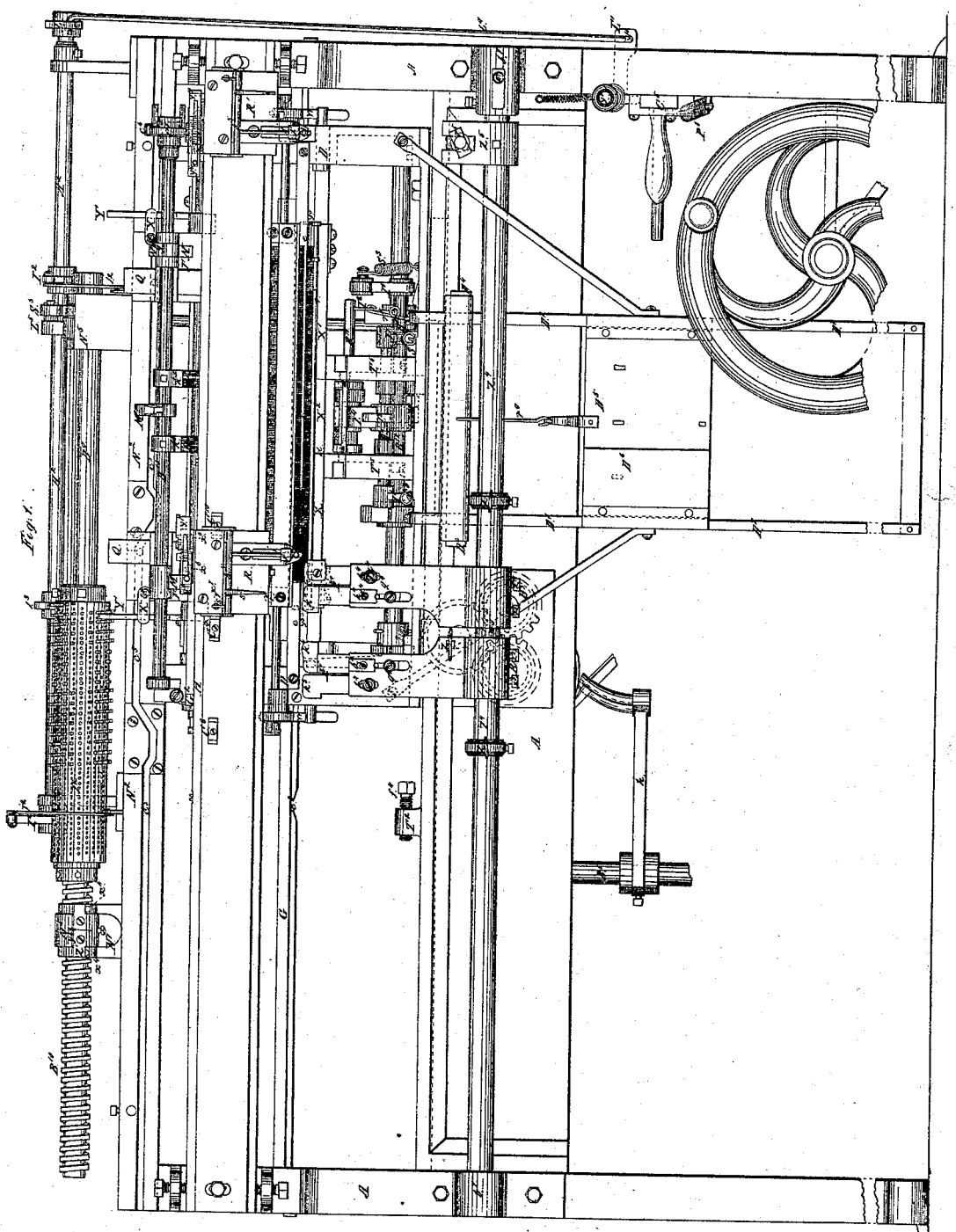
Sheet 1, 6 Sheets

E. E. Kilbourn.

Straight Knitting.

No. 47,829. Patented May 23. 1865.



Witnesses
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Sheets, 6 Sheets.

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Straight Knitting.

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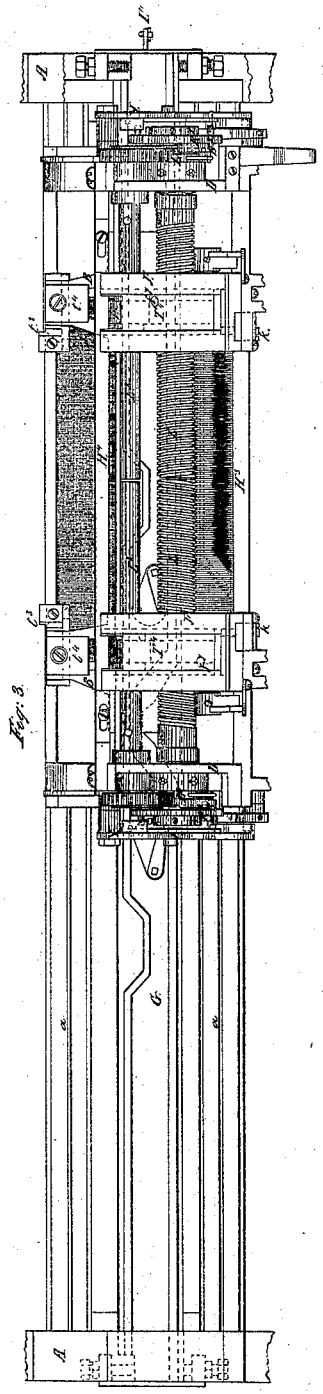

Fig. 3.

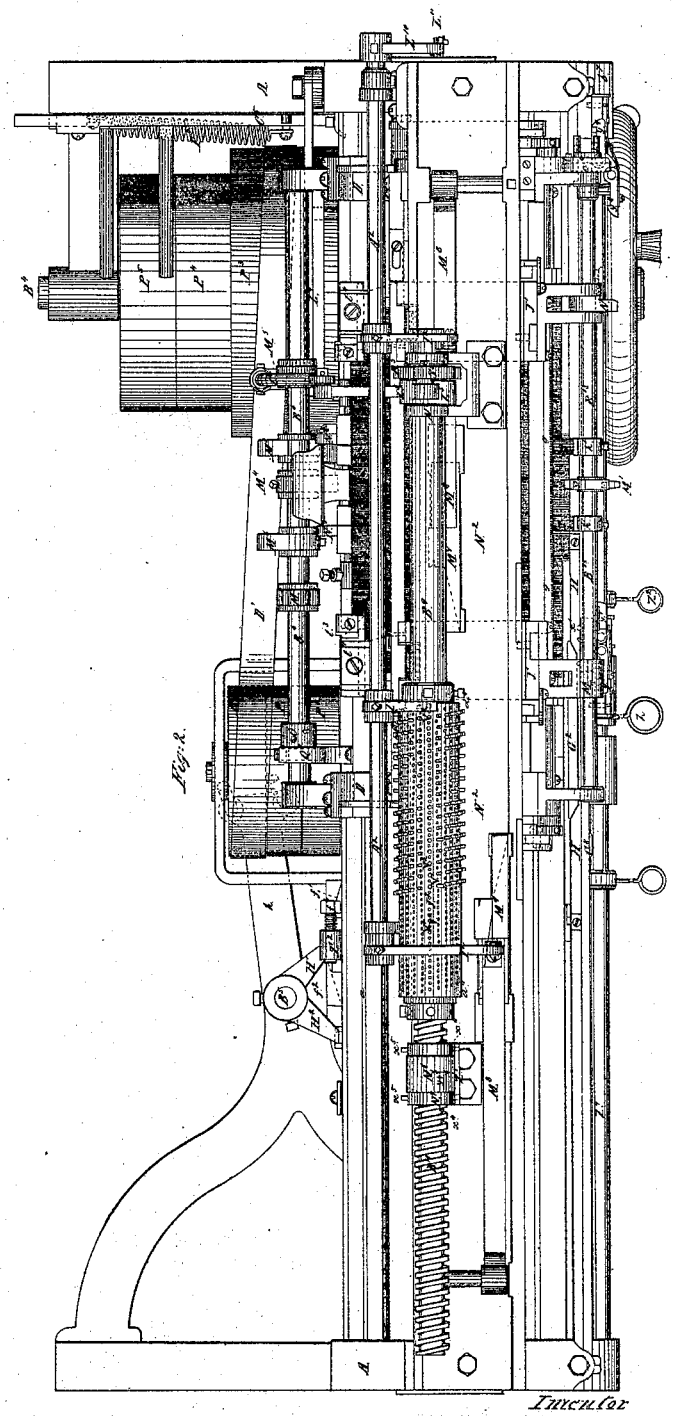

Fig. 2.

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Sheet 3, 6 Sheets

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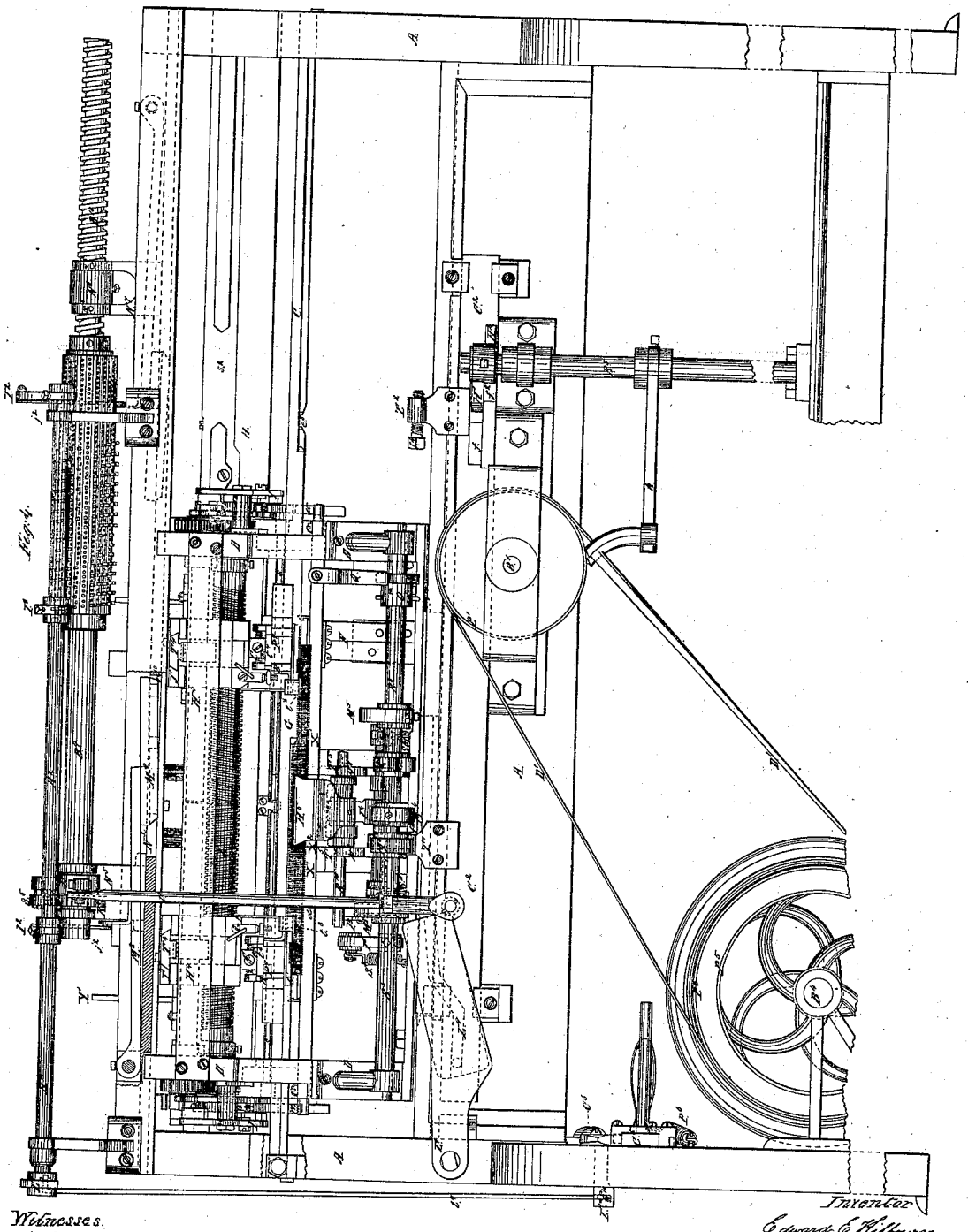
No. 47,849. Patented May 23, 1865.



