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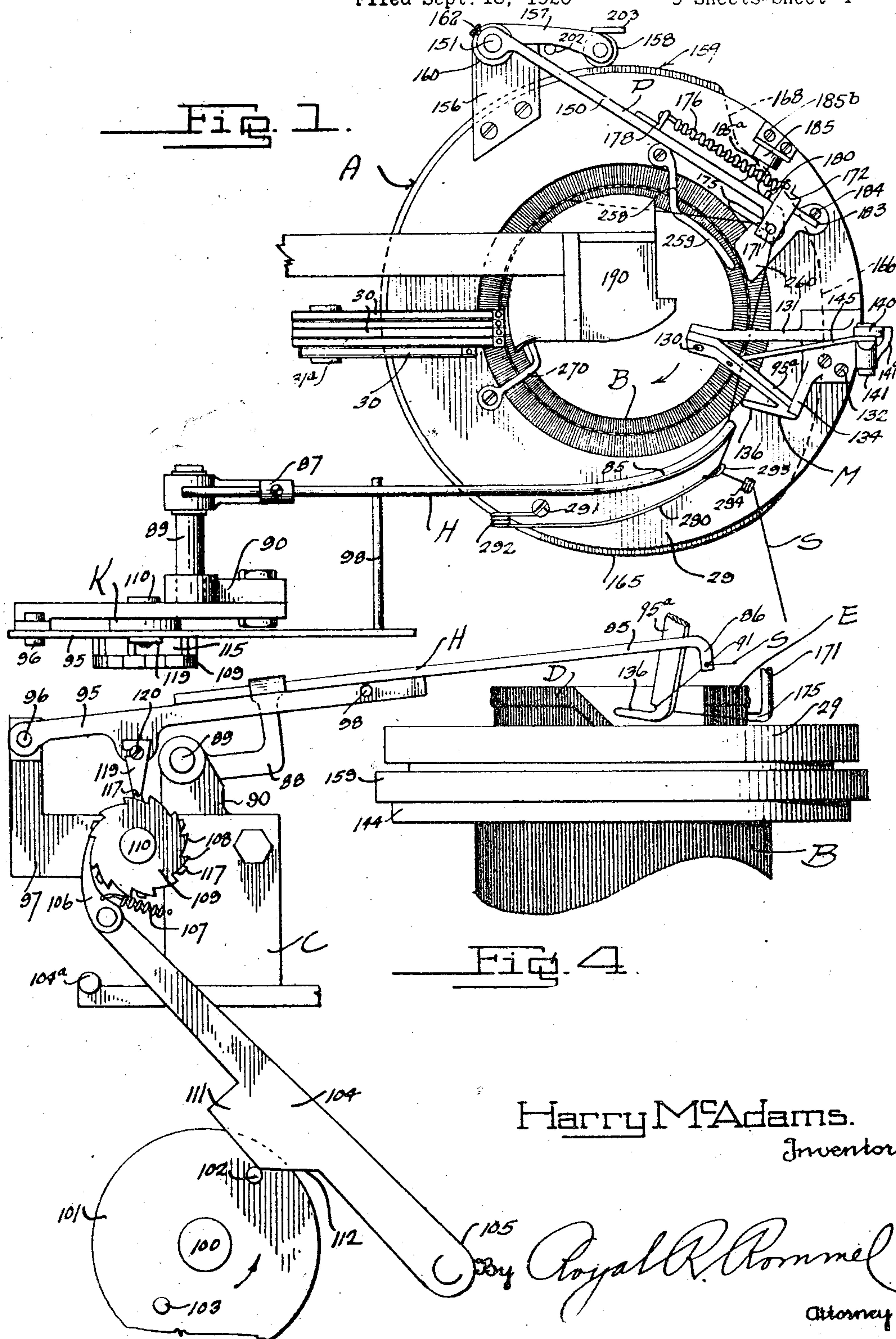
1,683,203

H. McADAMS

CIRCULAR KNITTING MACHINE

Filed Sept. 18, 1926

9 Sheets-Sheet 1



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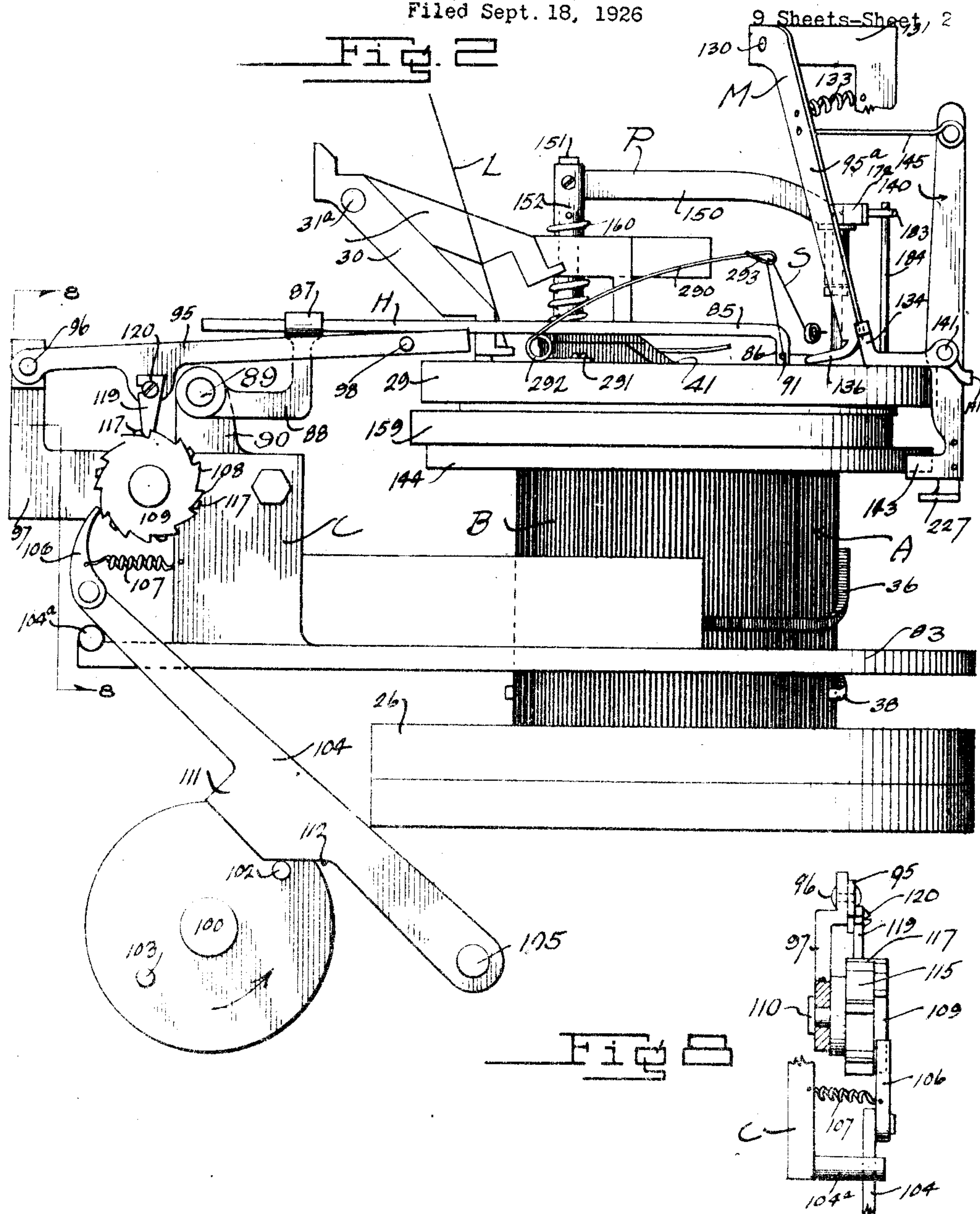
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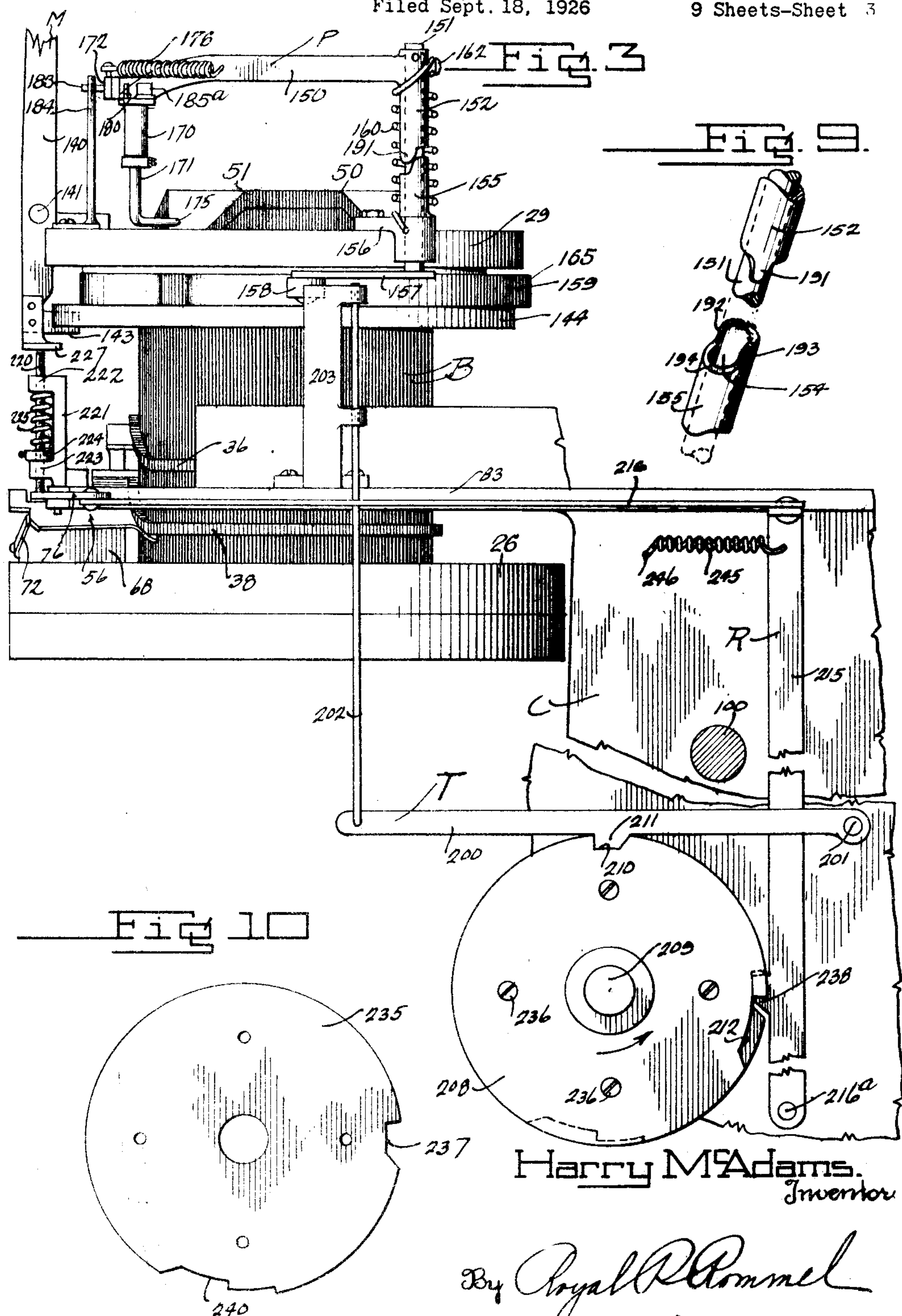
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H. McADAMS

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9 Sheets-Sheet 3



Sept. 4, 1928.

