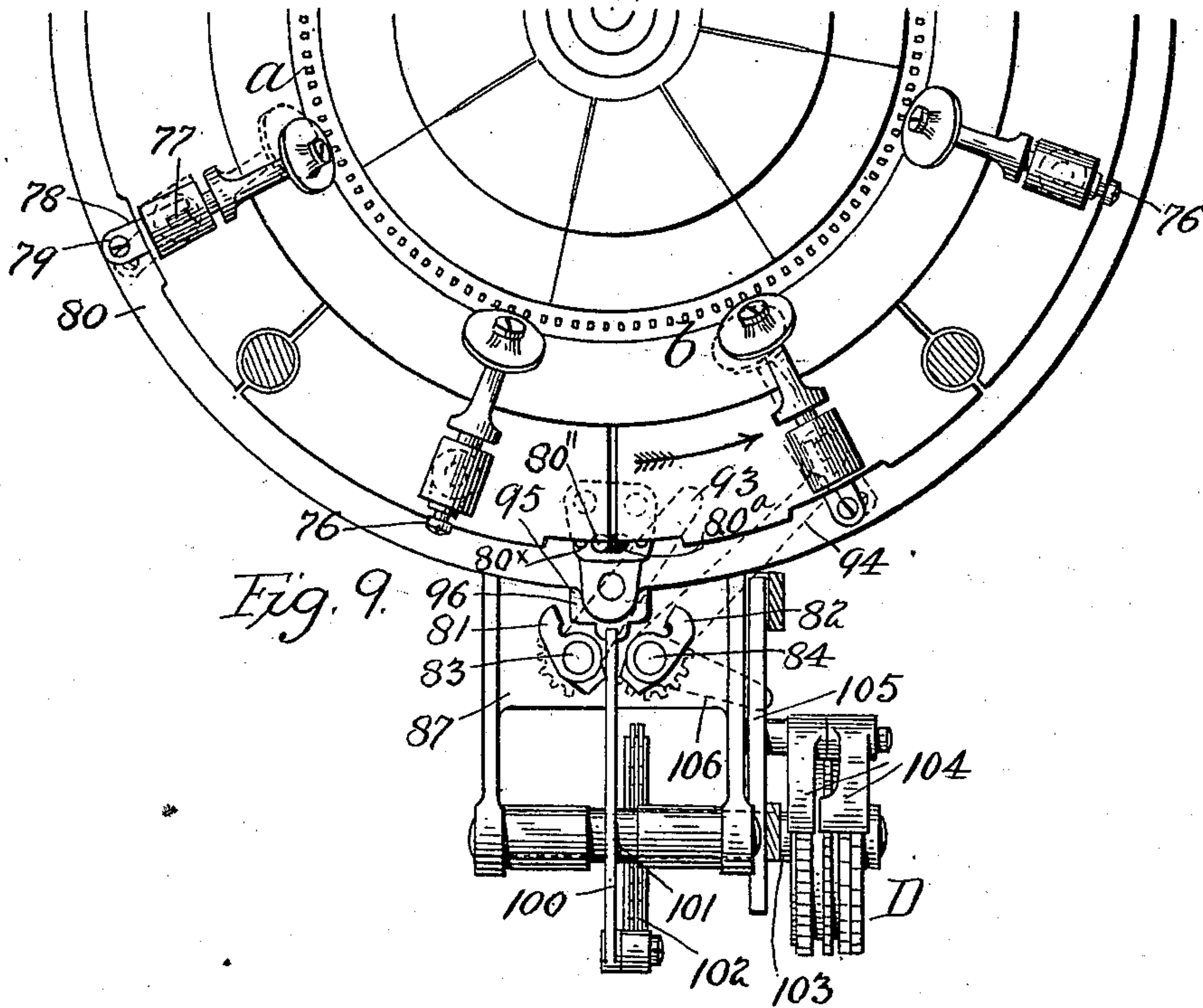
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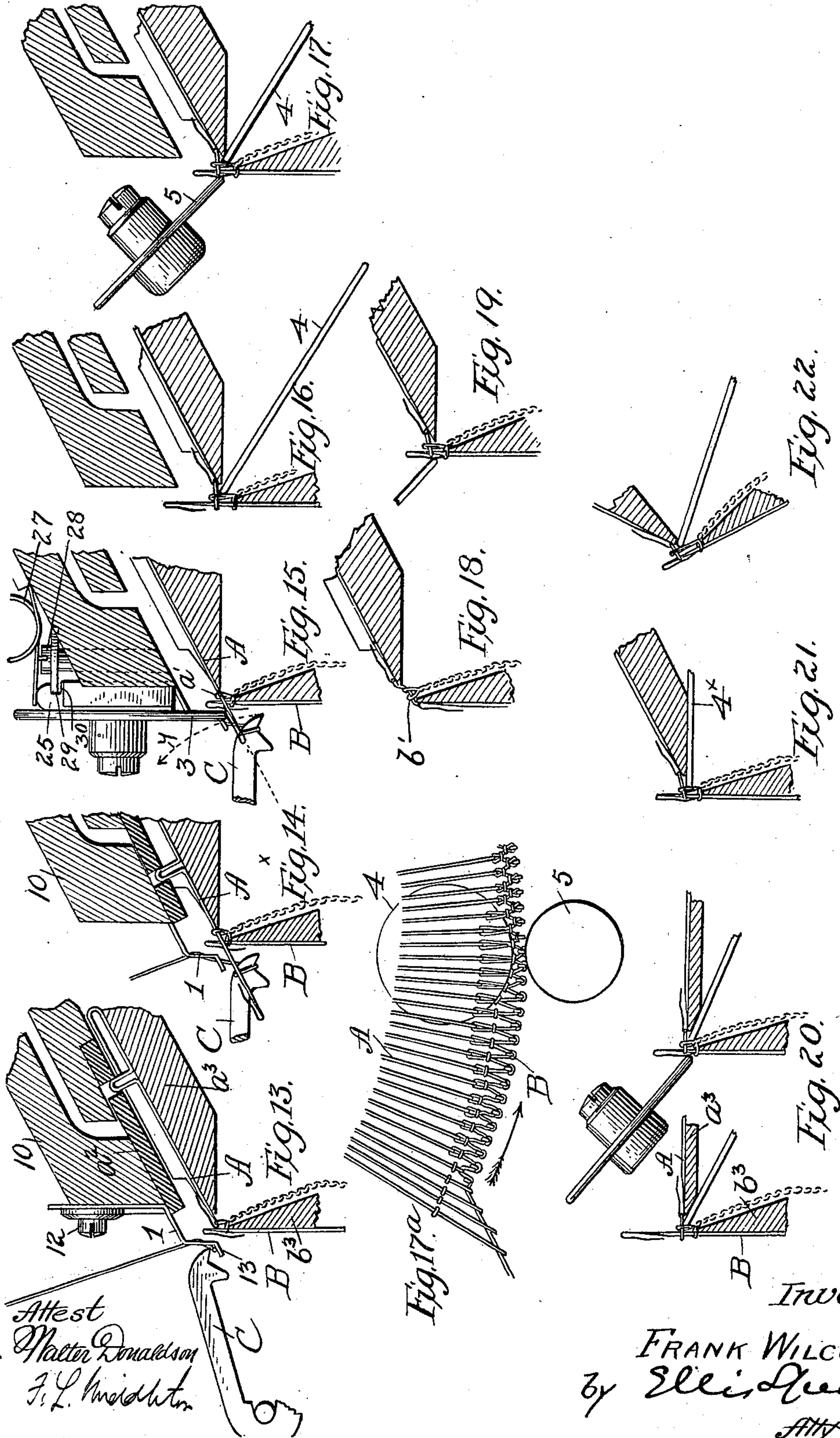
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(No Model.)