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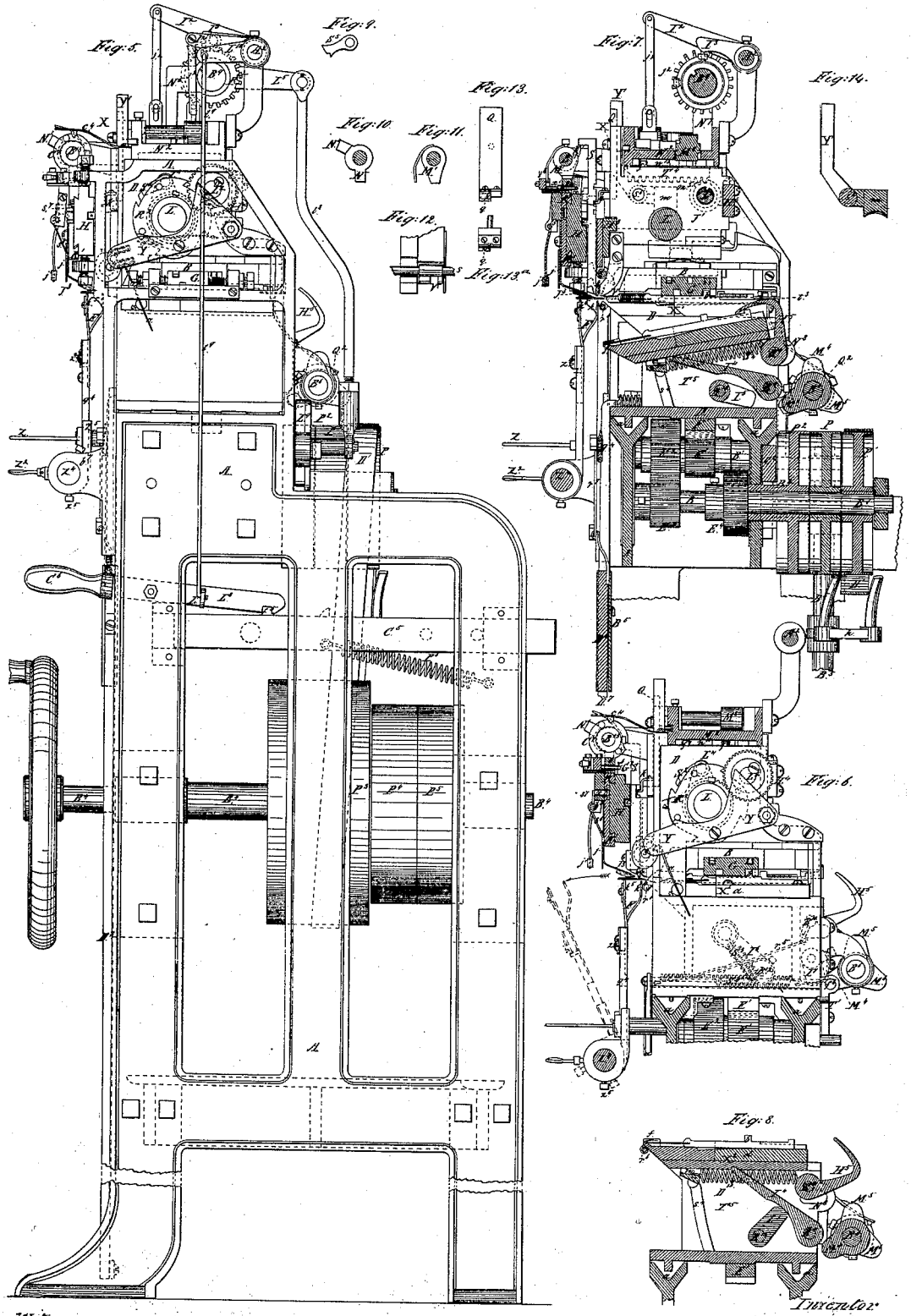
No. 47,829. Patented May 23 1865.



Witnesses.
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Sheets 5, 6 Sheets.

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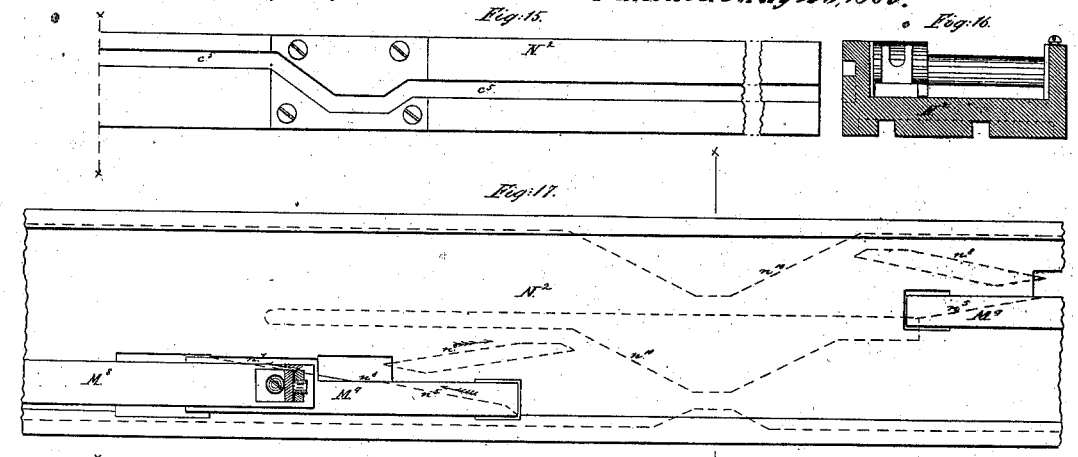
Straight Knitting.

No. 47,829. Patented May 23, 1865.



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Sheet 6, 6 Sheets.

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Straight Knitting.

No. 47,829. Patented May 23, 1865.

Fig: 32.

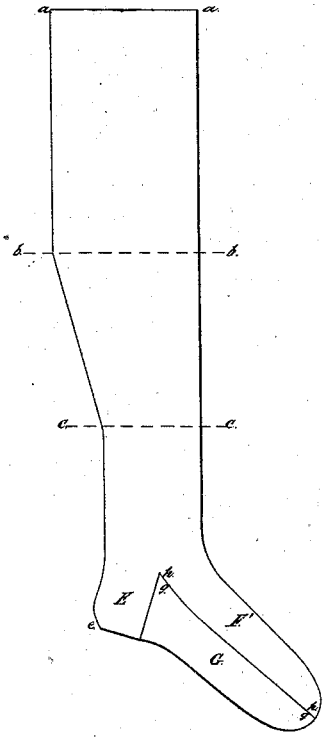


Fig: 34.

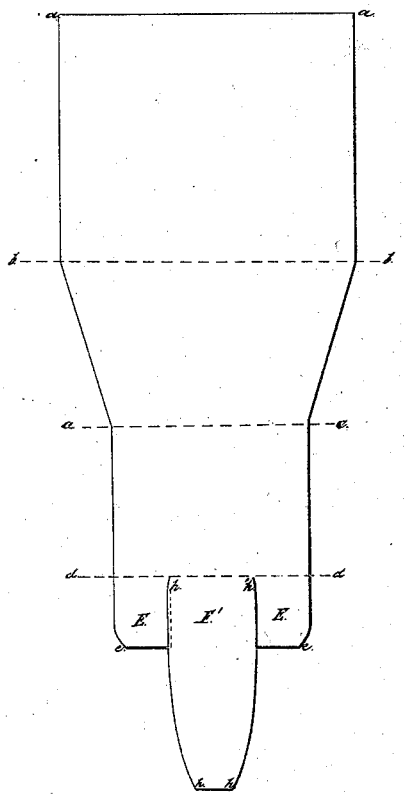


Fig: 33.

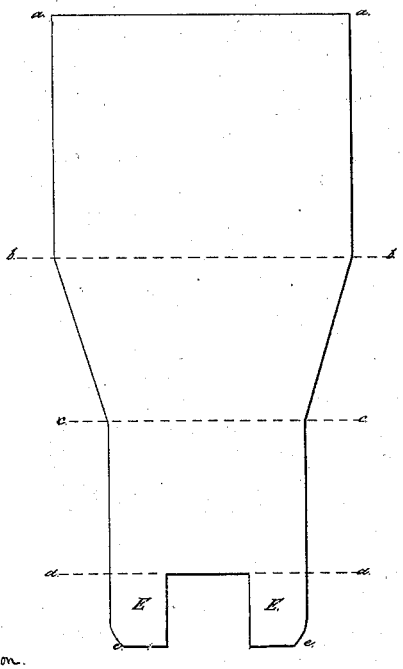


Fig: 35.

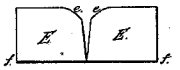
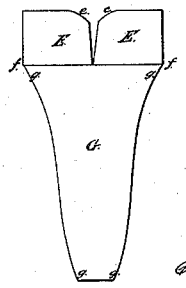


Fig: 36.



