(No Model.) 11 Sheets—Sheet 1.

W. ROBERTS.

WARP KNITTING MACHINE.

No. 542,208. Patented July 2, 1895.

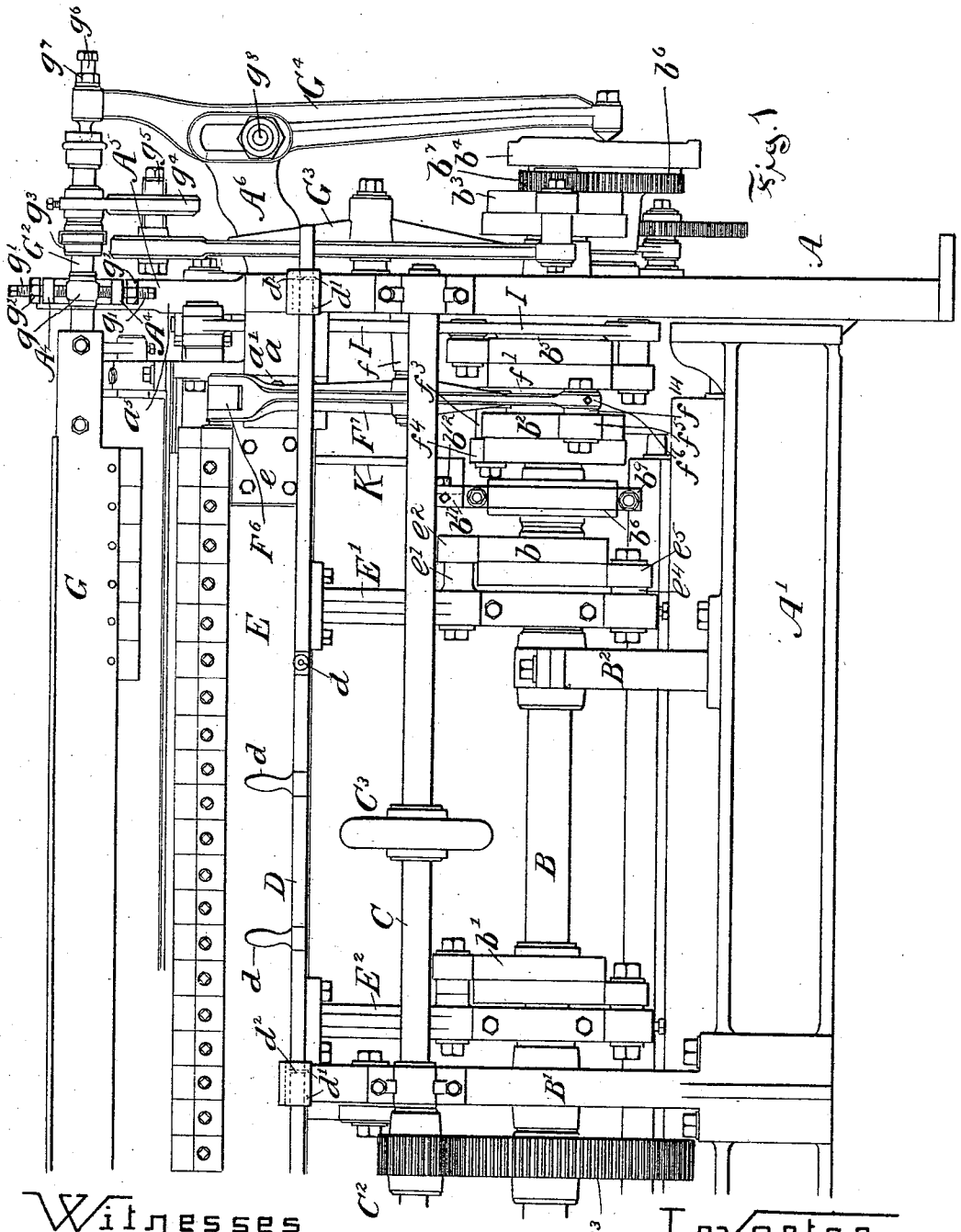

Fig. 1.

Witnesses

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Arthur B. Jenkins.

Inventor

Walter Roberts

by Chas. L. Burdett

Attorney

(No Model.) 11 Sheets—Sheet 2.

W. ROBERTS.

WARP KNITTING MACHINE.

No. 542,208. Patented July 2, 1895.

Fig. 2.

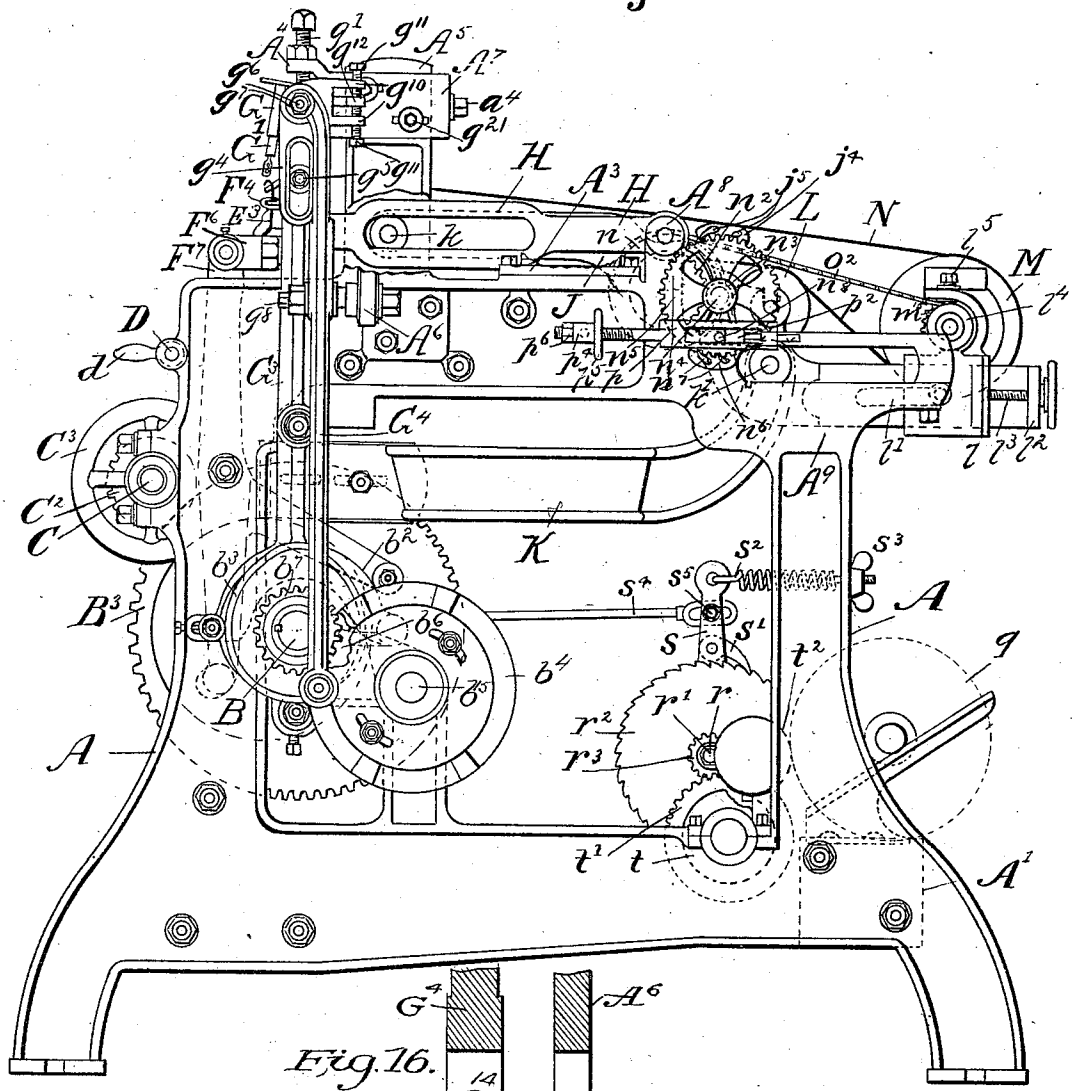
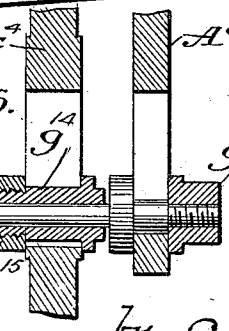


Fig. 16.



Witnesses:
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Inventor:
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(No Model.) 11 Sheets—Sheet 3.

W. ROBERTS.

WARP KNITTING MACHINE.

