

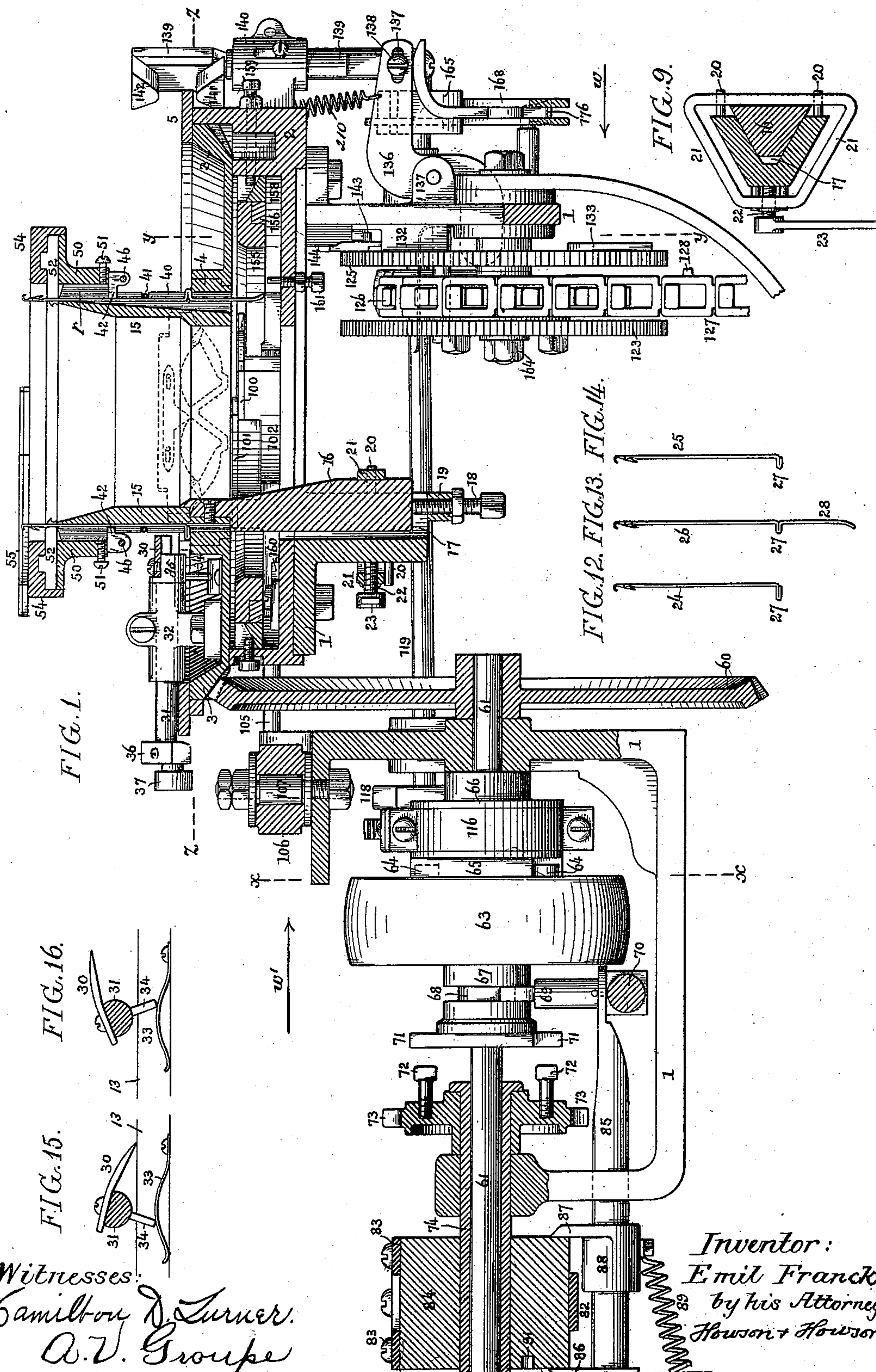
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6 Sheets—Sheet 1.

E. FRANCK.
CIRCULAR KNITTING MACHINE.

No. 504,417.

Patented Sept. 5, 1893.



