(No Model.) 4 Sheets—Sheet 1.

S. HENSHALL.

KNITTING MACHINE.

No. 386,821. Patented July 31, 1888.

FIG. 1.

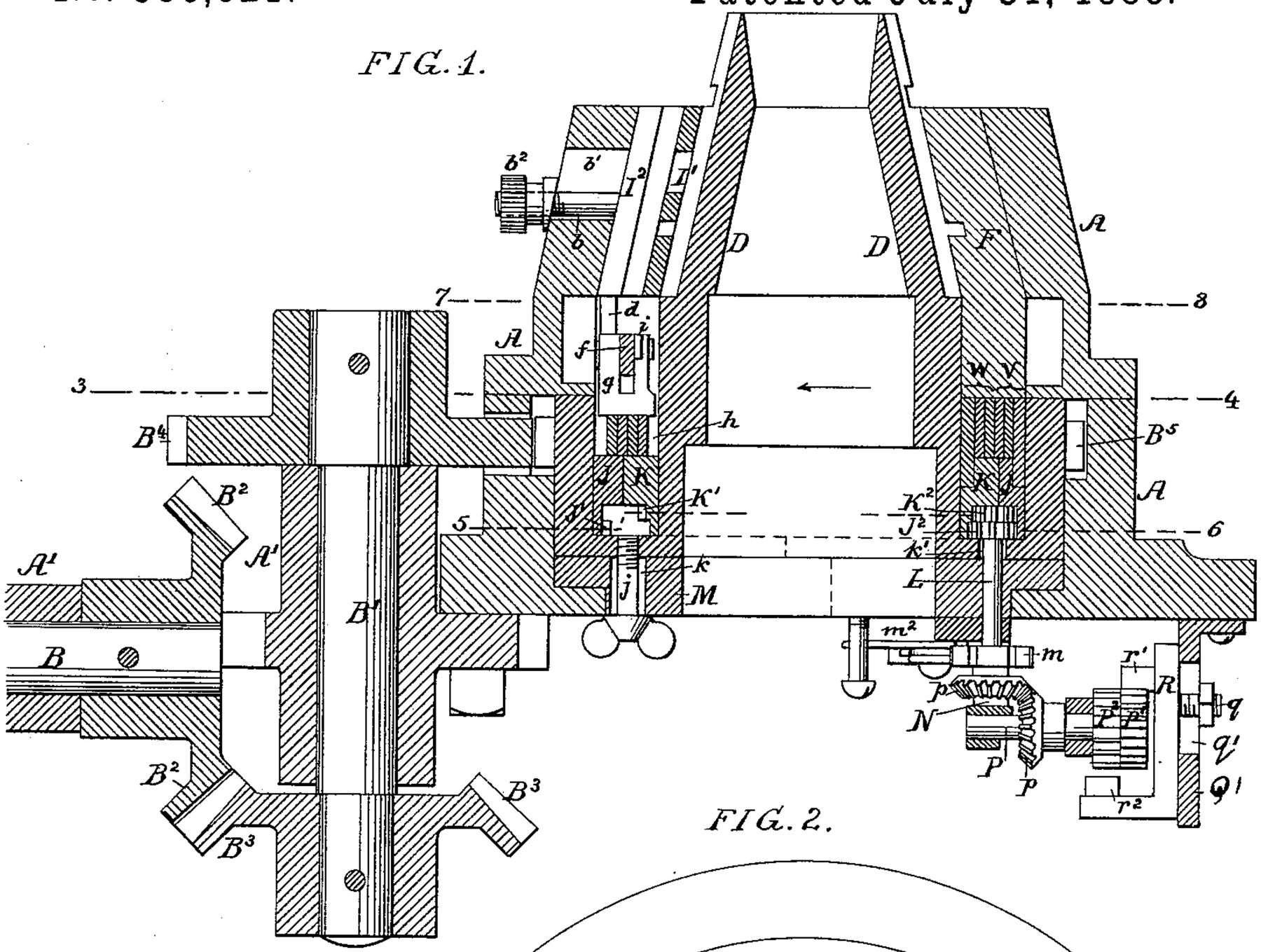
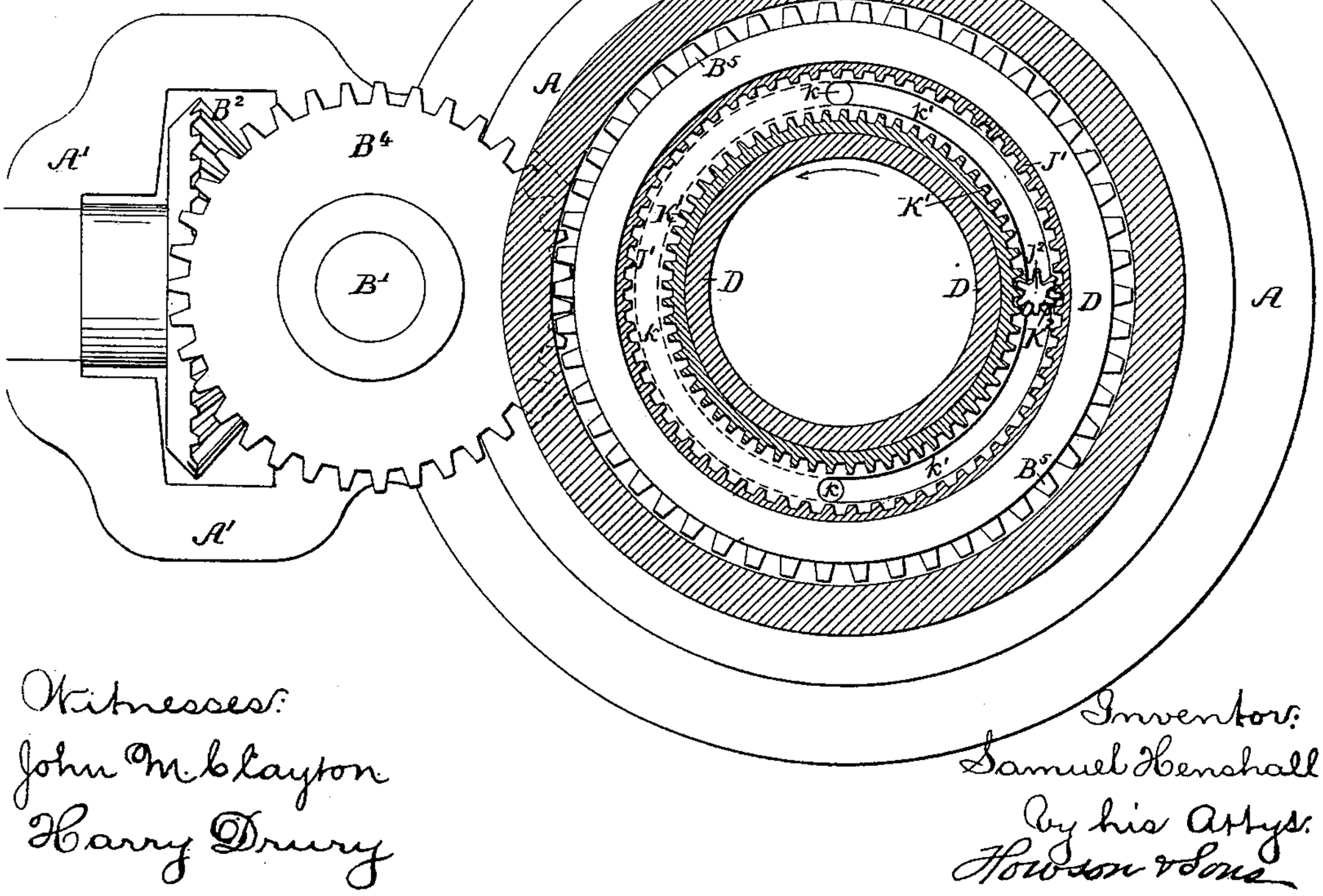


