

an inch above the dial needle and about  $\frac{1}{32}$  of an inch away from the cylinder needles; the circumferential position of the guides should be such as to allow the cylinder needle latches to close without striking the guides; the leading end of the guides should then cover both the cylinder and dial needle latches just before the latch passes through the fabric. This prevents the latches from closing after leaving the control of the fabric on the old loops.

**To Press-Up a Machine or Replace a Press-Off.** If there is no fabric on the machine, procure a circular piece of cloth, knitted if possible, of about the same diameter as the needle cylinder. Press up the machine by placing the fabric between the cylinder and the dial dogs. To do this, insert a needle down through the space between the cylinder and dial, and with the hook of the needle, catch a narrow,

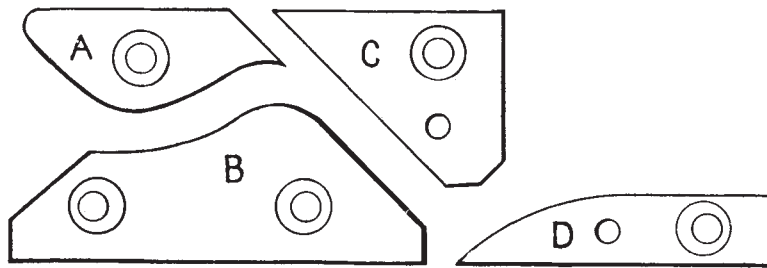


Fig. 76. Cylinder Cams.

yet firm, hold on the edge of the fabric which is to be placed on the needles, and pull it up until it can be grasped by the fingers of the right hand; put the left hand underneath and up through the hole in the needle cylinder, grasp the fabric, and by means of a sawing motion, force the fabric between one of the sets of dogs which prevent the dial from turning.

The machine should be turned at this time so that one of the resting points for the cylinder needles will come where the work is inserted between the cylinder and dial. At such points the cylinder needles are partially elevated, so that the edge of the fabric may be quite easily pulled on to the needles. Too wide an edge would make it difficult to operate the machine, and too narrow a bite would allow the cloth to be easily pulled off the needles. About  $\frac{1}{8}$  of an inch from

the needles to the edge of the fabric, or a trifle less, will be found sufficient in most cases.

After the fabric has been pressed on to several needles at this point, it is well to go around to the other side of the machine and pull it up between the other set of dogs, and place it on about the same number of needles, going through the same operations as before. Then press the cloth on to a few needles between the feeds, and turn

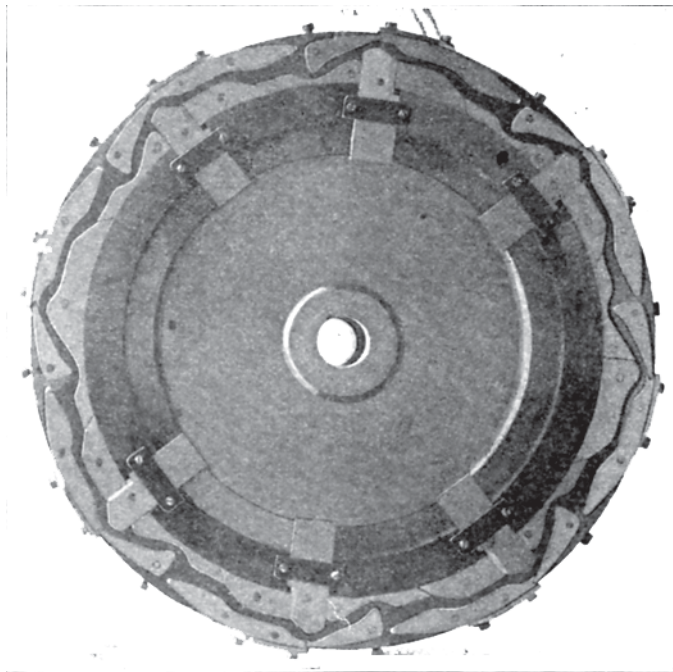


Fig. 77. Cap or Dial Plate.

the machine slightly, repeating this same process until the fabric has passed under the yarn guides.

*Thread the guides* and hold the work down by hand, catching hold of the cloth under the head with the left hand, while turning the machine slightly to bring other groups of needles into accessible positions to place the rest of the fabric on the empty needles. Repeat this operation until all the needles have loops placed upon them, then place the other end of the fabric between the take-up rolls, and adjust them to have a fairly taut tension on the fabric. Too much tension

should not be applied until the rough edge of the run-on portion of the cloth is off the needles.

Now, if all the yarn guides are properly threaded, the machine may be slowly turned by hand a short distance at a time, meanwhile opening all the latches that have not been opened by the pressing-up, and picking up all the dropped stitches and placing them on their

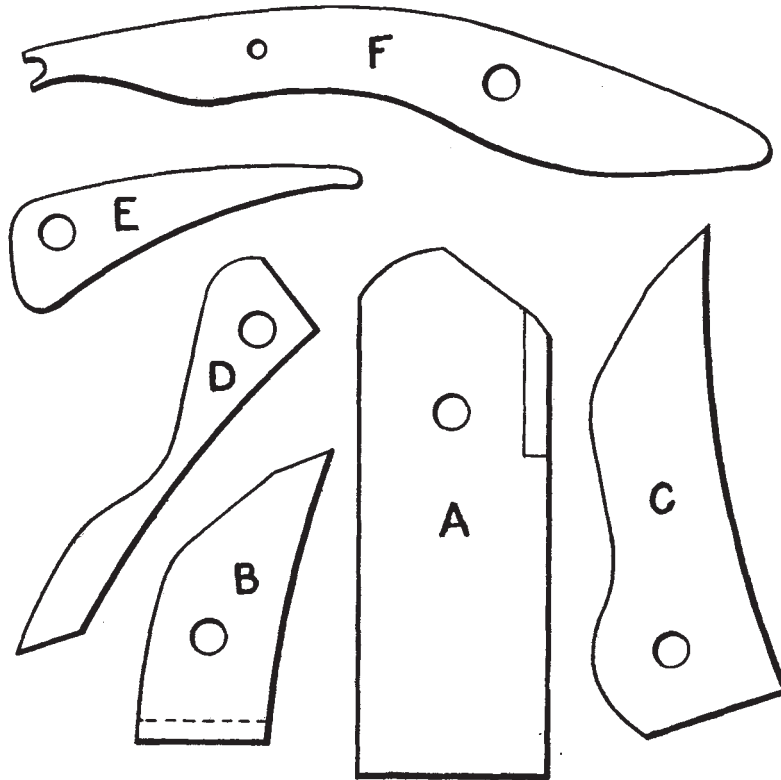


Fig. 78. Dial Cams.

proper needles. At this time, the cylinder and dial may be *thoroughly oiled*. Oiling was done but slightly before placing the fabric on the machine, as excessive oiling before that operation makes a machine hard to press up, the oil affecting the yarn and fabric to such an extent that it is almost impossible to get the needles through the fabric.

*Another way to replace a press-off*, in vogue with some knitters (assuming that the cloth is between the cylinder and dial and the first

set of dogs, and on the needles), is to keep jabbing it on to the needles a little at a time, turning the machine slowly until the first yarn guide and set of cams come to the point where the work was started on the needles; then thread the guide so that the needles will begin to knit, and proceed to place the work on the needles in continuous order, threading up the several guides as they come into position, until the other set of dogs is reached. Get the work in between these dogs by a similar process as described above, after which, continue to jab on the work continuously all the way around to the starting point, taking care that each guide is properly threaded when it arrives at

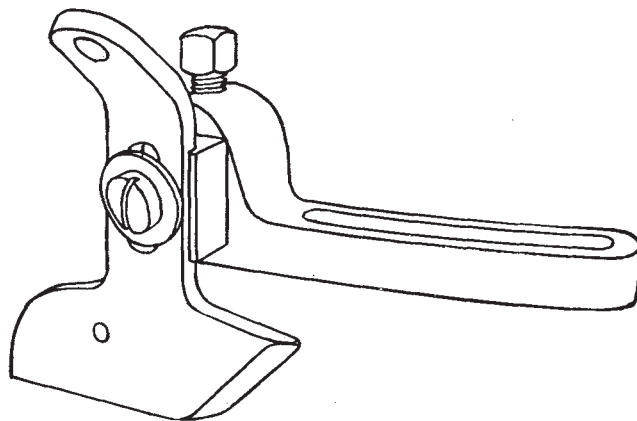


Fig. 79. Yarn Carrier.

the starting point. Then put the other end of the cloth into the take-up rolls and proceed as before.

**Adjusting the Feed.** Run the machine carefully until the new fabric has passed through the take-up rolls. In the meantime set all the cylinder cams evenly, by marking all the threads an equal distance from the yarn guides. To prevent unevenness of the cloth, each and every feed should draw exactly the same length of stitch. When unevenness of fabric shows in the cloth, it is often very difficult to locate the particular feeds that are not in even adjustment. The common practice of marking the yarn of each feed is the simplest, and perhaps the surest way of detecting which feeds are drawing more yarn.

To do this effectively, twist the yarn between the fingers, which have been more or less soiled with oil, so that the marking on the yarn may be easily noted, then turn the machine slowly by hand until the marked places on the yarn reach their particular guides. If all the marks arrive at the holes in the guides at precisely the same time, the fabric will be even as regards the feeds. If one or more of the marked places arrive at the holes in the guides in advance of the others, it or they are drawing more yarn, and should be adjusted accordingly. The cam drawing the longest loop will necessarily draw the mark to its guide first and should be slightly raised by means of the adjusting screw; the yarn with the mark farthest from the guide should be slightly adjusted down, to make it draw a longer loop. This operation must be repeated until all the marks on the yarn arrive at the holes in the guides at precisely the same time.

**Adjustment of the Dial Cap.** See that all the cap draw-in cams are set to draw the head or hook of the needle through the stitch. The adjustment of the cap which operates the dial needles should bear a certain relation to the cam ring which actuates the cylinder needles. The cylinder needle should be made to draw down just in time to lay its thread on the latch directly to the rear of the rivet in the dial needle. This relation is governed by the circumferential adjustment of the cap on the center spindle.

Now run the machine long enough to get an even weight on the fabric and to adjust the take-up rolls (Fig. 81) so that they will have an equal tension on their ends so as to make the fabric pass through *evenly*. At the end of the rolls, it may be seen whether the fabric is being drawn through too fast or too slowly; for if one end is slack, it is evident that there is a lack of tension on that particular end. At each end, there is a separate adjustment by means of which the fabric

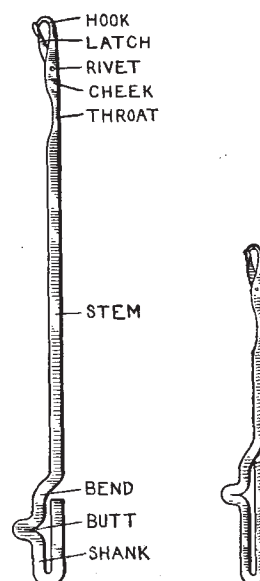


Fig. 80. Scott & Williams Needles.



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Utica Knitting Co.

may be made to run evenly and smoothly. The take-up rolls should not be pressed together too firmly, and *must be parallel* to draw equally at both ends.

After making the above adjustments, the knitter must ascertain what weight of fabric is desired, and adjust his machines accordingly. If only a slight adjustment of one or two stitches per inch is required

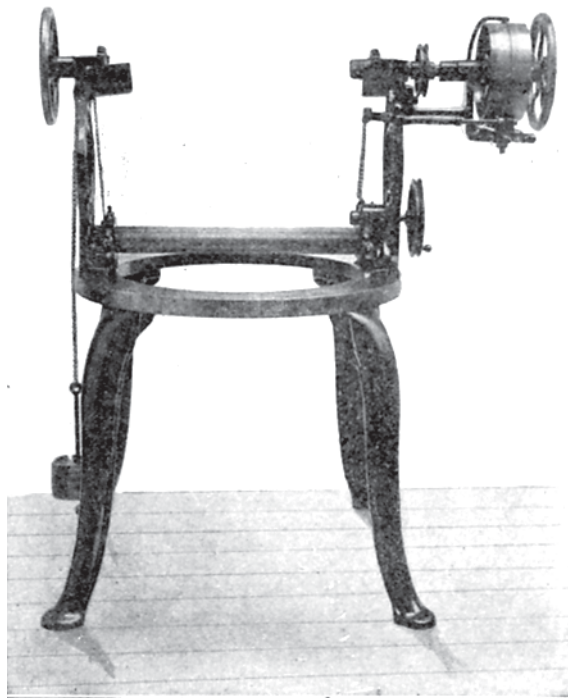
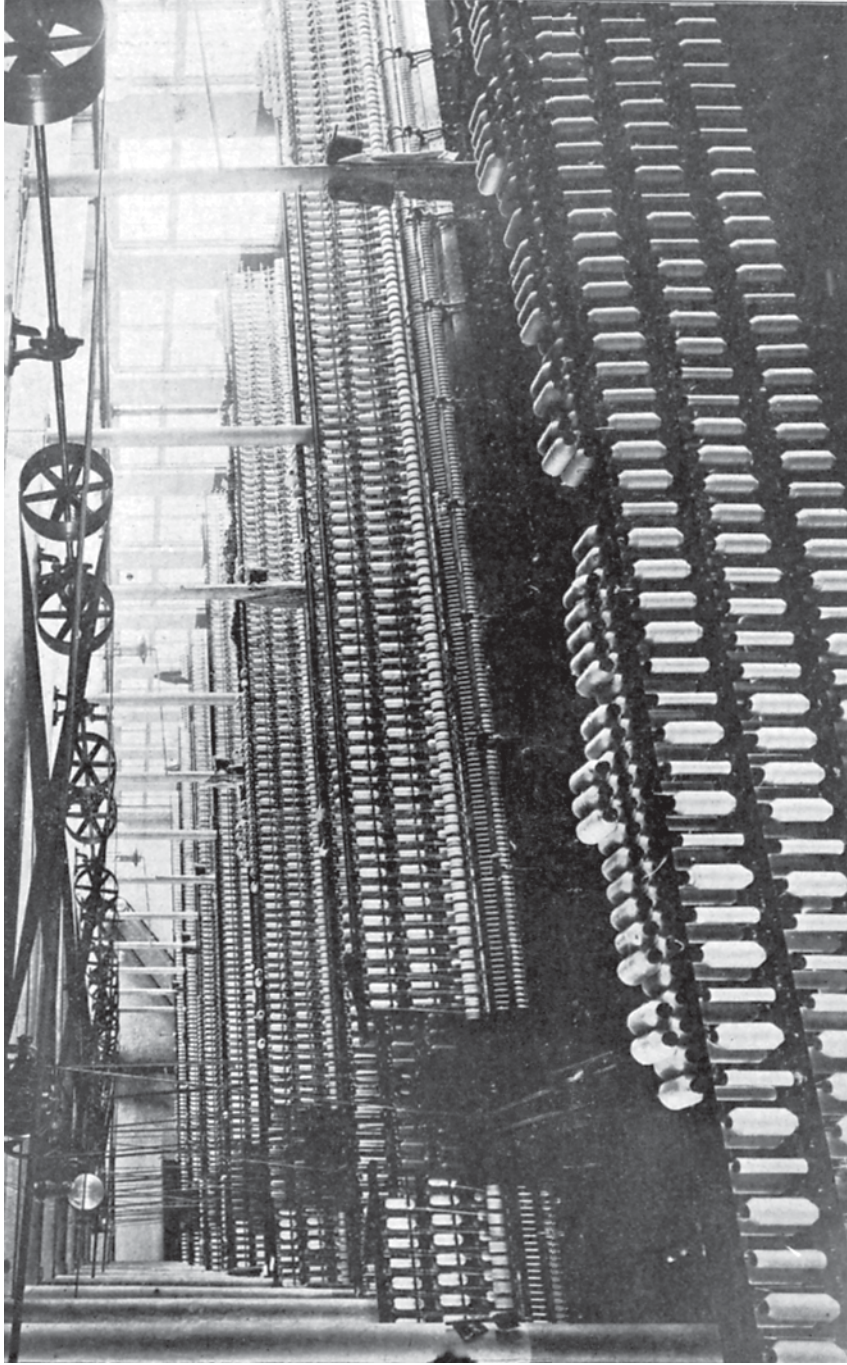


Fig. 81. Frame and Take-Up.

to obtain the proper weight of fabric, it can be made by adjusting the dial spindle wheel; but for more than one or two stitches per inch, the adjustment should be made on the cylinder draw-down cams. This adjustment requires the marking of the yarn, as previously described, to ensure a perfect evenness of the fabric, after the proper weight has been obtained.

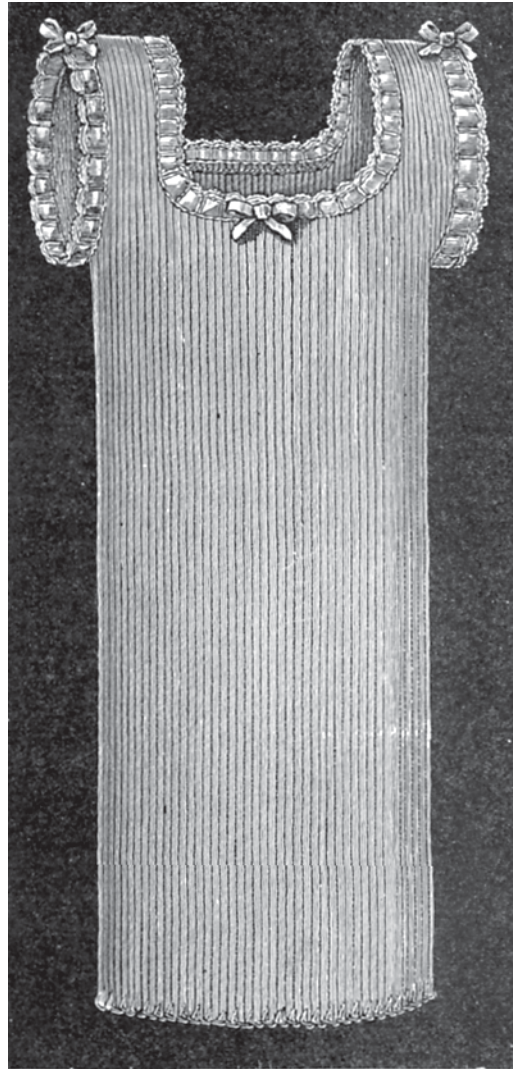
**To Slacken the Fabric**, either lower the draw-down cam in the



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ring, so that the needles will draw more loop, or raise the dial by loosening the retaining screw in the cross-bar, then turn the dial



Ladies' Swiss Vest.

spindle wheel in the direction calculated to raise the center spindle; the cap and dial will come with it. As a rule, it is not good practice to have the dial any higher than just enough to give ample space to

permit of a free passage of the thickest portion of the work; further slackening of the cloth should be obtained by adjusting the draw-down cam in the ring, as stated heretofore.

**To Remove a Section of the Sectional Cam Ring.** The sectional cam ring is provided for the purpose of obtaining easy access to the needle cylinder so as to remove and replace a broken needle or broken cam without removing the entire ring. After releasing the tension

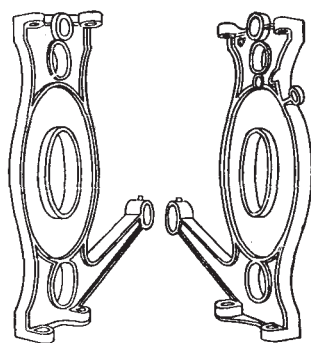


Fig. 82. Housing Plates.

from the work by slackening the take-up rolls, take out the retaining screw which passes through the solid outer ring, and remove the central section. Now, it will be possible to draw the cam section away in a direct line from the needle cylinder and disclose the needle cylinder, so that the difficulty may be located, and the broken needles or cams removed and replaced by new ones.

To restore the sections to their proper places, raise all the needles to a plane above the cams of the lower section; force this section up to the cylinder, drop in the central section, and secure with the retaining screw. Draw the work down through the take-up rolls, and re-adjust it to get the proper tension on the cloth between the cylinder and take-up rolls, turning the machine partially around by hand to see that everything is working properly; then ship on the power.

**In Readjusting the Cylinder Cams,** it is necessary that the dial needle should draw back within the dial only sufficiently to ensure the knocking over of its stitch; any additional draw means an unnecessary strain on the fabric, which will produce bad work.

**In Adjusting the Yarn Guide,** the latches of both sets of needles should not be permitted (by the guide) to close down on the hooks of the needles. The forward end of the guide is supposed to intercept any latch that may be inclined to fly shut. It is also important to see that the guides occupy such a vertical position that there is sufficient room for the hooks of the dial needles to pass under the lower edge of the guide.

When the fabric is being examined to see that the knitting is perfect and clear of any tuck stitch, it will be found that the holes

and tuck stitches often occur through the failure of the cap draw-in cams to draw the needles clearly through the stitch. If the machine is cutting holes in the fabric, *without* the presence of the tuck stitches, it may be prevented by setting the cap draw-in cams *outward*, as too much strain at this point cuts the yarn when knitting.