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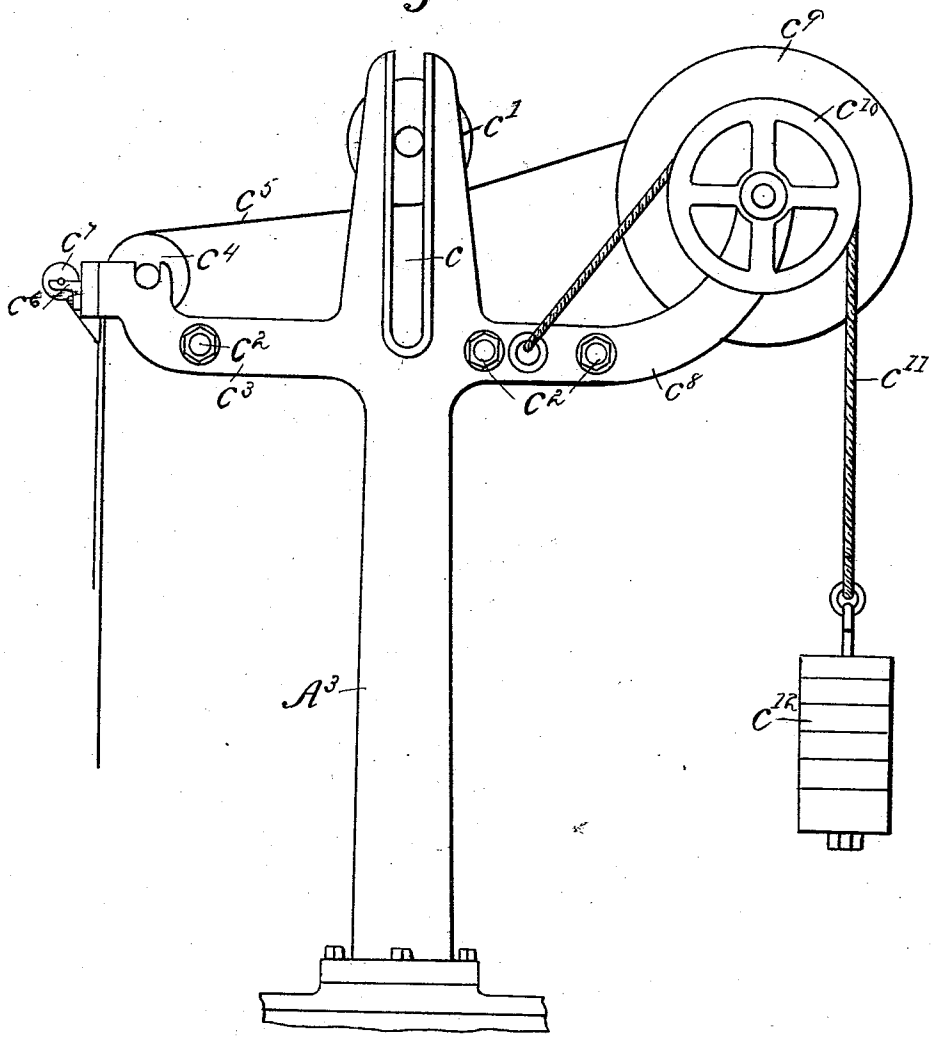
Fig. 3.



Witnesses.

Emory C. Whitney.
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(No Model.) 11 Sheets—Sheet 4.

W. ROBERTS.

WARP KNITTING MACHINE.

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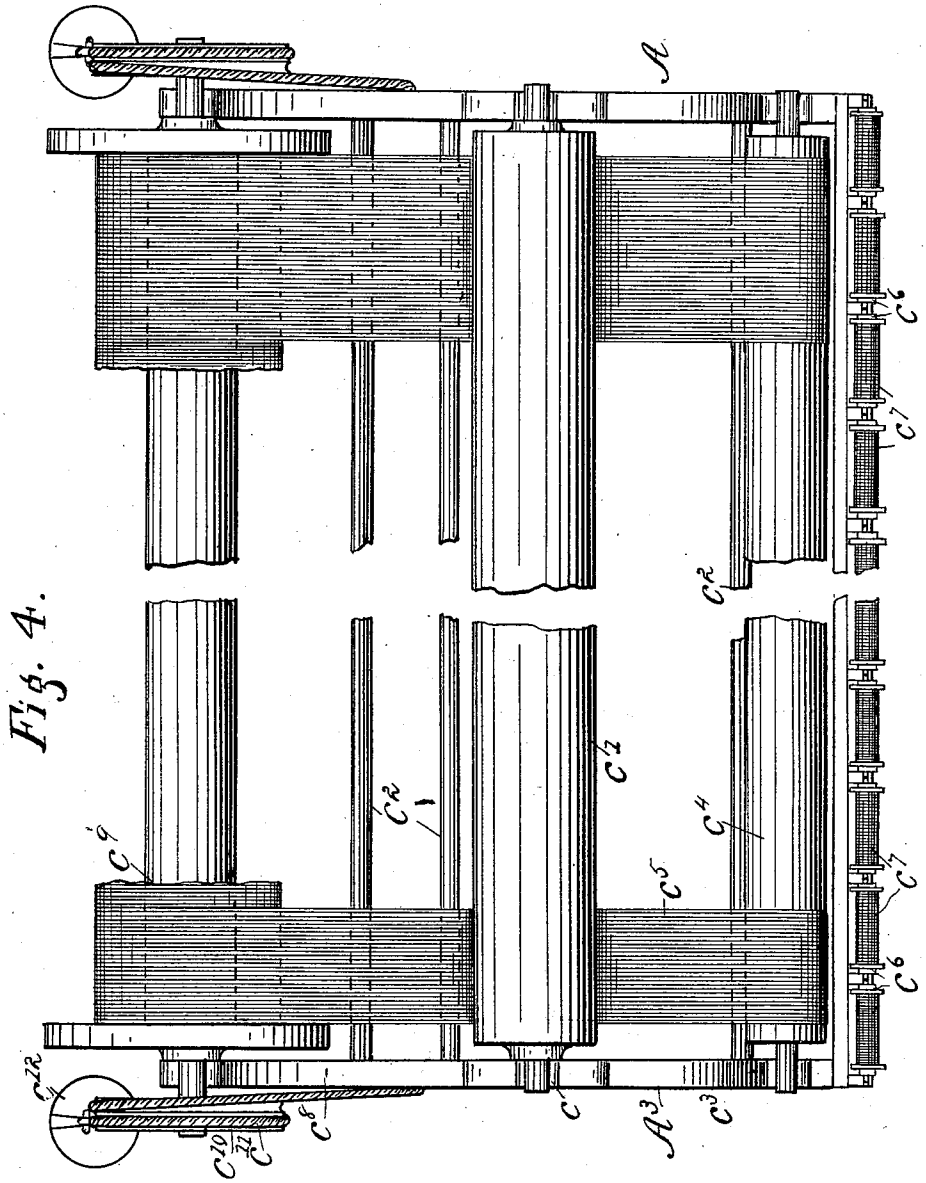
Fig. 4.



Witnesses.

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(No Model.)

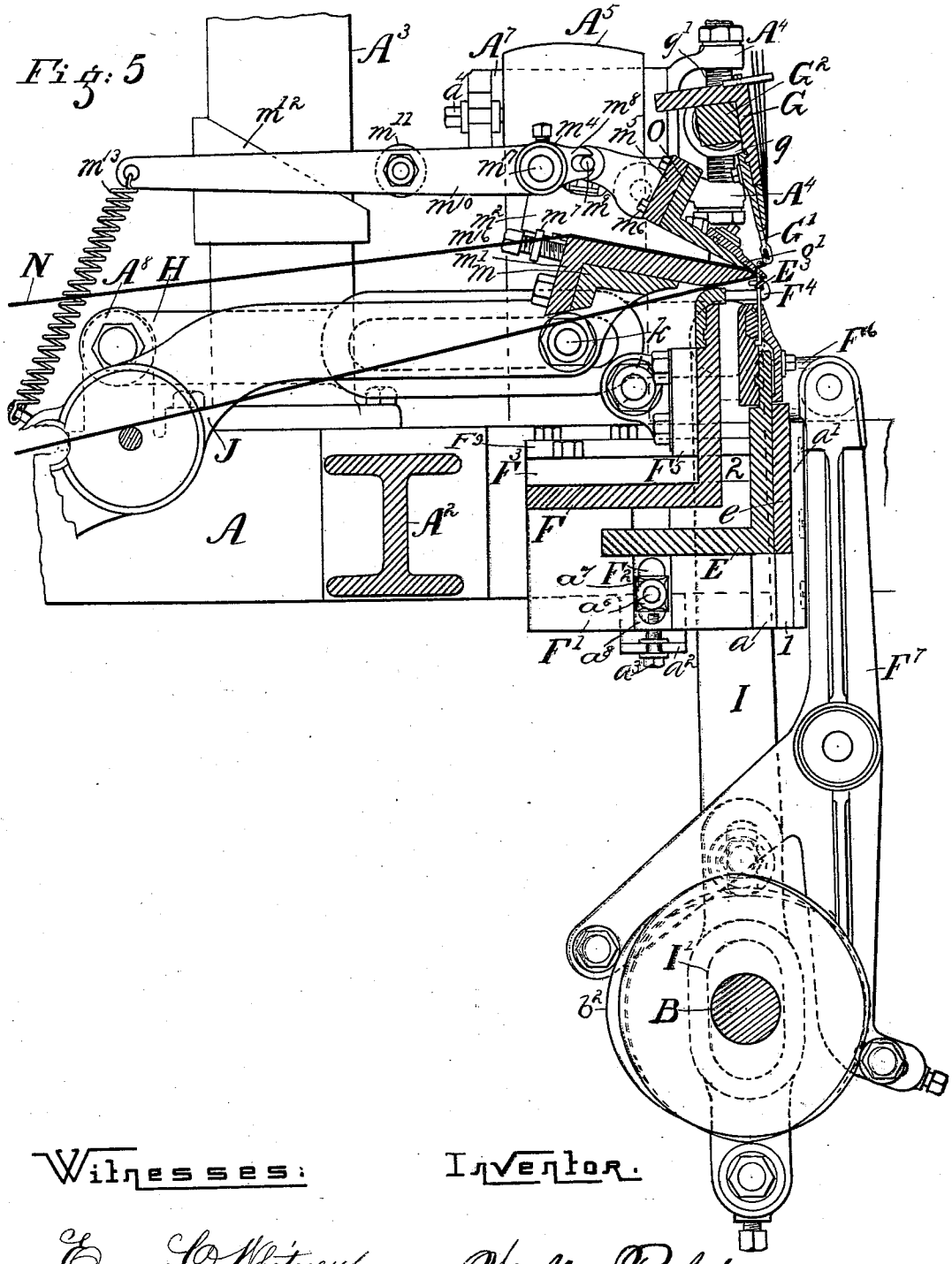
11 Sheets—Sheet 5

W. ROBERTS.

WARP KNITTING MACHINE.

No. 542,208. Patented July 2, 1895.

Fig. 5



Witnesses:

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(No Model.) 11 Sheets—Sheet 6.

W. ROBERTS.

WARP KNITTING MACHINE.

No. 542,208. Patented July 2, 1895.

Fig. 6.

