(No Model.) 4 Sheets—Sheet 1.

H. C. RIGHTMIRE.

CIRCULAR KNITTING MACHINE.

No. 388,721. Patented Aug. 28, 1888.

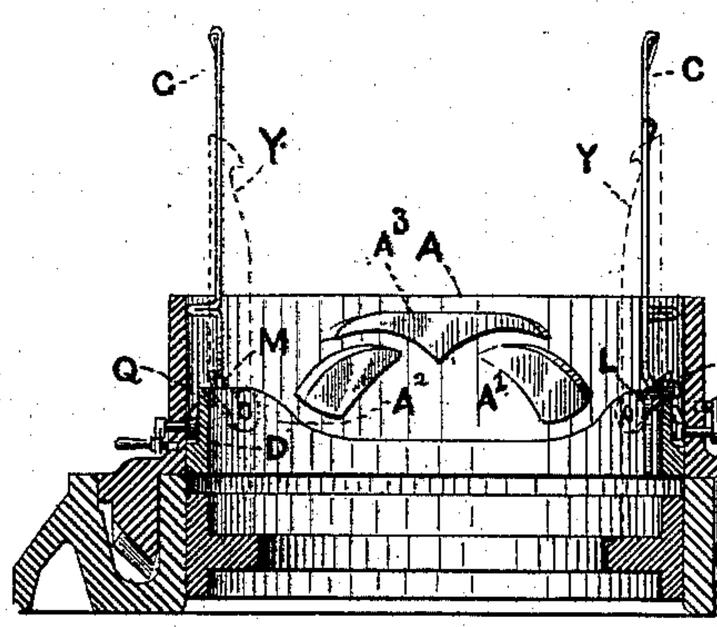

FIG. 2.

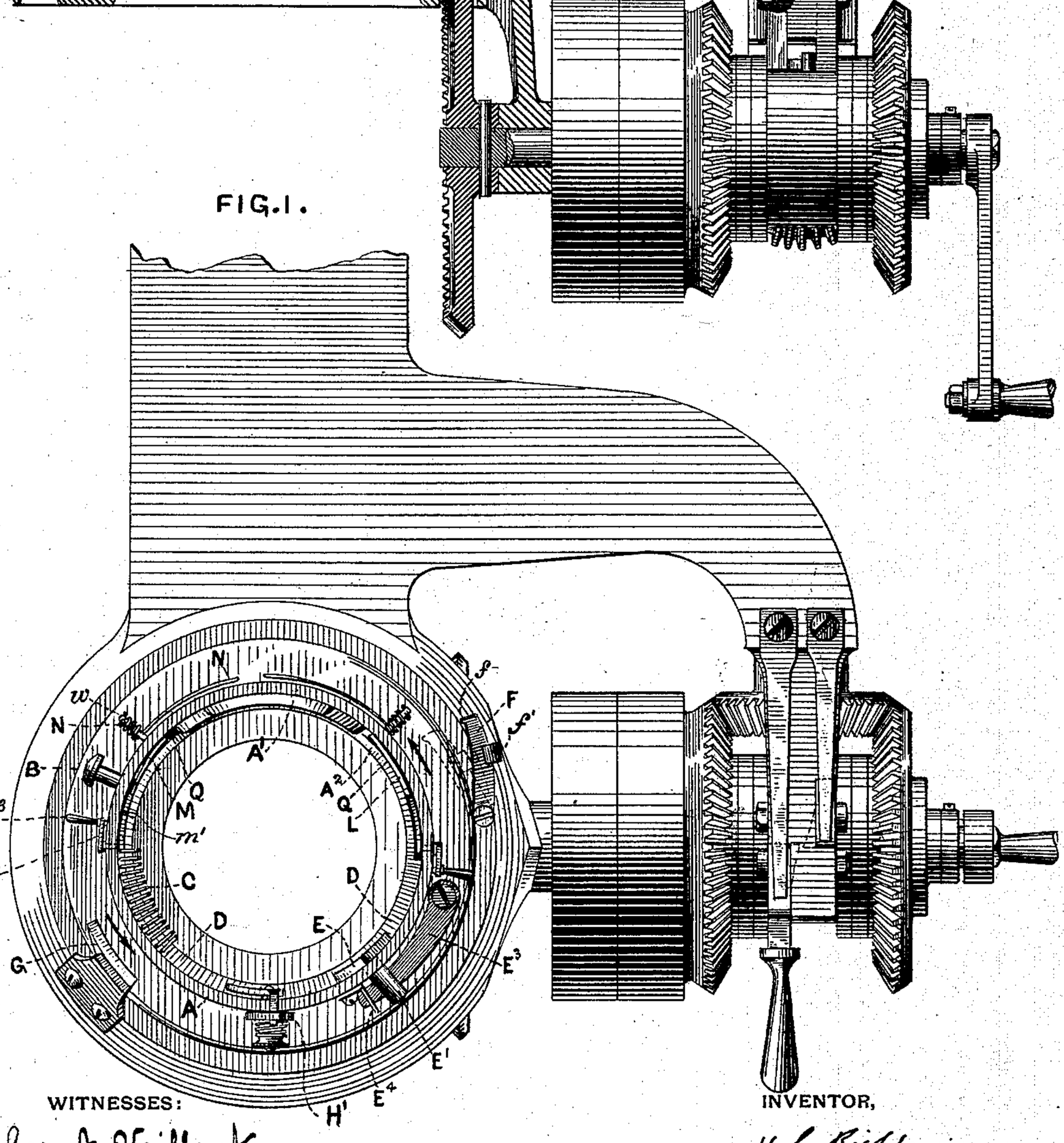

FIG. 1.

WITNESSES:

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(No Model.) 4 Sheets—Sheet 2.

H. C. RIGHTMIRE.

CIRCULAR KNITTING MACHINE.

No. 388,721. Patented Aug. 28, 1888.

FIG. 10.

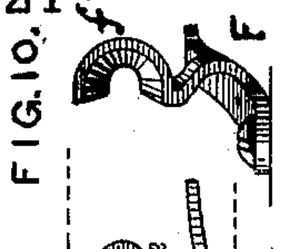

FIG. 6.

FIG. 5.