The cylinder not only holds the lower needles, or needles for making the outside of the fabric, but the cylinder top or comb acts as a *landing* or *knocking over* point for the cylinder needles. The

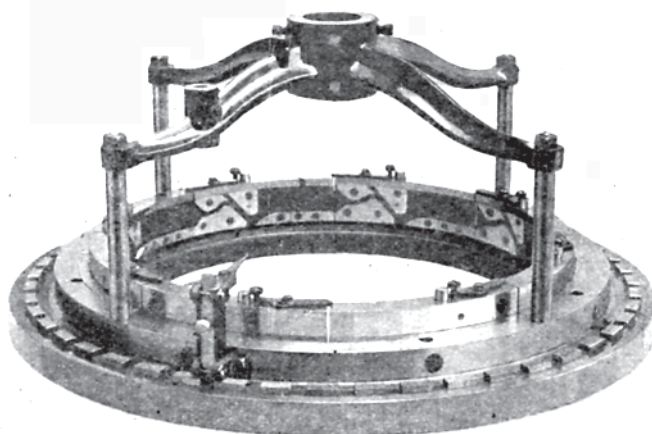


Fig. 83. Cam Cylinder, Showing Relative Positions of Cams, Cross-Bars, Etc.

cylinder cap or comb also acts as a knitting point for making the welt on a welting machine, as the dial needles are thrown out of action at this point of knitting.

**The Dial** is not only a plate to hold a given number of needles according to the gauge of the machine, but it has another function to perform, in that the outer edge, or sinkers, of the dial act as a *landing* or *knocking over* point for the dial needles on the inside stitch.

**The Take-Up** besides being present to perform its function of taking the knitted fabric from the needles as it is being made by the succeeding courses formed, is also employed as a weight or tension

to assist the opening of the needle latches, when the needles are clearing the old loops, prior to forming a new stitch. The take-up is also an important factor in *forming the loops*, as it is necessary to employ weight enough to carry the old loops out of the path of the needles without cutting the fabric.

The take-up on the "revolving cylinder" type is called a friction take-up, and on the "stationary cylinder" types it is called a gravity or balance take-up.

#### NUMBER OF NEEDLES.

The following table gives the total number of needles in each size machine, and the number of cuts in the cylinder, when the number of needles per inch is given, from 7 inches in diameter up to 24 inches in diameter.

The numbers given below are the nearest numbers to the rate given that will divide by three, for making two and two fabric.

	4 to 1	5 to 1	6 to 1	7 to 1	8 to 1	9 to 1	10 to 1	11 to 1	12 to 1	
7"	87	108	132	156	174	198	222	240	264	7"
8"	99	126	150	174	204	228	252	276	300	8"
9"	114	138	168	198	228	252	282	312	336	9"
10"	126	156	192	222	252	282	312	345	375	10"
11"	138	174	207	240	276	312	345	372	414	11"
12"	150	192	228	264	300	336	375	414	456	12"
13"	165	207	252	288	324	375	408	444	504	13"
14"	180	222	270	312	354	396	444	480	540	14"
15"	192	240	288	336	372	432	480	516	576	15"
16"	204	252	306	354	408	456	516	558	612	16"
17"	216	270	324	375	432	480	540	588	648	17"
18"	228	282	342	396	456	516	570	624	690	18"
19"	240	300	360	420	483	540	600	660	720	19"
20"	252	318	384	444	504	576	624	690	768	20"
21"	264	336	396	468	540	600	660	732	804	21"
22"	282	348	420	492	552	624	690	768	840	22"
23"	288	372	444	504	588	660	732	804	876	23"
24"	300	384	456	540	612	690	768	840	912	24"

It is a good practice to use eight needles to the inch for shaped goods, and ten to eleven needles to the inch for straight goods.

#### GEARING.

The gearing of each machine differs as to the size of the machine, but as a rule, like size driving pulleys on the driving shaft will produce the correct proportionate speed in the various sizes.

Detail of gearing and particulars of driving are contained in the following table.

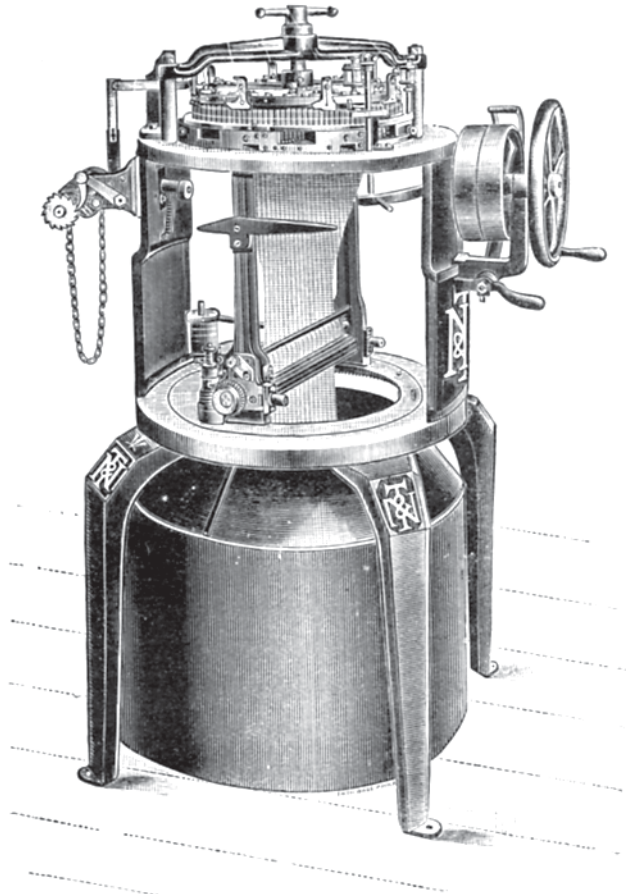
DIAMETER OF CYLINDER	SPEED OF HEAD	TEETH IN RING	TEETH IN PINION	DIAMETER DRIVING PULLEY	WIDTH DRIVING PULLEY
7 in.	68 rev.	152	30	7 in.	1½ in.
8 "	64 "	164	30	7 "	1½ "
9 "	60 "	140	28	7 "	1½ "
10 "	54 "	150	28	7 "	1½ "
11 "	50 "	136	28	7 "	1½ "
12 "	46 "	145	28	7 "	1½ "
13 "	42 "	153	28	7 "	1½ "
14 "	38 "	161	28	7 "	1½ "
15 "	34 "	169	28	7 "	1½ "
16 "	32 "	176	28	7 "	1½ "
17 "	30 "	185	28	7 "	1½ "
18 "	28 "	195	28	7 "	1½ "
19 "	27 "	205	28	7 "	1½ "
20 "	26 "	210	28	7 "	1½ "
22 "	25 "	244	28	7 "	1½ "
24 "	24 "			7 "	1½ "

The speed given here is a good average, but certain conditions require, perhaps, a lower speed, and on the other hand, may admit of an increased speed. This is wholly a matter of judgment with the knitter, for the nature of the yarn, its condition, the manner of winding and the climatic influences; in addition to the many other things that are not infrequently coming up to enter into the calculations of speed, are the most important factors in securing a large production. When the yarn is running well, the speed should be increased judiciously. If it runs poorly and all other conditions are in their most favorable running order, the speed of the machine will have to be reduced to a point that will manipulate the yarn without too many stops.

#### LEIGHTON FLAT HEAD LATCH NEEDLE MACHINE.

This type of latch needle circular machine, Fig. 84, differs materially from the customary build of latch needle machines, in that the plate or horizontal needles are operated *outside* of the cylinder *towards* the center, instead of *from* the center *outwardly* to the edge of the cylinder. This is the reverse of the customary position of the cylinder and dial type of machine. In this type, the horizontal or plate needles form the outside stitches, and the cylinder needles form the inside stitches of the fabric. It is the Leighton development of the Walter Aiken machine.

**Dial Needle Plate.** Fig. 85 represents the dial needle plate, and illustrates the principle on which these machines are built. As the needles are operated from the outside towards the center, and the butts of the needles on which the actuating cams operate are farther from



Nye & Tredick Circular Latch Needle Machine  
of the Revolving Head Class.

the center, the lands are thicker and stronger. The butts of the needles being wider apart than the gauge (at the inside edge of the needle plate) the yarn is taken into the machine with very little strain or stress, because each needle nearly completes its stitch before the next needle engages the yarn at the carrier; in this respect, somewhat

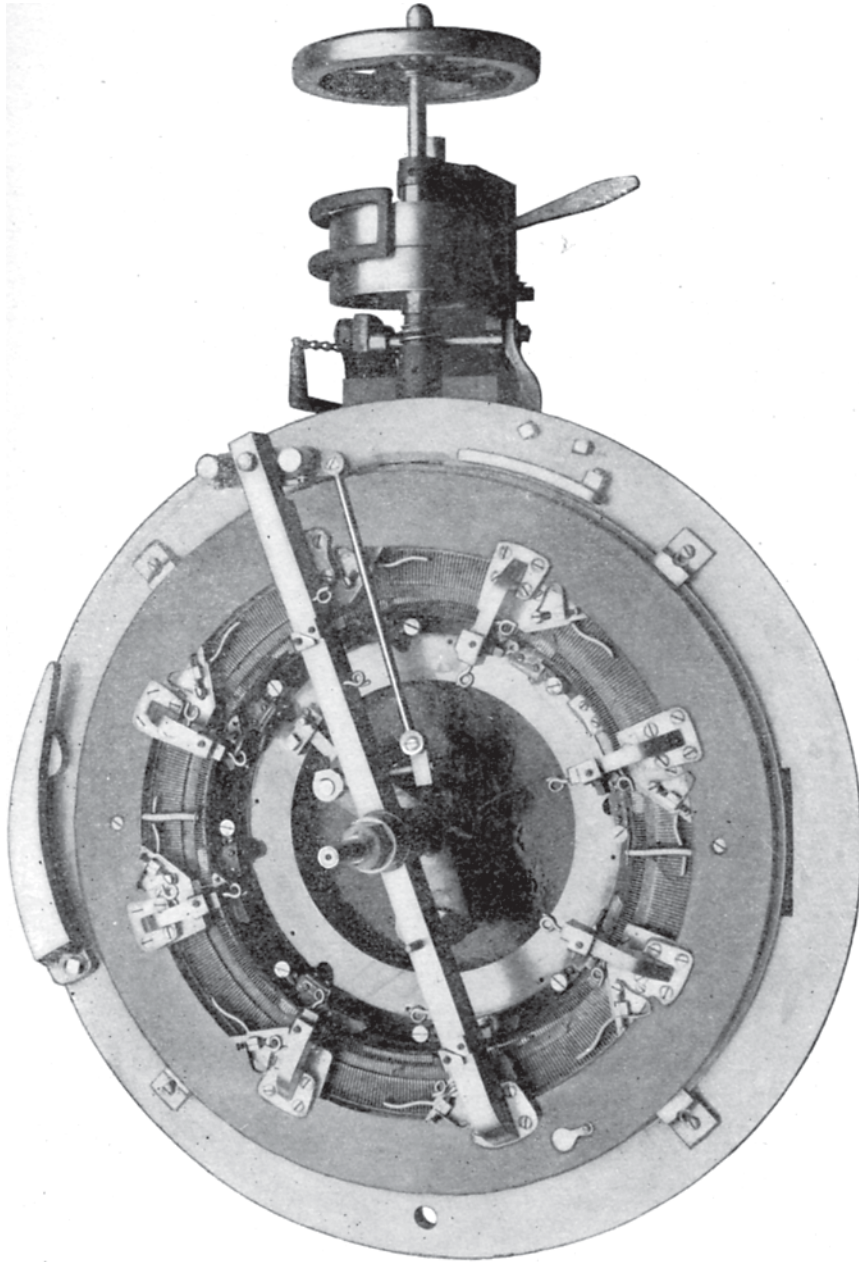


Fig. 84. Top View of an 8-Feed Automatic Underwear Machine.

resembling the operation of the spring needle frame in forming its stitches. This feature admits of using a large range in size of yarn on the same gauge machine, though cylinders and needle plates of different gauges may be used in the same machine.

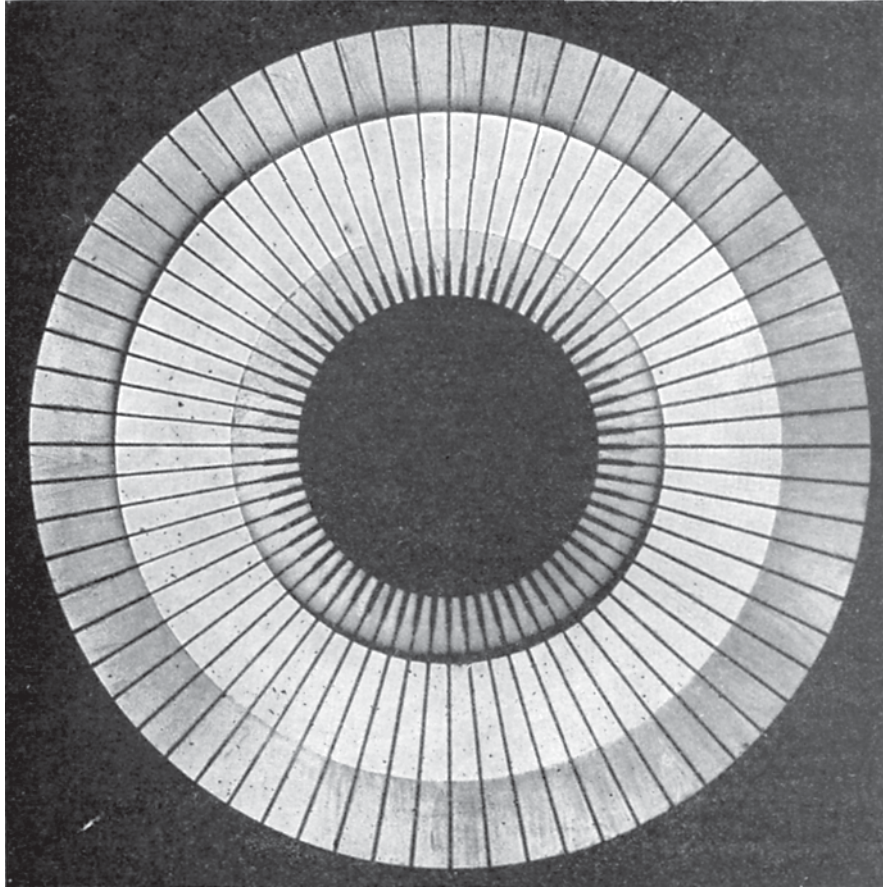


Fig. 85. Needle Plate.

**Shogged or Racked Stitches.** Among the other notable features of this machine, is the *shogged* or *racked* stitch, which forms the much desired edge for sweaters (Figs. 86 and 87) and other knitted garments. These stitches are made after knitting the body with the half cardigan, or royal fancy, the plain rib, or other stitches, as the



character or style of the garment may require. The shogged edges are formed automatically for any desired length at predetermined intervals, or may be made in a continuous, automatically racked web.

If it is desired to produce a fabric with equal intervals of shogged and plain stitches, or other stitches alternating, or a racked, or shogged portion of fabric to form the bottom of the garment, the machine can be regulated, by means of the pattern chain, to effect such result automatically.

**Plated Goods.** Another feature, is in knitting plated goods, *i. e.*, both sides of wool yarn, with cotton yarn between. This, of course, can be done in any combination of wool, cotton and silk, or other yarns, as the character of the cloth, or the demand for a fabric, may require.

These machines are designed and built for knitting straight, circular web, either plain rib, half cardigan, or tucked stitch, as used principally in making Swiss rib vests, pants, etc. Another style is for producing a variety of fancy knit combinations of stitches, in addition to the above, and also the regular fashioning machine, which automatically changes from plain rib to half cardigan or tuck stitches, as does any "automatic" for knitting underwear.

The sleeves may also be fitted with the racking attachments, where it is desired to have a racked edge or finish to the cuffs, which will produce tubular ribbed cuffs with racked or shogged borders and edges, making a complete finish for the cuffs as illustrated in Figs. 88 and 89.

Fig. 90 illustrates the *circular ribbed sweater collar*, showing automatically racked courses, made on the collar machine of this same type, which makes a circular collar with racked or finished edge, and with a variety of racked courses throughout the collar, as may be noted in the illustration. The machine works continuously, and automatically racks the courses as it knits.

Fig. 91 represents the *sweater and cardigan jacket machine*, with double feed and striping attachment, and automatic racking attachment, that racks borders and bands of any width and at any part of the web, without attention from the knitter.

Another important and desirable feature of these machines is the *separating course* of knitting (see across the middle of Figs. 86 and 87), which enables the operator to separate the goods without cutting the fabric, leaving a clean, smooth, finished edge.

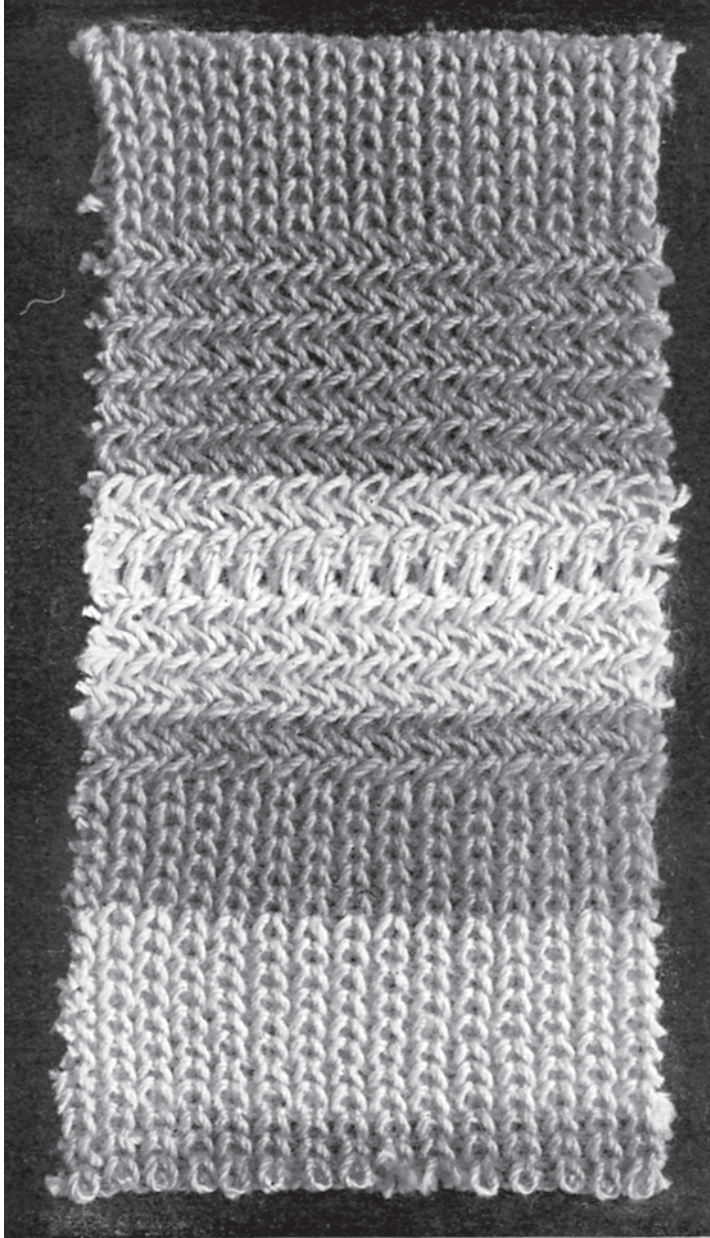


Fig. 86. Face of Sweater Cloth, Showing Separating Course and Racked Stitches.