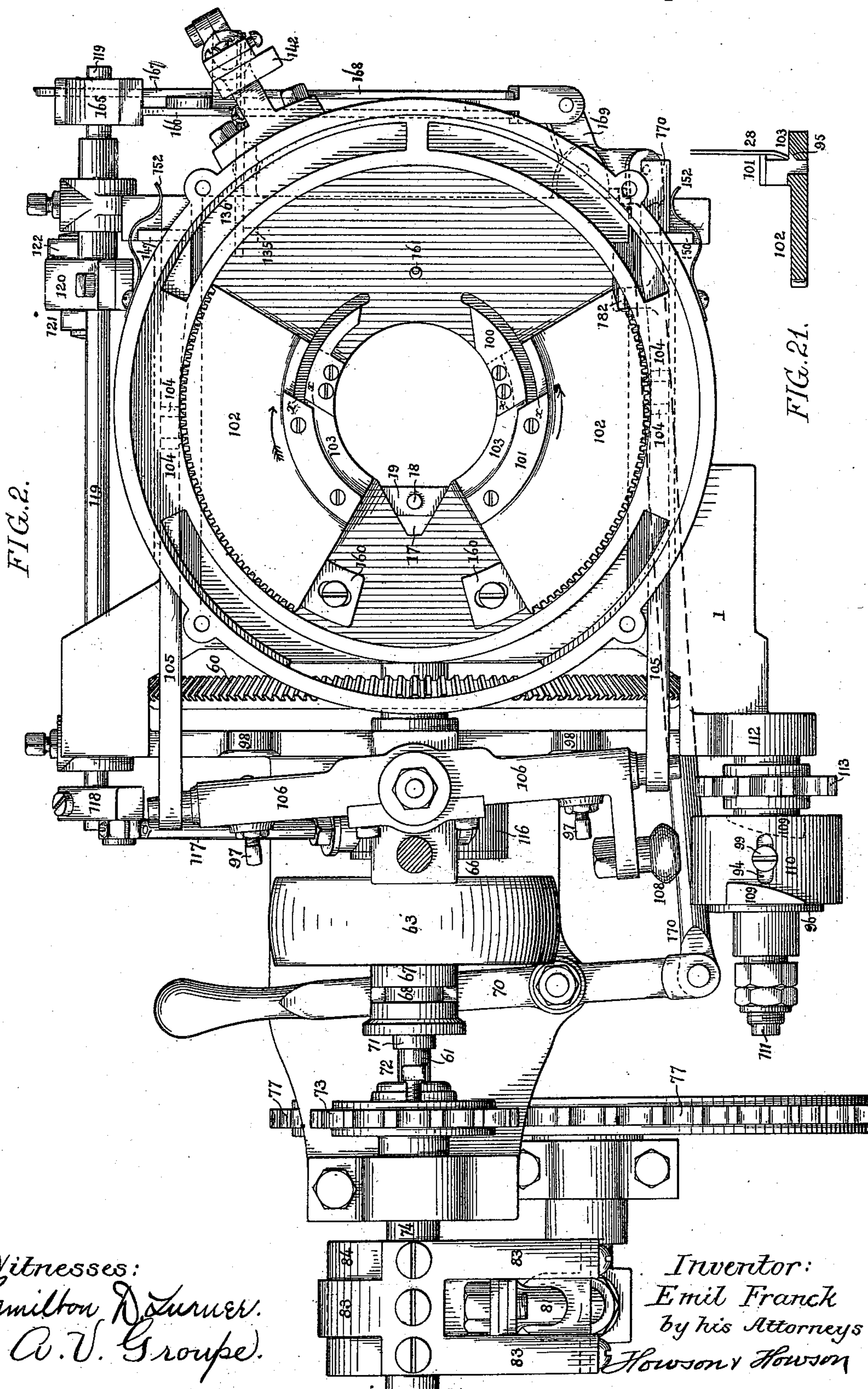
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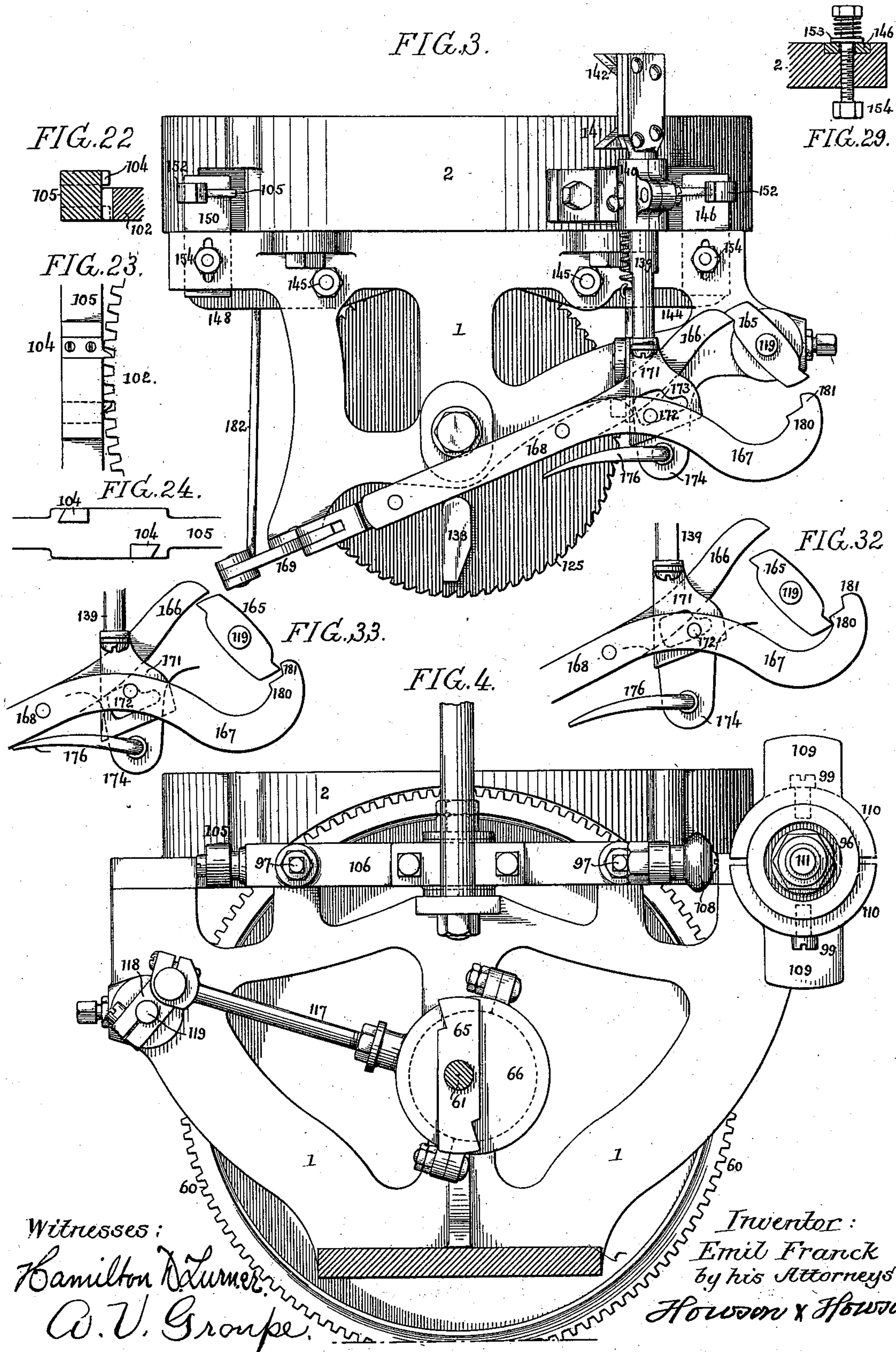
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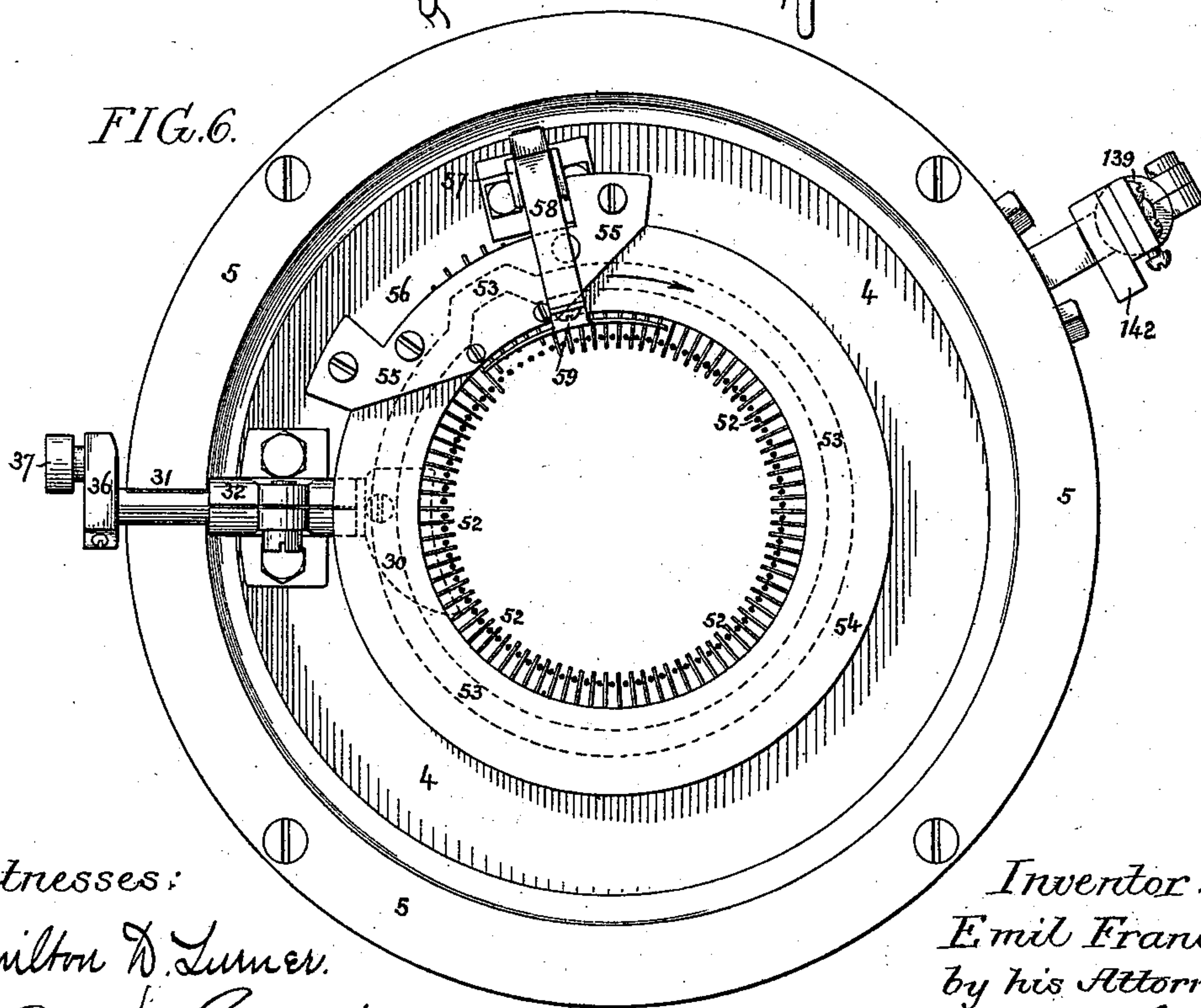
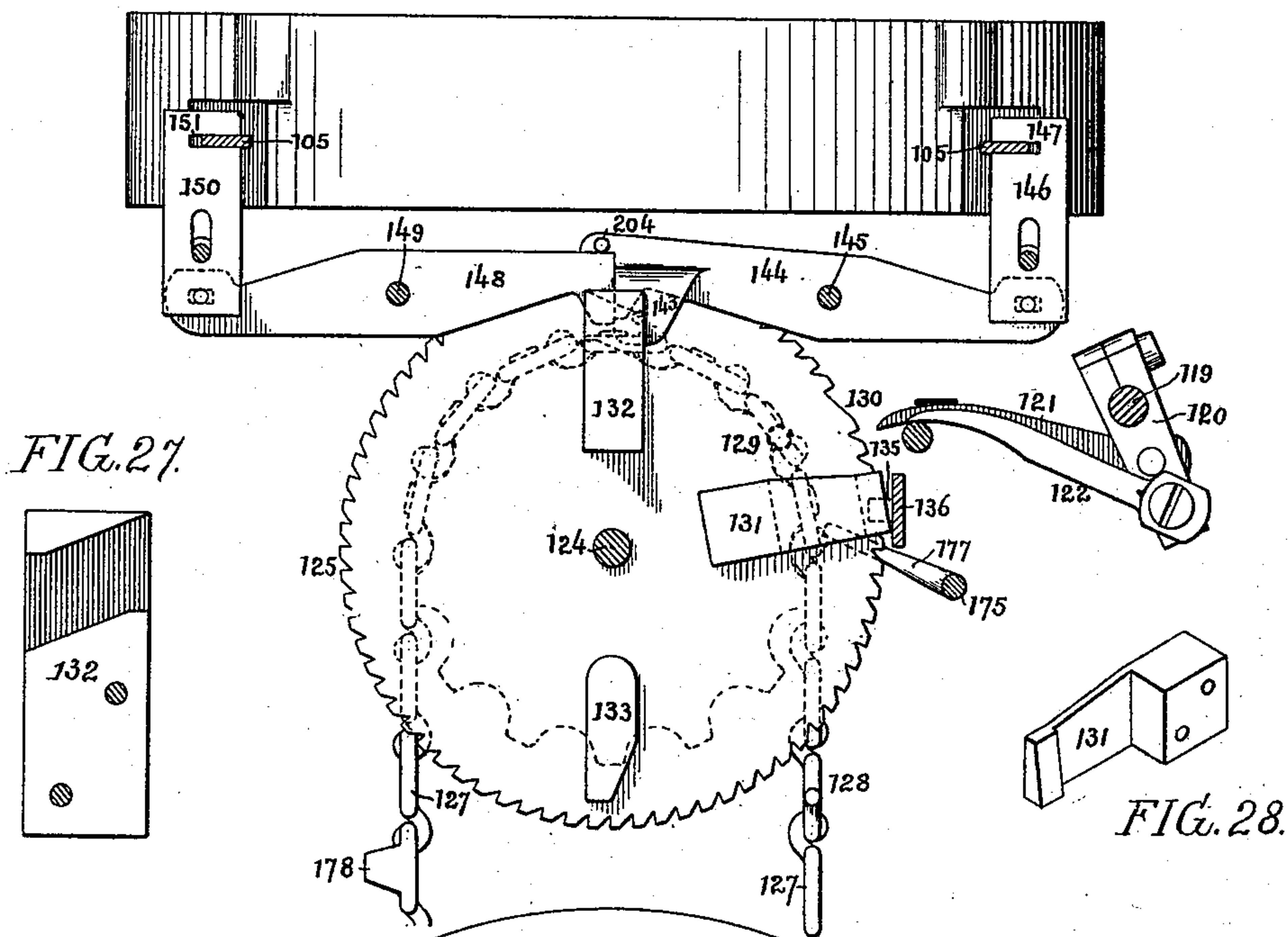
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FIG. 5.



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(No Model.)

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FIG. 7.

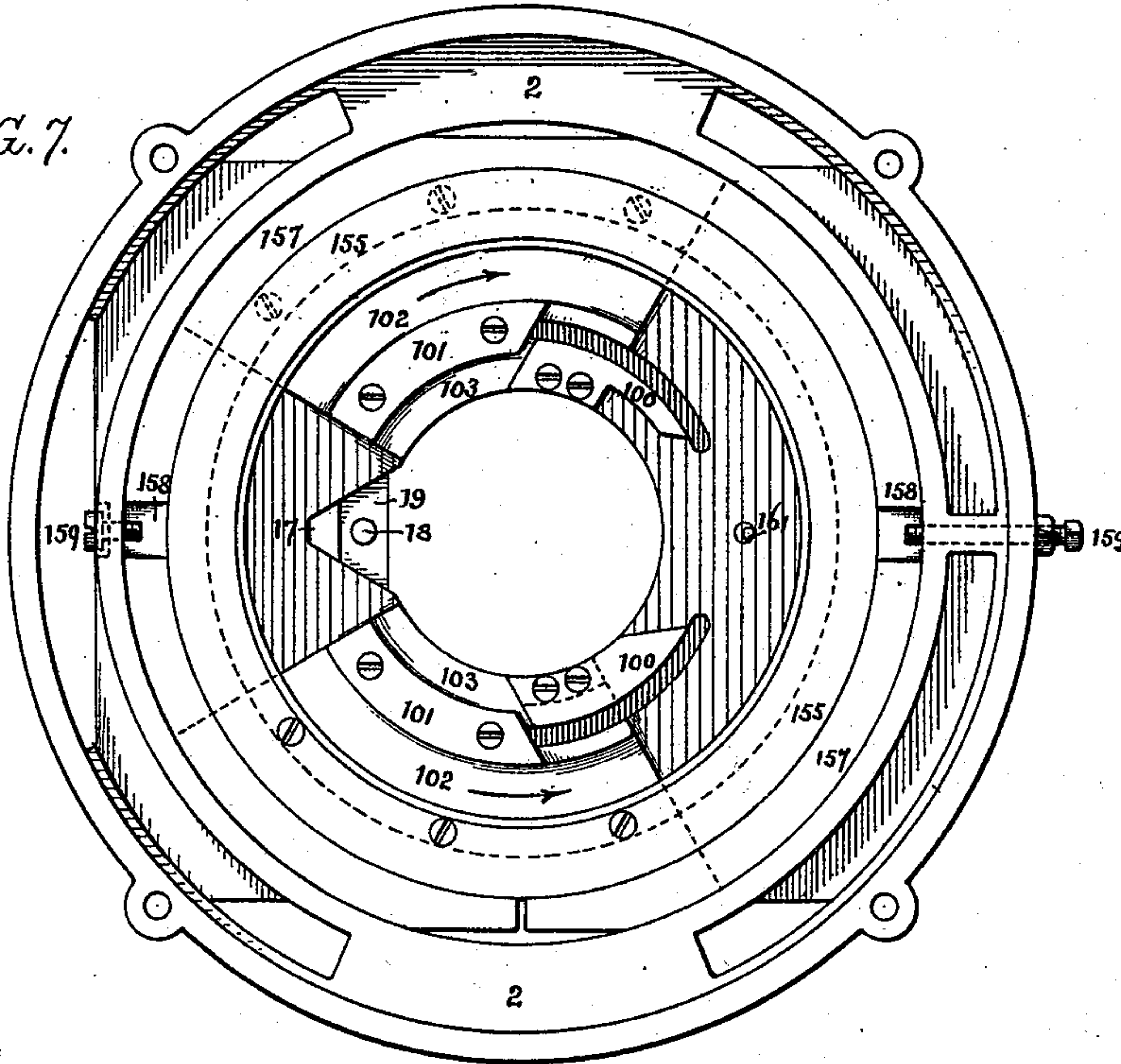


FIG. 17.