FIG. 2.



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By his Attys.
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KNITTING MACHINE.

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FIG. 3.

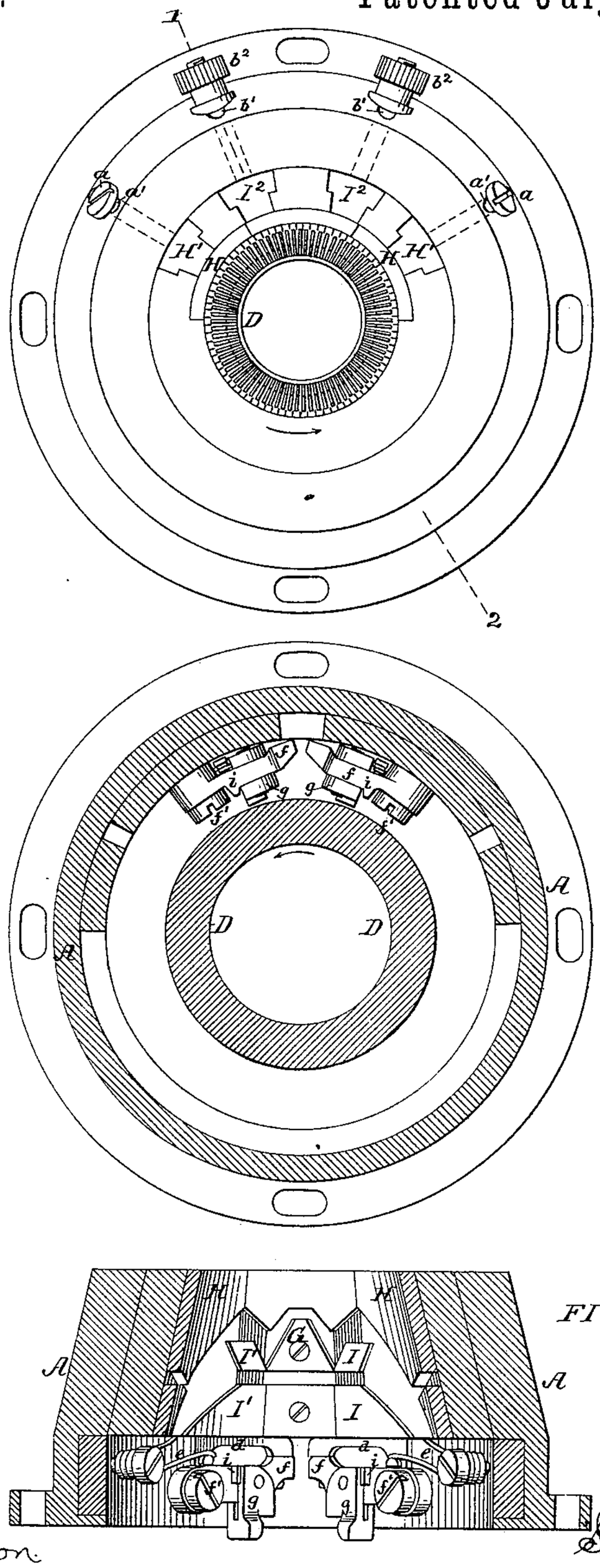

FIG. 12

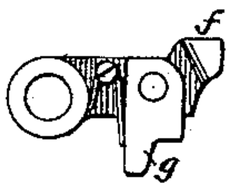

FIG. 13.

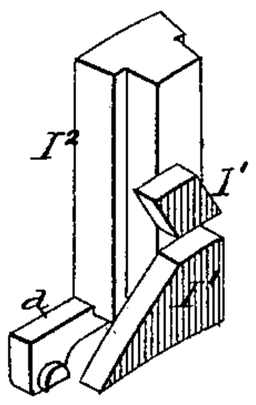

FIG. 4

FIG. 5.

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FIG. 6.