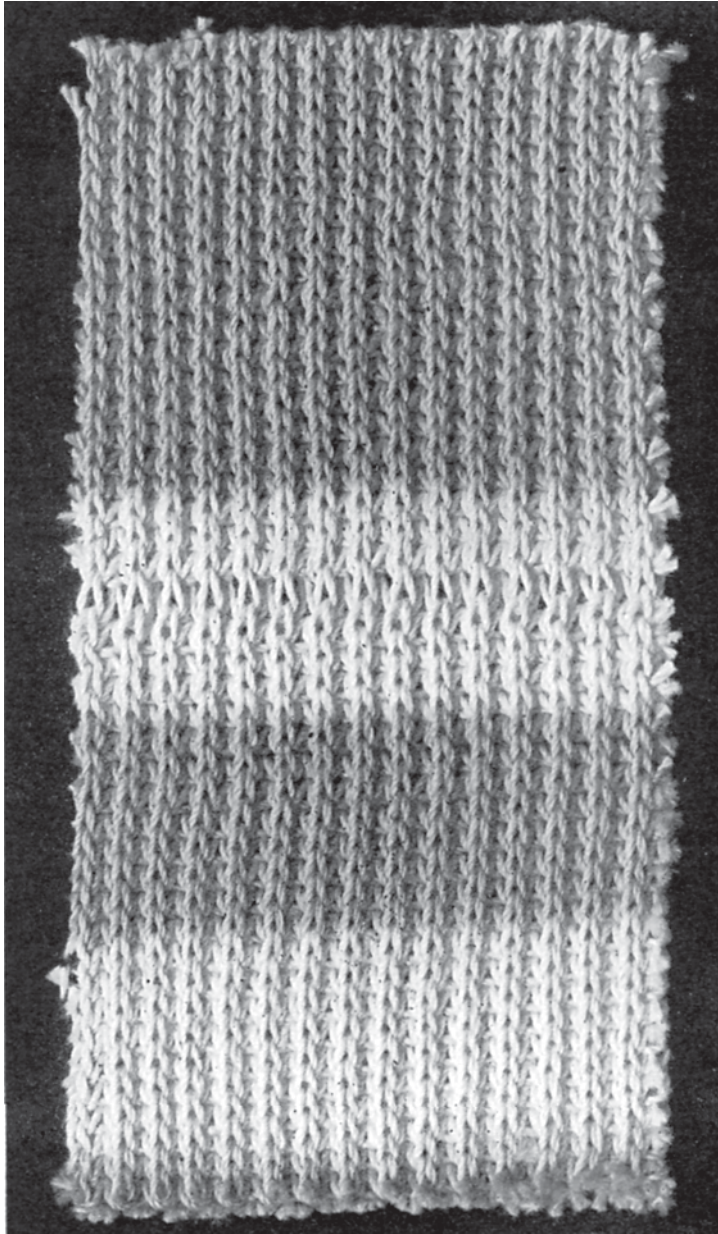


Fig. 87. Back of Fig. 86. Racked Courses do not show on the Back.

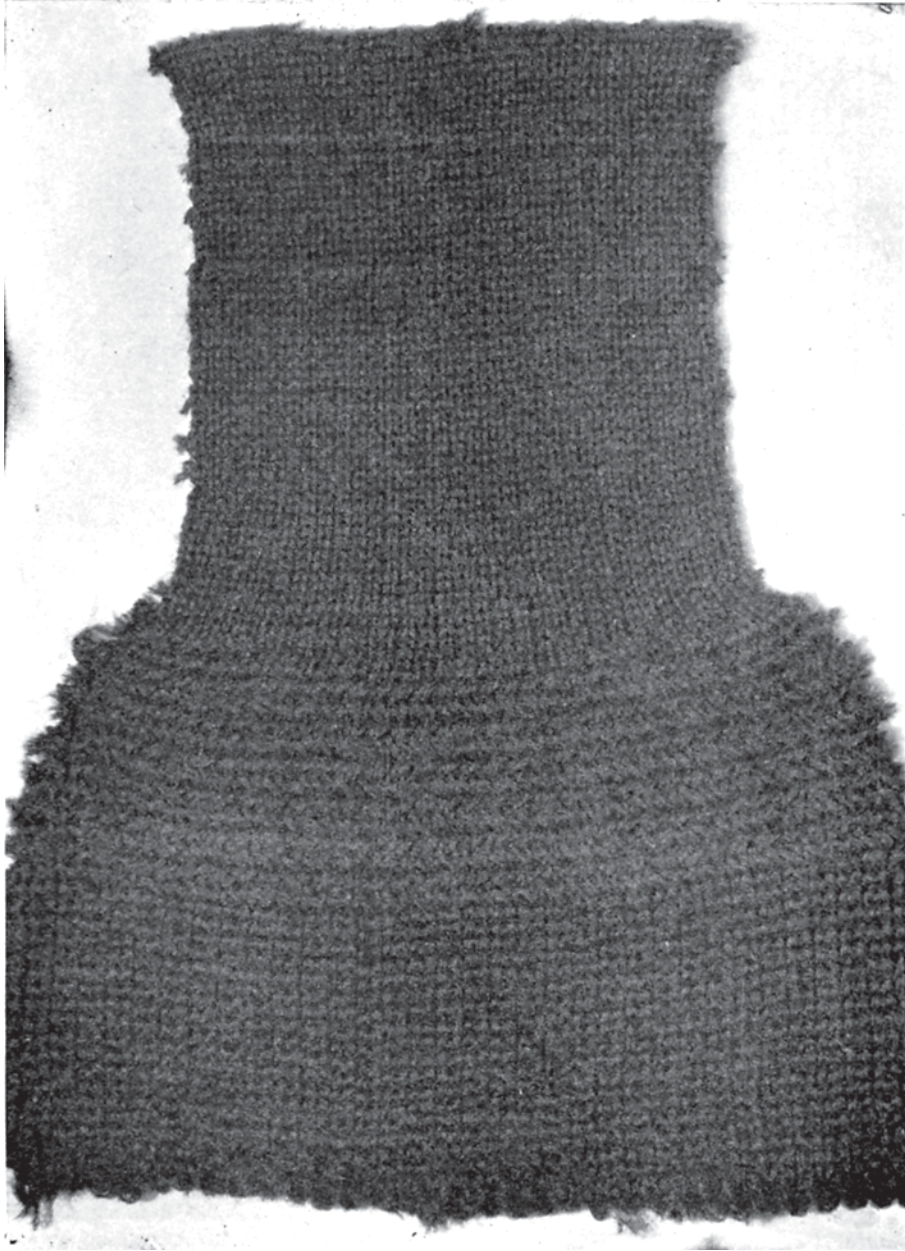


Fig. 88. Cuff-Racked Face.

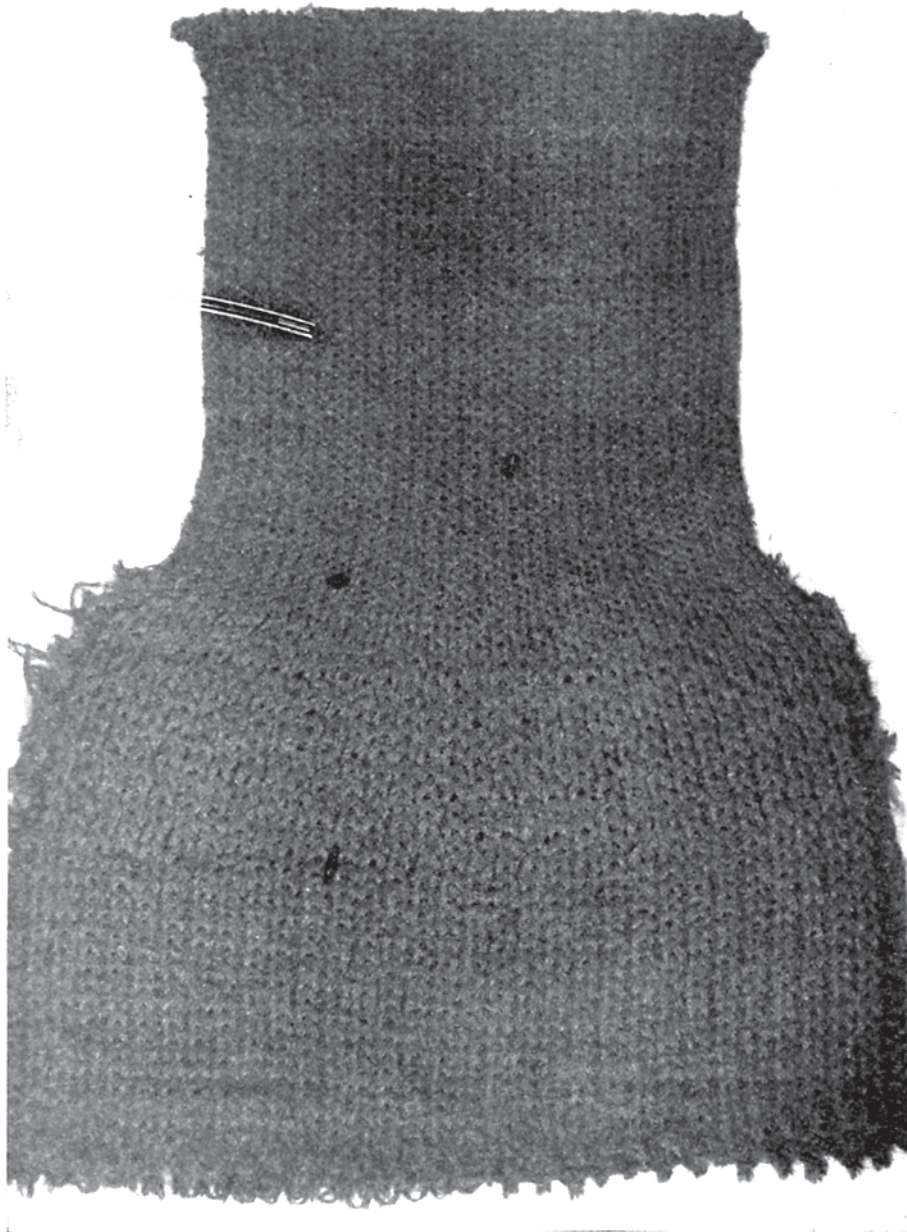


Fig. 89. Cuff-Raked Back.

Fig. 92 represents the sweater machine tipped partly over, in order to give a more comprehensive view of the top of the machine, and shows why the name "Flat Head" Circular Knitting Machine was so distinctively applied to it.

**Method of Driving.** The bed plate A, (Fig. 93), has the exten-

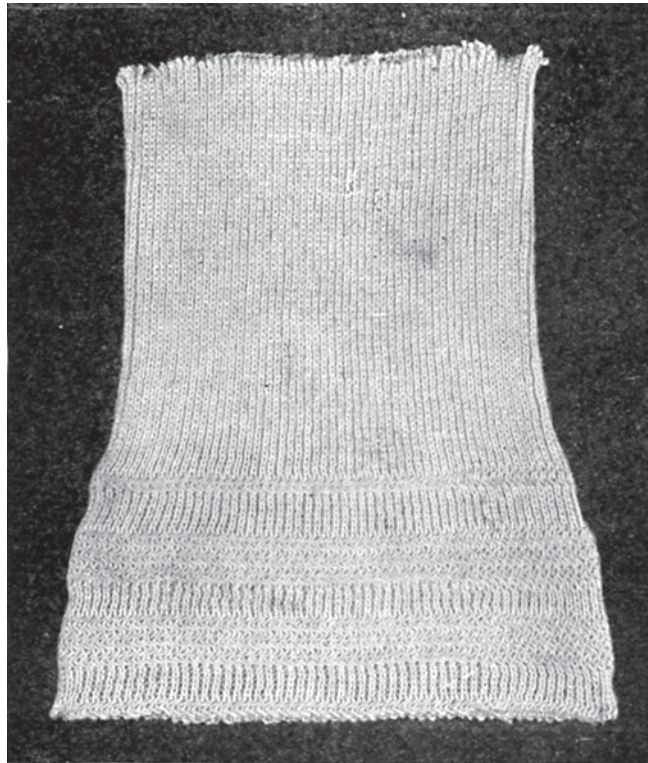
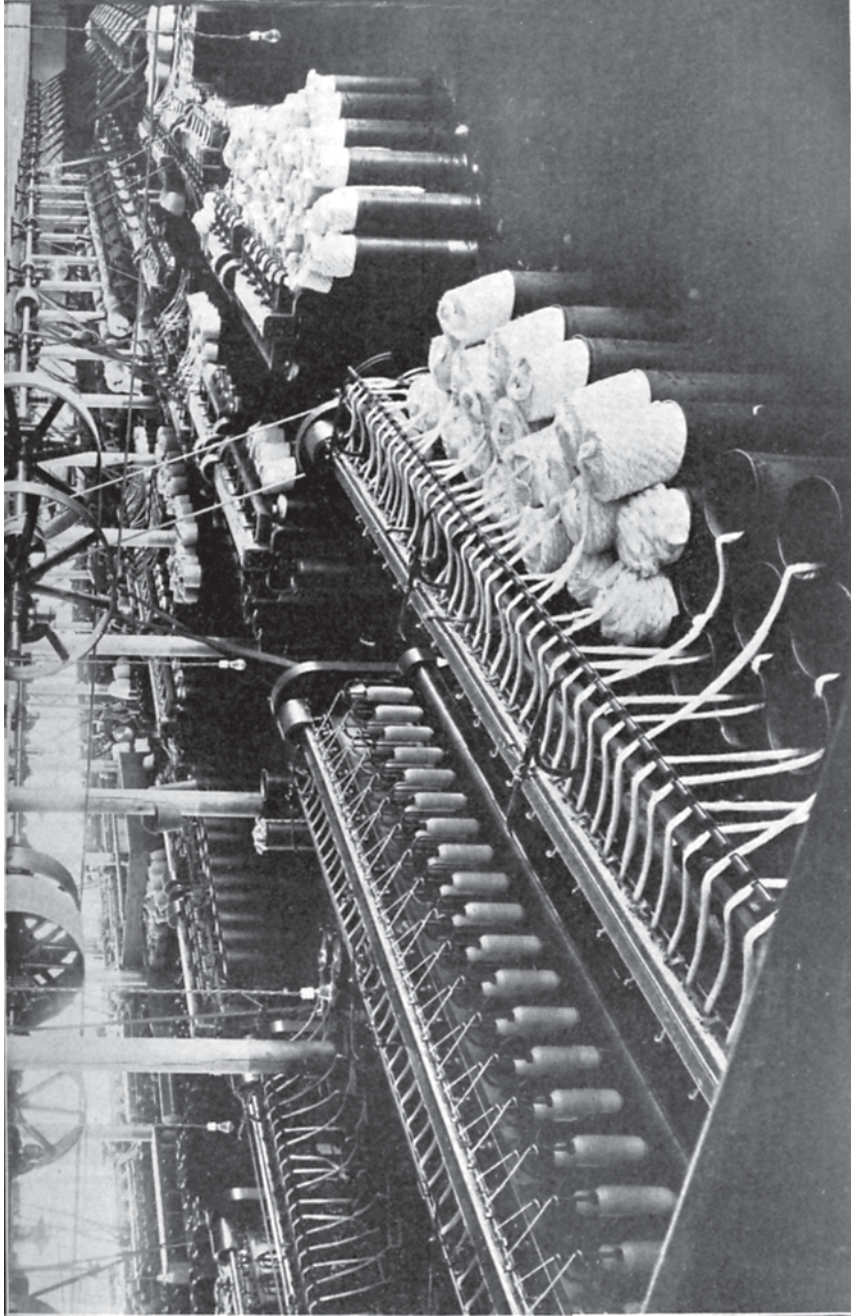


Fig. 90. Circular Ribbed Sweater Collar, Racked Courses.

sion  $A^1$  to furnish bearings for the main shaft, which is provided with tight and loose pulleys, and has a bevel gear, or pinion, which engages the teeth of the dial cam plate  $A^4$  to rotate it. The bolt  $A^{13}$  on the yoke  $A^5$  enters a link  $A^{14}$ , which is pivoted on an arm  $A^{15}$  projecting from the shaft of the cylinder actuating cam hub  $B^2$  (See Fig. 94), so that the hub will revolve in unison with the dial plate. The yoke  $A^5$  is connected to the cam plate by means of screws and supports, depend-



**VIEW IN YARN DEPARTMENT OF UTICA KNITTING CO., SHOWING CARDS, DRAWING FRAMES AND SPEEDERS**

ing from it is the central shaft A<sup>8</sup> (See also Fig. 94), having the attached collar A<sup>6</sup> on which rests the hub of the large ring-like washer B loose on the shaft. The needle cylinder B<sup>1</sup> is supported on the

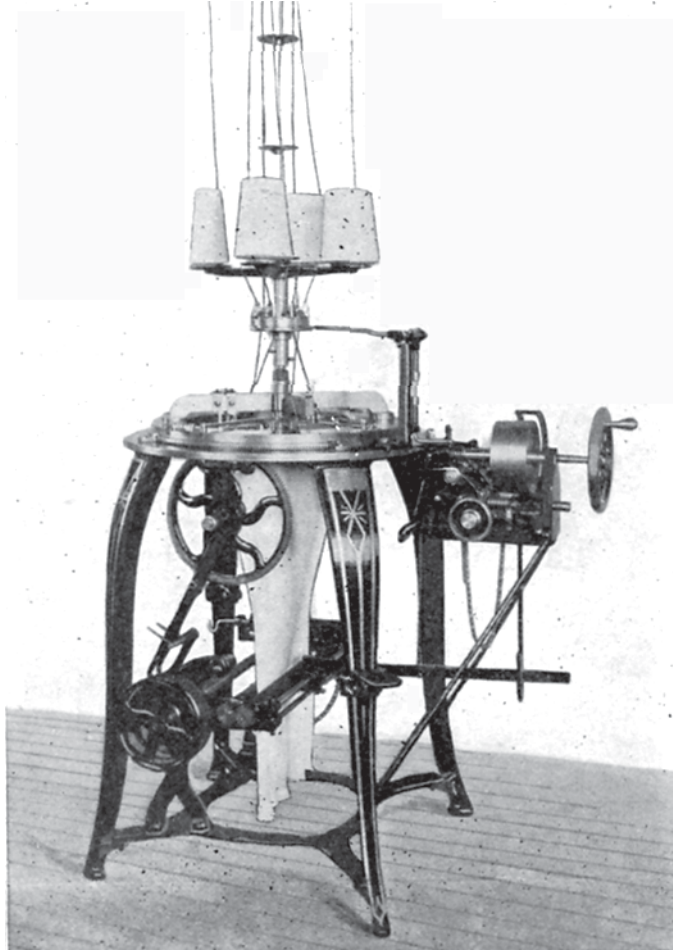


Fig. 91. Sweater and Cardigan Jacket Machine.

washer B, and prevented from rotating with the shaft by its projecting rib *a* engaging the fork B<sup>3</sup>. When the cam plate is rotated, the hub carrying the cams turns in unison with it and the needles in the stationary cylinder are thereby actuated to form their stitches, and the



movable cams or projections  $a^5$   $a^6$  in the groove  $a^4$  actuate the dial needles in the stationary needle dial plate 3, which is a part of the bed plate A. (See also Figs. 93 and 94).

**The Dial Needle Bed.** The dial needle bed is composed of two

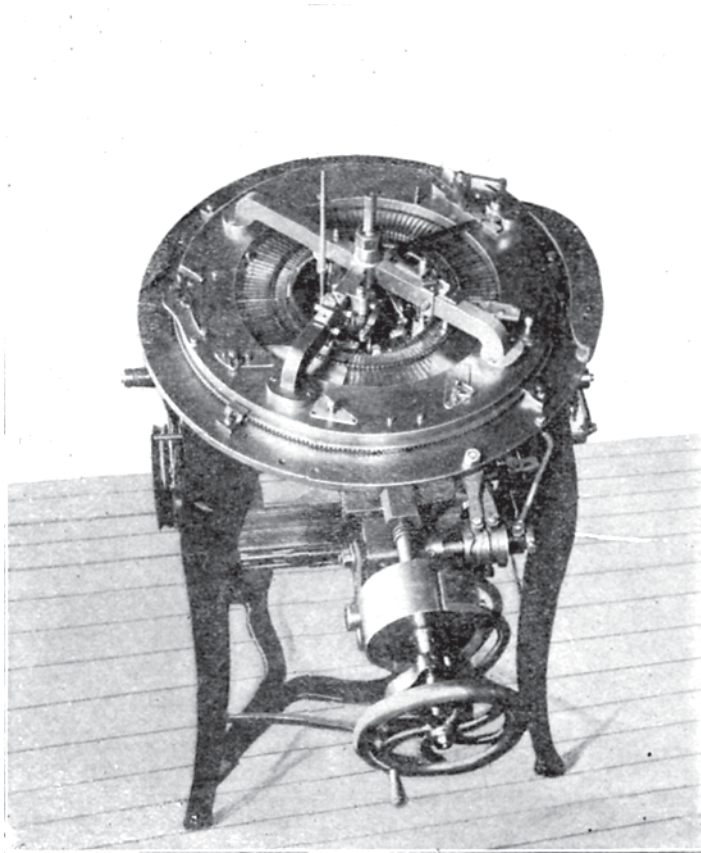


Fig. 92. Sweater and Cardigan Jacket Machine-Top View.

ring-like pieces 3 and 4, (See Fig. 95), which are bolted together, and the part 3 is connected with the frame bed A, the central part being grooved for the reception of the needles; the parts 3 and 4 being so shaped and attached as to leave a circular space in which is placed the segmental racking guides C.

