

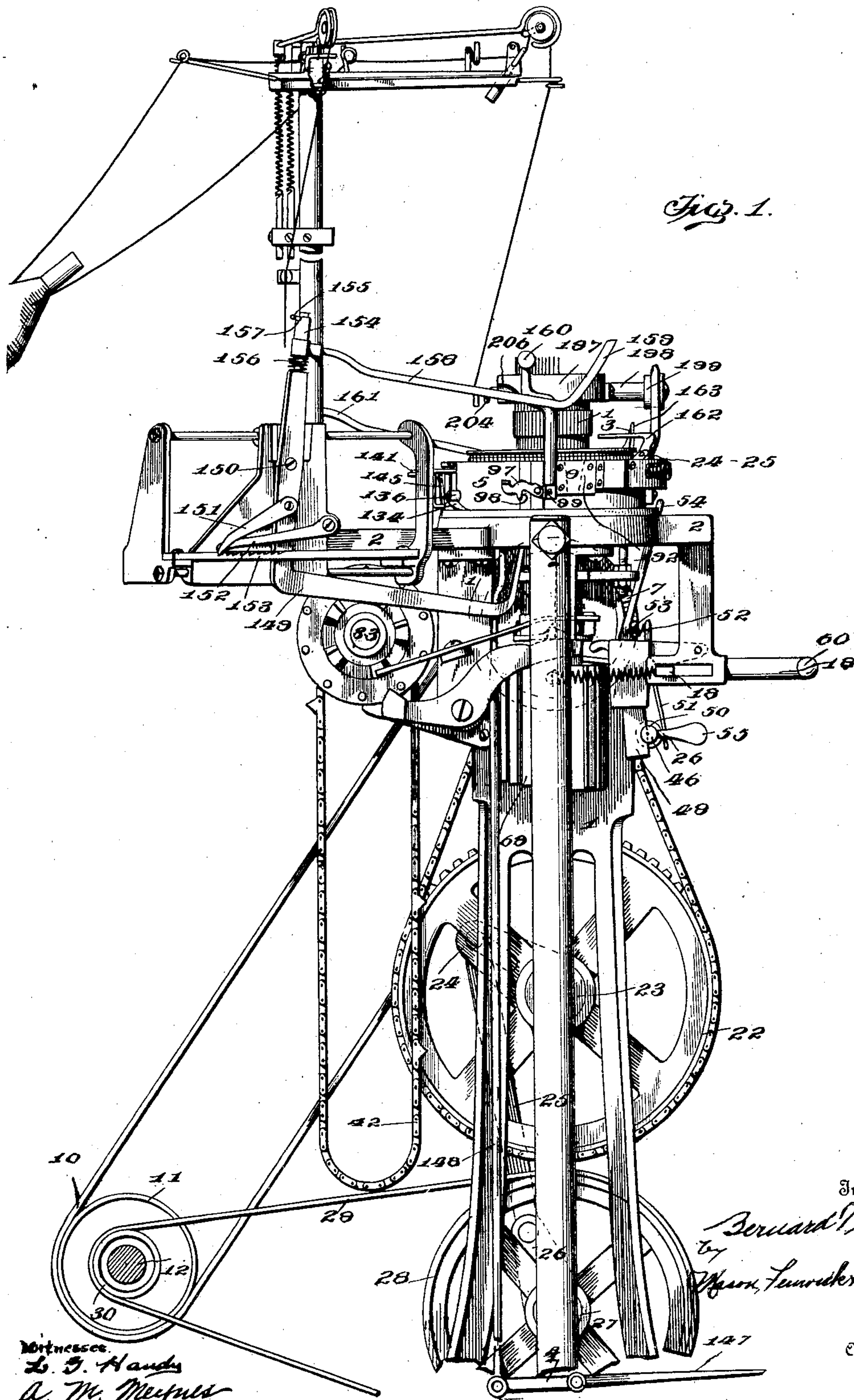
No. 753,645.

PATENTED MAR. 1, 1904.

B. T. STEBER.  
KNITTING MACHINE.  
APPLICATION FILED JAN. 18, 1902.

NO MODEL.

7 SHEETS—SHEET 1.



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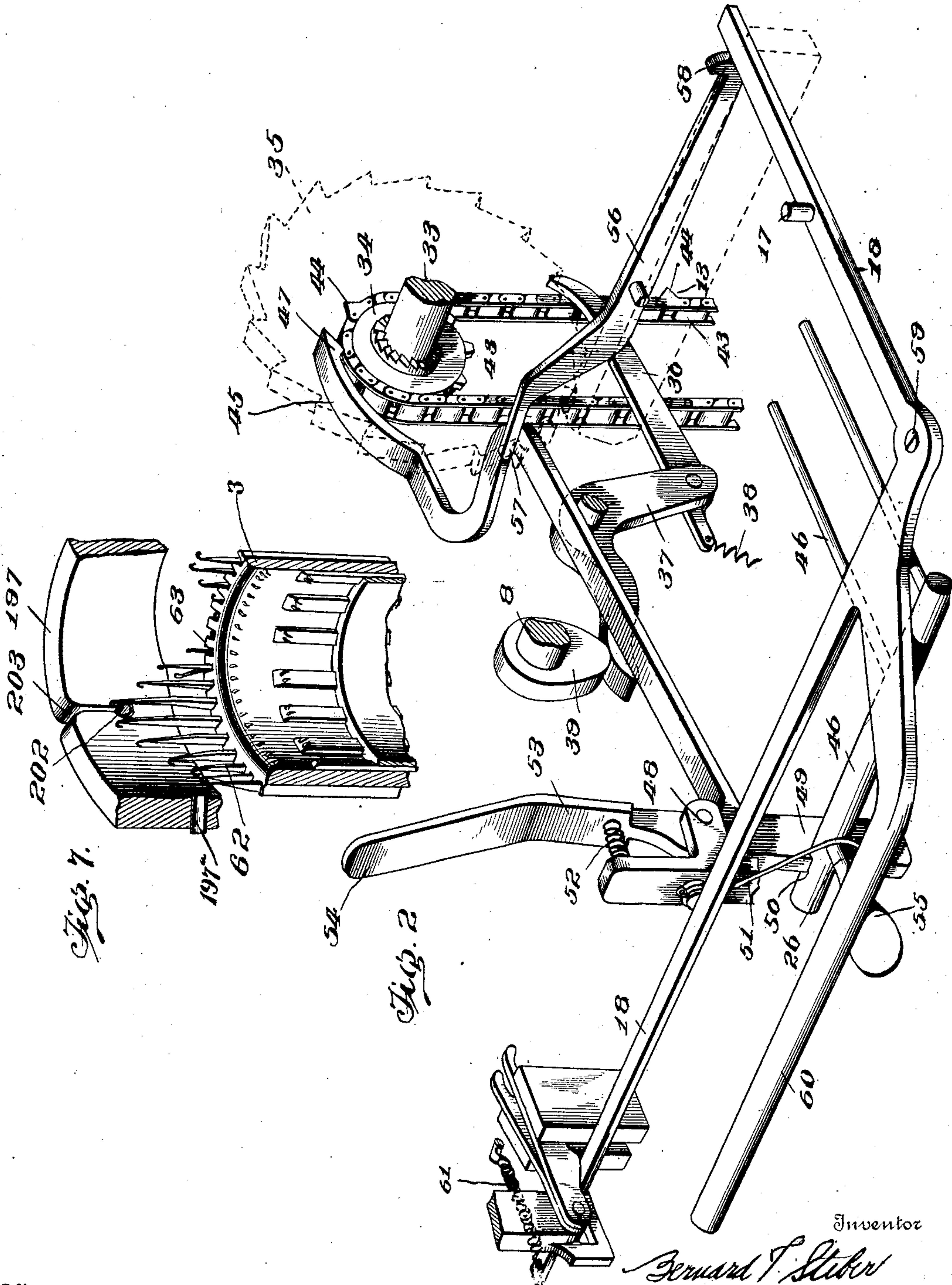
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7 SHEETS—SHEET 2.