FIG. 4

FIG. 3.

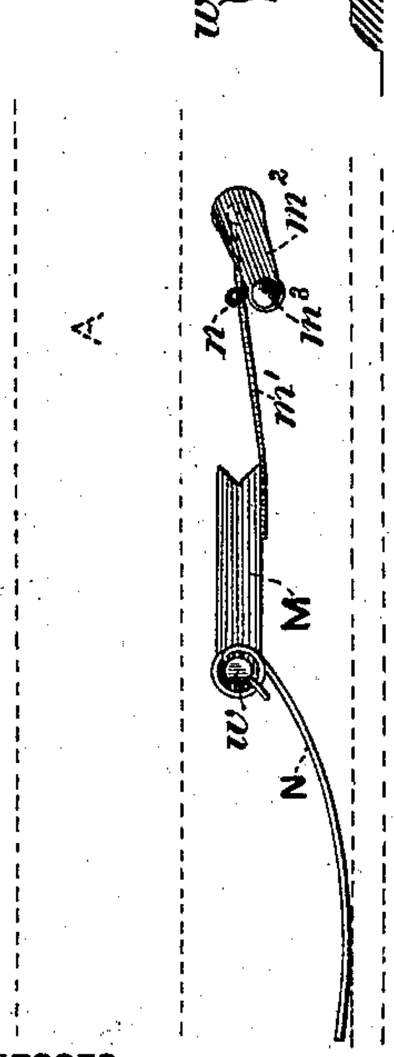

FIG. 7.

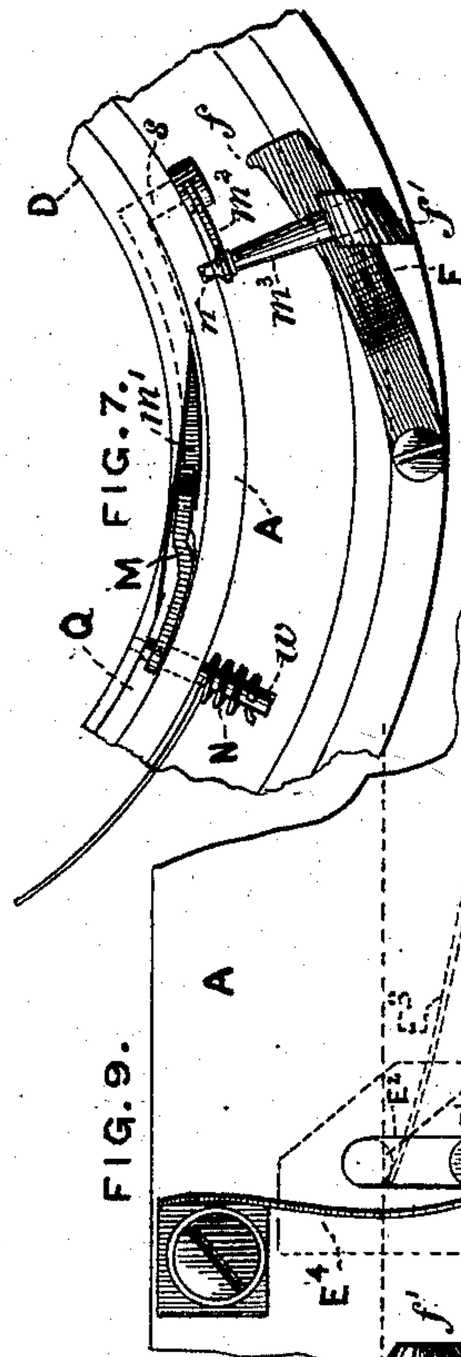

FIG. 9.