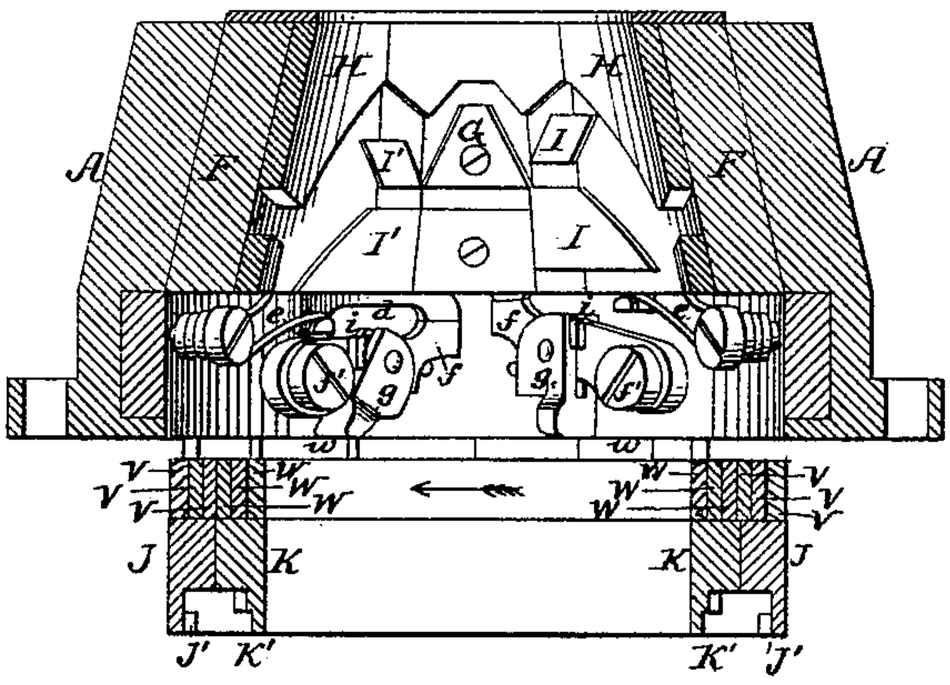

FIG. 15.

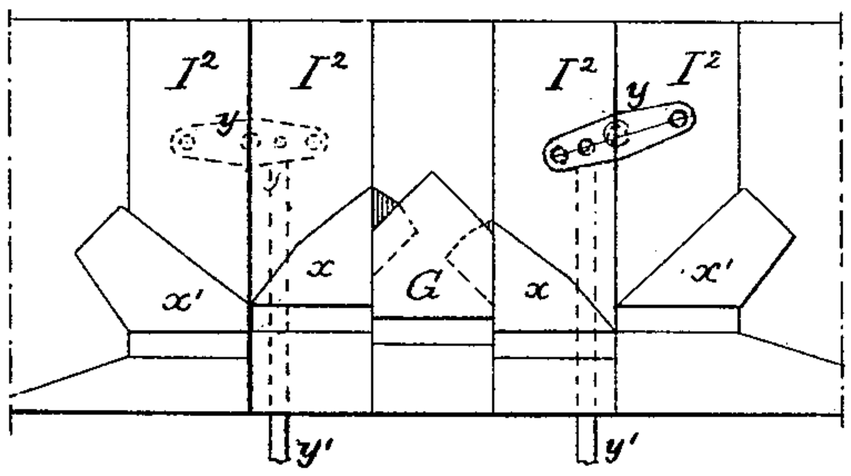

FIG. 16.

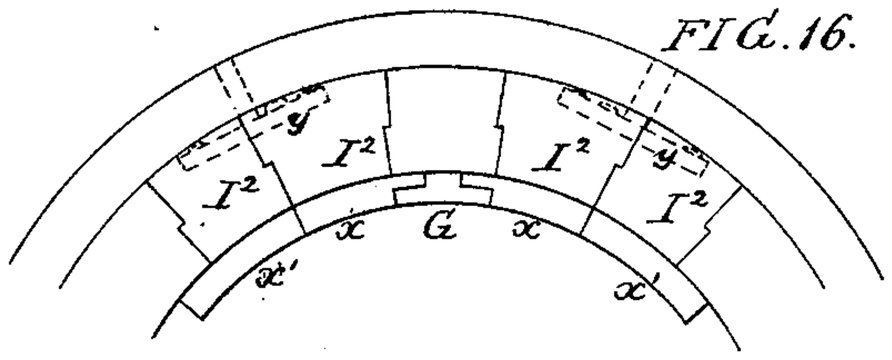

FIG. 17.

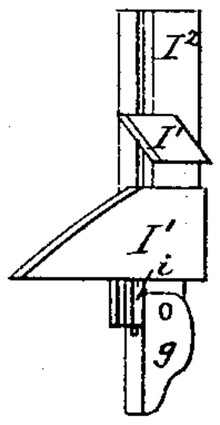

FIG. 19.

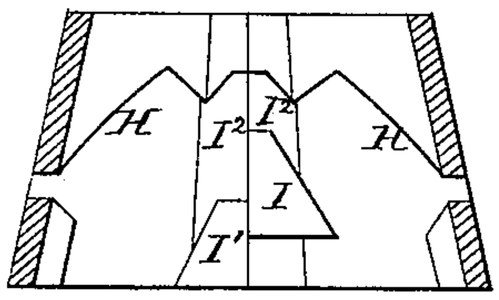

FIG. 18.