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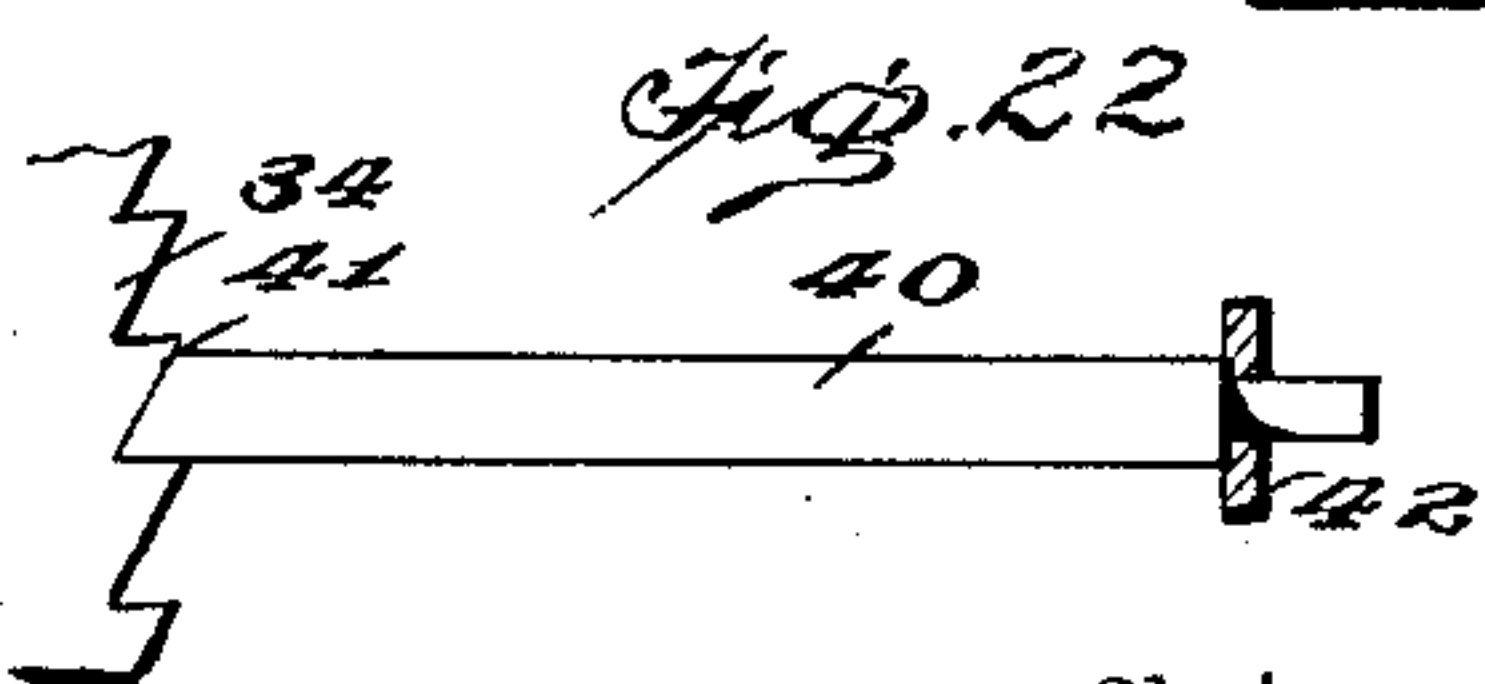
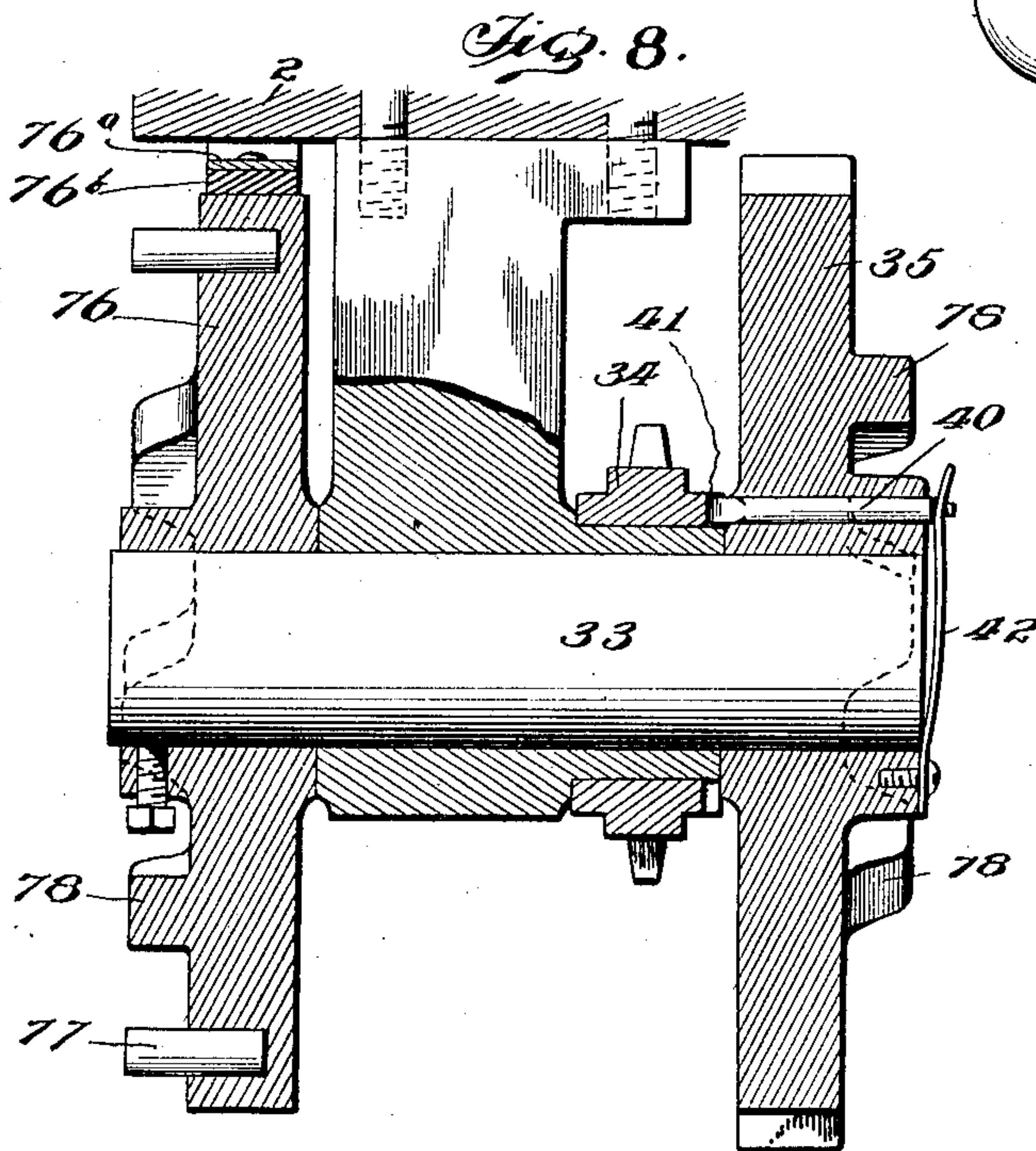
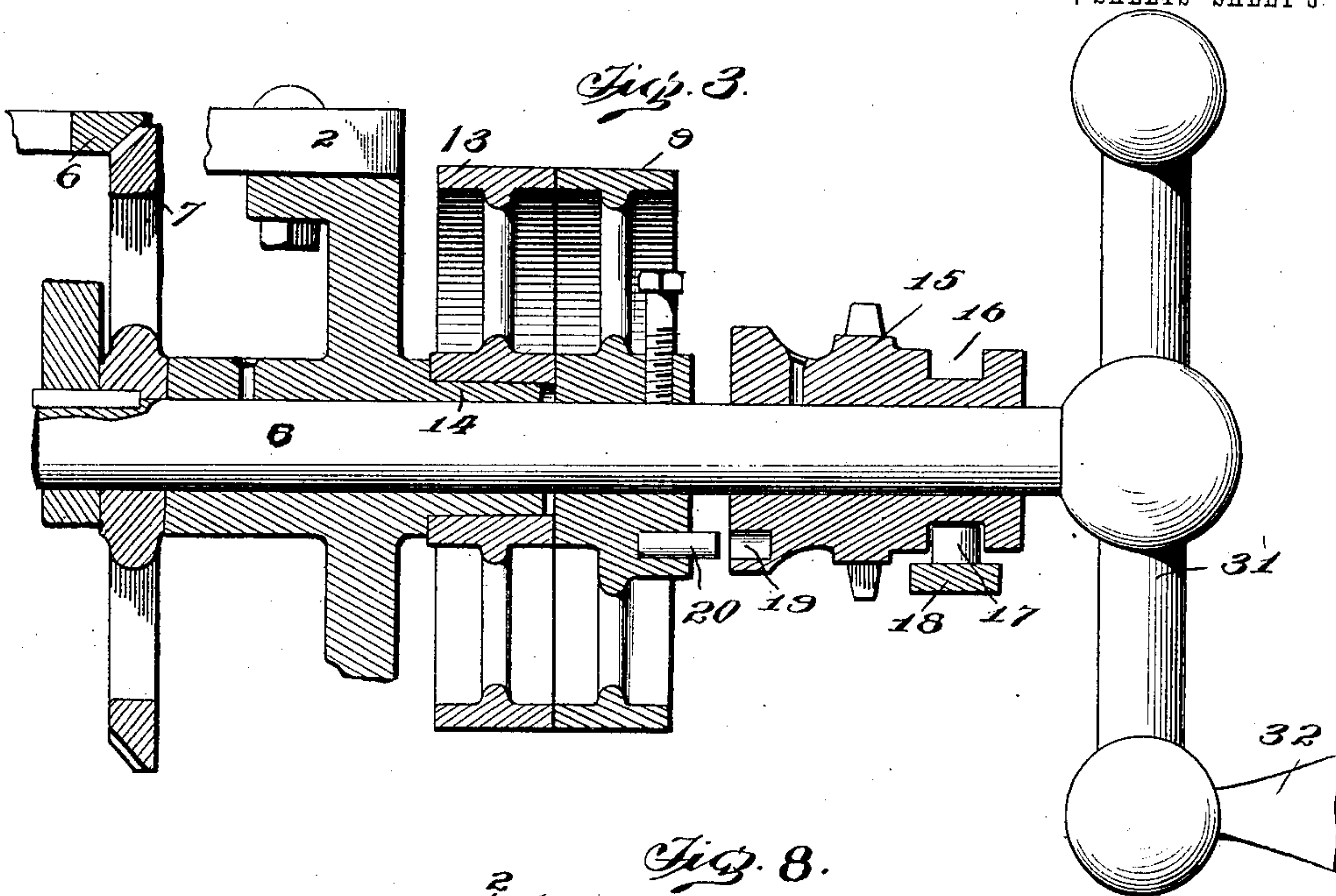
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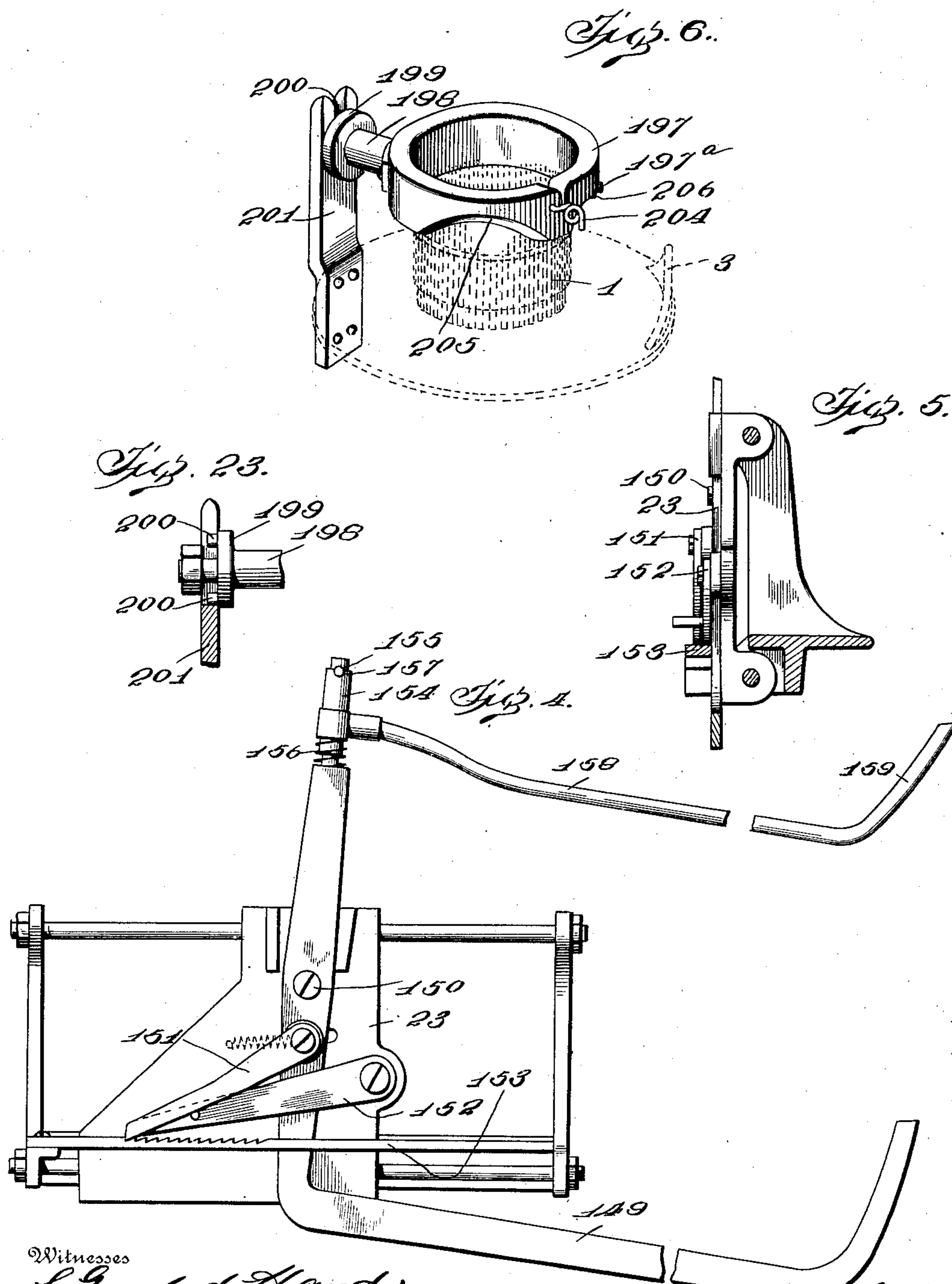
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7 SHEETS—SHEET 4.



