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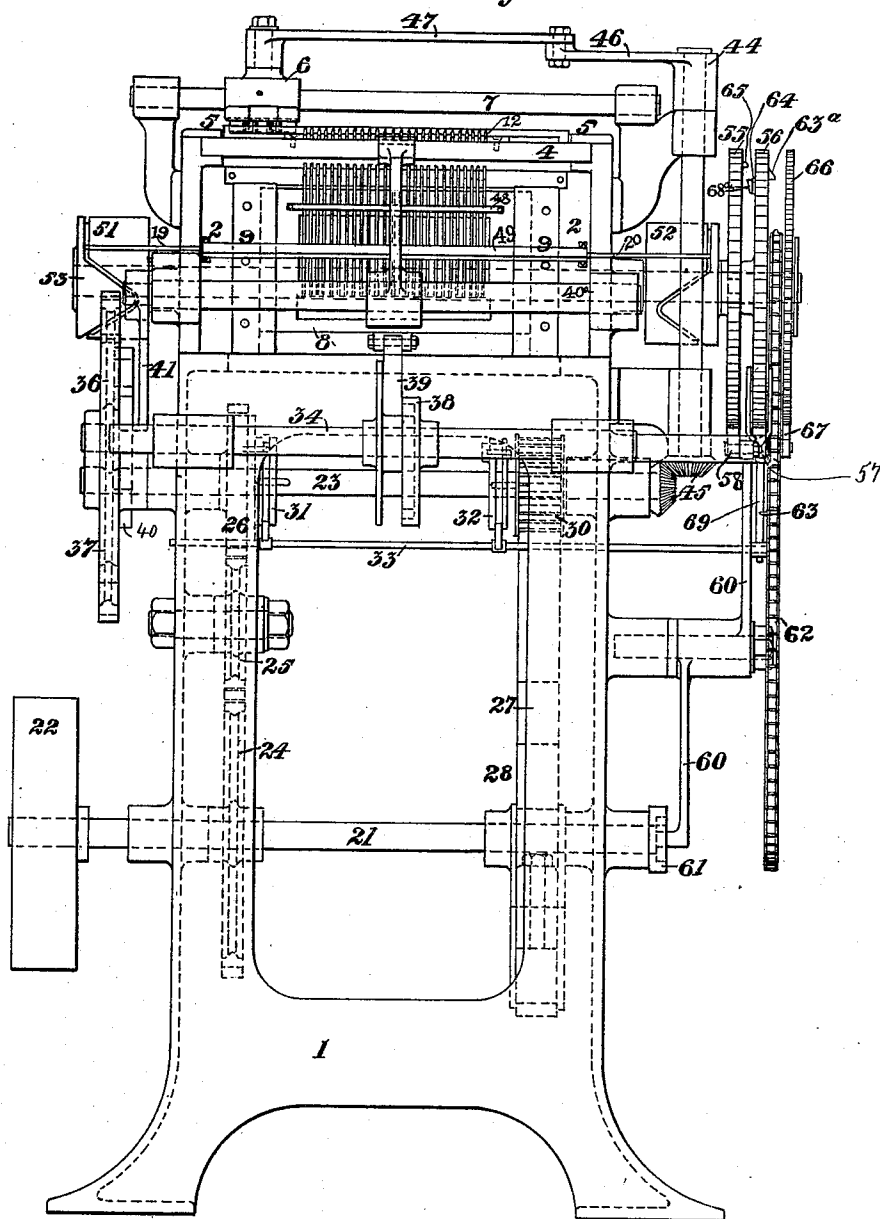
6 Sheets—Sheet 1

E. J. FRANCK & A. G. WRIGHT.
STRAIGHT OR FLAT KNITTING MACHINE.

No. 583,040.

Patented May 25, 1897.

Fig. 1.



