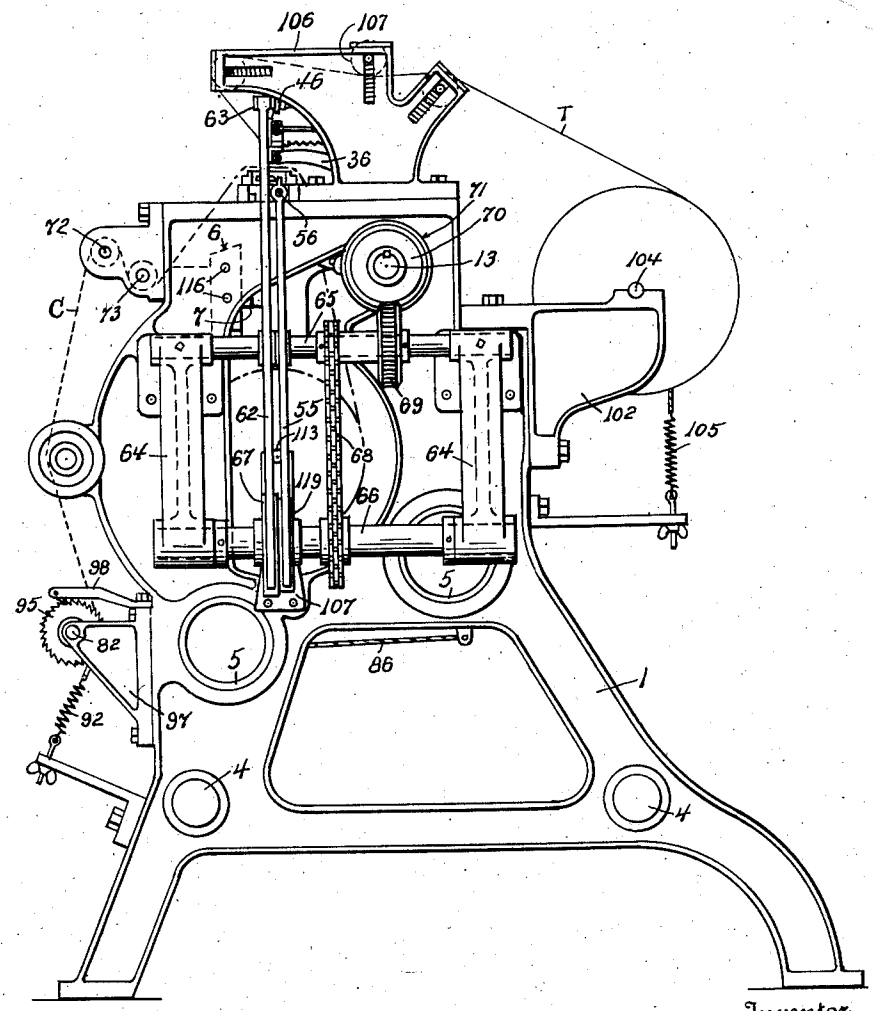
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Fig. 1.



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Fig. 2.