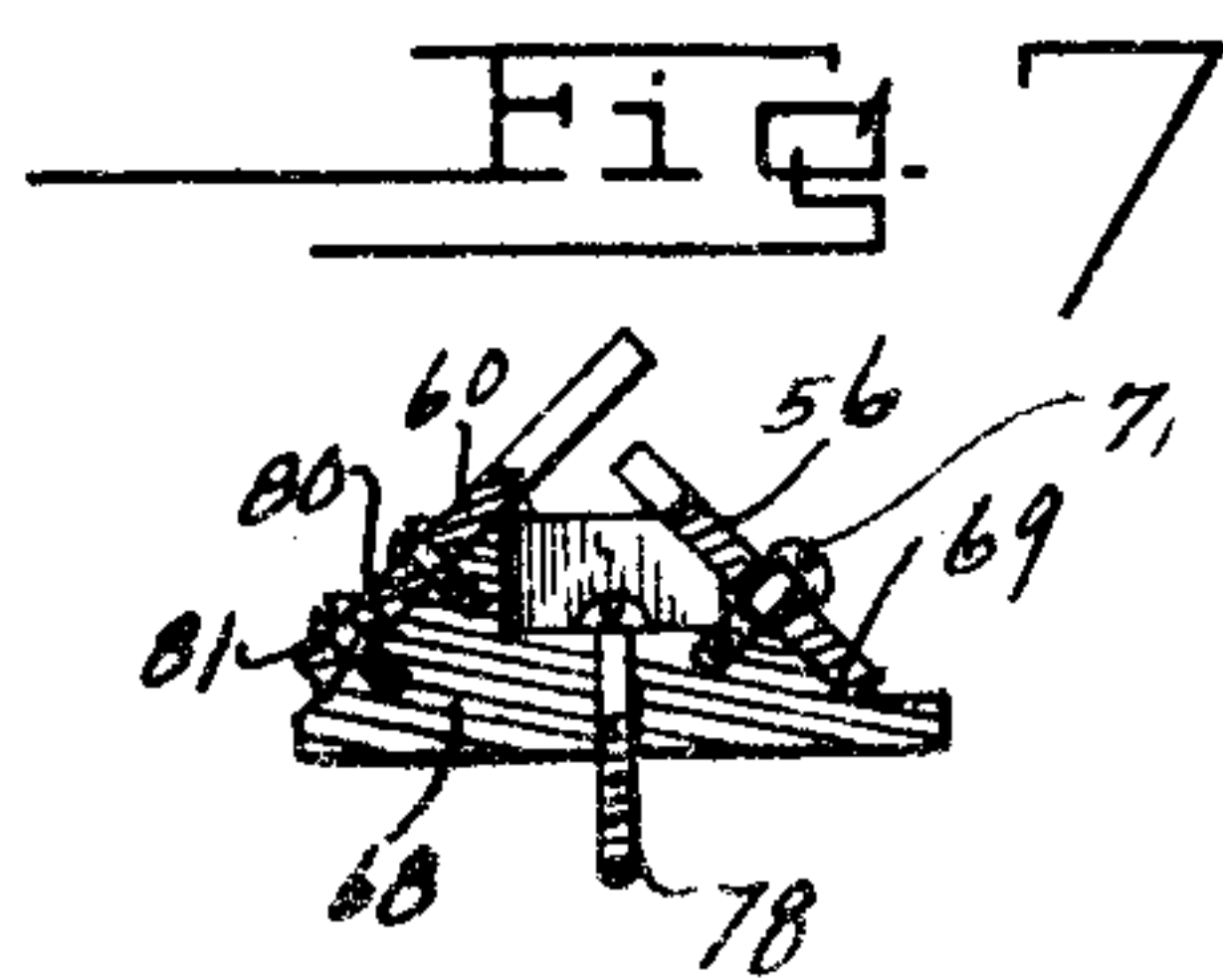
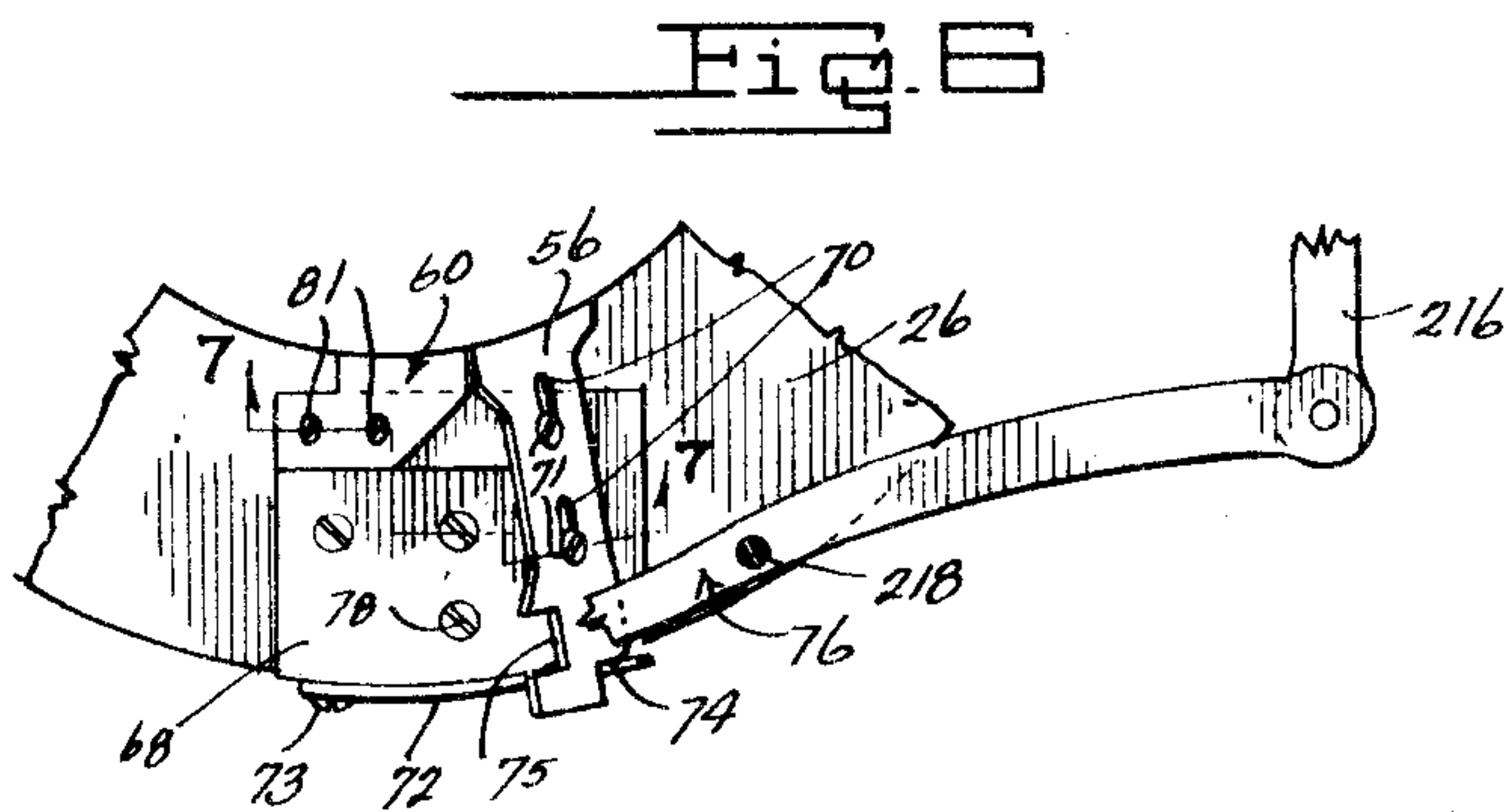
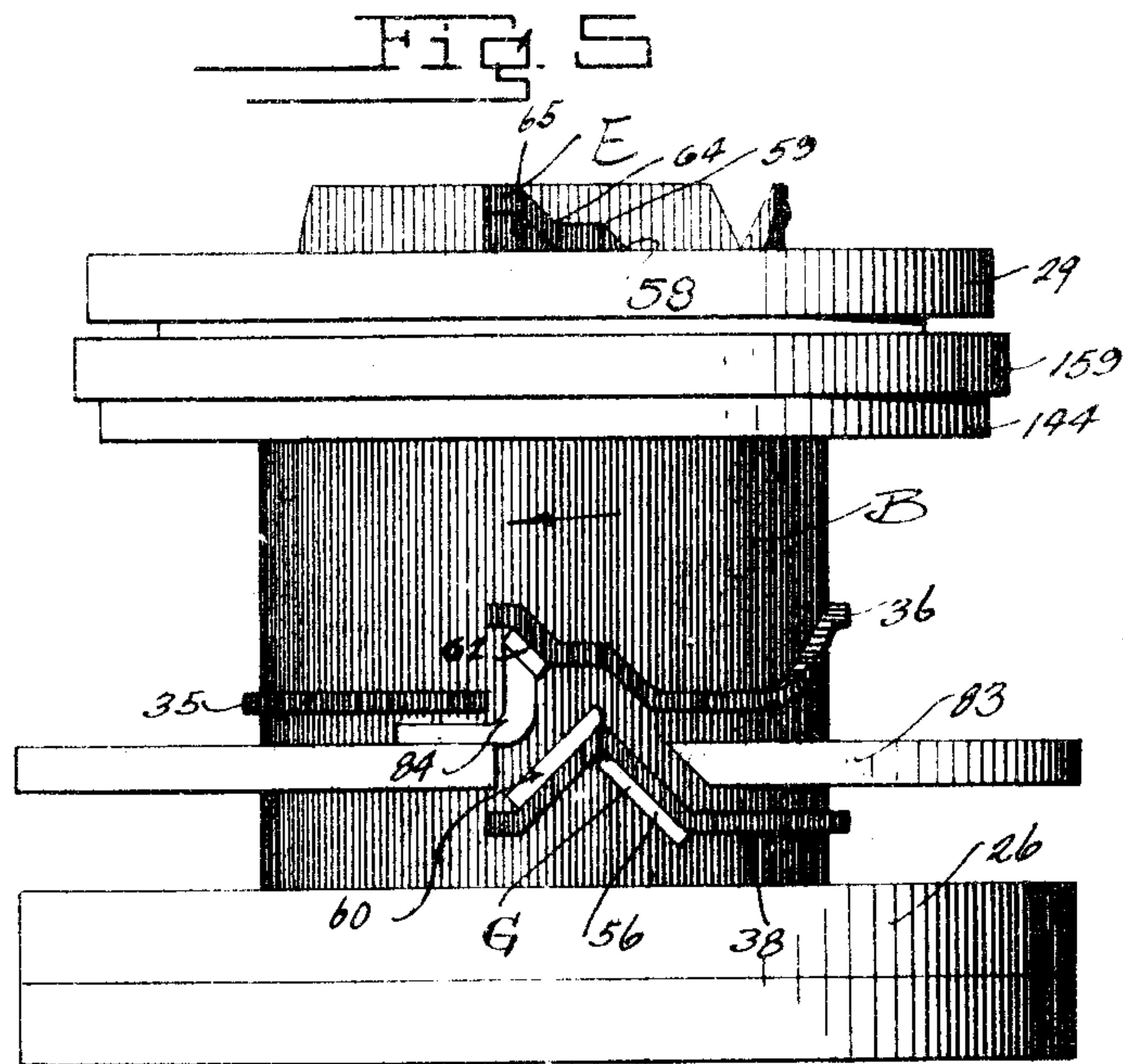
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CIRCULAR KNITTING MACHINE

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9 Sheets-Sheet 4



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1,683,203

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CIRCULAR KNITTING MACHINE

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9 Sheets-Sheet 5

Fig. 11.

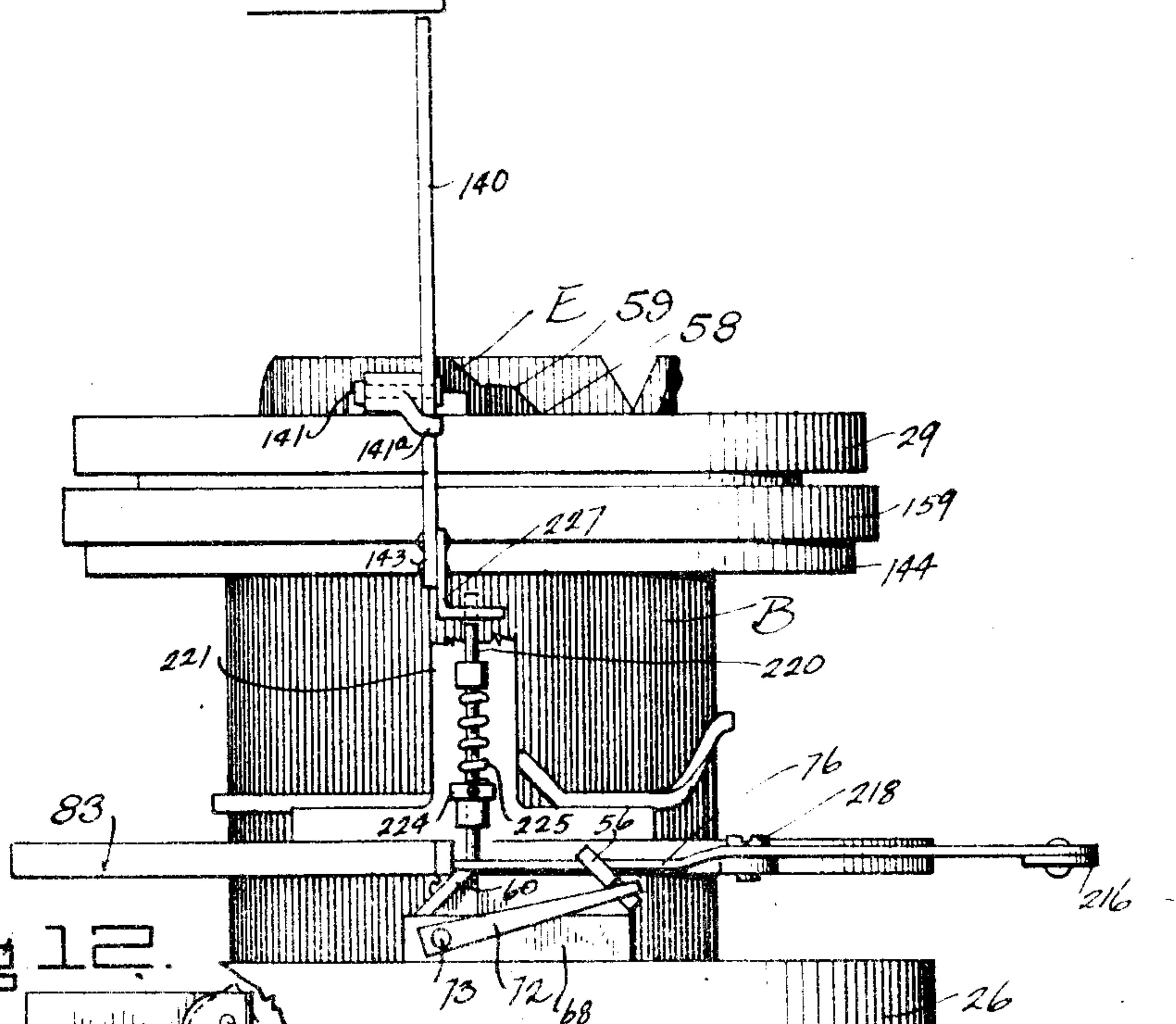


Fig. 12.

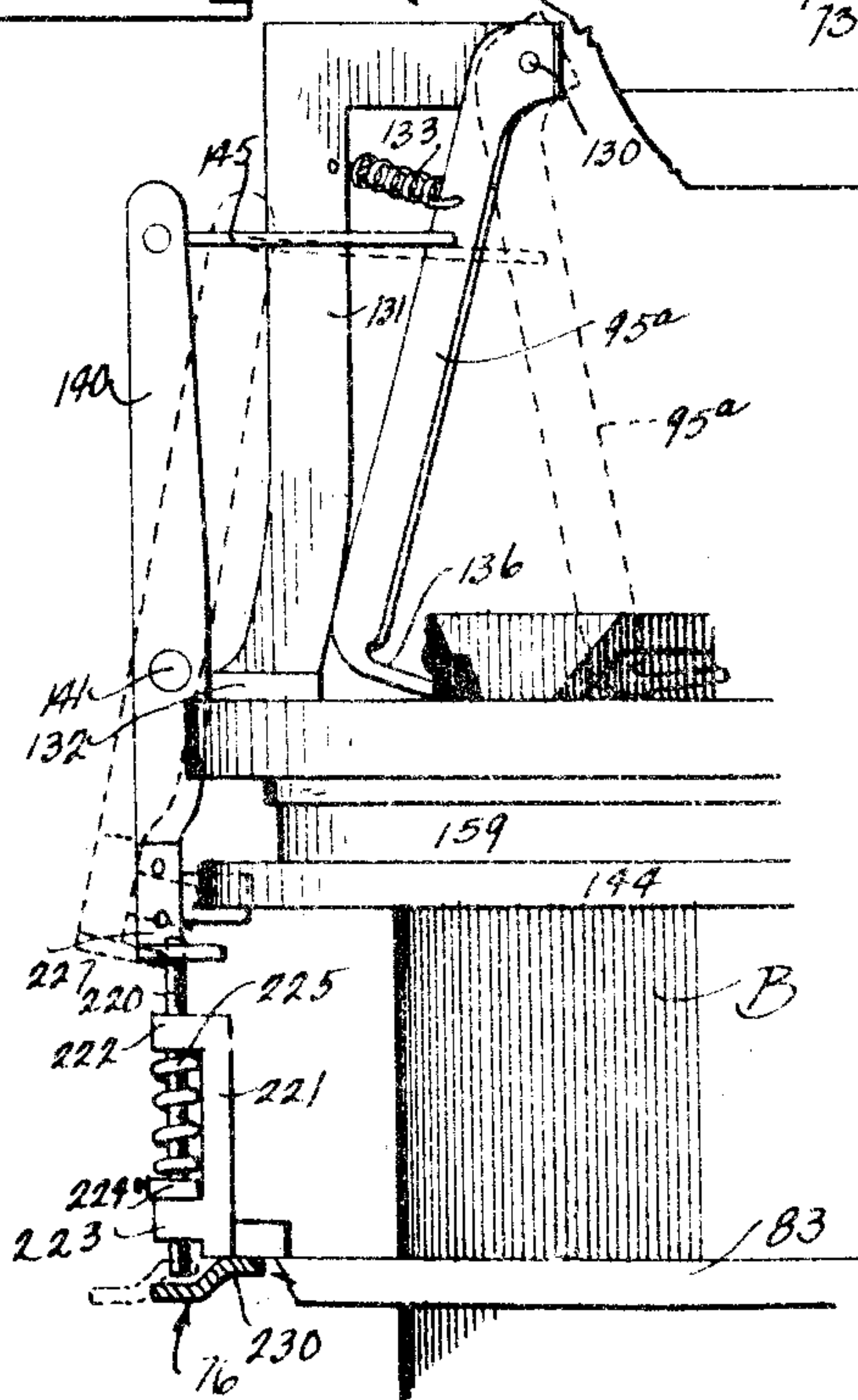
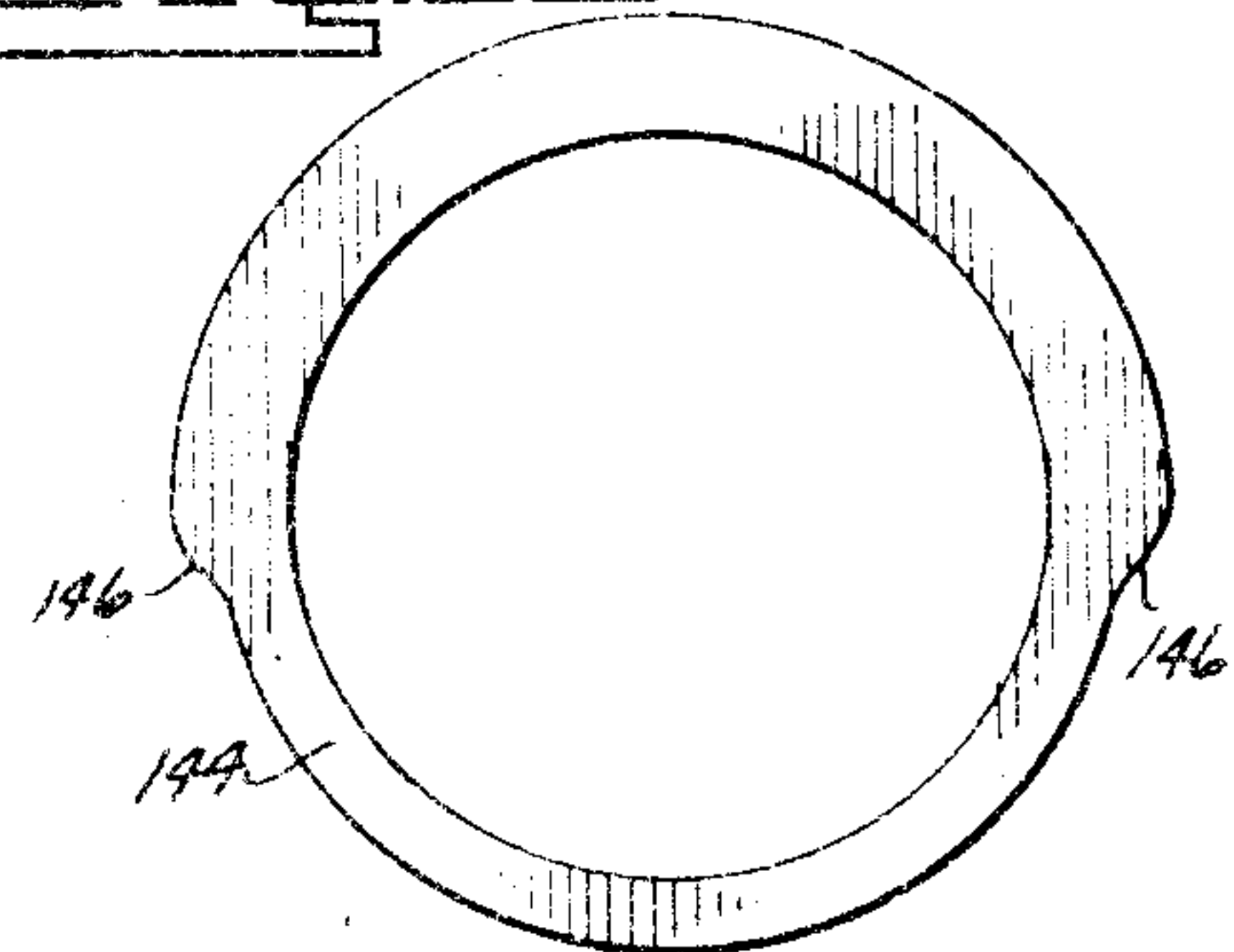


Fig. 13.