**The Racking Mechanism.** (Fig. 96.) The racking guides C have

fastened to the under side the studs *c*, which are extended down through slots in part 4 of the dial needle bed and connected to a block *c*<sup>1</sup> sustained in place by a nut *c*<sup>2</sup>. These blocks are connected by means of links *c*<sup>3</sup> *c*<sup>4</sup> to levers *c*<sup>5</sup> *c*<sup>6</sup>, having a common fulcrum. Each

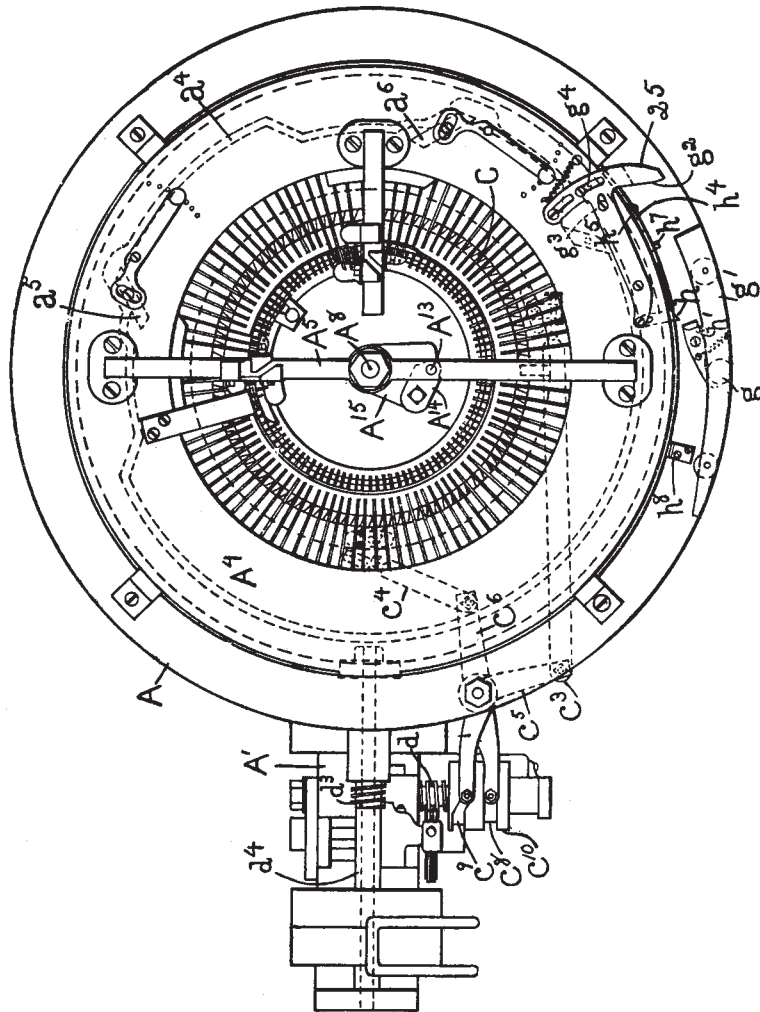


Fig. 93. Bed Plate and Driving Mechanism.

lever having a cam roller entering one of two grooves in the periphery of the cam hub *c*<sup>10</sup> fastened to shaft *d*, having loosely mounted upon it a worm gear having its sleeve inserted in a bearing made in the

extension  $A^1$ , the gear being engaged and rotated by a worm  $d^3$ , carried by a sleeve  $d^4$ , fast on the continuously rotated driving shaft  $A^2$ . (See also Fig. 93).

The worm gear forms part of a clutch mechanism illustrated at Fig. 66 (Part II), so arranged that during the regular knitting, motion is not transmitted to the racking mechanism. This is accomplished by means of a pattern chain mechanism, which by means of the high and low links in the pattern chain, controls the clutch that

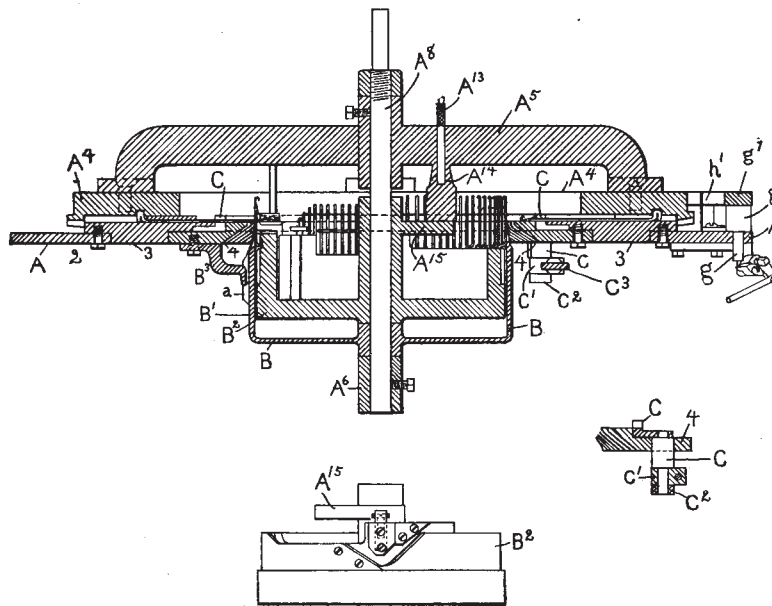


Fig. 94. Sectional View of Head.

lets the worm wheel start the shaft  $d$  and cam  $c^{10}$  at such times as predetermined to rack or shog the stitch, by deflecting the needles a little back of their hooked ends, putting them a little to one side of their true radial positions, so that they may, for some stitches, pass certain of the cylinder needles at one side, and for other stitches, pass the same needles at the other side, and remain in either of their two or changed conditions to knit any desired number of courses.

Fig. 95 shows part of the dial needle bed, dial cam plate, the top of the cylinder needle cam grooved for the cylinder needles, and the

cylinder needle bed, with some of the dial needles, the parts being in position for regular knitting. Needle 21, in the lower diagram of Fig. 95, if pushed forward, will enter the space between the grooves 5 and 6 for the cylinder needles; but when the racking guide C is moved to rack the needles, they will be moved, as in the upper diagram of Fig. 95, so that the needle 21 will pass to the right of the groove 5 and the needle 22 will enter the space between the grooves 5 and 6.

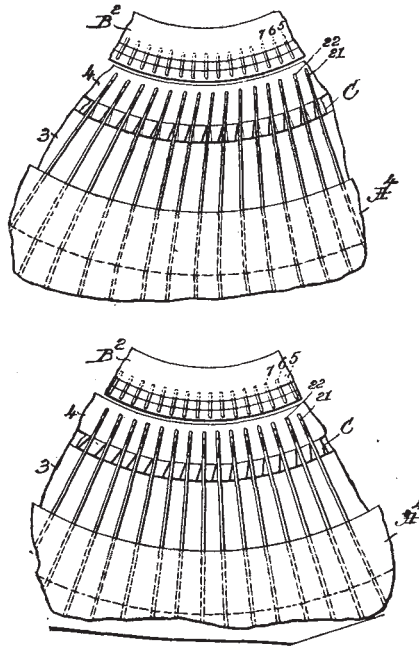


Fig. 95. Part of Dial Needle Bed, Cam Plate, etc. The Needles and Racking Guide in Different Positions.

This change of position of the dial needles, causing them to enter between different cylinder needles from those with which they cooperate in regular knitting, makes a change of stitch, and the stitch is designated as a "racked" or "shogged" stitch. The links on the pattern chain act at the proper and predetermined time to throw the racking mechanism out of action, and the regular knitting is resumed, unless it is desired to introduce the separating course to make a finished edge.

**The Separating Course.** (See Fig. 86.) One garment being

knitted, to form a finish for the next garment, a separating course is made by casting the stitches from the dial needles. To do this, the dial needles are given an inward motion by a movable throw-in cam, which enables all the loops held on their shanks, to be brought behind the latches. To effect this, a link, Fig. 96, just at the rear of the series of high links used for racking, is provided at its side, with a pin 24, which acts on an arm  $f$ , fixed on the rack shaft  $f^1$ , which then, by means of its connections, causes the rod  $g$  to rise, lifting the cam plate  $g^1$ , raising it into operative position.

When the cam plate is lifted, it is in position to be struck by the end 25 (Fig. 93) of the lever  $g^2$ , which, in its inward movement carries with it the cam  $g^3$ , pivoted to the dial needle plate at  $g^4$ , causing the plate in its new position to act on the butts of the dial needles, and move them inwardly far enough for their latches to pass through the loops on their shanks, so that the dial needles, when drawn back, are enabled to cast off the work previously held upon them. The movement of the lever to move the cam  $g^3$  into its extreme working position, also acts to push outwardly a stop  $h$ , so that it meets the catch  $h^1$ , which acted temporarily to engage in a notch and hold up the rod  $g$ , letting the rod and cam  $g^1$  immediately drop. When the lever  $g^2$  is pushed in, it should be held in for one rotation of the dial plate, and to do this, is provided the latch  $h^4$ , pivoted on the dial cam plate at  $h^5$ , and kept in place by a spring. The latch at its opposite end, has a heel, which in the rotation of the dial cam plate, meets the top of an inclined lug  $h^8$ , which immediately effects the release of the lever  $g^2$ , letting the spring draw it back into its normal position, after the separating course is made.

**Tuck or Royal Rib.** As rib knitting is commonly done on two sets of needles, when the fabric is made of that form called tuck or royal rib, it is customary to place the needles of one set in side position with relation to the thread guide, or guides used to supply such needles that they will receive the yarn, but will not be immediately withdrawn far enough to cast off their loops and knit. These same needles, however, knit when brought into such relation to a second thread guide that they may receive the thread, the needles casting their loops and knitting after they have taken the thread from the second thread guide, or from the same thread guide the second time, as when there is but one thread guide.

The thread guides referred to always supply threads to the needles, whether knitting tuck or royal rib, or plain rib. When tuck or royal rib is being knitted, the needles actually knit only at alternate thread guides, consequently but half the number of courses will be knitted as when plain rib is being made, for during the knitting of plain rib, every needle knits its thread before taking another thread.

**Royal Rib or Tuck Stitch.** The royal rib or tuck stitch differs from plain rib knitting only that in plain rib knitting, the cylinder needles, after receiving a thread, are actuated to knit *before receiving another thread*; whereas in royal rib or tuck stitch, the hooks of the

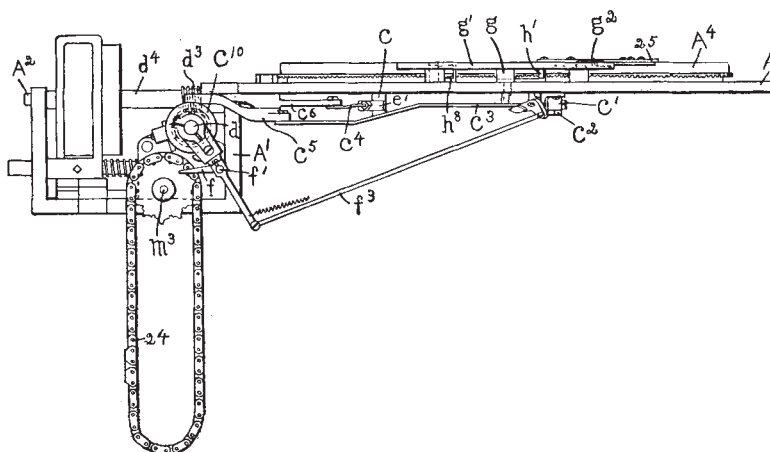


Fig. 96. Side View of Head and Mechanism for Controlling the Movements of the Dial Needle Racking Guide.

cylinder needles are provided with *two threads* before the needles are depressed to knit.

**Welts** are commonly knit on the needles of a rib knitting machine by temporarily discontinuing the action of one set of needles, putting them out of action yet permitting them to hold their loops. After a few courses of knitting have been effected on the one set of needles, the loops of the last course of the welt are joined with the loops held on the stems of the needles which had been temporarily put out of action. When knitting a welt with one set of needles only, the length of the welt is limited to the number of loops, or courses, that the needles will accommodate without loading up to the danger point.

**STARTING UP A LEIGHTON MACHINE.**

The machine should stand perfectly level after being fastened to the floor. The driving shaft should be speeded to allow the driving pulley to be about ten inches in diameter to avoid undue strain on the belts, and the consequent wearing of the shaft bearings. The bobbin stand on the spindle of the machine should be adjusted in position to connect the chain of the load-up stop motion with the stop-dog on the bobbin stand, and fastened to the spindle with the set screws provided for that purpose.

The *needles should be inspected* to see that they are all lying properly in their grooves, and that none are partly out, or otherwise disarranged. The *yarn guides* should be set in position to deliver the yarn into the hooks of the needles, and the latch openings adjusted to go through the hooks of the needles in the proper manner. Put on the yarn and turn the machine a few times, in order to make sure that the yarn guides are properly adjusted to perform their function, and are feeding the yarn to the needles without hindrance.

*Adjust the weight on the take-up* so that the web is fairly taut when touched with the hand; the weight should be moved farther out on the arm for heavy yarns, and for very light yarns, the weight may be removed entirely. Sometimes when using the lightest yarns, it becomes necessary to hang a light weight on the small hook in front of the take-up.

When there is a web on the needles, it is only necessary to thread up each feed and start up the machine, then, when a short length of fabric has been knitted, it is well to examine it to see that the stitches are all being made the same length. If one feed is drawing in yarn faster than the others, or some feeds are drawing in less yarn and making shorter stitches than others, they must be adjusted to all draw alike, and thereby make the stitches even. To do this, mark each yarn the same distance from the guide or carrier, and note which feeds use it up the fastest. The draw cams are provided with an adjusting screw for the purpose of adjusting the cam in or out, to shorten or lengthen the stitch, as the conditions may require. The cylinder needles should be allowed to draw sufficient thread to cast off their stitches freely.

In this "Flat Head" type of machine, the horizontal or plate

needles regulate the amount of yarn consumed in making the stitches, and it is very seldom necessary to raise or lower the cylinder, the only object in doing so being to allow sufficient throat for the web to pass through freely from the needles. When the stitches are all evened and a perfect fabric is being knit, make up the garment measuring chain, so that it will give the desired length to the garments.

**Dropping Stitches** from the plate needles, or the outside of the web, is generally owing to the yarn guide being too high above the needles, thereby allowing the yarn to slip over the hooks of the needles; or it may be caused by the latches flying shut, as they pass through the stitch. The yarn guide should guard them at this point and keep them open. Another cause for dropping stitches is that the stitch may lift off the hook if the stitch steels are too far back of the yarn carrier when the needles push forward after drawing a full length of stitch; the steel on which the hook rests should move from under that needle, by the time the hook reaches the *edge* of the steel, otherwise the steel may lift the stitch off the hook.

If the stitches are dropping on the *inside* of the fabric, the cylinder cam plug may be set too far forward, and the cylinder needle latches may fly closed just as they rise through the stitch. The yarn keeps these latches open if the cam plug is not too far ahead; on the other hand, if the cam plug is set too far back, the yarn will be laid behind the cylinder needle latches and close them up. When the cylinder plug and the plate needle are matched correctly, the cylinder needle will be drawing its stitch, just as the plate needle is coming forward over the steel.

Large holes in the work are usually caused by a *defective needle*

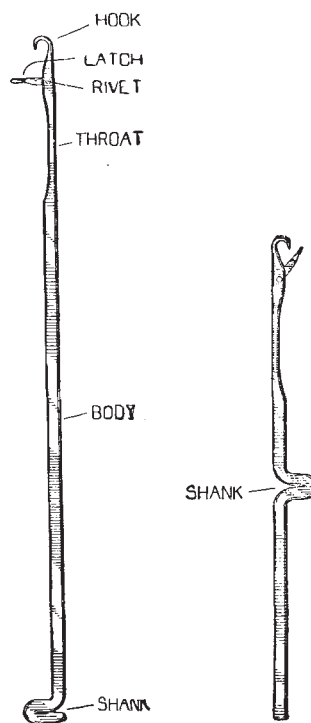


Fig. 97. Leighton Needles.



with either a crooked latch or a bent hook. Small holes are usually caused by *knots in the yarn*.

A rough stitch along one of the ribs in the web often indicates a *loose rivet* in the needle, and as all such marks in any one or more ribs can be easily traced to its needle, by following up the rib on the outside of the cylinder, such causes for poor work can be easily detected



Face. 2 and 1 Ribbed Fabric.

and remedied by replacing the imperfect needle with a perfect one. *Broken needles* may be taken out of the cylinder or plate any time, without removing the keys or slides.

If the trouble is that the yarn breaks, it can, in many cases, be located by examining the ends of the yarn. If the ends of the yarn



issors, it  
 the needle  
 tapered,  
 are long,  
 its stitch

Back. 2 and 1 Ribbed Fabric.

before the let up of the plate needle in which case, the cam plug should be let back a trifle. This is accomplished by means of the adjusting screw in the bottom, which connects the plug with the yoke of the machine.

If a quarter should from any cause run off the needles, push the edge of the web over the plate needles, just forward of the yarn car-

riers, or if the web is thin, the needles will push through it, by simply lifting the web up in front of the needles. The extra wide throat of the machine at the places ahead of the yarn carrier permits of this being easily done.

In starting the racking machine after a quarter runs off, it is necessary to see that the racking or shogging chains are in proper position to start a new garment.

The flyings of the yarn should be blown out of the machine occasionally. This may be easily done with a piece of pasteboard, or other like article used as a fan.

**Cams.** If there is any indication of breaking the shanks off the needles, after the machines have been running a short time, it is best to take the draw or knock-off cams out of the machine to see that they are smooth and free from any nicks or marks.

When the stitch cams or knock-off cams are ground, or a new one put into the machine, it is a good practice to see that the first corner is rounded a little and the balance sloped off after leaving the end wide enough to hold two needles at full length of the stitch. If more than two needles are held back, they may break holes in the web.

The *cams on the cam plate* or horizontal needles can be inspected by taking out the two screws which fasten the segments to the cam plate; the segment can then be slipped to the left by turning the machine by hand a short distance, holding the segment stationary; in returning the segment to place, drop it over the needles in its proper position, and slide it to the right, until the screw holes come into line, insert the screws and fasten down tightly.

The *knock-off cams* in the cylinder can be removed by taking out the large headed screw which acts as a stop to that cam when knitting the tuck stitch; the cam can then be removed and replaced in the same way. By pulling the knuckle pin, the ring can be moved to any position by hand. If after putting the machines together again, any drop stitches appear in the web, it may be found that the cylinder cam plug requires re-adjustment.

If the *geared ring* carrying the steels should get misplaced in taking a machine apart, it can be set into proper position by loosening the buttons on the outside of the cam plate, then lifting this plate out of mesh with the driving gear; turn the shaft backward or forward sufficiently to set the steels in their proper position.

When it is desired to make faced goods with one face of the fabric wool and the other or back of cotton, it is only necessary to thread the wool yarn into alternate carriers and the cotton yarn into the others.

When it is desired to make plated goods, with wool or silk surfaces and the middle or interior of the fabric of cotton, the wool threads should run through the quirl guides nearest the center of the machine near the carrier, and the cotton in the quirls next to the outside of the machine. Such plating can be done on the outside or inside surface of all tucked goods by threading alternate carriers with cotton, according to the side on which it is desired to show the wool. Threading the wool and cotton into all the carriers as above described to plate, will give both surfaces plated, either plain rib or tuck stitch.

#### FLAT OR STRAIGHT LATCH NEEDLE MACHINES, OR THE LAMB SYSTEM.

##### THE LAMB KNITTING MACHINE.

The machine illustrated at Fig. 98, is constructed upon the novel principle of employing two straight, parallel rows of needles sufficiently near each other to connect the two rows of knitting at either end, but far enough apart to allow the fabric to pass down between them as it is knitted.

**Position of Needles.** The two rows of needles are placed opposite each other, in grooves in a steel needle bed, the two sides of which slope from each other like the roof of a house, and are separated at the ridge, or center, where the needles form the stitches.

A *carriage* is propelled by a crank back and forth over the needle bed. This carriage contains, under each side, an arrangement of automatic cams, called a lock, (one for each row of needles) for operating the needles up and down in the grooves; and also carries a yarn guide for delivering the yarn from the bobbin into the hooks of the needles as they are moved up by the cams. As the carriage is driven over the needle bed, the needles are moved up, fed by the yarn, and drawn down almost simultaneously, all the needles forming stitches with one revolution of the crank.