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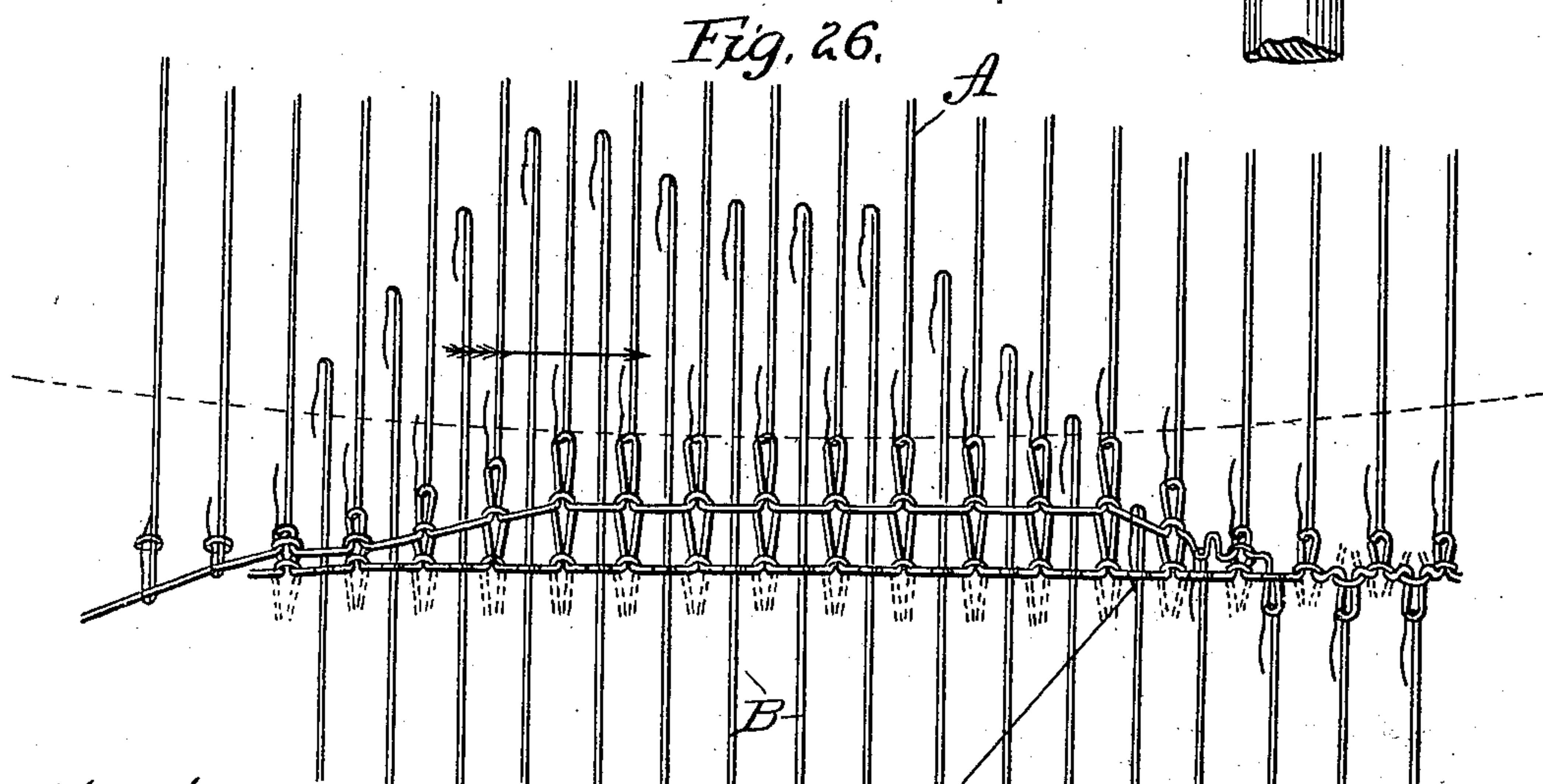
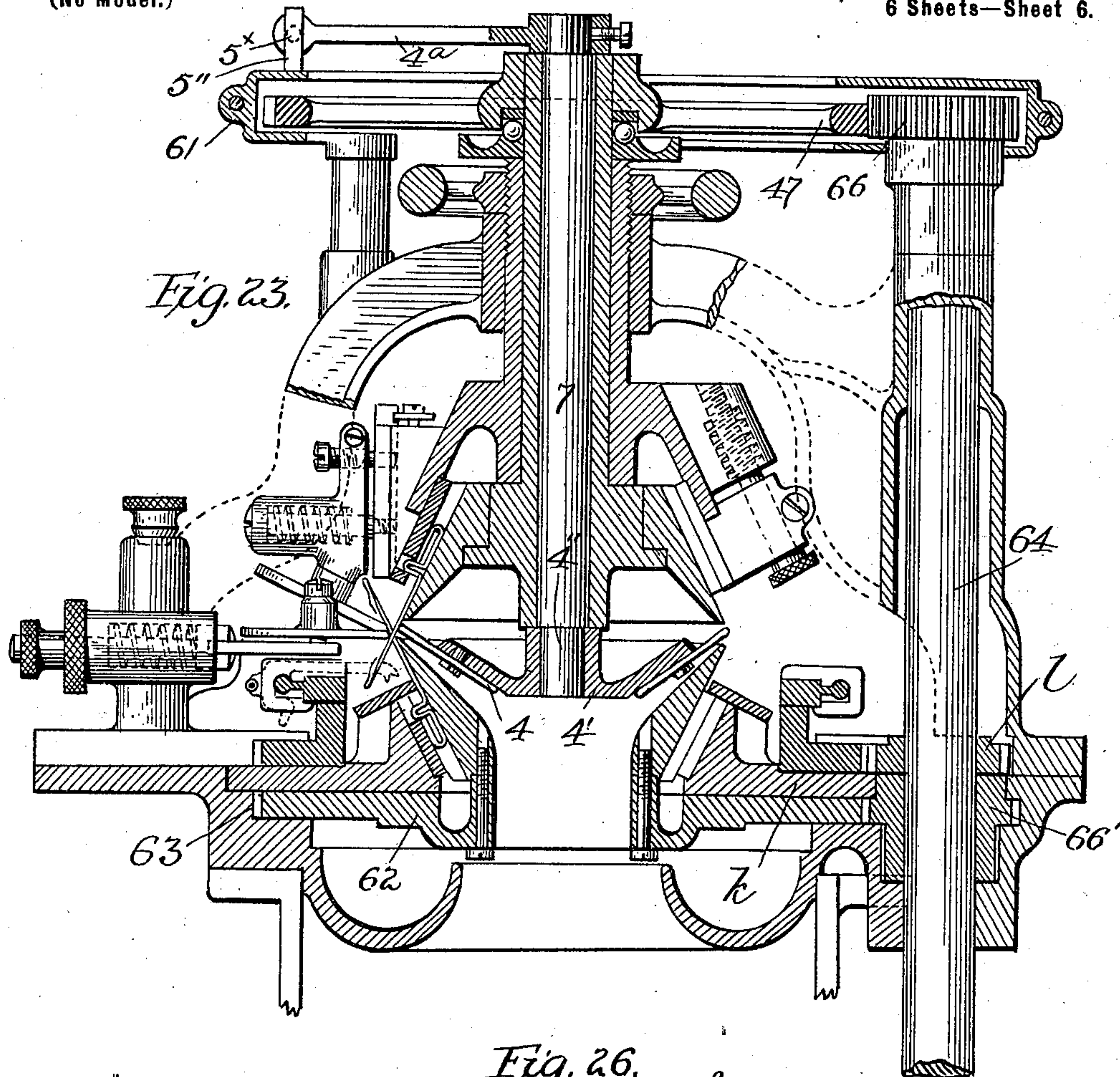
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(No Model.)

6 Sheets—Sheet 6.



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UNITED STATES PATENT OFFICE.

FRANK WILCOMB, OF NORRISTOWN, PENNSYLVANIA.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 685,075, dated October 22, 1901.

Application filed July 27, 1899. Renewed May 1, 1901. Serial No. 58,307. (No model.)

To all whom it may concern:

Be it known that I, FRANK WILCOMB, a citizen of the United States, residing at Norristown, Pennsylvania, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification.