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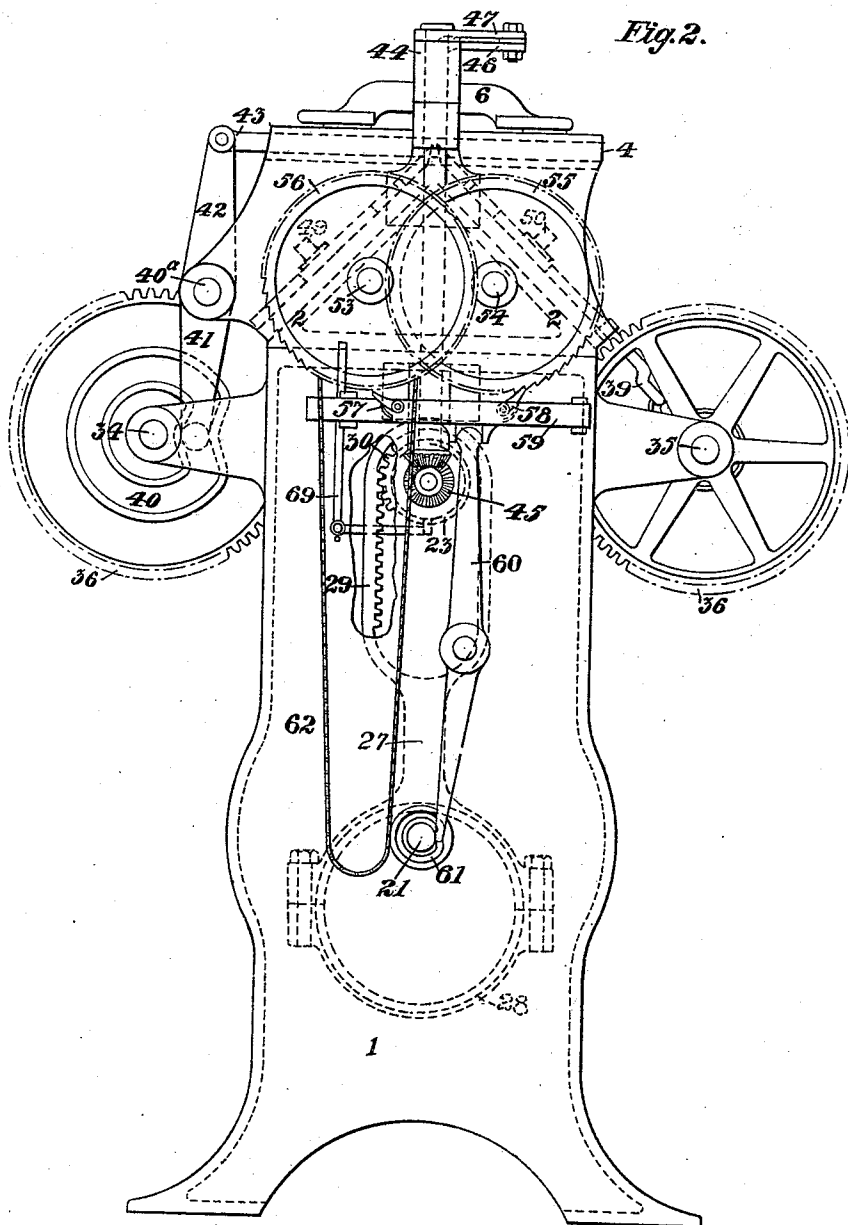
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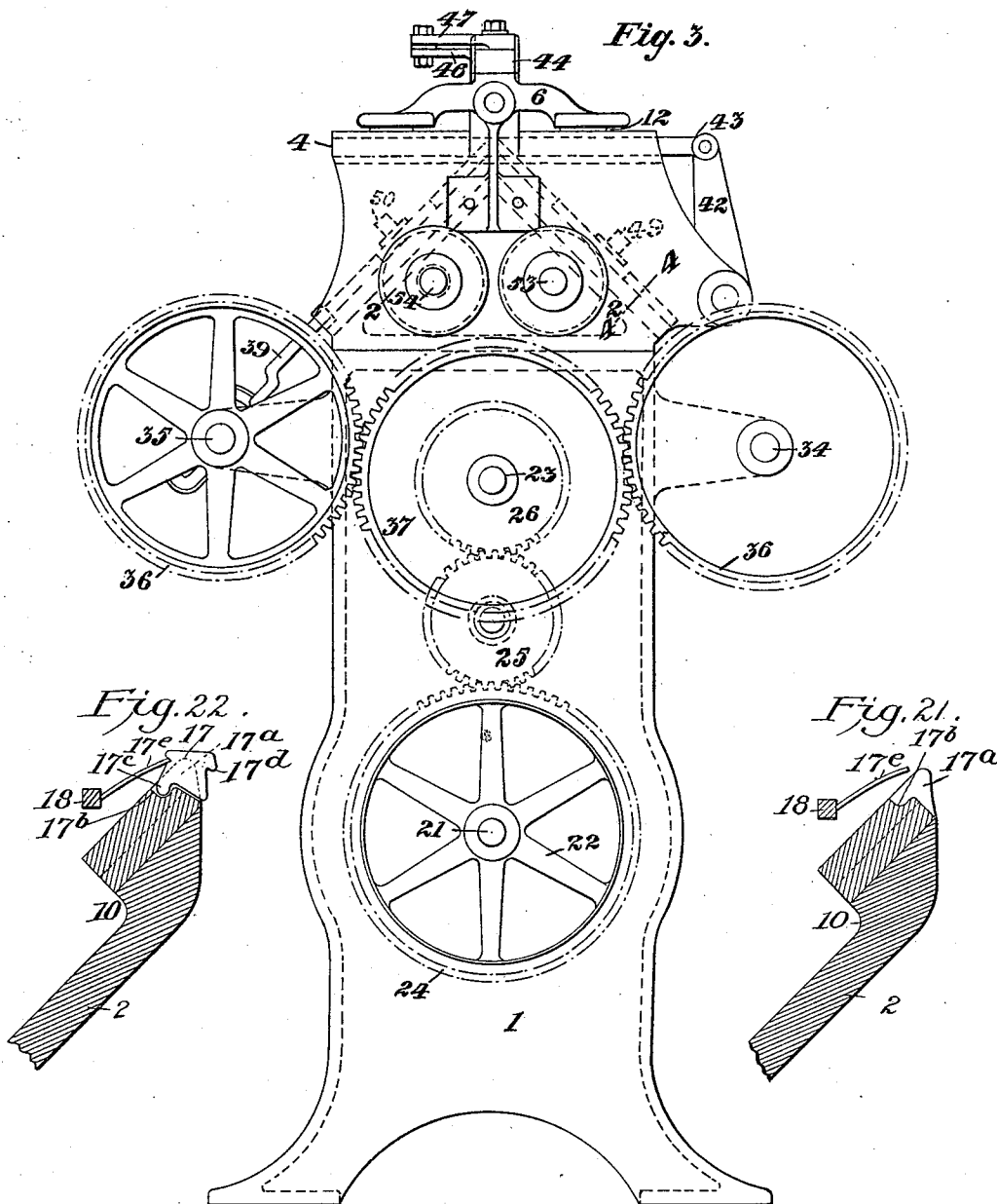
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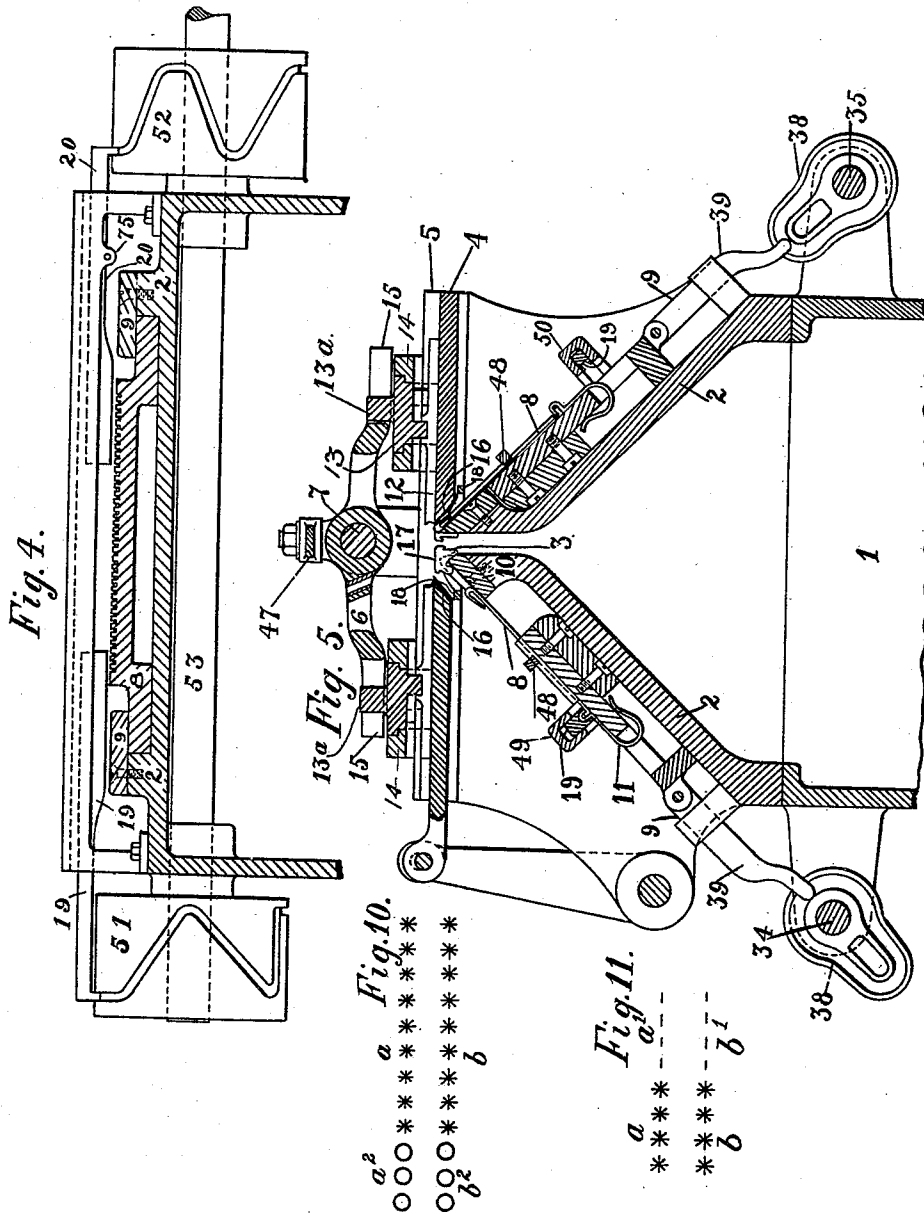