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UNITED STATES PATENT OFFICE.

EDWD. E. KILBOURN, OF NEW BRUNSWICK, NEW JERSEY.

IMPROVEMENT IN KNITTING-MACHINES.

Specification forming part of Letters Patent No. **47,829**, dated May 23, 1865.

To all whom it may concern:

Be it known that I, EDWARD E. KILBOURN, formerly of Norfolk, in the State of Connecticut, now residing at New Brunswick, in the State of New Jersey, have invented certain new and useful Improvements in Knitting Machinery; and I do hereby declare that the following is a full, clear, and exact description of the same.

The object of this invention is to knit stockings with facility and rapidity; but the invention is applicable to the knitting of other articles which require a similar mode of proceeding. The invention is made up of parts, all of which conduce to the object in view, but some of which are also applicable to the knitting of plain goods and goods other than stockings which vary in breadth.

The first seven parts of the invention have reference mainly to the construction of the mechanism for operating a traveling needle or needles for forming the stitches, in connection with a series of regular needles, more or less of which are used at any one time, according to the width of the fabric; and the first part of the invention consists of the combination of the carriage of a traveling needle of a knitting-machine with the mechanism for moving it in such manner that it can be readily disengaged from said mechanism to permit its movement by hand and can be readily re-engaged therewith.

The second part of the invention consists of the combination of the sliding rack or its equivalent through whose agency the pattern-barrel or its equivalent operates upon the traveling needle (or upon the instrumentalities for withdrawing or replacing the regular needles) with the carriage that carries that needle (or such instrumentalities) in such manner that the said rack is moved to and fro along the series of regular needles by the same instrument which moves said traveling needle or instrumentalities.

The third part of the invention consists in the arrangement of the movable cam-plates of a knitting-machine (that are controlled by a pattern-barrel or its equivalent) above the devices which they operate upon.

The fourth part of the invention consists of the arrangement of the pattern-barrel or its equivalent in a knitting-machine above the needle-carriage.

The fifth part of the invention consists of the combination of a pattern-barrel of a knitting-machine with mechanism for changing its relationship to the arm or other device upon which its pins operate, so that two rows of pattern-pins may be brought into action alternately.

The sixth part of the invention consists of the arrangement of the pins in a pattern-barrel in two helical lines commencing at opposite ends of the barrel, so that the pattern may be duplicated without moving the barrel back to enable the first pin of the row which operated last to recommence.

The seventh part of the invention consists of the combination of a cam-plate for restoring the withdrawn needles with a carriage by which it is moved along the withdrawn needles, so that the latter are restored to their positions for working by the movement of the carriage that carries the cam.

The special object of the eighth, ninth, tenth, and eleventh parts of the invention is to permit a portion of the needles at work in a knitting-machine to be thrown out of gear with the mechanism for operating them without removing them from the last row of stitches formed by them, and while the residue of the needles continue to work, and to permit the said portion of the needles to be again thrown into gear with the mechanism for operating them when required. To this end the eighth part of my invention consists in the partition of the needle-bed into divisions, each containing a portion of the needles, which divisions are so combined with the part of the machine which carries them that one of the divisions may be displaced from its normal position to move the needles carried by it out of the range of the mechanism for operating them, and may be replaced to move said needles again into range with said mechanism.

The ninth part of the invention consists of the combination of a removable division of the needle-bed with springs or their equivalents for counterbalancing its weight in part, so that the fabric is not strained by the dragging of said weight upon it.

The tenth part of the invention consists of the combination of a removable division of the needle-bed with a holder for holding the needles in their places in the said division.

The eleventh part of the invention consists

of the combination of the removable division of the needle-bed with the part of the machine which supports it by devices which permit it to move transversely to the length of the needle-bed, so that the needles in said divison, when not operating, may accommodate themselves to the position of the fabric while knitting is proceeding upon others of the needles.

The special object of the twelfth and thirteenth parts of the invention is to permit the width of the fabric to be varied automatically in the same machine in which a portion of the needles are thrown out of gear while the stitches remain upon them and while others of the needles continue to work; and the twelfth part consists of the combination, in the same machine, of one or more traveling needles with a needle-bed composed of divisions, one of which may be displaced from its normal position and replaced, as above set forth.

The thirteenth part of the invention consists of the combination, in the same machine, of one or more transferring-prongs (for transferring stitches from one needle to another) with a needle-bed composed of divisions, as above set forth.

The special object of the fourteenth and fifteenth parts of the invention is to permit the same series of needles to be employed in knitting a single strip of work or two detached strips of work. To this end the fourteenth part of the invention consists of the combination of a series of reciprocating needles with two thread-guides, one of which is movable out of gear with the mechanism for operating it when a single strip of work is being knit.

The special object of the fifteenth part of the invention is to permit the movement of the needle-carriage past the instrumentalities for changing the positions of the traveling needles when knitting narrow work without interfering with the operation of the thread-guide; and it consists of the combination of the thread-guide carriage with catches that connect and disconnect it with the device for imparting motion to it.

The sixteenth part of the invention consists of the combination of the needle-carriage with two sets of bumpers for operating two thread-guides in such manner that one of these sets may be thrown out of work when a single thread-guide is required.

The special object of the seventeenth part of the invention is to permit the thread-guide to operate at the inner side of a division of the needle-bed, which remains in place when an adjacent division has been displaced, without interference with the adjacent sinkers of the machine; and it consists of the combination of the said sinkers with a lifter for withdrawing them from the series of sinkers at work.

The special object of the eighteenth part of the invention is to permit the yarn to be depressed upon the last needle in the series which is fed without depressing the thread-guide for that purpose; and it consists in depressing the yarn by a sinker, or its equivalent for this purpose, intervening between the thread-guide and the last needle fed with yarn while the other intervening sinkers are raised.

The special object of the nineteenth part of the invention is to gripe the yarn, when necessary, without depressing the thread-guide; and it consists of the combination of the thread-guide carriage with griping devices that are independent of the thread-guide.

The special object of the twentieth part of the invention is to prevent the straining of the yarn at the selvage formed at the inner side of a division of the needle-bed, which remains in place when an adjacent division is displaced; and it consists of the combination of the needle-cam bar with a movable cam-block operating to withdraw one of the said needles to a less extent than the remainder.

The special object of the twenty-first part of the invention is to permit the under supports, which move the heads of the needles to close their barbs, to be adjusted laterally; and it consists of the combination of their stocks with the part of the machine which holds them by adjustable devices in such manner that the under supports can be moved laterally and secured in any desired position.

The special object of the twenty-second part of the invention is to permit the under supports to be readily withdrawn from their positions and replaced without disconnecting them from the machine; and it consists of the combination of their stocks with a rock-shaft or its equivalent.

The machine represented in the accompanying drawings embodies all parts of the invention, and is an illustration of one form of a machine by which the invention may be carried into effect.

Figure 1 represents an elevation of the front side of the machine. Fig. 2 represents a plan of the machine. Fig. 3 represents a plan of the machine with certain parts thereof removed. Fig. 4 represents an elevation of the hinder side of the machine. Fig. 5 represents an elevation of one end of the machine. Fig. 6 represents a partial cross-section of the machine, showing an end view of the needle carriage. Fig. 7 represents a partial cross-section through the center of the machine when the needle-carriage is in its central position and the central division of the needle-bed is lowered. Fig. 8 represents a partial cross-section of the needle-carriage when the central division of the needle-bed is raised. Figs. 9, 10, 11, 12, 13, and 14 represent views of detached parts of the machine, referred to by letters in the following description. All of the above figures to 14, inclusive, are drawn upon a scale of six English inches to one English foot. Fig. 15 represents a front elevation of parts of one-half of the upper longitudinal bar of the main frame, the front of which forms the cam-bar for lifting certain sinkers out of the way of the thread-guide; and Fig. 16, a cross-section of the same. Fig. 17 represents a plan of a portion of the same upper longitudinal bar of the frame, which carries the

movable cam-plates and stationary grades for operating the narrowing mechanism, the grades being at the under side of the bar, as shown in dotted lines. Fig. 18 represents a rear elevation of parts of the sinker-cam bar, and Fig. 19 represents a cross-section of the same. Fig. 20 represents a plan of parts of the needle-cam bar, and Fig. 21 a cross-section through the center of the same, and Fig. 22 a horizontal section of a part of the same at the line *x x* of Fig. 21. In the foregoing views of the cam-bars the line *x x* is the center of the machine. Fig. 23 represents a plan of one of the carriages of the traveling needles; Fig. 24, a front elevation of the same, and Figs. 25, 26, and 27 cross-sections thereof and of the parts adjacent thereto. Figs. 28, 28ª, 29, 29ª represent side views and edge views of the sinkers used in the machine. Figs. 30, 30ª, and 30ᵇ represent side views and an edge view of the intermediate needles, and Fig. 31 a side view of a traveling needle. Figs. 15 to 31, inclusive, are of the working dimensions. Figs. 32, 33, 34, 35, and 36 represent views upon a small scale of the fabric produced by the machine, as will be hereinafter described.

This machine is adapted to the knitting of stockings, or, more properly, of sheets of knit fabric of such form that they can be made into stockings by sewing the edges of each sheet properly together, and as the form of the fabric produced and the general mode of proceeding will enable the description of the machine to be understood with greater facility, it is deemed proper to describe these before proceeding with the description of the machine. The form of one side of the complete stocking, when flattened sidewise, is shown at Fig. 32, and the appearance of the fabric at certain successive periods of the knitting is shown at Figs. 33, 34, 35, and 36. The knitting commences at the top of the leg, or at *a a*. The fabric is knit of uniform width to the line *b b;* thence it is progressively narrowed by the operation of the machine to the line *c c*, which corresponds to the ankle of the stocking, the narrowing being effected by withdrawing some of the needles from the work and transferring their stitches to adjacent needles. From the last-mentioned line, *c c*, the fabric is knit of uniform width to the line *d d*, at which the heel-strips E E separate from the upper piece F′, which, when doubled, corresponds with the upper part F′, Fig. 32, of the foot of the finished stocking. From this line the machine knits the two heel-strips E E simultaneously, while the knitting of the central part F′, which is to form the upper piece F, is suspended, this operation being effected by dividing the needles at work into three gangs, the side two of which continue in gear and knit the heel-strips, while the central gang is thrown out of gear with the mechanism for operating the needles, but with the last line of stitches at the line *d d* remaining on them. In knitting the heel-strips they are narrowed at their outer corners, *e e*, by the successive withdrawal of needles. After the heel-strips are finished and thrown off the needles the work upon the central part of the fabric F′ is resumed by throwing the central gang of needles that hold the last line of stitches again into gear, and the fabric is widened by adding the selvage-needles that formed the outside selvages of the heel-strips to the central gang of workers. The work proceeds on this central strip at first without change of breadth, but as the needles approach the toe the work is progressively narrowed until it is completed. The sheet of fabric thus formed when flattened out has the form represented at Fig. 34, the edges of the central strip F′ overlapping the inner edges of the heel-strips E E by an amount equal to the work wrought at each side by the selvage-needles, (four at each selvage in the present machine.) In order to form the sole-piece G of the stocking, the sheet, Fig. 34, is thrown off the needles, and is set up anew on the needles by placing the two heel-strips together, as at Fig. 35, and setting the stitches at their edges *f f* upon the needles, the remainder of the sheet hanging freely downward. The work then proceeds toward the toe of the stocking, the fabric being narrowed, when required, as the work progresses until the sole-piece is completed, as shown at G, Fig. 36. This completes the knit work. Then the edges *a c a c* are sewed together by hand, and the edges *g g* are sewed to the edges *h h*, thereby making the complete stocking.