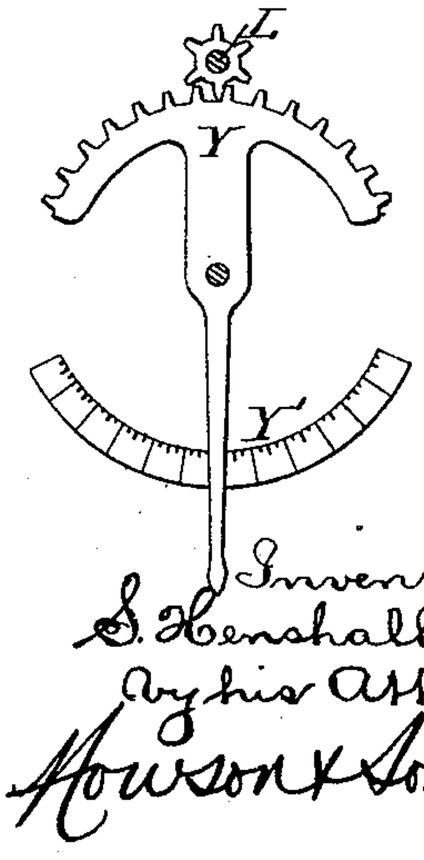

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FIG. 7.

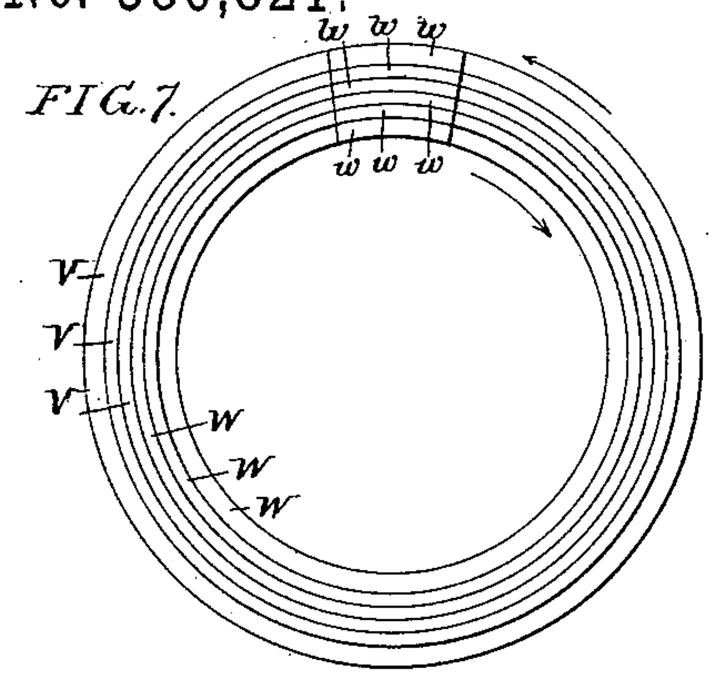


FIG. 8.

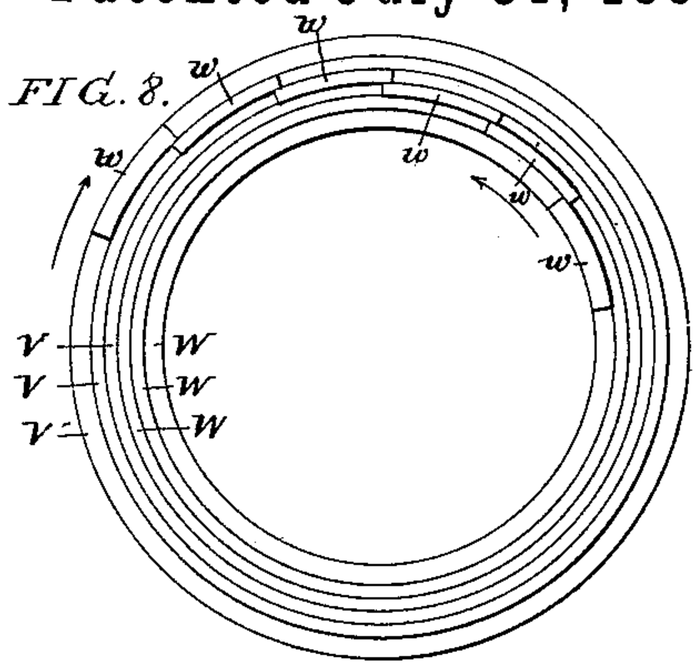


FIG. 9.

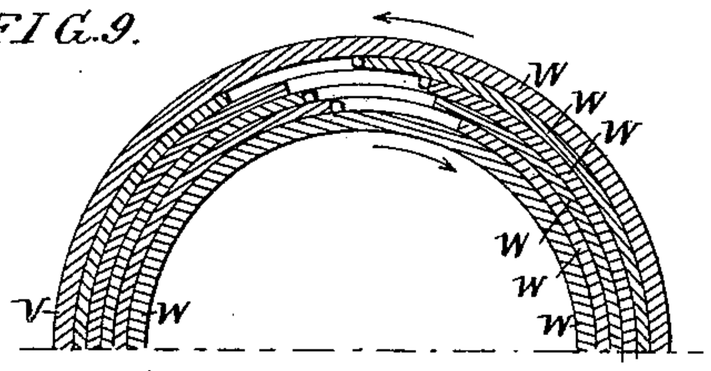


FIG. 10.

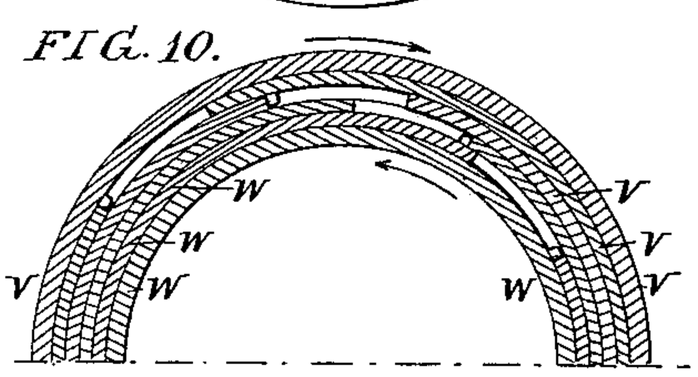


FIG. 13a

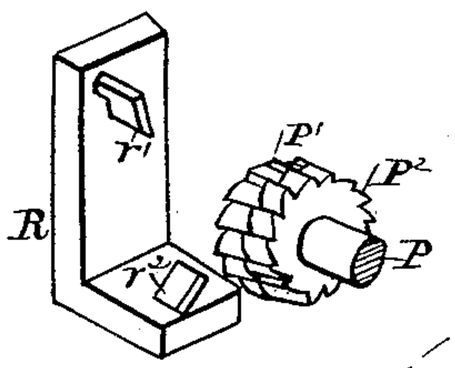


FIG. 14.