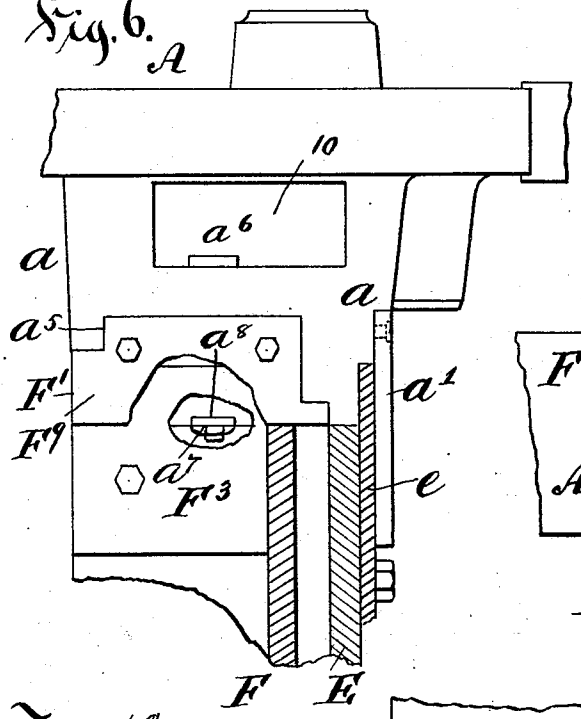


Fig. 17.

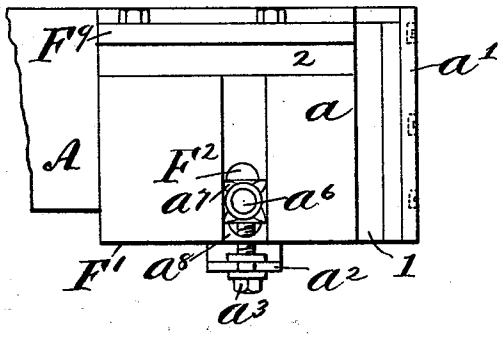
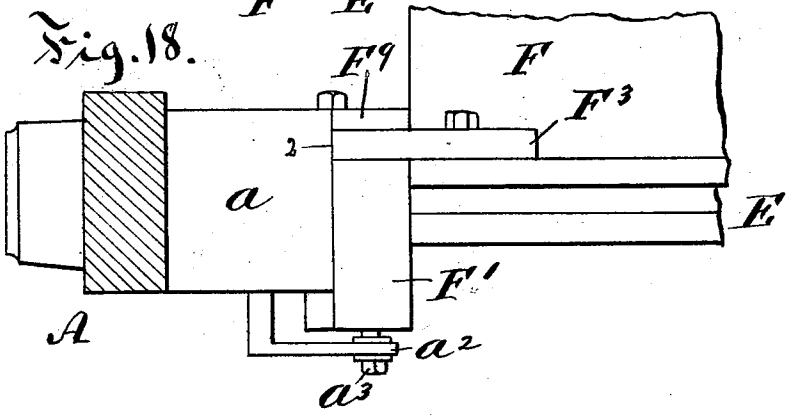


Fig. 18.



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(No Model.) 11 Sheets—Sheet 7.

W. ROBERTS.

WARP KNITTING MACHINE.

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Fig. 7.

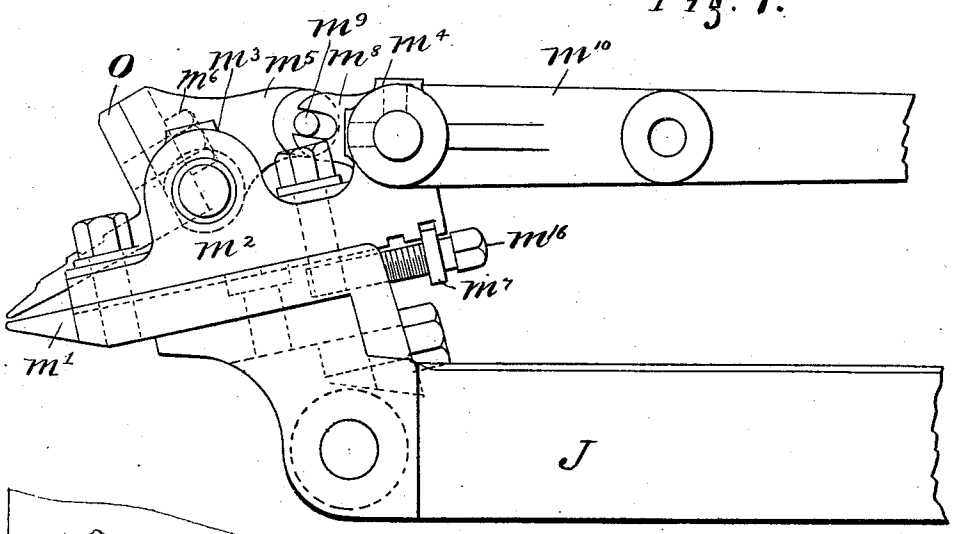
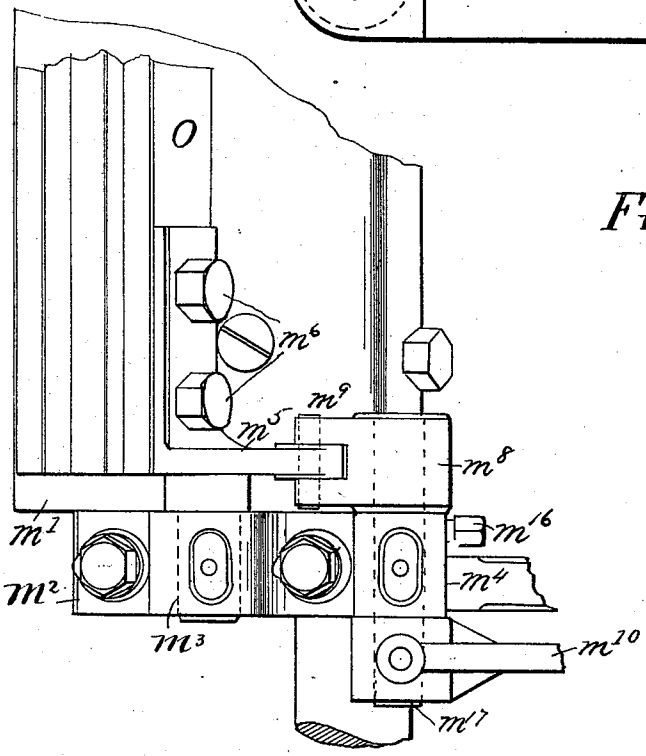


Fig. 8.



Witnesses.

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(No Model.) 11 Sheets—Sheet 8.

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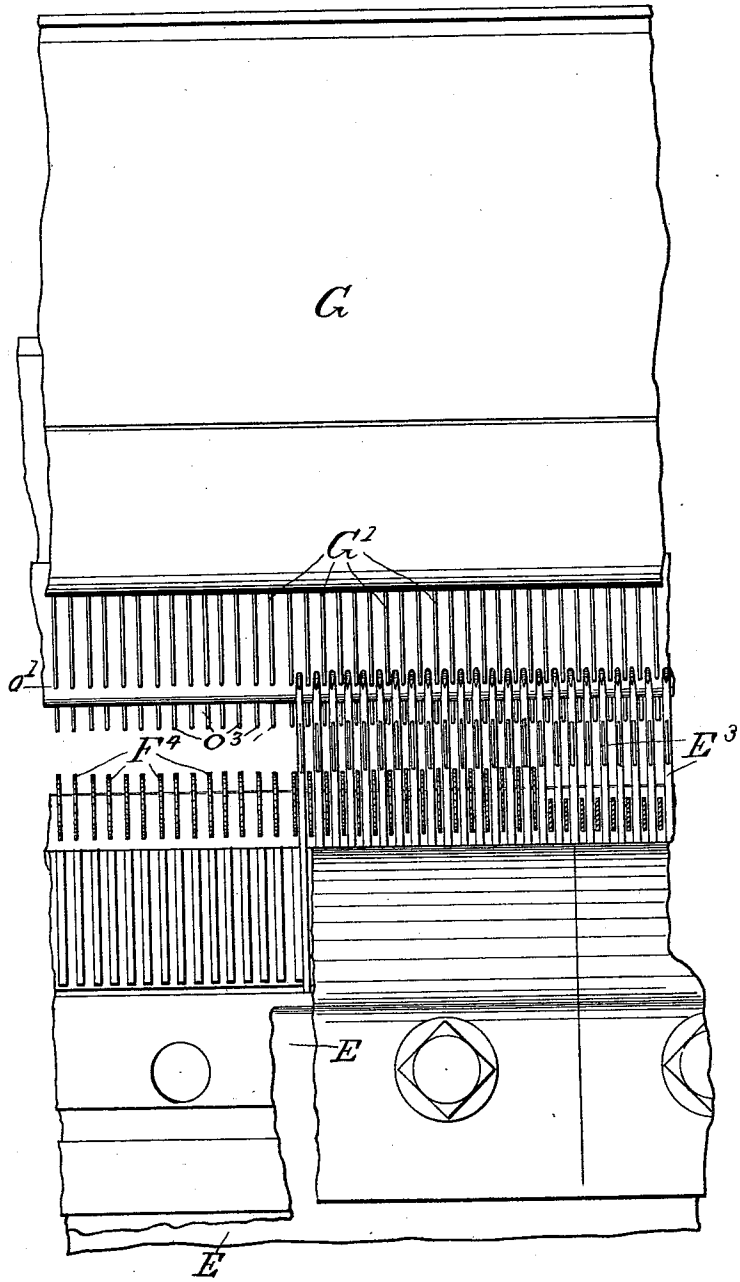
Fig. 9.



Witnesses:

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(No Model.) 11 Sheets—Sheet 9.