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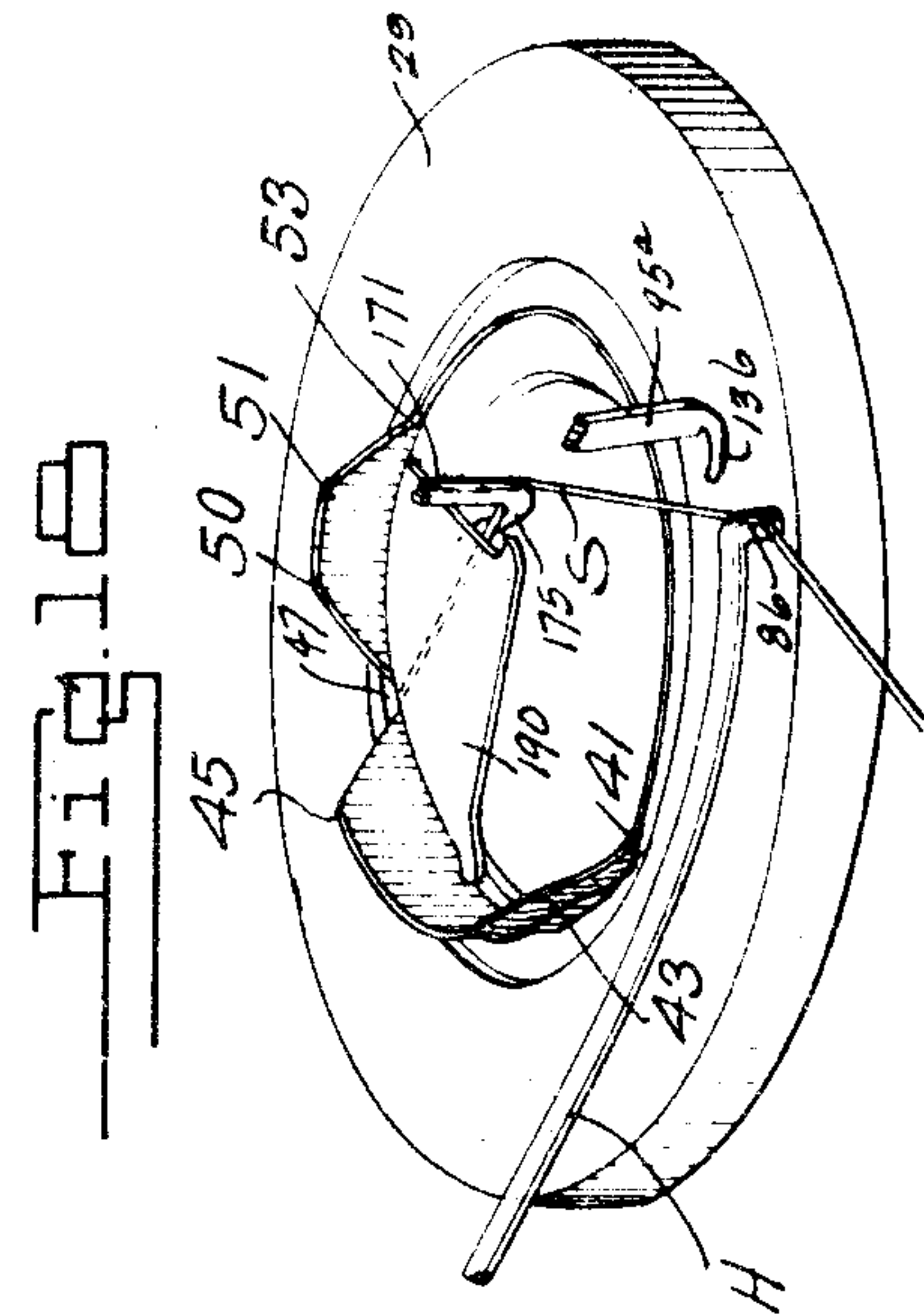
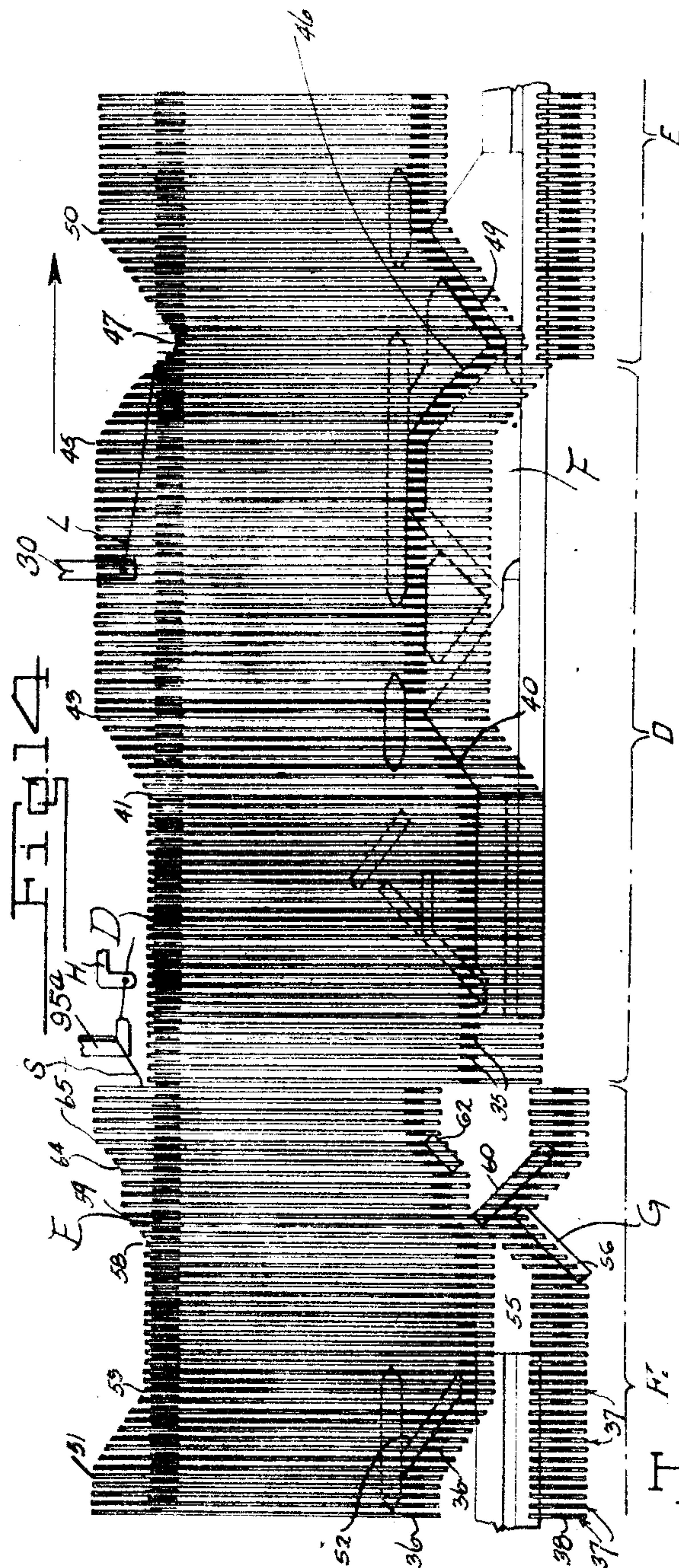
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CIRCULAR KNITTING MACHINE

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9 Sheets-Sheet 6



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1,683,203

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CIRCULAR KNITTING MACHINE

Filed Sept. 18, 1926

9 Sheets-Sheet 7

Fig. 15.

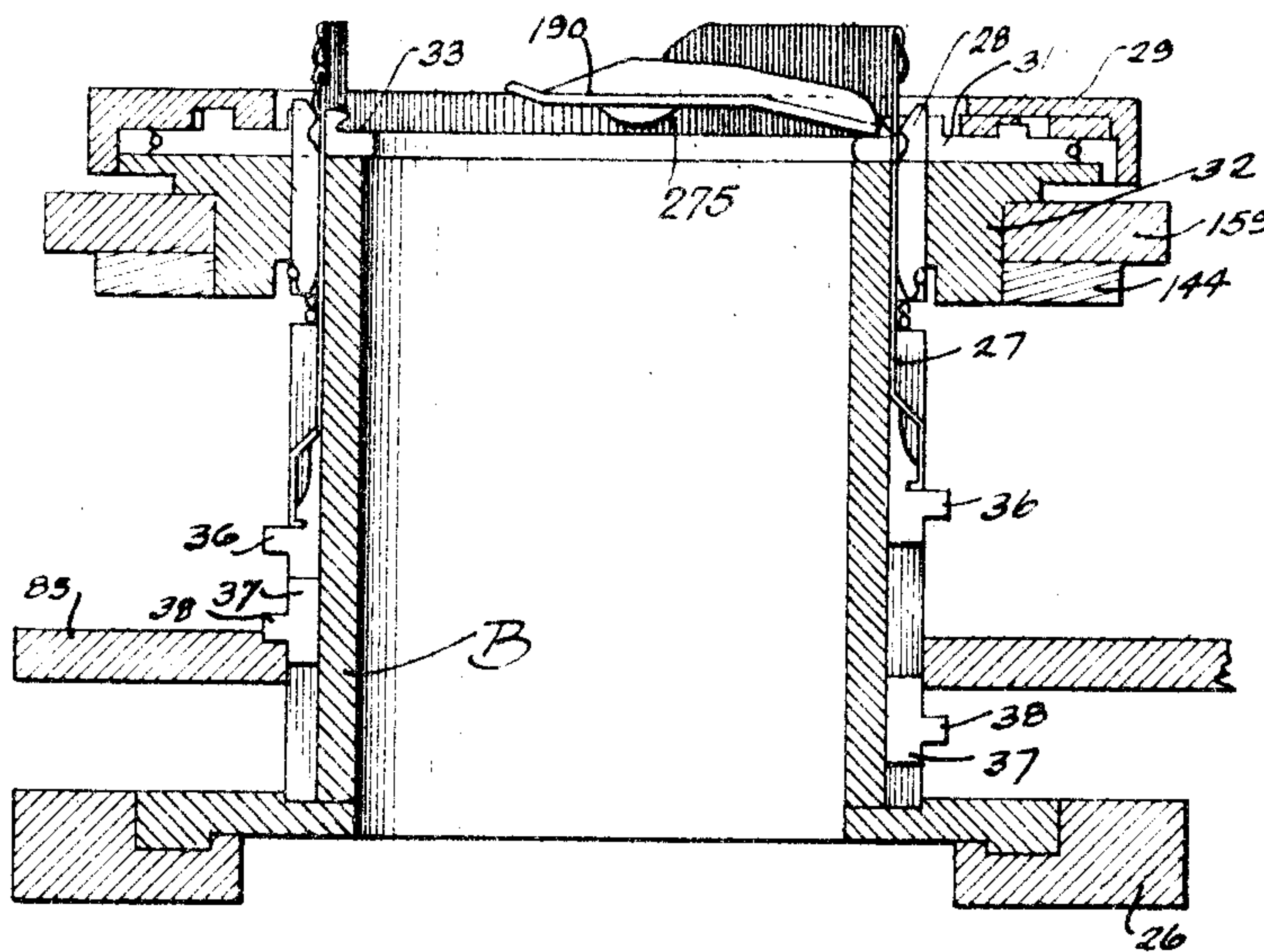
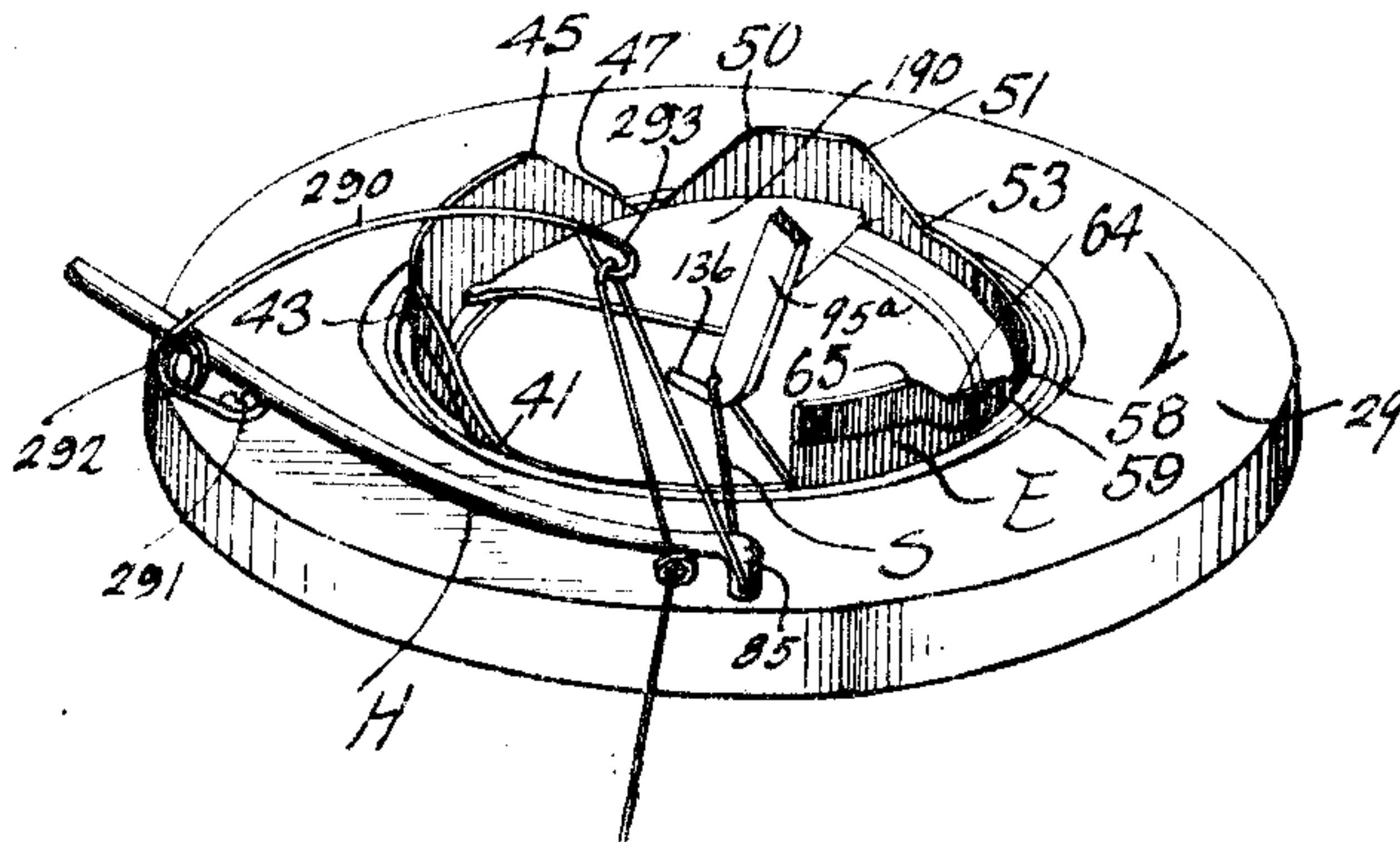