My invention relates to circular spring-needle knitting-machines, though some of the improvements are applicable to other types of machines. I employ two sets of independently-operated spring-needles, and I aim to so arrange the needle-beds of these two sets relatively to each other and to the strain of the fabric that the old loops will be held back on the second set of needles or those to which the yarn is fed last, while the new loops on these needles will be held in advanced position in order that the old and the new loops may be divided or separated from each other to facilitate and insure proper pressing of the needle-beards and casting off of the old loops.

To better carry out my purpose I arrange the dial-needles at an angle greater than a right angle with respect to the cylinder-needles, and then by feeding the yarn to the dial-needles first they will, by retracting upwardly at an inclination, draw the new loops across the stems of the cylinder-needles upward and away from the old loops on the cylinder-needles, which are held down to the lowest limit against the needle-bed by the strain of the fabric, which strain is approximately parallel to the direction of movement of the cylinder-needles. My object can, however, be carried out with other angular arrangements of the parts than that above referred to, as will be hereinafter set forth.

Whatever the angular relation between the two sets of needles may be it is essential in carrying out my invention to arrange the parts so that the needles of the second set or those fed last and the direction of take-up strain of the fabric will be approximately or more nearly parallel in order to insure proper dividing of the old and new loops for pressing and casting off. In addition to this relative arrangement of needles, feed, and take-up strain I have found it of advantage to use holding plates or wheels interposed between the edge of the dial and the fabric, which

serve to support the old dial-loops and the newly-formed loops in order to secure a maximum divisional space between the old cylinder-loops and these newly-formed loops at the time the cylinder-needle beards are pressed for engaging the old loops about to be cast off. These holding or supporting devices for the fabric act in opposition to the take-up strain of the fabric, and they are so located as to act on the fabric at the points where the beards of the second row—cylinder-needles in this instance—are pressed; but at other points the fabric is not supported by these devices, thus allowing the take-up strain of the fabric to insure perfect casting off and complete withdrawal of the newly-cast-off loop out of the way of the needle when it again advances.

I am aware that circular spring-needle knitting-machines have been provided with independently-operating needles, with the needles sometimes at right angles and in other angular relations; but so far as I know my arrangement of the needle-rows relative to each other, to the feed, and to the strain of the fabric from the take-up devices for the purpose of dividing, pressing, and casting off, as herein stated, is novel.

Another important feature of my invention is a novel arrangement and construction of sinker mechanism, which includes a row of pivotally-supported sinkers extending parallel with the needle-row and each sinker working independently of the others.

I aim to sink the greatest possible amount of yarn by the sinkers operating in succession, each sinker drawing its full amount of thread in advance of the sinker next following in the series, so as to avoid rendering or pulling through of the thread from one sinker to the others or causing possible rupture and also to hold the newly-formed loops across the stems of the needles of the first row while said first needle is being retracted and pressed. This is important to insure uniform knitting with any kind of yarn and is of the utmost importance in case of hard-twisted or wiry yarn—as, for instance, lisle-thread and silk.

I have illustrated my invention in connection with a plurality of feeds in which the devices acting in conjunction with the needles are arranged in groups around the machine, these groups being similar to each other. The

dial-cap and cams, the cylinder-cam ring, and the presser and sinker cam-supporting ring are each made up of removable sections, so that each section is removable independently of the other sections for inspection or repairs.

My invention is carried out on the general plan of machine in which the cylinder and dial-needles and take-up are made to revolve in unison, it being understood, however, that the cylinder-dial and take-up may be stationary and the cams for operating the needles made to revolve. In machines of the former class the take-up devices are rotated in unison with the dial and cylinder by means of perpendicular brackets or arms extending between the cylinder and take-up plate, and when the machine is in operation these revolving arms interfere with the operator's inspection of the fabric as it comes from the needles. This is, furthermore, an unsatisfactory mechanical construction, being weak and liable to breakage and susceptible of vibration.

In the drawings, Figure 1 is a front view of the machine with parts broken away and parts omitted. Fig. 2 is a central vertical section of the upper part of the machine. Fig. 3 is a plan view of a portion of the upper part of the machine with parts broken away and parts removed. Fig. 4 is a bottom plan view of one of the sections of the dial-cap with its attached devices. Fig. 5 is a front view of the cam for depressing the sinkers. Fig. 6 is a detail view of the cylinder-needle cams. Fig. 7 is a side view of a thread-guide. Fig. 7^a is an edge view of the same, and Fig. 8 is an edge view of a modification. Fig. 9 is a plan view, with parts in section, showing the pattern mechanism and connections for controlling the pressers in tucking, detail features being omitted from this view. Fig. 10 is an end elevation of parts in Fig. 9, some of the parts being shown in section. Figs. 11 and 12 are detail views relating to the tucking mechanism. Figs. 13 to 18, inclusive, are detail views showing the various steps in the method of knitting. Fig. 17^a is a detail relating to these steps. Fig. 19 is a detail view similar to Fig. 17, but illustrating a form of machine with the fabric-holder omitted. Fig. 20 shows detail views similar to Figs. 16 and 17, but with the needle-beds arranged at right angles to each other. Fig. 21 is a view similar to Fig. 17, but with the loop-supporting plate arranged horizontally instead of at an incline. Fig. 22 illustrates a modified arrangement of needle-beds. Fig. 23 is a central vertical section of a modified form of machine with needle-beds of cup shape, one being inverted in relation to the other. Figs. 24 and 25 represent details. Fig. 26 is a detail diagrammatic view showing the manner of dividing or separating the new loop lengths or stitches from the old loop on the cylinder-needles for the purpose of pressing the needle-beards and casting off of the old loops.

I employ two sets of needles A B, which, for

convenience, may be designated "dial" and "cylinder" needles, respectively; but when I refer to "dial-needles" herein I mean that set to which the yarn is fed first, whatever its position may be relative to the other set. Ordinarily the cylinder-needles receive the yarn first. I reverse this order for the purposes hereinbefore stated. The needles of each set are independently operated by cams a^2 b^2 . Each sinker is operated independently of all the other sinkers, and they are arranged in ring form about the dial-needles to cooperate therewith, and these sinkers have pivotal movement in sinking the yarn, both sets of needles and the sinkers rotating in unison.

In order to explain, first, the operation of knitting, reference is made to Figs. 13 to 18. The thread is fed to the dial-needles first by the thread-guide 1, Fig. 13, and the sinkers C, as shown in Fig. 14, measure off the thread for the new loop across the stem of the advanced dial-needle, and while the new yarn is thus held the presser operates between it and the old loop a' to press down the beard, the old loop being held back on the needle-stem by the strain of the fabric. The dial-needle retracting to the position shown in Fig. 16 draws the new loop across the stem of the advanced needle of the second set, which in the present instance is illustrated as being the cylinder-needle. With the needles of the first set—for instance, the dial-needles—arranged at an angle greater than a right angle relatively to the second set of needles the effect of their retraction, as shown in Figs. 15 and 16, will be to draw up or hold up the new loop on the stem of the needle of the second set B, and the old loop on this second needle will be held down against the edge of the needle-bed by the take-up strain of the fabric, which, as shown in Fig. 16, is approximately parallel to the needles of the second set and approximately at right angles to the needles of the first set. While the old and new loops are thus held divided or separated the beard of the second or cylinder needle is pressed, as shown in Fig. 17, by the presser 5, there being ample space provided by my arrangement between the old and new loops for this purpose. In order to facilitate this dividing or separating action, I employ plates or wheels 4, Figs. 17, 17^a, and 23, which may be preferably arranged inclined. These wheels or plates bear against the fabric before and at the moment of pressing, so that the new loop will be better supported at a distance from the old loop, as shown in Figs. 16 and 17. These supporting devices may be wheels, as shown in Fig. 23, or simply fixed plates.