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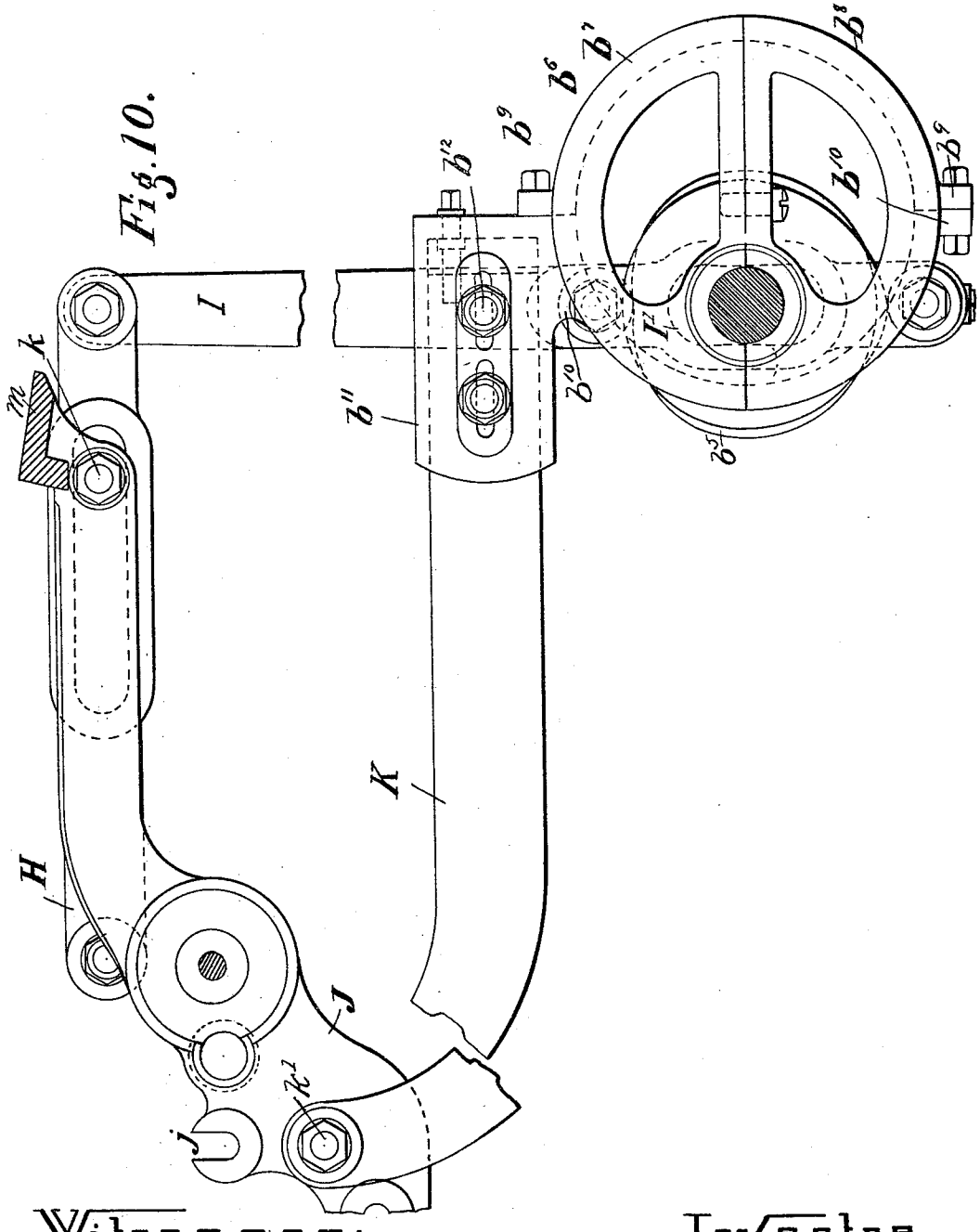
Fig. 10.



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(No Model.) 11 Sheets—Sheet 10.

W. ROBERTS.

WARP KNITTING MACHINE.

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Fig: 11.

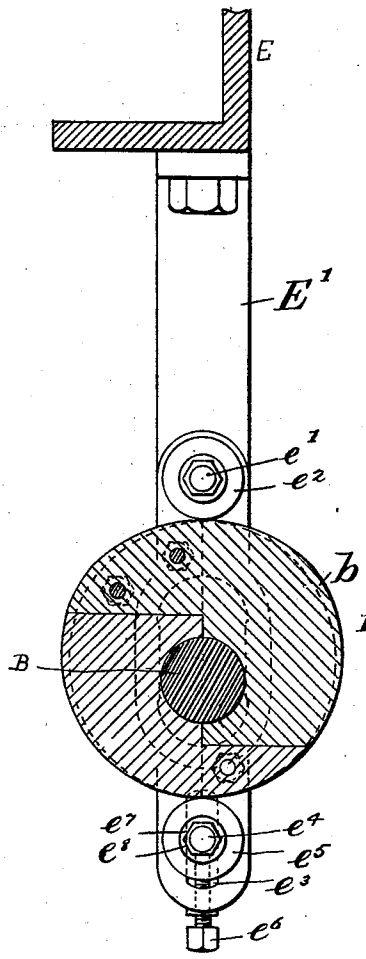
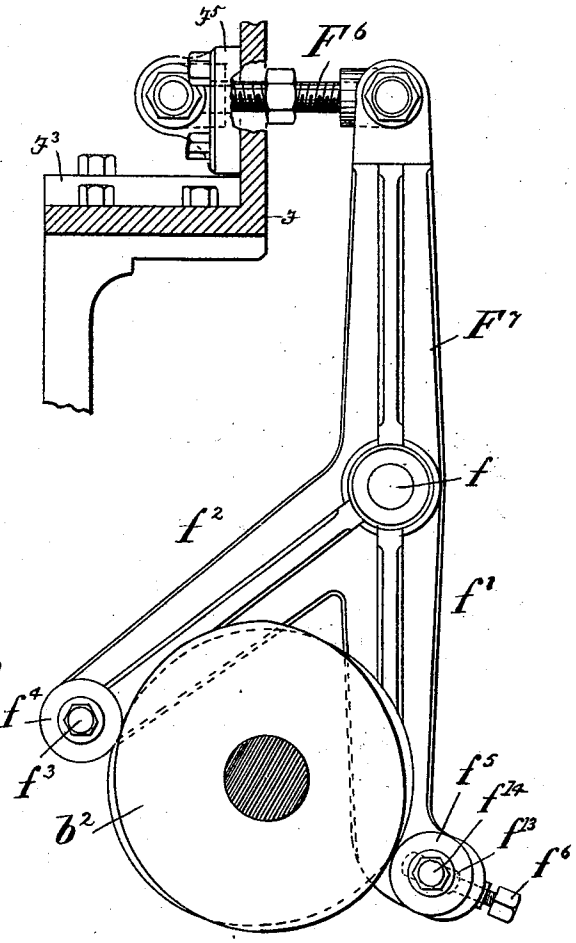


Fig: 12.



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(No Model.) 11 Sheets—Sheet 11.

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WARP KNITTING MACHINE.

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Fig. 13.

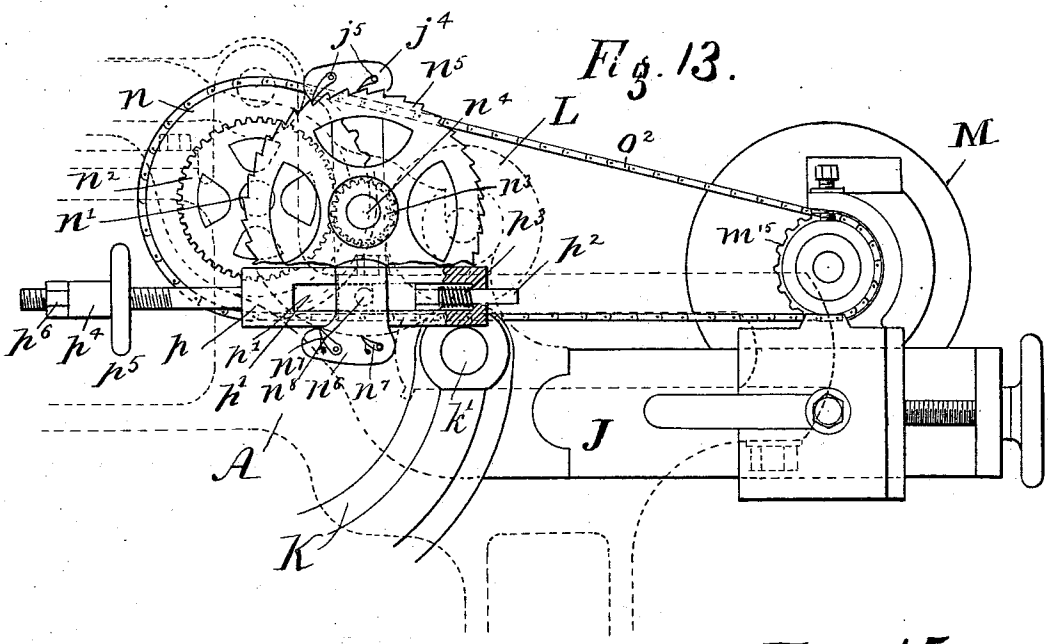


Fig. 14.

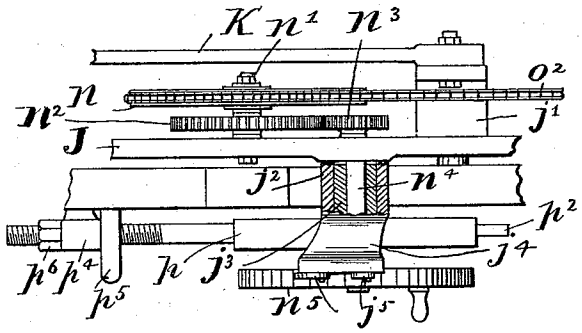
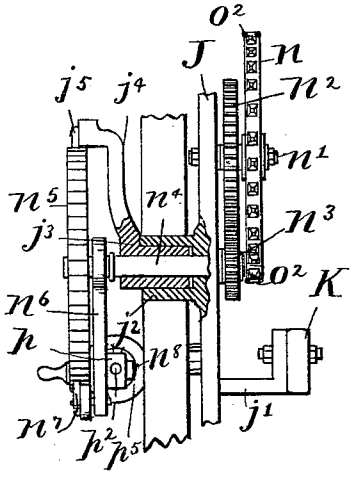


Fig. 15.



Witnesses.

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By Chas. L. Burdett,

Attorney.

UNITED STATES PATENT OFFICE.