Fig. 16



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1,683,203

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CIRCULAR KNITTING MACHINE

Filed Sept. 18, 1926

9 Sheets-Sheet 8

Fig. 19

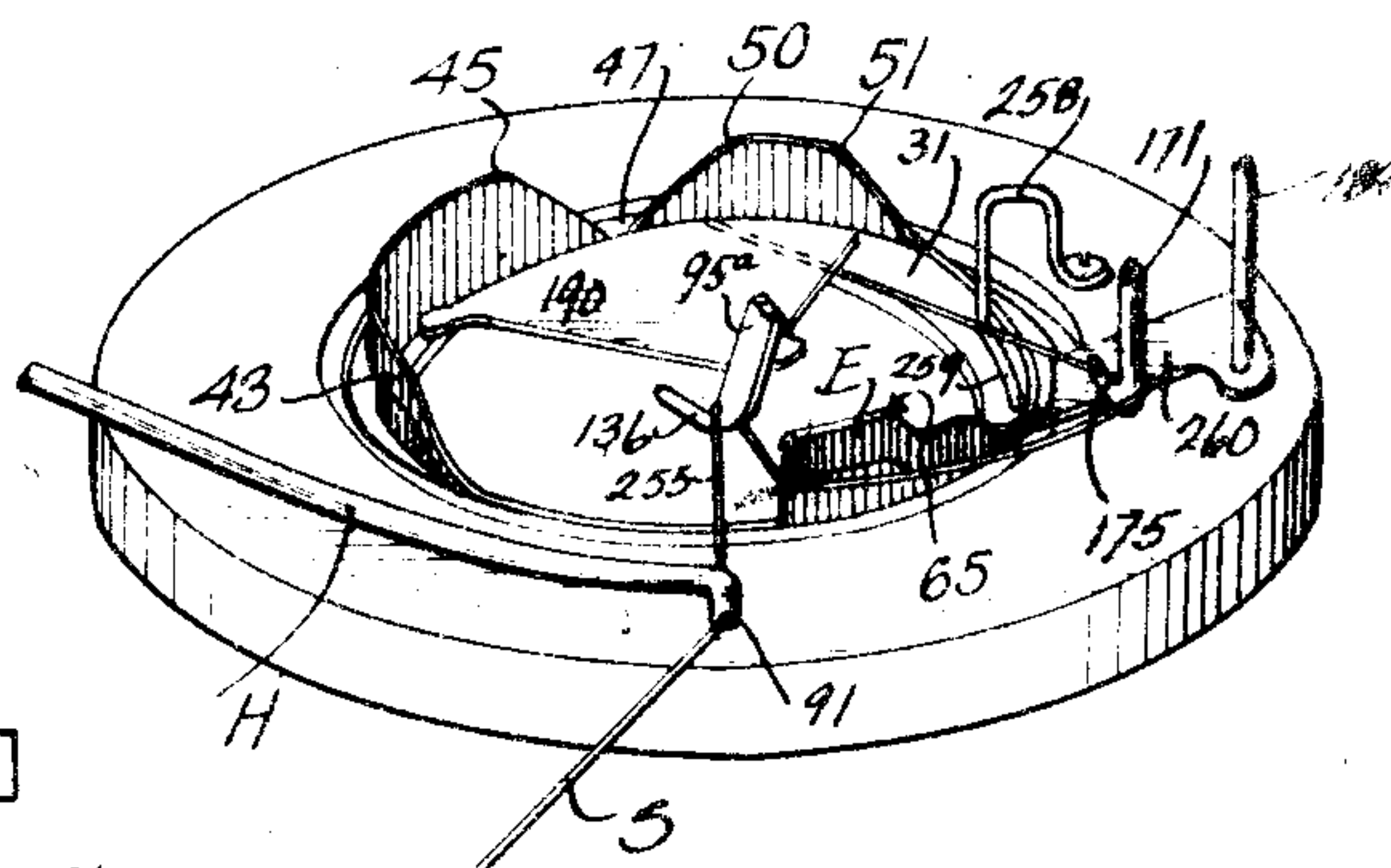


Fig. 20

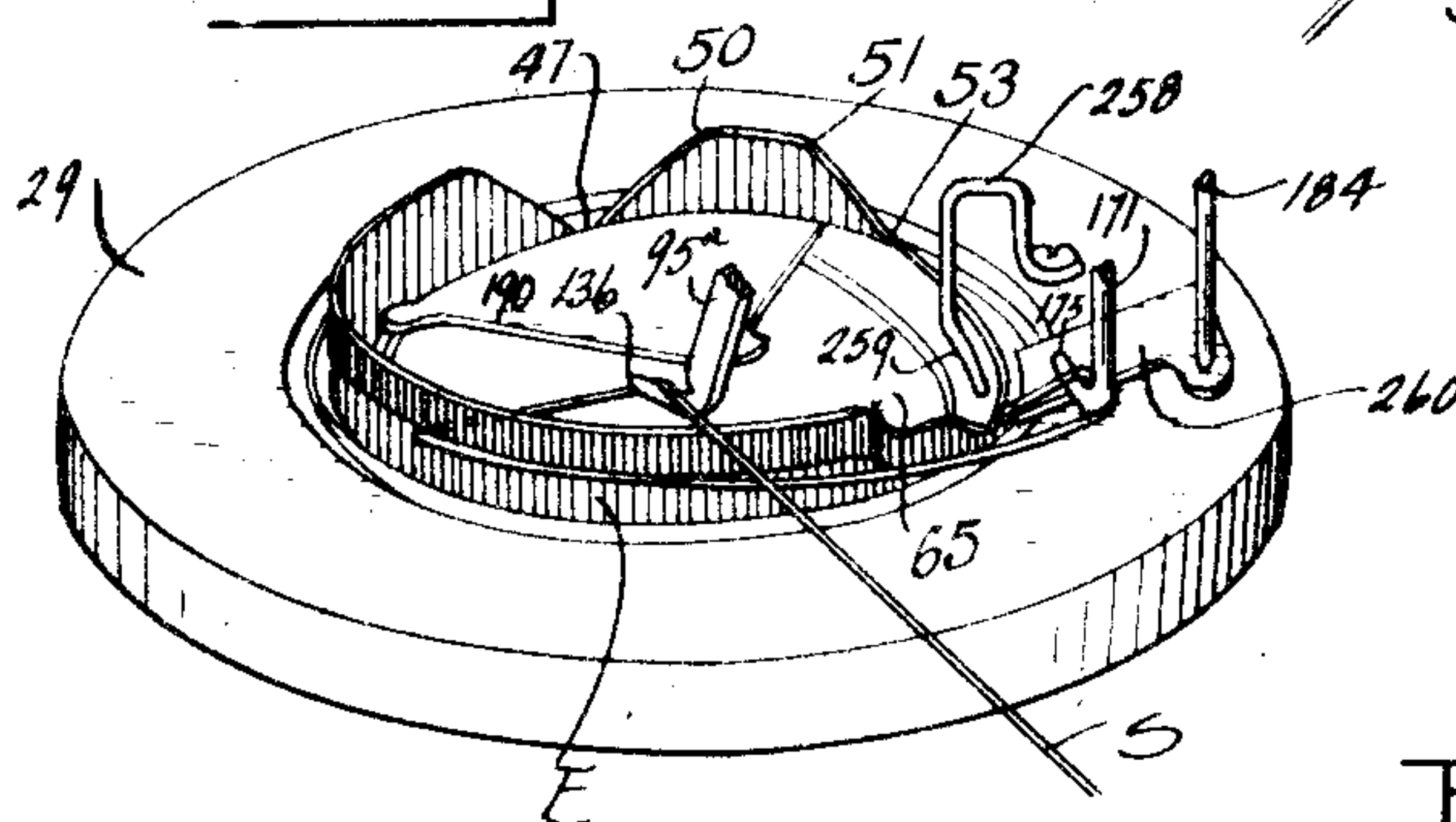
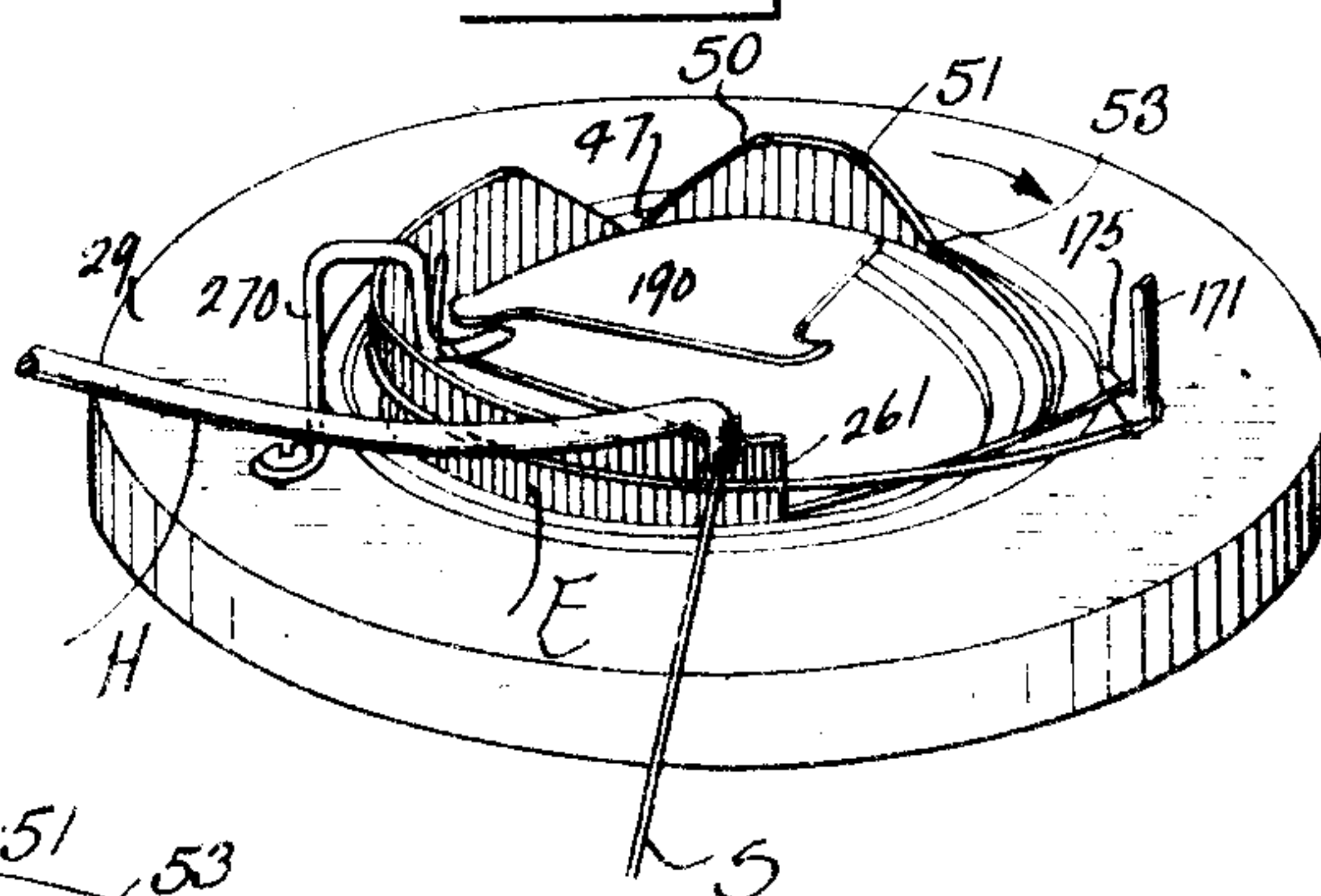
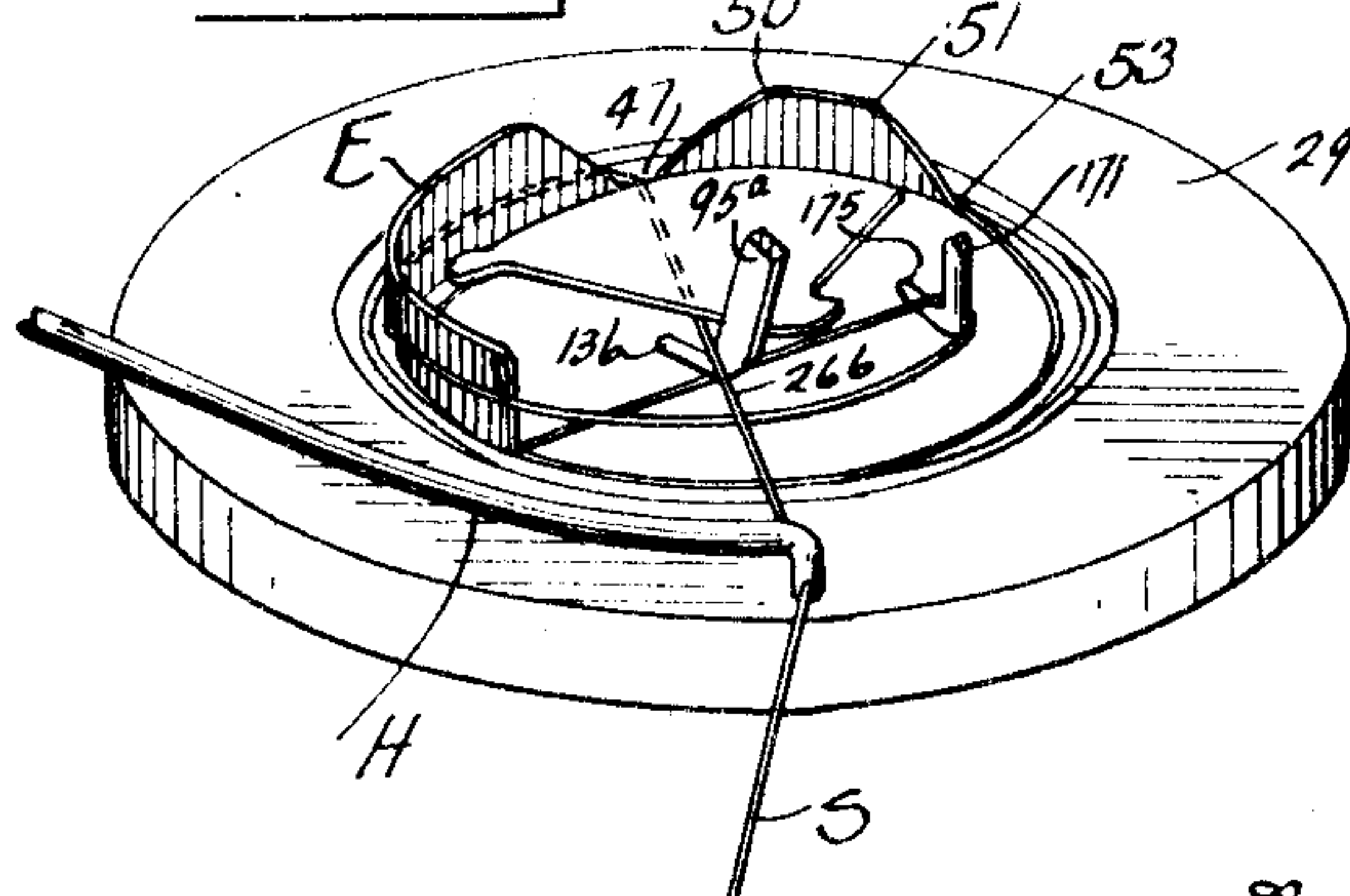


Fig. 21.