As indicated in Fig. 17^a, the plates or wheels 4 are arranged at the points where the pressing action takes place, they, together with the presser-wheels, remaining fixed with respect to the rotary motion of the needle-beds. At the moment the pressing action has taken place the rotation of the machine in the direction of the arrow, Fig. 17^a, will carry the

needle whose beard has just been pressed past this holding device, so that when the loop is cast off from this needle it will be opposite a free space between the needle-beds, where the fabric is unsupported, and the strain of the fabric will at once pull over the loop b' , Fig. 18, just cast off, so that it will lie entirely to one side of the line of movement of the cylinder-needle, and there will be no liability of the needle catching into this newly-cast-off loop as it advances again.

It will be seen from the above that the needles receiving the yarn last are those which are approximately parallel to the strain of the fabric—the cylinder needles in this instance—while the first set of needles to which the yarn is fed first are approximately at right angles to the line of strain, so that the position of the loops on the needle is least affected by the strain.

It will be seen from an inspection of Figs. 13, 14, and 15 that there is no difficulty in making and maintaining the necessary divisional space between the new and the old loops on the needles first receiving the yarn, for the sinker by remaining in engagement with the new loop-length holds it across the needle-stem near its point and at a distance from the old loop, which is held back on the stem by the strain of the fabric. This divisional space is ample for receiving the presser-wheel 3, which presses down the beard, as shown in Fig. 15. As above indicated, however, the described special provision must be made for dividing on the second set of needles, as there are no sinkers coöperating with these needles to assist in dividing the loops. It will be understood that the holding wheels or plates for the fabric are not absolutely essential in all cases, as by my arrangement of the needles and by feeding the dial-needles first good knitting may be obtained without their use under favorable conditions, as in the case of coarse-gage machines with good yarn.

The needle-beds or dial and cylinder $a^3 b^3$ may be arranged at right angles, as in Fig. 20, in which case I prefer to use the supporting wheel or plate for facilitating dividing of the old and new loops; but if this is omitted the needle-bed of the first set of needles is extended close to the second set of needles to support the newly-drawn yarn against the strain of the fabric. The retracted needle also by drawing the new loop tightly across the stem of the second needle will aid in holding it up.

Fig. 21 shows that the supporting wheel or plate 4^x may be horizontal and form practically an extension of the needle-bed of the first set of needles at the point of pressing.

Fig. 22 shows that the needle-beds of both sets may be arranged inclined, and Fig. 23 also illustrates this idea, the needle-beds being cup-shaped.

Referring now to the general structure of the machine, the thread-guides 1 are support-

ed adjustably one on each section of the dial-cap 10 by screws 12. The yarn passes through openings in these thread-guides, which have edges 13 extending in a plane substantially parallel with that of the needles. The thread-guide has an extension $1'$, Figs. 3, 4, and 7, which projects in a direction circumferentially with respect to the needle-circle, and in this extension an inclined slot $13'$ is provided, so that the thread can be readily passed through the upper end of the slot and thence to the sinkers and needles. This inclination of the slot is such that the yarn is directed to the lower end, which lies under the nose of the sinker, Fig. 13, and the other end of the inclined slot being above the plane of the sinkers allows of pulling the yarn through in threading. The lower end of the slot lies in the inclined portion 13 of the thread-guide, which directs it to the sinkers. The sinkers C are pivotally supported on a rib 14 of the sinker-bed 15, which is in the form of a ring surrounding and arranged to rotate with the needle-cylinder b^3 and with the dial a^3 . The sinkers are depressed by cams 16 to sink the yarn, and these cams are supported in fixed relation by brackets 17 upon the sections $18'$ of the stationary supporting-ring 18. As shown in Fig. 14, the sinkers move in the arc of a circle, the pivotal point x of which is above the plane of the needles, and in rising the sinkers cut the plane of the needles at an angle less than ninety degrees, so that the action of the sinkers tends to move the loop in the direction of retraction of the needle—that is to say, the nose of the sinker following the path indicated by the dotted arrow y moves slightly backward in its upward movement. The sinkers having sunk the yarn, as shown in Fig. 14, remain in this position until the dial-needle has retracted and the beard has been pressed, the new loop being securely held by the sinker from changing its shape until the dial-needle beard has been pressed and the loop partly drawn into the fabric, and during this movement of the dial needle and sinker the cylinder-needle has risen to receive the new formed loop when the sinker leaves it, thus insuring the new loops from losing their shape and preventing drop stitches.

By employing pivotally-moving sinkers I am enabled to multiply the movement imparted to them by the cams for sinking the yarn, so that cams can be used having gentle inclines. These cams engage the sinkers intermediate of their length, and I so multiply the action of the sinker that with a cam of low angle I secure a rapid, separate, and independent action of the sinkers—that is to say, one sinker completes the measuring off of the yarn before the next sinker engages the yarn, and there is no liability of rupturing the yarn by reason of several sinkers engaging it and sinking it at the same time. With the pivotal arrangement a low cam can be used and yet the movement can be so mul-

tiplied that each sinker will complete its sinking action before the next sinker engages the yarn. With this arrangement of pivoted sinker and cam operating thereon at a point intermediate of the pivot and the nose of the sinker and laterally in relation to the sinker it is important to provide means for holding the sinker in position with respect to the needles it coöperates with and prevent any lateral displacement. The sinker-bed is formed for this purpose with two slotted guiding-walls 15', forming between them a cam-path extending longitudinally of the bed. The cam travels in this cam-path, and by reason of the guiding-wall on each side of the cam the sinkers are firmly supported against the lateral action of the cam-incline. The sinker-bed is formed also with a slotted guiding-wall 15" for the tailpieces of the sinkers, and these tailpieces by striking the bottoms of the slots in this wall limit the return movement of the sinkers to normal position.

The advantages of my improved sinker and of its relation to the needles will be more apparent by describing the old forms of sinkers and their arrangement and showing their disadvantages as applied to a machine having two rows of independently-operated needles. The oldest form of sinker device is a bur-wheel or small wheel having a series of blades firmly fixed at approximately a forty-five-degree angle to its axis. This wheel was intended to sink yarn for a single row of needles, and in the case of fabrics made with a single row of needles only a very small quantity of yarn is required to be sunk for each of the loops. The bur or sinker wheel is arranged to stand at an angle to the needle and rotate in unison with the row of needles. The blades of the bur-wheel pass in between the needles and meshing therewith like teeth of gear-wheels, and the thread is fed to the needles by the blades of the bur-wheel forcing the thread between the needles. It will be readily seen that several blades must necessarily be in mesh with the needles at the same time, and all the blades, from the first one entering to the central point of mesh, must be holding thread at the same time, and in order that the loops shall be all made of the same length the thread must render or pull through from one needle to another. In the case of plain fabrics there is very little depth of mesh necessary. Consequently there is little rendering of yarn; but in the case of ribbed fabrics more than twice the quantity of yarn must be sunk to form the two rows of loops instead of one, as in plain fabrics. Ordinary yarn will not stand the strain of so much rendering. This is one of the things that knitters aim to overcome in all kinds of knitting and is entirely overcome by the form of sinker and the arrangement of the sinkers with relation to the needles as embodied in my machine. Another objection to a bur-wheel as applied to ribbed knitting is that, the bur-wheel standing at an angle of forty-five degrees to the

needles and being rotated by the needles themselves, each needle representing a tooth in a gear, a very little resistance applied to the bur-wheel would force the engaging needle out of perpendicular and two needles would be allowed to fall in between the blades, where only one needle is supposed to go, resulting in a bad hole in the fabric and a "smash-up," to use the knitter's term. This is more likely to occur when a large quantity of yarn is attempted to be fed, as in the case of a ribbed fabric, than in the case of plain fabrics, where such bur-wheels are usually employed and for which use bur-wheels were invented. It will also be evident that on extremely-fine-gage machines the needles of very fine wire are not rigid enough to rotate the wheel with its resisting thread with any degree of safety, and, again, another objection to the use of bur-wheels is that immediately the loop has been sunk the newly-formed loop is left unprotected and is liable to fall out from beneath the beard of the needle, causing drop-stitches and holes. In the case of soft pliable yarn the loops usually remain in the position and shape in which the loop-wheel leaves them; but in the case of hard-twisted yarn, lisle-thread, or silk the thread will immediately straighten out after the loop-wheel leaves it, and it has been found impracticable to knit such yarn with bur-wheels. This objection I first aim to overcome by constructing a sinker arrangement that will sink the necessary quantity of yarn without rendering from one needle to another and having formed the loops will hold them in their proper shape and position in relation to the needle until the needle-beards have been pressed and the loops partly drawn into the body of the fabric, and so far as I know such a construction, form of needle, and relative position to the needle has never been produced.