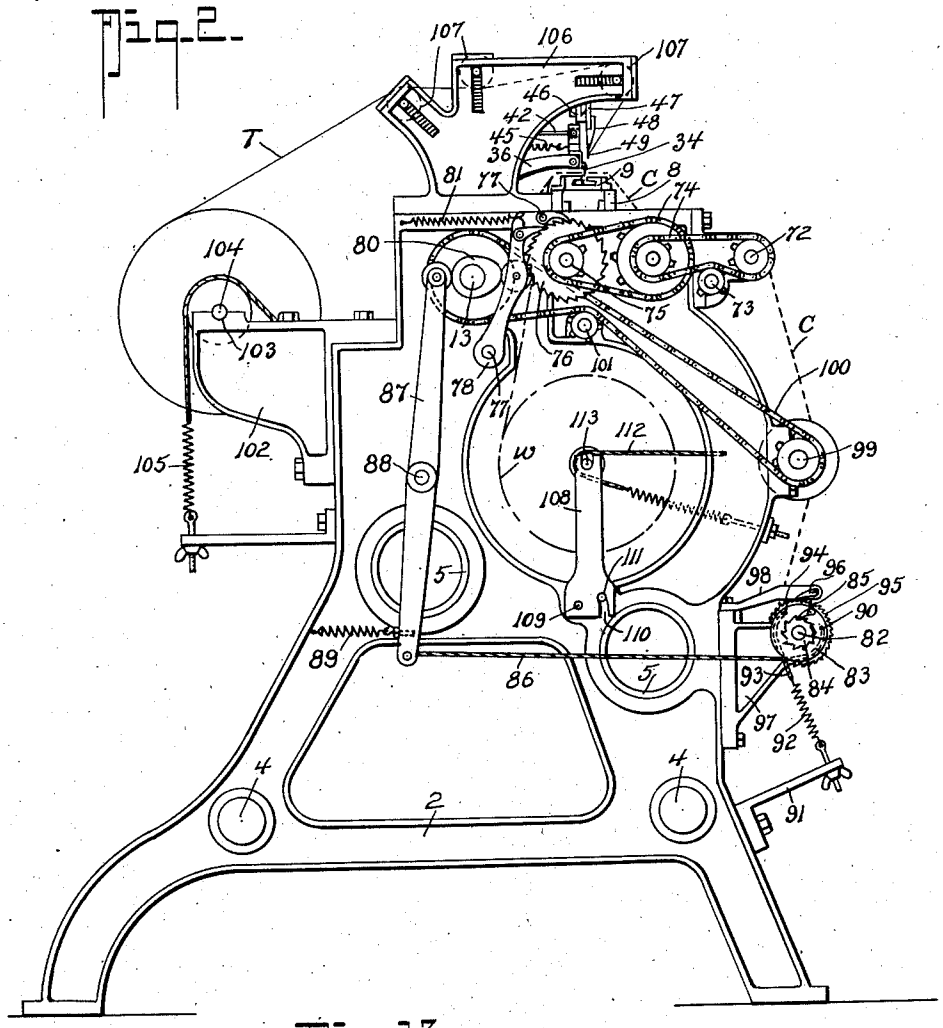


Fig. 13.

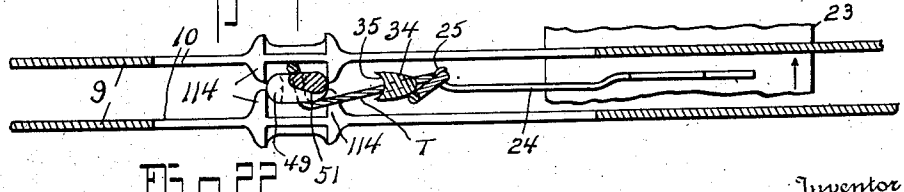
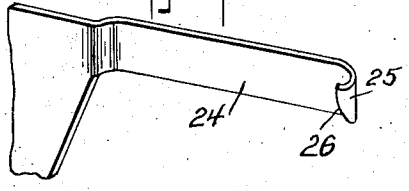


Fig. 22.



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Fig. 3.