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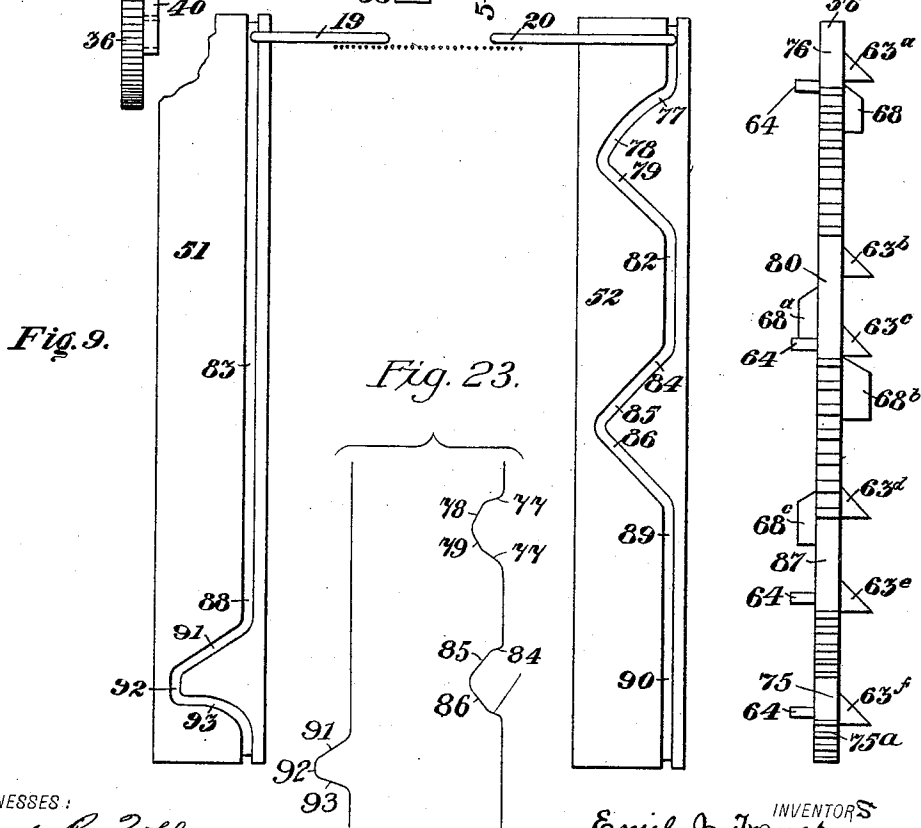
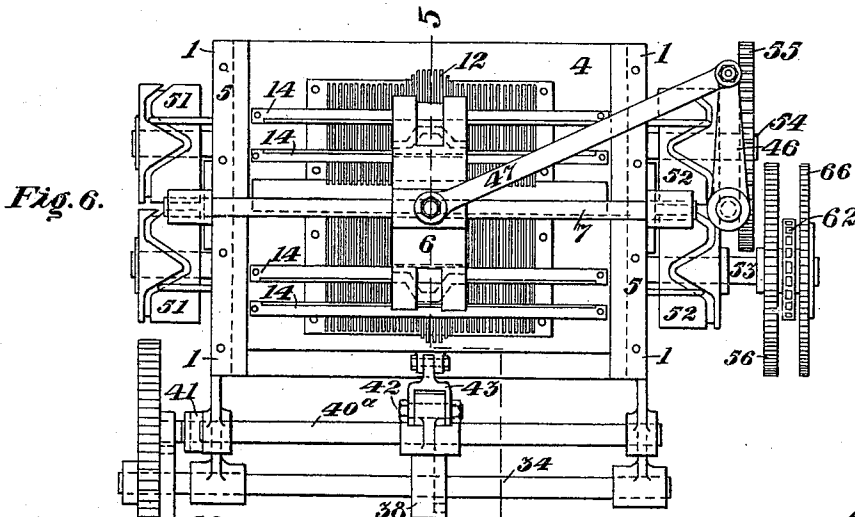
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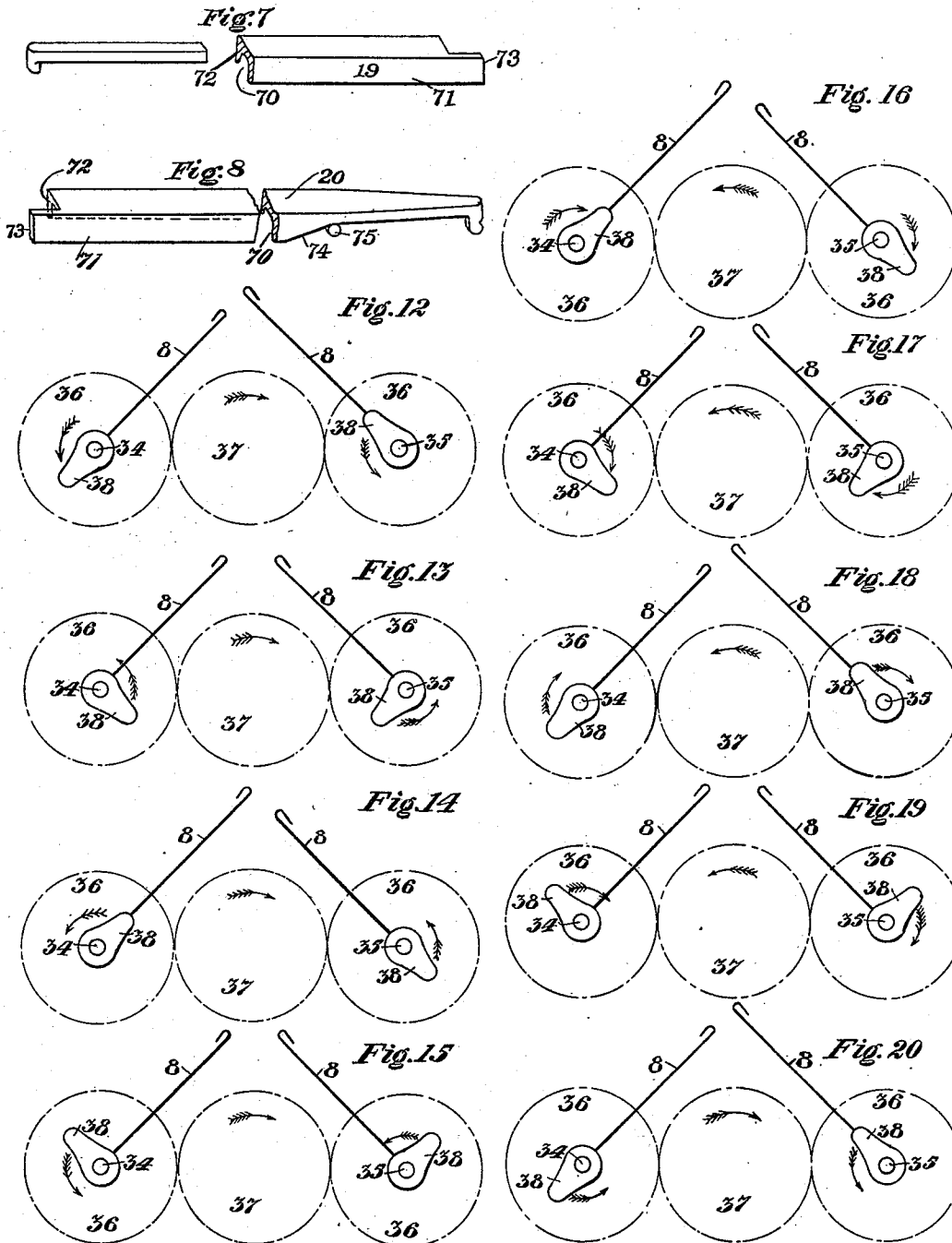
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UNITED STATES PATENT OFFICE.