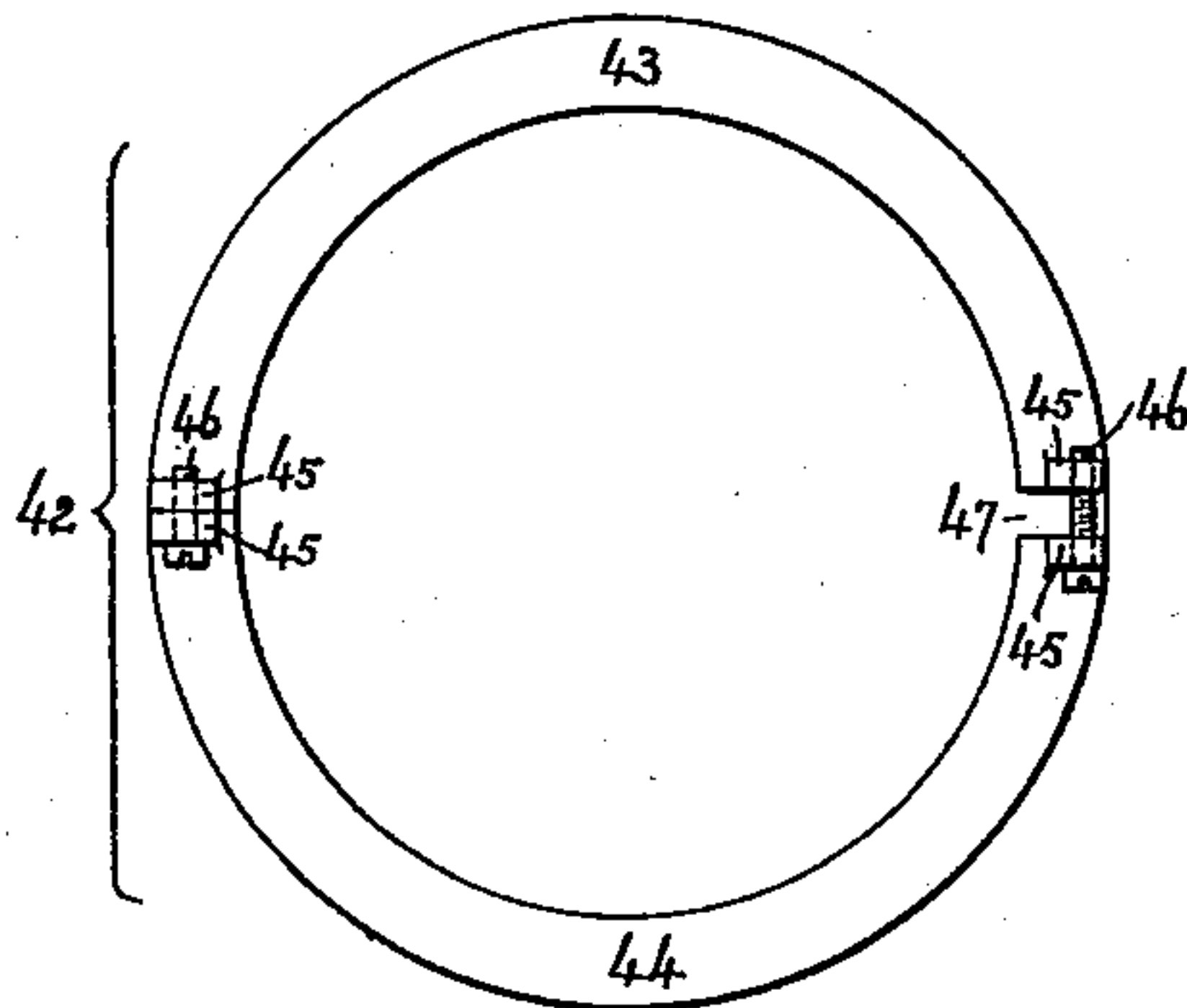


FIG. 30.

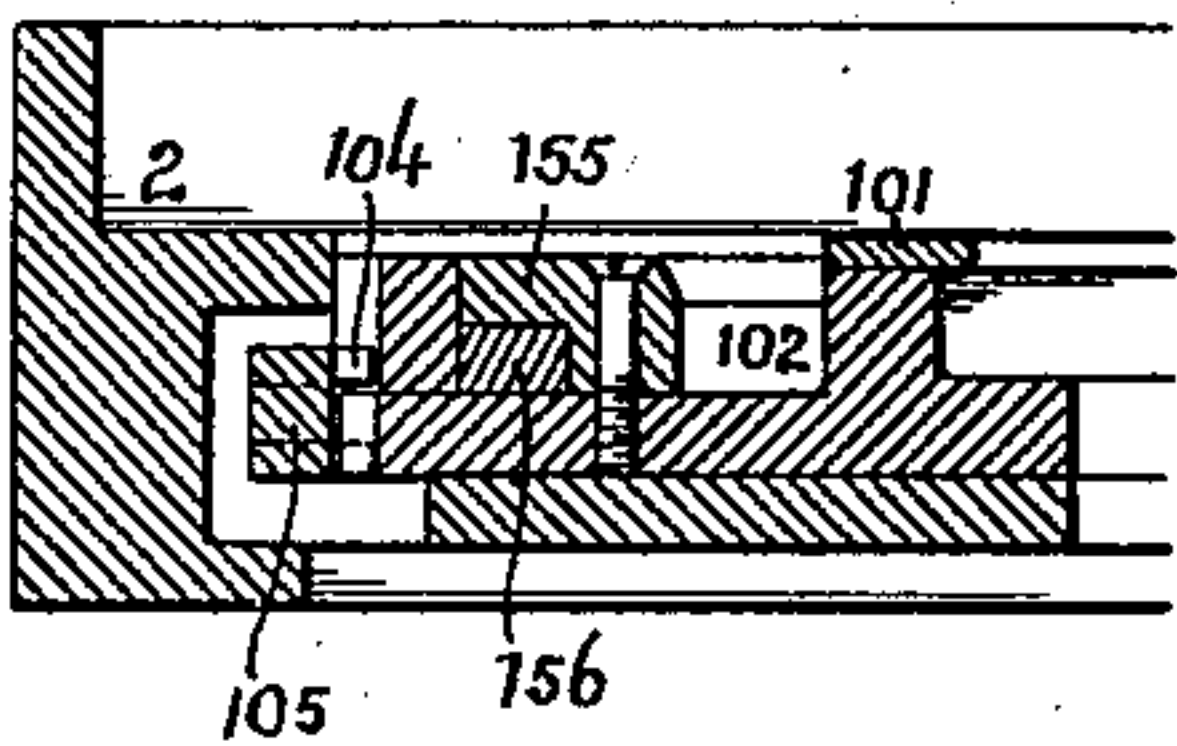


FIG. 31.

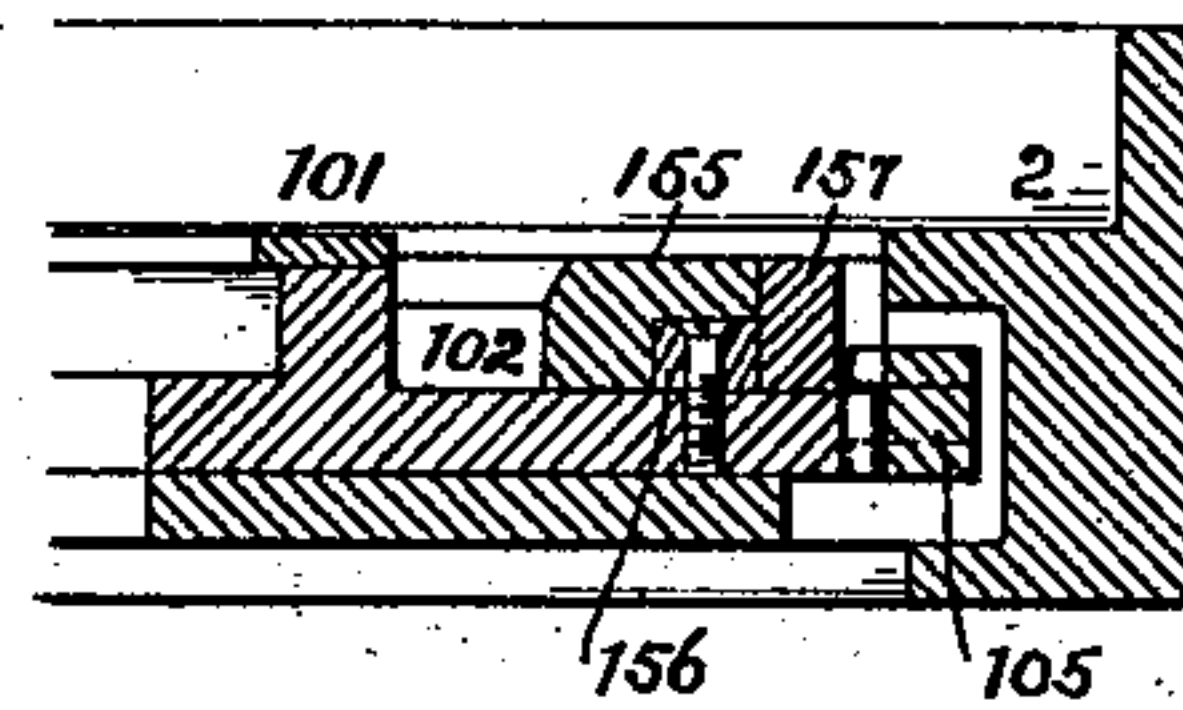
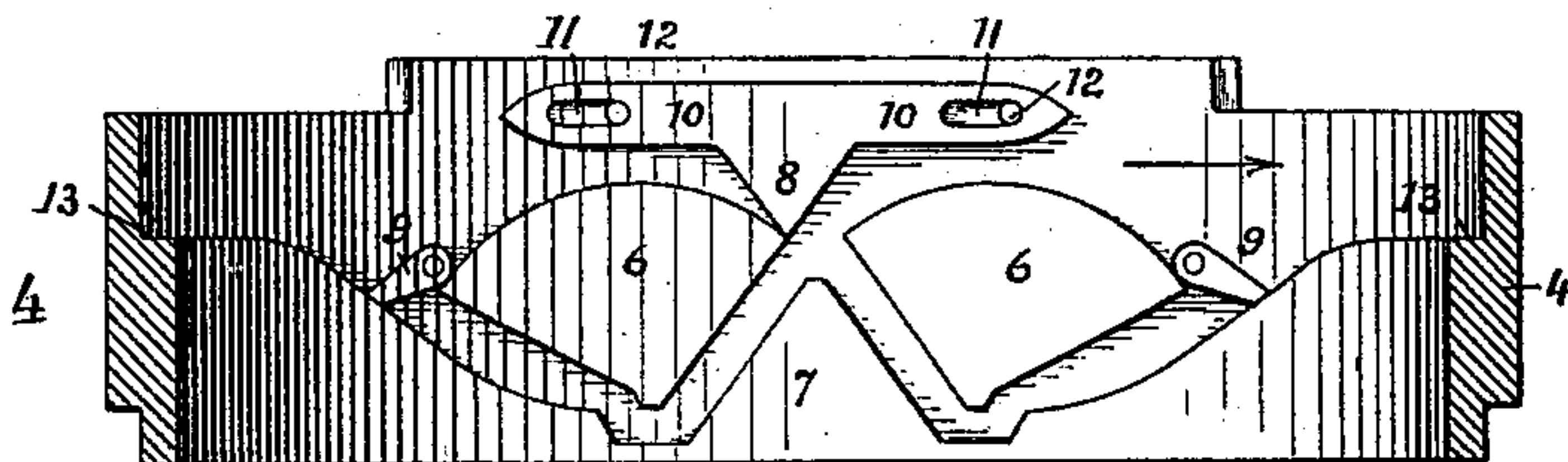


FIG. 8.