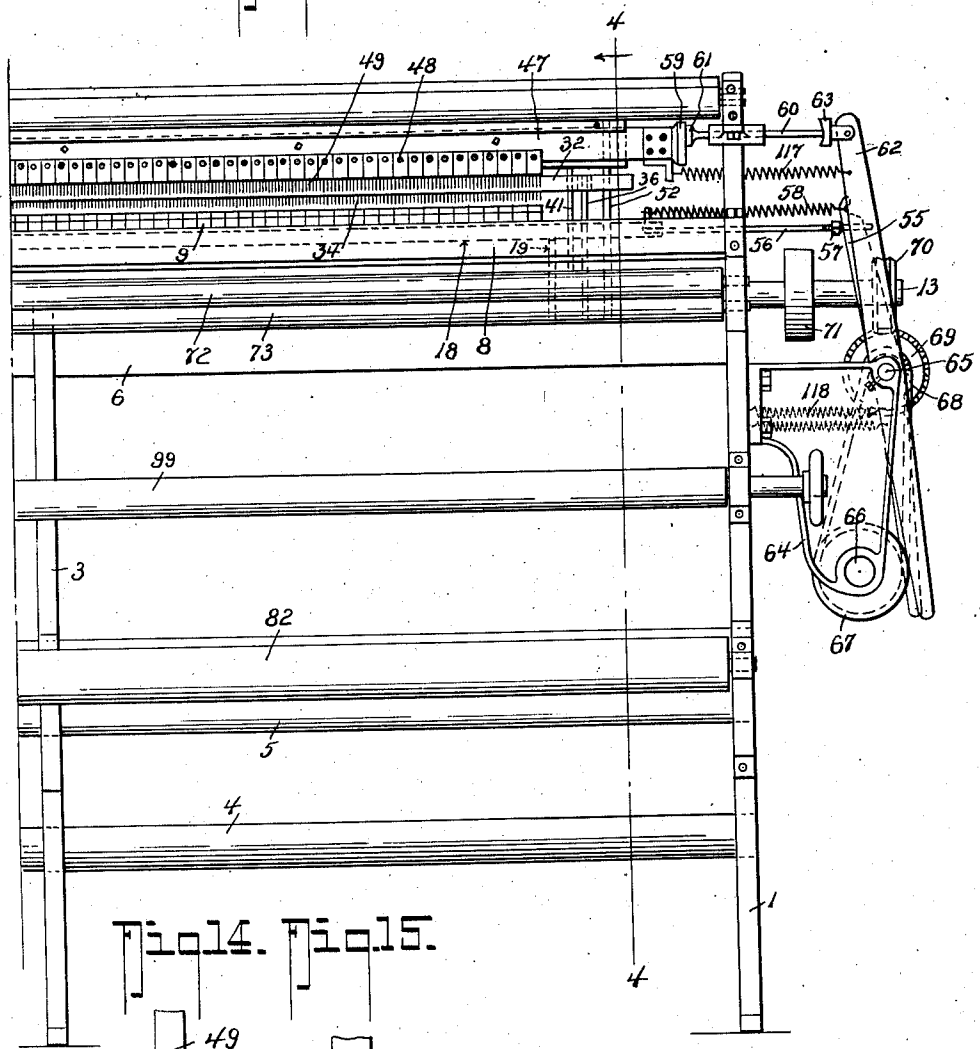


Fig. 14.

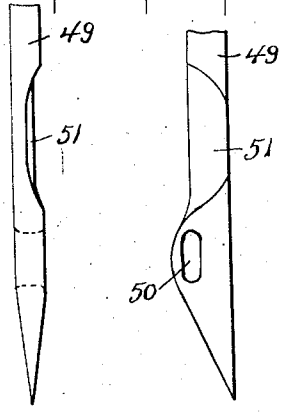


Fig. 15.

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Fig. 4.

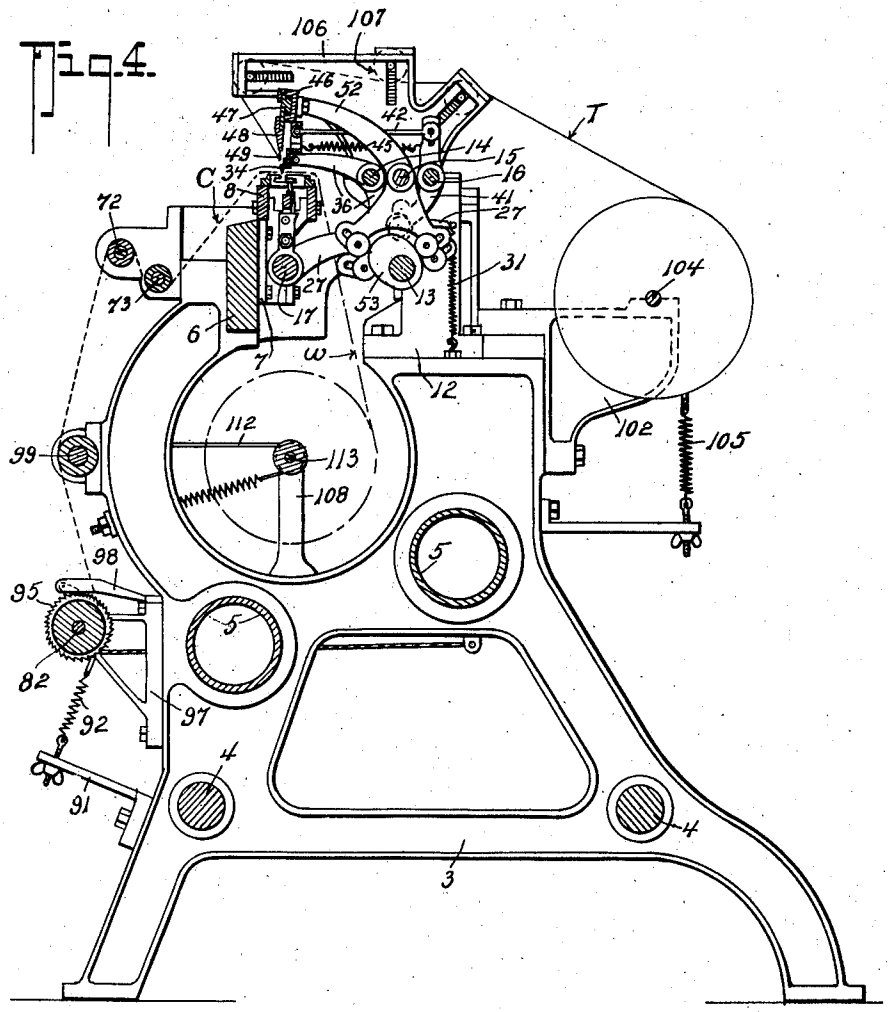
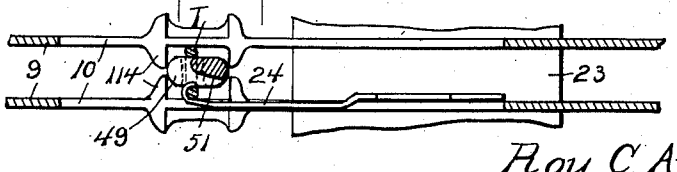