EMIL J. FRANCK, OF PHILADELPHIA, PENNSYLVANIA, AND ALFRED G. WRIGHT, OF DELANCO, NEW JERSEY.

STRAIGHT OR FLAT KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 583,040, dated May 25, 1897.

Application filed June 18, 1895. Renewed September 29, 1896. Serial No. 607,368. (No model.)

To all whom it may concern:

Be it known that we, EMIL J. FRANCK, of the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, and ALFRED G. WRIGHT, of Delanco, in the county of Burlington and State of New Jersey, citizens of the United States, have invented certain new and useful Improvements in Straight or Flat Knitting Machines, of which the following is a specification.

The principal objects of our present invention are, first, to provide a simple, durable, efficient, and automatic straight or flat machine for manufacturing full-fashioned seamless knit goods, such as hosiery and the like, and, second, to construct, arrange, and combine the various parts of the machine for operation in such manner that the fashioning is effected without the formation of holes in the work and by means of what may be designated "tucking"—that is to say, by taking two stitches off one needle at the same time and incorporating both of them in the web.

Our invention consists in the improvements hereinafter set forth and claimed, and its nature and objects will be more fully understood from the following description taken in connection with the accompanying drawings, forming part hereof, and in which—

Figure 1 is a side elevational view of a straight or flat knitting machine embodying features of our invention. Fig. 2 is an elevational view of the right-hand end of the machine as shown in Fig. 1, having parts broken away for purposes of illustration. Fig. 3 is a similar view of the left-hand end of the machine as shown in Fig. 1. Fig. 4 is a sectional view drawn to an enlarged scale and taken on the line 4 4 of Fig. 3. Fig. 5 is a sectional view of the upper part of the machine drawn to an enlarged scale and taken on the line 5 5 of Fig. 6. Fig. 6 is a top or plan view illustrating portions of the machine, one counter-shaft being omitted. Figs. 7 and 8 are perspective views illustrating the needle-strippers. Fig. 9 shows diagrammatically a development of the two cams at the front of the machine and their actuating ratchet-wheel, the latter being provided with projections for controlling the operations of the machine for widening and narrowing the

web. Figs. 10 and 11 are diagrammatic views representing the needles and illustrative of the description of the mode of operation of the machine. Figs. 12 to 20 are diagrammatic views hereinafter referred to in connection with the description of the operation of the parts. Figs. 21 and 22 are detail views showing sections taken through the ribs that separate the needles and illustrating the same slotted for the accommodation of web-holders, and Fig. 23 is a diagrammatic illustration hereinafter referred to.

In the drawings, 1 is a generally rectangular or other shaped framework of the machine. At or near the top of this framework are disposed slanting, fixed, or immovable beds 2, Fig. 5, that may extend from end to end thereof and that have an opening, as 3, between them and through which the finished work passes.

4 is a sinker-bed centrally slotted to correspond with the opening 3 and afforded a range of motion transversely of the machine and of the fixed beds 2—for example, in ways 5, applied to or formed on the end portions of the framework 1 at or near their top portions.

6 is a thread-carrier disposed above the sinker-bed and afforded a range of motion longitudinally of the machine—for example, by being mounted so as to slide on a rod 7, secured to brackets or otherwise carried by the end walls of the framework 1. This part 6, Figs. 5 and 6, consists of a socket through which the rod 7 passes and of laterally-projecting arms, whereof one is perforated for the passage of the thread or yarn or for the reception of a yarn-carrying tube and whereof both are slotted for purposes hereinafter described.

8, Figs. 5 and 1, are grooved movable needle beds or plates disposed at the respective sides of the machine and afforded a range of motion upward and downward on the fixed or immovable beds 2—for example, by providing the latter with channeled guides 9, Figs. 1 and 4. The upper portions 10 of the beds 2 are fixed and provided with grooves for the needles and for the web-holders 17. (See the left-hand side of Fig. 5.) The needles are or may be of the spring-beard type,

and are mounted in the needle-grooves of the movable needle beds or plates 8 and of the parts 10 of the fixed beds 2. The needles are provided with feet 11, Fig. 5, that frictionally engage the movable beds or plates 8, which are or may be cut away or slotted, as shown, for their reception. These feet 11 tend to attach the needles to the corresponding movable needle-beds 8 and are adapted, under circumstances to be hereinafter described, to slide and permit the movable needle-beds 8 to move independently of the needles, which for this purpose are held at rest. Obviously these feet 11 may be of a resilient nature and may be part of the needles themselves or may be connected therewith through the intervention of what are commonly designated "jacks"—that is, small pieces adapted to engage under the needle-bits and bent so as to form the feet 11.

12 are sinkers disposed intermediate of the needles and mounted so as to be capable of sliding in grooves extending from the central slot or opening in the sinker-bed 4 toward the opposite sides of the machine.

13 are sinker-cams afforded a range of travel longitudinally of the sinker-bed 4—for example, upon suitable ways or guides 14, formed on or carried by the end portions of the sinker-bed 4. These sinker-cams are provided with projections 13^a, adapted to work in slots 15, formed in the thread-carrier 6 and disposed transversely of the machine, so that when the sinker-bed 4 is shifted transversely of the machine the slots 15 permit the sinker-cams to move in a similar direction independently of the thread-carrier 6, and so that when the thread-carrier 6 is moved endwise of the machine the sinker-cams are caused to move therewith and to operate the sinkers, because the cam projects and engages between a pair of lugs extending upward from each sinker, as is illustrated in Fig. 5, the shape of the cams being indicated by dotted lines in Fig. 6.

The pressers 16, Fig. 5, for closing the beards of the needles are formed upon opposite sides of the longitudinally-ranging opening in the sinker-bed 4 by rounding or properly finishing the metal of the inner edges of the sinker-bed, which may be slotted transversely to form a separate projection for each needle, so that when this sinker-bed is shifted in one direction the pressers on one side of the slot cooperate with the beards on the adjacent needles, and when it is shifted in the other direction the pressers on the opposite side cooperate with the beards of the adjacent needles.

The webs or ribs of metal that project from the top portions 10 of the beds 2 and separate or lie between the successive needles are centrally cut away to form slots 17^a, Fig. 21, for the reception of the web-holders 17, Fig. 22. Consequently the web-holders 17 are located one between each two needles. Each of the slots 17^a is provided with a seat or counter-

sunk bearing 17^b for pivotally supporting a toe 17^c, depending from its corresponding web-holder, so that each web-holder is pivoted. The hooks 17^d of these web-holders are caused to hold down the web by means of a strip of spring metal 17^e, that bears upon the same beyond their point of pivotal support, as shown in Fig. 22. The strip of spring metal 17^e may be carried by a rod 18, attached to the ends of the framework of the machine.

From the foregoing description it is apparent that a tubular web may be produced or fabricated by first shifting the sinker-bed, for example, toward the left hand, lifting the needle bed or plate 8 on one side of the machine—for example, the right-hand side of the machine—and placing a thread under the beards of its needles through the intervention of the thread-carrier and sinkers, and by causing the thread-carrier 6 to travel the length of the machine, and by subsequently depressing said needle-bed, whereby its needle-beards are closed by the presser 16, the stitches are thrown off, and the web-holders let off the web; second, shifting the sinker-bed 4 toward the right, lifting the left-hand needle bed or plate, causing the thread-carrier to complete its return stroke, and then lowering the left-hand needle bed or plate, and then repeating the above-described operations. This tubular web may be fashioned or widened or narrowed by holding, successively or otherwise, one or more needles in such manner that their corresponding movable needle bed or plate 8 ascends and descends, while they remain at rest out of range of the thread-carrier, it being understood that the feet 11 of such needles overcome their frictional engagement with their moving needle bed or plate, so that the latter slides in respect to them.