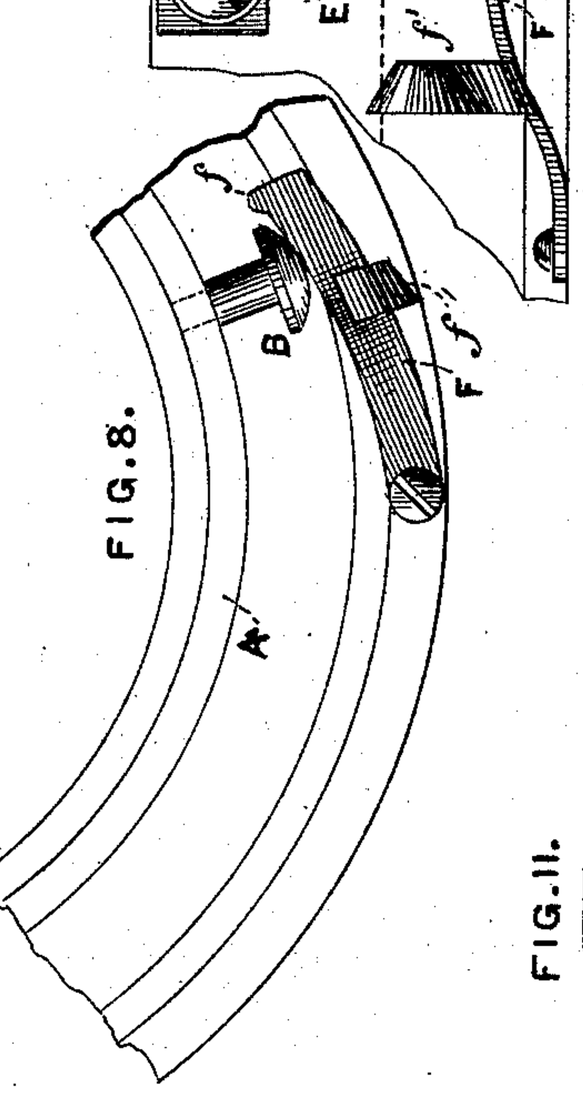

FIG. 9.a

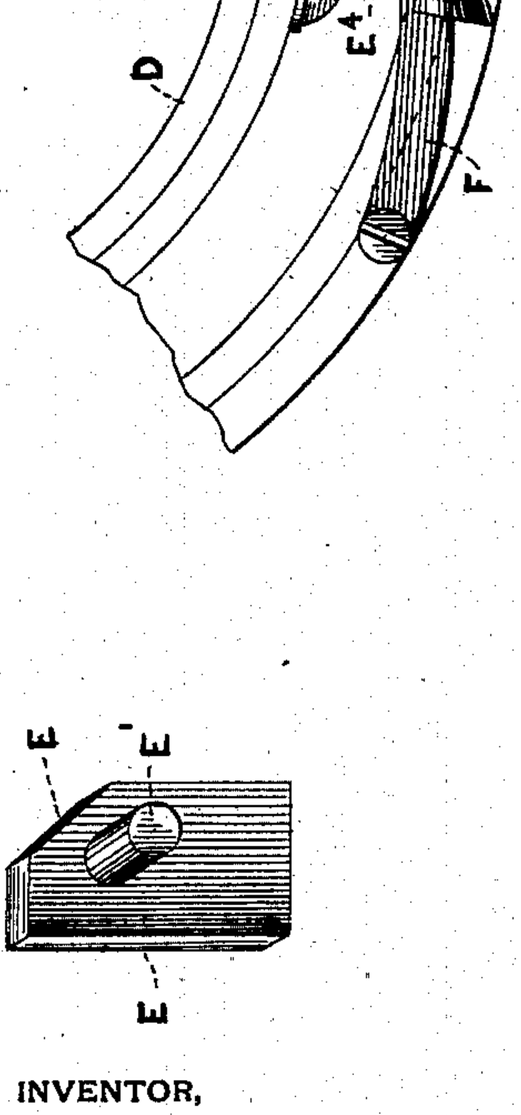

FIG. 8.

FIG. 11.

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No. 388,721. Patented Aug. 28, 1888.

FIG. 12.