WALTER ROBERTS, OF BEACON FALLS, ASSIGNOR TO THE BEACH MANUFACTURING COMPANY, OF HARTFORD, CONNECTICUT.

WARP-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 542,208, dated July 2, 1895.

Application filed April 28, 1893. Serial No. 472,257. (No model.)

To all whom it may concern:

Be it known that I, WALTER ROBERTS, of Beacon Falls, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Warp-Knitting Machines, of which the following is a full, clear, and exact description, whereby any one skilled in the art can make and use the same.

The principal object of my invention is to produce a machine for making a fleece-lined fabric, this lining being deposited on and secured to the body of the fabric in the process of knitting.

My invention relates to the class of knitting-machines commonly known as warp-knitting machines, the latch-needles, sinkers, and thread-guides being borne, respectively, on long bars, the operation of the said parts with each other being properly timed to produce the desired result.

To this end my invention consists in the combination of the several parts making up the machine as a whole, as more particularly hereinafter described, and pointed out in the claims.

Referring to the drawings, Figure 1 is a view in front elevation of one end of a machine embodying my invention, the other end of the machine being a substantial duplicate of the parts shown. Fig. 2 is a view in end elevation of the machine with the thread-supplying mechanism removed. Fig. 3 is a view in end elevation of the thread-supplying mechanism. Fig. 4 is a plan view of the same with the center broken away. Fig. 5 is a detail end view, in vertical section, of a portion of the machine, showing portions of the bat-feed device, the knitting devices, and their relation each to the other. Fig. 6 is a detail view, partly in section, of a portion of the end of the machine, showing the guideways and slides for the needle and sinker bars. Fig. 7 is a detail side view showing the bat-clamp device. Fig. 8 is a detail top view of one end of the bat-clamp. Fig. 9 is a detail view showing the relative position of the needles, sinkers, thread-guides, and bat-points and the parts to which they are secured. Fig. 10 is a detail view showing a portion of the bat feed or carriage, the mechanism for imparting vertical and horizontal reciprocation thereto, and the connections between the parts. Fig. 11 is a detail view, partly in section, showing the connection between the needle-bar and the cams for moving the same. Fig. 12 is a detail view, partly in section, showing the sinker-bar and the connection between it and the cams for imparting movement thereto. Fig. 13 is a detail view of a portion of the bat feed or carriage, showing the mechanism for imparting an intermittent movement to the apron, the frame of the machine and part of the side bar of the carriage being shown in dotted outline. Fig. 14 is a detail top view showing the mechanism for imparting movement to the apron. Fig. 15 is a detail end view showing this mechanism. Fig. 16 is a detail view, in vertical section, of a thread-guide lever and its support, showing the manner of mounting the former. Fig. 17 is a detail view showing the inside of a portion of the frame with the sinker-bar support in place thereon. Fig. 18 is a detail edge view of the same.

In a portion of the figures of the drawings forming a part of this application only so much of the machine as is necessary to a proper understanding of the invention is shown, and in such figures it will be understood that in referring to certain parts the other parts of the device not shown as forming duplicates of those described are to be included.

In the accompanying drawings the frame of the machine is composed of the standards A, preferably cast to shape and joined by girders A′ A^2, forming proper supports for the different parts of the machine, and also for strengthening the frame. To the upper side of each of the standards A are secured the uprights A^3, that support the thread-supply devices.

Supported on the lower front girder A′ is a shaft-support B′, and on each side and about midway of this support and the end of the machine are located the main-shaft supports B^2. The main shaft B is journaled in bearings in each of the supports just mentioned, and also in the standards A of the frame. On the shaft B is secured the gear B^3 in mesh with the gear C^2, secured to the hand-shaft C. This

hand-shaft C is journaled in bearings in the standards A of the frame and also in the shaft-support B′, and located along the length of this shaft C in any desired position are the hand-wheels C^3, this hand-shaft being used for the purpose of moving the mechanism to any desired position by hand when the driving-power is out of engagement with the main shaft.

On the main shaft B is secured the fast pulley for driving the machine, and a loose pulley is mounted on the shaft adjacent to the fast pulley, a belt passing around these pulleys to any suitable source of power. These driving devices are located on the opposite end of the machine to that shown in Fig. 1, and being of any well-known construction it is not deemed necessary that they should be illustrated herein. There is also mounted on the standards A of the frame and on the shaft-support B^3 the shifter-rod D. This shifter-rod extends from end to end of the machine, and on the end not shown in the drawings are located the devices that engage the driving-belt, these being of any well-known form and construction. This rod D has an endwise play in its bearings and is provided with locking means for securing it in any desired position, the construction of which will be hereinafter described.

On the inside of the upper part of the standards A are formed vertical guideways *l* for the needle-bar E, these consisting of a projection *a* on each of the standards cut away in such manner as to form one side of the way, a cap *a′* on each of the standards being secured to the projection and forming the other side of the guideway. On each end of the needle-bar E is secured a guide-plate *e*, that projects into the guideway *l* just described located on the end of the frame. To each end of the needle-bar E is secured a needle-bar rod E′, that engages a double cam *b* secured to the shaft B. There is also secured to the center of the needle-bar E a supplemental needle-bar rod E^2, in engagement with the double cam *b′*, also secured to the shaft B. The special construction of these cams and rods will be described farther on. To the upper part of the needle-bar E are secured the needles E^3, these needles being secured to the needle-bar in an improved manner that will be hereinafter described.

My improved machine is so constructed that the needle-bar E and needles supported thereon have a vertical reciprocation, and this forms one of the essential features of my invention. This construction of the mechanism, giving to the needle-bar a vertical reciprocation, is of especial advantage, in that the considerable weight of the said bar is utilized in drawing the needles and new loops through the old loops formed in the process of knitting, this operation requiring considerable force to overcome the combined resistance of the large number of loops, one to each needle, required to be shed at a single downward movement of the needle-bar. Another advantage of this arrangement of the needle-bar in a vertical position is that but little bearing-surface is required and very little friction is encountered in its movements. In a horizontal arrangement of the needle-bar the weight causes considerable friction in the bearings supporting the bar. The supplemental needle-bar rod E^2, connected centrally of the shaft B and needle-bar E, serves as a central support to the needle-bar, preventing a downward springing movement of the latter.

As shown in Fig. 5 of the drawings, the needle-bar E has an angular form in cross-section, the needles being supported on the vertical part of the bar and the needle-bar rod being connected to the horizontal portion.

Projections *a* are located on the inside of each of the standards A and near the top thereof. Openings 10 are made in these projections, and a recess or groove a^5 is formed on the inner face of the projection, as shown in Fig. 6 of the drawings. A foot or bracket a^2 extends downward from the projection *a* and forward, underlying the sinker-bar support F′, as shown in Fig. 18, located in the recess a^5. This recess a^5 is shouldered to form a guide for the sinker-bar support F′, the latter having a vertical movement in the recess. The sinker-bar supports F′ have slots F^2 and the headed studs a^8 are extended from the opening 10 through the slots in the supports F′, the latter being held in place by means of nuts a^7, secured on the outer threaded ends of the studs. These nuts a^7 are located in the grooves a^8, which hold them against rotation therein. Grooves extend inward from each of the feet or brackets a^2, and in these grooves are located bolts a^3, the bolt being held against lengthwise movement in the groove by means of collars located on opposite sides of the brackets a^2, the bolt, however, having a free rotary movement in the groove. The inner threaded end of the bolt fits a threaded hole through the support F′, as shown in Fig. 17 of the drawings. This bolt a^3 is used to adjust the support F′ in a vertical position and the nuts a^7 clamp them securely in place when the desired position has been reached.

The upper edges of each of the supports F′ are cut away toward the center of the machine, and the guide-plates F^3, secured to each end of the sinker-bar F, rest in this cut-away portion of the support F′. Guide-plates F^9 are secured to the upper surface of each of the supports F′ and overlie the guide-plates F^3, thus securely holding the sinker-bars in position, but allowing a free sliding movement in the recess 2, formed between the cut-away portion of the supports F′ and the guide-plates F^9.

The sinker-bar is supported as above described just back of the needle-bar E.

Each of the projections *a* is cut away on its front portion, as shown in Fig. 6 of the drawings, and plates *a′* are secured to the projec-

tions a, leaving a recess between the plate and the cut-away portion of said projection a, and in these recesses are located the guide-plates e, secured to the needle-bar E. These plates are held in the guideways, so that the needle-bar has a free vertical movement in the recess, the bar being supported by the needle-bar rod E′, as before described.

The sinkers F^4 are secured to the upright part of the angular sinker-bar F in a manner that will be hereinafter described.

Secured to each end of the upright portion of the sinker-bar F are the brackets F^5, to which are secured one end of each of the adjustable connecting-rods F^6, one end of each rod being pivoted to one of said brackets and the opposite end to the upper end of a forked sinker-bar lever F^7. The connecting-rods F^6 are threaded on each end, the threads being of opposite pitch or running in opposite directions, and the rods have between their ends a squared portion or the like, by means of which they may be turned, as by a wrench. Each threaded end of each of the rods is borne in a corresponding threaded socket in each of its supports, and by turning the rod, as by means of a wrench, the sinker-bar F and the sinker-bar lever F^7 are drawn together or separated as the case may be. These levers are in engagement with the double cams b^2 secured to the main shaft B. The construction of these levers and cams forms the subject-matter of a separate application Serial No. 472,258, filed April 28, 1893, and will be more specifically described hereinafter.

The thread-guide bar G is of L-shape in cross-section, as shown in Fig. 5 of the drawings, and to the lower part are secured the thread-guides G′ in a manner that will be hereinafter described. Secured to each end of the thread-guide bar G is a thread-guide journal G^2, that is preferably of rectangular shape on that portion in contact with the thread-guide bar and of rounded shape as to the remainder. These journals G^2 are supported in the adjustable bearings g, that are supported on the adjusting-screws g', located on opposite sides of the bearing in any suitable manner, as by means of a curved recess on the end of each screw receiving the curved outer surface of the bearing, this forming a universal joint. These adjusting-screws g' project through threaded openings in projections A^4 upon supporting-blocks A^7, adjustably mounted in grooves in the upward extensions A^5 of the standards A and are provided with the lock-nuts g^2. The journal for the thread-guide bar has a longitudinal movement within the adjustable bearings g, and also a rotary movement therein, and the mechanism just described allows for a vertical adjustment of the bearings to accommodate itself to another adjustment now to be described.