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1,683,203

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CIRCULAR KNITTING MACHINE

Filed Sept. 18, 1926

9 Sheets-Sheet 9

FIG. 23

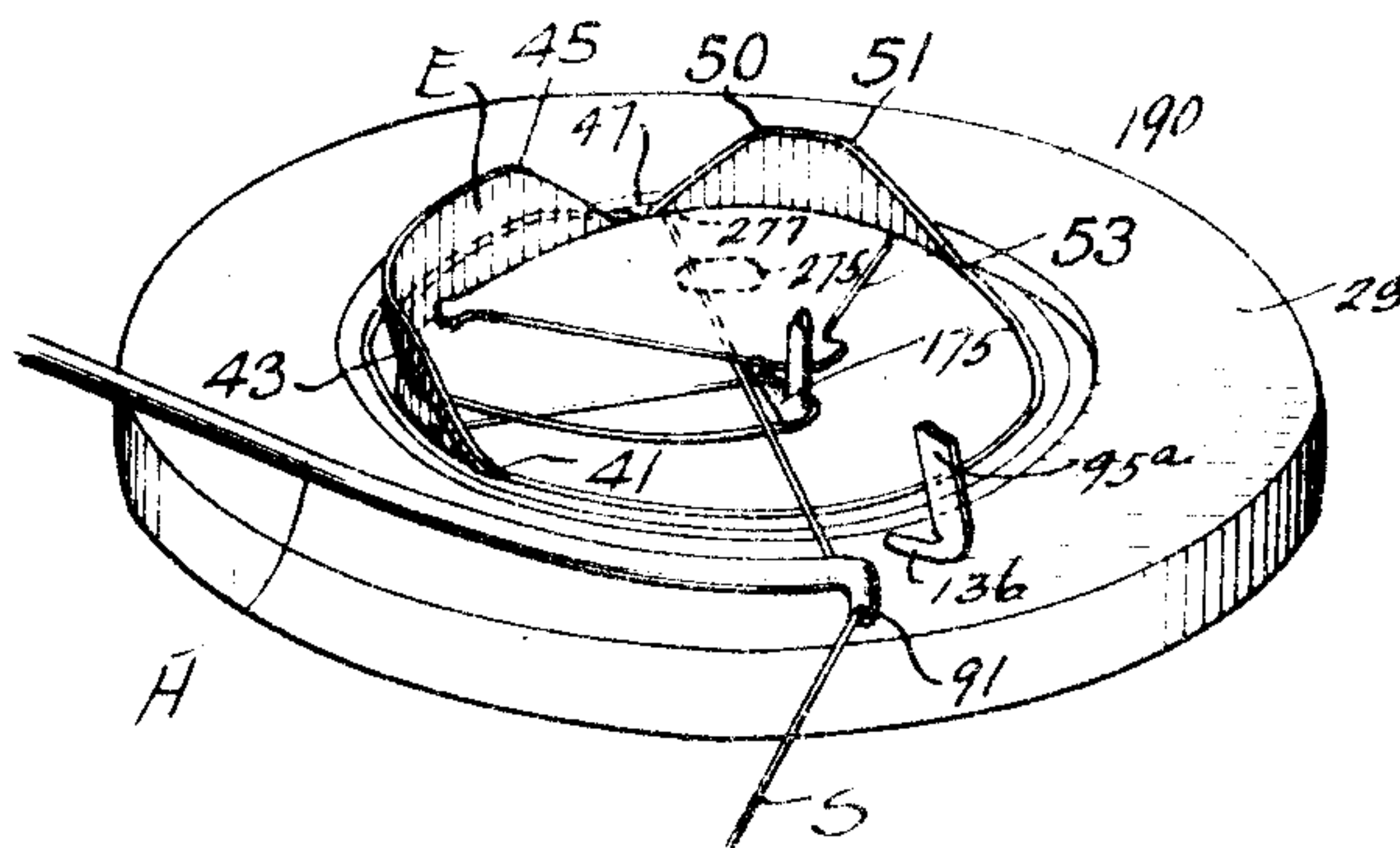


FIG. 24

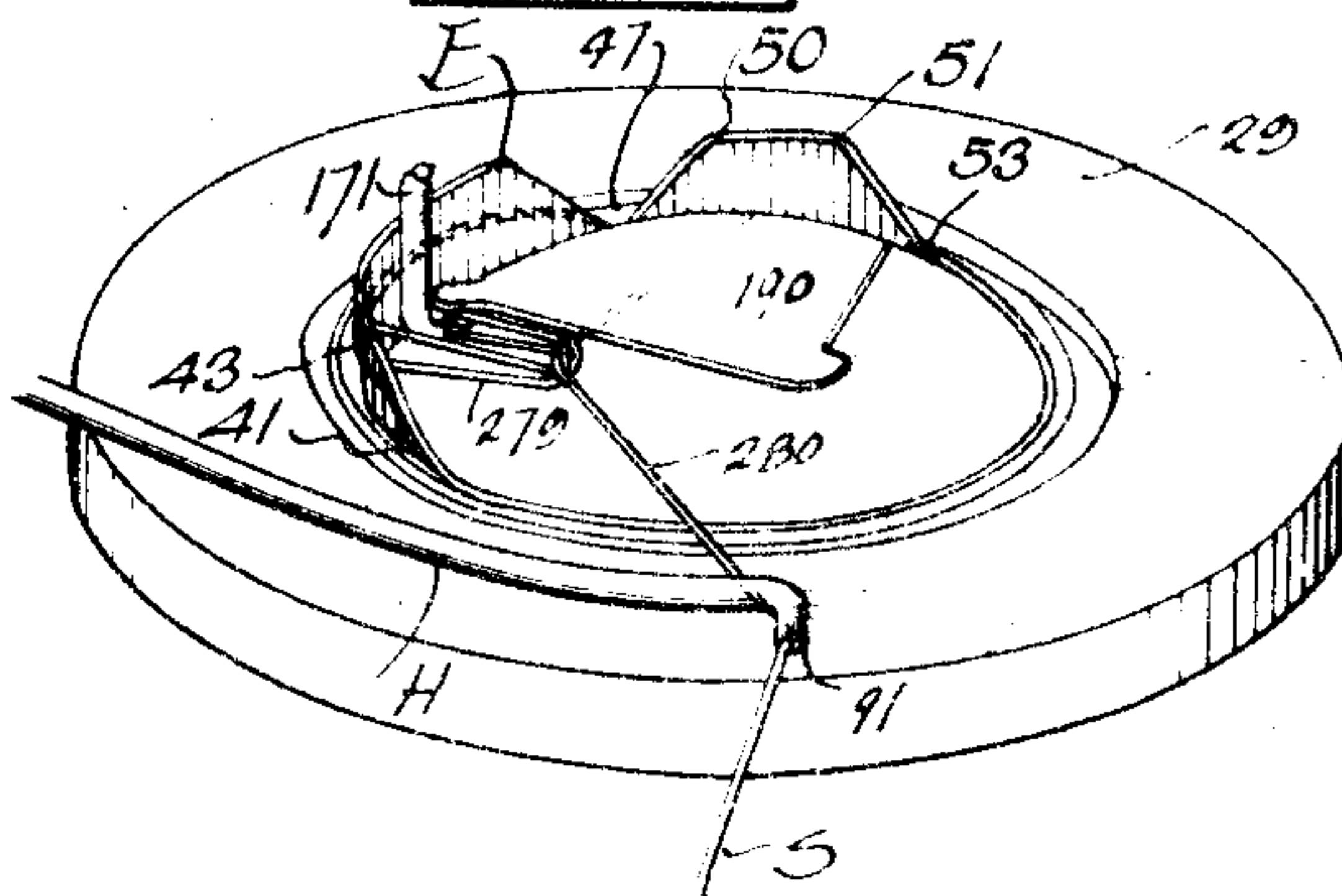
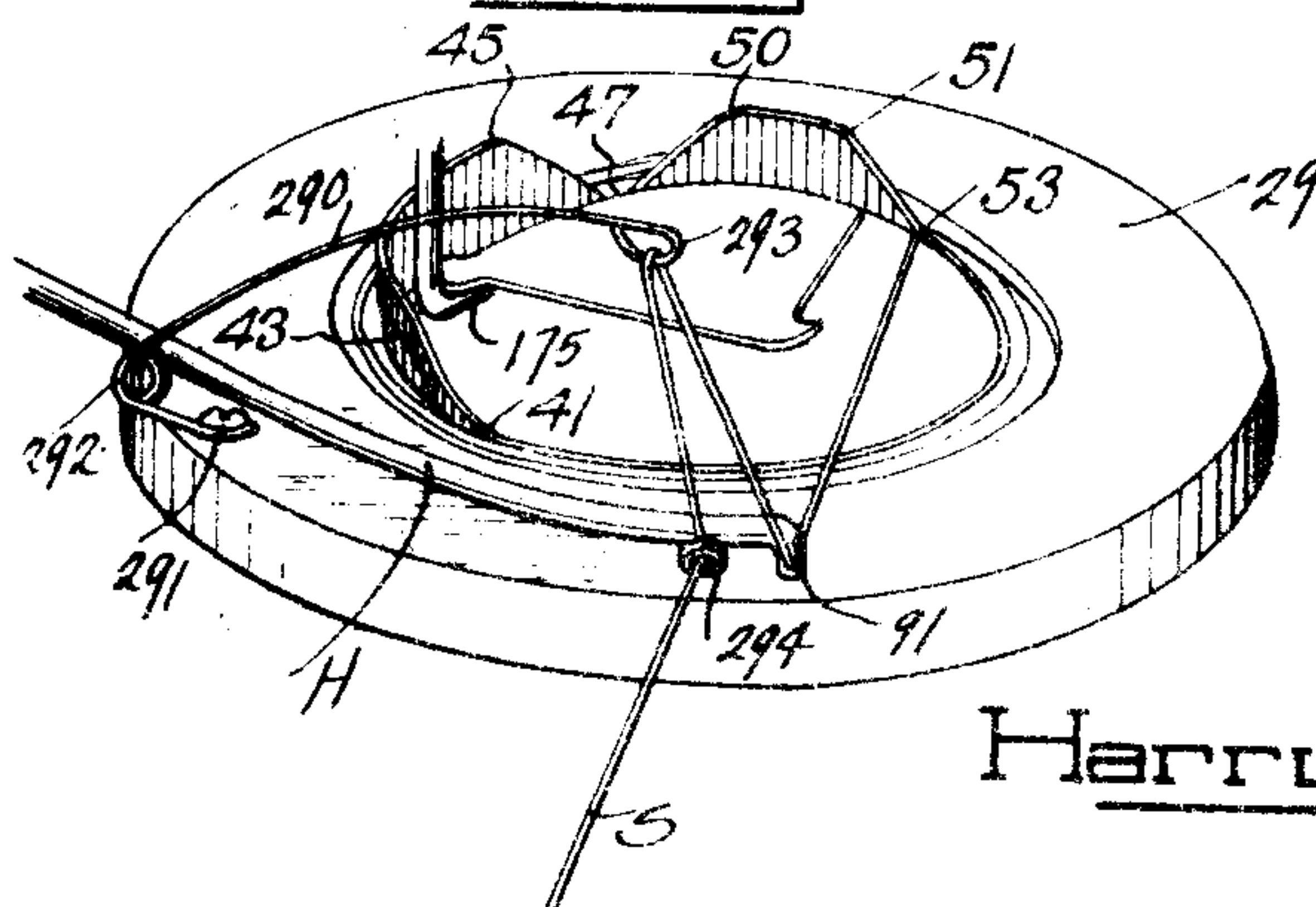


FIG. 25



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UNITED STATES PATENT OFFICE.

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CIRCULAR-KNITTING MACHINE.

Application filed September 18, 1926. Serial No. 136,276.

This invention relates to improvements in knitting machines.

The primary object of this invention is the provision of an improved circular knitting machine adaptable for the knitting of hosiery in which a splice, reinforcing, or secondary thread is to be knit, and embodying improved means for controlling, guiding, directing, and knitting the reinforcing, splice, or secondary thread in a continuous manner without waste thereof; without the ordinary floated or free portions conventionally found in circular knitting machines where a reinforcing area of less than the full circumference than the stocking is knit; and thereby using all of the splice yarn and obviating the usual cutting of the float portions.

A further object of this invention is the provision of improved means embodied upon a circular knitting machine for regulating the splice thread during the knitting thereof, to permit the same to knit the splice in regular manner, and to knit what would ordinarily be the float portion into the splice.

A further object of this invention is the provision of improved means specifically adaptable for any sort of circular knitting machine, and more particularly illustrated and adaptable for use in connection with the Pigeon type of circular knitting machine such as set forth in Patent No. 1,330,818, granted February 17, 1920, or in connection with the Banner type of knitting machine disclosed in Patent No. 933,443, dated September 7, 1909, but which is adaptable for use in connection with any type of circular knitting machine, embodying improved means for regulating a set of splice thread needles so as to permit the same to take the splice thread as each revolution of the needle cylinder passed a predetermined splice needle controlling cam mechanism, whereby to knit the splice thread in regular manner and to control the splice thread after knitting in regular manner to knit in the splice of the article what would ordinarily be the float thread, and thereby economically producing a stocking or article with a saving of practically one half of the splice or reinforcing thread, and obviating expensive float thread cutting operations now necessary.

Other objects and advantages of this in-

vention will be apparent during the course of the following detailed description.

In the accompanying drawings, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views—

Figure 1 is a plan view of the improved circular knitting machine, showing more particularly the mechanism for guiding and controlling the reinforcing or splice yarn; the same being shown in position to guide what would ordinarily be the float portion of the splice yarn into position to be taken in a knitting relation by the splice thread needles in order to obviate the float portion.

Figure 2 is a side elevation of the improved knitting machine, showing essential portions of the same in so far as the invention herein described is concerned, showing the parts in the relation described for Figure 1.

Figure 3 is a side elevation of the improved knitting machine, of the parts above shown, at the side directly opposite the view illustrated in Figure 2.

Figure 4 is a fragmentary side elevation of details illustrated in Figure 2, but showing an arrangement of parts by which the splice thread is "kicked" into position to be received by the beards or hooks of the splice thread receiving needles.

Figure 5 is a fragmentary front elevation of the knitting cylinder, showing more particularly the novel cam means for elevating and regulating the splice thread receiving needles.

Figure 6 is a fragmentary plan view of certain details of splice thread needle controlling cams.

Figure 7 is a sectional view taken substantially on the line 7—7 of Figure 6.

Figure 8 is a sectional view taken substantially on the line 8—8 of Figure 2, showing certain splice yarn controlling pawl and cam regulating means.

Figure 9 is a fragmentary perspective view of cam means for elevating and lowering the splice yarn swinging arm which plays an important part in the novelty of this invention.

Figure 10 is an elevation of a cam wheel mounted upon the conventional pawling

shaft, and operated by certain pattern control mechanism (not shown) to regulate the splice yarn guide means of this invention during the knitting of various portions of the stocking or garment.

Figure 11 is a front view of certain details of the improved knitting mechanism.

Figure 12 is a fragmentary side elevation of splice yarn controlling mechanism embodied in this invention.

Figure 13 is a plan view of a cam ring embodied in this invention and movable with the rotary needle cylinder to regulate the interval at which splice yarn is placed upon the splice yarn receiving needles.

Figure 14 is a diagrammatic development on a plane surface of the knitting needles and their cam arrangements.

Figure 15 is a vertical sectional view taken through the improved rotary knitting cylinder, showing the relation of needles and needle butt jacks.

Figures 16 to 25 inclusive are fragmentary perspective views illustrating the various steps in the knitting of the splice or reinforcing yarn, in proper sequence.

In the drawings, wherein for the purpose of illustration is shown only a preferred embodiment of mechanism for carrying out the objects of this invention, the letter A may generally designate the improved knitting machine, which may include a rotary needle supporting cylinder B rotatably supported upon a frame C.