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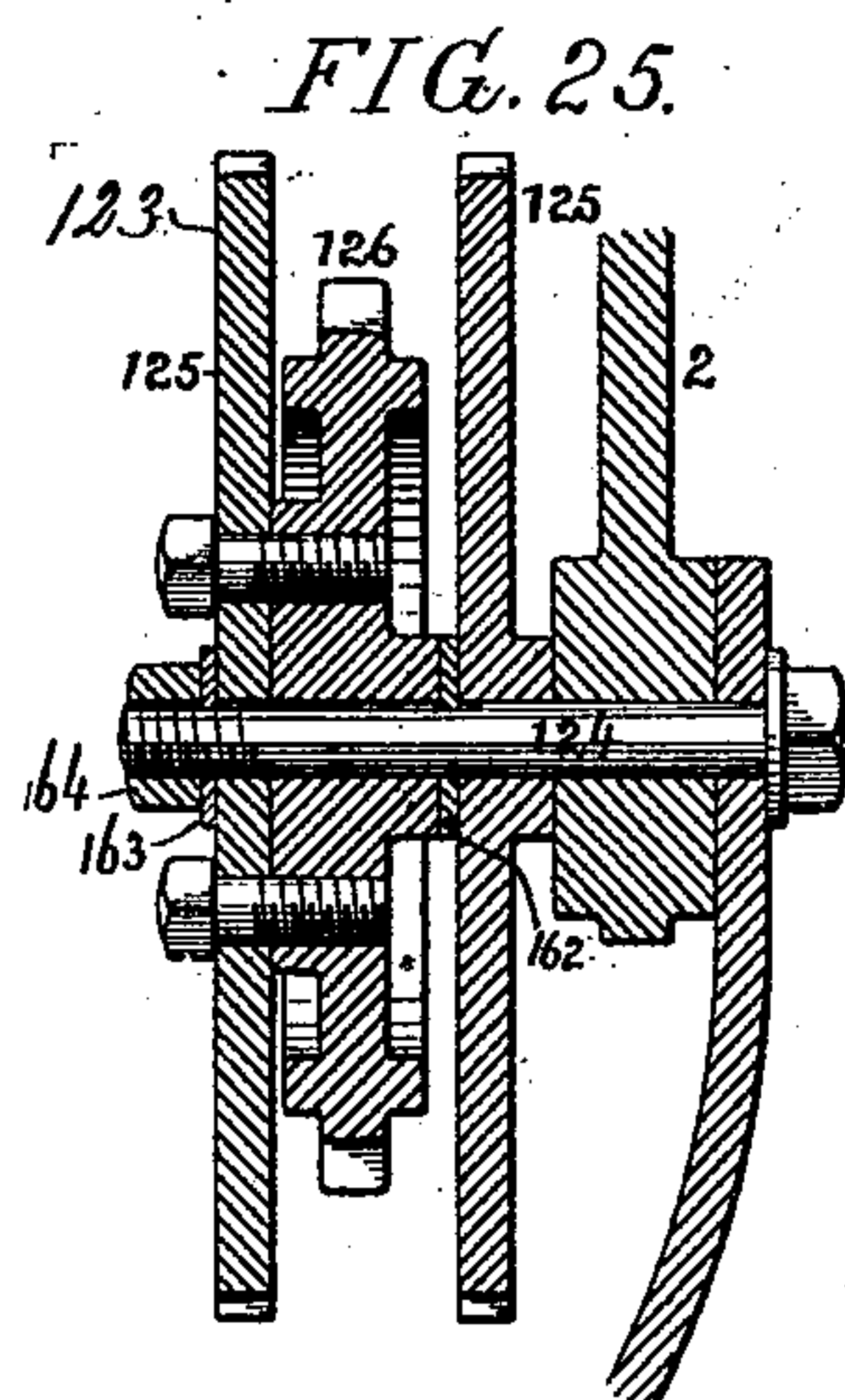


FIG. 26.

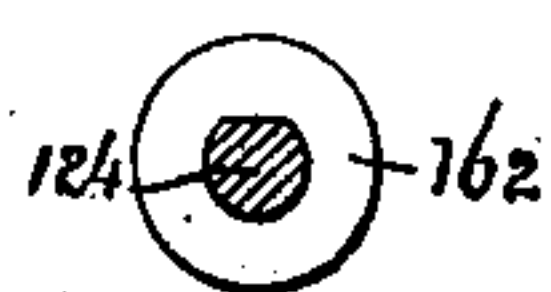


FIG. 10.

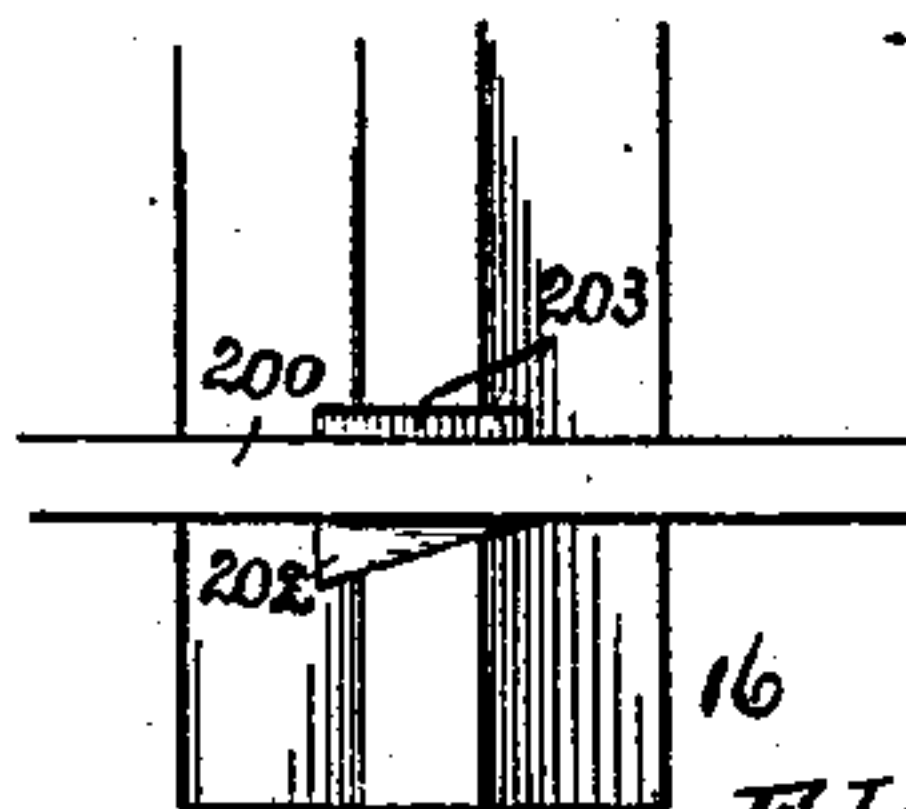


FIG. 10A.

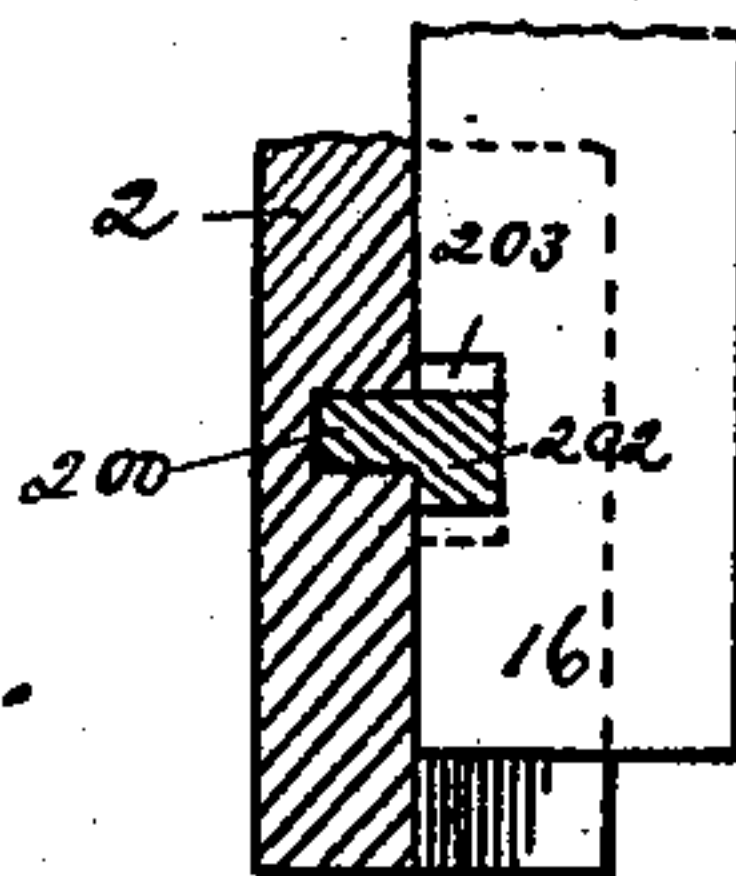


FIG. 11.