The lock is so constructed that by adjusting a cam stop, (this being possible without stopping the machine) the cam lock may be opened or closed, (but engages the needles only when open) in such a manner as to cause four different styles of fabric to be produced,

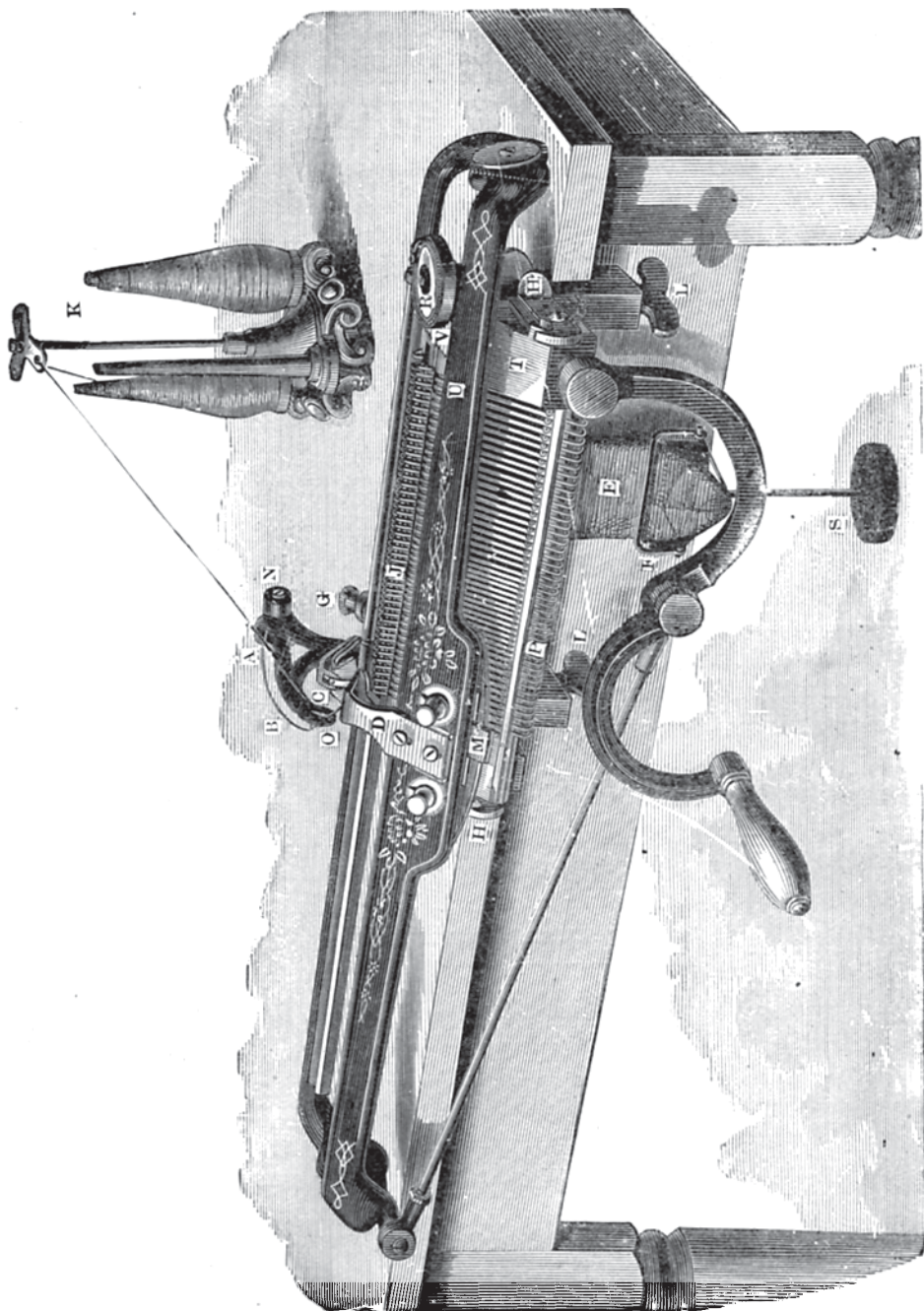


Fig. 98. Lamb Knitting Machine.

as follows: By operating continuously the back row of needles toward the right, and the front row toward the left, a *tubular or circular web* is produced. Operating both rows together in one direction and then one row in the other direction, will produce the *double flat web*, or *Afghan stitch*. Operating both rows together in both directions, produces the *ribbed or seamed flat web*, and operating forward and back each row alternately, connects the two rows of knitting at one end, leaving them open at the other, thereby forming the *wide flat web*.

In knitting any of the above webs, if every second, third or fourth needle, or a combination of them, in one or both rows is not used, other varieties of stitches can be formed, which make different styles of fabric.

Only those needles which are moved up within range of the cam are used. Any number of needles, in one or both rows, may be employed at the start, and the number be increased or diminished at any time, so any size of work, tubular or flat, and either single, double or ribbed, can be set up and widened or narrowed to any extent, producing such articles as union suits, fashioned hose, mittens, cardigan jackets, sweaters, etc. The two parallel rows of needles operating alternately, or crossing and uniting so as to form stitches on both sides of the fabric, is the distinguishing principle of the Lamb machine, in fact has come to be what is known as the *Lamb system*.

Referring to Fig. 98, the parts are as follows: A, tension nut; B, take-up spring; C, yarn guide; D, latch opener; E, work; F, buckle; G, hands, eccentric levers and thumb nuts; H, H, stops; J, jack wires or bitts; K, spool stand; L, thumb screws; M, slide plate; N, take-up stand; O, V-eyelet; P, needle stops; R, counter; S, weight hook; T, needle bed; U, carriage; V, caps.

**Construction.** As appears by examining the cut of the *short carriage machine*, Fig. 99, the bed frame consists of two parallel ways to which, at the desired angle and at the proper distance apart, is fitted the needle bed; at the right end of the frame are projections forming the bearings for the crank shaft. A connecting rod connects the crank with a projection of the carriage; by these means the carriage is propelled back and forth across the needle bed. On the back of the frame are projections for securing it to the bench or table. The term *bed* includes the two plates, (front and back) and the frame to which they are attached.

The cut of an 8-inch bed showing drop-jack (Fig. 100) shows more clearly how the needle plates are arranged in relation to each other. This cut also shows the drop-jack let down to allow space for picking in the stitches in knitting fingers and thumbs for gloves and mittens, for picking in stocking tops or legs, and similar work. The jack is made in two pieces, known as the *front half* and the *back half*, and is attached to the bed by means of a pin, on which it swings from the right end. The left end is held up by a spring, and by pressing this spring back, the jack is allowed to drop down, swinging on the pin at the right end. By letting down the jack at the left end, as shown in the cut, it leaves an opening between the plates wide enough to allow handling the fabric with the fingers, making it much easier to pick in stitches.

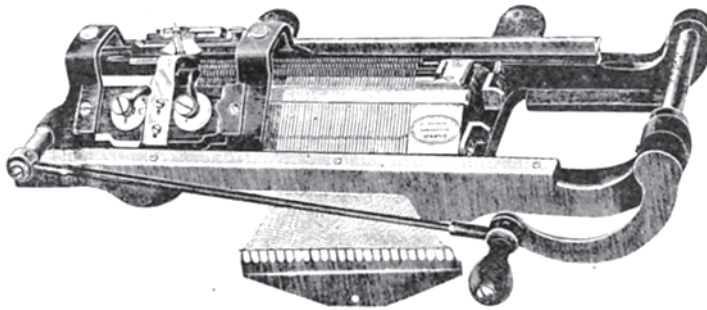


Fig. 99. Short Carriage Machine.

**The Jack.** The jack is made with bits for the purpose of forming the tubular stitch when one row of needles only is being used. When both rows are in operation at once, the opposite needle performs the work of the jack bitt, and the bitt is not then absolutely necessary. For this reason, the jack is also made with a smooth throat, which is often more convenient when making plain rib and some other styles of fabric; but when every other needle is drawn down out of action of the cams, or locks, then the bitt form of jack becomes necessary. The jack bits J are small pieces of steel that extend above the crown of the needle bed. Their function is to hold the fabric and assist in stripping the loops off the needles after they are formed.

**The Throat.** The throat of the machine, or space through which the fabric passes between the jacks, is an important factor in the

quality of work that is made on the machine when making any of the ribbed stitches. If very coarse or loose work is called for, the throat must be wide; and if close, snappy or elastic work, the throat must be as close as will allow the work to pass down without hindrance. As for the sleeve of a jacket; the part from the shoulder to the cuff should be loose, while the cuff should be as close and snappy as possible. To do this to the best advantage, use the adjustable throat, which is easily changed from loose to close.

**Locks.** The cut *common locks*, Fig. 101, represents the under side of a short carriage showing common locks. It is the function of these locks to operate the needles up and down to form the tubular stitch.

The cut *automatic drop locks*, Fig. 102, represents the under side of a short carriage showing the automatic drop locks which do away with cam stops, and enable the operator to make the tuck or polka stitch on the inside of the needle hook, instead of on the outside, as done by the cardigan lock and all other locks making this and the cardigan stitch.

The *automatic tubular locks*, Fig. 103, are used for the same purpose as the common locks, but, being automatic, they do away with the cam stops and with them it is not necessary to run the carriage over the full length of the bed, but only far enough to pass all the needles in action.

The *cardigan lock* differs from the common lock chiefly in the arrangement of the wing cams, it being their function to draw down the needles. The wing cams (see B, Fig. 104) of the cardigan lock are made so that the needles can hold two stitches, when the carriage goes in one direction, and cast two and take one on in the other direction, and also form a shorter stitch. The wing cams of the common lock never take nor cast but one stitch at a time.

The *racking plates* are for the purpose of making oblique stitches in fancy patterns, or finishing for borders or edges.

**Cam Stops.** The Cam Stops H, H are (see C, Figs. 98 and 105) the four short bars at each corner of the needle bed that act on the slide plate M, (also B in Fig. 106) extending below the carriage, and open and shut the cams.

**The Yarn Guide C** delivers the yarn into the hooks of the needles, and must move at the same distance from each row, and as close as possible to them without touching.





**SECTION OF A FINISHING ROOM**  
Lawrence Mfg. Company.

**Latch Openers.** The steel plates fastened to the carriage, with upper ends hooked and having knife edges, are called the latch openers (See D, Fig. 98, also Fig. 105). Their function is to open or guard the latches of the needles, so as to admit the yarn into the hooks, and also to hold the latches down, out of the way of the yarn guide.

**The Counter.** The counter R (Fig. 98) is for the purpose of relieving the operator from counting while working. Turn the dial

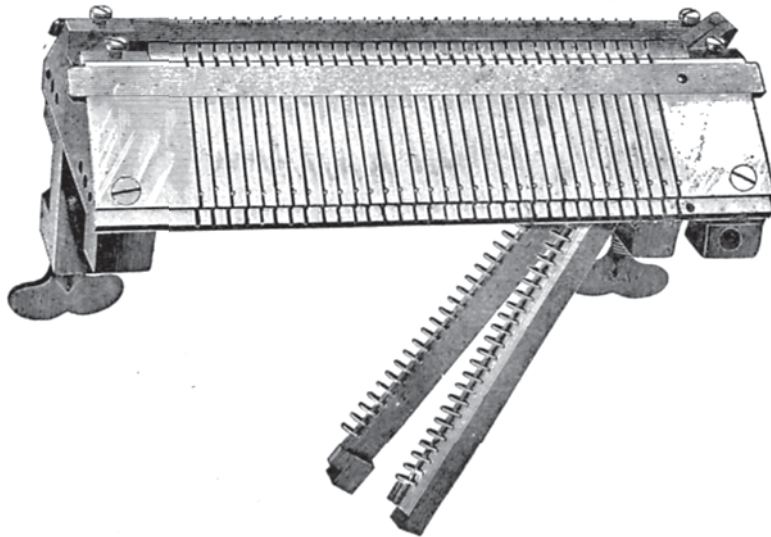


Fig. 100. 8-inch Bed, Showing Drop-Jack.

so that the pointer will rest on one hundred, and at every revolution of the crank, the dial will move one point, thus indicating each round knit.

**Gibs.** The needles are held in position by two flat slides with bevelled edges, called gibs, on which the carriage runs.

**Weights.** The work E is drawn down through the machine, between the jacks, by a weight on the weight hook S. As the object of weights on the fabric is to draw the loops off the needles as fast as made, it requires only just such an amount as will do this well. On coarse yarn, full width, four pounds is usually enough. With narrower width or finer yarn, three pounds; when operating less than thirty needles, use two pounds, etc. More weight is required in knitting

close, than in knitting loose. Cotton yarn requires more weight than woolen.

**The Buckle.** The buckle, F, which fastens on the fabric, is used only on long work; for all ordinary work, the combs are used.

**Hands, Eccentric, (or Thumb) Nuts and Levers.** The four hands, or pointers, on the carriage, are governed by the four thumb nuts 1 and 4 on the front side and 2 and 3 on the back side. The hands are connected with the wing cams. The wing cams draw the needles down, as the loops are formed, and determine the distance to be traversed by the needles. The farther the needle is drawn down, the longer the loop, and consequently the looser knit will be the fabric; the shorter the loops, the closer the fabric.

**The Tension Take-up.** If all the needles are in use, but little slack of the yarn will occur in any part of the traverse of the carriage; but if some of the middle needles are not in use, and the yarn is still being drawn out the full length of the needle bed, when the carriage moves one way, there will be a certain amount of slack yarn when it moves back; and the same thing will occur at the other end of the needle bed. The fewer the needles in use, the greater will be the length of the slack yarn.

As uniform tension is of great importance in a knitting machine, it is necessary to apply some device to all straight knitting machines, which will take up all slack yarn, and yet constantly exert a uniform tension on the thread of yarn that is passing into the needles. While the carriage is changing from one direction to the other, the yarn is held by the little weight (See Fig. 107) in the center of the cross piece, which drops upon it, as the take-up spring, changing from a horizontal position to perpendicular, releases the lever which holds the weight up while knitting. This applies more particularly to locks using cam stops than to drop locks.

#### ADJUSTING AND OPERATING.

**Formation of Stitch and Operation of Needle.** When knitting to the left, on the front row of circular work, the needles are moved up by the left side of the center cam, which is V shaped. Before they reach the highest point, the loops, one by one, slip down below the latches. On the right, the needles are drawn down again, at the same angle, by the wing cam. As the needles are drawn down, the yarn

is caught in the hooks, and the old loops pass under the latches, turning them over on the hooks. The needles continue downward until the loops slip over the ends, and the yarn is drawn through the old loops, forming a new set on the needles.

**Position of the Needles.** To place a needle in working position, move it upward until the hook is between the jack wires, or bitts J, Fig. 98. To move it out of position, draw it down half an inch, or

as far as it will go. The needles should be moved up by the bow springs or needle stops P, at the bottom of the needle bed T, and drawn down by the shanks of the needles. The needles should be kept in working position or entirely drawn down, for if left half way between, the shanks are exposed to the cams, and the breakage of needles or needle bed will occur when the machine is set in motion.

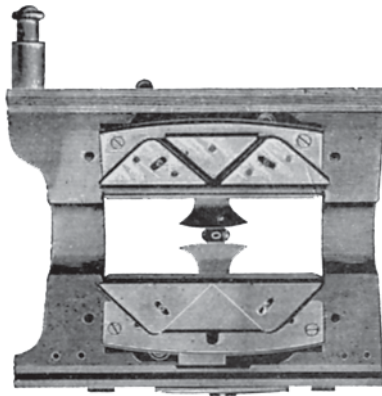


Fig. 101. Common Locks.

**Adjusting the Tension.** The tension nut A (Fig. 98) on the take-up stand, governs the wire take-up, B. To increase the tension turn the nut from you. To decrease it turn the nut toward you. In knitting stockings medium size, adjust the nut so that take-up wire stands about perpendicular. On double webs full width, diminish the tension so that the end of take-up wire is about *two inches* above the eye in the stand. The fewer needles in use, the more tension required, and coarse yarn requires more tension than fine yarn.

The yarn carrier traverses the full width of machine, but knitting is done at various widths. This occasions slack yarn, at either end, between the fabric and yarn guide. It requires only such a tension, in connection with take-up, as will draw in this slack and make the fabric perfect at the corners. The less tension used the easier the machine will operate.

**To Tighten or Loosen the Stitch.** The wing cams draw the needles down as the loops are formed and determine the distance to

be traversed by the needles. The farther the needle is drawn down, the longer it makes the loop and the looser will be the fabric. The hands G are attached to the wing cams. When the hand points to 1 at the top of the dial, the loops are shortest and the fabric closest. When the pointer is on the largest numeral, the loops will be longest and the fabric loosest.

#### TO SET UP THE WORK FOR A MITTEN.

Put up twenty-four needles (on each side), and draw down every third needle, commencing with the second from the end, then fasten the upright rod into the base of the spool-stand, so that each hole in the top plate comes directly above the wire post in the base. Place a spool of yarn on one of these posts, and draw the end of the yarn through the hole in the top plate directly above it.

Place the spool-stand K back of the needle bed with the spool to be used facing the machine. Have the crank at the left hand and move out right hand cam stop H on back side. Turn the crank to the right. Pass the yarn through the wire eye on top of take-up stand N, then through the V shaped wire O or hole in front end of the take-up stand N, and down through yarn guide C, dropping the end down between jacks J about six inches. Turn crank to the left and put in right hand stop, back-side. Both rows of needles have been moved up and taken the yarn, drawing it down in a sort of network. Draw the wire out of the comb Y, (Fig. 109) and push the teeth up through the network from below, and then run the wire into the teeth

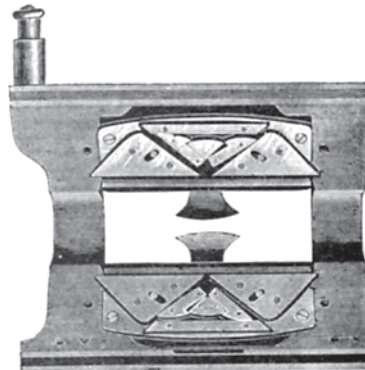


Fig. 102. Automatic Drop Locks.

again over the network. Attach to this comb a weight stand and a two pound weight. Turn the tension nut A back a trifle more than a quarter of a revolution, so that the take-up wire B stands about perpendicular, or leans backward a little. Now spring down the take-up wire B and hook it on the yarn between the guide C and the take-up stand, then knit eighteen times round.

Push up the needles drawn down and with the work hook (Fig. 109) pick up the last stitches or loops cast off the needles next to the ones pushed up, and put the loops on the empty needles. Knit four rounds, then widen for thumb as follows: Push up a needle at right hand on both front and back side and with a three point narrowing comb (W, Fig. 109) take the stitches on the three outside needles and put them on what are now the three outside needles including the needle just pushed up. This leaves the fourth needle empty. With

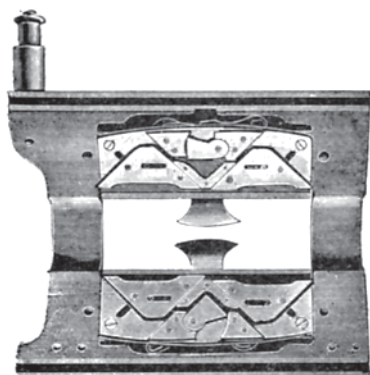


Fig.103. Automatic Tubular Locks.

the work hook pick up the last loop cast off of the fifth needle and put it on the fourth. Knit three round and widen again and so continue to widen until seven stitches are taken on each side. Use three point comb for widening the first three needles or for three stitches or less, then use four, five, and six, knitting three rounds between each. After the last widening knit six times round, then throw off these stitches which have been widened for the thumb on thumb combs X (Fig. 109) and

draw the empty needles down out of working position and knit thirty rounds, then narrow as follows: Leave five stitches at one end, and with a five point narrowing comb transfer the next five stitches one needle toward the center; then transfer the five stitches, lift at the end two needles toward the center, and draw down out of operation the empty needles thus left. Repeat this process at the other three corners of the web. Knit four rounds. Leave four stitches at one end and with the next size comb, four points; transfer in the same manner as before. Knit three rounds. Leave three stitches at one end, and with next size comb, three points, transfer as before. Knit two rounds. Take three stitches from end, transfer one toward center; then take the outside stitch and transfer one toward center. This being repeated at each corner will leave all the needles with two stitches on them. Knit two rounds and take the work from the machine.

**To Knit the Thumb.** Drop the jack J and pick the stitches which were thrown off after widening, into the machine; seven on each side. Make two new stitches by taking two loops from the hand, thus making sixteen stitches in all; then knit eighteen times round and narrow off as follows: Narrow every third stitch and knit three times round, then every second stitch and knit twice round. Take the work from the machine, ravel once round, fasten the ends, cut open the wrist and crochet off, or when knitting the wrist knit it long enough to fold inside, making it double thickness.

**Table of Sizes for Mittens.**

Stitches.	Rounds for Wrist.	Stitches to Widen for Thumb.	Rounds for Hand.	Stitches for Thumb.	Rounds for Thumb.
21	16	6	25	7	16
24	18	7	30	8	18
27	20	8	35	9	20
30	20	9	40	10	22

**TO KNIT GLOVES.**

Put up twenty-four needles (on each side;) draw down every third needle, commencing with the second from the end. Set up the work and knit eighteen times round. Push up the needles drawn down and put a loop on each needle, the same as in widening. Knit twice round, then widen for thumb as follows: Push up a needle at right hand on both front and back side and put a loop on each as in widening by hand. Knit four rounds, then push up two more needles at right hand and with transfer comb take a stitch from the needles previously widened and put them on these needles. Knit four rounds and widen again, this time transfer two stitches; so continue to widen until you have seven stitches on each side; use 3 comb for three stitches or less, then use 4, 5 and 6, knitting four rounds between each, after the last widening. Knit around six times, then throw off five of these stitches on each side which have been widened for thumb; knit sixteen times round, then at left hand throw off three stitches on each side; knit two rounds, and throw off next five stitches on each side; knit two rounds, throw off seven on each side; this leaves eleven stitches on each side; knit thirty rounds and narrow every third stitch, knit two more and narrow every second stitch; knit two rounds and take from the machine.