The needle supporting cylinder B receives complementary sets of needles D and E; and cam means F is provided for preferably operating upon all of the needles of both sets D and E for regulating the reception of the main yarn, and moving them into knitting relation with respect to main and splice yarns as illustrated in Figure 14. Novel cam means G is provided for guiding and regulating the needles on the set of needles E so that they may take the splice, reinforcing, or secondary yarn to continuously knit the same without any waste or float portions appearing in the knitted stocking or garment. A splice thread guide arm H is provided, operated by means K to control the splice thread S in the proper knitting relation with respect to the knitting needles of the splice thread receiving needles E as illustrated in Figures 1, 2 and 16. Means M is provided for operating upon the splice thread S to insure that the portion of the splice thread which would be the ordinary float portion in conventional knitting is thrown onto the needles of the set E so that the beards or hooks will receive the same in a knitting relation. Means P is provided for bringing what would ordinarily be the float portion of the splice thread to the outside of the circular line of knitting needles so that the needles of the set E may receive the same

in a knitting relation; the means P performing the additional function of regulating the knitting feed of the splice yarn S when that portion of the splice yarn which would be the ordinary float portion in conventional knitting, is knit into the splice in the garment. Means R and T illustrated in Fig. 3, are controlled by pattern control means of the knitting machine, for respectively maintaining the means M and P inoperative during the knitting of certain parts of the garment, such as in the case of hosiery, the knitting of the heel and toe pockets.

In the circular knitting means the needle cylinder is that type adapted to be rotated to produce plain tubular knitting, or oscillated to form heel or toe pockets for stockings or the like. The needles shown are of the spring beard type, although I use other types if desired. Suitable yarn supporters and beard depressors cooperate with the needles in a knitting operation. In the production of hosiery it is needless to state to those skilled in the art that a splice yarn, reinforcing yarn, or secondary yarn, is used to produce the high splice, reinforced foot portion, or other parts of the stocking or garment being knitted.

Many details of operating mechanism, conventionally known to those skilled in the art, and more particularly shown in the patents above referred to, are omitted from the type of knitting machine illustration in the drawings, and manufactured by the Wildman Mfg. Co., Norristown, Penna.

Referring to the drawings, the needle cylinder B is mounted to rotate or oscillate in a supporting bed 26, more particularly illustrated in Figure 15 of the drawings. This needle cylinder is provided with spring beard needles 27, which are divided into the two sets or series D and E, as diagrammatically represented in Figure 14 of the drawings. The needles in the set D operate at all times during plain tubular knitting, but the needles of the set E are preferably constructed and operated upon to make the reinforcing or high splice of the garment being knitted upon.

As above noted the needles 27 are preferably of the spring beard type, and cooperating with each needle 27 is a beard depressor 28, of the conventional type. The beard depressors are actuated by cams (not shown) carried by the cam ring or cap 29, which is stationary and may be considered a part of the frame C. These beard depressors and their operating mechanisms form no part of the present invention as may be noted, but it is essential to place certain guide means to avoid the same during the novel operation of the splice yarns.

The main yarn L is fed in ordinary manner to the needles 27 from a yarn guide 30, see Figure 2, pivotally supported upon a

pin 31^a, and a plurality of which yarn guides 30, for the main yarn L, may be provided, according to ordinary construction. The main yarn is of course fed against the shanks of the needles well below the beards of the needles when said needles are at their highest level. The yarn is supported by yarn supporters or sinkers 31 which are mounted to slide in radial slots in a sinker ring 32 secured to the upper end of the cylinder and rotatable therewith. The said yarn sinkers are provided with yarn and fabric supporting ledges 33, shown in Figure 15, which should be noted, in so far as this invention is concerned, since a special guide shown in Fig. 1, at 259 is provided to take the splice yarn over the same at a certain interval, as will be subsequently mentioned. The said yarn supporters 31 are moved radial of the needle cylinder B by means of certain cam grooves provided in the cam ring 29, and the construction is conventional as will be well understood by those skilled in the art. The needles of the series D have shanks which are longer than the shanks of the needles of the series E. That is, the length of each needle of the series D is greater than the length of the needle of the series E, as illustrated in Fig. 14, although this is merely one arrangement by which the control of the needles is effected. The needles of the series D and E may be respectively provided with butts 35 and 36, as shown in Figure 14. While ordinarily the butts 35 are longer than the butts 36, for this invention they may all be considered as of the same length. A novel feature of the invention is the provision of a special jack 37 for each needle of the series E, slidably disposed in the guide grooves of the needle cylinder, below the respective needles of the set or series E. Each of the short jacks 37 is provided with a butt 38. In fact, each needle of the series E may be said to be divided into upper and lower portions with an upper and lower butt respectively, movable relatively toward and away from each other by the cam means F and G to be subsequently described, to effect the purpose of this invention to be subsequently set forth.

The direction of rotation of the needle cylinder is as shown in Figure 1 of the drawings, by the arrow, and the needles rotate in the direction illustrated by the arrow in Figure 14.

As to the cam means F, the same includes a cam 40, upon which the butts 35 and 36 of the needles of both series D and E ride, to bring the needles from their lower positions, starting at the point 41 which is illustrated in Figs. 2, 14, 16, 17, 18, 19, 23, 24 and 25, to fully elevate the same above the sinkers 31. The needles of the series D and E during the normal rotary travel remain

elevated from the location 43 to the point 45 illustrated in Figs. 14, 16, 18, 19, 23, 24 and 25, and at location 45 the butts 35 and 36 are engaged by cam means 46 of Fig. 14, and the needles are lowered in order to bring the main and splice yarns, as the case may be, into knitting relation at the point 47 illustrated in Figs. 14 and 16 to 25 inclusive. After the knit of the yarn has been effected the butts 35 and 36 ride along a cam 49, as shown in Fig. 14, and are elevated once more, being fully elevated at the location 50, and all of the needles of the series D and E travel in fully elevated relation from the point 50 to the location 51, as shown in Figures 3, 14 and 16 to 25 inclusive, at which all of the needles of both sets D and E are again lowered by a cam 52, shown in Fig. 14, which operates on the butts 35 and 36. The needles of both series are then fully lowered at the location 53 illustrated in Figures 14, 16 to 18 and 20 to 25 inclusive, and in the case of the needles of the series D the same continue in a lowered travel during the rotation of the cylinder until the cam 40 shown in Fig. 14 and as above mentioned is reached, and whence they are elevated again. This is not true of the needles of the series E, however, since due to the front position of the special cam means G and the short jacks 37, the needles of the series E are elevated in order to take the splice yarn to the knitting point 47.

At this time referring to Figures 5, 6, 7, 11 and 14, which show the special cam means G, it is to be noted that as they approach the cam means G the short jacks 37 are positioned in a considerably spaced relation below the lowermost edges of the respective needles upon which they operate. Even when the needles in the series E are fully lowered, and prior to operation of the jacks 37 upon the cam means G, there is a space illustrated at 55 in Figure 14 of the drawings, between the top edge of each jack 37 and the lower edge of each respective needle thereabove in the series E. As the jacks 37 approach the cam means G, the butts 38 thereof first ride upwardly upon an inclined cam 56, and due to the fact that the effective throw of this cam is greater than the space 55, the top edge of each short jack 37 engages the lower edge of the needle thereabove and pushes its respective needle in the series E upwardly from the low point 58 to the point 59, as illustrated in Figs. 5, 11, 14 and 16 which is about one half of the normal high elevation of the needle beards. The butts 38 ride off of the cam 56 when the needles have been elevated to the point 59 and the butts 38 of the short jacks 37 then come into contact with an oppositely inclined cam 60, which lowers the short jacks 37 to their normal lower position, as illustrated in Figs. 5 and 14, and they continue in this lower position

for a complete revolution of the needle cylinder until they are again elevated by the cam 56 above mentioned. Returning again to the operation of the cam means G, after the needles of the series E have been elevated to the point 59, they are not fully elevated for taking the splice yarn, and hence a cam 62 is interposed, upon which the upper butts 36 of the needles of the splice yarn series E ride, and the needles of the series E are elevated from the location 64 to the fully elevated location 65, and in this elevated condition the needles of the series E receive the splice yarn S, as is illustrated in Figs. 14, 16, 19 and 20. And the said needles of the series E remain fully elevated from the location 65 until they are carried downwardly by the cam 46 to the knitting point 47, and at which time the splice yarn is of course knit in with the main yarn.

Referring to the mounting of the cams 56, 60 and 62, as is illustrated in Figures 6, 7 and 11 of the drawings, a cam supporting block or member 68 is mounted upon the supporting bed 26, at the front of the knitting machine, and one side of the block or member 68 is beveled at 69, and upon this side is slidably placed the cam 56. The cam 56 as illustrated in Figure 6 is elongated and provided with a pair of elongated slots 70 therealong which receive screws or guide pins 71 connected in the block or member 68, so as to permit the cam 56 to slide longitudinally and preferably radial of the needle cylinder B, so that when fully extended towards the cylinder the inner margin thereof will be positioned to engage the butts 38 of the short jacks 37. A leaf spring 72 shown in Figs. 6 and 11 is connected at 73 on the block 68, and at its free end is resiliently urged into engagement against a shoulder 74 at the outer end of the cam member 56, to urge the same normally into position for engaging the butts 38. This cam member 56 adjacent its outer end is provided with an upwardly facing recess 75 in which fits the outer end of a lever 76, which will be subsequently described as part of the means R to retract the cam 56 so that it will not engage the butts 38, and therefore will not operate during periods when the splice or reinforcing yarn is not received by the needle cylinder, such as when the latter is oscillating.

The block 68 is attached by screws 78 on the supporting bed 26, to prevent its movement, and the opposite side of the same is also beveled at 80, for receiving the stationary cam member 60 in a connected relation by screws 81 or the like. This cam 60 is not movable and is always in position to pull the short jacks 37 down to their fully lowered position.

A stationary frame plate 83 receives the needle cylinder therethrough and practically

surrounds the needle cylinder, in spaced relation above the supporting bed 26 above mentioned, the same at the front thereof being cutaway to accommodate the cams 56 and 60, as shown in Fig. 5, and it being preferred that the plate 83 support the cam means F above described and other details of conventional character well known to those skilled in the ordinary construction of machines of this character. The cam 62 is rigid upon a bracket 84 supported on the frame ring 83, at the front of the knitting machine, as shown in Fig. 5, and in the relation above described to elevate the splice yarn receiving needles of the series E to their fully elevated splice yarn receiving positions. The position of cams F and G is well illustrated in a developed plane in Figure 14 and the cams G in front elevation in Figure 5.

Other cam details which come into play during the oscillation of the cylinder B need not be described, as they are conventional and are illustrated in diagrammatic manner in Figure 14 of the drawings.

Details of the mechanisms K, M, and P will now be described, and the operation in a proper knitting sequence will be later given to set forth the cooperation of the elements of these various mechanisms.

The splice yarn guide arm H as is illustrated in Figures 1 and 2, and elsewhere, is preferably elongated, and at the front end thereof is inwardly curved at 85 as shown in Fig. 1, towards the knitting cylinder B, and at the free end thereof the same is provided with a downturned right angled portion 86 which is adapted to normally rest upon the top surface of the stationary cam ring 29. At its rear end the splice yarn guide arm H is adjustably received in a sleeve portion 87 of an L-shaped bracket 88, which is pivoted upon a supporting pin 89 rotatably mounted on a stationary bracket 90 as part of the frame C. The arm H at the lower end of the portion 86 is provided with a transverse opening 91, through which the splice yarn S extends in a guided relation for engaging the knitting needles as will be subsequently mentioned. The guide arm H is elevated from its normal position illustrated in Figure 2 to the position illustrated in Figure 4, in order to permit the splice yarn receiving needles of the series E to clear the splice yarn at the time after a swinging arm or member 95^a of the means M has pushed the splice yarn beneath the beards of the needles of the series E, as is illustrated in Figure 4 of the drawings. It is very necessary for the arm H to clear the splice yarn, feeding from the bobbin to the needles, to prevent entanglement when knitting what would ordinarily be the float portion of the splice.

Referring now to the means K which ele-

vates and lowers the splice yarn guide arm H, a lever 95 is pivoted at 96 upon a bracket 97 forming a part of the frame C. This lever 95 adjacent the free end thereof is provided with a laterally extending arm 98 normally spaced slightly below the guide arm H at a location between the free end of the arm H and its pivot 89, and in such position that upon elevation of the lever 95 the arm 98 will engage the arm H and elevate the same to the position illustrated in Figure 4. The means for elevating the lever 95 to perform its function is operated in synchronism with rotation of the cylinder B. To this end, upon the main shaft 100, or some other rotary shaft of the machine A having proper rotation with the cylinder B, a disc 101 is preferably placed, having diametrically opposed pins 102 and 103 thereon. A pawl supporting lever 104 is pivoted at 105 on the frame C, in any suitable location, and this lever 104 at the free end thereof is provided with a pawl 106 normally spring urged by means 107 into engagement with the teeth 108 on a ratchet wheel 109 rotatably mounted upon a pin or shaft 110 which is in turn supported by the bracket 97. Intermediate its ends the lever arm 104 is provided with an extension 111 which may have a beveled edge 112 in the nature of a cam surface over which the pins 102 and 103 may ride to oscillate the lever 104 to permit the pawl 106 to engage the various teeth 108 of the ratchet wheel 109 and rotate the latter. Rigid with the ratchet wheel 109 is a cam wheel 115 at the inner side thereof, of substantially the same diameter, and having a plurality of cam teeth 117 amounting to one half the number of teeth 108. These teeth 117 operate in a cam like manner upon an adjustable and detachable finger 119 which is carried intermediate its ends upon the lever 95 above described, as by a detachable screw 120.

In the operation of the means K it is assumed that the shaft 100 rotates at the same speed of rotation as the needle cylinder B. Assuming the yarn arm H to be lowered as illustrated in Figure 2, the needles of the series E are just starting to elevate to take the splice yarn S, which has been drawn by the means P to the outside of the line of needles of the cylinder. As the cylinder B continues to rotate the pin disc 101 will also rotate and the pin 102 rides over the edge 112 of the lever 104, elevating the lever 104 from the position illustrated in Figure 2, slightly, until the pawl 106 thereof engages beneath the uppermost tooth 108 immediately adjacent the top of the pawl 106, which pushes the ratchet wheel 109 around slightly, and just about sufficient to cause the finger 119 to ride up upon the adjacent tooth 117 of the cam wheel 115, to the position illustrated in Figure 4 of the

drawings. This operation of course elevates the lever 95 and consequently through the arm 98 elevates the yarn arm H to the position illustrated in Figure 4, and this elevates the splice yarn S to a position where the same can not be entangled by the approaching needles designated as E in Figure 4 of the drawings. In the meantime, just before the elevation of the arm H, the swinging arm 95^a has pushed the splice yarn to the inside of the line of needles E which have just been elevated, as illustrated in Figure 19 of the drawings, so that the splice yarn will catch beneath the beards of the needles in the series E. The arm H then remains elevated by reason of resting of the finger 119 on the top teeth 117, as illustrated in Figure 4, and the disc 101 continues to rotate for about 180°, according to the timing desired, until the pin 103 rides into engagement with the edge 112 of the lever 104 which has lowered in the meantime to stop 104^a, and at this time the splice receiving needles of the series E have all passed the splice yarn at the threaded location on the arm H, and due to coming of the pin 103 into engagement with the lever 104, the latter will be elevated for rotating the ratchet wheel 109 to the position illustrated in Figure 2 of the drawings, where the finger 119 is immediately in the rear of one of the teeth 117 and ready to ride upwardly thereon when the operation above described is repeated. This of course lowers arm H to the position shown in Figure 2.

Referring to the means M, as above mentioned, the same includes an arm 95^a adapted to move the splice yarn into receiving relation by the hooks or beards of the splice yarn receiving needles at the proper time. This arm 95^a may be a pivoted arm or slidable arm, just so it moves to perform the function above described in synchronism with the rotating needle cylinder B. The preferred arrangement is that of providing an arm 95^a pivoted at 130 on the upper end of a bracket arm 131. Bracket arm 131 is supported at 132 on the front top surface of the stationary cam ring 29 as shown in Figs. 1 and 2. A spring 133 is provided, engaging at one end the bracket 131 and at the opposite end the pivot arm 95^a below its pivot point 130; said spring 133 normally being under tension to urge the pivoted arm 95^a outwardly at its lower end to the outer side of the circular line of needles of the needle cylinder B, and against a stop projection 134 provided as a part of the bracket 131, although not necessarily a part thereof. The lower end of the arm 95^a is provided with a hook extension 136 inclined slightly toward the center of the needle cylinder B, and in a position just forwardly of the yarn guide arm H, where the same upon swinging inwardly to the inside of the circular line

of knitting needles may carry the splice yarn S into engagement with the outer side of the elevated needles which have just been elevated by the cam 62 to their fully elevated position, so that the beards of the needles of the series E may engage the splice yarn at the portion which is ordinarily the float portion, and as will be subsequently described in setting forth the cycle of operation.