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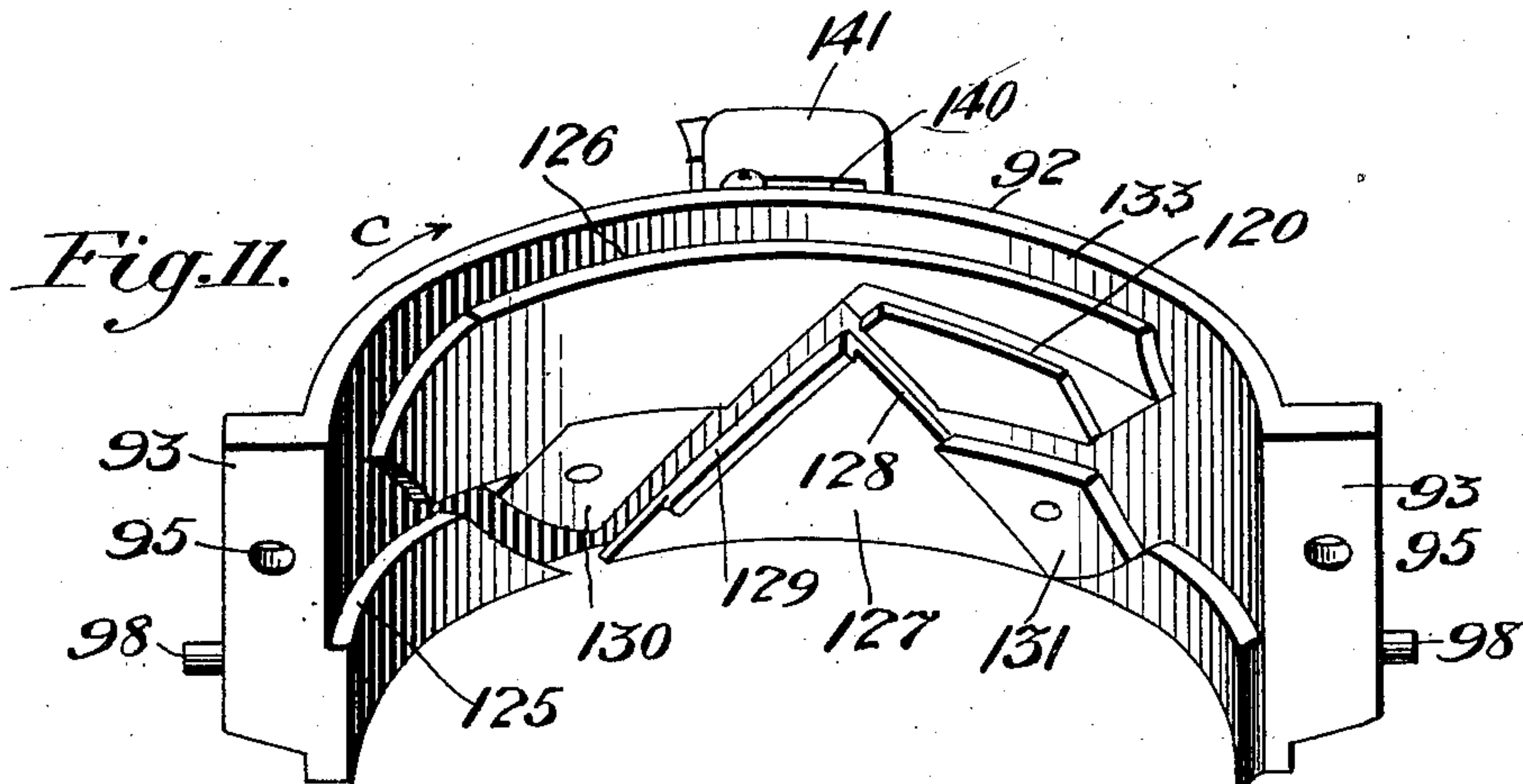
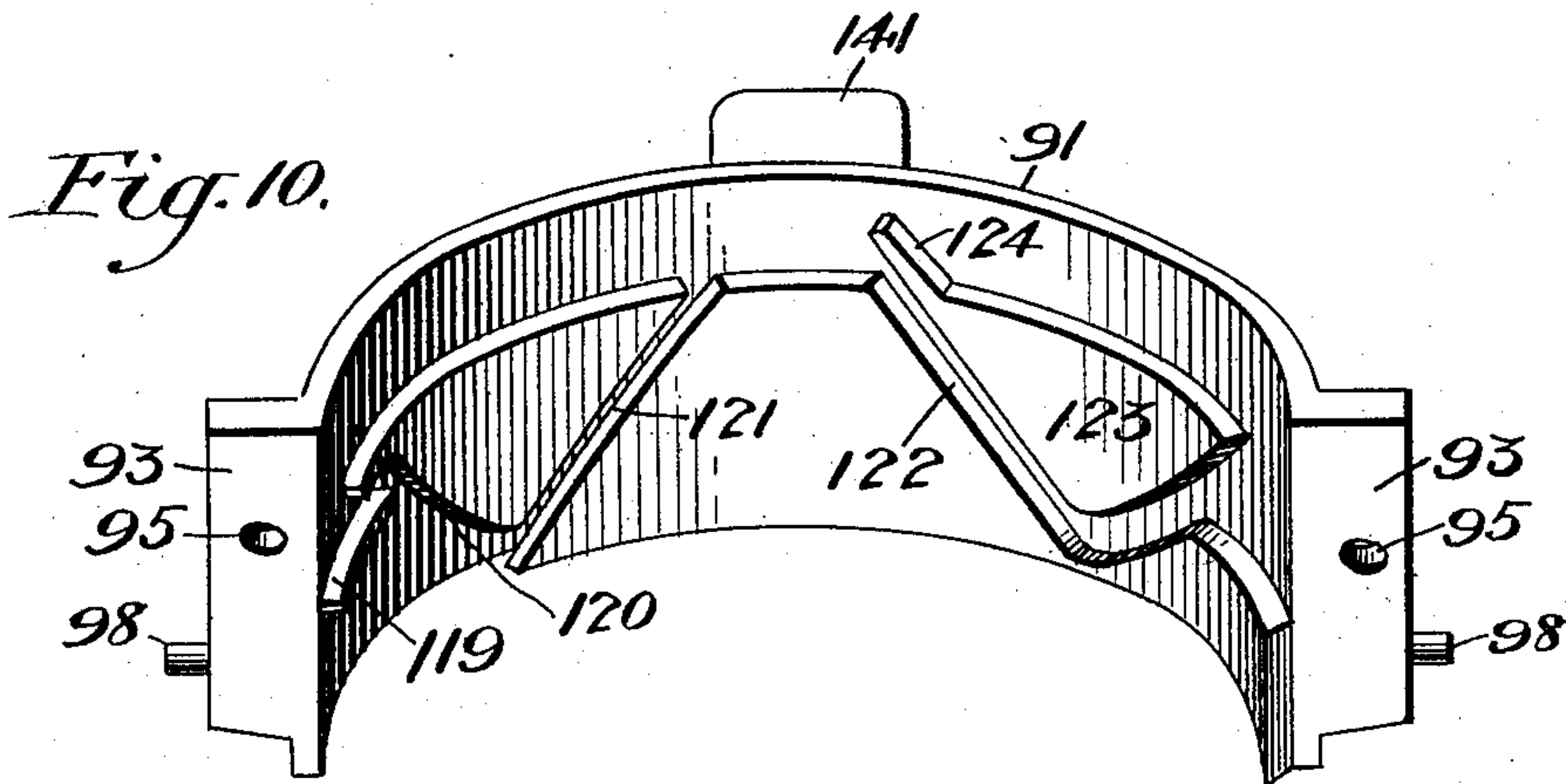
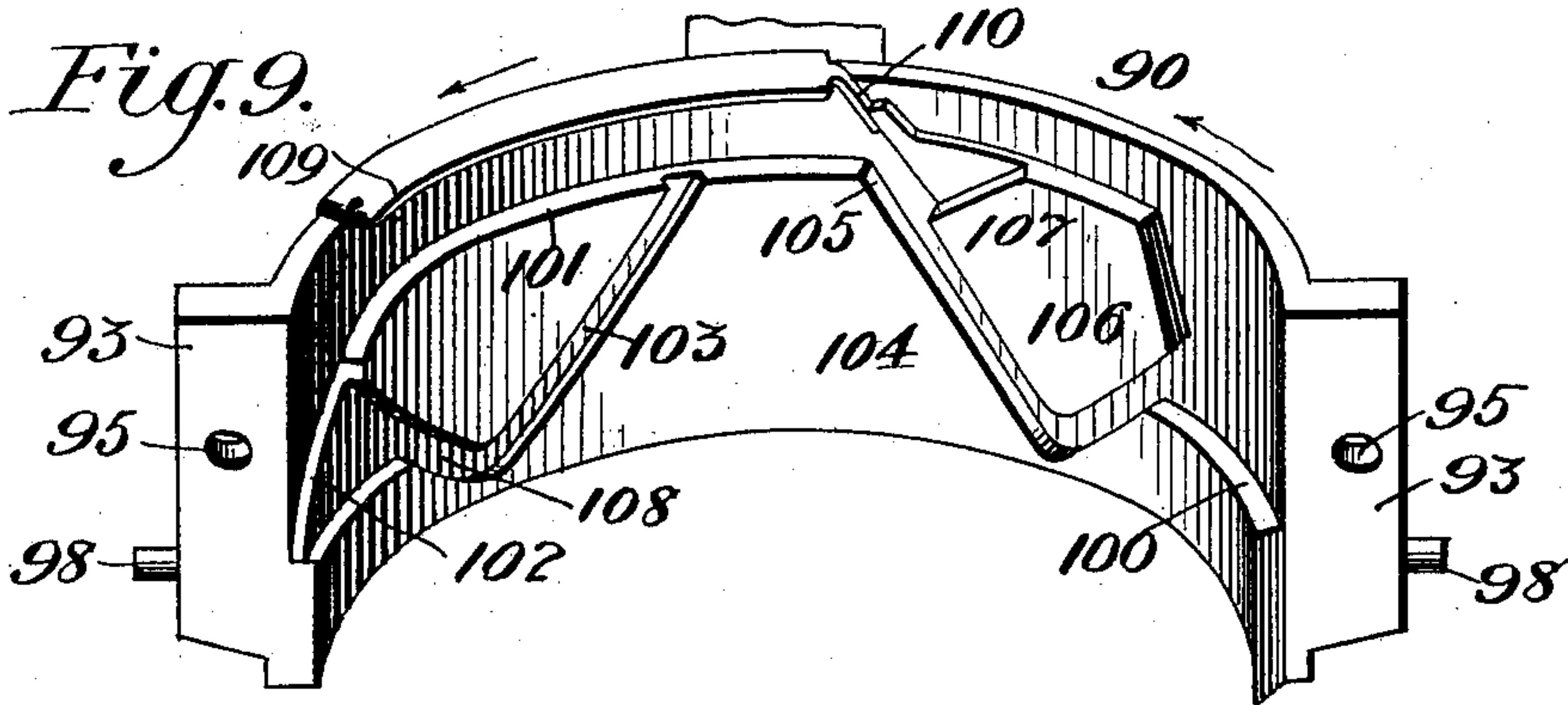
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7 SHEETS—SHEET 5.