Fig. 12.



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Fig. 5.

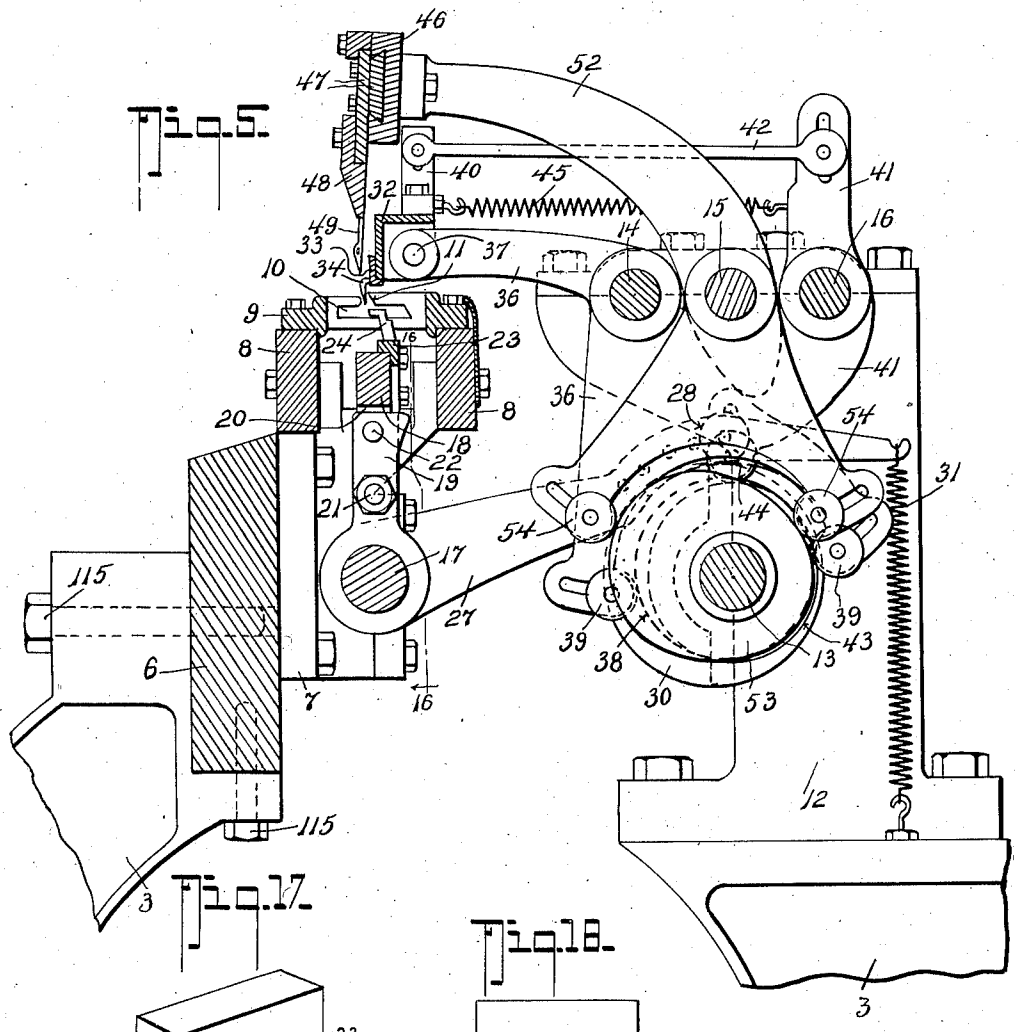


Fig. 17.