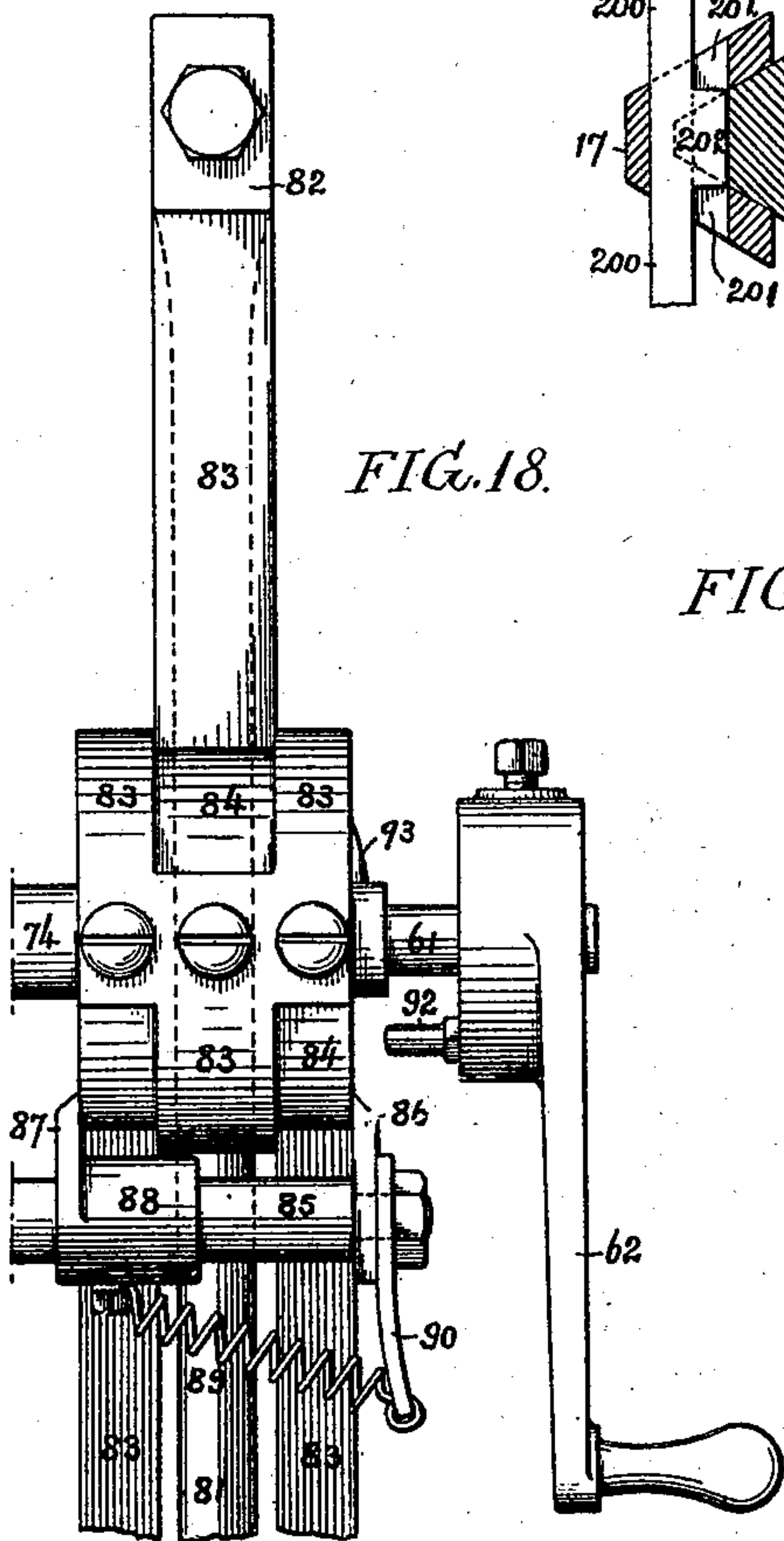
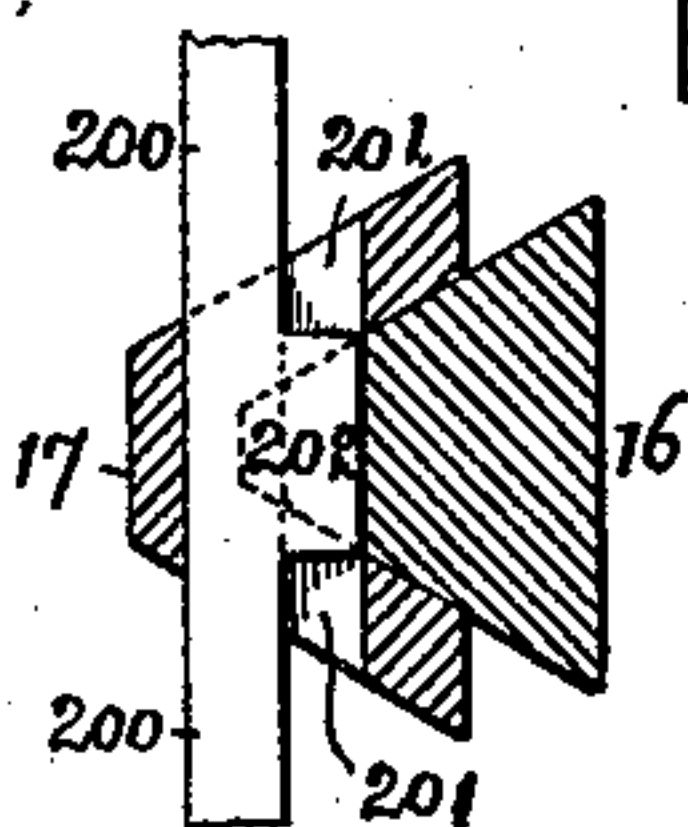
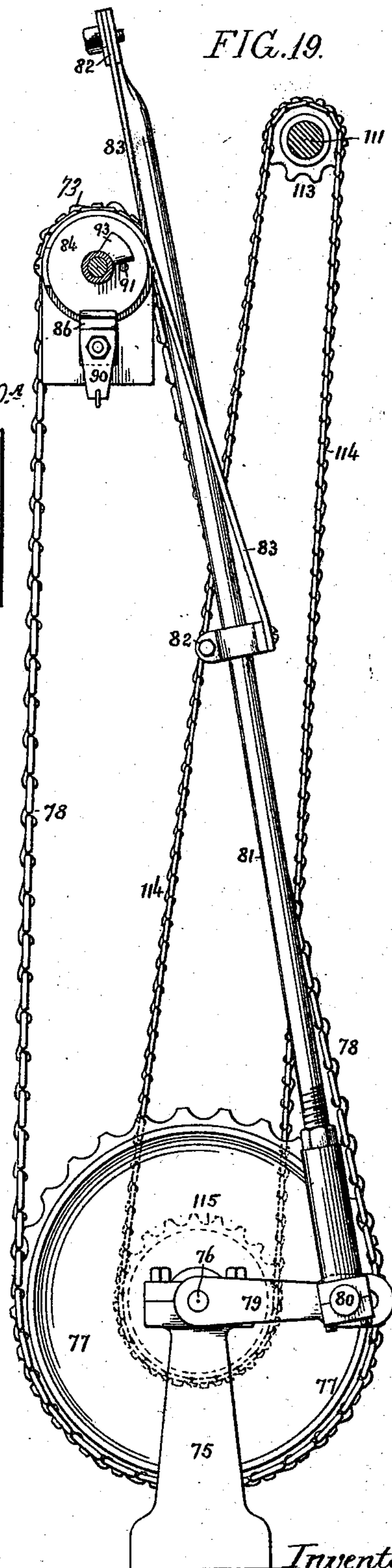
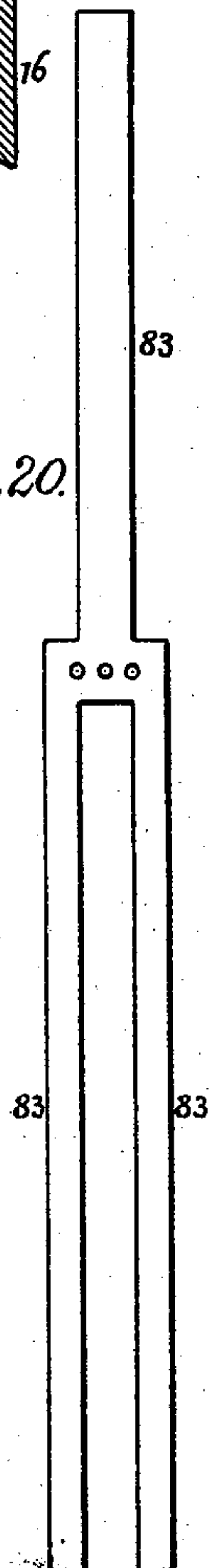


FIG. 20.



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UNITED STATES PATENT OFFICE.

EMIL FRANCK, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NATIONAL AUTOMATIC KNITTER COMPANY, OF SAME PLACE.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 504,417, dated September 5, 1893.

Application filed May 19, 1890. Serial No. 352,325. (No model.)

To all whom it may concern:

Be it known that I, EMIL FRANCK, a citizen of the United States, and a resident of Philadelphia, Pennsylvania, have invented certain
5 Improvements in Circular-Knitting Machines, of which the following is a specification.

My invention consists of certain improvements upon or additions to the knitting machine for which I obtained Letters Patent of
10 the United States, No. 419,513, dated January 14, 1890, the particular character of these improvements and their purpose or object being fully set forth hereinafter, and the special features of construction forming the subject
15 of the present invention being set forth in the claims.

In the accompanying drawings, Figure 1, is a longitudinal section, partly in elevation of a knitting machine constructed in accordance
20 with my present invention. Fig. 2, is a plan of the same with the needle cylinder, needle actuating cam ring and parts carried thereby removed. Fig. 3, is an end view of part of the machine, looking in the direction of the
25 arrow *w*, Fig. 1. Fig. 4, is a transverse section on the line *x x*, Fig. 1 looking in the direction of the arrow *w'*, Fig. 1. Fig. 5, is a transverse section, partly in elevation of part of the machine on the line *y y*, Fig. 1, also
30 looking in the direction of the arrow *w*. Fig. 6, is a plan of the head of the machine. Fig. 7, is a top view of part of the machine on the line *z z*, Fig. 1; and Figs. 8 to 33 are detached views illustrating certain features of construction of the machine.
35

The fixed frame of the machine is represented at 1 and is intended to be mounted upon legs or standards so as to support it at a proper distance above the floor. On this
40 fixed frame is firmly secured the bed 2 of the knitting machine, which, in the present instance, is in the form of an annular frame in the upper portion of which is a recess forming a bearing for a bevel wheel 3 which forms part of the cam ring 4 of the machine, or it
45 may be secured thereto in any appropriate manner, said bevel wheel being held in place vertically by a plate 5 which is bolted to suitable bosses on the bed plate 2, so that it can

be readily removed when it becomes necessary to remove the cam ring. 50

The cam ring 4 is shown in detail at Fig. 8, on reference to which it will be seen that the ring has two side cams 6, 6, a lower lifting cam 7, an upper sliding cam 8, and pivoted
55 wing cams 9, 9, adjacent to the outer edges of the side cams 6, the top cam 8, having lateral projections 10, with beveled ends and these projections having slots 11 for the reception of pins 12, on the cam ring, so as
60 to permit of the desired lateral sliding movement of the said top cam. By reason of this arrangement, when the cam ring is moving say from left to right, or in the direction of the arrow, the bits of the needles, Fig. 8, 65
rise upon the wing cam 9, at the right hand side and pass thence over the right hand side cam 6, so as to strike the depending portion of top cam 8, thus moving the same to the left
70 into contact with the left hand side cam 6; so that the bits of the needles will be directed beneath said cam, the left hand wing cam 9, rising as the bits pass under the same. When the cam ring moves from right to left the operation is simply reversed, the bits of the
75 needles passing above the left hand wing cam and side cam and moving the top cam into contact with the right hand side cam, the bits then passing under said right hand cam and lifting the right hand wing cam as they
80 emerge. The beveling of the ends of the lateral projections 10, of the top cam 8, serves properly to direct the bits of the needles beneath said projections in the event of their being carried too high as they rise on the side
85 cam 6, breaking of the bits of the needles, such as would be caused by their contact with an abrupt shoulder on the top cam, being thereby prevented. The needle cylinder 15, fits snugly in the central opening of the cam
90 ring and has a downwardly projecting leg 16, which is adapted to a recess 17, in the fixed frame 1, and is supported upon a set screw 18, carried by a cross bar 19, at the lower end of said recessed portion of the frame, and said
95 frame has laterally projecting pins 20, upon which is mounted a clamping yoke 21, threaded for the reception of a screw 22, which is

provided with an operating lever 23, and bears upon the back of the projection of the frame, as shown in Fig. 9. When the screw 22, is in the position shown in Figs. 1 and 9 it serves to press the leg 16, of the needle cylinder firmly into the recess 17, and thereby locks the cylinder in position, but upon slackening the screw by manipulation of the lever 23, the needle cylinder is released and may be readily removed and a fresh cylinder inserted in its place and locked in position by a reverse movement of the lever as will be readily understood. By adjustment of the set screw 18, the vertical position of the needle cylinder in respect to the cam ring is determined, and the length of stitch drawn by the needles thus regulated.