An arm g^4 is loosely mounted upon the journal G^2, the lower end of the arm being provided with an elongated slot, as shown in Fig. 2, said slot being adapted to receive the outer end of the stud g^5, adjustably mounted in the upper end of the lever G^3 by any suitable means, such as a shoulder and clamping-nut, as shown in Fig. 1, the object of adjusting the stud g^5 being to vary the amount of throw imparted to the arm g^4 and guide-bar G. The lever G^3 is pivoted upon the standard A, the lower end being in engagement with the cams b^3, this mechanism giving to the guide-bar G a rocking movement. The provision for adjusting the stud g^5 may be used whenever the bearing g is adjusted or when made necessary by any other change in the relative position of parts. The upper part of the arm g^4 projects rearwardly, as shown in Fig 2, and is forked, each arm g^{10} of the fork being provided with an adjusting-screw g^{11}, between which is located the end of an arm g^{12}, rigid upon the bearing G^2, so that by turning the screws g^{11} the position of the guide-bar and its guides with relation to the needles may be adjusted. A set-screw is provided by means of which the arm g^4 may be secured to the journal G^2.

The outer ends of the journals G^2 have a bearing on the adjusting-screws g^6, provided with the lock-nuts g^7 and located in the upper end of the levers G^4. These levers are pivoted in the projections A^6 from the standards A, the lever and the projection each being provided with a lengthwise slot through which project adjustable studs g^8. The studs g^8 are secured to the projections A^6 by means of the nuts g^{13}. On the opposite end of each of the studs g^8 is secured a bushing g^{14} that passes through a slot in the lever G^4, the nut g^{15} being used to clamp the lever to the bushing. A nut g^{16} is secured on the outer end of the stud g^8 to secure the bushing in place. This provides for the vertical adjustment of the stud both in its bearing in the projection A^6 and in the lever G^4. The lower end of each lever G^4 is provided with a cam-surface projection in engagement with the cam b^4, borne on a stud b^{15}, secured to the standard A. Secured to this cam b^4 is the gear b^6 in mesh with the gear b^7, secured to the main shaft B of the machine. This mechanism just described is used for giving to the thread-guide bar G a longitudinal reciprocation in the bearings g.

In the operation of the guide-bar in the manufacture of a knitted fabric in order to secure a coarser or finer stitch in the knitting process it is required that the thread-guide bar shall have a greater or less longitudinal reciprocation to cause it to pass by the requisite number of needles desired to produce such stitches, and in order to utilize one cam to produce this varied longitudinal reciprocation of the thread-guide bar the mechanism above described is employed. The cams for producing this movement are costly, and time is required to make changes. When a greater or less reciprocation of the thread-guide bar is desired, it is simply required to loosen the

nut on the adjustable stud g^8 and secure it in place in a different position, thus changing the fulcrum and giving to the lever a greater or less throw at its upper end as desired. The lever G^4 may also be lowered or raised, if desired, to regulate the tension or for any other purpose, and in this case the use of the adjustable bearing g and of the adjustable stud g^5 become apparent.

Each of the thread-guide-bar supports A^4 is formed on the outer end of a supporting-slide A^7 that is borne in a recess in the extension A^5 of the standards A, (see Fig. 2 of the drawings,) the supporting-slide being secured to the upward extension by means of bolts g^2 passing through slotted openings in the slide. The back part of the slide has an angular bend extending at right angles to the body thereof and lying on the back part of the extension A^5. In this angular bend is located an adjusting-screw a^4, this affording a horizontal adjustment of the slide A^7.

Bat-feed device.—The bat-feed device is located between the standards A at the top thereof and is supported on said standards in such manner as to have a horizontal reciprocation, a portion also having a vertical reciprocation. To each of the upward extensions A^8 is pivoted one end of the slotted arm H, the other end of this arm being pivoted to the actuating-rod I. This rod is in engagement with the cam B^5, secured to the main shaft, and is of a construction similar to the other levers or rods in engagement with similar cams located on this shaft, with the exception that a slot I′ is formed in the lower end of the lever, the main shaft passing through this slot. (See dotted outline, Fig. 5, of the drawings.) This rod causes the vertical oscillation of the bat-feed device as a whole. The side bars J of the carriage extend from side to side of the standards A, the forward end of each bar being supported on the removable stud k that extends through the side bar and through a slot in the arm H, a collar pivoted on this stud being formed flat as to its upper and lower sufaces, in order to slide within the slot in the arm H, and one end of the stud may be headed and the other end screw-threaded and provided with a nut for securing the same in place, a shoulder on the stud being provided against which the nut abuts in order to avoid any binding of the nut upon the sliding parts. A brace (not shown in the drawings) extends from end to end of the machine, each end being secured to a side bar J, and the brace may be located in any convenient position, preferably about midway of the ends of the side bars. In the upper back portion A^9 of each of the standards A is a slot through which extends the stud k', a collar pivoted on this stud being flat as to its upper and lower surfaces, and moves back and forth within this slot on the standard, that portion of the standard forming the upper walls of the slot being preferably removable, as shown in the end view, Fig. 2, of the drawings. These studs k' pass through the side bars J, forming a pivotal support for the said bars, and to the inner end of these studs k', or to a bracket located adjacent thereto on the side bar, is pivoted one end of each of the arms k. These arms K extend downward and forward and are connected to the eccentrics b^6, secured to the main shaft of the machine. These eccentrics b^6 may be of any well-known construction, and each, as shown herein, consists of two separable portions b^7 b^8, having a central annular groove in the periphery thereof, and located in this groove are the straps b^9 b^{10}. The strap b^{10} extends around one-half of the eccentric, and on its upper side is provided with a socket-piece b^{11}. The two straps are secured together in the usual manner by means of bolts, and a supplemental bolt may also be used between the two halves of the eccentric as an additional means of securing them together. The socket-piece b^{11} is provided with slots, through which and through the arm K extend the bolts b^{12}, thus adjustably connecting the arm K and the eccentric. On the side bars J are provided bearings j for the reception of the tension-roll L. At the rear end of each of the side bars J is supported the slide l, that extends around the side bar J in such manner as to have a sliding movement lengthwise thereon. The side bar is provided at this point with a slot l', a bolt extending through the slide l and through this slot, affording a means of securing the slide in any desired position. Through the angular end l^2 of the side bar J extends the adjusting-screw l^3, provided on its outer end with a suitable hand-wheel, the inner end being screw-threaded and taking into a screw-threaded opening in the slide l. On the upper part of the slides l are arranged the bearings for the apron-roll M, these bearings, consisting of boxes l^4, supported in a semicircular projection from the slides l. These boxes rest on the slides l and are each secured in place by means of screws l^5, projecting downward through the semicircular arms and taking against the boxes l^4, thus holding the bearings securely in place. (See Figs. 2 and 13 of the drawings.) The forward ends of the side bars J are formed with integral lateral projections m, extending for some distance toward the center of the machine when the bars are in place thereon, and to these projections are secured, as by means of bolts, the forward apron-support m', the apron N extending around this support m' and around the roll M, the lower portion of the apron passing over the tension-roll L. This apron-support m' extends from end to end of the machine and forms in addition to the apron-support a forward brace for the carriage, forming the bat-feed device. To the upper side of this support m' on each end thereof are secured, as by means of bolts, the adjustable brackets m^2, provided with the bearings m^3 m^4. Within the bearings m^3

is supported the bat-clamp that consists of the supports m^5, pivoted in the bearings m^3 and extending between and secured to said supports m^5, as by means of bolts m^6, the angular bat-clamp bar O. This bar extends across the machine from end to end and supports the bat-point plates o' that are secured thereto, as by means of bolts, the bat-points o^3 being held in suitable grooves in the plates o' and clamped between said plates and said bat-clamp bar. The bat-points are so secured to the plate or plates o' as to project forward beyond the ends of the plates and between the needles, the clamping of the bat upon the apron being accomplished by said plates or bat-point bar, or both, and not by the ends of the bat-points, this forming an important feature of my invention. Within the apron-support m', at the rear thereof, are located the adjusting-screws m^{16}, each provided with a collar m^7, engaging a recess in the adjustable bracket m^2. The bolts securing said brackets to the apron-support m' pass through enlarged openings in the brackets, and by means of the adjusting-screws m^{16} an adjustment of the brackets toward and from the needles may be secured. Extending through the bearings m^4 on each of the brackets m^2 are the shafts m^{17}, to which are secured the slotted rockers m^8. Each rocker is slotted at its forward end and engages a lug m^9, located on the support m^5. To the opposite end of each shaft m^{17} is secured a lever m^{10}, and on this lever m^{10} is supported a roller m^{11}, in such position as to engage the cam-surface on the lug m^{12}, located on the upright A^3 of the thread-supplying device. To the opposite end of this lever m^{10} is secured one end of the spring m^{13}, the other end of the spring being secured to any fixed part of the carriage and tending to hold this end of the lever m^{10} in a downward position.

The bat in a continuous sheet may be folded on a shelf located at the rear of the machine and extend up over the apron N and underneath the bat-clamping device above described, and the arrangement of this mechanism, as described, is such that as the carriage moves forward the pull of the spring m^{13} upon the rear end of the lever m^{10} raises the forward end of the said lever, and consequently the rear end of the supports m^5, this rocking the forward end of the supports m^5 downward and causing the bat-point bar or clamp to come in contact with the bat and hold it until a sufficient quantity has been removed from the sheet in the process of knitting. In this operation the edge of the bat is projected over and upon the ends of the needles, the thread-guides then laying a loop or stitch across each needle in such manner as to clamp the edge of the bat to the needles and hold it so that a portion will be torn off in the backward movement of the bat-feed. As the carriage moves backward the roller m'' moving up the cam-surface on the lug m^{12} causes the bat-clamp to be lifted from the bat, and in the movement of the apron, which at this time is given a step-by-step movement by a mechanism that will be hereinafter described, the bat is allowed to be fed forward a sufficient distance to supply the required amount of bat to the needles to be incorporated in the fabric as the next stitch is completed by the machine.