**To make the second finger,** have the crank at right hand, then

with thumb at right, pick the next twelve stitches (six on each side) into the machine, and ravel once round; cut thread near the finger and pick out ten stitches, five each side of opening, separating finger from hand front side; pick these into machine beside those already in, putting those from finger on back side, and those from hand on front side; knit thirty-five rounds and narrow as before. Repeat for third and fourth fingers, using ten stitches and thirty rounds for third, and nine stitches and twenty-two rounds for fourth.

For **thumb**, ravel once round, cut the thread and pick each way, both front and back, until there are ten in all picked out, five on hand, and five on thumb; pick into machine, knit twenty-two rounds and narrow off.

For *left hand* glove knit the same until you pick in stitches for second finger, then with thumb at left hand, proceed as directed above for knitting fingers.

Table of Sizes for Gloves.

Stitches for Wrist.	Rounds for Wrist.	Stitches to Widen for Thumb.	Stitches to Throw off for Thumb.	Rounds for Hand.	Stitches to Throw off for 4th Finger.	Stitches to Throw off for 3d Finger.	Stitches to Throw off for 2d Finger.	Stitches for 1st Finger.	Rounds for 1st Finger.	Stitches for 2d Finger.	Rounds for 2d Finger.	Stitches for 3d Finger.	Rounds for 3d Finger.	Stitches for 4th Finger.	Rounds for 4th Finger.	Stitches for Thumb.	Rounds for Thumb.
24	16	7	5	16	3	5	7	11	30	12	35	10	30	8	22	10	22
27	18	8	6	18	4	6	7	12	33	12	38	11	32	9	24	11	24
30	20	9	7	20	5	7	8	13	34	13	40	12	35	10	26	12	26
33	20	10	8	22	6	7	9	13	38	14	44	12	38	11	28	13	30
36	22	11	9	24	6	8	10	14	40	15	48	13	40	11	30	14	33

#### KNITTING A SOCK COMPLETE.

Put up thirty needles on the front row and the same on the back, then draw down every third needle put up, beginning with the second needle from the end. Set up the work as usual, and attach a two-pound weight. Before attaching the take-up spring, bind off the top as follows: With the crank at the left, push up the back needles, on which the work is set, as far as they will go; draw off the slack thread below the yarn guide about ten inches; and beginning at left wind this yarn (next to needles) as loosely as possible around each needle moved up. Pass the yarn under each needle and wind it around the hook to the left, sliding the needles down with the left thumb as fast as they are wound, far enough to cast off the stitches; then bind the front row in the same manner, beginning at the right hand. Adjust the take-up spring to take up the slack, and hook it on the yarn between



the take-up and the yarn-guide; knit twenty-five rounds and then put up the needles drawn down (every third), and knit one round.

For length of leg, knit seventy rounds. Have crank at left.

For the heel, set hand 1 at "close", and 3 same as 2. Put out both right hand cam-stops. Knit two rounds, at the same time drawing down on the back part of the fabric with the left hand. Now put the large triangular wire over the work, draw it down well between the rows of knitting, and attach to it a weight-stand and one-pound weight. Remove the two-pound weight from the set-up comb, leaving the weight-stand only.

For the length of heel, knit ten rounds, or one-third as many as there are needles in use on front side, stopping with crank at left. To prevent the work from rising up on the back needles while knitting

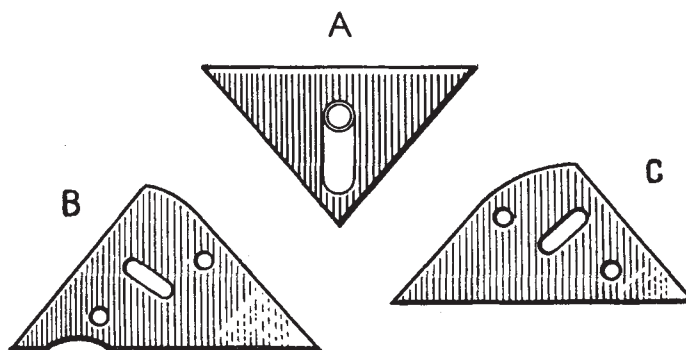


Fig. 104. Cams. A, "V" Cam. B, Wing Cam.  
C, Cardigan Cam for Common Lock.

the length of the heel, draw down on back part of it with the left hand.

Then lessen the weight on back, leaving only the weight-stand. Next take a worsted needle, threaded with a piece of yarn, and pass the needle up from below through the 11th stitch from the right. Tie this yarn underneath, and remove the weight-stand from the set-up comb on front, and hook it upon this yarn. Add to this a one-pound weight. With crank at left, push up, as far as they will go, 10 needles at right hand, back row. Transfer the stitch from 10th needle to 11th, the next needle to the left. Slide the other 9 needles partially down; not quite far enough to cast off stitches.

Place one of the small combs on the front side, opposite these 9 needles, and with the work-hook transfer the stitches from these nee-

dles to the hooks of the comb. Draw the empty needles down out of working position. Turn crank to right. Push up as far as they will go the 10 needles at left hand, back row, and transfer the stitch from the 10th needle to the 11th. Place the other small comb opposite these 9 needles, and transfer the stitches from them to the comb, drawing down the empty needles as before.

To knit the cap for the heel on the remaining 10 needles in use, the crank should be held at the lowest point and moved back and forth only far enough to form each end stitch. Every time the crank is moved to the left, transfer a stitch from the right hand comb to the 11th

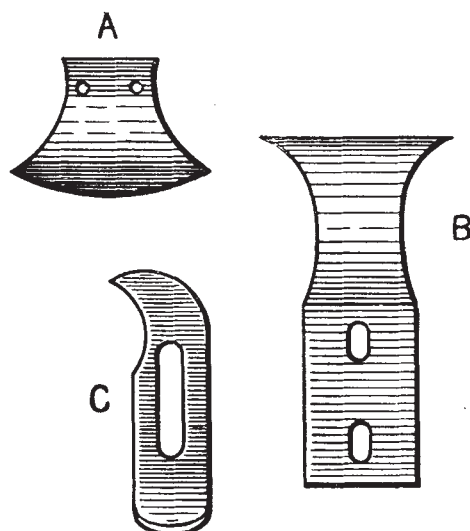


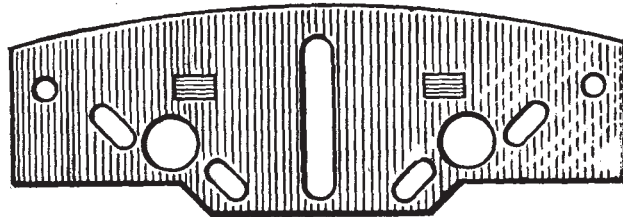
Fig. 105. Cam Stop C, Front Latch Openers B, and Back Latch Openers A.

or end needle; and every time the crank is moved to the right, transfer a stitch at left in the same way. With the crank at the left, transfer the last stitch from each comb, both at once. (In transferring stitches, be careful to carry the stitch straight across from the comb into the hook of the needle, without turning or twisting the stitch.) Remove the small combs and triangular wires. Put in both right hand stops, and replace the hands, setting 3 at "close" and 1 same as 2. Remove the weight from the back, leaving the weight-stand.

Now put up at right hand the 10 needles drawn down, and one

extra needle on front and back. With the flat end of work-hook, push up, from underneath, the selvedge of the heel, on a level with the needles, and pick on to the needles the 10 short loops of the selvedge made in knitting the heel. Draw down on the back part of fabric lightly with left hand, and turn crank to the right. Put up at left the 10 needles drawn down, and one extra needle on front and back; then pick on to them the 10 short loops of selvedge. Attach weight-stand and one-pound weight to the set-up comb on front. Set hand 2 at "close," turn crank to left, and then set hand 2 the same as hand 1.

A



B

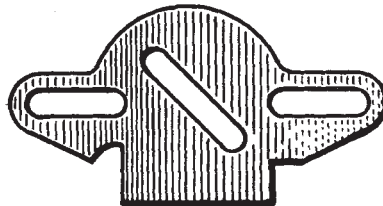


Fig. 106. Lock Plate A, Slide Plate B.

Replace the one-pound weight on back. Knit five rounds, drawing down on back side of fabric with left hand.

*For the gore,* narrow four needles, one at each of the four corners of the fabric, as follows: Narrow one at right and one at left, and knit three rounds. Then narrow one at right and one at left of the other two corners. (In narrowing on front, carry the stitch across to the end back needle; and in narrowing on back, carry the stitch across to the front end needle. It will be observed that the needles in the

two rows do not come exactly opposite each other at the ends. Always narrow the outside needle.)

*For the length of foot*, knit forty-five rounds, then narrow off the toe by narrowing one needle at every half turn of the crank until only 10 needles remain on each side. Knit two rounds and run off the work; ravel one round and with a worsted needle fasten the end stitches with the button-hole stitch, or over-and-over stitch. Pick the long stitches out of top of leg with the work-hook, beginning at the corner where the long yarn is; or cut the long stitches at the top and pick out the cut stitches.

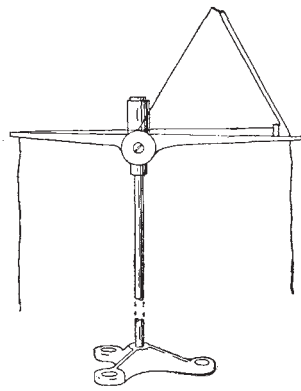


Fig. 107. Tension Take-up.

**To Knit Larger Sizes**, set up 33 or 36 needles on each side; or to knit any desired size, reverse the order of the rule in the Table of Sizes given on Page 183, and knit ten rounds less in the foot.

**To Knit a Stocking Narrowed in the Back**, proceed as follows: Push up all the needles in machine. Set up the work and knit one hundred and thirty rounds, then with crank at left hand, narrow two stitches at right, one on front and one on back side. Knit six rounds, and narrow in the same manner, and so continue to narrow until but 36 stitches are left on each side. Knit fifty rounds and take the work from the machine.

Now pick the work into the machine in such a manner that the narrowing in back will be in line with the center of the back row of needles, and knit heel and foot in accordance with the rule given above.

**To Use the Narrowing Comb:** Put the eyes of the comb into the hooks of needles and with the comb draw the needles up until the stitches pass back of the latches; then push down until the stitches cast on to the comb, and transfer them to the needles as desired.

*To Narrow Off Toe With Narrowing Comb.* Leave six stitches at one end and with comb 6 transfer the next six stitches one needle toward the center; then transfer the six stitches left at the end two needles toward the center, and draw down out of operation the two empty needles thus left.

Repeat this process at the other three corners of the work, and knit five rounds. Leave five stitches at one end, and with the next size comb (5) transfer in the same manner as before, and knit four rounds. Leave four stitches at one end, and with the next size comb (4) transfer in same manner and knit three rounds. Leave three stitches at one end, and with the next size comb (3) transfer in the same manner and knit two rounds. Leave two stitches at one end, and with comb 3 transfer in the same manner and knit two rounds. Leave one stitch at one end, and with comb 3 transfer in the same manner and knit two rounds. Now transfer so as to bring two stitches on each needle. Knit two rounds and run off the work.

**Tables of Sizes**

**MEN'S SOCKS**

Size of Shoe	No. of needles to set up on each side	No. of rounds for rib	No. of rounds for leg	No. of rounds for ankle	No. of rounds for heel	No. of rounds for foot
No. 5 .....	34	30	75	30	12	45
No. 6 .....	36	30	80	30	12	50
No. 7 .....	36	35	85	30	12	55
No. 8 .....	38	35	90	30	12	60
No. 9 .....	39	40	95	30	12	65

**LADIES' STOCKINGS**

Size of shoe	No. of needles to set up on each side	No. of rounds for rib.	No. of rounds for top of stocking	No. of rounds for ankle	No. of rounds for heel	No. of rounds for foot
No. 3 .....	38	—	110	32	12	40
No. 4 .....	40	—	110	34	12	45
No. 5 .....	42	—	120	36	14	50
No. 6 .....	44	—	120	36	14	55
No. 7 .....	46	—	130	38	15	60
No. 8 .....	48	—	130	38	16	65

**BOYS' AND MISSES' STOCKINGS**

Size of shoe	No. of needles to set up on each side	No. of rounds for top of stocking	No. of rounds for ankle	No. of rounds for heel	No. of rounds for foot
No. 12 .....	38	85	30	12	36
No. 13 .....	40	85	35	12	38
No. 1 .....	42	85	35	12	40
No. 2 .....	44	90	40	12	42

**To Ravel the Work in the Machine.** Ravel out the loops by pulling the loose yarn straight up over the ends of the needles. If holes appear or the yarn breaks the loops that run off, put on the needles, and ravel down the work to where it is perfect.

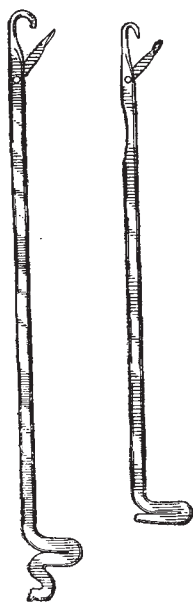


Fig. 108.  
Lamb Needles.

**To Remove a Needle from the Machine.** Take off the caps V at either end of the needle bed that hold down the carriage U, and remove the carriage. When removing the rod be careful not to let the block slip off the rod and not to turn the rod end for end. The hollow side of the block is the front and the pin on top of the block fits into a hole in the lever that operates the yarn guide C. See that this is adjusted properly and operates freely before fastening the caps V.

An arrow on each gib points the direction in which to move the gib in order to take it out. Push the gib out in the direction indicated by the arrow, until the end passes the needle to be removed; then draw the needle out and put in another. See that the new needle works freely after the gib is replaced. The caps should be replaced, putting each in its own place.

When any of the latches fail to open, press down on the latch opener with the hand, and move the crank to operate the needles once or twice before setting up the work. When the work rises up on the

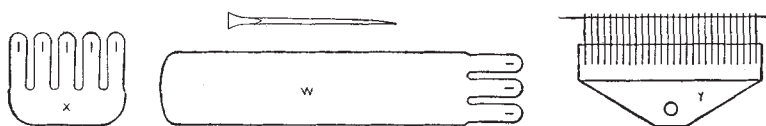


Fig. 109. Combs and Work Hook.

needles add more weight. When the needles move up in knitting, if the loops fail to slip down back of the latch, knit looser.

When the needles take the yarn and retain the loops without knitting push the needles up until the loops slip back of the latches, then drop the yarn into the hooks and draw the needles down, knitting off the old loops. After the loops are formed, if they fail to cast off

the ends of the needles, adjust the machine to knit looser. If the outside needle drops stitches, or long loops are made at the corners, use more tension. If stitches drop, along in the center of the fabric, see if the yarn has caught and broken, and if the yarn guide runs in the right position, *i. e.*, the same distance from each row of needles. If one particular needle drops stitches, bend upward the upper end of the needle. If the machine suddenly works hard, see if the yarn draws freely from the spool.

If one row of needles ceases to operate while knitting or both rows operate when not desired, arrange the stops H properly. If a needle catches or hits in operating, making a snapping or clicking

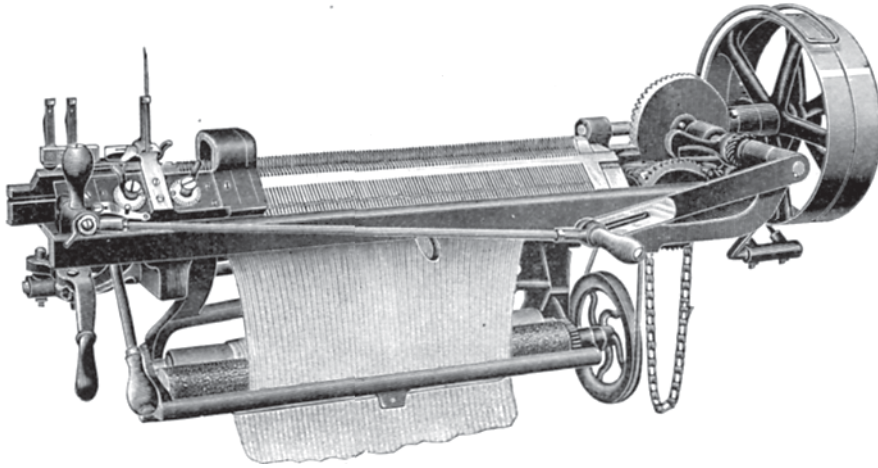


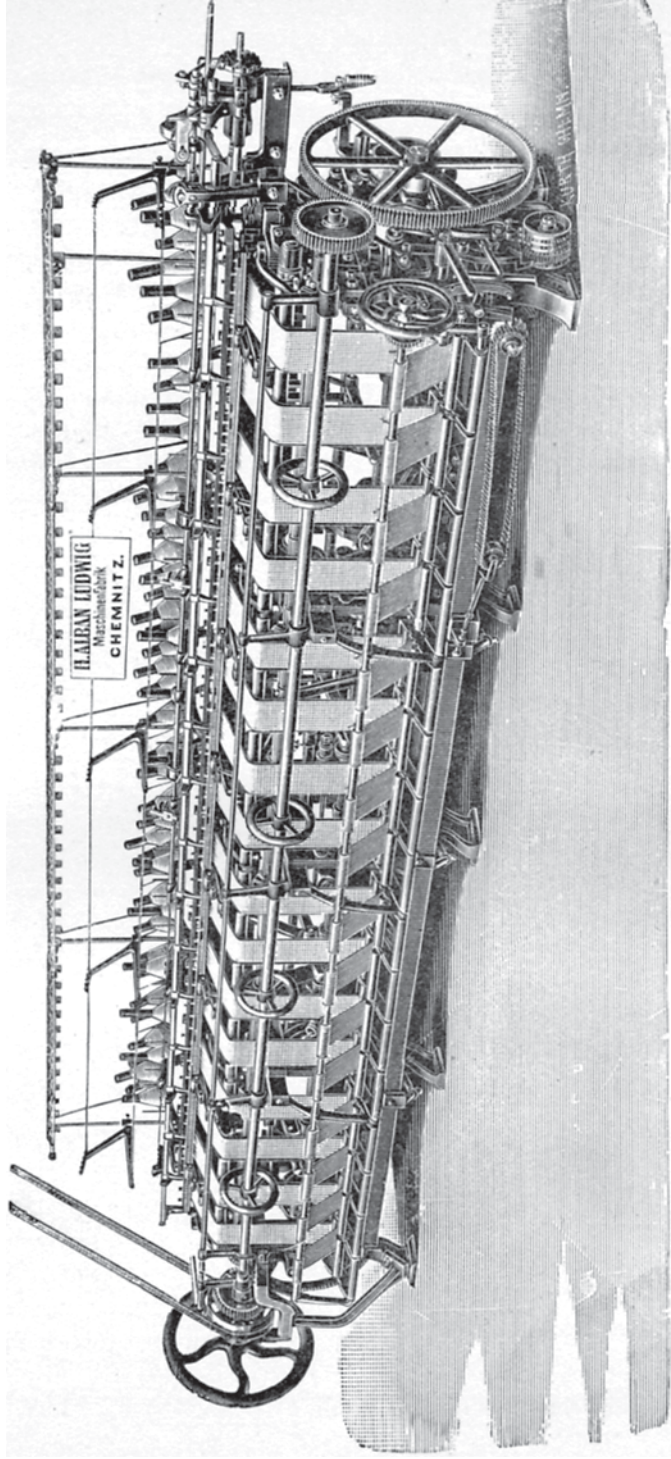
Fig. 110. Lamb Bench Bracket Power Machine.

sound, see that all the needles are in place; either in working position or drawn clear down. If the needles are all right, see that the slide plates M, just below the latch openers, are adjusted to require considerable force to shift by hand. If they are allowed to work loose the A shaped cam falls in the way of the needles. If one is found loose, tighten the large screw that holds the spring washer to the A shaped cam, and see that the lock spring is in its place on the slide. If this does not remedy the difficulty, turn the crank to the extreme right and see whether the slide plates can be moved farther to the left after the stops have shifted them; turn the crank to the left and see if the slide plates can be moved to the right after being moved by the

stops. If any one of the stops H, fail to shift the slide plate M as far as it will go, screw that stop closer to the needle bed or bend the point in a trifle.

If the latches of the needles become bent by accident or otherwise, straighten them with the fingers.





FLAT RIB KNITTING MACHINE ON COTTON PATENT, 16 SECTIONS MAKING RIB TOPS FOR FULL FASHIONED HOSIERY  
Grosser Knitting Machine Co.