The knitting of the yarn into the fabric above described is effected by means of series of needles and sinkers, which are supported by a carriage, and are caused to traverse to and fro in front at times of one thread-guide, which delivers thread or yarn, and at times of two thread-guides, the latter when the two heel-strips are being knit simultaneously. The movements of the needles and sinkers in knitting are effected by means of stationary longitudinal cam-grooves which the members of the machine carried by the carriage traverse in their movement to and fro.

The various operating parts of the machine are secured to a strong rectangular frame, A, which is supported by legs and holds the needles at a sufficient distance from the floor to permit the operator to tend the machine while standing. In the upper side of this frame are two longitudinal V-shaped grooves, *a a*, Figs. 2, 3, and 6, which extend from end to end of the frame, and form ways to support and guide the carriage D, that carries the needles and sinkers. The carriage is of rectangular form, and is constructed to move to and fro on the frame, its lower side being fitted with V-shaped runners, which slide in the V-shaped grooves in the top of the main frame. This needle-carriage carries the needles and sinkers, which are arranged in series, whose members alternate, so that there is a needle for each space between two adjacent sinkers. The length of the needle-carriage between its end plates must be sufficient to receive the requisite number of needles and sinkers to knit the widest work required, together with the

mechanism for moving them to effect the narrowing of the fabric and its widening, if widening is to be effected. This needle-carriage is caused to move alternately to and fro by means which are similar to those employed in a planing-machine for planing metal. To this end the under side of the carriage is fitted with a rack, F′, whose teeth engage with those of a cog-wheel, E′, which is turned alternately in opposite directions by means of two pulleys, P′ P². One of these pulleys is secured to a shaft, B⁷, which is connected directly with the shaft B′ of the cog-wheel E′ by means of a pair of cog-wheels, E² E³, Fig. 7. The other pulley is secured to a cannon-shaft, B², which is connected with the shaft B′ of the cog-wheel E′ through the intervention of a counter-shaft, B³, (dotted in Fig. 1,) and an additional pair of cog-wheels, E⁴, (partly shown in red lines in Fig. 1,) so that, although both pulleys P′ P² are caused to revolve in the same direction, the one causes the carriage to move from right to left and the other from left to right. Both pulleys are driven by the same belt, D′, which transmits motion from the pulley P³ on the driving-shaft B⁴, and the belt is shifted from one of the pulleys, P′, to the other, P², and vice versa, when the movement of the carriage is to be reversed. The two pulleys P′ P² are separated by a loose pulley, P. In order to shift the belt, it is passed between the prongs of an oscillating belt-shipper, *h*, which projects from an upright rock-shaft, B⁵, at the back of the main frame A. This rock-shaft is fitted with two arms, H′ H², which project from it in opposite directions, in positions to have their ends acted upon by two inclined blocks, *f′ f²*, which are carried by a horizontal slide-bar, C²; and this slide-bar has two ears, T′ T², fitted with adjustable screws *f³ f⁴*, whose heads are struck alternately by a bumper, M⁴, carried by the needle-carriage, so that as the needle-carriage approaches each end of its range of motion the slide-bar C² is put in motion by the contact of the bumper of the carriage with one of the ear-screws *f³ f⁴*, and the proper inclined block is caused to act upon the arm to rock the rock-shaft B⁵ and oscillate the belt-shipper, thereby transferring the belt D′ from one pulley to the other. The bumper projects from a hub which is secured to a rock-shaft, B⁶, that is carried by the needle-carriage; and as it is desirable (in order to save time) that the needle-carriage should traverse as small a distance as possible, this rock-shaft is fitted with two pairs of additional bumpers, M⁵ M⁶, projecting at different angles from the shaft and arranged to operate the slide-bar C² and transfer the belt at shorter intervals, so that when the fabric is narrowed one or other pair of these additional bumpers may be brought into operation by turning the rock-shaft B⁶ a part of a revolution. The movement of the rock-shaft in the present machine is effected, when necessary, by applying the hand to the pin-hub O, and it is prevented from moving accidentally by a spring-click, Q², whose nose engages in one of the notches in a collar that is secured to the rock-shaft B⁶. The driving-shaft B⁴ is caused to turn continuously in the same direction by means of a belt applied to a fast pulley, P⁴, secured to it. This belt passes between the prongs of a sliding belt-shipper, C⁵, Figs. 1, 2, 4, and 5, which has a spring, P⁶, applied to it that tends to transfer the belt to a loose pulley, P⁵, so that whenever the belt-shipper is free the belt is immediately transferred, whereupon the machine stops. The belt-shipper is held in place when the machine is working by a catch having the form of a lever, L⁸, with a notch, *f⁵*, in which a tooth on the sliding shipper engages when the machine is at work. This catch is disengaged automatically from the shipper when a change is to be made in the operation of the machine, as will hereinafter be described, and may be disengaged at any time by applying the hand to the handle C⁶ of the catch.

The needles used in this machine (as shown of full size at Figs. 30 and 30ª, 30ᵇ and 31) have the ordinary hook-formed head, the barb of the needle being received when depressed in a corresponding groove, *a′*, in the shank or stem, so that the loop of yarn on the needle-stem can then slip freely over the head of the needle. These needles are arranged in three series, two of which are used in knitting the selvages at the sides of the fabric, and are composed of traveling needles. These two series are caused to approach each other when the fabric is to be narrowed, the distance between them being always just sufficient to permit the operation of as many other needles as there are to be stitches between the two selvages of the fabric. All the needles of the machine which are not traveling selvage-needles constitute the third series, more or less of which are brought into operation between the two series of selvage-needles, according to the width of the space between them, as determined by the width of the fabric being knit, while those needles of the third series which are not between the selvage-needles are thrown out of gear with the mechanism for operating them. In commencing the leg of the stocking as many needles are employed as are required to form the required number of stitches, and this number of needles is made up of the two series of selvage-needles and of as many intermediate needles as are required to complete the number, the whole working as one gang. When the fabric is to be narrowed at either side the needle next within the selvage-needles at that side is withdrawn from the fabric and the selvage-needles are moved inward, so that the innermost selvage-needle takes the position of the needle withdrawn, the stitch which was upon that needle being transferred automatically to the next needle. The needles which work between the selvage-needles (whether at work or not) will hereinafter be designated as "intermediate" needles, the stem of each intermediate needle has a second groove, *a²*, Fig. 30ᵇ, to receive the point of the transferring-prong, hereinafter described, and each needle-stem is se-

cured to a needle-slide, E. (Shown at Fig. 30 of the full size.) These needle-slides are arranged to slide transversely to the direction in which the carriage is moved in a series of grooves formed in a bed, *d*, which extends from one end of the carriage to the other. Each of these needle-slides has a snug or nib, b^2, at its rear end. Each needle-slide has also a snug or nib, *b*, at a point intermediate between its ends, by means of which it is moved to and fro in the operation of knitting. These central snugs, *b*, when the needles are operating, are received in and operated by a cam-groove formed in the lower side of the needle-cam bar G, which extends from one end of the machine to the other, and is supported by the end plates thereof. The form of this groove is shown of full size in red lines in Fig. 20. The groove, after extending a certain distance from the center *x x* of the machine, divides into two branches, e' and e^2, having a movable switch at their intersection, which can be turned to cause the snugs of the needle-slides to traverse in either branch. When the machine is knitting they traverse in the hinder branch, e'; but the forward branch is useful to cause the needles to be projected forward for inspection and repair. The two branches of the needle-cam groove are crossed by a cross-groove, e^3, which permits the removal of bent or broken needles and their replacement by perfect needles. The needles project forward from the bed in which their slides lie, and pass through a corresponding series of grooves in a bar, *f*, which extends along the front side of the carriage and forms a nosing or series of orifices, into which the needles are withdrawn to cast off the loops of yarn. The grooves of this nosing have at bottom a V form, so that when the needles are depressed they are caused to place themselves at equal distances apart. The traveling selvage-needles of each series are each secured to a slide, F^4, Figs. 25 and 31, which is carried by a separate carriage that is mounted between the end plates of the needle-carriage and moves with it without changing the position thereon so long as the work produced remains of the same width; but whenever the width of the fabric is to be narrowed at one edge the selvage-needle carriage appertaining to that side is moved upon the needle-carriage so as to change the position of the selvage-needles carried by it. As the fabric to be made in the present machine must be narrowed at both edges, two selvage-needle carriages, B, are provided, and each carriage holds four selvage-needles, whose stems are bent downward, so that the heads of the selvage-needles and the parts of their stems immediately back of their heads project in the same plane and to the same extent as the corresponding parts of the intermediate needles. Each selvage-needle slide has a snug, b^4, formed upon it, which is received in a groove, e^4, formed in the upper side of the needle-cam bar G, and shown of full size at Fig. 20, so that as the selvage-needle carriages are carried along with the needle-carriage the selvage-needles are caused by the oblique portions of the cam-groove to move while knitting transversely to the length of the needle-carriage in the same manner as the intermediate needles.

A second block of metal, *g*, Figs. 2 and 7, is supported at the front side of the needle-carriage by a bar secured to the end plates thereof. This block has a series of grooves formed in it similar to those of the needle-bed, to receive and guide the shanks or slides of the sinkers, which are represented of the full size at Figs. 28 and 29. Below this sinker-bed there is a bar, *e*, Figs. 1 and 7, which extends from one end plate of the needle-carriage to the other, overlaps the nosing from which the needles protrude, and forms the bar against the lower side of which the barbs of the needles are pressed by the action of supports F F beneath to close them, so that when the needles are drawn into the orifices of the nosing they may pass through and cast off the loops already formed. Each sinker-slide has a snug, *c*, upon it, which is received in a cam-groove formed in the inner face of the sinker-cam bar H. This cam-bar, like the needle-cam bar, extends from one end of the machine to the other, and is supported by the end plates thereof. The form of its groove is shown of the full size at Fig. 18.