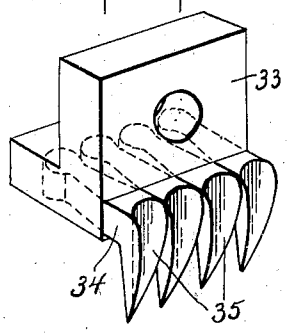
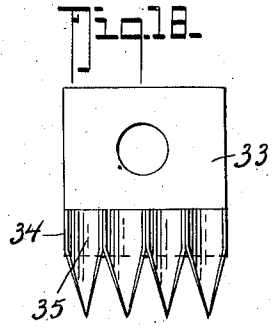


Fig. 18.



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Fig. 6.

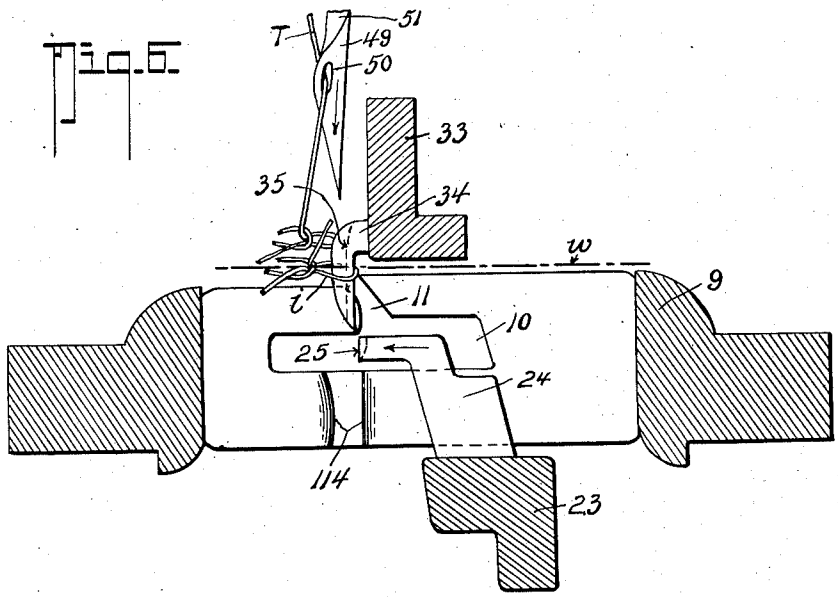
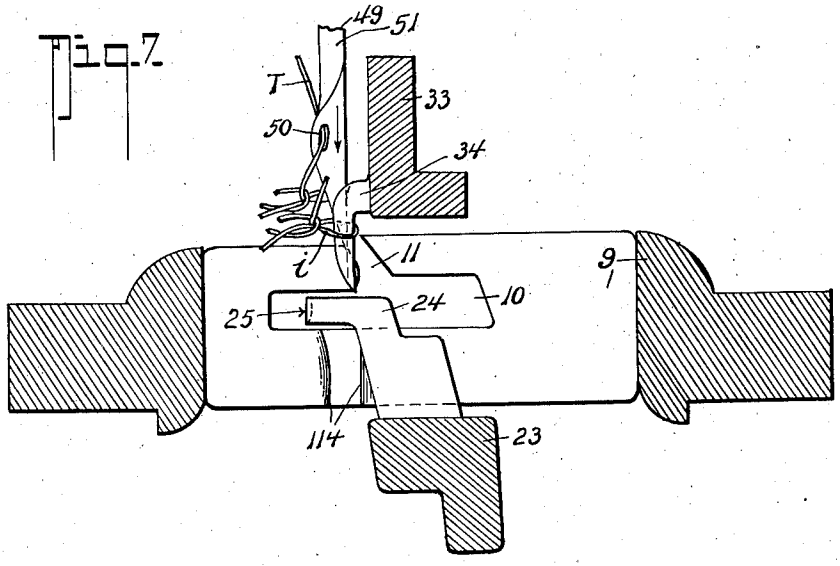


Fig. 7.