# KNITTING.

## PART IV.

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### HOSIERY KNITTING

The class of machines now commonly employed for knitting stockings and socks is of the Circular Latch Needle type, though in at least one instance spring needles are employed in a Circular Machine. In other instances spring needles are used in the Straight Rotary Machines for making full fashioned hosiery on what is known as "Cotton's System." This method will be explained in a subsequent chapter. As the Circular Latch Needle Machines are generally used in the United States, this type will be explained first.

#### CIRCULAR LATCH NEEDLE KNITTING MACHINES

There are several styles and classes of Circular Latch Needle frames which may be classed as follows: *Hand Machines*, *Semi-Automatics*, *Three-Fourths Automatics*, *Seven-Eighths Automatics*, *Fifteen-Sixteenths Automatics*, and *Full Automatics*. The progressive order impresses one with the splendid mental resources and superior mechanical ability of the builders of Circular Latch Needle Stocking Machines.

In knitting stockings a number of difficult propositions present themselves, of which the most important is the operation of shaping the stocking to the leg and foot of the wearer. Another difficult operation consists of splicing those portions of the stocking which are subjected to the most wear; while the ornamentation of the article, either by the use of a plurality of threads of different colors to produce vertical or horizontal stripes or figures, or by a variation in the character of the stitch to produce what is technically known as lace or open work, represents a third difficult operation. To produce these various effects automatically, devices have been perfected to accomplish the following purposes:

- (1). Change the length of the stitches.

- (2). Stop the machine or change its motion from rotary to reciprocating, without stopping.
- (3). Put up out of action about one-half the needles.
- (4). Put up out of action *one* needle of those remaining in action at each course knit.
- (5). Restore these needles successively to action.
- (6). Restore the instep needles to action.
- (7). Change the motion from reciprocating to rotary again.

These changes are accomplished in various automatic ways by the several different builders, but all depend upon a pattern chain or wheel, which measures the length of fabric knit, and at predetermined periods, shifts the motion-changing and needle-cam devices to effect the required result.

In the simple Hand Machines these various operations are effected by the operator manipulating the levers etc., as required to accomplish the desired result. One by one, almost, each operation has been made to accomplish the result automatically, until now we have the Full Automatic.

Full Automatics may run continuously on women's goods, passing from stocking to stocking without assistance from the operator. In making half-hose or socks the machines are automatic to a like degree, except that they must be stopped at the end of each article, so that another cylinder may be introduced with the rib-top on the needles; or a transferring device may be used for putting the rib top or hose leg on the needles, which in the latter case does not necessitate removing the cylinder from the machine.

Originally, machine-made seamless hosiery was made on hand machines wherein each needle for the formation of the heel and toe had to be manipulated by hand, and all other changes effected by the crudest means.

As the Hand Machine is the simplest form of machine knitting, more easily understood and plainly presenting operations, performed by hand, that the Automatics perform by mechanism, it may be well to take it up first, for it treats the fundamental principles simply and clearly. The results obtained on the several classes of Circular Latch Needle frames are practically the same, but the mechanical arrangements have grown more complex as devices have been perfected for performing automatically the various operations of shaping hosiery.

## HAND MACHINES

The stitch in plain machine knitting is exactly the same as made in plain hand knitting, though more perfect and even. The number of stitches required to be put on the needles, in setting up the work, depends upon the size of the yarn and the size of the sock or stocking desired. A large size stocking requires more stitches than a small one,

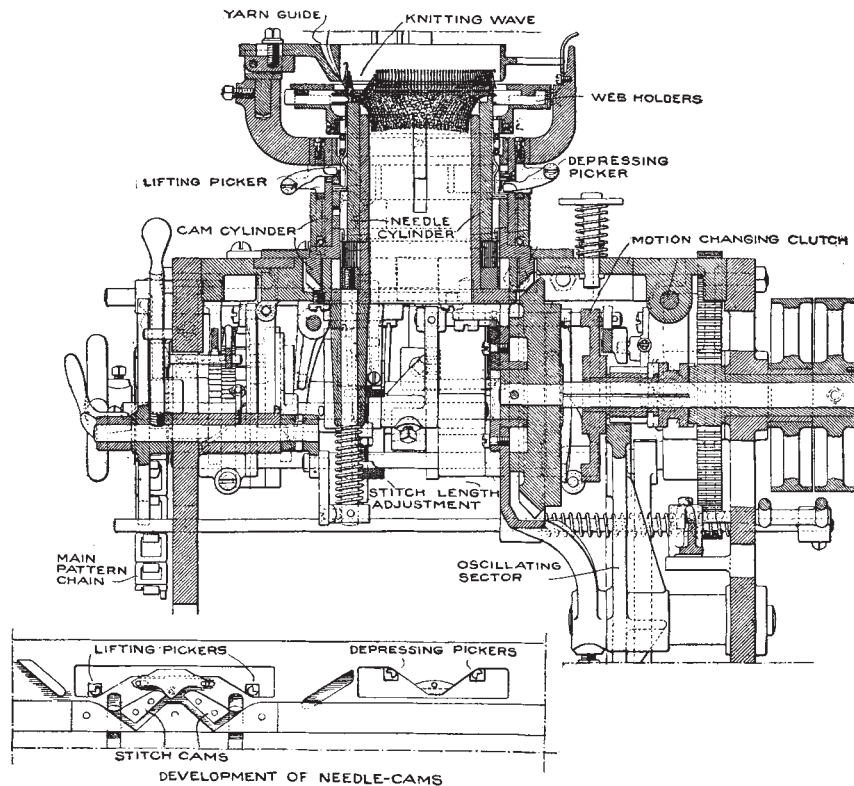


Fig. 111. Sectional View of Typical "Full Automatic" Circular Latch Needle Fashioning Machine.

and fine yarn requires more stitches and finer needles than are required by coarse yarn. It is for this reason that needle cylinders are required to contain a different number of slots, or places for needles, to suit different sizes or grades of yarn, and is also the reason why they are required to be made of different diameters to make the various sizes of hosiery. The number of slots may be different in cylinders of the same size, according to the requirements of the work.

There are three conditions that will change the size of the hose; *first*, the number of needles in the cylinder; *second*, the length of the stitch; and *third*, the size of the yarn.

Fine yarn knit on a cylinder containing 60 needles will produce a small size stocking, but if knit on a cylinder containing 100 needles will make full size hose. The tighter the stitch the smaller the tube, or

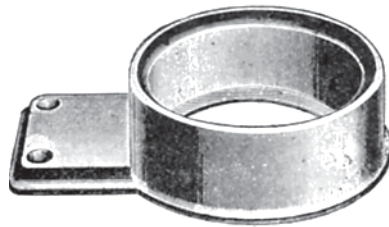


Fig. 112. Transfer Cup.

web, in diameter; the looser the stitch the larger the tube. The coarser the yarn used the larger will be the tube produced with a given number of needles, and the finer the yarn the smaller the web or tube produced. For example, the coarse cylinder will make a child's stocking with a

fine yarn knit with a short stitch. Seamed work is always smaller in diameter than where the full number of needles in the cylinder are employed. With every other needle out a very small tube can be knit.

**Operation.** These machines are operated entirely by hand during the circular and also during the reciprocating movement required to make the heel and toe, the needle being raised and lowered by hand, by means of a working-hook (A in Fig. 114). The work is held down by means of weights.

In starting the work, the knitting is commenced at the top of the stocking and set up with a selvage, the same as if knit by hand. For half-hose, or socks, the top may be ribbed or seamed as far as required by removing every second, third, or fourth needle, and then changed to plain knitting by replacing the needles removed for that purpose. Narrowing, for shaping the leg of a stocking, may be done with the stitch regulator without stopping the machine. The heel is knit at the proper place by knitting backward and forward, and may be made double thickness if desired. Knitting the foot is then continued and the toe finished on the machine, except joining a few stitches at the toe, which is done by hand with a finished needle after the stocking is taken from the machine. The machine is usually fastened to the table or bench by means of thumb screws.

Fig. 115 is an illustration of the Branson Hand-Knitting Machine. The parts are designated in this illustration as follows: A is the cam

cylinder; B, needle cylinder; C, yarn guide; D, yarn carrier; G, stitch regulating lever; and H, take-up spring.

**The Yarn Guide, C,** guides the yarn from the bobbin to the yarn carrier D. The three arms on the back part of the machine are used when knitting different colors of yarn, or when knitting double or triple threads.

**The Take-Up Spring, H,** is used only when knitting flat web, the heel and toe, or any tubular work where *some* of the needles are taken out, and where a close stitch is required. The spring is adjustable at the point where it is attached to the yarn guide and may be raised or lowered as more or less tension is required for knitting light or heavy yarns. In knitting the heel or toe it should draw the yarn close around the lifted needles. When in use it is to be hooked under the yarn between the tension ring and the slot in the end of the guide.

**The Yarn Carrier, D,** carries the yarn to the needles. It is fastened to the cam cylinder with screws, and must be removed before changing cylinders. When returned to place it should be

pressed down on the screws as far as possible. When threading the yarn carrier, always pass the yarn through both holes, from the outside to the inside.

**The Cams M and O** (Fig. 116) are stationary, and act simply as guides to guide the needles to the stitch cams N and L. The stitch cams perform the entire operation of knitting backwards and forwards; they swing loosely on pins provided for that purpose at their upper ends and swing back, as shown by L, when the needles pass under them to form the stitch. They are in position, as shown by N, when the need-

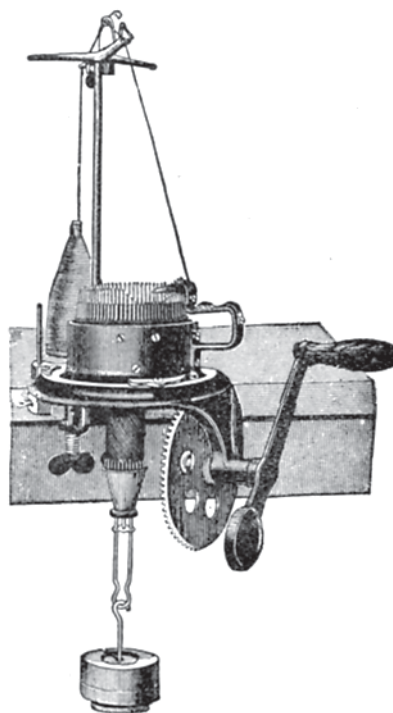


Fig. 113. Type of Hand Machine.

les pass over them to free the latches. The machine is turned until the needles are all passed out from under the cam in either direction when the cams drop automatically, bridging the opening, and causing the needles to pass up over the cam on that side and down under the cam on the opposite side, thus forming stitches. If by any means the cams

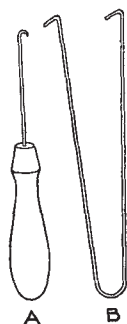


Fig. 114.  
Work Hook  
and Heel Hook.

get in a position so that the needles pass down under both of them and the needles are not lifted up to free the latches, by lifting up several of the needles above the cams and turning the machine past these lifted needles, the cam will drop down and the needles pass up over it. Then push down the lifted needles.

**To Regulate the Stitch.** Draw the stitch regulator, G, to the front of the machine to lengthen the stitch, and push it toward the back of the machine to shorten the stitch. In ordinary knitting the stitches should be long enough to easily draw down to the needle cylinder, for tight or close knitting makes the web hard and inelastic. When the stitch is too short it will not pass down over the latch of the needle freely unless considerable weight is applied. When the needles do not knit but the yarn lies in front of them, not knit in, the difficulty usually is in having the stitch too short.

The weights hold the stitches down so that the needles may pass up through them as they are raised up just behind the yarn carrier. Before any knitting is done, the needles must be raised up high enough to allow the stitches to get below the latch of the needles. The weight does not affect the length of the stitch, but only holds it down. If the stitch is of the right length, and the proper amount of weight is used there will be no difficulty with the needles, as they are self-acting.

**Needle Cylinders** are made to contain different numbers of slots for needles to suit different sizes and kinds of yarn, and to make different sizes of hosiery, as in the instance cited where fine yarn knit on a cylinder containing 60 needles will make small hose; but knit on an 84 or 100 needle cylinder, will make full sizes.

Fig. 118 represents needle cylinders, without needles, for each of the four different size heads used in this machine. The number of slots and needles a cylinder contains represents the number of stitches that will be made each round, while knitting with that cylinder in the

machine. The number of slots in a cylinder does not necessarily increase or diminish the size of that cylinder, but only places the needles nearer together or farther apart, as fine or coarse work is desired. Cylinders are commonly cut for any number of needles desired up to 176 slots, and sometimes finer, with inserted sheet steel walls.

Cylinders are changed by removing the yarn carrier D, and either

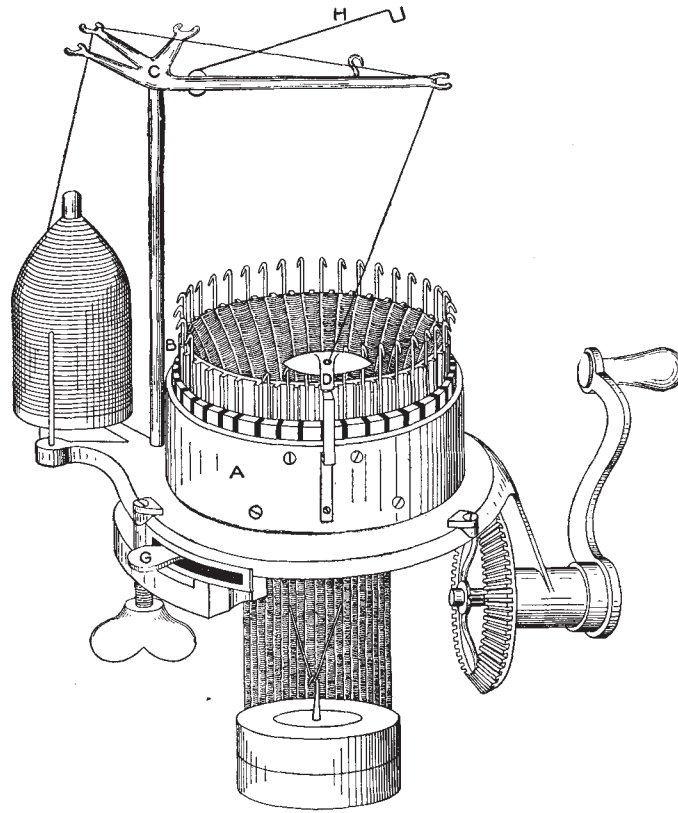


Fig. 115. Branson Hand Machine.

lifting up enough needles to allow the cams to pass under and be free of needles, or removing them and lifting the cylinders out of the cam cylinders. In putting another cylinder in place, put the slot, in the under edge of the cylinder, on the stud in the back of the bed plate, and then secure the yarn carrier in its proper place.

A combination is effected in these machines in such manner that



the bed (Fig. 119) or running gear of the machine accommodates the different size heads and their cylinders, the gear rim of the head being always the same size, the difference being in the size of the cup of the head for holding the needle cylinders. This is shown very clearly in Fig. 120.

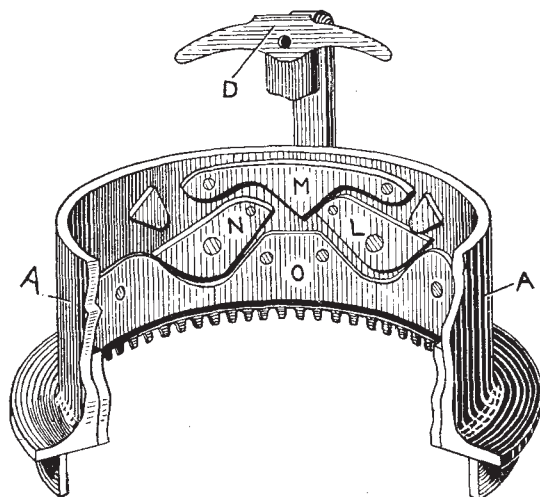


Fig. 116. Cam Cylinder Showing Cams.

**Needles.** There are three sizes of needles in general use in these machines, called 12 gauge, 18 gauge, and 24 gauge. They are used in knitting different grades of yarn so as to form large or small stitches. For coarse yarn such as is generally knit on the 60 and 70 needle cylinders, the 12 gauge needle is used. For finer yarns the 18 gauge needle in the 84 cylinder, and the 24 gauge in the 100 needle cylinder are used. The 18 and 24 gauge needles are also used in knitting cotton; the 18 gauge in the 84 needle cylinder, and the 24 gauge in the 100 needle cylinder.

The regular standard of gauges adopted by the builders of this machine is as follows:

12 gauge needles for cylinders having four to six	needles to the inch
18 " " " " " " six to eight	" " " "
24 " " " " " " eight to twelve	" " " "
36 " " " " " " twelve to fifteen	" " " "
42 " " " " " " finer than fifteen	" " " "

#### Sizes of Yarns Used in Different Cylinders.

A 56 needle cylinder will make a 5 inch child's stocking. Use 64

needle cylinder for 6 inch stocking, 72 needle cylinder for 7 inch stocking and 80 needle cylinder for 8 inch stocking.

Two-ply 18 or two-ply 20 cut woolen yarn makes a good hose for children.

Two-ply No. 7 or three-ply No. 10 cotton yarn makes the same size on cylinders as stated above.

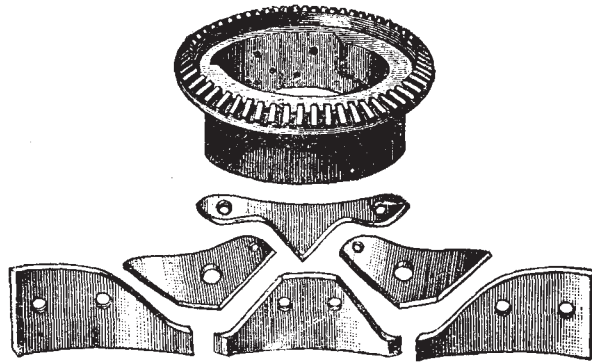


Fig. 117. Cams.

In making double heels and toes use a single thread of No. 10 or 12 cotton, or a single No. 18 or 20 worsted.

The length of the leg of ladies' or children's hose should be about three times the length of the foot.

**To Change Heads.** After removing the head from the machine put in the desired head, with the yarn carrier at the back of the machine directly opposite the yarn guide post, and with the crank hanging straight down with the handle at the lowest point. This will bring the handle in the easiest position for knitting the heel and toe with the backward and forward motion.

**Setting-Up the Work.** Turn the machine until the yarn carrier is directly in front of the machine. Have all the needles lying down all around the machine. Expand the set-up (See Fig. 121) so that the hooks rest against the inside of the needle cylinder as illustrated in Fig. 122. They should be held a little below the upper edge of the cylinder. Place the yarn in the yarn guide correctly and draw through the carrier; drawing through about a yard (enough to set up the first round, or course of stitches). Take the yarn between the thumb and finger close to the yarn carrier and put it under one of the hooks of the set-up,

then bring it up and around one of the needles in the machine close to the yarn carrier. (See Fig. 122). Always bring the yarn around the needle from the right to the left, and then down under the next hook of the set-up, and so on around each. This is continued on each needle until the needles down in the cams are reached, then hook the weights into the ring in the wire underneath the set-up and turn the machine



Fig. 118. Needle Cylinders.

slowly to the right until the remaining needles are brought up into full view. Continue to set up these needles as before, running over two or three of those that were first set up to fasten in the end of the yarn. Break off any yarn remaining in the fingers and the setting-up is completed. Note that bringing the yarn around the needle from the right to the left always forms a crossing of the yarn on the inside of the needle between it and the hook of the set-up, as shown in Fig. 123. If there are more needles in the machine than hooks in the set-up, catch under the same hook twice.

**To Knit Rib Tops Without Removing the Needles.** Before setting up the work lift up every fourth needle and tip it over at right angles with the cylinder, as shown in Fig. 124. The yarn carrier arm passes over these needles without operating them. Set up the work as previously instructed and knit the length of top desired. Then tip up and push down into the cylinder those needles that are away from the cams and yarn carrier, after which turn the machine forward and tip up and push down into the cylinder the rest of the needles. Then proceed with the knitting.

**To Knit the Heel.** On these machines there are marks on the upper edge of the needle cylinder dividing the cylinder exactly in halves, and the front is sub-divided into three equal parts, to serve as guides in knitting the heel and toe. Turn the yarn carrier to the front of the machine. Lift up, with the hook or fingers, all the needles in the back half of the cylinder as high as they will come, or up against the wire ring in the needle cylinder. Before turning the crank to revolve the machine, place the take-up spring under the yarn to bring it into action.