The movement of the selvage-needle carriage in narrowing, the removal of the intermediate needles from the series at work, and the automatic transference of the stitches in the present machine are all effected substantially in the same manner as is described in the patent granted to Joseph K. Kilbourn and Edward E. Kilbourn, No. 980, the 9th day of April, A. D. 1861, L L being the two narrowing-screws, V the transferring prong, *s* the rock-shaft of the transferring prong, and Y the lever which rocks this shaft. The mechanism for imparting the motions to the members has, however, been simplified. Moreover, as the knitting commences, with the present machine, at the top of the leg of the stocking, and as the width of the fabric is always changed by narrowing, it is unnecessary in this machine to provide any means for widening the fabric automatically. In the present machine, as in the machine described in the patent above referred to, each narrowing-screw L is turned a quarter of a revolution to move the selvage-needle carriage the space of one intermediate needle, the pitch of these screws being four times the distance between the centers of two adjacent needles. In order to turn each screw a quarter of a revolution, the end of each, which passes through the end plate of the needle-carriage, has a ratchet-wheel, R^2, with four teeth secured to it, and a vibrating pawl, S^2, is provided to act upon these ratchet-teeth. This pawl is pivoted to an arm, L^4, secured to a segment of a cog-wheel, which oscillates upon a collar surrounding the shank of the screw, and whose teeth engage with those of a corre-

sponding cog-wheel secured to the end of a shaft, L^2, that is parallel with the narrowing-screw. This shaft L^2 has a longitudinal groove formed in it, and it is fitted with a sliding pinion, m^3, which is placed between the cheeks of a sliding block, J′, which slides to and fro upon the traverse-bars H^3 and H^4, the former of which is secured to the front edges of the end plates of the needle-carriage and the latter to the hinder edges thereof. The sliding pinion m^3 is fitted with a feather, which slides in the groove of the shaft L^2, so that the shaft is caused to turn with the pinion, whatever be the position of the latter. The slide-block J′ is perforated to permit the narrowing-screw L to pass through it, and it has a lug, C, depending from it, which is fitted with an adjusting-screw that is received between two lugs projecting upward from the selvage-needle carriage B, so that when the slide-block is moved to and fro the selvage-needle carriage is moved correspondingly. The selvage-needle carriage is adjusted to its proper position by turning the adjusting-screw.

In order that the slide-block J′ and the selvage-needle carriage connected with it may be moved by turning the screw L, a segmental nut, *m*, is inclosed between the side pieces of the slide-block J′. This nut is connected with a rock-shaft, s^5, which passes through the slide-block, and is fitted at one side thereof with a lever, Y′, controlled by a turn-catch, X. By moving this lever forward the segment-nut *m* may be disengaged from the screw L to disengage the slide-block and the carriage of the traveling selvage-needles from the mechanism for moving them, so that they may be moved by hand along the needle-carriage to any desired position, after which the lever may be moved back to re-engage the nut with the screw, thereby re-engaging the carriage of the selvage-needle with the mechanism for moving it. The machine therefore embodies the first part of the invention. The slide-block J′ carries a sliding rack, T^4, whose teeth engage with those of the sliding pinion m^3, so that the movement of this rack transversely to the needle-carriage turns the grooved shaft L^2, and through it the screw L, thereby shifting the position of the selvage-needle carriage and operating the transferring-prong, and as the slide-block is connected directly, as above described, with the carriage of the traveling selvage-needles, so that the same screw operates both, the machine embodies the second part of the invention.

The mechanism for moving the sliding rack automatically operates upon the same principle as the corresponding mechanism described in the aforesaid Patent of April 9, A. D. 1861, No. 980; but in order to embody the third part of the present invention the movable cam-plates are arranged above the sliding racks which they operate upon, and are depressed to operate these sliding racks, instead of being raised for that purpose. There are two of these movable cam-plates, M^9 M^9, one for each selvage-needle carriage, and each is connected by a hinged link, M^8, with a stationary cam-bar, N^2, which holds the stationary jaws n^{10}, by which the racks T^4 are returned to their normal positions after being moved by the movable cam-plates. Each rack is fitted with a pin, f^7, which projects upward within the range of the movable cam-plate above it when the latter is depressed; and in order that each cam-plate may not act upon the pin of the wrong rack one movable cam-plate is placed nearer the front of the stationary bar N^2 and the other nearer its rear edge, the pins f^7 f^7, Figs. 3 and 6, of the two racks being placed correspondingly. These cam-plates are controlled by a pattern-barrel, J^2, which is arranged according to the fourth part of the invention above the needle-carriage D. This pattern-barrel is secured to a shaft, B^9 B^{10}, which is supported by two standards, N^5 N^7, secured to the main frame. One part, B^{10}, of the shaft is formed into a screw, which turns in a nut, N^6, that is supported by the standard N^7. The nut N^6 is held from turning in the direction of the arrow y^4, Figs. 1 and 2, by a pair of pins, x^4, Figs. 1 and 2, against which a bar, Z′, secured to the nut, abuts, so that when the pattern-barrel and its shaft are turned in that direction the screw will move through the nut and carry the pattern-barrel longitudinally. In order to embody the fifth part of the invention, the nut N^6 is permitted to turn in the direction opposite to that indicated by the arrow y^4 a half-revolution, when its further turning is prevented by a second pair of pins, x^5 x^5, Figs. 2 and 4, against which the bar Z′ of the nut then abuts. The effect of this turning is to shift the pattern-barrel lengthwise a distance equal to half the pitch of the screw B^{10} without turning it. The pattern-barrel is perforated with two helical lines of pin-holes, V′ V^2, (each of the same pitch as the screw B^{10},) to which pattern-pins can be applied, and these holes are arranged in rows longitudinally with the barrel at equal distances apart. The other part, B^9, of the shaft of the pattern-barrel has a longitudinal groove formed in it, and passes through a sleeve which turns in the standard N^5, and is fitted with a feather which engages in the groove, so that when the sleeve is turned the shaft is also turned in whatever position endwise it may be. The sleeve is fitted with a ratchet wheel, R^5, Fig. 2, having the same number of teeth as there are longitudinal rows of pin-holes in the pattern-barrel J^2. These ratchet-teeth are acted upon by a pawl, S^5, that is pivoted to and vibrates with an elbow-lever, L^5, which vibrates upon the sleeve as an arbor. The longer arm of the elbow-lever is connected by a rod, l^8, with the end of a plate, L^9, Figs. 4 and 5, which is pivoted to the main frame, and has a cam-groove in its inner face (shown in dotted lines in Fig. 4) in a proper position to be entered by a pin (also shown in dotted lines) secured to the needle-carriage, so that the needle-carriage in moving causes the cam-plate L^9 to vibrate, and the latter by its connection with

the elbow-lever L^5 moves the ratchet S^5 to and fro and turns the shaft B^9 B^{10} and pattern-barrel an angular distance equal to the tooth of the ratchet-wheel R^5 for each double vibration of the needle-carriage. The pawl S^5 is double-headed, (as shown at Fig. 9,) so that it can be turned over on its pivot by the hand of the attendant to cause the ratchet-wheel and pattern-barrel with its screw-shaft to turn in the direction opposite to the arrow y^4, thereby also reversing the longitudinal movement of the pattern-barrel.

In order that the pattern-barrel may let down the cam-plates into positions to act upon the pins of the racks T^4 and may raise them out of these positions, each movable cam-plate is connected by a rod, j^2, with an arm, I^2, secured to a rock-shaft, A^2, which is supported parallel with the axis of the pattern-barrel by standards secured to the frame of the machine. This rock-shaft is fitted with a third arm, I^3, which projects over the pattern-barrel with its end in position to be raised by pins placed in the helical line V^2 of pin-holes when the pattern-barrel is turning in the direction of the arrow y^4. So long as holes containing pattern-pins in them pass under the arm I^3 the rock-shaft A^2 does not rock to lower the movable cam-plates, and consequently they are then prevented from acting upon their racks, and the selvage-carriages are not moved to narrow the work. When a hole without a pin in it passes under the arm I^3 it is permitted to turn down, and the shaft A^2 rocks, thereby lowering the movable cam-plates M^9 so that they act upon the rack-pins, and the selvage-needle carriages are moved inward to narrow the fabric. As the pattern-barrel is moved by its ratchet once for each double reciprocation of the needle-carriage, and as each single reciprocation produces a row of stitches, half as many pin-holes are made in the helical line V^2 as there are to be rows of stitches in the fabric, and pins are placed in those holes (commencing at the end a^3, Fig. 2, of the pattern-barrel) which correspond with the rows where the width of the fabric is to remain unchanged, the pins being left out of those holes which correspond with the rows of stitches at which narrowing is to take place. The arrangement of the pins in the second line of pin-holes V' commences at the opposite end, a^4, Fig. 2, of the pattern-barrel, in accordance with the sixth part of the invention, and when one sheet of fabric is completed the machine is stopped and the pawl S^5 is turned over to reverse the movement of the pattern-barrel. The nut N^6 is also turned half round to change the relationship of the pattern-barrel to the arm I^3 and bring the second line of pin-holes under that arm when knitting the next sheet of fabric. The employment of two lines of pin-holes with the arrangement for bringing each alternately into action therefore dispenses with the necessity of turning the pattern-barrel backward by hand to the position which it occupied when the knitting of the fabric was commenced.

The pattern-barrel is also employed to stop the machine at any desired time. The mode in which this is effected is as follows: The rock-shaft A^2 is fitted with a fourth arm, L^{10}, which is connected by a rod, l^9, with a lug, L^{11}, projecting from the catch L^8 of the belt-shipper. This lug is perforated with a slot, y^{10}, Figs. 1 and 4, in which the hooked end of the connecting-rod l^9 engages, so that the latter may be raised or lowered as far as pattern-pins of the regular length will move it without affecting the catch L^8; but when the rod is raised by rocking the shaft A^2 about twice as high as its usual movement by the ordinary pattern-pins the catch L^8 will be raised to release the shipper C^5 and permit the spring P^6 to shift the belt to the loose pulley P^5, thereby stopping the machine. The raising of the rod l^9 for this purpose is effected by the use of pattern-pins of double the usual length, one of which is inserted in each pin-hole of the pattern-barrel which corresponds with the line of stitches at which it is desired that the machine should stop.