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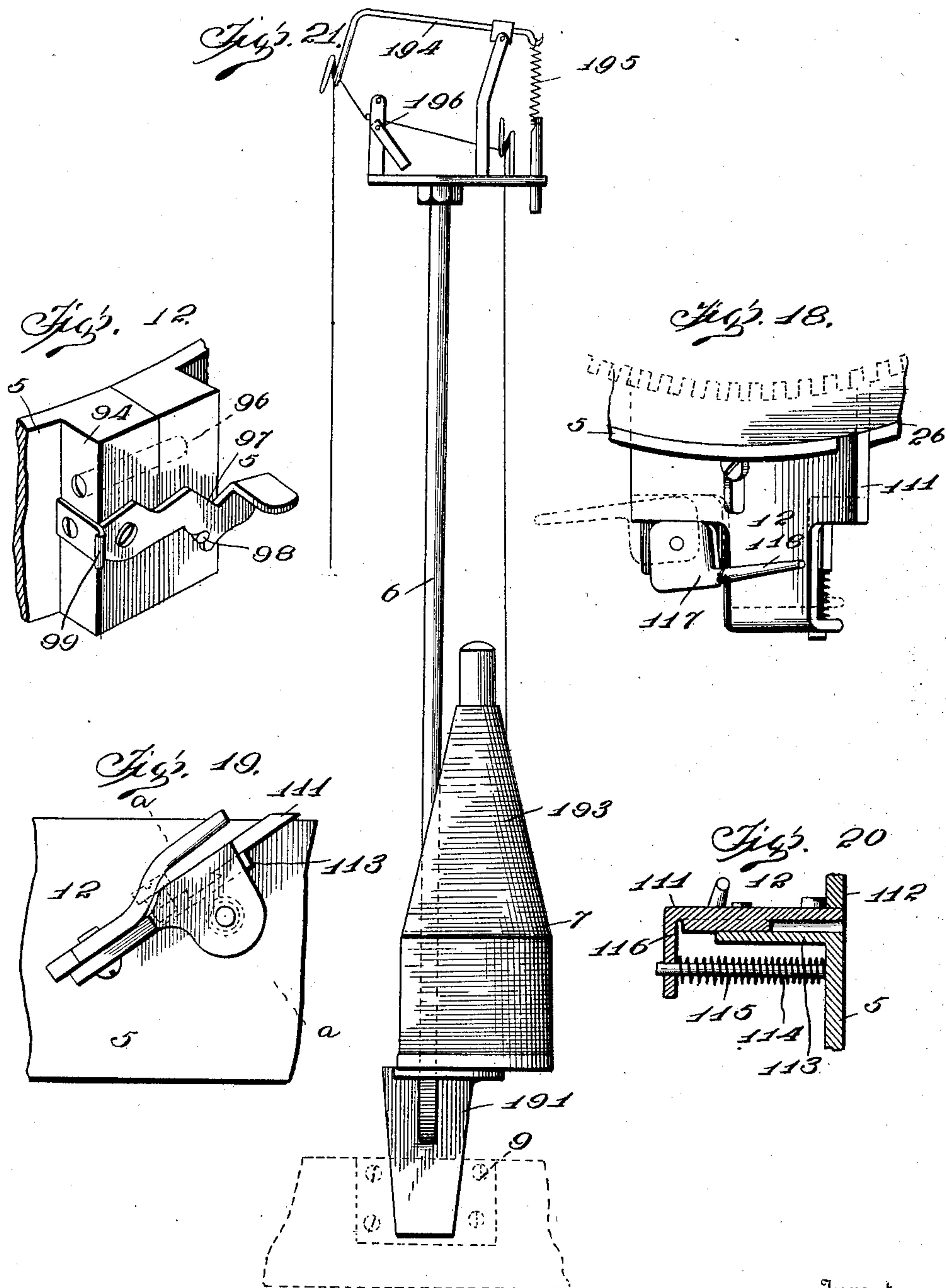
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APPLICATION FILED JAN. 18, 1902.

NO MODEL.