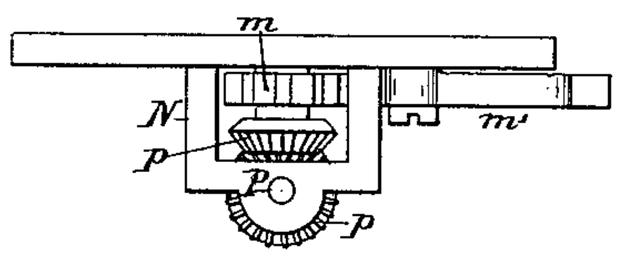


FIG. 13b

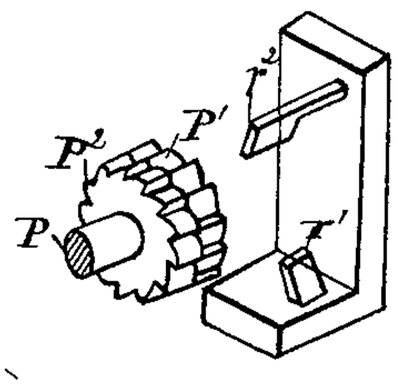
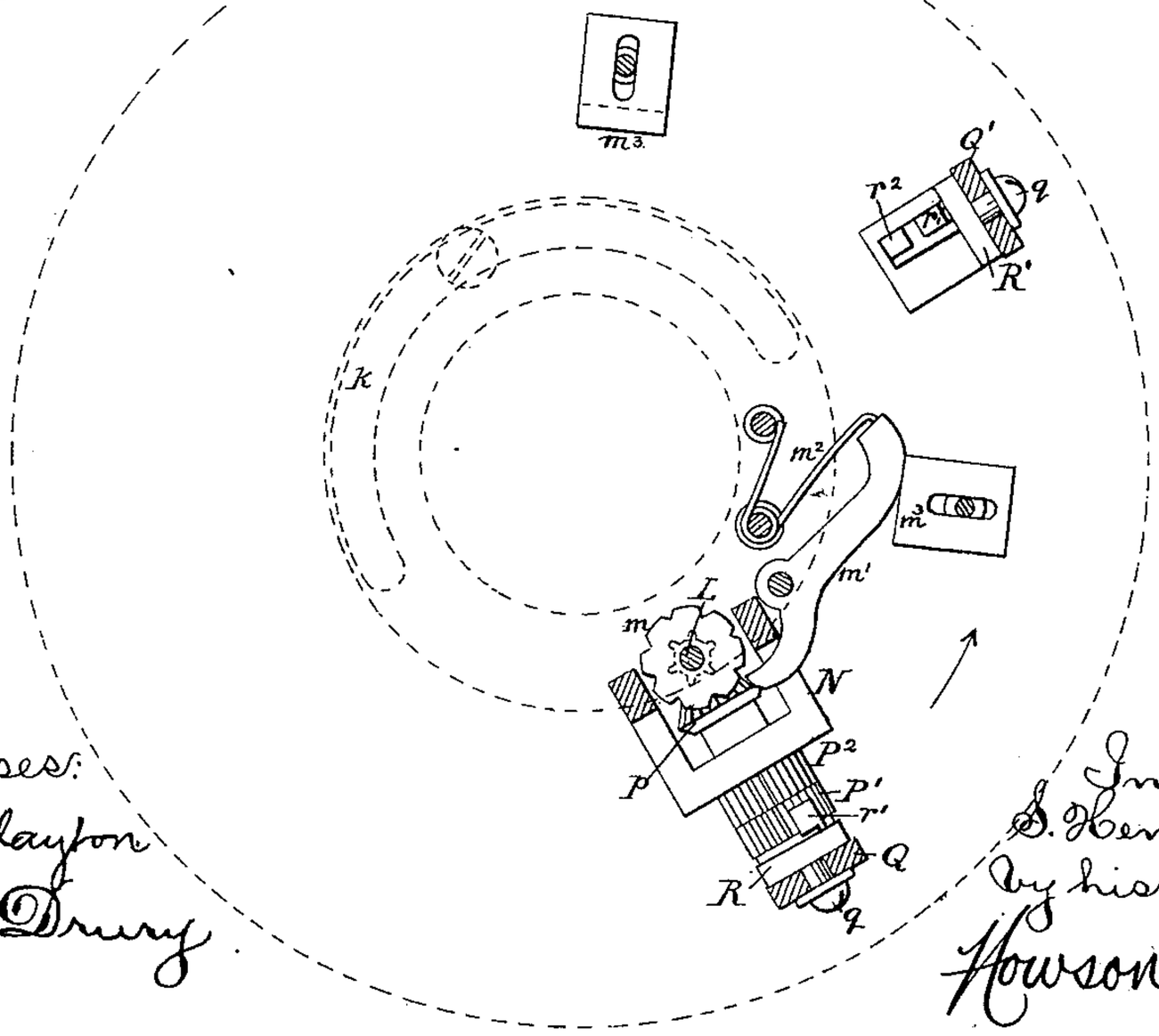


FIG. 11



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UNITED STATES PATENT OFFICE.

SAMUEL HENSHALL, OF PHILADELPHIA, PENNSYLVANIA.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 386,821, dated July 31, 1888.

Application filed October 7, 1884. Renewed March 12, 1886. Again renewed November 29, 1886. Again renewed October 25, 1887. Serial No. 253,334. (No model.)

To all whom it may concern:

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

My invention consists of certain combinations of mechanism, fully described and claimed hereinafter, for operating the cams of a knitting-machine in such a manner that the work on the needles can be narrowed or widened to any desired extent without disturbing any of the needles, the operation of widening and narrowing being, if desired, performed automatically.