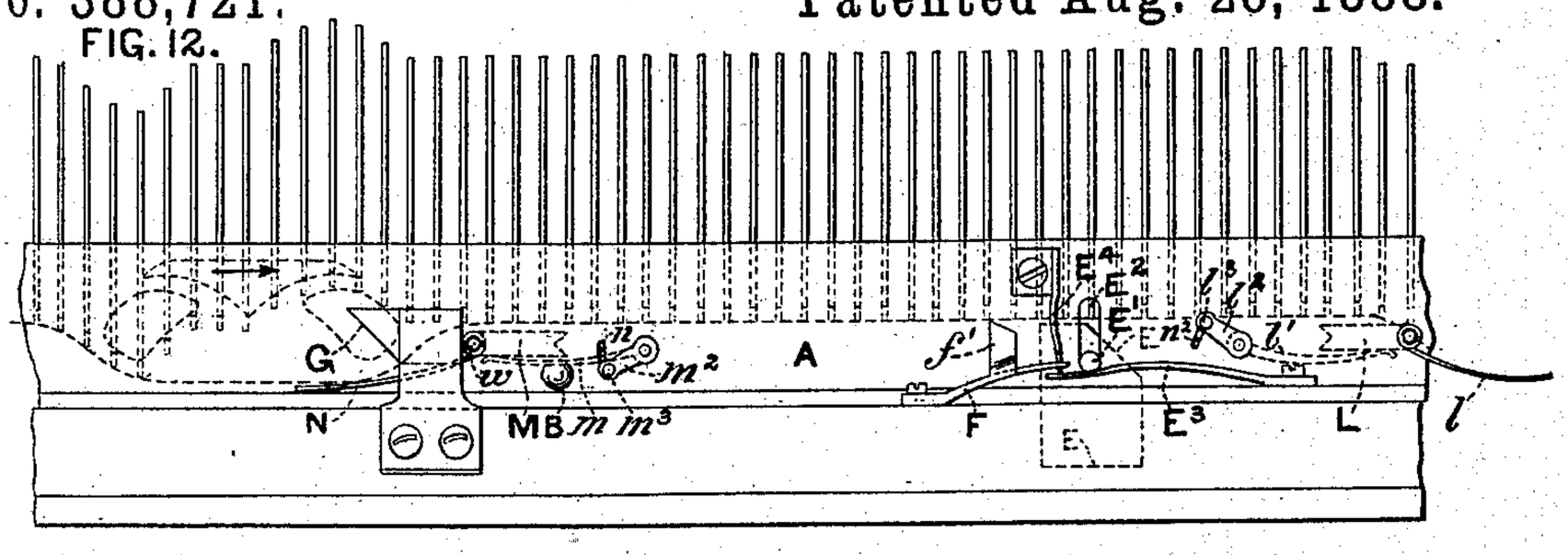


FIG. 12.a

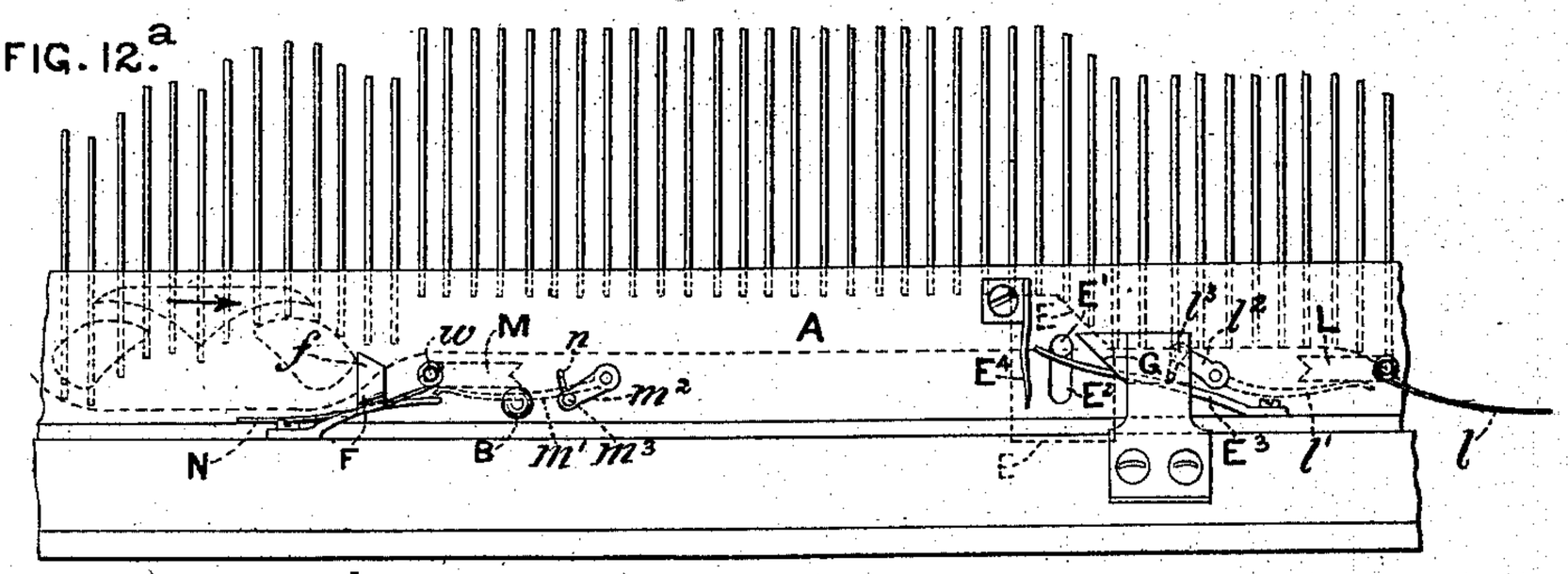


FIG. 12.b

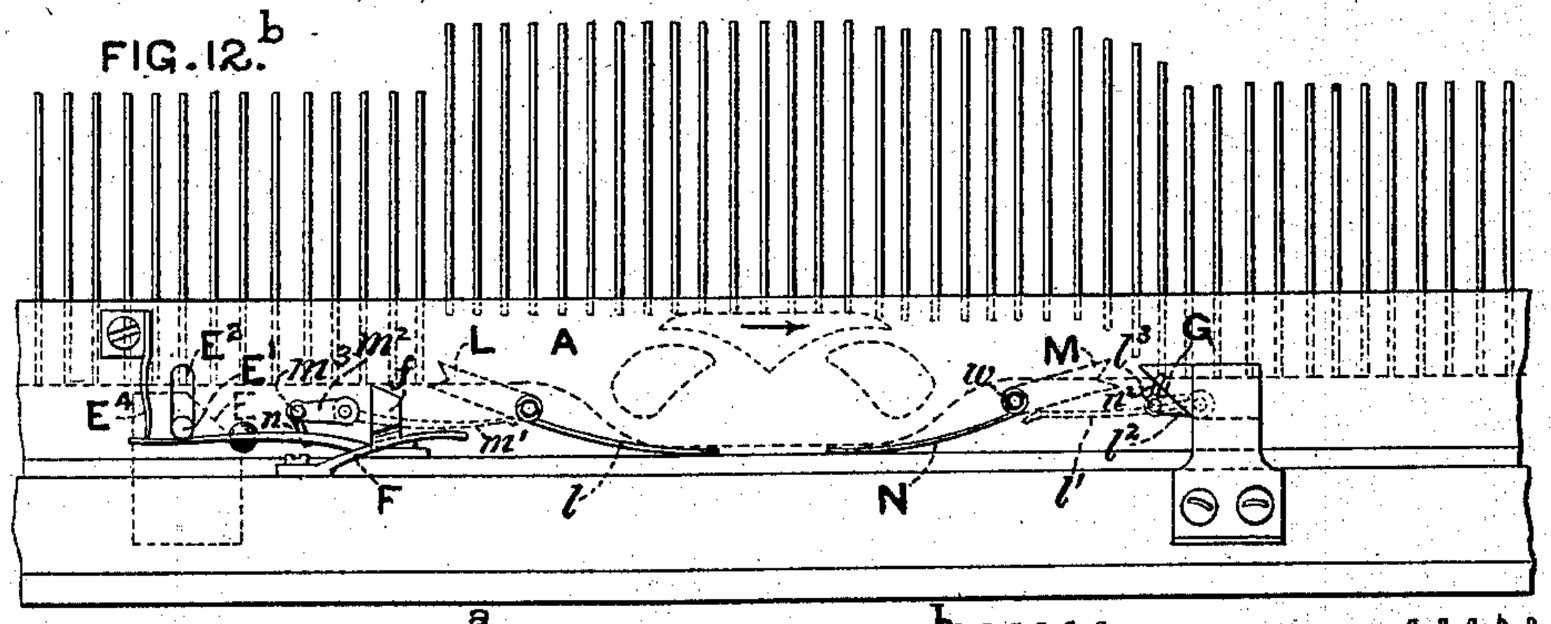


FIG. 13.