Another form of sinker is the so-called "sliding" sinker, which is frequently used on machines having one row of needles. There are several objections to this form of sinking device as applied to machines having two rows of independently-operated needles, and said objections are overcome by my construction. The sliding-sinker cam would necessarily be a very steep one in order to sink sufficient yarn for one loop before the following sinker comes in contact with the yarn to avoid rendering, and it has been found impracticable to operate sliding sinkers with cams of a greater angle than forty-five degrees, and with a cam of this angle it is impossible to sink sufficient yarn for a ribbed fabric without the yarn rendering from one sinker to another. This form of sinker is a very old one as applied to a machine with a single row of needles and is illustrated as applied to a machine with two rows of needles in the patent of Tiffany, No. 536,743. By the construction of my present invention I am enabled to multiply the motion of the sinker-nose, so that

with a cam of very moderate angle abundance of yarn can be supplied to the needles without rendering. This object was attained by me in a machine illustrated in my Patent No. 5 559,830, granted May 12, 1896; but I have found that that form of pivoted sinker, with its multiplied motion, would not hold the loops in their proper position and shape a sufficient length of time to prevent the thread from being disengaged, and also that the blades of the sinkers entering and leaving the row of needles were constantly swiveling, owing to the sinker-row and needle-row being tangent to each other, and therefore constantly diverging, resulting in crowding the needles and thread at both the entering-point and at the point where the sinkers leave the needle-row. I have found it necessary on the fine-gage machines, where fine and delicate thread is to be used or where hard-twisted, wiry, or smooth yarn is to be used, that the yarn must not render and must be held positively in its proper relation to the needle until after the pressing operation has been effected and also that the sinkers should be independent of the needles and should be positively held in their proper relation to the needles, so that they may fall directly between the needles without coming in contact with them, uninfluenced by slight resistance which is liable to occur with knots, bunches, or slightly-varying thicknesses of the thread, and I have so located the sinker pivot-point with relation to the needle that there is the least possible amount of rendering and so that the sinkers may be positively operated in unison with the needles, positively feed the yarn, and be positively returned to normal position at the proper time with relation to the movements of the other knitting devices. This result could not be accomplished as well if the sinker-row did not encircle the row of needles, so that the relative radial position of the needles and sinkers remains the same except for the sinking movement of the latter.

The brackets supporting the sinker-cams are adjustable vertically by a nut 35, engaging a screw-threaded post 36, extending from a stand 37, Figs. 1, 3, and 25, on the sectional supporting-ring. A spring 38 in the bracket presses it up against the nut. The bracket has a tailpiece 39, with a pin 40 passing into the stand 37 to hold the bracket against lateral movement. The nut is conical to get a firmer frictional engagement with the bracket.

As shown in Fig. 5, the sinker-depressing cams have a low part at 19, which depresses the sinkers for the measuring-off action, and also a low portion 20, which depresses the sinkers slightly as they pass under the presser-wheel and its bracket.

The sinkers are held in place by a spring 21, of ring form, which encircles the series of sinkers and engages notches in their tailpieces. Cams 22, Figs. 2 and 3, return the sinkers to the normal position of Fig. 13, and

these cams are supported upon the stationary sectional ring 18, being held by screws 23. A spring-ring 21' encircles the sinkers and bears on their tailpieces.

The arrangement of the pivotal sinkers encircling the needles possesses a number of advantages over that type of machine in which sinkers are carried by a dial and do not encircle the needles. It is more compact, simpler in construction, and a larger number of feeds can be applied to a machine than if the dial-support is used; but a still more important advantage is that the encircling sinkers will hold the thread on the needles up to the point of pressing or even later, which is essential in the case of wiry or smooth hard-twisted yarn, the sinkers always traveling with the needles. The sinkers may be held in the depressed position holding the yarn taut across the needle as long as desired.

By the dial arrangement of sinkers the needle-circle and sinker-circle were set tangent to each other. The continued revolution of the two circles after the yarn is sunk causes the sinkers to diverge from the path of the needles, and the sinkers have to be lifted from the yarn before the pressing on the second row takes place.

The presser-wheels 3 for the dial-needles are carried by blocks 25, Figs. 2, 3, 4, and 15, adjustable in guides 26, secured to the edge of the dial-cap sections. These blocks are pressed down by springs 27 to give the pressers a yielding effect on the needle-beards, and they are adjusted by screws 28, having disks 29 entering notches 30 in the blocks, the notches being large enough to allow yielding play of the pressers.

The presser-wheels 5 for the cylinder-needles are carried by brackets 31, Fig. 2, secured to plungers 32, supported in bearings 33, which are carried by shafts 34. These shafts are held in stands 41 on the sectional ring 18. The plungers are pressed inwardly by the springs 42 in order to give a yielding contact between the presser-wheels and the cylinder-needles. The parts are adjusted toward or from the cylinder by the barrel 43, screwed into the bearing and having a finger-wheel 43'. The stem of the plunger is threaded and is engaged by check-nuts 44. The presser-wheel may be drawn back from the needles by simply pulling on the nuts 44 to retract the plunger. A guide-pin 46 holds the presser-bracket in proper alinement in all adjustments.

As before stated, the dial, cylinder, and sinker-bed rotate in unison. The dial a^3 is supported upon a hollow shaft 7, Fig. 2, extending vertically therefrom and having a gear-wheel 47 attached thereto at its upper end. This gear is supported upon a ball-bearing consisting of the balls and a plate 48, which rests on the sleeve 49, to the lower end of which the dial-cover 50 is connected. This sleeve is threaded and passes through a nut 51, operated by a hand-wheel 52 and resting

on the central bearing 53 of the stationary frame 53'. By this nut and its hand-wheel the dial and its cover can be adjusted vertically toward or from the cylinder. In this adjustment, however, the relation of the dial-cover and its cams to the dial and cylinder is not changed circumferentially, as the cover is held against rotary movement by the link 50', adjustably held by a screw 50'' and arranged to slide on a pin 50^x of the fixed frame. This allows the vertical adjustment of the cover, and the cover may be adjusted circumferentially by loosening the screw 50'' and adjusting the link, which is slotted to receive the screw.

The holding plates or wheel 4, before described, which engage and support the fabric at the passing-points, are supported, as shown in Fig. 23, by the head 4', fixed to a post or rod 4'', extending up through the dial-supporting shaft 7 and having an arm 4^a fixed at its upper end, which extends laterally and has a stop-screw 5^x, engaging the pin 5'' on the fixed gear-guard 61. By this arrangement the head 4', with the fabric-holding wheels or plates, is held against rotation, so that the wheels or plates are radially opposite the presser-wheels of the cylinder-needles. By adjusting the stop-screw 5^x the wheels or plates can be adjusted circumferentially with respect to the needle-circle and in relation to the presser-wheels. By employing holders in the form of wheels there will be less friction on the fabric. The fixed bearing 53 is on the fixed supporting-frame 53', which comprises the arms 55 and the posts 56 connected thereto and extending up between the sections of ring 18 from the fixed base-ring 56', Figs. 1 and 2. This base-ring is supported by the standards 57, Fig. 1, one at each side of the machine, which connect at their lower ends with a ring 58, which in turn is supported by the legs 59. (Shown in dotted lines in Fig. 1.) From the arm 55 supplemental posts 60 extend up and support the gear-guard 61. The cylinder is driven by gearing also. It is carried by a ring 62, having gear-teeth 63 thereon and supported on a flange of the fixed base-ring 56'. A vertical shaft 64, having bearings in the main frame at 65, has a pinion 66 at its upper end meshing with the gear 47 for driving the dial, and near its lower end it has a pinion 66', meshing with the gear-teeth 63, for driving the cylinder. The shaft is driven from the shaft 68, Figs. 1 and 2, through the bevel-gearing 69.