In the accompanying drawings, Figure 1, Sheet 1, is a longitudinal section of a circular-knitting machine with my improvements, the section being on the line 1 2, Fig. 3, but showing driving-gearing, bed-plate, and devices beneath the latter not shown in said figure; Fig. 2, a sectional plan view, partly on the line 3 4 and partly on the line 5 6, Fig. 1; Fig. 3, Sheet 2, a plan view of the needle-cylinder and outer casing; Fig. 4, a sectional plan on the line 7 8, Fig. 1, the parts being in the position shown in Fig. 3, and nothing below the line 3 4, Fig. 1, being shown; Fig. 5, a longitudinal section of the outer casing and cam-cylinder, the cams and the means for operating the same being shown in elevation; Fig. 6, Sheet 3, a similar view with one of the cams in a different position, and showing means whereby the cam is held in this position. Figs. 7 to 14, inclusive, Sheets 2 and 4, detached views of parts of the machine, and Figs. 15 to 19, Sheet 3, views illustrating modifications of parts of the machine.

A is the fixed frame or casing of the machine, to which is bolted an arm, A′, having bearings for the driving-shaft B and a vertical shaft, B′, the latter being driven from the shaft B by means of bevel-wheels B^2 B^3, and carrying at its upper end a spur-wheel, B^4, which engages with a spur-wheel, B^5, formed on or secured to the needle-cylinder D, which is supported in the casing A, so as to be free to turn therein.

Within the casing A, and surrounding the needle-cylinder, as usual, is the cam-cylinder F, within which, in the present instance, are five cams, G, H, H, I, and I′. The cam G is permanently secured to the cylinder F, as its function is to elevate the needles, which must always be raised to the same height. The cams H H are depressing-cams, and are carried by blocks H′ H′, guided in the cylinder F, and provided with bolts *a*, adapted to slots *a′* in the casing A, so that the cams H can be adjusted vertically to regulate the descent of the needles and vary the length of loop drawn thereby, as usual.

The cams I I′ are carried by blocks I^2 I^2, also guided in the cylinder F, and each of these blocks is provided with a bolt, *b*, adapted to a slot, *b′*, in the casing A, and provided with a thumb-nut, b^2, by which the block and the cam carried thereby can be secured in position on the cylinder when desired. (See Fig. 1.)

Each of the cams I I′ has at the lower end a projection, *d*, one end of which is acted upon by a spring, *e*, the other end of the projection resting on an arm, *f*, pivoted by a bolt, *f′*, to the casing A. To each arm *f* is pivoted a pawl, *g*, which is free to swing in one direction, as shown in Fig. 6, but cannot move in the opposite direction, owing to the bearing of the upper end of the pawl against a lug, *i*, on the arm.

The lower portion of the needle cylinder D has formed therein an annular recess, *h*, for the reception of two rings, J and K, which fit so snugly in the cylinder that they will be carried round by the same as it rotates, and each of the rings has a rack formed upon it, the internal rack, J′, of the outer ring, J, gearing into a pinion, J^2, and the external rack, K′, of the inner ring, K, into a pinion, K^2, so that by turning the pinions a movement of the rings independent of the needle-cylinder can be effected, the movement of the rings being in opposite directions, owing to the fact that one has an internal and the other an external rack.

Both of the pinions J^2 and K^2 are carried by a shaft, L, adapted to bearings in a ring, M, a flange on which is fitted to the lower portion of the recess in the casing A beneath the needle-cylinder. The ring M is secured to the needle-cylinder by a thumb-screw, *j*, passing through

a slot, *k*, in the ring, so that the needle-cylinder can be adjusted in respect to the ring to an extent limited by the length of this slot and of a slot, *k'*, formed in the flange of said cylinder for the reception of the shaft L. The extent of the slots *k* and *k'* should be a little more than one-half of the circumference of the ring and cylinder, as shown in Fig. 2 and by dotted lines in Figs. 1 and 11.

Secured to the under side of the ring M is a frame, N, in which are bearings for a shaft, P, connected by bevel-wheels *p p* to the shaft L, the outer end of said shaft P carrying two ratchet-wheels, P' P², one right-handed and the other left-handed, as shown in Figs. 13ª and 13ᵇ.

On the under side of the casing A are two projecting bars, Q Q', each having a slot, *q'*. To the slot of the bar Q is adapted the threaded stem *q* of a slide, R, which carries a right-handed pawl, *r'*, and a left-handed pawl, *r²*, so arranged that when the slide R is depressed the pawl *r'* will engage with the top of the ratchet P', the pawl *r²* being free from engagement with the bottom of the ratchet P²; but when the slide is elevated the pawl *r²* will be brought into engagement with the ratchet P² and the pawl *r'* will be out of engagement with the ratchet P'. There is also on the under side of the casing A another bar, Q', similar to the bar Q and occupying the relation thereto shown in Fig. 11, said bar Q' having a slot, *q'*, for the reception of the stem *q* of a slide, R', which carries the pawls *r'* and *r²*, similar to those of the slide R, the pawl *r'*, however, acting on the bottom of the ratchet-wheel P' when the slide is raised and the pawl *r²* acting on the top of the ratchet-wheel P² when the slide is depressed. The pawls, it should be understood, are elastic, so that they will act on their respective ratchet-wheels only when moving forward, and will yield so as to have no effect on said wheels when moving backward.

To prevent the accidental movement of the shaft L, the latter is furnished with a notched disk, *m*, and a detent, *m'*, is hung to the ring M, so that it will engage with the said notched disk, a spring, *m²*, tending to keep it in engagement therewith. As the needle-cylinder rotates in either direction, however, the detent is struck by cams *m³* on the under side of the casing A, so as to release the disk *m* from the control of said detent just before the shafts L and P are turned by the action of the pawl-and-ratchet mechanism described, the disk being again locked by the detent, however, as soon as the movement of the shafts is completed.