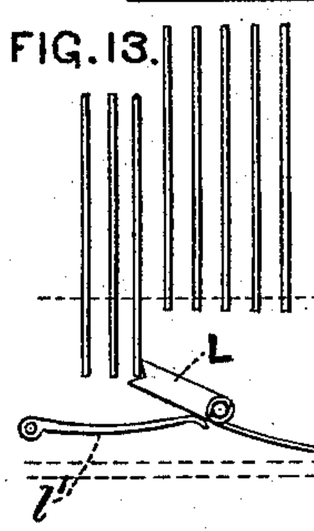


FIG. 13.a

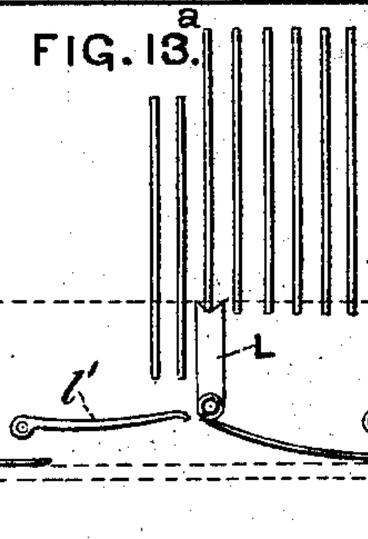


FIG. 13.b

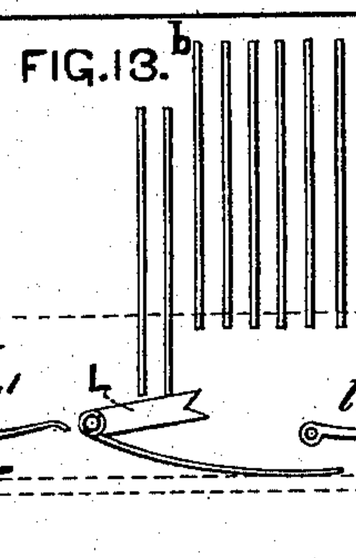
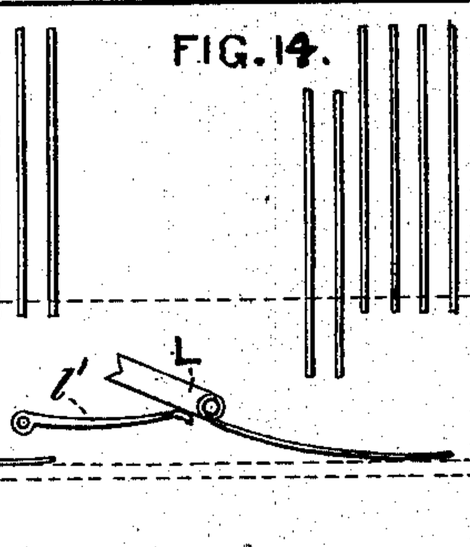


FIG. 14.



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By Hollingsworth & Riley,

Attorneys

(No Model.) 4 Sheets—Sheet 4.

H. C. RIGHTMIRE.

CIRCULAR KNITTING MACHINE.

No. 388,721. Patented Aug. 28, 1888.

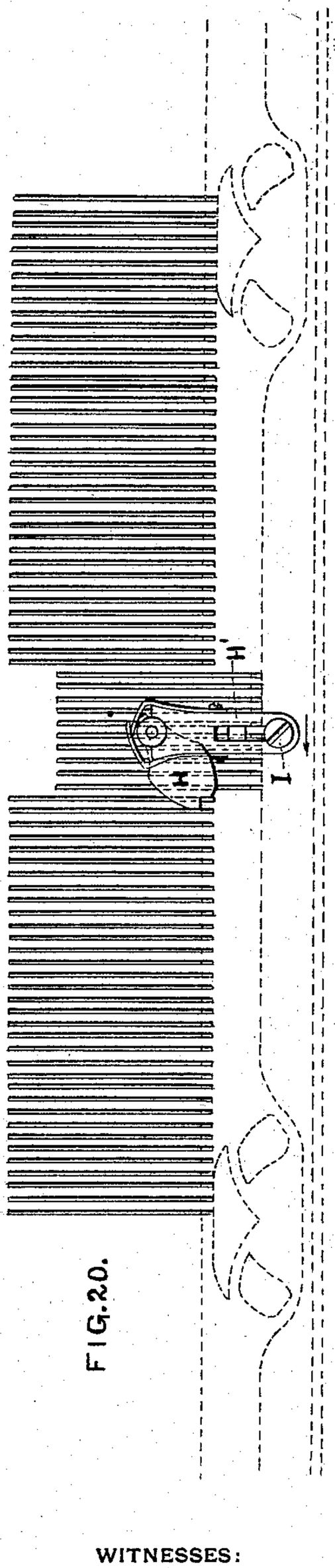

FIG. 20.

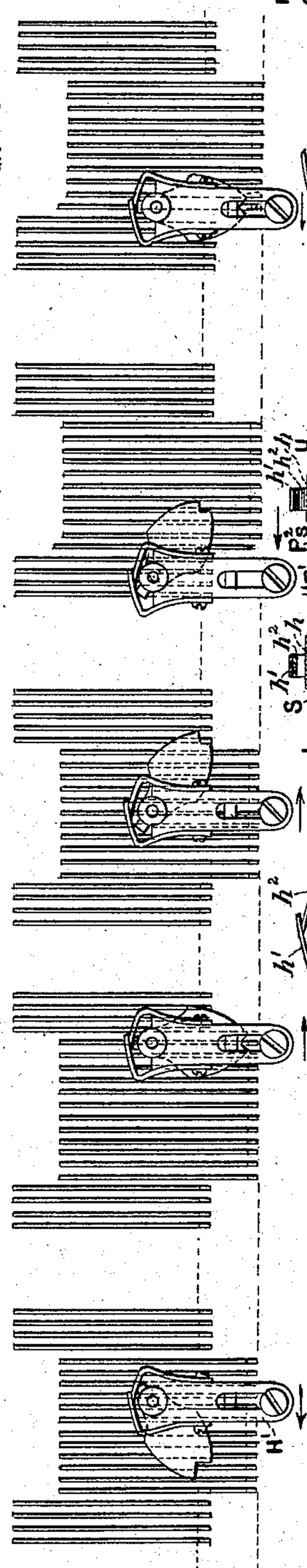

FIG. 21.

FIG. 21a.

FIG. 21b.

FIG. 21c.

FIG. 21d.