In order to prevent the needles which are intended for use as fashioning-needles from moving with their reciprocating needle bed or plate, use is made of one or more strip-pers, as 19 or 20, adapted to engage or contact with the bits of the needles and hold them immovable in respect to the reciprocating needle bed or plate.

During certain fashioning operations the movement of the needles on each side of the machine in respect to the thread-carrier is not always the same as it is during the production of a tubular web. For example, it differs, as will be hereinafter explained, during the formation of pockets, such as the heels and toes of stockings.

During the fabrication of a "tubular" web, and by this term we include a cylindrical web, such as the ankle and leg portions of stockings, and also a tapering web, such as the calf portion of stockings, the thread-carrier 6 supplies thread during one of its strokes or excursions in one direction to needles on one side of the machine—for example, the right-hand side—and during its return stroke

or excursion to needles on the other side of the machine. During the operation of fashioning the web for the heel and toe portions of stockings the thread-carrier supplies thread to the needles on one side of the machine—for example, the right-hand side—as they rise. These needles then descend and rise again, whereupon the thread-carrier accomplishes its return stroke and supplies thread a second time to these right-hand needles. The needles on the left-hand side of the machine then rise, and the thread-carrier supplies them with thread as it accomplishes another stroke. These left-hand needles then descend and rise again, whereupon the thread-carrier completes another return stroke and again supplies them with thread, and this operation is repeated as long as the work is being fashioned for the production of heels and toes by throwing needles into and out of action first on one side of the machine and then on the other.

In order that the foregoing description may be perfectly understood, reference is made in connection therewith to Fig. 10, wherein a and a^2 and b and b^2 designate the needles at the respective sides of the machine, and to Fig. 11, wherein a' and b' are the heel and toe fashioning needles on opposite sides of the machine. In making a round or tubular web, Fig. 10, the thread-carrier supplies the needles a and a^2 with thread. These needles a and a^2 descend, the needles b and b^2 rise, and the thread-carrier supplies them with thread. The needles b and b^2 then descend. The needles a and a^2 again rise and are supplied with thread, so that the thread-carrier moves back and forth across the needles and supplies thread first to the needles on one side and then to the needles on the other side. In fashioning a web for the production of heels and toes the needles a , Fig. 11, together with some of the needles a' , rise and are supplied with thread and then fall. During this operation the thread-carrier is moving from left to right. Subsequently the needles a and some of the needles a' rise again and are supplied with thread by the thread-carrier which moves from right to left. The needles b and some of the needles b' then rise, and the thread-carrier in traveling from left to right supplies them with thread. Subsequently the needles b and some of the needles b' fall and then rise again, whereupon the thread-carrier in moving from right to left supplies them with thread, so that the thread-carrier in producing fashioned work suitable for heels and toes supplies thread twice to the needles on the front of the machine and then twice to the needles on the back of the machine, or vice versa.

In the production of a tapered tubular web or calf portion of a stocking certain of the calf-needles a^2 and b^2 , Fig. 10, are brought into action, it being understood in this connection that the stocking is commenced at the toe, and these calf-needles are of course taken

out of action upon the completion of one stocking and preparatory to the commencement of another. During the shaping of the calf portion of the stocking by means of the calf-needles the needles rise and fall on one side of the machine and then rise and fall on the other side of the machine, and thread is supplied to them, as has been hereinabove described with reference to the production of the ankle and leg portions of the stocking.

In the drawings, 21 is a main shaft rotated or driven in one direction—for example, through the intervention of a pulley 22—and suitably journaled or rotatably supported by the ends of the framework 1.

23 is a driving-shaft disposed above the shaft 21 and rotatably supported by bearings in the ends of the framework of the machine. Motion is transmitted from this shaft 23 to the operative parts of the machine—that is to say, to the needles, thread-carrier, sinker-bed, and strippers—through the intervention of suitable mechanism, hereinafter described, and in order to properly operate these parts this shaft 23 is rotated continuously in one direction during the production of a plain or tapered tubular web and is rotated first in one direction and then in the other, or, in other words, reciprocated during the fabrication of a web fashioned for the production of the heel and toe portions of stockings or for other analogous purposes.

24, 25, and 26 are a train of gears located in the drawings at the left-hand end of the machine and interposed between the shafts 21 and 23, and whereof one, for example—the gear 26—is loose on its shaft.

27 is an arm located in the drawings at the right-hand end of the machine and reciprocated from the shaft 21—for example, by an eccentric 28—and provided with a rack 29, meshing with a pinion 30, loose on the shaft 23.

31 and 32 are clutches splined to or otherwise movable endwise of the shaft 23 and adapted for engagement, respectively, with the pinions 26 or 30, the former for effecting rotation continually in one direction and the latter for effecting a complete turn first in one direction and then in the other direction of the shaft.

33 is a shipper-rod carried by the ends of the framework 1 and moved endwise in a manner to be hereinafter described and adapted when shifted into its left-hand position in Fig. 1 to cause the pinion 26 to drive the shaft 23 continuously in one direction and when shifted into its right-hand position in said figure to cause the rack 29 and pinion 30 to drive the shaft 23 first in one direction and then in the other.

34 and 35 are counter-shafts disposed upon opposite sides of the machine and revolubly supported by the framework thereof—for example, through the intervention of brackets, as shown in Figs. 2 and 3. These counter-shafts 34 and 35 are provided—for example, at their left-hand ends, as shown in Fig. 3—with

spur-wheels 36, that mesh with and are driven by a spur-wheel 37, fast on the left-hand end of the shaft 23. The shafts 34 and 35 are respectively provided—for example, at or near their centers, as shown—with cams 38, that reciprocate the needle beds or plates 8 through the intervention of connecting-rods 39 and in such manner that when one is up the other is down. One of the spur-wheels 36, the one shown at the left-hand side of Fig. 2, is provided with a cam 40, that operates through the intervention of a radial arm 41 to reciprocate a rock-shaft 40^a, journaled to the frame 1 near the top of the machine. This rock-shaft 40^a is provided, for example, at or near its center with a radial arm 42, which operates, through the intervention of suitable means, a link 43 to shift the sinker-bed 4 transversely of the needle beds or plates and of the machine and in order to bring the pressers 16 into operative position in respect to the needles.

44 is a vertically-disposed crank-shaft supported, for example, by brackets attached to the right-hand end of the framework of the machine. This shaft 44 is rotated by the driving-shaft 23 by means of miter-gears 45, disposed at the right-hand end of the machine, as shown at Fig. 2. 46 is a crank-arm carried by the upper end of the crank-shaft 44 and adapted to operate the thread-carrier 6 through the intervention of a link 47.

48 are bars attached at or near their ends to the movable needle beds or plates 8 and disposed above the needles in order to retain them to place and prevent their accidental upward displacement.

49 and 50 are needle-stripper guides secured to the fixed beds 2 outside of the movable needle beds or plates, and, as shown, they are of channeled form. The needle-strippers are adapted to these guides 49 and 50 and operate upon the bits of the needles and prevent them from moving with the movable needle beds or plates 8 in order to fashion the work, as has been already stated, and consequently are pushed or moved crosswise of the needles into range of their bits. The necessary movements of the needle-strippers are effected by means of cams whose shape and number depend upon the work to be produced.

The machine illustrated in the drawings is designed to produce hosiery, and a description of the cams for operating the strippers for this purpose will now be given.