The withdrawal of the intermediate needles next the selvage-needles, when they are moved inward on the needle-carriage to narrow the fabric, is effected in the same manner as it is in the machine described in the aforesaid patent granted Joseph K. Kilbourn and Edward E. Kilbourn the 9th day of April, A. D. 1861, No. 980, P^9 being the sliding bar carried by the selvage-needle carriage, Figs. 4, 23, 24, 26, 27, with its block t^4 and its narrowing-driver t'. (Shown in dotted section-lines in Fig. 23.) Each sliding bar is fitted with a pin, t^5, which projects downward through a transverse slot in the selvage-needle carriage into a cam-groove, G', formed in the upper surface of the needle-cam bar, so that as the selvage-needle carriage is carried to and fro along with the needle-carriage the sliding bar, with its driver t', is caused to move transversely to the carriage and withdraw each intermediate needle that it is placed in position to act upon by the operation of the pattern barrel J^2 and the narrowing-screw L. After each sheet of fabric is completed the selvage-needles must be moved outward to the positions they occupy when commencing the knitting at the top of the leg of the stocking, and the intermediate needles that have been withdrawn in the process of narrowing the work must be restored to their positions in the gang of workers.

The selvage needle carriages are readily moved out by hand, as hereinbefore described, when the machine is stopped, and in order that the withdrawn interme iate needles may be restored to their positions by the same movement a wedge-shaped cam plate, t^3, is secured to each selvage-needle carriage in a position to bear against the butts of the withdrawn intermediate needle-slides whi h it passes when the selvage-needle carriages are moved outward on the needle-carriage, thus shoving them forward among the workers. The withdrawn needles are therefore restored to their

positions for working by the movement of the carriage which carries the cam-plate t^3, which carriage is in this machine the selvage-needle carriage, and thus the machine embodies the seventh part of the invention. As this cam-plate is inclined, the last slides which remain in contact with it when the selvage-needle carriage reaches its outward position are not pushed by it to their foremost positions. In order to push them forward, a widening-driver, t^2, is secured to the block t^4 of the slide-bar P^9, which is caused to push these needle-slides forward by a single reciprocation of the needle-carriage, made after the selvage-needle carriages have been moved to their outermost places.

In order that the machine may operate when the parts are constructed as has been described, the narrowing-screw should make three movements when narrowing is being effected, two of these taking place while the end of the needle-carriage is passing from the center of the machine toward the adjacent end thereof, and one while it is returning from that end of the machine, the three movements together comprising a quarter of a revolution of the screw L. During the first of these movements the screw is turned sufficiently to cause the transferring-prong V to enter the stitch on the needle whence it is to be transferred, and this of course must take place before the needle is withdrawn by the narrowing-driver. The second movement is sufficient to move the selvage-needle carriage laterally the space of a needle—or, in other words, the width of a stitch—so that the innermost selvage-needle is caused to travel inward to the next needle. This movement of the screw also permits the toe of the spring-catch *w*, Figs. 5 and 6, to rock back the heel of the prong into the groove of the nosing, as described in said patent granted to Joseph K. Kilbourn and Edward E. Kilbourn. The third movement of the screw is sufficient to rock the prong out of the stitch. This last movement must of course be effected after the needle has been protruded through the stitch and the groove in the nosing by the action of the incline in the cam-groove which effects this movement. The first part of these movements is effected while the pin of the rack T^4 is passing along the grade n^5, Fig. 17, of the movable cam-plate in the direction of the arrow applied thereto, the second while it is passing along the grade n^7, and the third while it is passing in the direction of the arrow along the stationary grade n^8, secured to the bar N^2.

Although the transferring-prong and the selvage-needle carriage are both operated by the turning of the screw L, the selvage-needle carriage must not be moved inward until the transferring-prong has entered into the stitch to be transferred from the intermediate needle which is to be withdrawn from the series of workers. There must therefore be a pause in the movement of the selvage-needle carriage until the transferring-prong has secured the stitch. This pause is produced by cam-collars secured to the narrowing-screw L, whose snugs operate upon inclined planes formed upon the adjacent faces of the bearing of the screw in the end plate of the needle-carriage, as described in the aforesaid patent granted to Joseph K. Kilbourn and Edward E. Kilbourn.

In order that the knitting may cease upon the central strip of the sheet of fabric while the heel strips are being knit, such of the intermediate needles as operate upon the central strip are thrown out of gear with the mechanism for operating them without withdrawing their heads from the fabric. In order to effect this in accordance with the eighth part of the invention, the needle-bed is divided transversely into three divisions, $X'X'X^2$, the two side divisions, $X'X'$, being fixed to the needle-carriage, and the central division, X^2, being movable thereon. The central division is fitted at its hinder side with a pair of ears, which are traversed by a shaft, B^{10}, that is supported in slotted bearings N^8N^8, secured to the needle-carriage, so that the hinder side of the central division of the needle-bed may be permitted to drop by the transverse movement of the shaft in its slotted bearings to drop the snugs of all the needles appertaining to it simultaneously out of the cam-groove which imparts movement to them, and at the same time that the front side of the central division of the needle-bed may turn downward on the shaft B^{10} as a hinge-pin to permit the heads of the needles to descend with the fabric as the knitting upon the heel-strips progresses. During the knitting of the leg of the stocking down to the line *d d*, Figs. 33 and 34, this central division remains in its highest position, as shown at Figs. 1, 4, 8, with its surface at the same level with those of the side divisions. It is held there by means of the arm I^4, which projects forward from the rock-shaft B^{11}, and is pushed up by an arm, I^5, which projects backward from a second rock-shaft, B^{12}. The two rock-shafts B^{11} B^{12} pass through bearings in the transverse plates T^5 of the needle-carriage, and the latter, B^{12}, is fitted at one end (on the outer side of the adjacent transverse plate T^5) with a second arm, I^6, which is connected with the bottom plate of the needle-carriage by a strong spring, S^3. This second arm I^6 is secured to its rock-shaft B^{12} at such an angle with the arm I^5 that when the latter is holding up the central division of the needle-bed the end of the second arm is in front of a vertical line passing through the axis of the rock-shaft, so that this shaft cannot be turned to release the central division of the needle-bed without extending the spring, which is strong enough to prevent accidental turning. When, on the other hand, the rock-shaft B^{12} is turned by hand to release the central division of the bed, as shown at Fig. 7, the end of the second arm I^6 is behind the same vertical line, and the rock-shaft is therefore held in its new position by the same spring.

In order that the weight of the front part

of the central division of the needle-bed and its needles may not drag the work downward, it is counterbalanced by springs, according to the ninth part of the invention, in the following manner: The ends of the rock-shaft B^{11} of the arm I^4 pass through the transverse plates T^5 T^5, and are fitted with second arms I^7 I^7, each of which is on the outer side of the adjacent transverse plate T^5. Each of these second arms is connected by a spring, S^6, with the front of the needle-carriage, so that these springs, acting through the rock-shaft B^{11} and its arms I^7 I^7 I^4, tend to bear up the central division of the needle-bed and counterbalance its weight in part. In order to compensate the increase in the tension of the springs as they are extended, the second arms I^7 I^7 are set at such an angle with the central arm, I^4, as shown in the drawings, that the leverage is greatest when the central division of the bed is in its highest position, and decreases progressively as the springs are progressively extended. Whenever the central division of the needle-bed is thrown out of gear its needles should be compelled to descend with it, and should also be prevented from sliding forward in their grooves. As the heads of the needles are in the last row of stitches they descend as the work upon the heel-strips progresses and bear down the front side of the central division of the bed with them. In order to compel the hinder ends of the needle-slides to remain in their grooves, and also to prevent them from sliding forward, the rock-shaft B^{10} is provided, according to the tenth part of the invention, with a broad hook-formed holder, H^5, whose edge is of the same breadth as the central division of the needle-bed, so that when the rock-shaft B^{11} is turned forward this hook-holder overlaps the hinder snugs of all the needle-slides and holds them in their places, as shown at Fig. 7. When the hook-holder is not operating it is turned back, as shown at Figs. 6 and 8, and is held in that position by means of a rod, r^5, (drawn in dotted lines in Fig. 6,) whose hinder end is connected with an arm, I^8, secured to one end of the rock-shaft B^{10}, and whose forward end is formed into a hook, which is then engaged in an eye secured to the needle-carriage. The rock-shaft B^{10} is turned forward to cause the hook-holder to operate by means of a spring, S^4, connected with an arm projecting from the shaft, and it is permitted to turn, when required, by disengaging the hooked rod r^5 from its eye by hand.

The fabric formed by the needles passes downward, and is connected by a sheet of cloth secured to a bar, D^4, and by a link-rod, r^9, with a tension-plate, D^5, which is loaded with one or more removable weights, D^6, to apply the proper amount of tension to the work according to its width. This tension-plate descends as the fabric is formed, and is guided by a pair of slides, D^7, upon which the ends of the tension-plate are fitted to traverse. The fabric as it descends must be held back out of the way of certain parts of the machine. This is effected by a removable rod, r^6, which is held in place by two hook-ended spring-catches, y^5, one at each end of the rod, whose hooked ends are engaged in notches formed in the end plates of the needle-carriage. As the fabric is upon the central needles and hangs behind the rod r^6 at the time the central division of the needle-bed is lowered, that division must be arranged to move transversely to permit the stitches held by these needles to remain in the same plane with the remainder of the fabric. This is effected by the form of the slots of the bearings N^8 of the shaft B^{10}, as shown in dotted lines in Figs. 6 and 8. It will be perceived that the slots extend a little forward of the shaft when it is raised, and some distance behind it. When, therefore, the shaft is dropped with the central division of the needle-bed it is free to move transversely backward or forward, as may be required. The machine thus embodies the eleventh part of the invention.

In order that the row of stitches upon the needles of the central division shall remain in the same plane with the remainder of the work, the front side of the central division of the needle-bed is guided in descending by guide-slots s^4, formed in the transverse plates of the needle-carriage, which slots are traversed by the rounded end of a bar, r^7, secured to the under side of the said division.

When the knitting of the heel-strips is being effected the selvages at their outer edges are knit by the two series of traveling selvage-needles, which are moved inward (as directed by the pattern-barrel) to narrow the heel-strips at their lower outer corners, *e e*. The inner selvages of the heel-strips are knit by the innermost intermediate needles of each side division of the needle-bed, which remains in gear after the dropping of the central division.