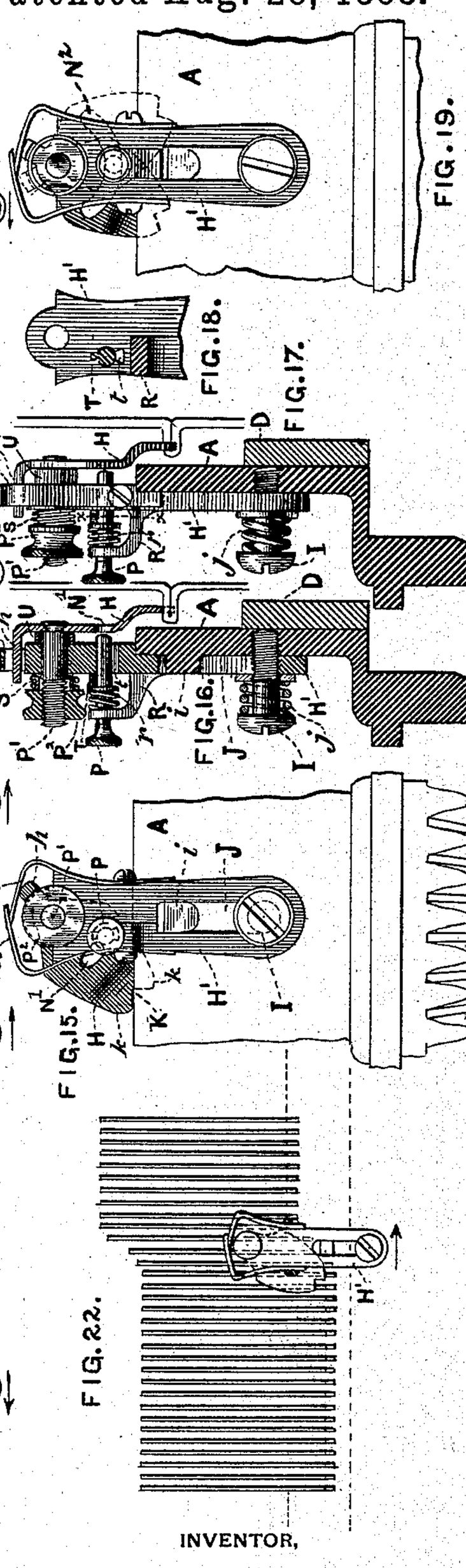

FIG. 19.

FIG. 18.

FIG. 17.

FIG. 16.

FIG. 15.

FIG. 22.

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UNITED STATES PATENT OFFICE.

HARRY C. RIGHTMIRE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO THOMAS A. PEARCE, OF SAME PLACE.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 388,721, dated August 28, 1888.

Application filed May 10, 1887. Serial No. 237,770. (No model.)

To all whom it may concern:

Be it known that I, HARRY C. RIGHTMIRE, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Circular-Knitting Machines, whereof the following is a specification, reference being had to the accompanying drawings.

The object of my invention is to facilitate the operation of knitting stockings where "narrowing" is required—as, for instance, at the heels and toes.

To this end my improvements consist in means for automatically raising needles to the "idle level," collectively as well as individually, and for depressing them in the same manner, the construction being such as to insure efficiency even when the machine is run at a high rate of speed.

The especial features to which attention is to be directed in comprehending the following specification may be thus summarized: first, a lifting-cam which, when thrown into play, raises one-half the needles at a single continuous movement, this being of course accompanied by the usual change from continuous to reciprocating rotary movement of the cylinder; second, a pair of spring-actuated lifting-pawls adapted to lift a single needle at each half-reciprocation until the minimum has been reached; third, a depressing-pawl adapted to throw down a needle at each half-reciprocation until half of the entire series of needles are again operative, whereupon the depressing-pawl is converted into a cam, which at a single continuous movement throws down all of the remaining needles; fourth, as all of these devices are of course to be intermittently operative, I provide means, which to a certain extent are automatic, for throwing them into and out of play.

The details of the mechanism will now be described by reference to the accompanying drawings.

In these, Figure 1 represents a top or plan view of the machine, and Fig. 2 a central vertical section through the cylinder. In these two views certain reversing mechanism is indicated; but, as it forms no part of the present application, it will not be particularly referred to, since the machine is adapted to be used in connection with any form of driving or reversing mechanism. Figs. 3 to 11, both inclusive, are detail views on an enlarged scale of various portions of the cam and pawl mechanism in different positions. Sheet 3 contains a series of diagrams in which the rotary movement of the cam-cylinder is represented as developed in a plane, Fig. 12, Fig. 12^a, and Fig. 12^b (which latter are continuations of Fig. 12) illustrating movements which correspond to two complete revolutions of the cylinder. Figs. 13, 13^a, 13^b, and 14 represent the series of positions assumed during the operation of one of the lifting-pawls. Figs. 15 to 18, both inclusive, are detail views on an enlarged scale of the depressing-pawl and its standard, showing also a part of the cam-cylinder, Fig. 15 being a front elevation, Fig. 16 a vertical section on the line *y y* of Fig. 15, and Fig. 17 a somewhat similar section. Fig. 18 is a partial sectional view on the line *x x* of Fig. 17. Fig. 19 is a front elevation of another form of pawl and standard, which may be substituted for the form shown in Fig. 15. Fig. 20 is a diagram showing developed upon a plane the movement of the needles and the commencement of operation of the depressing-pawl. Figs. 21, 21^a, 21^b, 21^c, and 21^d are diagrams which illustrate the series of movements of the depressing-pawl in its action. Fig. 22 is a diagram illustrating the action of the depressing-pawl when used as a cam to bring down the group of needles instead of an individual needle. In these diagrams, to avoid confusion, the needles are only indicated by lines which terminate where the heels of the needles would be situated.

The general construction of the knitting-machine may be generally stated as being similar to that specified in Letters Patent No. 357,472, granted to John C. Egly under date of February 8, 1887.

A represents the cam-cylinder, having the stationary driving-cams A', A^2, and A^3, the needle-cylinder being indicated at Y and the needle at C.

Within the ring or band D, upon which the needle-heels travel after leaving the operating-cams, a vertical slot is formed, which receives and guides a vertically-movable cam-piece, E, (see Figs. 2, 9, 9^a, and 11,) having a pin, E′, which projects radially outward through the vertical slot E^2 in the side of the cam-cylinder A. The range of motion permitted by this slot

E² is such that when the cam-piece E is in its lowest position its flat top is flush with the upper surface of the ring D, so as to be inoperative; but when raised to its highest position its incline terminates upwardly at the idle level, or above the upper surface of the top cam, A³. This movable cam-piece E, which I term the "lifting-cam", is of the proper thickness to engage beneath the needle-heels and by its rotation to raise the needles to the idle level.

Beneath the projecting pin E′ is a spring, E³, mounted upon the exterior flange of the cam-cylinder and normally tending to throw said pin (and consequently the cam E) upward. A vertical spring-detent, E⁴, is secured upon the outside of the cam-cylinder and engages above the free end of the spring E³ in such a way as to normally hold said spring down; but when tripped so as to move laterally it will clear the end of the spring E³, and thus permit the latter to fly up and raise the pin E′. This tripping action is performed by a lever, F, pivoted to the frame of the machine, and having at its free extremity an inward projection, *f*, which, when the lever is swung into its innermost position, as shown in Fig. 9ª and in dotted lines in Fig. 1, will engage with the lower end of the detent E⁴ as the latter passes in rotating with the cam-cylinder. This momentary holding of the detent E⁴ by the finger *f* is sufficient to release the spring E³.