A modified form of locking device is shown in Figs. 10, 10^a and 11, and consists of a laterally sliding bolt, 200, guided in notches 201, in the frame 2, and having a beveled portion, 202, which engages with a recess 203, in the front of the leg 16. In this case the leg 16 is locked by the downward pressure of the beveled lug 202 and not by being thrust laterally into the recess 17 as in the construction shown in Figs. 1 and 9.

The needle cylinder 15, has three different varieties of needles 24, 25 and 26, such as shown in Figs. 12, 14 and 13. The needles around one half of the head and which are to remain out of action during the formation of the pocket or bulge on the tube by to and fro knitting around the other half of the head are similar to that represented in Fig. 12, the stem of the needle having at the lower end a projecting bit 27, for the action of the knitting cams. The needles of the fashioning set which are intended to be thrown into and out of action in order to effect the narrowing and widening of the knitted web during to and fro knitting, are similar to that represented in Fig. 13, each of these needles having its stem extended, as at 28, below the bit 27, upon which the knitting cams act, so that these needles may be controlled by cams beneath the needle cylinder, as in the machine shown in my patent before alluded to, that portion of the needle cylinder which contains these needles having the backs of the needle grooves beveled as shown in Fig. 1, so that the needles may be moved radially inward at their lower ends in order to carry their bits 27 inward beyond the range of the knitting cams on the cam ring 4. The central needles of the fashioning set are similar to that shown in Fig. 14, and are the same as the needles shown in Fig. 12, with the exception that the bit 27, is somewhat shorter than the bits of the needles of Fig. 12. The object of making these latter bits long is to permit of the ready elevation of the needles around one half of the needle cylinder, so as to carry their bits away from the influence of the knitting cams and thus throw said needles out of action during the time that the to and fro knitting is being carried on upon the needles

around the other half of the cylinder. This elevation of the needles is effected by means of a switch plate 30, which is carried by a shaft 31, mounted in a bearing 32, on the cam ring 4. The switch plate 30, is capable of assuming two positions, as represented in Figs. 15 and 16, being retained in either of these positions, so far as regards accidental displacement, by means of a spring plate 33, which acts upon a pin 34, projecting from the hub 35, of the switch plate. When said plate is adjusted to the position shown in Fig. 15, its outer end bears upon the needle rest 13, of the cam ring. Hence, as the latter is rotated, the plate passes under the long bits of the needles 24, and raises the same to inoperative position. When the switch plate is adjusted to the position shown in Fig. 16 the under side of said plate acts upon the elevated bits of the needles 24, and restores the same to operative position. The outer end of the shaft 31, has an arm 36, with anti-friction roller 37, which is acted upon by devices described hereinafter so as to effect the automatic shifting of the switch plate 30, at the proper times and thus insure the throwing out of action and bringing into action of the needles around one half of the needle cylinder.

The ribs 40, between the needle grooves of the cylinder 15, are notched so as to form a groove for the reception of the spring 41, which binds upon the needles and serves to retain the same in their vertical position when they have been elevated, and in said ribs 40, above the groove which receives the spring 41, are notches forming a second groove for the reception of the ring 42 which, as shown in Fig. 17, is made in two parts, 43 and 44, the parts having lugs 45, which are secured together by set screws 46. Each part of the ring is somewhat less than a half circle, so that a gap 47, is formed in the ring at one side to permit of the removal from the cylinder 15, of any one of the needles into line with which the gap has been moved, the screw 46, at this side of the ring being so far beyond the inner periphery of said ring as not to interfere with the withdrawal of the needle bit through the gap. By this means any of the needles of the cylinder can be readily removed and new needles inserted in their places.

There is a web holding structure at the top of the needle cylinder and it will be understood that this is removed preparatory to removing or replacing a needle. This web holding structure consists of a ring 50, supported vertically upon the ring 42, and secured to the needle cylinder by set screws 51, which bear upon the ribs 40, of the cylinder, as shown in Fig. 1. The ring 50, has radial grooves for the reception of a series of sliding web-holding plates 52, one for every needle, or for every two or three needles of the cylinder, these web holding plates having bits which enter a cam slot 53, (see dotted lines Fig. 6) in a ring 54, sup-

ported upon the ring 50, so as to be free to turn thereon, said ring 54 having a plate 55 with segmental recess 56 into which projects a post 57 extending upward from the cam ring 4, the upper end of said post having a pivoted arm 58 carrying the thread guide 59, as shown in Fig. 6. The ribs *r* of the needle cylinder extend to the top of the same and serve as sinkers over which the stitches are drawn by the needles as they descend, and the web holding plates 52 work closely to the top of the needle cylinder so that, as they are projected, their lower portions will push inward or "knock over" the stitches cast by the descending needles. Each web holding plate is notched at the inner end as shown in Fig. 1, so that after "knocking over" a stitch the projecting upper lug or finger of the plate will catch said stitch and prevent it from rising with the needle when the latter is again lifted. As the cam ring 54 is rotated or reciprocated therefore, the plates 52 will be advanced and retracted, and will properly "knock over" the stitches and then prevent the rise of the same with the needles, the segmental slot 56 in the plate 55, providing for the lost motion necessary in order that the thread guide will always have the proper lead of the cam plate in to-and-fro work, and the cam slot 53 of the ring 54 being such that the web holders will be retracted at the point where the needles are drawing the stitch, as shown in Fig. 6, it being understood that in that view the thread guide is moving in the direction of the arrow, and the needles are drawing the stitches immediately in rear of the center of the guide where the thread delivering eye is located.

I will next describe the mechanism whereby the rotating and reciprocating or to-and-fro movements are imparted to the cam ring 4. The bevel wheel 3, of said ring meshes into a bevel wheel 60, the bed plate 2, being suitably cut away at one side as shown in Figs. 1 and 2, in order to permit this. The wheel 60, is carried by a shaft 61, which is mounted at one end in a bearing in the frame 1, and at the other end in a sleeve 74, turning in a bearing in said frame as described hereinafter, the outer end of said shaft 61, being provided with a crank 62, Fig. 18, so that the parts may be operated by hand if desired. Loosely mounted on the shaft 61, is a pulley 63, which has, at one side, projecting pins 64, for engagement with a bar 65, on an eccentric 66, secured to the shaft 61, as shown in Figs. 1 and 4, the opposite side of the pulley having a hub 67, with groove 68, for the reception of a shifter fork 69, on a shifter lever 70, referred to hereinafter.

The hub 67, has a bar 71, which, under the circumstances described hereinafter, is caused to engage with lugs or pins 72, on a sprocket wheel 73, mounted so as to turn freely on the sleeve 74, before referred to as constituting one of the bearings for the shaft 61. To a suitable bearing in a standard 75, on the floor beneath the machine, is adapted a shaft 76,

which carries a sprocket wheel 77, which is driven from the wheel 73, by means of a chain 78. (See Fig. 19.) The shaft 76, is also provided with a crank 79, the crank pin 80, of this arm being adapted to a bearing at the lower end of a rod 81, the upper portion of which carries clamps 82, for the opposite ends of a strap or band 83, of leather or other equivalent flexible material, and preferably cut from one piece of material in the form shown in Figs. 2, 18 and 20, said strap passing around and being secured to a drum 84, mounted on the sleeve 74, and free to turn thereon. The upper portion of the strap 83, thus passes from the top of the rod 81, downward and around the bottom of the drum while the lower portion of the strap passes from a point on the rod below the drum up to and over the top of said drum. The consequence of this is that as the rod 81 is reciprocated the upper portion of the strap 83 on the upward movement of the rod causes the turning of a drum 84, in one direction, the lower portion of the strap winding on the drum during this movement, while on the downward movement of the rod the lower portion of the strap causes a movement of the drum in the opposite direction, the upper portion of the strap being wound upon the drum. This will be understood by reference to Figs. 18 and 19. To the shifter lever 70, is hung a rod 85, (Fig. 1,) the outer end of this rod having a finger 86, which projects upward so as to engage with the drum 84, at the outer face of the same, as shown in Fig. 18, a finger 87, engaging with the inner face of the drum and being carried by a sleeve 88, which is mounted on the rod 85, but is free to move longitudinally thereon, this sleeve being connected, by a spring 89, to an arm 90, at the outer end of the rod. In the outer face of the drum 84 is an opening 91 (Figs. 1 and 19), for the reception of a pin 92, projecting inwardly from the hub of the crank 62 at the outer end of the shaft 61, and adjacent to this opening and terminating in line with the same, is a beveled cam block 93 on the drum. (See Figs. 18 and 19.)

The operation of this driving mechanism is as follows: When the machine is knitting round and round for the production of tubular work the driving pulley 63 occupies the position shown in Fig. 1, the pins 64 being in engagement with the bar 65 of the eccentric 66, and the bar 71 being free from engagement with the lugs 72, of the sprocket wheel 73, so that the rotating movement of the pulley is imparted to the eccentric and hence to the shaft 61 and bevel wheel 60, and from the latter to the bevel wheel 3 and cam ring 4. Under these circumstances there is no movement of the sprocket wheels 73 and 77, rod 81, and drum 84, and the said drum is drawn inward on the sleeve 74, by means of the rod 85, and its finger 86, so that there can be no engagement of the pin 92 of the crank 62, with the opening 91 in the drum. When it is de-

sired to change from round and round or circular to reciprocating or to and fro knitting, however, the shifting lever 70, is operated so as to move the pulley 63 and its hub 67 longitudinally on the shaft 61, thereby carrying the pins 64 out of engagement with the bar 65, and bringing the bar 71 into engagement with the lugs 72 of the sprocket wheel 73. The rotating movement of the pulley is therefore transmitted to the said sprocket wheel 73, and thence to the sprocket wheel 77 and crank 79, thus effecting the reciprocation of the rod 81, and the back and forth movement of the drum 84. The same movement of the shifter lever acts through the medium of the rod 85 and finger 87 to effect the outward movement of the drum 84 on the sleeve 74, so as to cause the pin 92 of the crank 62, to enter the opening 91 in the drum, the back and forth movement of which is thus transmitted, through the crank, to the shaft 61 and its pinion 60, and thence to the pinion 3 and cam ring 4. If, when the outward movement of the rod 85, is effected, the crank 62 is not in position for its pin to enter the opening 91 in the drum 84, the outward movement of the said drum will be arrested by contact of its outer face with the pin 92, the finger 86 and arm 90 at the outer end of the rod 85 continuing to move and thus imparting increased tension to the spring 89, which acts upon the sleeve 88, carrying the finger 87, which bears upon the inner face of the drum. As soon, therefore, as the drum 84 has been turned forward to such an extent that its opening 91 is brought into line with the pin 92, the action of the spring 89, sleeve 88, and finger 87, causes said drum to move outward on the sleeve 74, so as to insure the entrance of the pin 92 into the opening 91, any over-running of the drum so as to carry the opening past the pin being prevented by the stop block 93, which comes into contact with the pin and prevents any farther forward movement of the drum independently thereof. If the turning movement of the drum 84 is backward, the pin 92 will ride over the beveled block 93 and spring into the opening 91 in the rear of the same.