As to the proper oscillation of the arm 95^a, an operating lever 140 is provided, pivoted on a pin 141 carried by the bracket 131 or a part adjacent thereto. This lever 140 at its lower end extends below the cam ring 29 and is provided with an intumed foot 143 which rides against the outer surface of a cam ring 144, which is more particularly detailed in Figure 13, and which is suitably mounted as by keying on the sinker ring 32 of the rotating needle cylinder. The sinker ring 32, as is well understood in the practical art rotates with the cylinder B, since the sinkers 31 intermesh with the cylinder needles. This cam 144 may be provided with cam shoulders 146 designed to swing the foot 143 outwardly and cause inward swinging of the splice yarn controlling arm 95^a due to a link connection 145 between the lever 140 at the upper end thereof and said arm 95^a, as is illustrated in Figure 2 of the drawings. Lever 140 is limited by a stop 141^a shown in Figs. 1 and 2.

Referring to the means P, it may be stated at this time that the same serves two very important and primary functions, first, to bring what would ordinarily be the float portion of the splice thread to the outside of the circular line of cylinder needles in order that this portion of the splice yarn or thread may be received on the series E of the splice knitting needles. The second important feature of the means P is to hold the splice yarn until sufficient of the splice or reinforcing thread S has been pulled off of the bobbin in an amount required to knit what would ordinarily be the float thread into the splice, and after this mount has been pulled from the bobbin the means P slowly feeds it to enable what would ordinarily be the float thread to knit into the fabric. This operation will be more thoroughly detailed hereinafter.

The means P is best illustrated in Figures 1, 3 and 9 of the drawings, and also in Figure 2. It includes a horizontal swinging arm 150, which at one end thereof is provided with a right angled and vertical shaft 151 received in a rigid relation within a sleeve portion 152 thereof, so that the lower end of the shaft 151 extends below the lower edge of the sleeve 152. This lower end of the shaft 151 is slidably mounted in the vertical passageway 154 of a vertical sleeve

155 provided as part of a detachable bracket 156 mounted on the stationary cam ring 29, as illustrated in Figure 3 of the drawings. The shaft 151 may reciprocate in the passageway 154 of the sleeve 155. At its lower end the shaft 151 extends below the sleeve 155 and is provided with a right angled arm 157 which supports a roller 158 at the free end thereof, operating upon a detachable cam ring 159 which is detachably keyed on the sinker ring 32 of the rotary cylinder B, as illustrated in Figure 15. A spiral spring 160 encircles the sleeve 155 and the portion 152 of the arm 150, at its lower end being connected to the bracket 156 and at its upper end being connected about a pin 162 which is part of the sleeve 152; the spring 160 being under a tension to normally swing the arm 150 inwardly toward the main yarn guide 30, to a position to be subsequently described.

The cam 159 rotates with the cylinder in the direction of the arrow illustrated in Figure 1, and during the normal riding of the roller 158 on the portion 165 of the cam 159 which is concentric with the rotary cylinder, the arm 150 is maintained in the position illustrated in Figures 1 and 3. As the roller 158 rides onto the gradually sloping portion 166 of the cam 159, the arm 150 is slowly fed inwardly to feed the splice thread to enable the knitting of what would ordinarily be the float portion of the splice yarn, and after the splice yarn has been knitted to the end of the series of needles E, the roller 158 rides onto the sharply inclined cam surface 168 of the cam 159 and quickly throws the arm 150 to the outside of the circular line of knitting needles, and in so doing the same engages the splice yarn to pull the same to the position illustrated in Figure 1, as will be subsequently understood more fully.

The arm 150 at the free end thereof is provided with a tabular sleeve portion 170, in which a shaft 171 is oscillatively mounted. The shaft 171 at the upper end thereof is provided with a laterally extending arm 172 rigid therewith shown in Fig. 1, and at the lower end thereof the same is provided with the right angled hook portion 175 shown in Fig. 3 which guides the splice yarn in the various operations above and to be subsequently mentioned. A spring 176 under tension engages the arm 172 at one end and is held at its opposite end by a bracket 178 attached to the arm 150, and normally swings the hook end 175 away from the arm 150, but this movement is limited by means of the arm 172 engaging a stop extension 180 rigid on arm 150 as shown in Figures 1 and 3. The arm 172 is provided with a finger projection 183, shown in Figs. 1 and 3, which engages against a vertical stop rod 184 rigid on cap 29, as the arm 150 approaches its outer movement, to turn the arm 172 slightly and swing the hook end 175

away from the line of needles. This operation of course only occurs when the arm 150 swings to its outermost position as illustrated in Figure 1 of the drawings.

To buff the action which the sharp cam surface 168 has on the swinging of the arm 150, a resilient buff pad 185 is placed on a bracket 185^b carried by the cam ring 29, which an extension 185^a on the arm 150 may engage at the outward limit of movement of the arm 150, as illustrated in Figure 1. This eliminates noise and shock upon the parts, since it must be understood that the needle cylinder rotates at a considerable speed and unnecessary shock and vibration of parts of such will have to be eliminated.

The hook end 175 of the means P must of course be elevated above the top surface of the cam ring 29 at the outward limit of swinging of the arm 150, but it is desirable that the same be lowered within the passageway of the needle cylinder B, in order to pass beneath the plate 190. Both at the inner and outer limits of movement of the arm 150 the hook end 175 is elevated, and this is attained as shown in Figs. 3 and 9, by providing a cam finger 191 on the lower end of the sleeve portion 152 of the arm 150, which operates upon inclined cam shoulders 192 and 193 of sleeve 155, to mark the inner and outer limits of amplitude of movement of the arm 150, and consequently when the finger 191 rides upon the surface 194 of the sleeve 155, the hook 175 will be lowered in the upper end of the needle cylinder, but when it rides up on the shoulders 192 and 193 the shaft 151 will slide upwardly in the sleeve 155 on the bracket 156, to elevate the hook 175.

There are times when the reinforcing thread is not used. Then the swinging splice thread control means P, and the means M are locked and retained inoperative. This locking, as above mentioned is controlled by the means R and T, which themselves are operably controlled by the pattern controlled means, as will be well understood by those skilled in the art to which this invention relates.

Referring to the means T for locking the arm 150 against swinging, and to maintain the means P inoperative, the same includes a lever 200 illustrated in Figure 3 of the drawings, pivoted at 201 on the frame C, and which at the free end thereof is connected to a vertically slidable lock rod 202, guided by bracket means 203 supported by the frame table or ring 83, so that normally when the lock rod 202 is lowered it will be out of obstructing relation with respect to the roller supporting arm 157 of the swinging arm shaft 151, as illustrated in Fig. 3, but upon certain elevation of the lever 200 the said lock rod 202 may be elevated to engage against the inner edge surface of the

arm 157, to lock the arm 157 outwardly so that it cannot swing inwardly responsive to the spring 160, as can be understood from Fig. 1. The upper end of the bracket 203 may act as a stop against which the roller 158 abuts to limit the outward swing of the roller supporting arm 157 and consequently the arm 150, as can readily be gained from Figures 1 and 3 of the drawings.

The means for operating the lever 200 consists of a special disc or member 208 connected for rotation with the pawling shaft 209 of the machine A, which as is well understood in the art is controlled by pawl and ratchet mechanisms operated in turn by links with special lugs, so that the high splice and reinforced sole can be brought into play as desired. This mechanism is of course all controlled by the pattern control device. This disc 208 is provided with a peripheral notch 210 therein, wherein a lug 211, formed intermediate the ends of the lever 200 drops during the knitting of the high splice, in order to remove the stop rod 202 from obstructing swinging movement of the arm 157. The disc 208 has a second notch 212 therein, illustrated in Figure 3 of the drawings, into which the lug 211 falls, to remove the stop rod 202 from the path of the swinging arm 157 during the knitting of the splice or reinforced sole of the stocking. During all other times the lug 211 rides on the periphery of the disc 208, such as during the oscillation of the needle cylinder when knitting the heel and toe, and during other operations, as will be readily apparent, to lock the means P.

Referring to the means R, the same, as shown in Fig. 3, includes a vertically disposed lever 215, pivoted at 216^a on the frame C, and at the upper end thereof being connected by a link 216 with the lever 76, which is pivoted at 218 on the stationary supporting bed 26, as illustrated in Figure 6. The lever 76 as above mentioned has one function in that the same controls the cam 56. It has another function in connection with the mechanism illustrated in Figures 11 and 12 of the drawings. This mechanism includes a stop shaft or rod 220, slidably supported by a bracket 221 which is mounted upon the frame ring 83. The rod 220 is vertically disposed, and the bracket 221 includes upper and lower apertured sleeves 222 and 223 thru which the said rod 220 is guided. A detachable collar 224 is placed on the shaft 220 between these sleeves 222 and 223, and a spring 225 under compression is placed between the upper apertured sleeve 222 and the collar 224, and acts to normally force the rod 220 downwardly so that the upper end thereof is below a stop extension 227 connected with the lower end of lever 140 and extending below the cam

engaging foot 143 thereof, in such position that when the rod 220 is elevated it will extend above the lower portion of the stop member 227 to hold the lever 140 out of engagement with its cam ring 144, and thus holding the arm 95^a, at its lower end, entirely within the circular line of knitting needles, and out of operating relation with the splice yarn. As is illustrated in Figure 12 of the drawings, the free end of the lever 76 is provided with an upwardly inclined cam portion 230, which under certain circumstances, when it is desired to maintain the means M inoperative, rides against the lower end of the stop pin or shaft 220 to force the same upwardly into obstructing relation with the lever 140 to maintain the latter inoperative as above mentioned, and as will be subsequently set forth.

The means for operating the lever 215 as is shown in Figs. 3 and 10 consists in the provision of a notched operating disc 235, keyed in any manner for movement with the disc 208 as by detachable screws 236. The disc 235 is provided with a notch 237 therein similar to the notch 210 of the disc 208, and likewise adapted to receive a lug 238 of the lever 215, when the lever 215 is to be maintained in position to retract the stop pin 220 and permit the cam 56 to operate on the butts 38. The lug 238 rests in its notch 237 during the knitting of the high splice. The lug or extension 238 is received within a second notch arrangement 240 of the disc 235 during knitting of the splice sole, and during the knitting of the reinforced toe, the lug 238 rides on the outer periphery of the disc 235, to swing the lever 215 outwardly and move the lever 76 to withdraw the cam 56 out of the path of the butts 38 and to elevate the stop pin 220 to hold the means M inoperative. A spring 245 under tension, is connected at one end 246 on the frame C and at the other end engages the upper end of the lever 215 to normally urge the extension 238 against disc 235.

Referring now to the cycle of operation in so far as the knitting of the splice thread S is concerned, the Figures 16 to 25 inclusive follow in sequence with the description of the operation.

In Figure 16 is illustrated the needle cylinder with the needle means of the series E elevated and about to receive the splice yarn S in a manner in which splice yarn is received upon the needles of an ordinary circular knitting machine for "regular" knitting of the splice yarn. The rotation of the needle cylinder is in the direction indicated by the arrow in Figure 16, and while the lower hook end 136 of the arm 95^a is shown as engaging the splice yarn S and holding it at the inside of the circular line of needles, yet in this position of parts the hook end of the arm 95^a plays no important

function, since the splice yarn would just as well be received on the needles E for "regular" knitting of the splice yarn, where the arm 95^a not present. This is so because the guide arm H is lowered and enables the foremost advancing elevated needle to pull the yarn S off the hook 136 to the outside of the needles of series E. It is in a future operation that the hook end of the arm 95^a plays an important part, as will be subsequently described. As the cylinder rotates to the position illustrated in Figure 17, about a half a revolution of the cylinder B, in the parts shown, the splice thread S has wrapped about all of the needles of the series E, as in regular splice thread knitting, and is being knit in at the point 47, as can readily be understood. Splice yarn S at the location 250 illustrated in Figure 17 is engaged about the last of the needles of the series E, and the part of the splice thread shown in Figure 17 from the point 250 toward the apertured eye at the free end of the guide arm H is the part that would ordinarily be the float thread in conventional knitting. It is to be noted that from the position illustrated in Figure 16 to the position illustrated in Figure 17 the needles E have all passed the splice yarn guide end of the arm H and the splice yarn has of course passed off of the hook end of the arm 95^a due to the fact that the arm H remains lowered and the splice yarn catching on the first needle of the series E pulls the same off of the hook end of the arm 95^a. During this movement of parts, the inclined portion 166 of the cam 159 receives the roller 158 of the means P, to slowly swing the arm 150 inwardly over the needle cylinder, and this moves the lower hook end of the means P across the top of the cylinder B, to the location illustrated in Figure 17, and before the splice thread has passed under the hook end 175, the cam finger 191 illustrated in Figure 9 rides up on the shoulder 192, to elevate the hook end 175 beneath the cutter plate 190, and this movement enables the thread to pass efficiently beneath hook 175. Immediately after the splice yarn has passed under the hook end 175, after a slight advance of the rotation from a position illustrated in Figure 17, the sharply inclined surface 168 of the cam 159 rides against the roller 158 and quickly swings the arm 150 back to its normal position, and the hook end 175 grasps the splice yarn S during this movement, as illustrated in Figure 18, and swings the same to the outside of the circular line of knitting needles, to the position illustrated in Figure 19. At this time, the last of the "regular" knit in the splice has been effected, and the threads shown in Figure 18 is what would ordinarily be the float thread of the splice yarn, which is brought to the outside of the

circular line of knitting needles by the hook end 175 of the swinging arm 150 to the position illustrated in Figure 19. After the hook 175 has swung the splice yarn S to this position, the first of the needles of the series E commence to rise by reason of operation on the cam means G above described. Before the first of these needles of the series E reaches the splice yarn guide end of the arm H, the foot end 143 of the lever 140 is engaged by the cam 144, at the throw portion 146 thereof, to swing the upper end of the lever 140 inwardly and incidental to the link connection 145 this swings the arm 95^a at its lower hook end 136 against the splice yarn S between the connection in the aperture 91 on the arm H and the first elevated needle of the series E, so that the splice yarn is pushed inwardly to engage beneath the beards of the elevated needles of the series E. At this time the guide arm H is lowered as illustrated in Figure 19, and in the position illustrated in Figure 2 in side elevation. But at this interval, however, and before the first elevated needle of the series E can reach the portion 255 of the splice yarn as illustrated in Figure 19, the means K operate to throw the lever 95 upwardly, as above described, which elevates the guide arm H at its free end, and throws the splice yarn upwardly, in so far as the portion 255 is concerned, so that it will clear the advancing needles of the series E. The arm 95^a has now performed its function, since it has brought what would ordinarily be the "float portion" of the splice yarn about the outsides of the line of needles E, and upon continued rotation to the position illustrated in Figure 20 the yarn S rides off of the lower hook end of the swinging arm 95^a. During all of this time, however, the hook end 175 of the means P keeps hold of the splice yarn, and is pulling the splice yarn from the bobbin as the splice yarn is carried on the needles E away from the hook end 175. The object in pulling the splice yarn off of the bobbin at this time, is to insure that a sufficient amount of the splice yarn will be provided to enable knitting in the splice of the stocking, of that portion of the yarn which would ordinarily be the "float portion", since during the knitting of this portion the bobbin is at the wrong end of the thread about to knit in, that is, the thread from the bobbin has its line extending direct to the first needle of the series E where the knitting first takes place, whereas when knitting "regular" in the splice the splice thread from the bobbin extends to a point about a needle of the series E to the rear of the knitting point. Thus, the means P at this time pulls sufficient of the thread from the bobbin to enable the knit in of the splice thread and prevent the formation of a "float",

In order to guide the splice thread S from engaging the yarn sinkers 31, at the ends 33 which extend to the inside of the circular line of needles, a guide bracket 258 is provided, having an arcuate lower portion 259 on which the splice thread rides; the said arm 259 being at a location immediately above the inwardly extending ends of the yarn supporters 31, as illustrated in Figure 19. Also, to prevent the splice yarn at this point from catching on the beard depressors 28, a guide plate 260 is provided, over which the splice yarn rides as illustrated in Figures 19 and 20.