After the heel-strips are completed the machine is stopped, the central division of the needle-bed is restored to its position, and the selvage-needle carriages are moved inward, so that the needles which recommence work upon the central strip are made up of the two sets of selvage-needles and the needles of the central division of the needle-bed, four of the stitches along the inner edge of each heel-strip being set up on the selvage-needles before recommencing work. As the knitting of this part of the fabric proceeds it is narrowed, as required, by the operation of the pattern-barrel, transferring-hook, selvage-needles, and their appurtenances, as before. As the machine therefore contains traveling needles, transferring-prongs, and a needle-bed divided into divisions, one of which is arranged to drop so that its needles are thrown out of gear with their operating mechanism without being withdrawn from their stitches, while the needles of other divisions continue to operate, and as the traveling needles and transferring-prongs are combined with the said needle-bed so as to cooperate with it in the production of the fabric,

the machine embodies the twelfth and thirteenth parts of the invention. While the leg of the stocking is being knit down to the line *d d* the needles are fed with yarn or thread by means of a single tubular thread-guide. While the heel-strips are being knit a second or supplementary thread-guide is brought into action, so that the gang of needles knitting each heel-strip is fed by a separate thread-guide. After the heel-strips are completed and the work is recommenced upon the central strip the supplementary thread-guide is thrown out of gear, in accordance with the fourteenth part of the invention, and the gang of needles at work on the central strip is fed by the primary thread-guide of the machine. Each thread-guide has the form of a short flattened tube, the larger axis of its elliptic cross-section being horizontal. The shank of the primary thread-guide J is secured to a carriage, R, which slides longitudinally on ways secured to the front side of the sinker-cam bar H. The thread-guide carriage is moved to and fro by bumpers carried by the needle-carriage and acting alternately upon the opposite sides of a snug, *o*, Figs. 6 and 7, secured to the top of the thread-guide carriage, and as the thread-guide, to act properly, must always occupy a certain position relatively to the outermost selvage-needle, the bumpers which operate upon the primary thread-guide carriage (when the supplementary thread-guide carriage is not in use) are controlled by the selvage-needle carriages, so as to move with the traveling selvage-needles and maintain the thread-guide in its proper position relatively to the outermost selvage-needle. To this end one of the bumpers, M, is made fast to one of the slide-blocks J′, which is connected with one of the selvage-needle carriages. The other bumper, N, is secured to a hub which is mounted upon a rock-shaft B^{13}, supported by brackets on the needle-carriage, and this hub is received between a pair of cheeks secured to the other slide-block J′, which is connected with the other selvage-needle carriage, so that when the latter is moved the bumper is caused to move with it and slide along the rock-shaft. The hub of the bumper is fitted with a feather, which slides in a groove of the rock-shaft B^{13}, so that when the latter is turned the bumper is turned out of range of the snug of the supplementary thread-guide carriage to permit this carriage to be moved out of the range of the bumpers, and be thereby thrown out of gear.

In operating this machine the needle-carriage must always be moved far enough when narrowing is to be done to enable the movable cam-plates M^9 to put in motion the narrowing mechanism when the fabric is narrow. The amount of movement necessary for the purpose would carry the thread-guide beyond the position it should occupy when yarn is taken from it by the needles. In order to compensate for this excess of movement of the thread-guide, provision is made in this machine for returning it to its proper position, in accordance with the fifteenth part of my invention. To this end the thread-guide carriage is provided with two spring-catches, y^6 y^7, Figs. 1 and 2, which engage alternately with the two bumpers M N, as the needle-carriage carries the thread-guide carriage beyond its proper position for feeding yarn, and retain their hold until the thread-guide carriage is returned to that proper position, after which the spring-catch is disengaged to permit the thread-guide to remain at rest until the needles have all passed it.

In order to disengage the catches at the proper times, two pins, x^6, Figs. 1, 2, and 6, are fitted to slide transversely in the selvage-needle carriage, one behind each catch, and a fixed cam-block, G^2, with inclined ends, is secured to the top of the sinker-cam bar H, with its ends in the proper positions to act on the pins x^6 and force them outward against the catches at the adjacent ends of the thread-guide carriage when they are to be detached.

The supplementary thread-guide J^3 is also fitted to a carriage, R′, of the same construction as that of the primary thread-guide, and fitted, like it, with spring-catches y^8 y^9, to connect it with the bumpers that drive it to and fro. When not in use it is moved by the hand of the attendant to the end of the machine, as shown at Figs. 1 and 2, where it remains at rest until it is wanted, when it is moved toward the center of the machine, the rock-shaft B^{13} being first partially turned to move the bumper N and permit the snug of the supplementary thread-guide carriage to pass it. When both thread-guides are in operation each acts in connection with one of the gangs of needles that knits one of the heel-strips. As the outer selvage of each heel-strip is formed by the traveling selvage-needles, the bumpers carried by them are in proper positions to place the thread-guides for the outer edges of the heel-strips. In order to place the thread-guides for the inner edges thereof, and to embody the sixteenth part of the invention, a supplementary bumper, M′, is secured to the rock-shaft B^{13}; and as the two gangs of needles which knit the heel-strips are separated by but a short space, and both thread-guide carriages must therefore at times be simultaneously engaged with this bumper, it is forked, as shown at Figs. 7 and 11, so that the inner catch, y^7, of the primary thread-guide may engage with one fork, and the inner catch, y^8, of the supplementary thread-guide with the other fork, and that the two catches may not interfere with each other.

As all the bumpers are connected either directly with the selvage-needle carriages, or indirectly with them by the rock-shaft B^{13}, and as the selvage-needle carriages are connected with and caused to traverse by the main needle-carriage, the bumpers are combined with the main needle-carriage, and the forked bumper M may be thrown in or out of work, as required, by turning the rock-shaft B^{13}.

Thus, when the primary thread-guide alone is operating, the supplementary forked bumper is turned upward out of range of the thread-guide carriages by turning the rock-shaft B^{13}, to which it is secured. When both thread-guides are operating the supplementary bumper is turned down by turning the rock-shaft B^{13}, and as the turning of this rock-shaft to turn down the supplementary bumper also turns one of the bumpers, N, of the selvage-needle carriages out of its position, so that it cannot operate, its hub is provided with another bumper, N′, which is turned into position to operate the thread-guide carriage when the first is turned out. The turning of the bumper rock-shaft B^{13} is effected in the present machine by the hand of the attendant when the central division of the needle-bed is raised or dropped, and the rock-shaft is held in either position in which it is placed by a spring-catch, c^4, whose end engages in one or other of two notches formed in a collar, c^7, secured to the rock-shaft.

In order that a tight selvage may be formed by the machine at the outer selvages, and that the sinkers on the outer sides of the traveling selvage-needles may not interfere with the thread-guides, a part of the sinkers at each selvage are lifted substantially in the same manner as is described in the aforesaid patent granted to Joseph K. Kilbourn and Edward E. Kilbourn. Two lifters, k k, are employed for this purpose, (one for each set of traveling selvage-needles,) and they are moved by the action of the cam-groove c^5, formed in the face of the cam-bar N^2, which cam-groove acts upon pins secured to the slides Q of the lifters. The snugs of these sinkers which are lifted pass through the gates s', Fig. 18, in the sinker-cam grooves into the upper middle branch of the sinker-cam groove.

In order to form tight selvages at the inner edges of the heel-strips, the sinkers thereat are lifted, in accordance with the seventeenth part of the invention, when the supplementary thread-guide is brought into operation. As, however, narrowing does not take place at the inner selvages of the heel-strips, it is unnecessary to make provision for changing the sinkers which are raised thereat; but advantage is taken of the position of the bumper rock-shaft B^{13} to lift all these sinkers simultaneously by the same operation which changes the bumpers. For this purpose those sinkers S, Figs. 1, 2, 4, 6, 7, 28^a, 29^a, which are to be thus raised are made longer than the others, and their upper ends are fitted with secondary snugs, which project forward toward the rock-shaft B^{13}. The latter is provided with two lifting-hubs, k' k', one for each of the sets of sinkers to be lifted, and each lifting-hub has a lifting-tooth projecting from it, so that when the rock-shaft B^{13} is rocked to place the central bumpers in position to act on the thread-guides the two sets of sinkers S S at the inner selvages of the heel-strips are simultaneously lifted out of the gang, and become inoperative until they are again lowered.

The adjustment of the machine for knitting the heel-strips and its readjustment for resuming work on the central strip are effected while the needle-carriage is at one end of its track. A wide gate, s^2, Fig. 18, is therefore made in the part of the sinker-cam groove which is then opposite the sinkers that are to be raised, so that their snugs may pass up out of the cam-groove.

It is important that the yarn extending from the last needle that is fed with yarn to the thread-guide should be depressed upon the stem of the needle, so that it may be seized with certainty by that needle, and that the barb thereof may not catch upon and split the yarn. In preceding machines this depression of the yarn has been effected by depressing the thread-guide after the needles have passed by it. In the present machine it is effected, in accordance with the eighteenth part of the invention, by depressing an instrument which is not connected with the thread-guide, and is in this instance one of the sinkers between the thread-guide and the outermost selvage-needle, while the thread-guide is retained at its usual level, and the other sinkers between the thread-guide and the selvage-needle are lifted, together with a sufficient number in addition, to avoid conflict with the thread-guide. To this end the lifters k k, for lifting the sinkers at the selvages, are each made broad enough to lift the sinker between the outer two selvage-needles and nine sinkers outside thereof, and each has a kerf, q, Figs. 13 13^a, of sufficient width and in the proper position to permit the snug of the fourth sinker outside of the outermost selvage-needle to pass through it, so that this sinker is free to be depressed by its cam-groove onto the yarn extending to the thread-guide, thereby depressing the yarn upon the stem of the outermost selvage-needle. An equivalent arrangement is made for the sinkers which are at the inner selvages of the heel-strips by using an ordinary sinker in place of one of the elongated sinkers, S, at the proper distance from the needle at the inside selvage of each heel-strip. This ordinary sinker, being without a secondary snug, is not raised by the lifting-tooth which raises the elongated sinkers at each side of it; hence it is depressed by the sinker-groove upon the yarn extending to the thread-guide from the selvage needle at the inside edge of the heel-strip.

In order that the selvage may be tight, the delivery of the yarn is checked in the present machine while the outermost needles are receding until their receding heads pass within the range of travel of the inner end of the thread-guide. In a preceding machine this check in the delivery is effected by griping the yarn between jaws, one of which is formed by a pad operated by the descent of the thread-guide. In the present machine the thread-guide does not descend; hence special devices are used for griping the yarn, in accordance with the nineteenth part of the invention. The pad j', which forms one of the griping devices, is therefore

secured to the lower end of an arm which projects downward from a rock-shaft, b^5, that is carried by the thread-guide carriage. This rock-shaft is fitted with a spring-arm, s^6, which tends to bear the pad away from the adjacent surface of a perforated plate, j', which is secured to the thread-guide carriage, and through which the yarn is passed, so that the pad can press against it. The pad rock-shaft b^5 is also provided with a second arm, s^7, which projects upward from it and bears against a slide, x^7, that passes through and slides transversely in an aperture in the thread-guide carriage, with its inner end within the range of two cam-blocks, C^8 C^9, that are secured to the sinker-cam bar H. These cam-blocks are in such positions that when the thread-guide carriage is moved along in each direction with the needle-carriage after feeding yarn to the last needles the slide is acted upon by the cam-block then adjacent to it, and, being moved thereby, rocks the pad-shaft b^5 and causes the pad to press upon and gripe the yarn; and the cam-blocks are of such length that they permit the release of the yarn as the thread-guide carriage moves along, when the loops are properly formed by the needles.