I will now describe the mechanism whereby the various changes in the operation of the machine involved in the production of the pocket or bulge for the knitted tube are effected automatically. The downwardly projecting shanks 28 of the fashioning needles 26 are acted upon by fashioning cam plates 100 and 101, which are of different radii and have their adjacent edges beveled as shown at *x* in Fig. 2, so that as the cam plates are moved in the direction of the arrows, Fig. 2, the fashioning needles will have their lower ends drawn inwardly by the beveled ends of the plates 101, so as to withdraw the bits of these needles from the control of the knitting cams, while when the plates are moved in the opposite direction, the depending shanks of the needles are acted upon by the beveled

ends of the plates 100 and are moved outward, so as to bring the bits of the needles again into the range of the knitting cams. This construction is substantially the same as that set forth in my former patent, but in the present machine the toothed slides carrying the fashioning cams have ledges 103, which serve as bearings for the lower ends of the shanks of the fashioning needles after the latter have been pushed inward by the cam plates 101, thus preventing the dropping of said needles so as to carry their bits below the line of the knitting cams when said needles are out of action. This will be understood on reference to Fig. 21. The lower ends of the shanks 28, of the fashioning needles, are bent outwardly to a slight extent, as shown in Figs. 1, 13 and 21, so that, in inserting a needle into the machine, it will not strike and be stopped by either of the plates 100, and each of the slides 102 at a point beneath the beveled ends of the cams 100 and 101 has a beveled portion 95, whereby as the shank of a needle passes under the action of the cam 101, the lower end of said shank, if it chances to be below the level of the ledge 103, will be raised on to said ledge and jamming of the needle will thereby be prevented. The toothed slides 102 are acted upon by pawls 104, carried by reciprocated bars 105, hung to the opposite ends of a lever 106, which is mounted on a stud 107 secured to the frame 1, one arm of this lever 106 carrying an anti-friction roller 108 which is acted upon alternately by cam shaped tappets 109 on segmental plates 110 carried by a drum 96 on a shaft 111, undue movement of the lever 106 in either direction being prevented by contact of set screws 97 on said lever with stop lugs 98 on the frame 1. The shaft 111 has a sprocket wheel 113, which is connected by a chain belt 114 with a sprocket wheel 115 on the shaft 76, which carries the sprocket wheel 77, (see Fig. 19,) so that as said shaft 76 is rotated in the manner hereinbefore set forth, the shaft 111 is likewise rotated and the tappets 109 are caused to act alternately upon the roller 108 of the lever 106, thus imparting a vibrating movement to the latter and reciprocating the pawl carrying bars 105. The plates 110 have lateral slots 94 for the reception of set screws 99, so that said plates can be adjusted laterally on the drum 96, and the extent of movement imparted to the lever 106 by the tappets 109 thereby regulated. The two pawls 104 of each bar 105, are in different horizontal planes on said bars, the pawls consisting simply of teeth let into recesses in the top and bottom of a central expanded portion of the bar as shown in Figs. 22, 23 and 24, so that by elevating the outer or free end of either of the bars 105, one of its pawls is caused to engage with the teeth of the corresponding cam slide 102, while by lowering the outer end of either bar the other pawl of the same is caused to engage with said teeth,

and, as one of the pawls of each bar is right handed and the other left handed, it follows that the rising and falling movement of the pawl carrying bar is sufficient to change the direction of the movement imparted thereby to the cam carrying slide. The inner faces of the bars 105 bear against the teeth of the slides 102, which serve to limit the inward movement of the bars. The eccentric 66 on the driving shaft 61 has a sleeve 116, which is connected by a rod 117 (Figs. 2 and 4), to an arm 118 on a rock shaft 119 mounted in suitable bearings upon the frame 1, so that, as the shaft 61 is either rotated or vibrated, a rocking or vibrating movement will be imparted to said shaft 119. On the rock shaft 119 is an arm 120, (Fig. 5,) which carries two pawls 121 and 122, the pawl 121, engaging continuously with a ratchet wheel 123, mounted on a stud 124, (Fig. 25,) this stud also carrying a toothed wheel 125 with which the pawl 122 engages under the circumstances hereinafter referred to. Secured to the ratchet wheel 123, is a sprocket wheel 126, which carries a pattern chain 127, having at one side a projection 128, and on one side of the toothed wheel 125, is a projecting pin 129, (see dotted lines Fig. 5,) which extends into the path of the projection 128. During the operation of round and round knitting to produce tubular work the toothed wheel 125, is stationary, the pawl 122, acting upon a long tooth 130, of said wheel, as shown in Fig. 5, so as to fail to move the same. When the desired length of tubular fabric has been produced, however, the projection 128 upon the pattern chain will strike the pin 129, and move the wheel 125, to such an extent as to carry its long tooth beyond the pawl 122, the latter then acting to rotate the wheel. On the outer face of the wheel 125, are three cams 131, 132 and 133, (see Figs. 1, 5, 27 and 28.) The cam 131 has a beveled end, as shown in Fig. 28 and a thickened securing butt, as also shown in said figure, said butt being so much thicker than the beveled end of the cam that the latter will be held some distance away from the face of the wheel 125 and with its beveled portion toward said face of the wheel, and when the wheel is stopped, by the bringing of the long tooth 130 into the path of the driving pawl, the beveled end of the cam will, as shown in Fig. 5, be in position to overlap and draw toward the face of the wheel a pin 135, carried by a lever 136, which is hung to a bracket on the frame 1, the other arm of this lever having a slot 137 for the reception of a screw 138 whereby it is connected to the lower end of a sliding rod 139, mounted in a bearing 140, on the bed 2, and carrying at its upper end two cams 141 and 142, (see Fig. 1,) these cams being so located that when the rod is raised the cam 141, will act upon the anti-friction roller 37, on the arm 36, of the switch plate shaft 31, so as partially to rotate said shaft and throw the switch plate into the position shown in Fig. 15, in order to elevate

the needles around one-half of the needle cylinder, while, when the slide rod is depressed, the cam 142, will act upon said anti-friction roller 37, so as to shift the said plate from the position shown in Fig. 15, to that shown in Fig. 16, and thus bring the needles down into operative position again. When the machine is knitting round and round the pin 135 of the lever 136 is under control of the cam 131 and the rod 139 is depressed and the switch plate is in the position shown in Fig. 16, all of the needles being in operation. On the first movement of the wheel 125, however, the pin 135 is released from the control of the cam 131 and the lever 136 is then raised by the spring 210 (Fig. 1) so as to raise the rod 139 and move the switch plate 30 to the position shown in Fig. 15, where it remains until the wheel 125 has completed its revolution and the pin 135 is again brought under the influence of the cam 131. The cam 132, (Fig. 27,) acts upon a pin 143, on one arm of a lever 144, hung to a stud 145, on the frame, the other arm of this lever acting upon a guided slide 146, which has a notch 147, for the reception of one of the pawl carrying bars 105, of the machine. The inner arm of the lever 144, has a pin 204, which overlaps the inner arm of a like lever 148, hung to a stud 149 and acting upon a slide 150, which has a notch 151, for receiving the other pawl carrying bar 105. The action of the cam 132, is therefore to depress the inner arms of the levers 144, and 148, and thereby elevate the outer arms of the same and the slides 146, and 150, so as to throw the lower pawls 104, of the bars 105, into operative position. When the wheel 125, has, however, made a half revolution, the cam 133, acts first upon the pin 143, of the lever 144, and then upon the lever 148, so as to elevate the inner arms of said levers and depress their outer arms and the slides so as to bring the upper pawls of the bars 105, into engagement with the toothed edges of the cam slides 102, thus reversing the movement imparted to the latter, the levers and slides being restored to their original position by the cam 132, when the wheel 125, has completed a whole revolution. Owing to the overlapping of the levers 144 and 148 the action of the cam 132, operates said levers simultaneously so that both pawl bars 105 are lifted simultaneously when the cam 132, acts, the levers being operated in succession by the cam 133, however, so as to drop the pawl bars and change the action of the pawls, first on one fashioning cam slide 102, and then on the other, as is rendered necessary by the alternate operation of said cam slides. Each of the pawl bars 105, is acted upon by a spring 152, which permits said bar to yield outwardly, to permit the acting pawl to pass the teeth of the cam slide on the backward movement of the bar, and each of the pawl bar carrying slides 146 and 150, is acted upon by a spring actuated washer 153, as shown in Fig. 29, so as to

be self-retaining in the position to which it is adjusted, the tension of the spring and pressure of the washer being regulated by manipulating the set screw 154. One of the cam slides 102, carries a ring 155, and the other of said slides carries a ring 156, the ring 155, being recessed for the reception of the ring 156, so that the outer peripheries of both rings are in the same vertical plane, as shown in Figs. 30 and 31. Surrounding and confining the rings 155 and 156, is a split ring 157, which also bears upon projecting portions of the slides 102, as shown in Figs. 30 and 31, and this ring 157 has beveled portions 158, which are acted upon by set screws 159, as shown in Figs. 1 and 7, the effect being to press the ring 157, upon the peripheries of the rings 155 and 156, and also downward upon the slides 102, so that it not only serves to retain the latter rigidly in their proper vertical position, but it also constitutes a friction brake to prevent undue movement of either slide under the action of the pawl bars. Adjustable stops 160 and 161 are also provided to limit positively the swinging movement of the slides 102, the stops 160 being slotted for the reception of their confining screws, and the stop 161, consisting of a set screw having an eccentric stud, as shown in Figs. 1 and 2, the slides coming into contact with this stud at one limit of their movement, so that by partially turning the set screw, the stud may be moved laterally until it is adjusted to the exact position required. In order to prevent the movement of the toothed wheel 123, and sprocket wheel 126, from being communicated to the wheel 125, a washer 162, is interposed between the said wheel 125 and the hub of the sprocket wheel 126, this washer bearing upon a flattened portion of the stud 124, as shown in Figs. 25 and 26, so as to be incapable of turning on the stud. A similar washer 163, is interposed between the wheel 123, and the confining nut 164, at the end of the stud 124, to prevent the backing off of the said nut. At the outer end of the rock shaft 119 is a double tappet 165, which is adapted to act upon the ends 166, and 167, of a bar 168, the opposite end of which is connected to a bell crank lever, 169, also connected by a rod 170 to the shifter lever 70. The bar 168, is supported by a plate 171, carried by the lower end of the slide rod 139, a pin 172, on the bar being adapted to a slot 173, on said plate, so that while the bar will be raised by the plate, it is free to move longitudinally independently of the same, the slot being wider than the pin, so that a slight rise and fall of the bar independently of the plate is also possible. In a bearing 174, on the frame is a rock shaft 175, having two arms 176, (Fig. 3,) and 177, (Fig. 5,) the arm 176, being adapted to act upon the bar 168, to elevate the same slightly when the arm 177, is acted upon by a lug 178, on the pattern chain 127, (Fig. 5.) The lower arm 167, of the bar 168, is recessed at its outer end so as

to form two shoulders 180, and 181, upon either of which the vibrating tappet 165 can act. When the machine is knitting round and round to produce tubular work, the bar 168 is depressed by the action of the upper arm of the tappet 165, on the end 166, of said bar, as shown in Fig. 3, but as soon as the slide rod 139, has been raised on the first movement of the wheel 125, the shoulder 180, of the lower arm 167, of the bar 168, comes into contact with the lower arm of the vibrating tappet 165, as shown in Fig. 32, and the bar 168, is thereby moved outward so as to operate the shifter lever 70, and thus effect the change from round and round to to-and-fro knitting in the manner hereinbefore set forth. Whenever it is desired to stop the machine automatically, as for instance, in changing the needle cylinders, the lug 178, of the chain 127, acts on the arm 177, of the rock shaft 175, and thus causes the arm 176 of said shaft partially to lift the bar 168, so that its shoulder 181, will come under the influence of the lower arm of the vibrating tappet 165, as shown in Fig. 33, and there will be a partial movement of the bar 168, and shifter lever 170, so as to move the clutch hub 67, to the intermediate position, and thus stop the machine. The shifter rod 170, has an upwardly projecting arm 182, which, as said rod is moved so as to operate the shifter lever to change the machine from to-and-fro to round and round knitting, strikes the end of one of the cam slides 102, as shown in Fig. 2, and imparts to the same the final impulse necessary to restore the last fashioning needle on that side of the machine to operative position, so that the cam ring can then continue its forward rotation for the production of tubular work. If the pawls 104, were relied upon to impart this last impulse to the cam slide, another reciprocation of the cam ring would be necessary in order to restore the pawls to their normal position and an extra course of stitches would thus be produced.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. The combination of the needle cylinder having a downwardly projecting finger, with the bed having a support for said finger and means for securing the finger to the bed, substantially as specified.