The upright supports A^3 are secured to the standards A, the upper ends of the supports being provided with the slots c, affording a bearing for the tension-roll c'. Braces extend between the supports A^3, as shown at c^2, in Fig. 3 of the drawings. On the forwardly-extending arms c^3 of the uprights A^3 is supported the roll c^4, over which the threads c^5 extend downward to the thread-guides. On the brackets c^6, supported on the front of the arms c^3, are formed bearings for the supplemental thread-rolls c^7, these rolls or bobbins being used to supply thread to the needles when for any reason a thread has become broken, the thread being supplied from these bobbins until such time as the broken thread has been unwound a sufficient distance from the main thread-roll to enable a connection again to be made with the needles. Each standard A^3 has also a rearwardly-extending arm c^8, on which is supported the main thread-roll c^9, that supplies the thread to the guides and needles for use in the fabric that is being knitted in the machine. On each end or on both ends of the shaft bearing the main thread-roll c^9 is secured a drum c^{10}, around which may be wound, any desired number of times, a rope or like device c^{11}, one end of this rope being secured to the arm c^8 and the other end bearing a weight c^{12}. This device provides means to be used as a tension on the thread in addition to the roll c', this tension being governed by the number of turns of the rope c^{11} about the drum c^{10}. The rolls c^4 and c^9 are each supported in slotted bearings in the arms c^3 and c^8, respectively, in order to enable them to be removed at any time when desired.

The cams and driving-rods or actuating-levers in connection therewith for imparting vertical movement to the needle-bar, longitudinal reciprocation to the thread-guide bar, horizontal reciprocation to the sinker-bar, and vertical reciprocation of the bat-feed device are of special construction and are made the subject-matter of a separate application, filed April 28, 1893, Serial No. 472,258, but are described herein as being of especial advantage in connection with a knitting-machine of this class. These cams are so constructed as to form in one structure, and integral each with the other, what may be termed a "double" cam—that is, on one cam are formed two separate cam-surfaces, one cam giving to the lever a certain movement and the other cam causing a positive return movement of the same lever.

In Figs. 11 and 12 are shown devices for giving a vertical and a horizontal reciprocation to the needle-bar and to the sinker-bar, respectively. Each needle-bar rod E' is se-

cured to the under side of the needle-bar, and to this rod is secured a stud e', that supports a roller e^2 in engagement with one of the cam-surfaces on the cam b. One end of the stud is provided with a head and the other with a washer and nut to hold it in place. In the lower end of the needle-bar rod E′ is provided a longitudinal slot e^3, within which is secured a stud e^4, on which is mounted a roller e^5 in contact with the opposite cam-surface on the cam b. Projecting upward through the under side of the rod E′ is the adjusting-screw e^6, the inner end of which bears against the stud e^4, this construction of slot and stud providing means whereby a vertical adjustment of the stud may be obtained in order to take up any wear that may be occasioned between either of the rollers e^2 or e^5 and the cam b. A washer e^7 is inserted between the head of the bolt e^8 and the surface of the rod E′, the opposite end of the stud e^4 being provided with a like washer and with a head to prevent the stud from pulling through the slot in the rod E′. In Fig. 12 is shown one of the sinker-bar levers F^7, that imparts to the sinker-bar a horizontal reciprocation. This lever is pivoted at f and has the branched arms f' f^2. Through the arm f^2 projects the stud f^3, on which is mounted the roller f^4 in engagement with the cam b^2, one end of the stud being headed and the opposite end being provided with washer and bolt to screw the parts in place.

In the end of the arm f' is a slot f^{13}, through which projects the stud f^{14}, on which is mounted the roller f^5 in engagement with the opposite surface of the cam b^2, one end of the stud being provided with a head and the other with a nut and washer to secure the same in place. A screw f^6 projects through the end of the lever into the slot f^{13} and abuts against the stud f^{14}, this screw and slot providing means whereby an adjustment of the stud, as before described, may be obtained. It is obvious that this means of adjustment may be provided on each of the rollers in contact with the cam-surfaces.

By reference to Figs. 5 and 9 of the drawings it will be seen that the needles have their lower ends bent laterally, which bent ends terminate in a longitudinal slot in the needle-plate, which is secured to the needle-bar E by bolts, said needles having a bearing at their shanks in vertical grooves in said needle-plate, a cap secured to the needle-bar holding the needles in place. This construction and arrangement of the needles, needle-plates, and needle-bar are of special advantage in knitting-machines, and it constitutes the subject-matter of a separate application filed April 28, 1893, Serial No. 472,259.

The cams b^4 which actuate the levers G^4 to impart a reciprocating motion to the thread-guide bar G, (there being one cam at each end of the machine,) will be oppositely arranged relative to each other in such manner that when the lever at one end is moved outward the lever at the opposite end will move inward, and vice versa.

Inasmuch as the needle-bar, sinker-bar, bat-bar, and thread-guide bar have the usual relative movements one to the other, and their functions being unchanged, it is deemed unnecessary to burden the specification with a minute description of an operation so well known in the art to which this appertains.

By the construction and arrangement of the bat device to reciprocate in a horizontal plane I secure an improvement over a bat device having vertical reciprocation and thus preclude the admission of air between the bat and apron, which air caused the bat to slip and resulted in an uneven feed, especially when the apron became greasy, as the bat would not adhere to the apron sufficiently to feed upward over the edge at the knitting-point, and frequently it was necessary to remove the apron when it became greasy.

With a horizontally-reciprocating bat-feed a greasy apron has special advantages, as it permits the free presentation of bat to the needles without adhesion to the apron.

The belt-shifter rod D, as before described, extends along the front of the machine from end to end and is provided at suitable intervals with handles d, this enabling the machine to be stopped or started by the operative from any part along the front of the machine.

In order to prevent the machine from being accidentally started by the operative when engaged in changing needles or in any other duty whereby the hands may be placed in dangerous positions in the working parts of the machinery, as by a pressure of the body upon the belt-shifter rod, an automatic locking device is provided. The bearings for the belt-shifter rod D are slotted, so as to allow of a vertical movement of the belt-shifter rod within the bearings, and said bearings are provided with recesses d', adapted each to engage a collar d^2 on the shifter-rod.

When it is desired to start or stop the machine, the shifter-rod is lifted out of engagement from the recesses and is moved to the desired position, when the hold upon the rod is released and the rod falls into position with the collar engaging the other recesses in the bearing. It is obvious that this locking feature may be embodied at either or both ends of the machine, or in place of the bearing being provided with the locking feature a plate may be located on the frame of the machine outside of the bearing and provided with recesses, a collar on the shaft being adapted to engage these recesses.

The arms K, connected to the eccentrics b^6, are described herein as having their inner ends attached to the stud k' or to a bracket j', located adjacent thereto, and in Figs. 14 and 15 is shown this latter form of connection. The operation of the parts would be the same if this arm K was pivoted on the stud k'; but in the use of some sizes of sprocket-

wheels in connection with the apron-roll feed the chain passing over the sprocket-wheels would come in direct line with this stud k', and to avoid this conflict in the use of said sizes of sprocket-wheels the bracket j', herein referred to, is made use of.

Apron-roll feed.—The bat used in the manufacture of the peculiar fabric made on this machine is preferably laid in folds on a shelf and extends upward and rests on the apron N. This apron, extending around the roll M, around the forward end of the apron-support m', and over the tension-roll L, has an intermittent motion given to it by the mechanism, as follows: (See Figs. 13, 14, and 15.) Secured to the end of the roll M, or to the shaft thereof, is a sprocket-wheel m^{15}, around which and the sprocket n extends the chain o^2. The sprocket-wheel n is secured to a stud n', mounted in one of the side bars J of the bat-feed device, and there is also secured to this sprocket the gear-wheel n^2, in mesh with the gear n^3, secured to the shaft n^4. On the side bar J is an integral projection j^2, and extending for some distance and having a bearing within an angular opening in the projection j^2 is the projection j^3, located on the retaining-pawl support j^4, on which are pivoted the retaining-pawls j^5. The shaft n^4 is rotatably mounted in the projection j^3, and on the outer end of this shaft is secured the ratchet-wheel n^5. On the shaft n^3, just back of the ratchet-wheel n^5, is loosely mounted the driving-pawl support n^6, on which are pivoted the driving-pawls n^7. On the back side of the driving-pawl support n^6 is a pin n^8, movable in a longitudinal slot p', located in the adjustable stop p. Within one end of this adjustable stop p is located the buffer p^2, provided with a spring p^3 within the stop, and against which the pin n^8 is adapted to be forced. The smaller threaded end of the stop p passes through a pivoted support p^4, supported on the frame of the machine, and located on the threaded end of the stop p, on one side of the pivot-support p^4, is the adjusting-wheel p^5, and on the opposite side of the support the lock-nut p^6. This affords a longitudinal adjustment of the stop p, which enables any degree of movement to be given to the ratchet-wheel n^5. It will be noticed that two driving and retaining pawls are used in connection with the ratchet-wheel n^5, the longer of each of these pawls being in engagement with the edge of a tooth, while the shorter of the pawls rests half way between the two edges of adjacent teeth. This is in order to enable the ratchet to be turned a half-tooth space at each backward movement of the side part J of the bat-feed device, the next rearward movement of this side bar bringing the shorter of the pawls into engagement with the edge of a tooth and the longer resting half way between two edges.

The operation of the device is as follows: All of the moving parts being located on the carriage or bat-feed device have a horizontal reciprocation, and in the rearward movement of these parts the pin n^8, coming in contact with the spring-buffer p^2, located in the stop p before the carriage has reached its rearward reciprocation, causes the ratchet-wheel n^5 to be fed forward a certain distance through the medium of the driving-pawls n^7 and depending upon the adjustment of the stop p. This forward movement of the ratchet-wheel n^5 turns the shaft to which it is secured, and also the gear n^3, in mesh with the gear n^2, secured to the shaft n'. This latter movement has revolved the sprocket-wheel n, secured to the shaft n', and through the latter and the chain o^2 revolves the sprocket m^{15} and the apron-roll M.