The supplementary thread-guide carriage R′ is fitted with griping devices like those of the primary carriage R, and one, C^9, of the cam-blocks is in a proper position for working them when the supplementary thread-guide is at one end of the gang of needles which is fed when knitting the heel-strip. In order to operate the griping devices when the supplementary thread-guide is at the other end of the gang of needles, a third cam-block, C^{10}, is secured to the sinker-cam bar H in a proper position for that purpose.

As before stated, the inner selvages of the heel-strips are knit by the innermost needles of the two side divisions of the needle-bed, and as these needles are operated by the intermediate needle-cam groove, they will operate (if no change be made) in the same manner while knitting the heel-strips as they do while knitting the interior of the sheet of fabric. Experience has shown that if they operate in this manner there is a tendency to strain the yarn. In order to obviate this tendency, the machine is constructed, according to the twentieth part of the invention, so that the second needle at the inner selvage of each heel-strip is not drawn to the same extent as the others. In order to effect this, the snug b of this needle, Fig. 30^a, is notched, and a sliding cam-block, V^6, Figs. 21 and 22, is inserted in the needle-cam bar G. The thickness of this cam-block is equal to half the depth of the needle-cam groove, and it is controlled by a screw, q', so that it can be drawn forward, as shown at Figs. 21 and 22, or set backward until its rear is as far back as the most protuberant part of the needle-cam groove. The sides of the grades e^6 e^6 are also grooved, so that they form two grades of different slope, the one being the regular slope and the other sloping less rapidly, so as to project no farther than the sliding cam-block when it is set forward. From this construction of the snug of the needle, Fig. 30^a, and of the sliding cam-block and of the cam-groove it follows that when the cam-block V^6 is set forward (by turning the adjusting-screw q') the projecting part of the snug b passes along the less-sloping grade and along the rear of the cam-block V^6, while the snugs of the other intermediate needles pass along the regular grade e^6; hence the needles, Fig. 30^a, which are the second needles at the inside selvages of the heel-strips, are not then drawn into their nosings as far as the remainder of the intermediate needles. When, on the other hand, the sliding cam-block is set back by turning the adjusting-screw q', as its rear is then in line with the most protuberant part of the ordinary needle-cam groove, the needles, Fig. 30^a, operated by it are drawn back to the same extent as the other intermediate needles. The cam-block V^6 is therefore moved forward by turning its screw when the central division of the needle-bed is let down to adjust the machine for knitting the heel-strips, and when the central division of the needle-bed is raised the cam-block V^6 is moved back to its place.

In order that the barbs of the needles may be closed as they draw into the nosing in which they lie so as to pass through the stitches upon the needle-stems, and that these stitches may be cast off as the new stitches are drawn in by the needles, the needles are pressed up against the bar e by supports F F beneath as they are carried over the upper edges of these supports by the reciprocation of the needle-carriage D. Each of these under supports is constructed in two parts, one, k^4, of which is inside of the sinkers and effects the raising of the needles, while the other part, k^5, is in front of the sinkers and supports the needles during the feeding of yarn and the descent of the sinkers to form the loops. In previous machines such supports have been made adjustable vertically, but no means have been employed to render them adjustable laterally; hence these supports have been fitted to their exact positions by filing away the material. In the present machine they are made adjustable laterally as well as vertically. The capacity to adjust vertically is provided for by passing the clamp-screws z^4, that secure the supports to their stocks g^4, through vertical slots h^4, in which they may be moved. The lateral adjustment is provided for, in accordance with the twenty-first part of the invention, by securing the stocks to a longitudinal shaft, Z^4, along which they may be slid, and to which they are made fast when in place by set-screws z^5. The under supports, when in the proper positions for operating, are much in the way when the needles and sinkers are being adjusted. In order to enable them to be put out of the way and replaced with facility, in accordance with the twenty-second part of the invention, the shaft R^4, to which they are secured, is arranged to rock in its bearings b^7, so that the under supports

can be turned forward, as shown in red lines in figure 6, or turned down horizontally, so as to be out of the way, and can be turned back again to the exact places which they should occupy during knitting. In order that they may be held in their places, the support-shaft Z^4 is fitted with an arm, Z^5, Figs. 1 and 5, whose inside face bears against the face of one of the longitudinal bars of the main frame of the machine when the supports are in place for knitting, and this arm has a slot in it, which passes over a projection from the frame of the machine to which a turning-button, g^5, is affixed so that when the button is turned crosswise to the slot the shaft Z^4 is prevented from turning and the supports are held in place. When they are to be turned forward the button is turned so that the slot in the arm will pass over it.

In knitting on this machine it is convenient to make use of a sheet of coarse cloth to connect the knit fabric with the tension-plate D^5. This sheet of cloth is cut in such manner that its selvage is horizontal and uppermost, and is equal in length with the breadth of the sheet of fabric to be knit, or longer than that. Its lower edge is sewed upon the bar D^4, which is connected by links with the tension-plate D^5. A portion—say six—of the horizontal threads are drawn from the cloth a little below the selvage, leaving a few horizontal threads at the selvage and a space below it formed by vertical threads alone. In commencing to knit, this piece of cloth is thrust upon the needles, whose heads pass through between the vertical threads at this space, and the needle-carriage is traversed once, to cause the needles to draw the selvage of the cloth into their barbs. Then the needle-carriage is traversed a second time, during which a thread of sewing-silk is fed by hand to the needles, after which the yarn from the thread-guide is applied to the first needle in the series and the machine set to work. The effect of this proceeding is that the knit fabric is connected with the sheet of cloth by the silk thread, and is readily disconnected from it by pulling out the silk thread by hand.

In the knitting of stockings coarser yarn is generally used to knit the heels than for the remainder of the stocking; hence in using the machine three cops of yarn are employed—two of coarser yarn while knitting the heel-strips, and one of finer yarn while knitting the remainder of the sheet of fabric. These cops may stand upon the floor of the room, the cop of fine yarn in front of the center of the machine, and the coarser two at either side of it. When the fine yarn is used it is conducted through a stationary thread-guide, Z, to the primary thread-guide carriage; and when the coarser yarn is used each thread of it is conducted through a lateral stationary thread-guide, Z^2, to the thread-guide carriage that feeds for the heel-strip at that side of the machine.

In knitting stockings it is found convenient to arrange the pins of the pattern-barrel of some machines so as to knit the sheet of fabric whose form is represented at Fig. 34, and to employ these machines only for doing this part of the work. The pins of the pattern-barrels of other machines are then arranged to knit the sole-strips G from *f f* to *g g*, Fig. 36, and these machines are employed only for doing this part of the work. This mode of conducting the work saves time in adjusting the machine, and one machine working on sole-strips can finish the work produced by two or three of the other machines.

Although the machine thus described embodies all the improvements which constitute the subject-matter of this patent, the invention is not limited to such machine, as parts of the invention may be applied with advantage to other knitting-machines—as, for example, to those in which only a part of the movements of the machine in knitting is effected automatically. Parts of the invention may also be used without other parts thereof; nor is the invention limited to a knitting-machine of the precise construction of parts herein described, or to the precise mode of imparting the requisite motions to parts thereof, as these may be varied as circumstances may render expedient to suit particular cases or the views of different constructors or manufacturers, or to adapt the machine to the knitting of particular forms of fabric. Thus, for example, the central division of the needle-bed may be fixed, and one or both side divisions may be arranged to drop; or one lateral division of the needle-bed may be arranged to drop and the remainder to remain fixed; or, if necessary, the needle-bed may be divided into divisions, all of which are arranged to drop, so that any one or more may be dropped, while the remainder are retained in their normal positions. When such modifications are made in the needle-bed the other parts of the machine must of course be suitably modified to correspond.

A knitting-machine constructed in the best manner known to the inventor having been thus described, what is claimed as the invention to be secured by Letters Patent is—

1. The combination of the carriage of a traveling needle, in a knitting-machine, with the mechanism for moving it past the other needles of the machine in such manner that it can be readily disengaged from said mechanism and re-engaged therewith, substantially as set forth.

2. The combination of the instrumentality through which the pattern mechanism operates upon the traveling needle (or upon the instrumentalities for withdrawing or replacing the regular needles) with the carriage of said needle, (or of said instrumentalities,) substantially as set forth.

3. The arrangement of the movable cam-plates, in a knitting-machine, above the devices which they operate upon, substantially as set forth.

4. The arrangement of the pattern mechan-

ism of a knitting machine above the need e-carriage, substantially as set forth.

5. The combination of the pattern-barrel of a knitting-machine with mechanism for changing its relationship to the device upon which its pins operate, substantially as set forth.

6. The arrangement of the pins of a pattern-barrel in two helical lines commencing at the opposite ends of the barrel, substantially as set forth.

7. The combination of a cam for restoring the withdrawn needles with a carriage, substantially as set forth.

8. A needle-bed divided into divisions, which are so combined with the machine that a division may be displaced and replaced, substantially as set forth.

9. The combination of a removable division of the needle-bed with instrumentalities for counterbalancing its weight, substantially as set forth.

10. The combination of a removable division of the needle-bed with a needle-holder, substantially as set forth.

11. The combination of a traveling needle with a needle-bed divided into divisions, one of which may be displaced and replaced, substantially as set forth.

12. The combination of a transferring-prong with a needle-bed divided into divisions, one of which may be displaced and replaced, substantially as set forth.

13. The combination of a removable division of the needle-bed with its support by devices which permit a transverse movement, substantially as set forth.

14. The combination of a series of reciprocating needles with two thread-guides, one of which can be thrown out of gear when a single strip of work is being knit, the whole operating substantially as set forth.

15. The combination of the thread-guide carriage with catches that connect and disconnect it with the mechanism for imparting motion to it, substantially as set forth.

16. The combination of the needle-carriage with two sets of bumpers for operating two thread-guides, substantially as set forth.

17. The combination of the sinkers at the inner side of a division of the needle-bed which remains in place with a lifter, substantially as set forth.

18. The depression of the yarn between the thread-guide and the last needle fed with yarn by an instrumentality which is separate from the thread-guide and effects the depression, substantially as set forth.

19. The combination of the thread-guide carriage with devices for griping the yarn which are independent of the thread-guide.

20. The combination of the needle-cam bar with a movable cam-block operating to withdraw one of the needles to a less extent than the others, substantially as set forth.

21. The combination of the under supports of the needles of a knitting-machine with devices which permit their adjustment laterally, substantially as set forth.

22. The combination of the stocks of the under supports with a rock-shaft, substantially as set forth.

In witness whereof I have hereunto set my hand.

EDWARD E. KILBOURN.

Witnesses:
JAMES DAYTON,
CHAS. A. LANG.