51 and 52 are stripper-cams whose grooves engage suitable rollers or other projections upon the ends of the strippers 19 and 20 in order to shift them either into or out of range of the needles, as required. As shown in the drawings, there are two strippers and two stripper-cams for each side of the machine—that is to say, four in all. These stripper-cams are carried by cam-shafts 53 and 54, revolvably supported by bearings formed in or carried by the ends of the framework of the machine and disposed on opposite sides there-

of, so that when a cam-shaft is turned its corresponding cams 51 and 52, acting through the intervention of their grooves, shift the strippers 19 and 20, which are afforded a range of motion endwise of the machine and are guided by means of the channel-like guides 49 and 50, attached at their ends to the fixed beds 2 of the machine. The motion imparted to the stripper-cams will be continuous or intermittent, according to the character of the work to be produced. However, in practice it is usually intermittent. This intermittent motion is effected by means of ratchet-wheels 55 and 56, keyed, respectively, to the right-hand ends of the cam-shafts 53 and 54 and driven through the intervention of suitable spring-pressed pawls 57 and 58. These pawls 57 and 58 may be operated continuously through the intervention of a pawl-bar 59, afforded a range of endwise movement in suitable brackets applied to the right-hand end of the framework of the machine and shifted endwise through the intervention of a centrally-pivoted arm 60, which in its turn is operated by means of a cam 61, applied in the present instance to the right-hand end of the main shaft 21. Of course the pawls 57 and 58 tend to drive the ratchet-wheels 55 and 56 and their corresponding cams continuously; but this continuous motion may be interrupted by putting the pawls out of action—for example, by permitting them to work in toothless spaces upon the peripheries of the ratchet-wheels, as shown in the drawings. When this construction is resorted to, means must be provided for bringing the pawls again into action, and this result may be accomplished by means of a positively-driven sprocket-chain 62, provided with pins 63, adapted to collide with projections 63^a 63^b 63^c 63^d 63^e 63^f upon one of the faces of one of the ratchet-wheels—for example, the ratchet-wheel 56—and thus turn it far enough to bring its pawl 57 clear of the toothless space in its periphery and into range with its teeth, so as to drive it intermittently. The motion imparted to the ratchet-wheel 56 by the sprocket-chain 62 is also availed of for shifting the ratchet-wheel 55 in such manner that its pawl 58 clears its toothless space and engages its succeeding teeth by providing the adjacent faces of the ratchet-wheels 56 and 55 with projections 64 and 65, adapted to collide with each other and by means of which the wheel 56, when turned by the sprocket-chain through the intervention of the parts 63 and 63^a or 63^b or 63^c or 63^d, imparts motion to the ratchet-wheel 55.

The sprocket-chain 62 may be conveniently driven by providing its sprocket-wheel with a ratchet-wheel 66, having teeth all around its periphery and driven continuously through the intervention of a spring-pressed pawl 67, carried by the pawl-bar 59.

The movements of the ratchet-wheel 56 control the strippers 19 and 20, and consequently the fashioning of the work, so that the

wheel 56 is well adapted to effect the necessary motions of the shipper-rod 33 for effecting the necessary changes in the movements of the driving-shaft 23 that correspond with the production of either tubular or heel and toe fashioned work. For this purpose one or both (in the present instance both) of the faces of the ratchet-wheel 56 is or are provided with wedge-like projections 68 68^a, &c., disposed in range of the respective tines of a fork 69, formed on or applied to the shipper-rod 33.

From the foregoing description the skilful mechanic will understand the construction and relation of the parts of the machine embodying features of our invention. However, for the sake of a further explanation thereof we will describe the mode of operation of our machine when designed and arranged for the production of full-fashioned seamless hosiery, but before doing so it may be remarked that for this purpose the strippers 19 and 20 are shaped as shown in Figs. 7 and 8—that is to say, they are channeled, as at 70—and one of their walls 71 depends lower down than the other of their walls 72, and also extends or projects from one end of the stripper, as shown at 73. The object of this construction is as follows: When the stripper is moved inward, the portion 73 of its projecting wall comes in range of the bit of a descending needle and of course interrupts its descent in such position that it may not throw off its stitch. The continued inward motion of the stripper then causes the bit of this needle to enter the channel 70 and be retained by its walls 71 and 72 until it is desired to withdraw the stripper and permit the needle to again move with its bed or carrier 8 and come into action. However, when it comes into action and rises, it has already upon it a stitch, so that when it again falls it throws off two stitches at once, and these two stitches are incorporated in the web, thus preventing the formation of holes therein. It is often desirable to simultaneously throw a number of needles out of or into action. For this purpose each stripper 20 may be provided with an inclined surface, as 74, which coöperates with a roller or guide 75, journaled transversely of the walls of the channeled stripper-guides 49 and 50 in such manner that when the stripper 20 is moved toward the right in Fig. 8 it is lifted up by the roller 75 in such manner that it clears the bits of all the needles, and when it is moved toward the left in said figure it drops down past the roller into range of the bits of a number of the needles, and thus holds them simultaneously out of action. The needles used in fashioning the calf portion of the stocking occupy the extreme left of the needle-beds. Then to the right come the needles used in knitting the bottom of the foot and the toe, including the toe-fashioning needles. Then come the small number of additional needles used in fashioning the heel, and then the needles at the right of the needle-beds,

which are the instep-needles and which knit the front of the leg and the top of the foot.

Having thus briefly referred to certain peculiarities of a machine of our invention when arranged for the fabrication of full-fashioned seamless hosiery, we will now proceed with the description of its mode of operation in the production of such articles, having reference to Fig. 9, wherein is illustrated a diagrammatic view showing a development of the stripper-cams 51 and 52 and of the ratchet-wheel 56, and also to the diagrammatic illustrations of Figs. 12 to 20. For the purposes of this description it will be assumed that the strippers 19 and 20 on each side of the machine occupy the positions shown in Fig. 9 and that the gear-wheel 37 is being rotated continuously in, for example, a clockwise direction, which results in the elevation and depression of the needles first on one side and then on the other side of the machine, as will be apparent from an inspection of Fig. 12. Under these circumstances the strippers 20 are in their right-hand position and consequently are held by the rollers 75 (shown in Fig. 8) clear of the needle-bits of what may be termed the "heel and toe fashioning" needles and also of the instep-needles, the strippers 19 are in their right-hand position and consequently engage the bits of what may be termed the "calf-fashioning" needles and hold them out of action and in such manner that they do not rise and fall or move with their plate or bed 8, and the shaft 23 is rotated continuously in, for example, a clockwise direction, by means of wheels 26, 25, and 24, with the result that the thread-carrier 6 and other parts of the machine are operated for the production of round work, as has been described, and the space 76 accommodates the driving-pawl 57, so that the ratchet-wheel 56 is at rest. The parts above mentioned remain in the relation above set forth while the machine operates to fabricate several courses—for example, ten or more—of round or tubular work upon all the needles except the calf-fashioning needles, of which the number depends upon the shape and size required for the legs of the hosiery. The ten courses, more or less, of tubular work above referred to are made before commencing to fabricate the toe of the stocking and are advantageous or useful in the subsequent operation of looping the end portions of the toe together—for example, by means of a well-known looping-machine. Upon the completion of the ten courses of tubular web above referred to a pin or projection 63^a upon the ratchet-wheel 56 is struck by the projection 63 upon the constantly-moving sprocket-chain, and thus the ratchet-wheel 56 is rotated for a short distance until its teeth come in range with the driving-pawl 57, whereupon the pin 63 clears the projection 63^a. This rotation of the ratchet-wheel 56, acting through the instrumentality of the projections 64 and 65, turns the ratchet-wheel 55, with the result that its driving-pawl 58 clears the toothless