7 SHEETS—SHEET 6.



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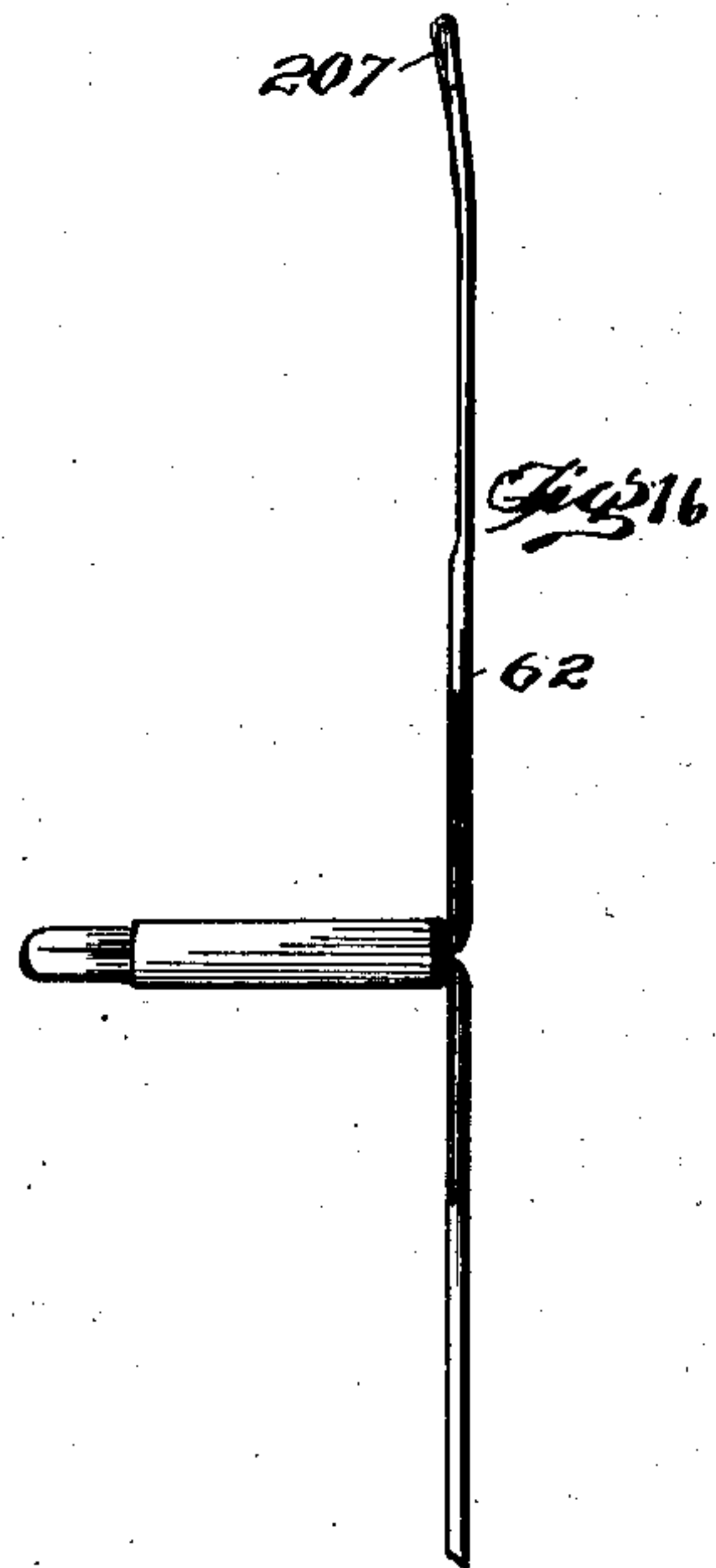
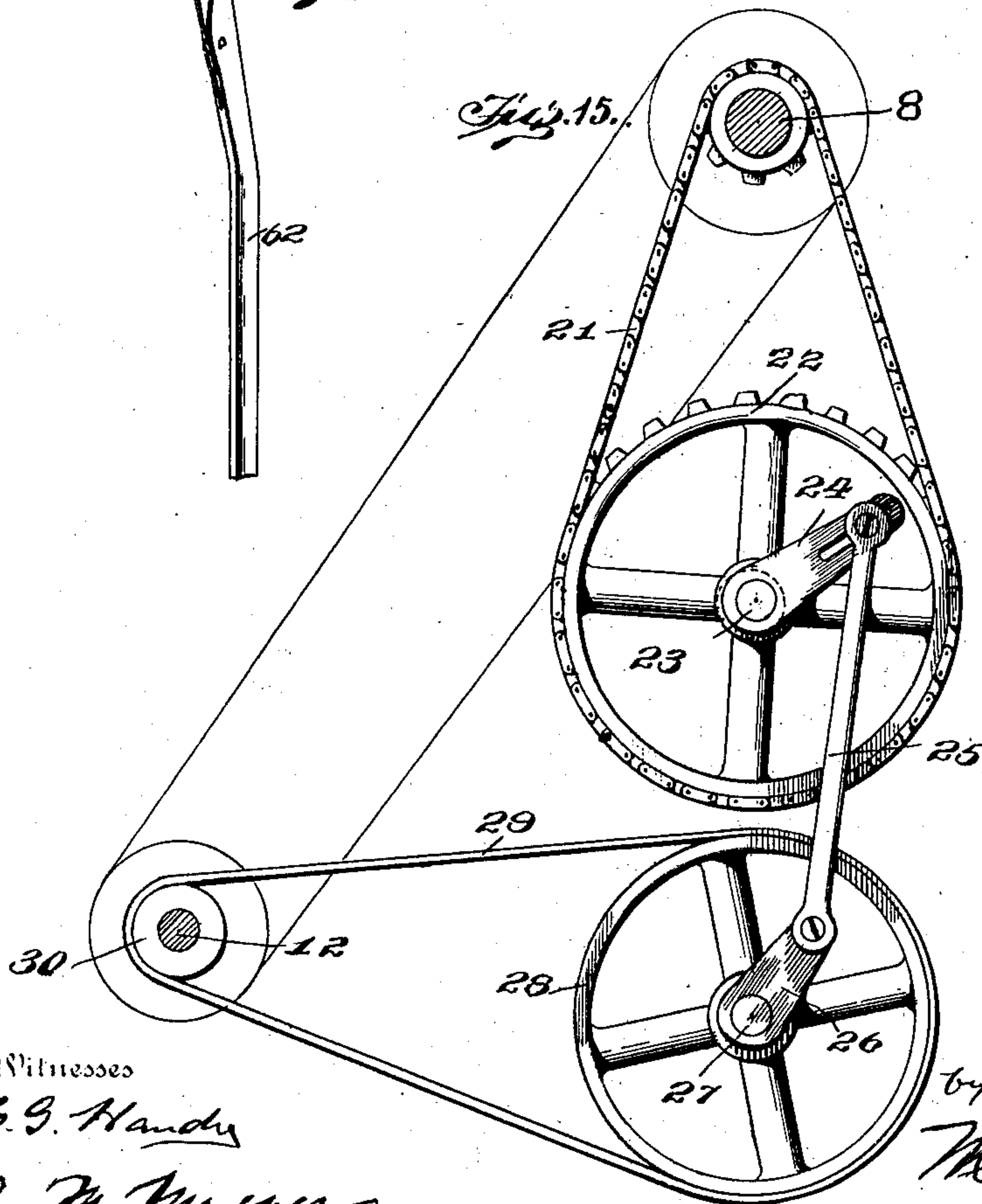
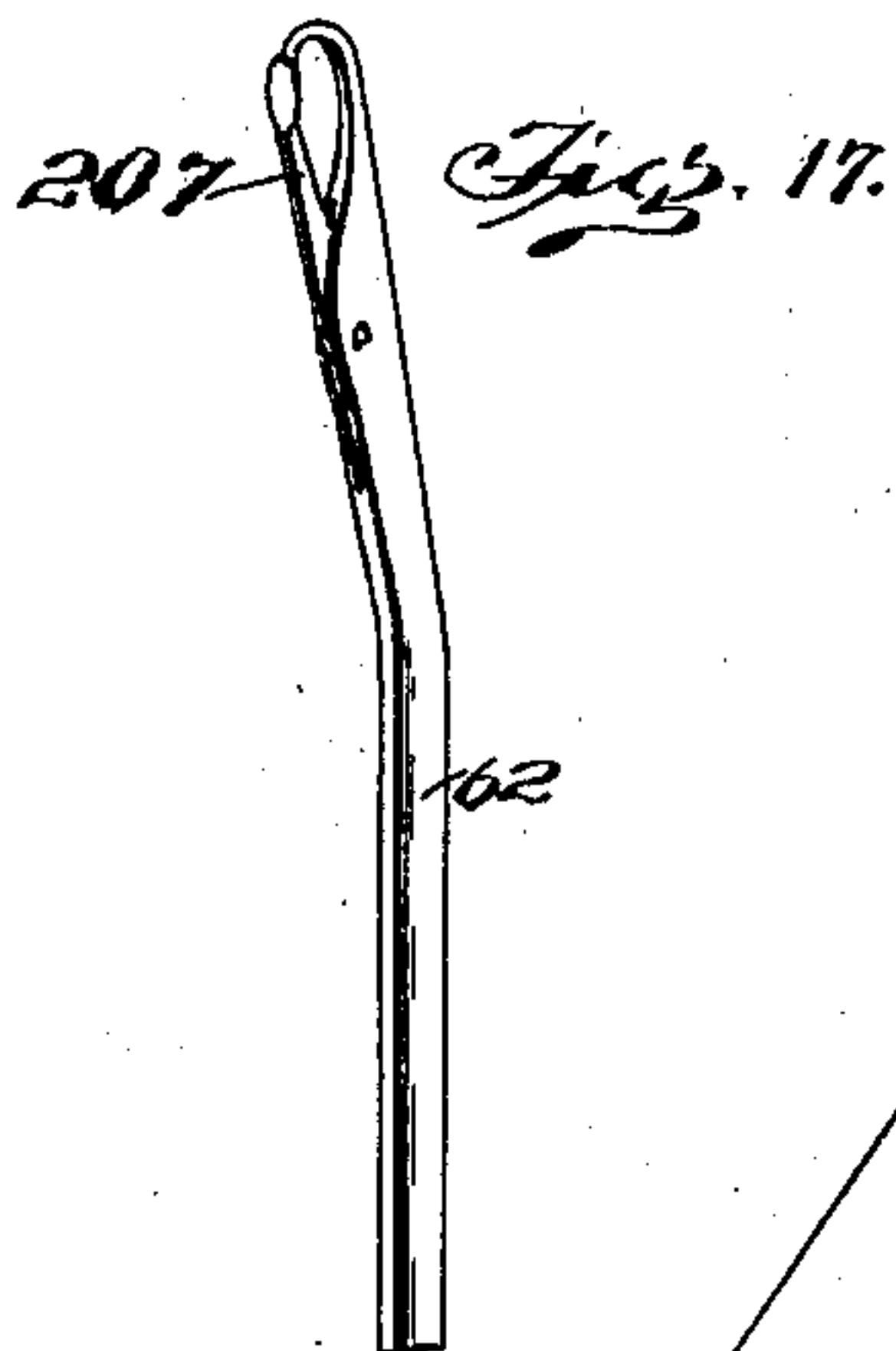
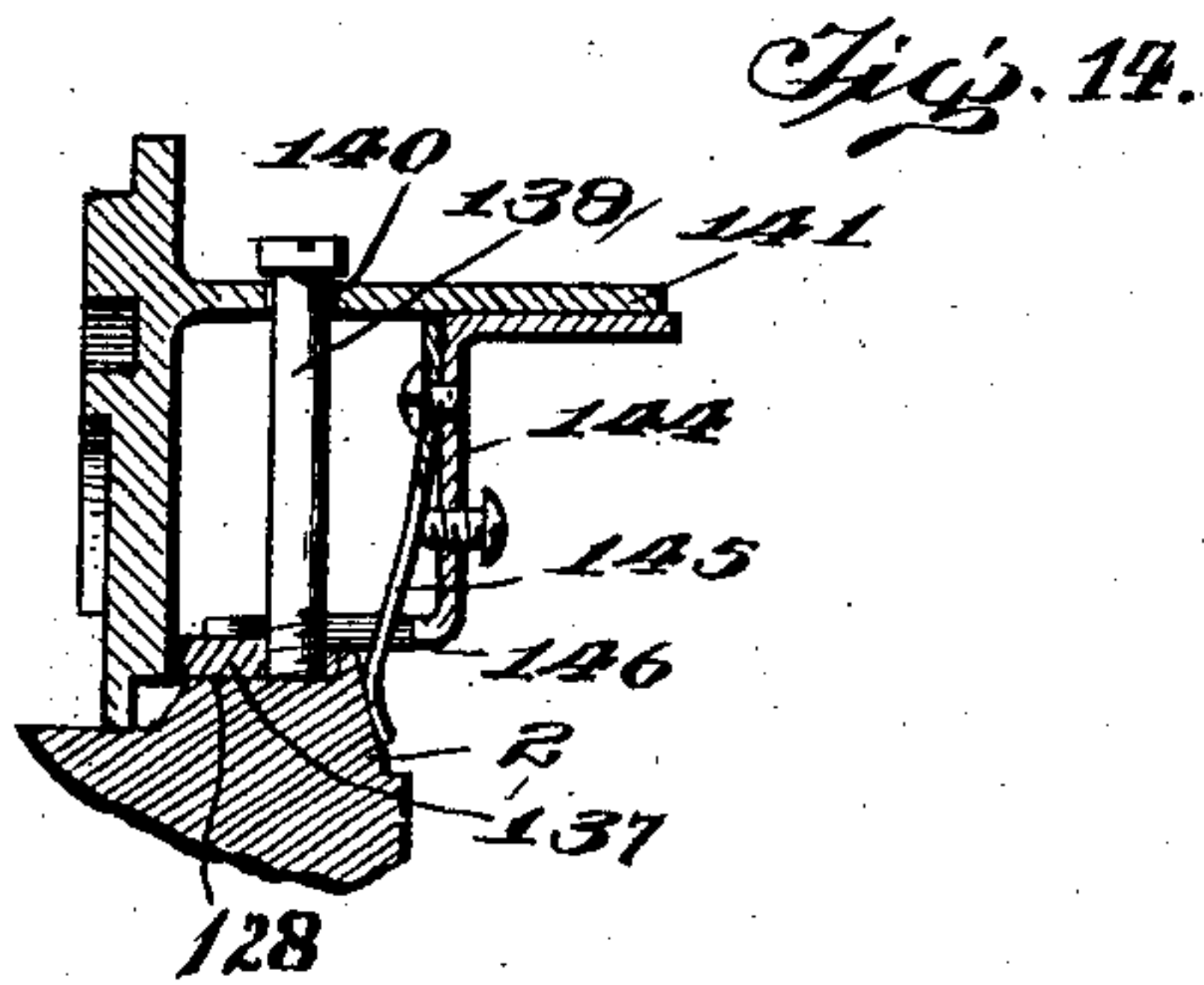
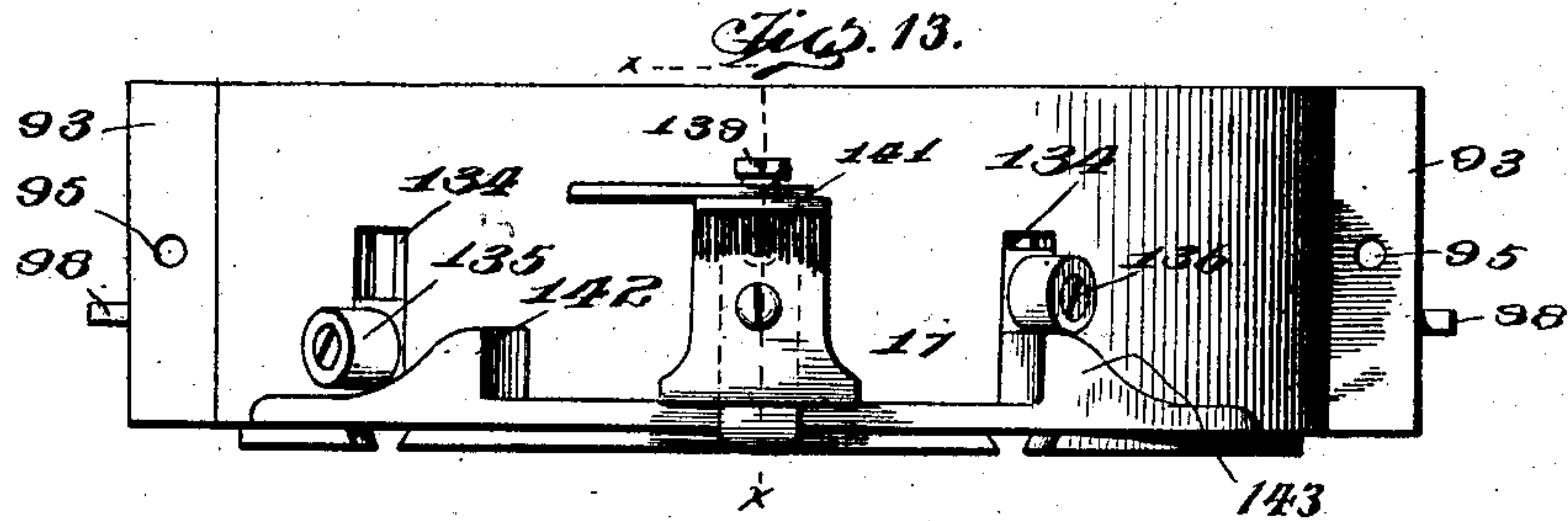
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NO MODEL.