The weight of the dial and needles and driving-gear is such in this class of machines that the supporting-surface becomes heated and very soon worn out, causing frequent stoppages for repairs and readjustment. I have interposed the antifriction-bearing, as shown and described, which is especially adapted for this purpose and entirely overcomes the difficulty hereinbefore mentioned.

The dial-cover comprises two portions, the cap part 10 and the inner part 11, Figs. 2 and

3. Each part carries needle-cams for the dial-needles, the cap 10 carrying the retracting-cams 70, Fig. 4, while the inner part carries the advancing cams 71, Fig. 3. The cap being formed in sections, any one of which can be removed separately, it is possible to gain access to the needles at any point without disturbing the whole cap, and when any section of the cap is removed the needles will still be held against falling out of their grooves by the advancing cams 71, attached to the inner portion of the cover, as shown in Fig. 3, which represents one of the cap-sections removed.

The cams for the cylinder-needles are carried upon a ring made up of two parts, the outer part 72 being formed of removable sections carrying the retracting cams, while the inner part 72', Fig. 2, carries the advancing cams. This cam-ring is connected to the fixed base-ring 56'.

The vertical needles are held in their grooves by guards 74, which are held by the screws 23 to the sectional support or ring 18. These guards, as indicated in Fig. 3, are arranged about the cylinder and their ends are rounded off at 75, Fig. 3, to prevent any needle from striking a sharp corner, the direction of rotation of the machine being indicated by the arrow.

In order to do tucked work, I throw out of action every other of the cylinder-needle presser-wheels so that they will accumulate a plurality of loops. For this purpose I leave some of the shafts 34 free to rotate in their stands 41 in order to remove the pressers from action, while the others are held by the screws 76, Figs. 3 and 9, in action. These rock-shafts have flattened lower ends 77 engaged by forks 78, connected by screws 79 to the ring 80, which surrounds the edge of the fixed base-ring 56'. By giving a circumferential movement to this ring 80 the forks are operated to rock the shafts and swing the presser-wheels out of contact with the cylinder-needles, so that the beards of the needles will not be pressed down by these wheels, and consequently there will be no casting-off action at these points until the wheels are back again in normal position.

For operating the ring 80 back and forth I employ a pair of fingers 81 82 on parallel shafts 83 84, extending vertically at one side of the machine in bearings 85 and 86, the latter bearing being in the bracket 87. These shafts are geared together by pinions 88, fixed thereon, so that when either is moved the fingers will have movement in opposite directions or toward or from each other. The shafts are rotated separately by cams 89 90, secured to the rotary take-up plate 91, Fig. 1, by posts 92. The cams are at approximately opposite sides of the machine and one, 89, is in the plane of an arm 93, secured to the shaft 83, while the other cam, 90, is in the plane of an arm 94, secured to the other shaft 84.

Supposing the arm 93 were moved toward the right by its cam moving in the direction

of the arrow, Fig. 9, the finger 81 will be swung to the right, and if at that time the block 95 is raised from the position shown in Figs. 10 and 11, so that the lug 96 thereon is in the plane of the finger 81, said finger will strike the lug and through the block will push the ring 80 around to the right to remove the pressers at *a b* from contact with the cylinder-needles, as indicated in dotted lines, Fig. 9.

The block 95 is connected to the tucker-ring 80 by a screw 95' extending therefrom into a boss 97 on the ring, a spring 98 in the boss tending to force the pin, with the block, upwardly. The rear end of the block is guided in a fork 99, Figs. 10 and 11, on the boss 97 of the ring. The block is held down against the pressure of the spring out of the way of the finger 81, as in Figs. 10 and 11, by a lever 100, pivoted at 101, Fig. 9, on a cross-bar of the bracket 87 and having a roller bearing on a toothed wheel 102. This wheel is turned at the required times by pattern mechanism of any suitable kind. In the present instance I have shown such pattern mechanism generally at D. This mechanism at the required intervals turns the shaft 103, on which the wheel 102 is fixed. When the roller on the pattern-lever drops into the space between two teeth, its inner end frees the block 95 and allows it to rise under action of the spring 98, and then upon the movement of the finger 81 to the right, which takes place once for every revolution of the machine, the ring will be moved through contact of the finger with the block. As the block is raised the finger 82 in closing toward the finger 81 passes under the block. When the arm 94 is operated by its cam 90, the fingers open. The pattern mechanism will then press the block 95 down, and upon the next movement given by the arm 93 to the right under the action of its cam the block 95, then being down and at its right-hand limit, will be struck by the finger 82 and returned to the normal position of Fig. 9. In this closing action of the fingers the one 81 will pass over the lug 96 on the now depressed block, and upon the next contact of the arm 94 with its cam the fingers will open, ready for the next rising movement of the block.

The pattern mechanism is driven by pawls 104, connected with a slide 105, which is reciprocated by an arm 106, extending from the shaft 84.

The take-up plate 91 rests upon the lower fixed ring 58 and is operated by the pinion 107 on the shaft 108 meshing with teeth in its edge. The shaft has bearings 108^x in the stationary frame and is driven from the shaft 68 by bevel-gearing 109. A wheel 110 on this shaft serves to turn the machine by hand. By this method of driving the take-up plate the space about the fabric and between the rotating cylinder and take-up plate is left entirely free and unobstructed, so that the workman may readily have access thereto while the machine is in operation.

The take-up mechanism *c d* is of a known

form and is operated from the fixed geared ring 111 by the pinion 112.

I have thought it unnecessary to show each section of the machine with all its attachments complete, and therefore in Fig. 3 I have only shown the sections *e f* complete, the devices of these sections coöperating with each other, and in Fig. 1 I have shown only the sections *g h* as provided with the necessary attachments.

In Fig. 4 a cam-section 112 is shown secured to a slide 113, arranged to slide in the dial-cap and adjusted by the screw 114, which has a disk engaging a groove in the slide, so that the cam may be adjusted to retract the dial-needles more or less, as desired. This cam 112 is of special importance in order to facilitate dividing of the new and old loops. It constitutes an adjustable drawing-in cam for the dial-needle and is of such shape and arrangement as will allow of retracting a series of needles to the limit of their movement at the pressing-point of the cylinder-needle. This effect is illustrated in Fig. 26. I aim to have a plurality of these dial-needles drawn nearly concentric with the edge of the needle-dial, so that the loops will be evened between this series of retracted needles, thus preventing any inequality in consequence of the yarn rendering through from one needle to the other after having been fed to the needles, and also that the divisional space between the new and old loops on the cylinder-needles may be of the greatest possible length and width. The strain of the fabric would tend to break the loop if only one needle was drawing the loop taut, as this loop would be supporting all the strain of the take-up. By having a large number of loops drawn taut by the retraction of the dial-needles the strain of the take-up is evenly distributed among this number and the divisional space is much more uniform and of greater width and length than would be the case if one or two needles were retracted to the limit of the loops at the time of pressing. This renders unnecessary fine adjustment of the presser-wheel. This cam is made with its working face approximately concentric with the dial edge and is attached to the movable slide 113, adjustable parallel to the needle movement, so that all of the needles that are in contact with the working surface of this cam are kept approximately concentric with the edge of the dial, whether long or short loops are being made, if the cam is adjusted to take up the full amount of yarn fed to the needles. A guard 115 is secured to dial-cap for holding the dial-needles down while the dial-needles are receiving the thread from the sinkers.

The sinker-bed in Fig. 23 is shown as provided with a gear-rim *k*, meshing with a pinion *l* on the shaft 64. By this arrangement the sinker-bed is rotated in unison with the dial and cylinder, which, as shown, are driven by the means before described.

In Fig. 2 the sinker-bed is shown as shrunk onto the rim *m* of the cylinder, and this rim is slotted for the needles.

As shown in Figs. 9, 11, and 12, the tucker-ring 80 is held under frictional restraint by the spring-pins 80', carried thereby, engaging, and having conical or beveled tops engaging sockets in the plate 80^x, fixed to the stationary supporting-ring 56'. When the ring 80 is moved, the pin is depressed, but remains in frictional engagement with the plate 80^x. A pin 80'' limits the movement of the ring by striking the ends of a slot 80^a in the plate 80^x.