Carried by the ring J are three rings, V, three similar rings, W, being carried by the inner ring, K, and each of these rings has a projection on the top, the projections uniting to form a rib, *w*, which can be expanded or contracted in length by a proper movement of the rings, as described hereinafter. The outer ring V is secured to the ring J, but the other rings V simply rest thereon, a pin on said outer ring being adapted to a slot in the adjacent ring V, and a pin on the latter to a similar slot in the innermost ring V. In the same manner the inner ring W is secured to the ring K, the other rings W resting on said ring K, and a pin on the inner ring W being adapted to a slot in the adjacent ring, a pin on which is adapted to a like slot in the outermost ring W. By this arrangement of rings with pins and slots the rib *w* can be expanded from the condition shown in Fig. 7 to that shown in Fig. 8 or contracted from the condition shown in Fig. 8 to that shown in Fig. 7 by simply rotating the pinions J² K² in one direction or the other. Thus, supposing the rib to be fully expanded, as shown in Fig. 8, the rings V and W are then in the positions shown in Fig. 10.

By rotating the pinions J² K² so as to move the outer and inner rings J and K in the direction of their respective arrows, Fig. 10, the outer ring V and inner ring W, with their rib-sections, will be moved likewise until their pins reach the ends of the slots in the adjacent rings V and W, the movement being then transmitted to the latter, and this movement being in turn transmitted to the inner ring V and outer ring W when the pins of the intermediate rings V and W reach the ends of the slots in said inner ring V and outer ring W, the rib-sections being all in line with each other, as shown in Fig. 7, by the time the movement is completed. A gradual expansion of the rib, as will be evident, can be effected by a movement of the pinions and rings in the opposite direction.

The operation of the machine is as follows: For the production of plain work, the needle-cylinder is revolved continuously in one direction (say in the direction of the arrow, Fig. 1) and the cam I is elevated, as shown in Fig. 6, and secured in this elevated position by means of the bolt *b* and nut *b²*, so that all of the needles will be directed to and compelled to pass over the cam G. The slides R R' are so adjusted that the pawls *r' r²* of both slides are out of engagement with the ratchets P' and P², so that, independent of their movement with the needle-cylinder, there is no movement of the shafts P and L or of the rings carrying the sections of the rib *w*, the rings occupying the position shown in Figs. 8 and 10, so that the rib-sections are fully extended, having been moved to this position before starting the machine or left in this position at the completion of a previous narrowing and widening operation. The rib passes beneath the arms *f* on each rotation of the cylinder, but does not cause any operation of the cams, the cam I being elevated and the arm *f* beneath the cam I' not being lifted, owing to the yielding of the pawl *g* of the same, as shown in Fig. 6. When it is desired to perform the narrowing and widening operation, (such, for instance, as may be required in forming the heel or toe in a stocking,) the nut *b²* upon the stem of the block I² of the cam I is

loosened and said cam allowed to descend, so that its projection *d* is supported by the arm *f*. The cylinder D is now vibrated to the extent of, say, three-quarters of a turn, and the support formed by the rib *w* is carried back and forth beneath the pawls *g* of the arms *f*. In moving in the direction of the arrow, Fig. 6, the cam I will be elevated, as shown, so as to direct the needles to the cam G, and will be held in this position as long as the supporting-rib is passing under the pawl *g* of the arm *f*, which acts upon the said cam I, the pawl *g* of the arm *f*, which acts on the cam I′, however, yielding during this movement, as shown, so that said cam I′ is not elevated. On the backward movement, however, the cam I′ will be elevated and the cam I allowed to remain down. Before commencing to vibrate the cylinder D the slides R and R′ must have been adjusted so that the pawl *r*′ of the slide R will be in position to engage with the top of the ratchet-wheel P′ as the cylinder reaches the limit of its movement in the direction of the arrow, Fig. 11, the pawl *r*′ of the other slide, R′, engaging with the bottom of said ratchet-wheel P′ when the cylinder reaches the limit of its movement in the opposite direction. There will consequently be a slight forward movement of the shaft P as the cylinder reaches the limit of its movement in either direction, this movement being transmitted through the medium of the shaft L to the pinions J^2 K^2, so as to cause a movement in opposite directions of the rings J and K. This movement is in the direction of the arrows, Fig. 8, and effects a slight contraction in the length of the rib *w*, the gradual contraction in the length of the rib *w* as the cylinder reaches the limit of its vibration in either direction continuing until the rib has been shortened to the desired extent, whereupon the slides R R′ are reversed—that is to say, they are moved to such a position that the pawl r^2 of the slide R engages with the bottom of the ratchet-wheel P^2 and the pawl r^2 of the slide R′ with the top of the same. As the wheel P^2 is toothed in a direction the reverse of the wheel P′, it follows that the vibration of the cylinder will now effect a movement of the shafts P and L and rings J, K, V, and W in directions the reverse of those above described, and thereby cause a gradual expansion in the length of the rib *w*, this expansion continuing until the rib has been restored to its full length. It being understood that when the cams I I′ are down the bits of the needles pass beneath the cam G, it will be seen that the number of needles elevated on each vibration of the needle cylinder depends upon the extent of the rib *w*, and as this rib is gradually contracted in length and then gradually widened it follows that on each vibration of the cylinder an end needle or needles of the set will be dropped or allowed to remain down, these end needles being then gradually brought into action again after the contraction has been carried to the proper extent. After the narrowing and widening operation has been completed the slides R R′ are adjusted so as to throw both sets of pawls, *r*′ r^2, out of engagement with the ratchet-wheels P′ P^2, the cam I being then again secured in its elevated position and the knitting of the complete tube proceeded with as before; or, if it is desired to perform the narrowing and widening operation on the other half of the tube, the thumb-screw *j* may be loosened and the cylinder D turned on the ring M to the extent of a half-revolution, the rings J and K being prevented from turning with the cylinder, owing to the fact that they are held by the shaft L and pinions J^2 and K^2, so that on again vibrating the needle-cylinder the needles acted on by the cams I I′ will be those on the half of the cylinder opposite that carrying the needles which were previously acted on. When it is desired to change at once from continuous fabric to a narrow strip and widen therefrom, the rings J and K should be moved so that the sections of the rib *w* will be in the contracted position shown in Fig. 7 before commencing the vibration of the needle cylinder, and the slides R R′ should be so set that the pawls r^2 are in position to engage with the ratchet-wheel P^2, and thus effect the extension of the rib as the cylinder is vibrated, the slides being shifted when the extension is complete, so as to effect a gradual contraction of the rib on continuing the vibration of the cylinder.