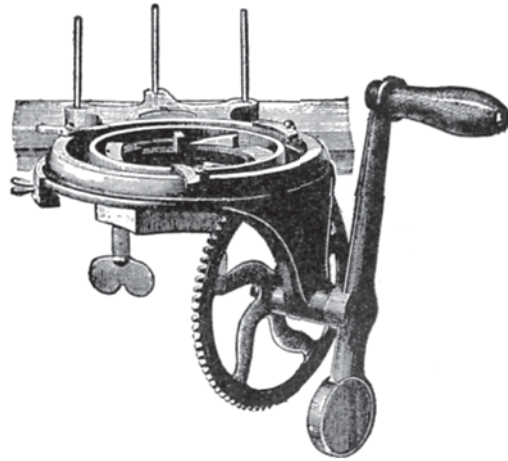


Fig. 119. Bed Plate.

Turn the machine until the needles in operation have all formed loops, then lift up one needle next to the yarn carrier and next to the needles already lifted up, as shown in Fig. 125. Turn the machine backward until the stitches are again formed on the opposite side, and again lift up one needle next to the yarn carrier and next to the needles already lifted up. Turn the machine forward again until stitches are formed on the side of the beginning, and then lift up a needle as before. Continue, in a like manner, to knit backward and forward, each time lifting a needle, until all the needles are lifted up next to the yarn carrier and next to the mark. Before moving the machine push down the first needle next to the mark on the *opposite* side and away from the yarn carrier.

During this operation of lifting up the needles, the weights at-

tached to the set-up are drawing down the work at the back of the machine, and not on the part then being knit. This latter part of the work must be held down with the left hand as shown in Fig. 125. Draw down on it so that the stitches will be kept down on the edge of the cylinder and properly knit in.

After the needles have all been lifted up to the marks and one has

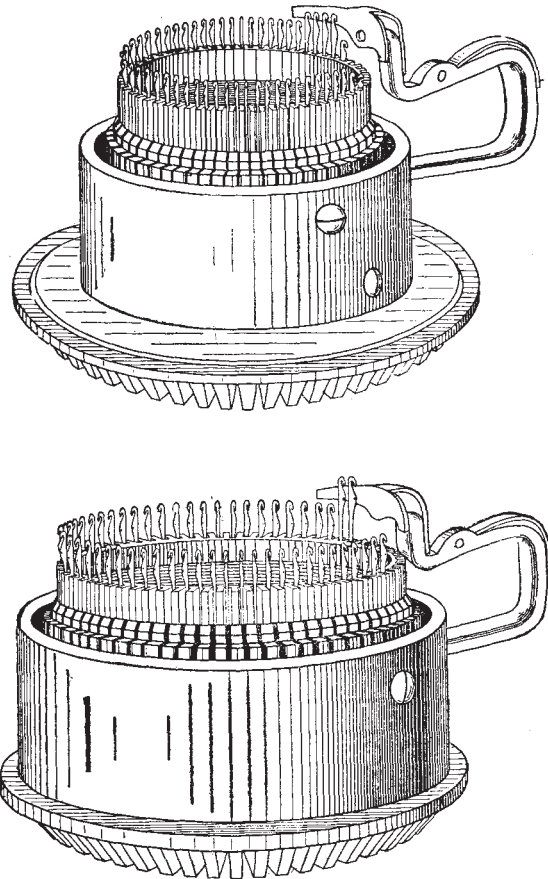


Fig. 120. Showing Arrangement for Holding Cylinders.

been pushed down on the opposite side from the carrier, push the heel hook up between the web and the cylinder and hook it into the web directly under the needles that are not lifted up, and about half an inch from the upper edge of the needle cylinder. Take the weights from

the set-up and hook into the ring in the lower end of the heel hook. Now push down a needle on the opposite side and away from the yarn carrier; knit across, and then push down another needle (always on the side away from the yarn-carrier). Knit across and continue to push down needles in a like manner until all are down to the marks where the start was made, except one on each side, these being the first ones raised up; turn the machines until the yarn carrier is directly in front, and push down all the lifted needles. Be sure that all the latches are down at the back of the machine, otherwise stitches will be dropped. Then proceed to knit the foot.

**To Knit the Foot.** With the left hand, catch hold of the leg of the stocking at the back of the machine and hold down on it, as the weight in the heel hooks are drawing only on the web in the front part of the machine. As all the needles are in use to knit the foot, as in knitting the leg, and as it is simply plain circular knitting, it is merely a matter of turning the crank in the right direction to make the cams actuate the needles, until the place is arrived at where the toe should be. Then proceed to knit the toe.

**To Knit the Toe.** The toe is knit, in every particular, like the heel. When completed, knit two rounds with the needles all down, break off the yarn and run the work out of the machine, holding the weights up so that they may not draw down too hard while running out.

**To Knit a Mitten.** Take out every fourth needle as in knitting rib top; set and knit the length required for wrist; put in the needles taken out, and lift the stitches over these needles to close the opening that is left if they are allowed to set their own stitches. Knit fourteen rounds of plain knitting, then lift up the needles as in knitting the heel of a stocking, leaving twenty-four down in operation. On these

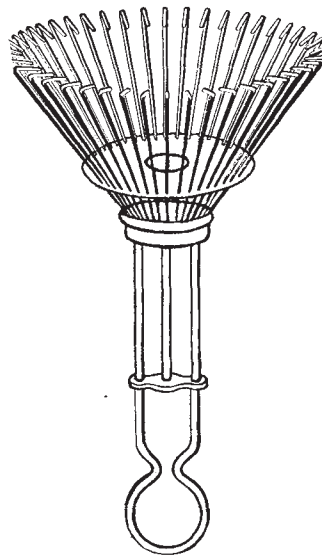


Fig. 121. Set-Up.

needles knit the thumb. Knit back and forth forty-five times; close off the end of the thumb by lifting up six needles on each side; then proceed as in knitting a heel. Push down all the twenty-four needles and run the thumb out, leaving the yarn carrier on the left. Now take the selvedge stitches on each side of the thumb thus knit, beginning close at the bottom, and put them over the empty needles, twelve from each selvedge; put the yarn in the yarn carrier, push all the nee-

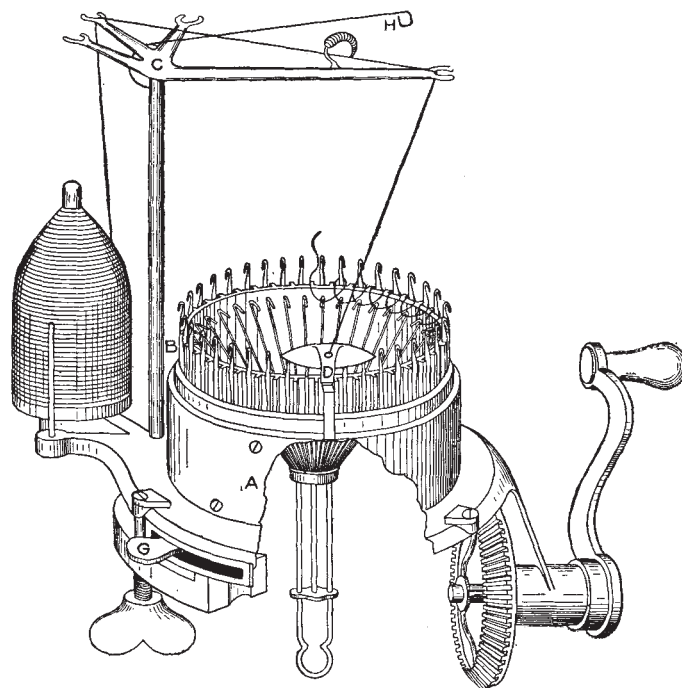


Fig. 122. Setting Up Work.

dles down, and knit round and round for the hand forty or fifty rounds. Close off as in the toe of the stocking. While knitting the thumb hold down the strip with the left hand or heel hook (B in Fig. 114).

**To Close a Selvedge.** Take up the short stitch with a darning needle on each edge on the wrong side of the fabric, and sew over as in over-seaming. Every other stitch on the selvedge is a short stitch and is referred to as the selvedge stitch.

**Mending Broken Stitches.** Take one of the needles of the ma-



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chine and hook it in the dropped stitch, either when the work is in the machine or after taking it out, and push it far enough through to bring the stitch below the latch. Continue to draw the needle back until a new stitch is formed, and continue in the same way until all the dropped stitches are knit in. If the mending is done out of the machine, tie the dropped stitch with a short piece of yarn and draw the ends inside of the web.

**To Take Out Needles.** Lift them as high as they will raise up and then turn the tops outward and downward until they come out from under the wire ring in the needle cylinder. To put them in, press the end of the hub of the needle down behind the wire ring until it is fully down behind it, turn the needle up to the cylinder and push it down as far as it will go.

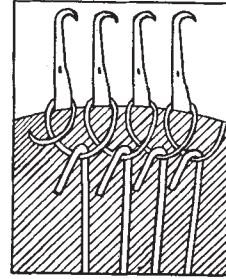


Fig. 123.  
Crossing of Yarn.

Several needles can be taken out at one time as easily as one.

When the needles are raised up out of the cam cylinder against the wire ring in the cylinder, the hub of the needle projects above the cams and are not operated by them.

If the latch of a needle becomes bent, by accident or otherwise, straighten it with the fingers. See that all the latches work freely for if any do not they must be loosened or the needles will have to be replaced by new ones.

Do not attempt to reverse the machine while it is knitting, unless enough needles have been lifted up to allow the cams to pass under. The machine knits as well one way as the other, but it is awkward to turn it backwards.

Fig. 127 shows the manner of closing the toe with the "knitting stitch" which leaves no seam, and if done with the same yarn, cannot be distinguished from the other knitting.

The take-up spring should be adjusted to take up all the yarn drawn through the yarn carrier after leaving the operating needles. Too much tension will draw the stitches too tight at the selvedge, and too little tension will cause stitches to be dropped at the selvedge.

In knitting tight work put on plenty of weight or hold down hard with the left hand. Be sure that the yarn comes from the bobbin freely and without hindrance of any kind whatever. Much trouble

and poor work arise from poorly wound bobbins, and the yarn not coming off freely.

**Table of Sizes of Yarn Used in Branson Machines**

Needles to Inch	Wool Cuts Ply Cut	Cotton No. Ply No.	Worsted No. Ply No.	No. of Needles in $\frac{3}{8}$ " Machines
4	2-12	2- 4	2- 6	48
4 $\frac{1}{2}$	2-14	2- 5	2- 7	52 & 56
5	2-14	2- 5	2- 7	60
5 $\frac{1}{2}$	2-18	2- 6	2- 9	64
6	2-20	2- 7	2-10	68 & 72
6 $\frac{1}{2}$	2-20	2- 7	2-10	76
7	2-22	2- 8	2-11	80 & 84
7 $\frac{1}{2}$	2-25	2- 9	2-13	88
8	2-25	2- 9	2-13	92 & 96
8 $\frac{1}{2}$	2-28	2-10	2-15	100
9	2-32	2-11	2-17	104 & 108
9 $\frac{1}{2}$	2-38	2-14	2-19	112
10	2-38	2-14	2-19	116 & 112
10 $\frac{1}{2}$	2-45	2-16	2-24	124
11	2-50	2-18	2-27	128 & 132
11 $\frac{1}{2}$	2-56	2-20	2-30	136
12	2-56	2-20	2-30	140 & 144
12 $\frac{1}{2}$	2-62	2-22	2-33	148
13	2-80	2-28	2-42	152 & 156
13 $\frac{1}{2}$	2-96	2-34	2-50	160

#### AUTOMATIC MACHINES

The following preliminary description of the operation of knitting a sock on an automatic machine, gives a general idea of making a stocking, reference being had to the diagrammatic view, Fig. 130, in which the circular series of small dots represent the needles of the machine.

The needles may be said to be divided into sets, one set, namely, those inclosed with the bracket *a*, extending, say, one-half way around the machine; two sets *b b*, each extending about one-sixth or more of the distance around the machine on opposite sides of the same, and adjoining the ends of the set *a*; and finally a set *d*, extending between the sets *b*.

Supposing that the knitting of the sock or stocking is begun at the top of the leg, a thread is fed to all the needles and the machine is rotated so as to produce, by round-and-round knitting, continuous

circular courses of stitches until the desired length of tubular fabric for the leg has been formed, and it is necessary to form the heel.

In knitting a sock, the stitches of a short length of ribbed tubular fabric may be applied to the needles of the machine before commencing to knit the leg of the sock, so that when the sock is completed the leg

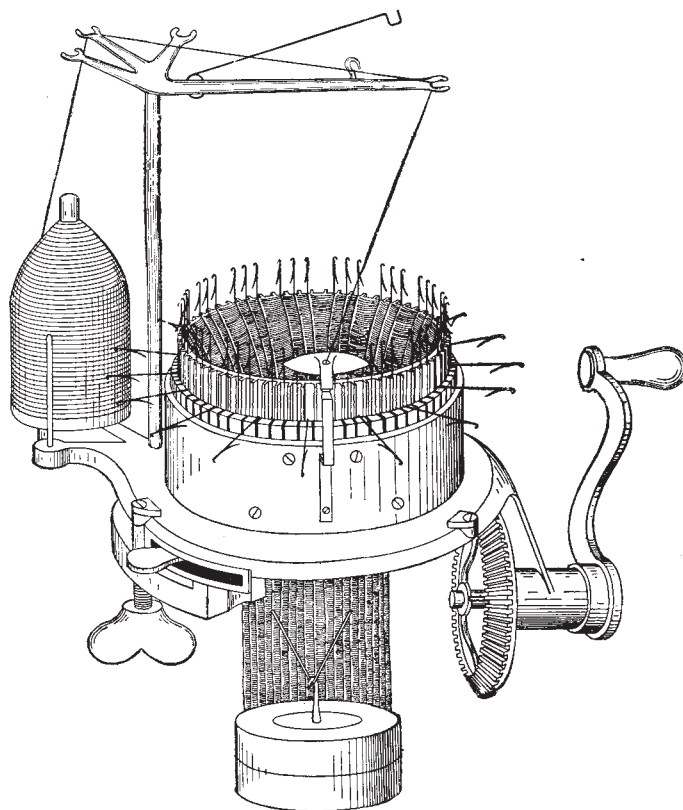


Fig. 124. Needles Tipped Down.

will have a ribbed top. In knitting long stockings where the ribbed top is not required, the needles may have greater draft while knitting the upper or calf part of the leg than while knitting the lower or ankle part, so as to shape the leg by drawing longer stitches and making a tube of greater diameter. After the proper length of tubular fabric has been produced the needles of the set *a* are, while still retaining their stitches, raised out of action. That is to say, they are raised so

that their butts will be above and free from the influence of the knitting cams, these cams being the ones which effect the vertical reciprocation of the needles at the proper time to cause them to catch the thread and draw the stitches. This leaves only the needles *b* and *d* in action. The motion of the machine is then changed from rotary to reciprocating,

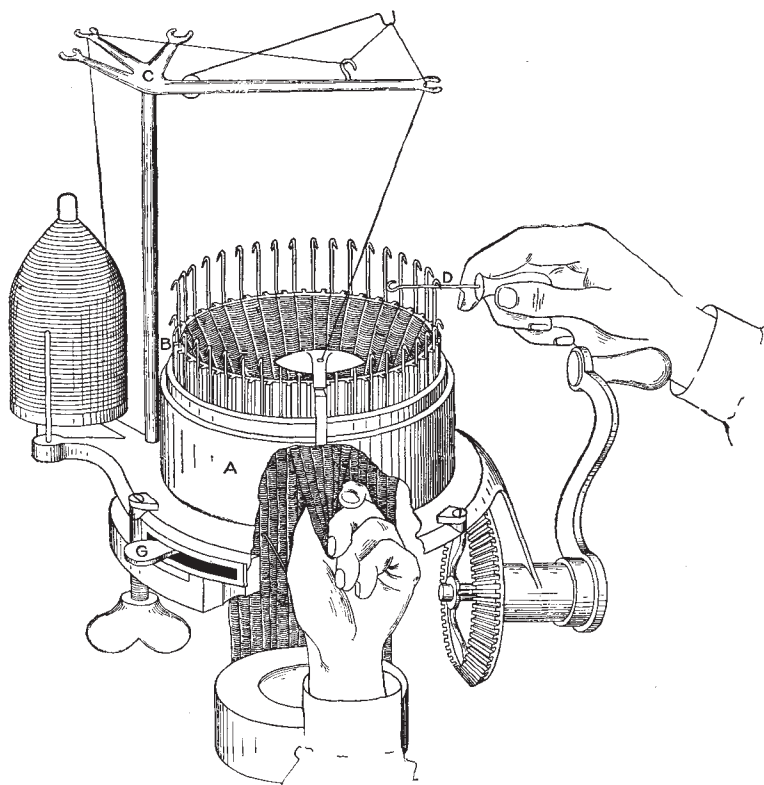


Fig. 125. Lifting Needles.

ating, and at the same time the extra or thickening thread is introduced, the double thread being carried back and forth around that part of the needle cylinder having the needles *b* and *d*, to form stitches upon these needles by to-and-fro knitting. The needles *b* are those upon which the fashioning of the toe and heel is effected and are termed "*fashioning-needles.*"

At the end of each reciprocating motion a needle, of one of the sets *b* at the end of the set adjacent to the needles *a*, is thrown out of

action—that is to say, it is so raised that its butt is free from the influence of the knitting-cams—but retains its stitch. The end needle, first of one fashioning set *b* and then of the opposite fashioning set *b*, is thus thrown out of action so that with each reciprocating movement the flat web produced is narrowed to the extent of one needle, first at one edge and then at the opposite edge. This narrowing operation is continued until all the needles of the fashioning sets *b b* have been thrown out of action.

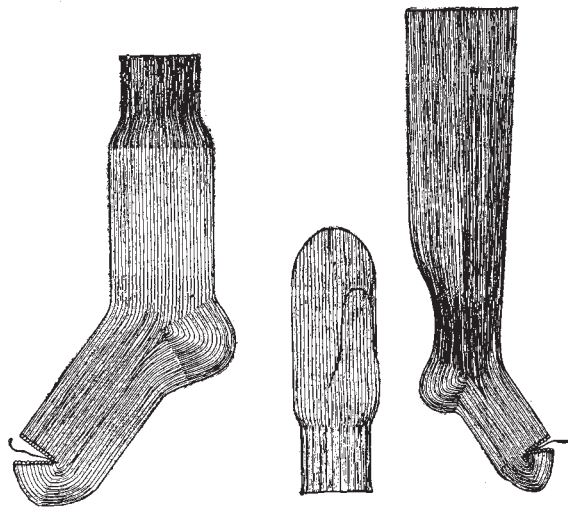


Fig. 126. Product of Branson Hand Machine.

Sometimes it is advisable to produce a series, of, say, two or more courses of stitches extending completely around the cylinder, to give greater depth or fullness to the center of the heel and prevent the stocking from binding at the instep. In this case all the needles *a* and *b* are temporarily lowered, so that their butts are again brought under the influence of the knitting-cams, and the motion of the machine is changed from reciprocating to rotary until the desired number of circular courses have been produced; the stitches carried by the needles *a* and *b* joining those of the first of the circular courses. It is also advisable to remove the thickening-thread during the formation of that part of each circular course which extends over the instep portion of the stocking.

As soon as the circular courses have been completed all the nee-

dles *a* and *b* are again raised out of action and the reciprocating motion of the machine is resumed. As soon as this has been done, needle after needle, first a needle of one fashioning set *b* and then a needle of the other set *b*, is brought into action by lowering the same so as to bring its butt under the control of the knitting-cams, the needles being brought into action in the reverse order from that in which they were thrown out of action. This operation results in the production of a gradually widened flat web, and in the uniting of this widened web to the last of the circular instep courses, owing to the fact that each of the fashioning needles *b*, retaining its stitches as it is thrown out of action after the formation of the circular courses, casts this stitch and catches

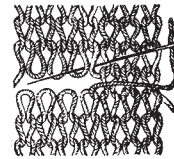


Fig. 127.  
Method of Closing Toe.

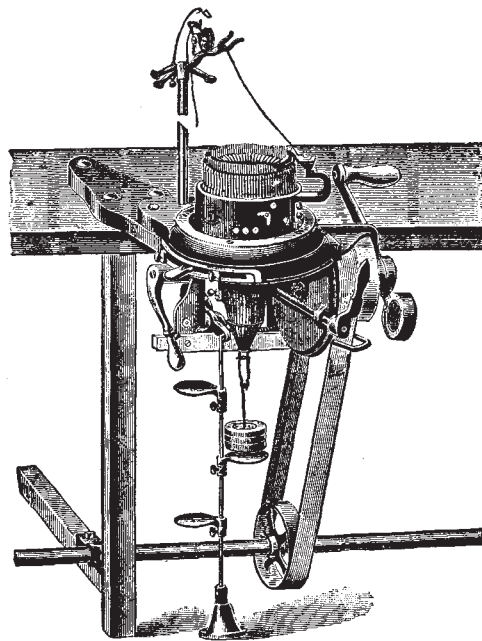


Fig. 128. Hand Machine with Power Attached.

a new loop formed upon the needles in effecting the production of the widened web. When all of the fashioning needles have been thus brought into action the thickening-thread is removed, the needles *a*