space on its periphery and engages and drives its teeth. The above-mentioned rotation of the ratchet-wheel 56, acting through the instrumentality of the wedge-like projection 68, shifts the shipper-rod 33 and clutches 31 and 32 toward the right, thus throwing the gear-wheels 24, 25, and 26 out of action and causing the rack-bar 27 to turn the driving-shaft 23 through complete revolutions first in a clockwise and then in a counter clockwise direction and to operate the parts of the machine, including the thread-carrier, for the production of heel and toe fashioned work, as has been hereinabove mentioned. In this connection it may be remarked that in producing heel and toe fashioned work the movable needle beds or plates 8 are lifted twice on one side of the machine and then twice on the other side thereof. This result is accomplished as follows: Assuming that the rack 29 has completed one quarter of its stroke and then commences to operate upon the wheel 37, when it is moving in a clockwise direction, and when the needle-beds are in the position shown in Fig. 12, it is obvious that in completing the other three-quarters of its stroke the rack will turn the wheel three-quarters of a complete revolution in a clockwise direction. During the next stroke of the rack it turns the wheel one complete revolution in a counter clockwise direction, and during the next stroke it turns the wheel one complete revolution in a clockwise direction. During this operation the left-hand needle-bed rises, Fig. 14, and then descends, Fig. 15, and then rises again, Fig. 16, so that the left-hand needle-bed rises twice in succession. In Figs. 17 and 19 both needle-beds are down and in Figs. 18 and 20 the right-hand needle-bed is up. Thus each needle-bed is caused to rise twice in succession. Inasmuch as the four stripper-cams are directly connected in pairs with the ratchet-wheels 55 and 56, they partake of the same motions as the latter, so that the pin 63^a, when acted upon by the sprocket-chain, operates to set the cams 51 and 52 on the back and front of the machine in motion. These and the subsequent motions of the cams 51 at the left of the machine, Fig. 1, have no effect upon the strippers 19 until after the completion of the toe, foot, heel, and ankle portions of the stocking, because their grooves are perfectly straight, as shown at 83, Fig. 9. Upon coming into action to fashion the toe the strippers 20 are advanced toward the left sufficiently far to engage the instep and extra heel-fashioning needles at one stroke, whereas upon coming into action to fashion the heel they are advanced far enough toward the left to be in position for engaging the instep but not the extra heel-fashioning needles. This result is accomplished by designing the cam-groove upon the cam 52, for example, as shown diagrammatically in Fig. 23. As an obvious structural modification the projection 63^a may be located lower than is indicated in Fig. 9, so that when the strippers

20 are advancing toward the left under the influence of the portion 77 of the cam-groove to inaugurate the fashioning of the toe the cam 52 is being turned by the positively-driven sprocket-chain 62 in the manner above described and therefore moves quite rapidly, and so that while moving rapidly under the influence of the sprocket-chain the cam-groove, or rather the portion 77 of it, moves the strippers toward the left, not only far enough to clear the roller or guide 75, and thus drop into position for engaging the instep-needles, but also far enough to engage at the same time the extra heel-fashioning needles, it being understood that this movement is so rapid as to constitute in effect a single stroke of the strippers.

To inaugurate the fashioning of the heel, the projection 63^a is disposed as indicated in Fig. 9 and the cam-wheel 52 is turned under the influence of its pawl, and hence comparatively slowly. Under these circumstances and by reason of such slow or intermittent motion of the cam-wheel 52 the portion 84 of the cam-groove advances the stripper quite slowly, so that it first comes down in respect to the roller or guide 75 into position for engaging the instep, but not the extra heel-fashioning needles at one stroke and then at subsequent strokes moves gradually toward the left, so as to engage said extra and ordinary heel-fashioning needles. The motion of cam 52 on the front of the machine inaugurated by the pin 63^a causes its grooved portion 77 to move its complementary stripper 20 rapidly inward, so that it not only falls clear of the roller 75, which would result in throwing a certain number of needles, for example, a quarter minus five, of all the needles out of action, but also shifts it at the same time so far inward as that it takes out of action the five needles above referred to. Thus the stripper 20 takes out one-quarter of all the needles at once. Subsequently the pawl 57 drives the ratchet-wheel 56 tooth by tooth, and thus imparts a similar motion to the cam 52, and the portion 78 of the cam 52 causes the stripper 20 to take one needle out of action at a time, and the portion 79 of the cam 52 causes the stripper 20 to throw these needles one at a time into action. In the meanwhile the cams 51 and 52 on the opposite side of the machine are operating in a similar manner with the exception that their motion is so timed as that a needle is thrown out of or into action first on one side of the machine and then on the other, and so on.

The above-described operations of throwing needles first on one side of the machine and then on the other out of and into action and of reciprocating the thread-carrier so as to supply thread twice to the needles on one side of the machine and then twice to the needles on the other side of the machine, all of which has been fully described, results in the fashioning of the toe portion of the stocking. Upon the completion of the toe por-

tion of the stocking the ratchet-wheels 55 and 56 come to rest by reason of the fact that their pawls enter and work in toothless spaces, for example, 80, Fig. 9, on their peripheries, and if necessary they may be held at rest by means of friction devices, as spring-washers or the like. However, just as the spring-pressed pawls enter the toothless spaces 80 a pin, as 63, on the sprocket-chain 62 collides with a projection 63^b on the ratchet-wheel 56 and shifts it not far enough to bring its teeth into engagement with the spring-pressed pawl 57, but far enough to cause the projection 68^a to shift the shipper-rod 33 and clutches 31 and 32 toward the left into position for causing the machine to fabricate a tubular web. This last-mentioned movement of the ratchet-wheel 56 has no effect upon the needle-strippers because the corresponding portions 82 and 83 of their cam-grooves are straight. The machine now fabricates a tubular web which is the foot portion of the stocking. Upon the completion of the foot portion of the stocking a pin, as 63, on the sprocket-chain 62, acting through the instrumentality of the projection 63^c, imparts motion to the ratchet-wheels 55 and 56, as described, and turns them in such manner that their pawls again drive them. The movement imparted by means of the projection 63^c causes the projection 68^b to operate upon the shipper-rod 33 to shift the clutches 31 and 32 toward the right to set the parts of the machine for the production of fashioned heel work. As the cam-wheel 52 is driven by its pawl the part 84 of its groove shifts the stripper 20 inward only far enough to clear its roller 75, and thus holds one-quarter minus five of the needles out of action, whereby the heel is made fuller by five needles on each side of the machine than the toe. The subsequent movement of the ratchet-wheel 56, under the influence of its pawl, causes the portions 85 and 86 of its groove to move the stripper first inward and then outward.