From the position of parts from Figures 20 to 21, that portion of the splice yarn which would ordinarily be the "float" portion has been placed about the outer sides of the series of needles E, and the last of the series E has elevated and is designated at 261 in Figure 21. The cylinder B is still rotating and the hook end 175 still holds the splice yarn to pull the same from the bobbin. Immediately at the time that the first of the needles of the series E lowers to knit in at the point 47, the cam surface 166 rides against the roller 158 and permits the arm 150 to slowly feed the hook end 175 inwardly across the top of the cylinder B, as is illustrated in Figure 22, and this enables what would ordinarily be the "float" portion to knit into the splice.

While the cylinder is rotating from the position illustrated in Figure 20 to position in Figure 22 the splice yarn is guided into proper relation beneath the thread cutting plate 190 by means of a special guide arm construction 270, best illustrated in Figure 21, which has an arm portion at the lower end inside of the line of needles to properly guide the splice thread, as is quite apparent from this view.

From the position illustrated in Figure 22 to the position illustrated in Figure 23 the arm 95^a has swung to the outside of the circular line of knitting needles, out of obstructing relation with respect to the splice yarn. As is illustrated in Figure 23, a lug 275 is placed beneath the cutter plate 190, to depress the splice yarn S along its length from the splice point 277 illustrated in Figure 23 to the guide aperture 91 in the arm H; and this depression is effected in order to lower this length of splice yarn below the inwardly swinging hook end 175. It is to be noted that all of the time the hook 175 is swinging inwardly over the needle cylinder, and due to the fact that the length between the points 91 and 277, as illustrated in Figure 23, rides beneath the hook 175, and since the hook 175 has disposed thereover the thread portion which is to be knit into the splice, the splice thread between the points 91 and 277 will catch this portion which is looped over the hook 175, as the

hook 175 swings inwardly to its inner position, to hold the portion of the splice yarn designated by number 279 in Figure 24 of the drawings in a taut relation so that it will not become caught in the yarn supporters and depressors. All of this portion 279 of the yarn is of course knit into the splice during the finish of the knitting of what would ordinarily be the "float" thread. The portion 280 of the splice yarn S as illustrated in Figure 24 is the portion which is used to knit "regular" in the splice, and immediately after the needle cylinder has rotated to such point that the portion 279 of the splice thread has been drawn off of the hook end 175 to complete the knit of what would ordinarily be the "float" portion, the portion 280 will then not hang loose in the cylinder, but as soon as the portion 279 is released a spring 290 under tension will spring upwardly to draw the portion 280 taut across the top of the needle cylinder. The spring arm 290 is connected at 291 on the cam ring 29, and it is convoluted at 292 in spring manner, and its free end is provided with an eye 293 through which the splice yarn is threaded at a location between the aperture 91 in the guide arm H and a guide eye 294 which is likewise supported on the cam ring 29. The needle cylinder B then rotates to the position illustrated in Figure 16 of the drawings, and the cycle of operation again takes place, as above described.

It is apparent from the foregoing description of this invention that the mechanism will knit the splice, reinforcing, or secondary thread into the stocking or other garment, for a part of the circumference of the garment, without the attendant float or free portions; resulting in the saving of considerable yarn; and simplifying the number of operations necessary to complete the article. To my knowledge this has never before been done in connection with knitting machines of this character.

It is to be noted that at the end of the inner swing of the arm 150 the cam finger 191 rides on the shoulder 192 to elevate the hook end 175. This enables the splice thread S as illustrated in Figure 17 to ride beneath the hook 175, and immediately after which the arm 150 is swung outwardly and hook end 175 is lowered to catch the splice yarn in the position illustrated in Figure 18.

Various changes in the shape, size, and arrangement of parts may be made to the form of invention herein shown and described, without departing from the spirit of this invention or the scope of the claims.

I claim:

1. In a knitting machine, a rotary needle cylinder, needles carried thereby for receiving a body yarn and including a set of needles for receiving a splice yarn, means

for directing a body yarn to the needles of the cylinder, means for supporting a splice yarn, means for operably dividing the splice yarn receiving needles from the remainder of the needles, and means cooperating with said last mentioned means for guiding and controlling the splice yarn with respect to said splice yarn needles to entirely knit said splice yarn in a continuous knitted relation with the body yarn along a splice section which extends about part only of the circumference of the article being knit, and without float portions, during full rotary knitting action on the article while the cylinder is rotating.

2. In a knitting machine the combination of rotary knitting means to conventionally knit a portion of an article from a main yarn extending throughout the full circumference of the article, and means to cooperate with the last mentioned means during full rotary knitting to knit a complete continuous splice yarn together with the main yarn about a portion only of the circumference of the article without the formation of the ordinary splice yarn float portion.

3. In a stocking knitting machine the combination of a rotary knitting machine including means to conventionally knit a tubular stocking from a main yarn, and means to operate with the last mentioned means during full rotary knitting to knit a splice yarn into the stocking together with the main yarn for a portion of the circumference of the stocking with the splice yarn being continuous along the splice section without the attendant formation of ordinary splice yarn float portions.

4. In a circular knitting machine the combination of a needle cylinder, needles on the cylinder, means for feeding main and splice threads to the needles, cam means for operating the needles to knit with the main thread, a second cam means to operate a selected number of said needles to engage and knit the splice thread together with the main thread, and means for guiding and regulating what is ordinarily the float portion of the splice thread, with respect to said selected number of needles operated by the second cam means, and during full rotary knitting to entirely knit the splice thread continuous with the main thread along the splice section.

5. In a circular stocking knitting machine having a main yarn feed, and means for reinforcing an area less than the full circumference of the stocking including means which during full rotary knitting will knit a continuous reinforcing yarn together with the main yarn from course to course along a stocking without floated portions.

6. In a circular knitting machine a needle cylinder, two sets of needles for said cylin-

der, means for feeding a main yarn to both of said sets of needles, splice yarn supporting means, cam means for the needles of both sets of needles to knit the main yarn, 5 cam means to operate on the needles of one set of needles to receive the splice yarn thereabout and means to take, guide, and direct during full cylinder rotation what would ordinarily be the float portion of the splice 10 yarn immediately after knitting of the splice yarn, into knitting relation on the splice yarn needles on their next operation by the second cam means whereby to knit a continuous splice yarn together with the main yarn 15 without waste and floated portions.

7. In a circular knitting machine, a rotary needle supporting cylinder, two sets of needles supported by said cylinder, means for supporting a main yarn, means to operate 20 the needles so that all of the needles of both sets will take the main yarn for knitting a tubular article, means for supporting a splice yarn, cam means for operating on one of said sets of needles to elevate the same prior 25 to the knitting point on the cylinder, and means actuating during full rotary knitting of the article for taking the splice yarn at alternate times at the end of the knitting thereof together with the main yarn into 30 the splice and bringing it into receiving relation with the last mentioned set of needles to operatively engage thereon prior to the knitting point whereby a continuous splice yarn is knit together with the main 35 yarn without float portions.

8. In a circular knitting machine, a rotary needle supporting cylinder, two sets of needles supported by said cylinder, means for supporting a main yarn, means to operate 40 ate the needles so that all of the needles of both sets will take the same yarn for knitting a tubular article, means for supporting a splice yarn, cam means for operating on one of said sets of needles to elevate the 45 same prior to the knitting point on the cylinder, means actuating during full rotation of the cylinder for taking the splice yarn at alternate times at the end of the knitting thereof together with the main yarn into the 50 splice and bringing it into receiving relation with the last mentioned set of needles to operatively engage thereon prior to the knitting point, and means for operating on the splice thread when the same is in the position 55 indicated in the last mentioned means and during rotation of the cylinder prior to the knitting point for taking a supply of splice thread from the bobbin to enable the knitting into the splice together with the 60 main yarn of what would ordinarily be the float portion of the splice yarn, whereby a continuous splice yarn is knit together with the main yarn without float portions along the splice.

9. In a circular knitting machine the com-

bination of a rotating needle cylinder, a plurality of needles arranged in circular arrangement on the needle cylinder, means to continuously knit a body yarn into a garment on the cylinder, cam means operating 70 on a portion of the needles to elevate the same at a predetermined location in the rotation of the cylinder, means for guiding a splice yarn into receiving relation by said portion of needles above mentioned to knit 75 into the main yarn for a portion of the circumference of the garment, means for taking the trailing splice yarn at the end of the knitting thereof into the splice of the garment and what would ordinarily be the 80 float portion and bringing it to the outside of the circular line of needles on the needle cylinder, means for moving the splice yarn from said position about the first of the needles of said portion of needles above mentioned to enable the splice yarn in this relation 85 to be received in position for knitting on said needles, and means to operate on the splice yarn in the last described position to pull a supply thereof from the bobbin to enable the same to knit into the splice on the 90 next knitting operation.

10. In a circular knitting machine the combination of a rotary needle cylinder, a plurality of sets of needles arranged in circular relation on said needle cylinder, one 95 of said sets of needles being the splice thread receiving needles, means to elevate the splice thread receiving needles at a predetermined location during each revolution of the needle 100 cylinder, means to operate on all of the needles on the needle cylinder to knit, means to supply a body yarn to the needles, means to guide a splice yarn for knitting into the splice in regular manner, a movable arm, 105 means synchronized with the needle cylinder and operating upon the arm to swing the same across the top of the needle cylinder during cylinder rotation for bringing the trailing splice yarn after each regular knit 110 into the splice of the garment to the outside of the circular line of needles so as to extend said splice yarn from said arm to the splice yarn guide means above mentioned, a second arm, means operably synchronized with the 115 needle cylinder to move the second arm against the splice thread and upon the advancing elevated needles of the splice yarn receiving needles as they move toward the knitting point on the needle cylinder, means 120 for operating on the first mentioned arm to hold the splice yarn as the splice yarn receiving needles move to the knitting point in order to take a supply of splice yarn from the bobbin to permit the knit of what would 125 ordinarily be the float portion of the yarn in the splice of the garment, means for slowly feeding said supply of splice yarn to permit such knitting, and means for guiding and directing the splice yarn during the knitting 130

thereof into the splice to prevent catching thereof in the needles and other parts of the rotating needle cylinder.

11. In a circular knitting machine the
5 combination of a needle cylinder, means for feeding a main yarn to the needle cylinder, a plurality of sets of needles on the needle cylinder including a splice yarn receiving set of needles, means for operating on all
10 of the needles to knit the main yarn into a tubular garment, a guide for receiving a splice yarn, means for operating on the splice yarn receiving needles to regularly knit the splice yarn into a splice portion of the garment, an arm, means for moving said arm
15 to take the free splice yarn after it has been regularly knitted into the garment and draw what would ordinarily be the float portion of the said splice yarn to the outside of the circular line of needles on the cylinder during rotation of the cylinder, pattern controlled means for operating at intervals on the last mentioned means to maintain the same inoperative to perform the function
20 last mentioned, a member, means operated on the member for feeding the splice yarn into position about the splice yarn receiving needles after the arm above mentioned has drawn the splice yarn to the position outside of the circular line of needles, means to maintain the last mentioned means inoperative during certain knitting operations on the garment, and means for guiding and directing the splice yarn in proper relation
25 with respect to the needle cylinder, needles, and other operating parts to prevent catching of the splice yarn thereon during the operation above mentioned.

12. In a circular knitting machine the
40 combination of a rotary needle cylinder, needles supported in circular line upon said needle cylinder including splice needles, means for feeding a main yarn to the cylinder needles, means for guiding a splice yarn to said splice needles, means for moving the splice yarn from within the area of the circular line of needles to the outside of said circular line of needles after a splice knitting operation, and means operably associated with the cylinder while rotating
45 to move the splice yarn from its last mentioned position into operating engagement against the splice needles of the cylinder to enable the knitting into the main yarn of what would ordinarily be the float portion of the splice yarn.

13. The method of circular knitting which consists of knitting a seamless tubular article during full rotary knitting from
60 a main yarn, and while knitting the main yarn also knitting a continuous splice yarn in its entirety with a portion of the knitting main yarn for a part of the circumference of the article in a splice a plurality of wales in width without any float portions.

14. In a circular knitting machine a rotary cylinder including a circular line of needles, means for feeding a main yarn in operating relation with the needles to form a seamless knit tubular article, and means for
70 knitting a splice yarn, during the full rotary knitting of the knitting yarn in a zig-zag knitted relation with the main yarn for a portion of the circumference of the article, entirely into the main yarn without float
75 portions.

15. The method of knitting seamless tubular articles which consists in knitting a body yarn into a seamless tubular article, and while knitting the same also knitting there-
80 with a splice yarn in its entirety in a zig-zag relation for a portion of the circumference of the tubular article in a splice a plurality of wales in width without float portions.

16. In a circular knitting machine the combination of a rotating cylinder having a circular line of needles therein including a series of splice needles arranged about a part of said circle, means to feed a main yarn to
90 said needles for knitting a tubular seamless article, means to actuate the splice yarn needles during full rotation of the cylinder to take a splice yarn and regularly knit the same in with the main yarn, and means for
95 taking the normal float portion of the splice yarn after regular knitting of the splice yarn in the splice and bringing the said float portion of the splice yarn exteriorly of the splice needles for operative knitting engagement
100 thereby.

17. In a circular knitting machine a rotary cylinder having a circular arrangement of knitting needles including an arcuate row of splice needles, means for feeding a main
105 yarn to said knitting needles, cam means to operate on the knitting needles to knit, a guide for receiving a splice yarn, cam means for elevating the splice needles to position them for taking the splice yarn, a splice yarn
110 controlling member, means to actuate said member during full cylinder rotation to take the splice yarn between its connection on the splice needles and the guide after a regular splice knitting operation, and move what
115 would ordinarily be the float portion of the splice yarn in conventional knitting, to the outer sides of the splice needles, and means to force the splice yarn, after the splice needle cam means has elevated the splice
120 needles, into operative knitting engagement upon the splice needles, so that what would ordinarily be the float portion of the splice yarn will be knitted together with the main
125 yarn into the splice.

18. In a circular knitting machine a rotary cylinder having a circular arrangement of knitting needles including an arcuate row of splice needles, means for feeding a main yarn to said knitting needles, cam means to oper-
130

ate on the knitting needles to knit, a guide for receiving a splice yarn, cam means for elevating the splice needles to position them for taking splice yarn, a splice yarn controlling member, means to actuate said member during full cylinder rotation to take the splice yarn between its connection on the splice needles and the guide after a regular splice knitting operation, and move what would ordinarily be the float portion of the splice yarn in conventional knitting, to the outer sides of the splice needles, means to force the splice yarn, after the splice needle cam means has elevated the splice needles, into operative knitting engagement upon the splice needles so that what would ordinarily be the float portion will be knitted together with the main yarn into the splice section, and pattern control operated means to hold said member and said last mentioned means inoperative in predetermined knitting operations.

19. In a circular knitting machine a rotary cylinder having a circular arrangement of knitting needles including an arcuate row of splice knitting needles, means for feeding a main yarn to said knitting needles, cam means to operate on the knitting needles to knit, a guide for receiving a splice yarn, cam means for elevating the splice needles to position them for taking a splice yarn, a splice yarn controlling member, means to actuate said member during full cylinder rotation to take the splice yarn between its connection on the splice needles and the

guide and after a regular splice knitting operation to move what would ordinarily be the float portion of the splice yarn to the outer sides of the splice needles prior to operation of the splice needles by the splice needle cam means above mentioned, and means to force the splice yarn at what would ordinarily be the float portion, after the splice needle cam means has elevated the splice needles, between the guide and the most forwardly advanced splice needle, into operative knitting engagement upon the latter and succeeding splice needles, so that a continuous splice yarn will be knitted together with the main yarn into the splice section.

20. The method of mechanical knitting an extra yarn in seamless tubular fabric which consists in knitting main yarn in succeeding seamless circumferential interknitted courses, and introducing with the main yarn during full rotary knitting an extra yarn interknitted with said courses of the main yarn along a plurality of wales of the courses as they are formed for part of the circumference only of the courses, with the extra yarn extending from the wales of a course unbroken into interknitted relation with the wales of adjacent courses of main yarn as they are knitted, and with the extra yarn extending about part only of the circumference of the courses without the formation of float portions of the extra yarn.

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