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Fig. 8.

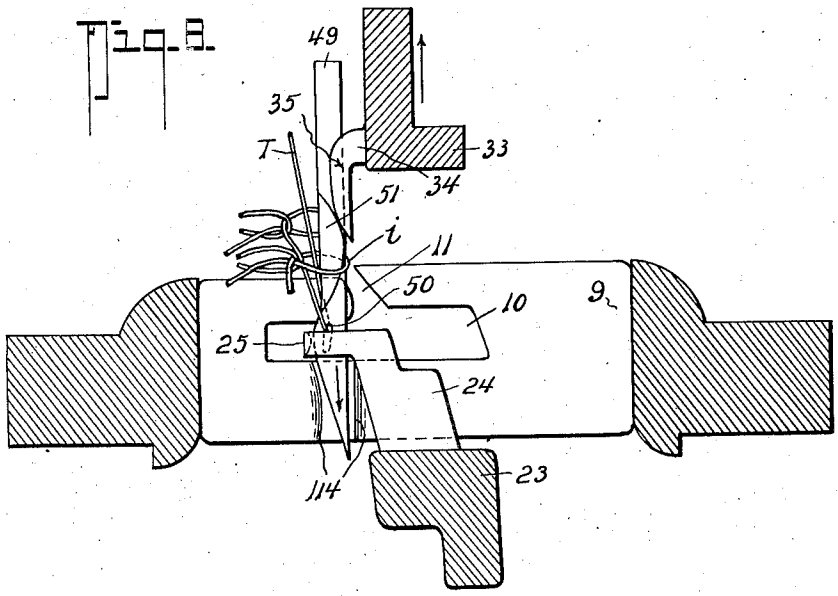
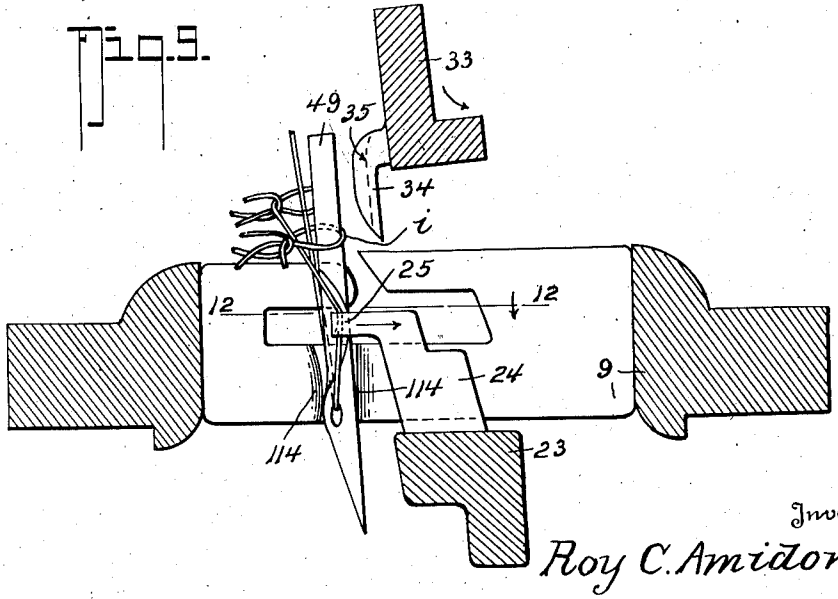


Fig. 9.



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Fig. 10.