Fabric-roll feed.—On each end of the rear girder A′ are supported inclined rests for the fabric-roll q, around which is wound the fabric after it has been completed on the machine. This roll is caused to rotate by friction and by mechanism shown in the lower right-hand corner of Fig. 2 of the drawings. In a bracket r, fast to the standard A, is secured a stud r', on which is mounted a ratchet-wheel r^2. There is also secured to this ratchet-wheel a gear-wheel r^3, and pivoted on the stud r' is the lever s, upon which is a pawl s' in engagement with the teeth of the ratchet-wheel. To the upper end of the lever s is secured one end of a spring s^2, the other end of the spring being adjustably secured to the frame by means of a screw-bolt and thumb-screw attached to the spring, as shown at s^3. There is also secured to the upper end of the lever s the connecting-rod s^4. One end of this rod is slotted, and through this slot and the lever s extends the bolt s^5 loosely borne in the rod. The bolt s^5 is loosely borne in the slot in the rod for the purpose of causing a lost motion of the rod s^4, and to vary the extent of throw of the lever s and consequently the extent of rotation of the ratchet-wheel r at a single throw of the lever s. The spring and thumb-screw shown at s^3 are used to determine the position of the lever s when not actuated by the rod s^4, and the lever s may be thrown forward and backward by the connecting-rod s^4, or it may be thrown forward by said rod and drawn backward under the impulse of the spring. The other end (not shown) of the rod s^4 is connected to the rocking-lever G^3 at the front of the machine, this lever G^3 having, as before described, a horizontal reciprocation for the purpose of giving a rocking movement to the thread-guide bar. Secured in bearings in the lower part of the frame A is a friction-roll t, to one end of which is secured the gear t', in mesh with the gear r^3, secured to the ratchet-wheel r^2, this friction-roll extending from end to end of the machine. There is also mounted in the frame of the machine an intermediate friction-roll t^2, that also extends from end to end of the machine, as shown in full and dotted lines in Fig. 2 of the drawings. This latter roll is so mounted in the machine that it has a bearing against the roll t, and also in such posi-

tion that the fabric-roll q, located on the inclined bearings, rests against its periphery. The fabric extending downward from the fabric-forming devices at the front of the machine passes to the rear, around the under side of the roll t, upward between it and the roll t^2, around the upper part of the roll t^2, and downward between it and the fabric-roll q, and thence around the latter, upon which it is wound. Fabric-guide rolls at the front of the machine may be used, if desired. It will be seen from this construction that upon each rearward throw of the rocking-lever G^3 the ratchet-wheel r^2 is rotated to an extent depending on the location of the upper end of the lever s, that is determined by the tension of the spring regulated by the thumb-nut at s^3. This turning of the ratchet r^2, through the medium or the gears r^3 and t', rotates the roll t, and by friction, through the medium of the latter and the roll t^2, the fabric-roll q is rotated in order to wind the fabric threreon.

I claim as my invention—

1. In a knitting machine, a needle bar having a vertically reciprocating movement, a sinker-bar having a horizontally reciprocating movement, a thread-guide bar having a longitudinal reciprocation and lateral oscillation, and a bat-mechanism having an intermittent horizontally reciprocating and vertical movement, and mechanism to impart said movements to the said several devices in proper relation one to the other, substantially as and for the purpose described.

2. In a knitting machine, a bat-feed device having a horizontal sliding bearing in the frame of the machine at the rear end and a sliding bearing at its forward end in slotted bars pivotally connected at one end to the frame, and capable of vibration, the slotted bars and mechanism to impart a horizontal reciprocation to the bat device and a vibratory motion to the forward slotted support and consequently to the forward end of the bat device, substantially as described.

3. In a knitting machine, the bat-feed device comprising the side bars J of the carriage carrying the apron-roll M at one end and the apron support m' at the other end and having a sliding bearing at the rear end in the frame of the machine and having a sliding bearing at the forward end in slotted bars H, the slotted bars pivoted at one end to the frame of the machine, in combination with rods pivoted thereto and engaging cams upon the main shaft, and arms pivoted to the rear end of the carriage and connected with eccentrics upon the main shaft whereby horizontal reciprocation is imparted to said bat carriage and an oscillating or vibratory motion is caused at its forward end, substantially as described.

4. In a knitting machine, the bat carriage borne on the frame of the machine and comprising the two side bars J having the apron-roll M adjustably mounted at the rear end and having the fixed apron support m' at the forward end, the tension roll L mounted in the side-bars J and interposed between the apron-roll and apron-support, and the apron extending around said roll M, support m' and overriding the tension roller, in combination with mechanism for imparting reciprocating motion to said bat carriage in horizontal and vertical planes, all substantially as and for the purpose specified.

5. In a knitting machine, the combination with the apron-supporting bar of the bat device, of a bat clamp pivoted in brackets adjustably secured to the apron-support, and means to elevate and depress said bat-clamp, substantially as specified.

6. In a knitting machine, the combination with the apron-supporting-bar m', of the bat-clamp comprising the brackets m^2 adjustably secured to the ends of the bar m' and having the bearings m^3, m^4, therein, the bat-clamp support m^5 fulcrumed at its forward end in the bearing m^3 in the bracket and having a lateral projection at its rear end, the angular bat-point bar secured to said support, and means for rocking the support and bat point bar, substantially as and for the purpose specified.

7. In a knitting machine, the combination of the apron support m', the brackets m^2 adjustably secured thereto, the bat-point bar secured to supports fulcrumed at their forward ends in bearings in the brackets m^2, and having a lateral projection at the rear end, a rocker m^8 pivoted to the bracket and slotted at its forward end and engaging the projection m^9 upon the support, and means to operate said rocker to elevate and depress the bat point bar, substantially as described.

8. In a knitting machine, the bat device comprising a sliding carriage supported on the frame, and having the apron-support at its forward end, the bat-clamp fulcrumed in brackets upon said support, the lever m^{10} having the rocker m^8 to engage and rock the bat-clamp and having the roller m^{11} thereon, in combination with a cam-lug m^{12} upon the frame which forms a ride for the roller in the backward movement of the carriage and elevates the bat-clamp arms supporting the forward end of the carriage, means for imparting a vertical movement thereto, and means for reciprocating the carriage substantially as described.

9. The combination with the apron support m' of the bat clamp-bar O secured to supports fulcrumed in brackets adjustably secured to the apron support, the bat-point-plate o' bolted to said bar O and having the bat-points projecting therefrom in such manner that they contact with the bat in advance of and exert no pressure upon the apron support, substantially as described.

10. The combination with the apron support m' and the bat-clamp fulcrumed upon brackets secured thereto, of the pivoted lever m^{10} operatively connected to the bat-clamp and having a spring connected to its free end,

and having a lateral projection, and a fixed plate having an inclined cam-face to form a ride for the projection upon the lever and govern its vertical movement, substantially as described.

11. In a knitting machine, the angular thread-guide bar G having the thread-guides G′ secured to the lower forward edge thereof and having circular journals at its ends, journal bearings *g* therefor supported on blocks A^7 adjustably secured to uprights upon the frame of the machine, and mechanism to impart a longitudinal reciprocation and an oscillating motion to said thread-guide-bar, substantially as described.

12. In a knitting machine, in combination with the frame, a horizontal shaft bearing cams and eccentrics, a vertically reciprocating needle bar, a horizontally reciprocating sinker bar, and a longitudinally reciprocating and laterally rocking thread guide bar supported on the frame, rods and levers connecting said devices with their respective cams to impart said respective movements, a horizontally reciprocating and vertically moving bat feed device pivoted in slotted bearings on the frame, means for reciprocating the bat feed device, and means for causing a vertical movement of the same, all subtantially as described.

13. The combination with the frame and thread-guide bar, of the supporting block A^7 adjustably secured to the frame and having projections A^4, the journal bearing *g*, in which the guide-bar is journaled, adjustably supported between said projections by adjusting screws *g′* extended therethrough and the adjusting screws, substantially as described.

14. In a knitting machine, in combination with the apron supporting bar of the bat feed device, the brackets secured to said bar, the bat clamp pivoted in said brackets and with its forward end adapted to bear upon the apron-support, the plates bearing bat points located on the upper side of the bat clamp, and means as described for rocking said bat clamp, all substantially as described.

15. In combination with the frame a thread guide bar loosely borne in adjustable bearings in a supporting block, the supporting block adjustably secured to the frame, and the adjusting screws borne in the block and in engagement with the bearings, all substantially as described.

16. In a knitting machine, a bat carriage comprising side bars pivoted in sliding collars borne on the frame of the machine, means for reciprocating the bat carriage, and means for supporting and actuating the forward end of the carriage, all substantially as described.

17. In a knitting machine in combination, a bat feed device, the brackets borne on the frame of the bat feed and supporting an apron roll, and an adjusting screw borne in the frame and in engagement with the roll supporting brackets, all substantially as described.

18. In a knitting machine, a thread guide bar loosely supported in bearings at each end thereof, the bearings supported on adjusting screws, means for clamping the screws, and the adjustable slides supporting the adjusting screws, all substantially as described.

19. In combination with the carriage of the bat feed device, a hollow stud secured to the carriage, a pawl support having a projection located within the stud, the ratchet wheel pivot borne in the pawl support, the retaining pawl pivoted to the pawl support, the driving pawls secured to a swinging arm, a stop located in the path of movement of the arm, and means for reciprocating the carriage, all substantially as described.

20. In combination with the carriage of the bat feed device, the retaining pawl support secured to the carriage, the ratchet wheel borne in operative relation to the said pawl support, the swinging arm bearing driving pawls in engagement with the ratchet wheel, the engaging pawls, an adjustable spring buffer located in the path of movement of the swinging arm, and means for reciprocating the carriage, all substantially as described.

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