7 SHEETS—SHEET 7.



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# UNITED STATES PATENT OFFICE.

BERNARD T. STEBER, OF UTICA, NEW YORK.

## KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 753,645, dated March 1, 1904.

Application filed January 18, 1902. Serial No. 90,363. (No model.)

*To all whom it may concern:*

Be it known that I, BERNARD T. STEBER, a citizen of the United States, residing at Utica, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Knitting-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it ap-  
 10 pertains to make and use the same.

The present invention relates to improvements in knitting-machines, and is particularly adapted for the complete knitting of such fabrics as stockings, socks, or the like, the machine being capable of beginning at one end of such fabric and carrying on the knitting process to produce the various parts thereof without the fabric being removed from the mechanism.

It consists in a knitting-machine provided with a series of reciprocating needles formed with operating-heels, the said machine having a cam-cylinder for engaging said needles and manipulating them, the cylinder being provided with removable cam-sections which carry cam-surfaces, together with means for quickly engaging and disengaging the removable sections, whereby they may be quickly removed and substituted one for the other in  
 30 knitting different parts of the fabric.

It further consists in a knitting-machine having reciprocating needles and provided with several removable cam-sections adapted to be used interchangeably, each section being  
 35 capable of a different function in directing the needles of the machine in producing different kinds of work.

It also consists in certain other novel constructions, combinations, and arrangements of parts, as will be hereinafter fully described and claimed.

In the accompanying drawings, forming a part of this application, Figure 1 is a side elevation of my improved knitting-machine.  
 45 Fig. 2 is a detail prospective view of a portion of the mechanism for stopping or starting the machine and controlling its operation. Fig. 3 is a detail sectional view through the shafting and pulleys which receive and trans-

mit power to the mechanism. Fig. 4 is a side elevation of the mechanism for automatically raising separate needles out of operation. Fig. 5 is a transverse cross-section through the same. Fig. 6 is a perspective view showing the feed-ring for delivering the yarn to the needles of the machine in position with respect to the needles. Fig. 7 is a detail perspective view looking at the inside of a portion of the cylinder and the feed-ring for delivering yarn to the needles. Fig. 8 is a detail sectional view through the lugged wheels or disks which control the operation of the sinker mechanism. Fig. 9 is a detail perspective view of the cam used for knitting a ribbed stitch, as in the leg portion of a stocking. Fig. 10  
 65 is a perspective view of a similar cam, but showing one which is formed for knitting a plain stitch, as for the ankle of a stocking. Fig. 11 is a perspective view of a cam adapted for knitting continuously in one direction or back and forth for producing the heel and toe of a stocking in a continuous operation. Fig. 12 is a detail perspective view of a portion of the cam-cylinder, showing means for removably holding the various cams in position.  
 75 Fig. 13 is an elevation showing the upper surface of the cam-cylinder and illustrating the friction device for automatically changing sections of the cams according to the direction in which the cam-cylinder travels. Fig. 14 is a vertical cross-section through a portion of the same. Fig. 15 is a detail view showing the manner of transmitting power from a power-shaft to the actuating parts of the knitting-machine. Fig. 16 is a detail side elevation of one of the knitting-needles employed in the present machine. Fig. 17 is an enlarged perspective view of the yarn-engaging end of the needle. Fig. 18 is a top plan view of the switch employed for returning needles to ac-  
 90 tion which have been lifted out of operation. Fig. 19 is an end elevation of the same. Fig. 20 is a sectional view on the line *a a* of Fig. 19. Fig. 21 is a detail view showing an auxiliary bobbin-holder and yarn-guiding mechanism adapted to be removably mounted on the cylinder for delivering a second yarn to the machine. Fig. 22 is a detail view of the



spring-pressed pin for controlling the chain mechanism. Fig. 23 is a detailed view showing the means of holding the feed-ring for the yarn in proper position.

5 Knitting-machines for making ribbed-legged stockings heretofore used have been so built that it was necessary to alter them for knitting different portions of the fabric or to knit one portion of the fabric in one machine  
10 and change the same to another machine for completing the same.

In the present invention the machine is capable of knitting fabrics of various kinds—such, for instance, as stockings, socks, and  
15 the like with a ribbed outside, as described in Patent No. 635,817—without removing the fabric from the machine until completed, the leg portion of the stocking being knitted with one kind of stitch, the ankle portions with another kind, and the heel and toe portion with  
20 still another stitch, while the foot portion is formed with a stitch similar to that of the ankle portion and preferably with yarn from one feeder only.

25 The machine is also so constructed that many operations which required attention from an attendant are now controlled automatically.

The machine is provided with a supporting-standard 1, having a bed-plate 2, upon which  
30 is mounted the needle-cylinder 3 and the web-holder cylinder 4, together with other parts of the mechanism, as will be hereinafter described. The cam-cylinder 5 is mounted upon the bed-plate 2 and moves outside the needle-  
35 cylinder at some little distance therefrom. The cam-cylinder 5 is operated by gears 6 and 7, the gear 6 being secured to the cam-cylinder and meshing with the gear 7, secured to a shaft 8, which is journaled in the frame of  
40 the machine. The shaft 8 is adapted to receive a continuous movement in one direction or an intermittent motion, moving first in one direction and then in the other. For the purpose of giving the said shaft a continuous  
45 movement I secure a fixed pulley 9 to the said shaft, connecting the same, by means of a suitable belting 10, with a pulley 11 on a power-shaft 12, arranged in suitable proximity on the machine. To one side of the fixed pulley  
50 9 is a loose pulley 13, journaled upon a sleeve 14, which surrounds the shaft 8, the said sleeve projecting from one of the shaft-cylinders. When the belt is moved to the pulley 13, the shaft 8 will no longer receive power from the  
55 belting 10. When it is desired to run the machine continuously in one direction, the belt 10 is moved from the loose pulley 13, the fixed pulley 9 easily communicating motion directly to the shaft 8. The shaft 8 also carries a loose gear 15. The loose gear 15 is preferably formed with an elongated hub portion, one end of said hub having an annular groove 16 formed therein, which is engaged by the stud 17 of a shifting-lever 18, (see Fig. 2,) so

that by moving the said shifting-lever the  
65 gear 15 may be moved longitudinally upon the shaft 8. The hub of the gear 15 (see Fig. 3) is also provided in its opposite end with a recess 19, adapted to engage a projecting lug or pin 20, carried by the hub of the fixed pulley  
70 9, the structure being such that when the said gear 15 is moved toward the pulley 9 the recess 19 will engage the pin 20 and the said gear 15 will impart its motion to the pulley 9 and through the same to the shaft. 8. The  
75 gear-wheel 15 can be disconnected from the pulley 9 and shaft 8 at any time by a reverse motion of the shifting-lever 18. The gear-wheel 15 is connected, by means of a sprocket-chain 21, with a large sprocket-gear 22, mounted upon a shaft 23. (See Figs. 1 and 15.) The  
80 shaft 23 also carries an arm 24, which is connected, by means of a pitman 25, with an arm 26 upon a counter-shaft 27. The counter-shaft 27 also carries a pulley 28, which is connected, by means of a belt 29, with a pulley 30 on the power-shaft 12. The relative lengths of the crank-arms 24 and 26 are such that a complete revolution of the crank-arm 26 will only move the crank 24 back and forth, so  
90 that a continued revolution of the shaft 27 will produce a back-and-forth movement of the shaft 23 and the gear 22, which in turn imparts a back-and-forth movement to the gear 15, and the said motion will be imparted  
95 to the cam-cylinder through the shaft 8 and the gearing 6 and 7. The relative sizes of the gears 15 and 22 are preferably such that the cam-cylinder will be moved almost one complete revolution in one direction before it is  
100 reversed, moving a similar distance in the other direction. It will thus be seen that the movement imparted to the cam-cylinder can be changed from a continuous motion to an intermittent movement, and this is accomplished by throwing the belt 10 from one pulley to the other and the gear-wheel 15 into or out of engagement with the fixed pulley 9. This is necessary to the knitting of the heel, foot, and toe portions of a stocking, since the  
110 heel and toe portions are knitted with a back-and-forth movement, while the intermediate foot portion is knitted with a continuous circular movement in one direction. The shaft 8 is also provided with a hand-lever 31, which  
115 carries a suitable handle 32, by which the said shaft 8 may be operated by hand, if desired, instead of power. The movement of the cam-cylinder causes the reciprocation of the knitting-needles of the machine in the usual way  
120 for performing the knitting operation.

The throwing of the knitting mechanism out of operation when the style of stitch is to be altered or the movement of the cam-cylinder is to be varied can be automatically accomplished by a simple mechanism, as will now be described. A shaft 33 (see Figs. 1, 2, and 8) is mounted in the machine parallel



with the shaft 8 and carries a sprocket-wheel 34. This shaft 33 also carries a ratchet-wheel 35, which is formed with ratchet-teeth on its periphery, the said teeth being engaged by a pawl 36, which is pivoted to a bell-crank lever 37, said lever being mounted in the frame of the machine. The nose of the pawl 36 is kept in engagement with the teeth of the ratchet 35 by means of a spring 38, secured to a projection on said pawl and connecting the same with the frame of the machine. The free end of the bell-crank lever 37 engages a cam 39, which is carried by the shaft 8. The ratchet-wheel 35 is provided with a spring-pressed pin 40, which passes through an aperture in the hub of said ratchet-wheel and engages a series of ratchet-teeth 41, formed on the hub of the sprocket-wheel 34. A spring 42, secured to the hub of the ratchet-wheel 35, bears against the outer end of the pin 40 and normally holds the same in engagement with the ratchet-teeth 41. The arrangement of the ratchet-teeth 41 is such that when the ratchet-wheel 35 is rotated step by step by means of the pawl 36 the pin 40 will turn the sprocket-wheel 34. The sprocket-wheel 34 could, however, be turned ahead of the said pin, if desired, the beveled end of the pin merely slipping over the inclined surfaces of the teeth 41. The sprocket-chain 43 is suspended upon the sprocket-wheel 34, its lower end merely hanging therefrom. The said sprocket-chain, however, carries at suitable intervals lugs 44, which project therefrom and are adapted to engage a lever 45, which holds the belt-shifter 46 of the belt 10 so that said belt will be on the fixed pulley 9. When such a projection on the sprocket-chain 43 engages the beveled nose 47 of the arm or lever 45, it will be raised on its pivot 48, and an arm 49, which is adapted to engage a notch 50, formed in the belt-shifter 46, will be withdrawn from said notch, and the belt-shifter can thus be moved so as to bring the belt 10 upon the idler-pulley 13. The belt-shifter 46 is preferably actuated by a spring 51, so that when it is released from engagement with the arm 49 the said shifter will be immediately operated by the spring to shift the belt 10 upon the idler-pulley. A spring 52, interposed between a support of the lever 45 and a second arm 53, projecting therefrom in an opposite direction from the arm 49, tends to normally hold the arm 45 in engagement with the chain 43. Of course it will be understood that the moment the belt-shifter is permitted to move the belt in the manner just described by the lifting of the lever 45 the cam-cylinder will be stopped until the mechanism for rotating it again is brought into operation. In order to operate the lever or arm 45 by hand in case of an emergency, a hand-engaging portion 54 is formed in the arm 53, which may be grasped at any time for releasing the said le-

ver-arm and stopping the operation of the machine. The shifting-lever 46 will remain with its notch 50 out of engagement with the arm 49 until it is desired to bring the belt upon the fixed pulley again, when the said shifter 46 is moved by a handle 55, which projects from the said shifter for this purpose.