I claim as my invention—

1. In combination in a circular spring-needle machine, a first and second set of needles, means for operating each needle of each set independently, means for feeding the yarn to the needles of the first set which then feed it to the needles of the second set, the said second set being arranged nearly parallel to the direction of strain of the fabric which pulls or holds back the old loops thereon from the new loops.

2. In combination in a circular spring-needle machine, a first and second set of needles, means for operating each needle of each set independently of the other needles, means for feeding the yarn to the needles of the first set which in turn feed it to the needles of the second set, the said second set being arranged nearly parallel to the direction of strain of the fabric which pulls or holds back the old loops thereon from the new loops and the two sets of needles being arranged at an angle to each other greater than that of a right angle, substantially as described.

3. In combination in a spring-needle machine, a first and second set of needles, means for operating each needle of each set independently, means for feeding the yarn to the needles of the first set which then feed it to the needles of the second set, the said second set being arranged nearly parallel to the direction of strain of the fabric which pulls or holds back the old loops thereon from the new loops.

4. In combination in a spring-needle machine, a first and second set of needles, means for operating each needle of each set independently of the other needles, means for feeding the yarn to the needles of the first set which in turn feed it to the needles of the second set, the said second set being arranged nearly parallel to the direction of strain of the fabric, which pulls or holds back the old loops thereon from the new loops, and the two sets of needles being arranged at an angle to each other greater than that of a right angle, substantially as described.

5. In combination in a knitting-machine, two sets of spring-needles, pressing means therefor, means for operating each needle independently of the others, means for feeding the yarn to the needles of one set which then feed it to the needles of the second set, and means for supporting the fabric adjacent to

the new loops on the needles of the second set against the strain of the take-up to divide the new and old loops for pressing on the second set of needles, substantially as described.

6. In combination in a knitting-machine, two sets of spring-needles, pressing means therefor, means for operating each needle independently of the other needles, means for feeding the yarn to one set of needles which then feed it to the second set, and holding means projecting beyond the needle-bed of the first set of needles to support the fabric adjacent to the new loops on the second set of needles against the strain of the take-up, the second set of needles being substantially parallel to the direction of strain of the fabric whereby the old loops will be held divided from the new loops for pressing, substantially as described.

7. In combination with two sets of spring-needles, means for feeding the yarn, pressing means, and supporting means for the fabric interposed between the needle-beds and forming extensions of the bed of the first set of needles at the pressing-points to enlarge the divisional space between the old and new loops on the second set of needles for pressing, substantially as described.

8. In combination with two sets of spring-needles, means for feeding the yarn, pressing means, supporting means for the fabric operating at the pressing-points to enlarge the divisional space between the new and the old loops for pressing, the two sets of needles being arranged at an angle greater than a right angle, and means for feeding one set of needles which then feed the second set, said second set being more nearly parallel to the direction of strain of the fabric, substantially as described.

9. In combination with two sets of needles arranged at an angle to each other greater than a right angle, means for feeding the yarn to the needles of the first set which then feed it to the needles of the second set, supporting means for the fabric interposed between the two sets of needles and forming extensions of the needle-bed of the first set at the pressing-points, the second set of needles being arranged approximately parallel with the direction of strain of the fabric, substantially as described.

10. In combination, the two sets of needles with means for operating each needle independently of the other needles, pressing means, and supporting means for the fabric operating at the pressing-points and forming an extension of the needle-bed at said points to hold the new loops separated from the old loops, substantially as described.

11. In combination, the two sets of needles with means for operating each needle independently of the other needles, means for feeding the yarn to the needle of one set first which then feed it to the second set of needles, means for moving the needle-beds, pressing means,

and holding means for the fabric arranged at the pressing-point, said pressing and holding means being fixed relative to the movement of the needles, substantially as described.

5 12. In combination in a knitting-machine, two sets of needles, means for operating each needle of each set independently of the others, a set of pivotally-supported sinkers arranged as a set parallel with the sets of needles and
10 means for operating each sinker independently to sink the thread to the needles of one set for knitting, said set then feeding the thread to the needles of the other set, substantially as described.

15 13. In combination in a knitting-machine, two sets of needles, means for operating each needle of each set independently of the other needles, a set of pivotally-supported sinkers encircling the needles, and means for operating each sinker independently of the others to sink the yarn for the knitting operation, substantially as described.

20 14. In combination in a knitting-machine, two rows of needles, means for operating each needle of each of the two rows independently, a row of pivotally-supported thread-feeding sinkers arranged as a set parallel with the two rows of needles and means for operating each sinker independently of the others to
30 sink the thread for the knitting operation, substantially as described.

15. In combination, the needles, a sinker-bed having grooves in its upper and side faces, a pivot-rib between the two sets of grooves
35 substantially in the longitudinal plane of the needles and beyond the ends thereof and thread-feeding sinkers having tailpieces working in one set of grooves while the main portions of the sinkers move in the other set
40 of grooves, substantially as described.

16. In a multiple-feed circular-knitting machine, the needles and sinkers, the cams for the needles, a plurality of feeding and pressing devices, and supporting means therefor
45 formed in removable sections and carrying also the needle-cams, there being as many removable sections as there are groups of needle-cams, feed and presser devices, substantially as described.

50 17. In a knitting-machine, a dial with its needles, a dial-cover formed in two parts, the cap part being formed of removable sections, drawing-in cams attached to the removable sections and outthrow cams removably attached to the inner portion of the cover, substantially as described.

18. In a multiple-feed circular-knitting machine, the needles, the sinkers, a plurality of feeding and pressing devices, a plurality of
60 needle-operating cams, a plurality of sinker-cams, and a cover-ring inclosing the needle-cam ring and formed in sections and carrying the sinker-cams and pressing devices, there being as many sections of cover as there
65 are groups of needle and sinker cams and feeding and pressing devices, substantially as described.

19. In combination with a set of independently-operated spring-needles, a presser, a sliding block carrying the presser, an adjustable
70 stop consisting of a screw having a disk engaging a notch in the block and allowing limited movement of the presser and a spring bearing on the block for giving a yielding pressure thereto, substantially as described. 75

20. In combination with a spring-needle knitting-machine with sinkers, a thread-carrier composed of a plate having an elongated slotted eye, the lower end of said slot being arranged to extend beneath the nose of the
80 sinker and the opposite end of which slot occupies an elevated position for convenience in threading, substantially as described.

21. A thread-guide consisting of a plate having an inclined slotted thread-eye, the
85 portion of the plate at the delivery end of the slot being turned at an angle to the portion at the threading end, in combination with sinkers under the nose of which the turned portion of the plate lies, substantially
90 as described.

22. In combination with the needles, the sinkers, the cam for the sinkers, the hollow bracket for supporting the cam, the spring within the bracket, tending to force it away
95 from the sinkers, the post extending through the bracket and the nut on the post for adjusting the bracket, substantially as described.

23. In combination in a circular-knitting
100 machine, the needles, the sinker-bed in the form of a ring surrounding the needle-cylinder and having two slotted walls and a pivot-rib located out beyond the slotted walls, the sinkers pivoted on said rib and extending in-
105 wardly from said pivot across the two slotted walls and the cam for the sinkers working in the path between the slotted walls, substantially as described.

24. In combination in a circular-knitting
110 machine, the cylinder and dial needles, the sinker-bed having the two slotted walls and the pivot-rib, the sinkers pivoted on said rib and extending inwardly therefrom across the slotted walls, said sinkers coacting with the
115 dial-needles which then sink the yarn to the cylinder-needles and the cam for the sinkers, working between the slotted walls.

25. In combination, the needles, the pressing device therefor, the sinkers, the sinker-bed having two slotted walls with a cam-path
120 between, the cam adjustable in said path or removable therefrom, an adjustable bracket for the sinker-cam to permit the same to be adjusted or withdrawn from the cam-path
125 and a removable plate carrying the presser and sinker brackets, substantially as described.