Of course the above-described movements occur on the back and front of the machine and result in throwing needles first on the back and then on the front, or vice versa, out of and into action, whereby the heel is fashioned, and the object of throwing out of action one-quarter of the needles minus five at the start of the heel and on each side of the machine is to make the heel more full or "full-fashioned," as it is sometimes called. Upon the completion of the heel the driving-pawls 57 and 58 enter toothless spaces, as 87, and at the same time a pin on the sprocket-chain 62 operates upon a projection 63^d, and thus shifts the ratchet-wheel 56 to cause the projection 68^c to act through the shipper 33, and thus set the machine for the production of round work. During this operation the strippers are not moved because the parts of their cams 88 and 89 are straight. The ratchet-wheels then remain at rest and the machine fabricates a tubular web, which is the ankle

portion of the stocking. Upon the completion of the ankle portion of the stocking a pin upon the sprocket-chain operates in the manner above described upon the projection 63^e, and thus, acting through the intervention of the parts 64 and 65 and their accessories, causes the cams 51 and 52 to be moved under the influence of their complemental driving-pawls 57 and 58. During this operation the strippers 20 remain at rest because the portions 90 of their cams are straight. However, the strippers 19 are drawn toward the left by the portion 91 of their cams and thus throw needles into action first on the front of the machine and then on the back, because there are two strippers 19, one on each side of the machine, with the result that the calf portion of the stocking is fashioned or widened. The driving-pawls of the ratchet-wheels 55 and 56 then enter toothless spaces, as 75, the ratchet-wheels remain at rest, and the strippers are held out of action by the portions 90 and 92 of the cams, while a tubular web, that constitutes the leg portion of the stocking, is fabricated. Upon the completion of the leg portion of the stocking a pin 63 on the sprocket-chain 62 collides with or operates upon the projection 63^f, and the teeth 75^a shift the cams 51 and 52 in such manner that the portions 93 of the cams 51 return the strippers 19 to their original positions—that is to say, inward—so as to take the calf-needles out of action, whereupon the ten courses, more or less, are fabricated, as has been hereinabove described.

The repetition of the above-described operations results in the production of additional stockings.

It will be obvious to those skilled in the art to which our invention relates that modifications may be made in details without departing from the spirit thereof. Hence we do not limit ourselves to the precise construction and arrangement of parts hereinabove set forth and illustrated in the accompanying drawings; but,

Having thus described the nature and objects of our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A straight or flat knitting machine provided upon its respective sides with inclined beds having an opening between them for the passage of the work, flat grooved needle-plates continuously reciprocated in respect to said beds, a thread-carrier, needles attached to and moving with said needle-plates, a sinker-bed and its sinkers and pressers for the needles reciprocated across the machine, actuating mechanism for the sinkers and means for actuating said parts, substantially as described.

2. A straight or flat knitting machine provided upon its respective sides with beds having needle-grooves at their tops and having an opening between them for the passage of the work, grooved needle-plates continuously reciprocated in respect to said beds and to the

grooved portion thereof, a thread-carrier, needles attached to and moving with said needle-plates and working in the grooves of the beds, a sinker-bed and its sinkers and pressers for the needles reciprocated across the machine, and means for actuating said parts, substantially as described.

3. A straight or flat knitting machine provided upon each side with a reciprocating needle plate or bed, needles frictionally engaging said plates or beds, devices movable longitudinally of the machine and adapted for engaging and disengaging needles to prevent them from moving with said plate or bed, a sinker-bed and its sinkers and pressers for the needles reciprocated into and out of range of the needles and across the machine, and means for actuating said parts, substantially as described.

4. A straight or flat knitting machine provided on its opposite sides with reciprocating plates or beds carrying needles, a reciprocating sinker-bed provided with pressers appertaining to the needles of the respective plates or beds, a thread-carrier afforded a range of travel longitudinally of the machine, sinkers and their complemental cams, and means for actuating said parts, substantially as described.

5. A straight or flat knitting machine provided on its opposite sides with reciprocating plates or beds carrying needles, a sinker-bed afforded a range of movement transversely of the machine and provided with sinkers and pressers appertaining to the needles of the respective needle-plates, a thread-carrier afforded a range of motion longitudinally of the machine, sinker-cams movable longitudinally of the machine and working in transversely-ranging slots in the thread-carrier, and means for actuating said parts, substantially as described.

6. In a straight or flat knitting machine, a sinker-bed provided with sinkers afforded a range of motion transversely of the machine, a thread-carrier afforded a range of motion longitudinally of the machine, sinker-cams afforded a range of motion longitudinally of the sinker-bed and fitted in transversely-ranging slots in the thread-carrier, and means for actuating said parts, substantially as described.

7. In a straight or flat knitting machine, a reciprocating needle bed or plate, needles, feet engaging the under side of the bed and attached to the needles to shift the same up and down with the bed, a stripper provided with a channel for receiving the needle-bits and holding the needles in position intermediate of their full strokes, and a projection, as 73, substantially as described.

8. In a straight or flat knitting machine, needles provided with feet engaging a reciprocating needle plate or bed, an endwise-movable channeled stripper provided with a projecting wall, as 73, for detaining a needle and guiding it to the channeled portion of

the stripper, and means for actuating the needle plate or bed and shifting the stripper, substantially as described.

9. In a straight or flat knitting machine, a reciprocating needle bed or plate, needles provided with feet engaging said plate or bed, a stripper adapted for holding the bits of said needles and provided with an inclined face, as 74, a roller or guide cooperating with said inclined face, and mechanism for shifting the stripper and actuating the bed or plate, substantially as described.

10. A straight or flat knitting machine provided upon its opposite sides with reciprocating needle beds or plates, a thread-carrier, needles having feet frictionally engaging said plates or beds, mechanism for reciprocating said thread-carrier and lifting the needle beds or plates to present first one and then the other to the thread-carrier, means for presenting the needles of each needle plate or bed twice in succession to the thread-carrier, and strippers for throwing needles out of and into action, substantially as described.

11. In a straight or flat knitting machine, needles, a reciprocating needle plate or bed, fixed guides ranging transversely of the needle-bed, feet attached to the needles and frictionally engaging the bed or plate, strippers movable endwise in said guides and provided with channels for engaging the needle-bits at the respective ends of the machine to hold the needles in position intermediate of their full strokes, projections, as 73, on the strippers, and mechanism for operating said needle plate or bed and strippers, substantially as described.

12. A straight or flat knitting machine provided upon its opposite sides with reciprocating needle beds or plates and shafts 34 and 35, and their cams for operating the same, needles provided with feet frictionally engaging said plates or beds, a sinker-bed provided with pressers and sinkers and movable across the machine, a cam and its link and rock-shaft and its two arms interposed between one of said shafts and the sinker-bed, a thread-carrier movable lengthwise of the machine and slotted for engagement with the sinker-cams, a shaft, as 23, provided with gearing for operating the shafts 34 and 35, and for operating a crank-arm and its complemental link connected with the thread-carrier, mechanism substantially as described for rotating the shaft 23, to cause said parts to fabricate a tubular web by knitting first on the needles of one side of the machine and then on the needles of the other side thereof and for reciprocating or oscillating it to produce a flat or non-tubular web by knitting twice in succession on the needles on each side of the machine, strippers for throwing certain of said needles out of and into action to fashion the web, stripper-cams for shifting said strippers, intermittently-driven ratchet-wheels for operating the stripper-cams and whereof one has devices for actuating provisions for controlling the operating mechanism of the shaft 23, to effect con-

tinuous revolutions or reciprocations thereof, together with said provisions, and pins on a continuously-driven sprocket-chain for setting said ratchet-wheels in motion, substantially as described.

13. In a straight or flat knitting machine, reciprocating needle-beds on opposite sides thereof, needles frictionally engaging said needle-beds, a sinker-bed afforded a range of motion transversely of the machine and provided with sinkers and with pressers appertaining to the needles of the respective needle-beds, a thread-carrier and its complementary actuating mechanism, sinker-cams operated

by the thread-carrier, counter-shafts provided with cams for operating the needle-beds and with a cam for operating a rocker-arm connected with the sinker-bed, and means for rotating said shafts in one direction and for rocking them first in one direction and then in the other, substantially as described.

In testimony whereof we have hereunto signed our names.

EMIL J. FRANCK.
ALFRED G. WRIGHT.

In presence of—

EVAN J. LESTER,
A. B. STOUGHTON.