It will be observed on reference to Fig. 1 that the upper slotted portion of the needle-cylinder in which the needles are guided is made conical or tapering, being widest at the base. The object of this construction is to provide an increased circumference of cylinder at the lower portion, where the devices for operating the cams are located, so that the machine may be made of fine gage without unduly contracting the space in which these cam-operating devices are compelled to work.

Where a very quick movement of the cams I I′ is desired, I prefer to adopt the construction shown in Figs. 15 and 16. In this case each movable portion of the cam is made of two parts, *x* *x*′, each carried by a block, I^2, these blocks being suitably guided in the cylinder F, so that in adjusting the cam the blocks may be moved in opposite directions, the necessary movement of each part being only half that which is required in moving the single cam—for instance, a movement of each of the parts *x* *x*′ to an extent of one half of the width of the cam-slot only is needed to change from the position shown at the left of Fig. 15, which directs the bits of the needles beneath the cam G to the position shown at the right of said figure, which directs the needles over said cam. The two cam-blocks are hung to the opposite ends of a lever, *y*, pivoted to the cylinder F, and having an arm, *y*′, for bearing on the arm *f*.

I have described my invention in connection with a circular-knitting machine; but it will be evident that the devices may be combined with a straight-knitting machine with-

out change in construction, and only such change in shape and arrangement as is necessitated by the difference in the shape and movement of the machine.

The use of the arms *f* is not absolutely essential to the proper carrying out of my invention, as the cam-blocks may have pawls, as shown in Fig. 17, to be acted on directly by the rib *w*, and the expansion and contraction of this rib may be effected by hand where an automatic action is not desired. For instance, the shaft L may be furnished with a pinion gearing into a segmental rack on an arm, Y, as shown in Fig. 18, and a suitable dial, Y′, may be used to indicate the proper extent of movement of the arm.

Fig. 19 illustrates an arrangement of cams in which the fixed central cam, G, is dispensed with, the two cams I I′ being placed side by side and being lifted or allowed to remain down, according as it is desired to operate the needles or allow them to remain out of action.

My invention is shown as applied to a machine in which the cam-ring is stationary and the needle-cylinder rotates; but it is applicable, also, to that class of machines in which the needle-cylinder is stationary and the cam-ring rotates; hence I wish it to be understood that my claims are not limited to a machine having a moving needle-cylinder and fixed cam-ring, but cover the alternate construction as well.

I claim as my invention—

1. The combination of the frame, the needle-carrier and its needles, needle-actuating cams movable into or out of operative position, a supporting-rib for the cams, and means for contracting and expanding said rib, all substantially as and for the purpose set forth.

2. The combination of the frame, the needle-carrier and its needles, needle-actuating cams movable into or out of operative position, the pawls *g*, the supporting-rib, and means for expanding and contracting the latter, as set forth.

3. The combination of the frame, the needle-carrier and its needles, needle-actuating cams movable into or out of operative position, the pivoted arms *f*, having pawls *g*, the supporting-rib *w*, and means for expanding and contracting the latter, as specified.

4. The combination of the frame, the needle-carrier and its needles, needle actuating cams movable into or out of operative position, a fixed lifting-cam, G, located between the movable cams, a supporting-rib, *w*, for said movable cams, and means for expanding and contracting said rib, as set forth.

5. The combination of the frame, the needle-carrier and its needles, needle-actuating cams movable into or out of operative position, the supporting-rib *w*, mechanism for expanding and contracting the same, and means for locking one or both of the movable cams in the elevated or operative position, as set forth.

6. The combination of the frame, the needle-carrier and its needles, needle-actuating cams movable into or out of operative position, the rib *w*, a series of rings, V and W, each carrying a section of the rib, and devices for moving the rings of one set in one direction and those of the other set in the opposite direction, as set forth.

7. The combination of the rings J and K, having racks J′ K′, the pinions J^2 K^2, the pinion-shaft L, the shaft P, having ratchets P′ P^2, gearing connecting the shafts L and P, and adjustable pawls for engaging said ratchets, as set forth.

8. The combination of the rings J K, having racks J′ K′, the pinions J^2 K^2, the pinion-shaft L, the shaft P, having ratchets P′ P^2, gearing connecting the shafts L and P, and the adjustable slides R R′, having pawls r' r^2, as set forth.

9. The combination of the frame, the needle-cylinder and its operating mechanism, the cams I I′, the rings J K, having rib-sections and racks, the shaft L and its pinions, pawl-and-ratchet mechanism for operating the shaft, notched disk *m*, the detent *m′*, and cams m^3, as specified.

10. The combination of the frame and needle-cylinder, the cams I I′, the rib *w*, and mechanism for expanding and contracting the rib, the said needle-cylinder being adjustable in respect to the portion of the frame carrying the rib and its operating mechanism, so as to widen and narrow on either or both sides of a tube, as set forth.

11. The combination of the frame, the conical needle-carrier and its needles, needle-actuating cams movable into or out of operative position, a supporting-rib for the movable cams, and devices for expanding and contracting the rib, said rib and its operating devices being located adjacent to the lower portion of the cylinder, where its diameter is greatest, as set forth.

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

SAML. HENSHALL.

Witnesses:
JOHN M. CLAYTON,
HARRY DRURY.