The throwing of the sprocket-wheel 15 out of engagement with the pulley 9 can also be automatically accomplished by the action of the lever-arm 45. For this purpose I mount a lever 56 pivotally upon the machine, one end of said lever, as 57, projecting from a portion of the lever-arm 45, while the other end of said lever 56 is formed with a hooked end 58, which is so positioned as to engage one end of the shifting-lever 18 when the said lever is moved to throw the sprocket-wheel 15 into engagement with the fixed pulley 9. The shifting-lever 18 is preferably a bell-crank lever pivoted to the frame 1 at 59 and having a forwardly-projecting handle portion 60 within easy reach of the operator of the machine. By operating the handle 60 outwardly the inner end of the lever 18 is moved to one side to bring the gear 15 against the pulley 9, at the same time its outer end engaging the hook 58 of the lever 56. The parts will remain in this relation, and the cam-cylinder will be moved back and forth with an intermittent movement until the lever-arm 45 is raised by the next projection 44 of the sprocket-chain 43. When said projection 44 engages the beveled end 47 of said lever-arm, it will be raised and the end 57 of the lever 56 will be lifted, so as to depress the hook 58 at the other end thereof and release the shifting-lever 18. This lever 18 will be then moved automatically by a spring 61, so as to throw the gear 15 out of engagement with the pulley 9 and stop the operation of the machine again. The spring 61 is interposed between one of the free ends of the shifting-lever 18 and the frame of the machine. It will thus be seen that by a suitable arrangement of the lugs or projections 44 upon the chain 43 the operation of the machine may be automatically changed at the proper time for producing certain fabrics in the machine. Thus in knitting a stocking the cam-cylinder will be permitted to operate continuously in one direction a sufficient length of time to knit the said leg portion. When this part of the stocking is completed, the machine will be automatically stopped and may be altered by changing its cam, so as to produce a different stitch for the ankle portion. The machine will then be started again by throwing the shifting-rod 46, so as to operate the machine continuously until the heel of the stocking is reached, when another projection 44 on the chain 43 will again stop the machine. The shifting-rod 18 is then actuated, so as to throw the gear 15 into connection with



the shaft 8, and the intermittent back-and-forth movement of the cam-cylinder will be started for producing the heel of the stocking. After a sufficient number of stitches to  
 5 accomplish this purpose have been produced the next projection on the chain 43 will stop the machine, and the machine may then be caused to operate continuously for forming the foot of the stocking. The next projection  
 10 on the chain 43 will stop the operation in time to again throw in the intermittent mechanism for producing the toe of the stocking and completing the fabric. It will thus be seen that the function of the chain 43 is very im-  
 15 portant and that the projections 44 may be so arranged and timed as to automatically stop the machine precisely at the proper moment.

The needle-cylinder is formed with vertical needle-grooves on its outer periphery, occupied by the needles 62 of the usual or ordinary construction. The needle-cylinder is larger outside at the top than it is lower down, and therefore the walls or partitions between the needles extend farther outwardly radially  
 25 at the top than below, so that when a needle draws its loop downwardly the loop can avoid the groove by being pulled over the corners of the walls thereof, especially when needles are employed which are bent as described in  
 30 my Patent No. 635,817 and shown in Fig. 7 thereof.

The needles are provided with the usual heel portions, which engage the cams of the cam-ring 5, so that they are reciprocated for  
 35 performing the knitting operation.

Instead of forming the cams of the cam-cylinders so that their portions have to be continually adjusted and varied in order to produce the various stitches desired, I provide  
 40 the cam-cylinder with a number of removable sections, as shown in Figs. 9, 10, and 11, each section having a cam within it adapted for knitting a certain kind of stitch. These cam-sections 90, 91, and 92 are preferably semi-  
 45 cylindrical in shape and are provided with laterally-projecting lugs 93, having faces which meet corresponding lugs 94 on the fixed portion of the cylinder 5. Each of these lugs is formed with an aperture 95, which is adapted  
 50 to fit upon the end of dowel-pins 96, secured to the lugs 94. Latches 97 are pivoted to the lugs 94 and when turned downwardly engage studs 98, carried by the flanges 93 of the said cam-sections. A spring 99 bears  
 55 against the pivoted end of each latch 97 and holds it in its open or closed position, as will be clearly understood by reference to Fig. 20 of the drawings. It will thus be seen that the cam-sections can be quickly and easily re-  
 60 moved and put in place and when in place form an integral part of the cam-cylinder. While I may use a series of differently-formed cams, I preferably employ a cam 90 for knitting a ribbed stitch in the leg of stockings.

This cam 90 is formed with a lower path 100 65 and an upper path 101, with inclined paths 102, 103, and 104 leading from one to the other. This cam is adapted for use in connection with knitting-needles having long and short heels alternately arranged. The path 70 102 is narrower than the paths 100 and 101, so that only long-heeled needles will travel up the same. These needles will therefore be raised to the path 101 and after traveling along upon the same will engage a path 105, 75 projecting from the cam-section 106. The lower portion of this path 105 is made full width or as wide as the cam-path 100 or 101. The cam-cylinder revolves in one direction, as shown by the arrow in Fig. 9, for forming 80 the leg of the stocking. When traveling in this direction, the long-heeled needles will be caught by the cam-path 102 and raised to the path 101, traveling along the same until they strike the under surface of the cam-section 106, being directed downwardly by the 85 cam-path 104, so as to perform the knitting operation, after which they will be returned to the path 100. The short-heeled needles do not engage the cam-path 102, but do engage 90 the cam-path 108, by which they are depressed sufficiently to perform the knitting operation, and are then carried upwardly by the path 103 to take a new supply of yarn. The short-heeled needles will then travel along the path 95 101 until they come in contact with a path 107, formed in the cam-section 106, by which they will be lifted out of action while the long-heeled needles are operating. It will thus be seen that the alternate sets of needles, long 100 and short heeled, will be operated at different points on the cam-cylinder at each revolution thereof, the long-heeled needles knitting at one point and the short-heeled needles at another point for producing the ribbed effect in 105 the fabric. There is always at least one yarn fed to the machine for performing the knitting operation. This yarn passes through the aperture 197<sup>a</sup> in the wall of the ring 197. When a second yarn is employed, it is drawn 110 from a second bobbin and passed through the aperture 202 in the walls of said ring 197. In order to prevent a possibility of the needles which travel up the inclined path 102 from climbing too high, I place an overhang- 115 ing shoulder or guide-piece 109 along the upper edge of the cam-section 90 for a short distance. The said shoulder 109 is provided at one end with a downwardly-extending projection 110, which will operate to lead the needles back to the cam-section 106. The short-heeled needles which have been raised to the height of the upper surface of the cam-section 106 will return to the cam-path 100 at each revolution of the cam-cylinder by means 120 of a switch-plate 111, (shown in Figs. 18, 19, and 20,) which is adapted to project through a slot 112, formed in the side of the fixed por-



tion of the cam-cylinder. This plate 111 is dovetailed to a bracket 113, formed in the cam-cylinder, the said bracket being arranged at such an angle as to hold the switch-plate in a proper position to engage the heels of the needles and depress them, when the said switch-plate is pushed inwardly through the slot 112. The switch-plate is normally held in its outer position by means of a coiled spring 114, surrounding a face 115 on the cylinder 5, the said spring bearing against a downturned lug 116, carried by the switch-plate 111. A cam 117 is pivoted to the said bracket 113 and bears against the edge of the switch-plate 111. This cam is provided with a handle 118, by which it may be turned on its pivot-point, so as to push the switch-plate 111 inwardly or permit of its remaining in its outer position. This switch-plate can be very quickly manipulated by the operation of the cam 118. All the short-heeled needles will thus be returned to the lower path 100. When the ankle portion is reached, it is usually desirable to knit the same with a plain stitch. I therefore remove the cam-section 90 and insert the cam-section 91 in place, the cylinder being still operated continuously. In using the cam-section 91 all the needles, long and short, will be carried upwardly by the cam-path 119 to take yarn, being then depressed by the cam-path 120, so as to knit, after which they are raised again by the path 121 to take a second supply of yarn and are again depressed by the cam-path 122 for knitting a second time. The needles then return to the lower cam-path until the cylinder makes another revolution. The upper end of the cam-section 123 is provided with a projecting nose 124, which extends above the upper cam-path a sufficient distance to insure the collection and depression of all the heels of the needles. After the ankle portion has been formed and the heel portion has been arrived at the cam-section 91 is removed from the cylinder and the section 92 is put in place. This section is formed with cam-surfaces suitable for forming a tightly-knit fabric at the heel and toe portions by a back-and-forth movement. The best result is accomplished by forming this cam so that all the needles will knit when the cam-cylinder turns in one direction and only every other needle will knit when turning the cam-cylinder in the opposite direction. This cam-section is therefore provided with a lower and upper path 125 and 126, respectively, and is formed with an intermediate cam-section 127, having a thin edge 128 and a thick edge 129. Movable cam-sections 130 and 131 are also employed which are alternately raised and lowered as the knitting operation proceeds. As the cam-cylinder turns in the direction indicated by the arrow *c* the cam-section 131 will be lowered and the section 130 raised and all the needles will travel along the upper surface of the cam-

section 131; but after leaving said section only the long-heeled needles will be engaged by the thin edge 128 of the section 127. These needles only will therefore be raised to take yarn, being carried downwardly by the cam-path 132 and passing beneath the section 130, so as to knit, thence rising again to the lower cam-path 125. The short-heeled needles in the meantime have engaged the under surface of the thick edge 129 of the central cam-section and have been carried down also without having a chance to take yarn. They will be raised with the long-heeled needles to the path 125. In the return movement of the cam the heels of the needles will be depressed and pass over the section 130 and will be raised by the thickened portion 129 of the center cam-section 127, so as to take yarn, after which they will be depressed again, passing beneath the movable section 131, so that all of them will be caused to knit, after which they will rise again to the lower cam-path 125. In knitting the heel or toe of a stocking the said portions are formed of two triangular sections, as is well known in the art, and in forming the first section it is necessary to remove one needle at the end of each course of stitches. When the smallest portion of the heel has been reached and the second portion thereof is being knitted, one of the needles which has been raised out of action is returned to activity at the end of each course of stitches, and for this purpose I provide a groove or cam-path 133 in the upper section of the cam, having a flaring mouth portion and leading into the cam-path 132. One of the needles at a time is depressed, and if it is a short-heeled needle it will engage the path 133 and be led back to action again. If it is a long-heeled needle, it will engage the end of the upper cam-section and also be led back to the path of the other active needles. When employing the cam-sections 90 and 91, the switch-plate 111 and the cam 117 are brought to the position shown in Fig. 18.