2. The combination of the needle cylinder having a downwardly projecting finger, the bed having a set screw serving as a support for said finger and means for securing the finger to the bed, substantially as specified.

3. The combination of the needle cylinder having a downwardly projecting finger with beveled face, the bed having a beveled recess in which said finger fits, a vertical support for the finger and means for securing said finger within the recess of the bed, substantially as specified.

4. The combination of the needle cylinder having a downwardly projecting finger, the

bed having a support for said finger, and a clamping yoke and set screw whereby the finger is laterally confined to the bed, substantially as specified.

5 5. The combination of the needle cylinder having a downwardly projecting finger with beveled face, the bed having a beveled recess for the reception of said finger and a vertical support therefor, and a clamping yoke and
10 set screw whereby the finger is secured within the recess, substantially as specified.

6. The combination of the needles, the needle cylinder having an annular groove therein, and a needle retaining ring adapted to
15 said groove and composed of separable sections, and having, between the adjoining sections, a gap for the withdrawal of a needle, substantially as specified.

7. The combination of the needle carrier,
20 the needles, some of which have longer bits than the others, a pivoted switch cam so mounted in respect to the needles that when in one position it will engage with the long bits and raise the needles, and when in the
25 opposite position will engage with said long bits and depress the needles, a projection on said switch cam, a spring acting upon said projection and serving to hold the switch cam in its extreme positions, and means for
30 shifting said switch cam from one position to the other, substantially as specified.

8. The combination of the needle cylinder and its needles, some of which have longer bits than others, a switch cam mounted in
35 respect to the needles so as to raise the long bitted needles out of action when in one position and restore them when in the other position, a rock shaft carrying said switch cam, a pin or projection on said rock shaft, and a
40 spring acting upon said pin or projection and serving to retain it in its extreme positions, substantially as specified.

9. The combination of the needle cylinder, the needle operating cams, needles, some of
45 which are movable into and out of range with said cams, fashioning cams for acting on the lower portions of the needleshanks to so move them into and out of action, and a rest for the lower ends of the needles when they are
50 out of action, substantially as specified.

10. The combination of the needle carrier, the knitting cams, the needles, some of which are movable into and out of range with said knitting cams, some of the fashioning needles
55 having bent lower ends, and fashioning cams for acting on the lower portions of said fashioning needles to move them into and out of range of the knitting cams, substantially as specified.

60 11. The combination of the needle carrier, the knitting cams, the needles, some of which are movable into and out of range of said knitting cams, the fashioning cams acting upon the lower portions of the needles to move
65 them into and out of range of said knitting cams, and cam carriers having beveled por-

tions at the points where the movement of the needle is effected, substantially as specified.

12. The combination of the needle cylinder, the knitting cams, needles, some of which are
70 movable into and out of range of said knitting cams, fashioning cams acting on the shanks of the needles to move them into and out of range of the knitting cams, slides carrying said fashioning cams, means for recip-
75 rocating said slides, and a friction ring acting as a brake upon the slides, substantially as specified.

13. The combination of the fashioning cams, and their slides, means for reciprocating the
80 latter, a ring bearing upon the slides and having beveled portions and set screws acting upon said beveled portions of the retaining ring to press it down upon the slides substantially as specified.

14. The combination of the fashioning cams, slides carrying said cams, means for reciprocating said slides, rings, one attached to one slide and the other to the opposite slide, and
90 an encircling ring bearing upon said cam slides and their rings, substantially as specified.

15. The combination of the fashioning cams, slides carrying said cams, means for reciprocating the slides, and adjustable stops for
95 limiting the movement of the slides in either direction, substantially as specified.

16. The combination of the fashioning cams, slides carrying said cams, means for reciprocating said slides, and an eccentric stop for
100 limiting the approach of the slides toward each other, substantially as specified.

17. The combination of the needle cylinder, the knitting cams, the needles, some of which are movable into and out of range of said
105 cams, the fashioning cams for acting on the needles to move them into and out of action, toothed slides carrying said cams, reciprocated rack bars having fixed pawls in different planes for engaging with said toothed
110 slides, and means for raising and lowering said reciprocated bars so as to throw one or other of the pawls of each bar into operation, substantially as specified.

18. The combination of the needle cylinder,
115 the knitting cams, the needles, some of which are movable into and out of range of said knitting cams, the fashioning cams acting on the needles to move them into and out of action, toothed slides, reciprocated bars bearing
120 against the toothed faces of said slides, pawls carried by said bars and arranged in different horizontal planes and means for raising and lowering the bars so as to throw one or other of the pawls of each bar into opera-
125 tion, substantially as specified.

19. The combination of the toothed slides with the reciprocated rack bars having recesses or notches in opposite faces, and pawls
130 consisting of blocks secured in said recesses and projecting therefrom so as to engage with the toothed slides, substantially as specified.

20. The combination of the cam box, the driving shaft, gearing connecting said shaft to the cam box, a clutch sleeve having a pulley for the driving belt, means for connecting
5 said sleeve to the driving shaft, a sprocket wheel also adapted to engage with the clutch sleeve, a second sprocket wheel having a crank arm, a belt for connecting said sprocket wheels, a rod connected to the crank arm, a drum in
10 connection with said rod, and a clutch for connecting said drum to the driving shaft, substantially as specified.

21. The combination of the driving shaft of the machine, the arm thereon, a vibrated
15 drum, an opening in one of said parts, a pin or projection on the other part for engaging with said opening, a shifter rod having fingers embracing the drum, one of said fingers being free to move on the rod, and a spring
20 connecting said finger to a projection on the rod, substantially as specified.

22. The combination of the driving shaft and its arm, having a projecting pin, the vibrated drum having an opening for the re-
25 ception of said pin and a beveled block having an abrupt face in line of said opening, substantially as specified.

23. The combination of the needle cylinder, the knitting cams, the needles, some of which
30 are movable into and out of range of said cams, fashioning cams acting on the needles to move them into and out of action, toothed slides carrying said fashioning cams, bars having
35 pawls for engaging with said toothed slides, a lever carrying said bars, and a rotated drum having opposite tappets for acting on the said lever and moving the same first in one direction and then in the opposite direction, sub-
stantially as specified.

40 24. The combination of the pawl carrying bars, the lever for actuating the same, a rotating drum and a sleeve thereon carrying tappets for acting on said lever, said sleeve being made in sections adjustable laterally in
45 respect to each other to vary the action of the tappets upon the lever, substantially as specified.

25. The combination of the driving shaft, a power-driven clutch-member adapted to en-
50 gage directly with a clutching element on said shaft, other mechanism for imparting to and fro movement to the shaft, said mechanism having an element with which the power-driven clutch-member is also adapted to en-
55 gage, a rock shaft having tappets thereon, means for vibrating said rock shaft, a bar having arms one of which is adapted to be acted on by one of said tappets and the other by the opposite tappet, means for connecting
60 said bar to the clutch-member, and means for raising and lowering the bar so as to carry its arms respectively into and out of range of the tappets, substantially as specified.

26. The combination of the shifting clutch
65 member, the vibrated shaft having tappets thereon, a bar connected to the shifting clutch-member and having a bifurcated end or arms

movable into and out of range of the tappets, one of said arms having a notched end, a pat-
tern chain, and means whereby said chain is
70 caused to lift the bar for the action of the tappets so as to effect a partial movement of the shifting clutch-member to throw the machine out of gear, substantially as specified.

27. The combination of the needle cylinder,
75 the knitting cams, the needles, some of which are movable into and out of range of said knitting cams, fashioning cams for acting on the needles to move them into and out of ac-
80 tion, slides carrying said cams, means for reciprocating the slides, a clutch for changing the machine from to and fro to round and round knitting, a clutch operating rod, and a
85 bar or finger carried by the said rod and acting on one of said cam slides so as to impart the final impulse thereto, substantially as specified.

28. The combination of the pattern chain, the sprocket wheel carrying the same, the ratchet wheel connected to said sprocket
90 wheel, the toothed pattern wheel, pawls for acting on said toothed wheels, a shaft or stud carrying the wheels and permitting them to turn loosely thereon, and a washer interposed
95 between the toothed pattern wheel and the sprocket wheel, said washer being keyed to the pivot shaft or stud, substantially as specified.

29. The combination of the cam slides, the reciprocated bars carrying pawls in different
100 planes for operating said slides, shifting levers and slides for effecting the raising and lowering of said bars, and the pattern wheel having cams for operating said levers, sub-
stantially as specified.

30. The combination of the toothed cam
slides, the reciprocated bars having pawls for engaging with said slides, levers and slides
110 for vertically shifting the said bars, one of said levers overlapping the other, and a pattern wheel having cams for acting on said levers, whereby the movement of one lever is imparted to the other, when said lever moves in one direction, the levers moving independ-
115 ently of each other in the opposite direction, substantially as specified.

31. The combination of the toothed cam
slides, reciprocated bars having pawls in different planes engaging with said teeth, slides
120 guided on the frame of the machine and engaging with said bars, levers acting on said slides and a pattern wheel having cams for acting on said levers, substantially as specified.

32. The combination of the toothed cam
125 slides, the reciprocated bars having pawls in different planes for acting on said slides, guided slide bars engaging with said pawl bars, levers acting on said slides, and a frictional retaining device or brake acting upon
130 each slide, substantially as specified.

33. The combination of the needle cylinder and its needles, the cam box, a switch cam for acting on the bits of some of the needles,

an arm on the shaft of said switch cam, a clutch forming part of the driving mechanism of the machine, mechanism for moving said clutch, a vibrated tappet acting on a bar
5 forming part of said mechanism, and a slide rod carrying said bar and having cams for acting upon the arm of the switch cam, substantially as specified.

34. The combination of the needles, a cylinder having ribs extending to the top of the same so as to serve as sinkers for the stitches, the guided web holders working close to the top of the cylinder and each notched at its inner end so as to serve both as a web holder
15 and as a means of "knocking over" the stitch, a grooved carrier for said web holders, a cam for acting upon the web holders to project and retract the same, and means for operating said cam, substantially as specified.

35. The combination of the needles, the
knitting cams for actuating the same, cam
slides having cams whereby said needles are
caused to engage with or are released from the
control of the knitting cams, a lever and de-
vices carried thereby for operating said cam
25 slides, means for vibrating said lever, and set screws and lugs whereby the movement of the lever in either direction is positively limited, one of said elements being carried by each arm of the lever, and the other by the fixed
30 frame, substantially as specified.

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

EMIL FRANCK.

Witnesses:

EUGENE ELTERICH,
HARRY SMITH.