26. In combination, the needles, the pressing device, the sinkers, the cam-surface for
130 operating the sinkers to measure off the yarn and a second cam-surface for depressing the sinkers in passing the pressing device, substantially as described.

27. In combination, a cylinder with its vertical spring-needles, a dial with its needles, means for operating each needle of each set of needles independently, means for feeding the
 5 yarn first to the dial-needles which then feed it to the cylinder-needles, the cylinder-needles being approximately parallel with the strain of the fabric, pressing means and take-up means to draw the fabric downward
 10 through the cylinder, substantially as described.

28. In combination, a cylinder having vertical spring-needles, a dial having spring-needles inclined with respect to the cylinder-
 15 needles at an angle greater than a right angle, means for operating each needle independently of the others, means for feeding the yarn to the dial-needles first which then in turn feed it to the cylinder-needles, the said
 20 cylinder-needles being approximately parallel with the strain of the fabric, pressing means and take-up means to draw the fabric downward through the cylinder, substantially as described.

29. In combination, the needles, the pivoted sinkers having tailpieces extending on the opposite side of the pivot from the main
 25 portion, the sinker-bed having a slotted wall for the ends of the tailpieces, and a cam arranged between the slotted wall and the pivot
 30 of the sinkers, substantially as described.

30. In combination, the cylinder, the sinker-bed in the form of a ring surrounding the cylinder and supported therefrom, the sinkers
 35 having horizontal main portions and downwardly-extending tailpieces, the horizontal cams engaging the tailpieces, the ring upon which said cams are supported, the vertical
 40 cams for the sinkers, and the supports for the vertical cams held on the ring and extending upwardly and inwardly.

31. In combination in a circular-knitting machine, the needles, the sinkers arranged about the needles, the sectional ring, each
 45 section supporting a needle-guard, a pressing device and cams for the sinkers, one of the sinker-cams being in a vertical plane and the other in a horizontal plane, substantially as described.

32. In combination, the dial, the cylinder, the supporting-frame, the dial-cover having a sleeve passing through the frame and threaded at its upper end, a nut engaging said end
 50 and resting on the frame, a shaft passing through the sleeve to which the dial is attached, a gear fixed on the end of the shaft and means for driving the same, the said nut supporting the sleeve and the sleeve supporting the shaft and gear, substantially as described.
 55 60

33. In combination, the vertical cylinder, the dial above the same, the upper supporting-frame above the dial, the dial-cover having a sleeve screw-threaded and passing
 65 through the frame, a nut on the projecting end of the sleeve above the frame, a shaft extending down through the sleeve to support

the dial and the gear on the upper end of the shaft, substantially as described.

34. In combination in a circular-knitting
 70 machine, a dial with its needles, a dial-cover having a sleeve, a nut resting on the frame and engaging a thread on the sleeve, a shaft supporting the dial and extending up through
 75 the sleeve a gear on the end of the shaft, and an antifriction-bearing between the gear and the upper end of the sleeve whereby the gear and shaft are supported by the sleeve and the sleeve in turn is supported by the nut and
 80 main frame, substantially as described.

35. In combination, the needles, the pressing device, a supporting-arm pivoted at its outer end and carrying the pressing device at its inner end, said support having movement
 85 to swing the pressing device in a direction across the needle, and the reciprocatory ring for moving the said support, substantially as described.

36. In combination, the needle, the pressing-wheel, supporting means therefor pivoted
 90 at its outer end and carrying the pressing-wheel at the inner end, said supporting means being arranged to permit the pressing-wheel to be retracted by hand from the needle in
 95 line therewith or to be swung aside and automatically-operating means for swinging the support, substantially as described.

37. In combination, in a circular-knitting machine, the needles, the pressing device, with supporting means by which it may be
 100 swung aside from the needles, a reciprocatory ring surrounding the machine, connections between the same and the pressing device and means for operating the ring, substantially as described.
 105

38. In combination, the needles, the presser, the support therefor comprising the rock-shaft, the reciprocatory ring and the arm connecting the same with the rock-shaft, substantially as described.
 110

39. In combination, the needles, the pressing device, a reciprocating part for throwing the pressing device in and out of action, and means for operating the said reciprocating
 115 part consisting of the rock-shafts, the fingers thereon, means for operating the rock-shafts reversely, a shifting block on the reciprocating device to lie in the path of the fingers alternately and pattern mechanism for controlling the position of the shifting block, substantially as described.
 120

40. In combination, the needles, a pressing device, means for throwing out of action the pressing device comprising a reciprocating
 125 part, a shifting block thereon, fingers operating on opposite sides of the block and means for shifting the block into line with one finger and then the other, substantially as described.

41. In combination in a spring-needle knitting-machine, a series of independently-operated radial needles, a second set of needles and needle-cams comprising a drawing-in cam having a broad cam-surface substantially con-
 130

centric with the center of the set of radial needles, and adapted to hold a plurality of radial needles in a retracted position to even up any inequality in the lengths of the loops and to facilitate dividing in the needles of the second set, substantially as described.

42. In combination, the two sets of spring-needles, pressing means, means for feeding the first set of needles which then feed the second set, and means for supporting the fabric at the pressing-points to facilitate dividing and pressing, said fabric being unsupported at the intermediate points whereby the strain of the fabric at these unsupported points will draw the newly-cast-off loops out of the path of the needles, the said second set of needles being nearly parallel to the direction of take-up strain of the fabric, substantially as described.

43. In combination in a knitting-machine, means for changing the pattern, a reciprocating part connected with said means, a shifting block carried by said reciprocating part, pattern mechanism controlling the position of the block and oppositely-moving fingers for engaging the block to move the reciprocating part, substantially as described.

44. In combination in a spring-needle knitting-machine, a first and second set of needles, means for operating each needle of each set independently, means for feeding the yarn to the needles of the first set which then feed it to the needles of the second set, the needle-bed of the second set of needles having its inner and outer faces at the most acute angle possible whereby the strain of the fabric lying against the inner face will be nearly parallel to the needles of the second row, substantially as described.

45. In combination with two sets of spring-needles, means for feeding the yarn, pressing means, and supporting means for the fabric interposed between the needle-beds and forming extensions of the bed of the first set of needles at the pressing-points to enlarge the divisional space between the old and new loops on the second set of needles for pressing, said supporting means being wholly to one side of the plane of the needles' movement, substantially as described.

46. In combination with two sets of needles arranged at an angle to each other greater than a right angle, means for feeding the

yarn to the needles of the first set which then feed it to the needles of the second set, supporting means for the fabric interposed between the two sets of needles and forming an extension of the needle-bed of the first set at the pressing-points, the second set of needles being arranged approximately parallel with the direction of strain of the fabric, said supporting means being wholly to one side of the plane of the needles' movement, substantially as described.

47. In combination in a knitting-machine, two sets of needles, means for operating each needle, of each set independently of the others, a set of pivotally-supported sinkers arranged as a set parallel with the sets of needles and means for operating each sinker independently to sink the thread to the needles of one set which then sink the thread to the needles of the other set, the latter being more nearly parallel to the direction of the strain of the take-up, substantially as described.

48. In combination, a set of needles, a set of sinkers, a bed for the sinkers having a lateral pivot-rib for the sinkers, means for operating the sinkers and yielding means for holding the sinkers in place, said sinkers' bed having also two slotted guide-walls in its upper face and a cam working between said guide-walls upon the sinkers, substantially as described.

49. In combination, in a circular-knitting machine, a first and second set of needles, means for operating each needle of each set independently, means for feeding the yarn to the first set which then feeds it to the needles of the second set, said second set being arranged nearly parallel to the direction of strain of the fabric, a series of independently-operating sinkers arranged parallel with the sets of needles and acting in connection with the needles of the first set, means for supporting the fabric at the pressing-points forming extensions of the needle-bed at said points and a broad drawing-in cam for the needles of the first set to hold a plurality of said needles retracted, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK WILCOMB.

Witnesses:

HENRY I. FOX,

FRANK B. WILDMAN.