The alternate raising and lowering of the sections 130 and 131 is effected in a suitable manner. Each of these cam-sections is provided with a stud which extends through a vertical slot 134 in each cam-section, the said studs carrying in their outer ends antifriction-rollers 135 136. A slide-plate 137 is arranged just outside the cam-section and moves on an operating surface or way 138 on the bed of the machine. A pin 139 rises from said plate and passes through an elongated slot 140 in a laterally-projecting handle portion 141, formed on said cam-section. The movement of this pin in the said slot limits the stopping of the plate 137 with respect to the cam-section. This plate 137 carries two upwardly-projecting cams 142 and 143, which alternately engage the antifriction-rollers 135 and 136, according to the direction in which the cam-



cylinder is revolved. The plate 137 also carries an outwardly-projecting arm portion 144, to which is attached a spring 145, which extends downwardly to an opening 146 in said arm 144, the lower end of said spring bearing against a beveled annular surface of the bed-plate 2. It thus occurs that when the cam-ring moves in one direction the rubbing of the spring 146 against the bed 2 tends to make the plate 137 drag, and one of the cams 142 or 143 will be forced beneath its corresponding antifriction-roller 135 or 136. When the cam-cylinder moves in the opposite direction, the plate will drag again and the other cam carried thereby will raise its antifriction-roller, while the other is permitted to drop again. In this manner the sections 130 and 131 will be alternately raised and depressed.

In knitting the heel or toe of a stocking it is necessary for a while to operate only a portion of the needles. When starting to knit the heel or the toe, I raise about half of the needles out of action at once by means of a foot-lever 147, which forces a plunger-rod 148 upwardly, so as to engage the heels of the said needles, as heretofore described and illustrated by me in my Patent No. 657,182. In progressing with the first portion of the heel or toe the number of needles is diminished, one at a time being raised at the end of each course of stitches by an arm 149, which is pivoted at 150 on the frame of the machine and extends upwardly beneath the heels of the needles at its inner end, as shown and described in the patent just referred to. This lever and the standard which carries it are provided with pawls 151 and 152, which engage a rack 153 on the frame of the machine for feeding the said mechanism forward step by step to engage the heels of the needles successively. This structure and its operation has been minutely described in the former patent and needs no further description at this time. The upper end of the arm 149 is reduced and carries a sleeve 154, which is held in said reduced portion by means of a pin 155, extending transversely from the upper end of said arm. A spring 156 is interposed between the sleeve and shoulder formed in the arm, so that said sleeve is normally forced against the pin 155. The sleeve is oppositely notched, as at 157, for engaging the pin 155, so that the said sleeve will not be easily dislodged from its adjusted position during the operation of the mechanism; but when it is desired to return the sleeve again it may be depressed against the action of the spring 156 and again partially turned. This sleeve 154 carries an arm 158, which when the sleeve is swung in one direction projects in sufficiently close proximity to the cam-cylinder to have its inner open end 159 engaged by a stud 160, which projects from the standard on the frame of the machine. There is one of these arms, 149, on each side of the

machine; but the actuating-arm 161 of one of them is arranged on a lower plane than the actuating-arm 158 of the other, so that they may be engaged by different actuating projections without interfering with each other. These mechanisms are only employed when knitting the heel or toe of a stocking, and the spring-pressed swivel connections for the arms 158 and 161 accommodate the turning aside of said arms out of operative position when the devices are not needed.

The device just described is for lifting needles out of action one by one as the knitting of a heel or toe progresses; but when the second half of the heel or toe is being formed I employ an automatic device for returning the needles one by one into action. This device is like the one shown and described for this purpose in my Patent No. 654,813, July 31, 1900, and is operated by an arm 162, which is engaged by a projection 163, extending upwardly from the frame of the machine, and is arranged in the path of the said arm 162 as it is carried back and forth by the cam-cylinder. It will thus be seen that the machine is adapted to automatically operate the needles for producing the heel and toe of the stocking as well as the other parts thereof.

It is sometimes desirable to employ more than one kind of yarn at the same time during the knitting operation, and I therefore employ a bobbin-carrier and take-up device 191, which is formed with a wedge-shaped support adapted to engage a wedge-shaped recess formed at 192 on the side of the cam-cylinder 5. This yarn-support carries a bobbin 193 and at its upper end is provided with a take-up lever or arm 194, which is controlled by a spring 195 in the same manner as the take-up arm 171. This device is also provided with a yarn-controlling gripping mechanism 196 like the one heretofore described upon the arm 166. A second yarn may thus be delivered to the knitting-needles simultaneously with the yarn delivered to the arm 171, permitting of the knitting of a fabric with yarns of two different colors or of different materials simultaneously, if desired.

After the yarn passes from the take-up arm it is led to a feed-cylinder 197, which surrounds the upper ends of the knitting-needles and is adapted to deliver the yarn to the needles as the knitting operation progresses. The ring 197 is formed with a stem 198, carrying a disk 199 at its upper end. Projecting from the outer face of the disk 199 are studs 200, the upper one shown in Fig. 6, which studs engage a bifurcation in the upper end of a standard 201, secured to the cam-ring 5, so that the said standard and the cam-ring revolve about the needles as the machine is operated. The feeding-ring 197 is formed with an aperture 202, through which the yarn passes, and a notch 203 is formed in the edge



of the ring leading into said aperture, so that the yarn does not have to be threaded through the aperture, but can be threaded sidewise through the passage 203 at any time. This often obviates the necessity of breaking the yarn in order to place the same within the guiding-aperture 202. Just outside the aperture 202 is a guiding-eye 204, formed of a bent piece of wire, for receiving the yarn from the take-up arm and delivering it to the guiding-opening 202 in the ring. The ring 197 is preferably cut away on its under edge at two places, (shown at 205 and 206.) These cut-away places are arranged to accommodate the movement of the latches of the needles. The needles, as shown in Figs. 16 and 17, are formed with pivoted latches 207, which open or close in the knitting operation for taking and releasing the yarn. Since these latches open outwardly, they would strike the walls of the ring 197 if the cut-away portions 205 and 206 were not provided.

From the above description it will be seen that my improved knitting-machine is capable of forming and completing a fabric in which a number of different stitches have to be made and in which different shapes have to be given to certain parts of the fabric. The machine is automatic in many of its operations, so as to minimize the time and labor required to operate the device and to make it easier to teach attendants and operators how to do the knitting. This is quite an important feature when it is considered that most of the knitting-mills have to employ a number of hands to operate the knitting-machines, and it is an advantage to have machines which are not dependent in too large a degree upon the help obtained for running them. The parts of the device are comparatively simple and not likely to get out of order readily.

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

1. A knitting-machine having reciprocating needles, a fixed or principal cam-cylinder section, a removable cam-section and means for removably securing the removable section to the principal section, comprising pivoted latches, springs engaging the same for holding them in their opened or closed positions, and studs or projections carried by the removable section and engaged by the said latches, substantially as described.

2. A knitting-machine, comprising a series of knitting-needles, a cam-cylinder for reciprocating the said needles, gearing capable of giving to the cam-cylinder both a continuous motion in one direction as well as a back-and-forth motion at different times for knitting different portions of a fabric, a shaft carrying said gearing, a fixed pulley secured to the shaft, a loose pulley on said shaft, a belt for operating the machine, the fixed pulley re-

ceiving the said belt for operating the machine continuously and the loose pulley receiving it when the continuous operation ceases, a clutch adapted to be brought into engagement with the fixed pulley and a sprocket wheel and chain for giving the clutch a back-and-forth movement, and power mechanism for actuating the chain to and fro, substantially as described.

3. A knitting-machine, having a cam-cylinder adapted to be revolved for operating the knitting-needles of said machine, gearing for turning the said cylinder, a shaft operating said gearing, a fixed pulley carried by said shaft, a belt connecting the pulley-shaft with the said fixed pulley, an idler-pulley for receiving said belt when the machine is not being operated continuously by the fixed pulley, a clutch for moving said shaft and adapted to be brought into engagement with the fixed pulley so as to move the same and thereby the said shaft, a sprocket-chain connecting said gear with an actuating sprocket-wheel, a crank for moving the sprocket-wheel back and forth, a second crank of shorter throw connected with the first crank, and means for turning the short crank continuously, the longer crank being only moved back and forth thereby, substantially as described.

4. A knitting-machine having a cam-cylinder for operating the needles thereof, a shaft for rotating said cylinder either continuously or intermittently in opposite directions, a lever for stopping the operation of the machine, a sprocket-wheel carried by said shaft and a chain actuated thereby and provided with a series of projections for raising the said lever when the machine is to be stopped, a pulley fixed to the driving-shaft, gearing operated thereby for producing the continuous operation of the cam-cylinder, a clutch to engage the fixed pulley, a sprocket-wheel attached thereto, a chain driving said sprocket-wheel and means for moving the chain back and forth, a belt-shifter, controlled by said lever, for moving the belt which operates the fixed pulley continuously, off from said pulley, the said stopping-lever holding said belt-shifter in position to keep the belt on the fixed pulley until the stopping-lever is raised when the shifter will move the belt off the fixed pulley, a bell-crank lever for moving the sprocket-gear into engagement with the fixed pulley for giving an intermittent motion to the cam-cylinder, a locking-lever for holding the said bell-crank lever in this position, the said locking-lever being engaged by the stop-lever when it is raised for releasing the bell-crank lever and permitting of the sprocket-gear being disengaged from the fixed pulley, substantially as described.

5. A knitting-machine having a series of reciprocating needles, a cam-cylinder for actuating said needles, means for raising some of



the needles having both long and short heels  
out of action simultaneously, means for re-  
turning the said needles to action comprising  
a slide projecting through a slot in the cylin-  
5 der, a guide-pin projecting from the cylinder  
below the said slide, a lug on the slide having  
an aperture engaging said guide-pin, a spring  
interposed between the cylinder and said lug  
for normally forcing the slide outwardly, and  
10 a cam engaging the upper edge of said slide

for forcing it inwardly against the action of  
the spring for engaging the needles, substan-  
tially as described.

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

BERNARD T. STEBER.

Witnesses:

FRANK STEBER,  
JOHN P. WEIS.