Upon the frame of the machine, at the side opposite the lever F, is a fixed cam, G, having an overhanging projection adapted to engage above the pin E′ when the latter by the rotation of the cylinder reaches it. The downward extent of the said cam G is such that it will not clear the pin E′ until the latter has been depressed sufficiently to carry the spring E³ below the end of the spring-detent E⁴, so as to permit said detent to again spring over the end of the spring E³ and hold it down.

The lifting-pawls for raising the individual needles are constructed and arranged as follows: On each side of the operating-cams A² A² a cavity, Q, is made in the ring D sufficiently deep to completely receive the pawls L M and their supports. As these pawls are counterparts of one another, a description of one will suffice for both.

The pawl M is rigidly attached to a stem, *w*, which projects out through a hole in the cam-cylinder and carries a coiled spring, N, whose end abuts against the exterior flange at the bottom of said cylinder. The pressure of this spring N tends normally to throw the pawl M into a horizontal position, as shown in Fig. 3, in which position it is completely beneath the top surface of the ring D. The pawl M has a notch at its free end adapted to engage with a needle-heel when the pawl has been raised into the proper position therefor, and it is of such length that when raised vertically, as shown in Figs. 4 and 5, it will lift the needle-hub to the idle level, or so as to clear the upper surface of the top cam, A′.

The pawl M rests upon a spring-finger, *m′*, also within the cavity Q. The finger *m′* is rigidly attached to a stem, *s*, which projects out through a hole in the cam-cylinder, and carries at its outer end a short lever, m^2, and pin m^3, forming a sort of crank or winch, by the turning of which the spring-finger *m′* may be raised or lowered. The pin m^3 projects inwardly through the lever m^2 for a short distance and bears against the outside of the cam-cylinder, the lever m^2 being made thin enough to act as a spring for that purpose. A hole, *n*, is formed in the outside of the cam-cylinder at such a point that when the lever-arm m^2 is raised to its highest position the end of the pin m^3 will enter the hole and form a stop. This highest position of the lever-arm m^2 corresponds to such a position of the finger *m′* as will raise the end of the pawl M above the surface of the ring D, as shown in Fig. 6, ready to engage with the heels of the needles. The pawl L upon the other side of the operating-cams is a counterpart of the pawl M, and is provided with a spring finger, *l′*, attached to a winch, l^2 l^3, the only difference in the arrangement of its finger and winch from those of pawl M being that which is necessitated by the opposite facing of the two pawls. The lever F, before referred to, carries near its middle a funnel-shaped cam, *f′*, (see Figs. 7, 9, 9ª, and 10,) open at the side toward the cam-cylinder and arranged at such a point as that the outer end of the pins m^3 and l^3 shall in rotating enter the funnel-shaped opening and be moved until their stops enter the holes *n* and n^2, respectively.

Upon the outside of the cam-cylinder, at a point which in rotating comes just after the pawl M, is a stud, B, (see Figs. 1 and 8,) arranged in such a plane as to strike the lever F and throw it outward in passing.

The depressing-pawl is constructed and arranged as follows, (see Figs. 15, 16, and 17:) Upon the outside of the cam-cylinder is mounted a standard, H′, having a longitudinal slot, J, through which a screw, I, passes. Between the head of said screw and the outside of the standard is a spring, *j*, which presses the standard firmly against the outer surface of the cam-cylinder. A stud, *i*, mounted upon the cam-cylinder, projects into the slot J near its upper end, and thus holds the standard H′ against lateral movement. Obviously, however, by tilting the standard outward it may be thrown clear of the stud *i* and then swung to either side.

The depressing-pawl H is suspended upon a pin, P′, passing through the top of the standard H′ and having its outer end provided with a screw-thread and thumb-nut, P². A spring, S, is coiled about the pin P′ between the nut P² and the standard H′, and a washer, U, is arranged between the pawl H and the inside of the cam-cylinder. By means of the nut the tension of said spring may be regulated so as to steady the movement of the pawl H and prevent its jumping. The pawl H termi-

nates at the top in a head, *h*, over which are two springs, *h' h²*, mounted upon each side of the standard, and adapted to lightly hold the pawl in definite angular positions when it has swung to either side of the center. The bottom of the pawl H has a central notch, K, adapted to engage with a needle-heel from above; but the corners on either side of this notch are rounded, as shown at *k k*, so that when resting upon the series of needle-heels it will slide freely thereon in either direction without engagement. The pawl H has a central slot, N', to admit the end of a fastening-pin, P, passing through the standard H' and supported in a bracket, R, mounted on the outside thereof. Said pin has a spring, *r*, normally pressing it inward or toward the pawl; but its movement in that direction is stopped by a feather, T, which bears against the outer face of the standard H. The opening in the standard through which the pin passes has, however, an enlargement, *t*, (see Fig. 18,) at the bottom to permit the passage of the feather T when the pin P is turned so as to register therewith.

It will be observed that the pin P is not arranged in the center of the standard, but somewhat to one side thereof, and consequently when it is in its innermost position, so as to pass through the pawl H, it holds the latter at an angle to the vertical.

The operation of the machine is as follows: During the knitting of the stocking-leg the lifting-cam E and pawls M L are of course down below the surface of the ring D. The depressing-cam is also thrown out and to one side, so as to be clear of the needles. When the stocking has been knit down to a point where the narrowing is about to commence, the operative throws the lever F inward. This movement must be made at a definite point in the rotary movement of the cylinder, which may be stated as the moment after the operating-cams have passed beyond the lever F. The first effect of this action is to cause the funnel-shaped cam *f'* upon the lever F to engage with the pin *l*³ and lower the winch of which it forms part, so that the spring-finger *l'* bears lightly against the under side of the pawl L and presses it upward against the needle-heels. The pressure of this spring is not sufficient, however, to cause the pawl to raise the needles; but the heels ride freely over it. As soon as, by the rotation of the cylinder, the spring detent E⁴ reaches the projection *f* of the lever F, said detent is tripped thereby, and the spring E³, being thus disengaged, forces the pin E' and lifting-cam E up to the highest position, whereupon the incline of said cam, engaging beneath the needle-heels, raises the needles to the idle level. This action of the cam continues during a half-rotation of the cylinder, whereupon the pin E' strikes against the under side of the cam G and is forced down again until the spring E³ clears the lower end of the detent E⁴, which latter immediately springs over and again holds down the spring E³. While this action of the cam (which is illustrated in the diagram of Fig. 12ª) has been taking place the funnel-shaped cam *f'* has raised the other winch, *m² m³*, whose finger *m'* has been brought to bear against the under side of the pawl M. The two winches of the pawls, when at the proper level, are stopped by the entry of their projecting pins into the holes *n* and *n²*, respectively. As the lifting action of the cam E precedes the arrival of the pawl M, the latter at once rises into the now open space to a position proper for engagement with the needle-heels, and as soon as the other pawl, L, has reached this open space it springs upward into a similar position facing the pawl M, as shown in Fig. 12ᵇ and in Fig. 1. As the rotation of the cylinder continues the stud B strikes the lever F and throws it out again, so as to be no longer operative. The cam-cylinder is now caused to reciprocate by any desired mechanism, in the usual manner, and at each movement one of the pawls, L or M, (toward which the movement is made,) will engage beneath the heel of the first approaching needle of the series and throw it upward in passing. The pawl turns completely over during this operation and the remaining needle-heels ride over it. These several movements of the pawl L are illustrated in the series of diagrams, Figs. 13 to 14, inclusive. In Fig. 13 the pawl L is just engaging with the needle-heel. In Fig. 13ª it is in its highest position and the needle has been thrown to the idle level above the top cam, A³. In Fig. 13ᵇ the remaining needles are indicated as riding along the top of the pawl, and in Fig. 14, the end of the series of needles having been reached, the pawl is clear and the spring *l* throws it back to its original position upon the finger *l'*. A similar series of positions occurs with the pawl M upon the return movement of the cylinder. Thus one by one the needles are raised until the narrowing is complete, say ten needles being left down. When it is desired to commence widening again, the lifting pawls are thrown down by turning the winches of their respective fingers. The depressing-pawl H is then thrown into play by shifting its standard so as to bring the slot J into engagement with the stud *i*. The pin P is of course in its outermost position, so that the pawl H is free to swing. This position of the parts is indicated in the diagram Fig. 20 and the series of movements which follow in the diagrams Fig. 21 to Fig. 21ᵈ, inclusive. The pawl H rides on top of the needle-heels of the idle series until it reaches the end thereof, whereupon it drops slightly and is held by one of the springs *h' h²* at just the proper angle for its notch K to engage with a heel of the idle series. As soon, therefore, as it reaches the end needle of said series toward which it is traveling it takes hold of the heel thereof and presses it downward in passing, as shown in Fig. 21, to a level within the range of the operating-cams. The pawl, having thus swung past its center, assumes the position shown in Fig. 21ª, and

during the remainder of that movement of the cylinder rides, as before, upon the top of the needle-heels. It then returns thereon until it reaches the end of the series, when it again drops down, and, after passing the open space, it engages, as shown in Fig. 21[b], with the extreme needle-heel at the opposite end of the idle series, depressing it, as shown in Fig. 21[c], then rides again upon the needle-heels, returns, and drops down, as shown in Fig. 21[d]. This operation continues until one-half of the needles are down again, whereupon, to depress the remaining half and resume the continuous rotation of the cylinder, the operative proceeds as follows: The pawl H is swung so as to bring its slot N′ opposite to the end of the pin P. Said pin is then turned so as to permit its feather T to pass through the opening *t*, whereupon the spring *r* throws the pin inward and secures the pawl H at an angle on that side of the standard upon which the pin T is mounted. This position of the pawl H is indicated in Fig. 22, and it now becomes a cam, its curved under side bearing down upon the heels of the remaining idle needles as it passes and forcing them down into the range of the operating-cams. When this movement is complete, the standard H′ may be again tilted outward and thrown to one side, so as to throw the pawl H out of play, and the continuous knitting operation then proceeds. The alternative form of pawl H and standard shown in Fig. 19 differs from the one described only in the fact that the fastening-pin P is central to the standard instead of at one side, and the pawl has an arc-shaped slot, N², of considerable extent. This permits the use of the pawl as a cam when the cylinder is rotating in either direction, while the form shown in the other views is only adapted to act as a cam in one direction of rotation.

Having thus described my invention, I claim, in a cylinder knitting-machine, the following combinations:

1. The combination, with the cam cylinder, of the lifting-cam E, arranged in guides formed within the ring D, means, substantially as set forth, whereby said cam may be raised and maintained raised during a portion of the cylinder's rotation, and the cam G, whereby on reaching the desired limit the cam E is thrown down flush with the top of said ring, as and for the purposes specified.

2. The combination, with the lifting-cam E, arranged with reference to the ring D substantially as set forth, of the cam-cylinder having the slot E², pin E′, a spring arranged beneath said pin, a detent engaging with said spring, and means, substantially as set forth, whereby said detent may be tripped and the spring permitted to rise at a definite point in the rotation of the cylinder, as and for the purposes specified.

3. The combination, with the cam-cylinder having vertical cavities in its ring D, of the lifting-pawls L M, pivoted within said cavities and provided with actuating-springs *l* N, respectively, the spring-fingers engaging beneath the under side of said pawls, the stems carrying said fingers and extending out through the periphery of the cam cylinder, and means, substantially as set forth, whereby said fingers may be raised and lowered and secured in a raised position.

4. The combination, with the spring-actuated lifting-pawl, of the spring-actuated finger on which it rests, the stem and winch connected therewith, and the funnel-shaped cam *f′*, adapted when thrown into play to engage with and move said winch into the position for raising the finger, as and for the purposes set forth.

5. The combination, with the depressing-pawl, of the springs *h′* *h²*, arranged substantially in the manner set forth, to hold the pawl at a definite angle on either side of its central position, substantially as specified.

6. The combination, with the depressing-pawl, of a fastening device, substantially as set forth, whereby said pawl may be rigidly secured to operate as a cam, in the manner specified.

7. The combination, with the depressing-pawl, of the pin P′, collar U, nut P², and spring *s*, substantially as and for the purposes set forth.

HARRY C. RIGHTMIRE.

Witnesses:
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