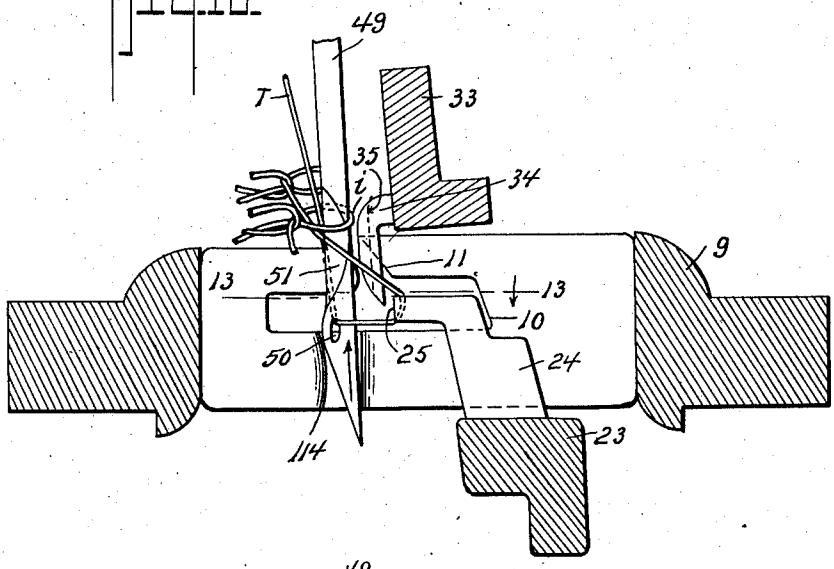


Fig. 11.

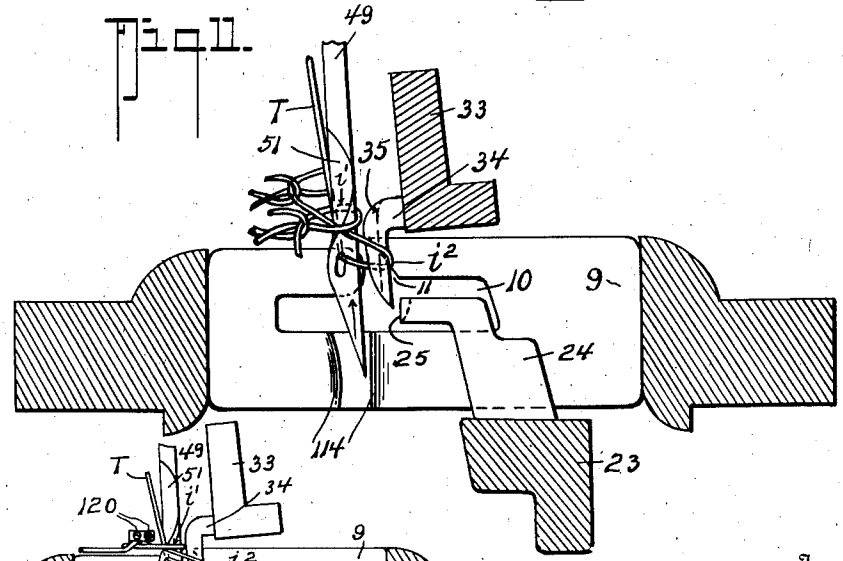
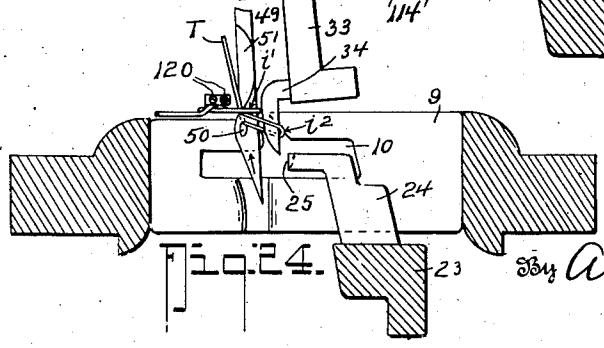


Fig. 24.



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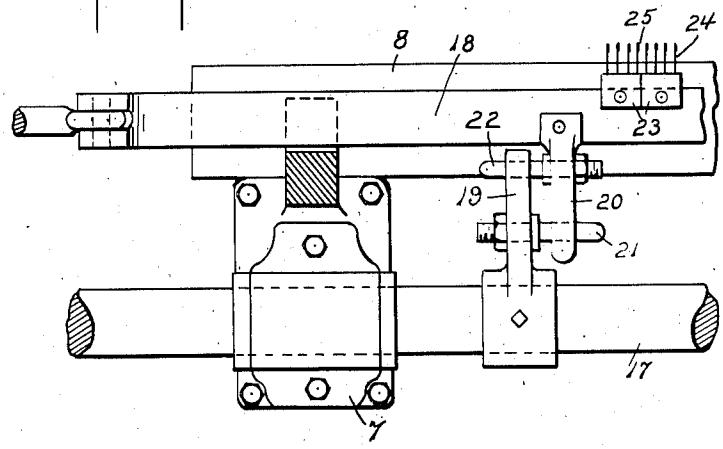
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Fig. 16.



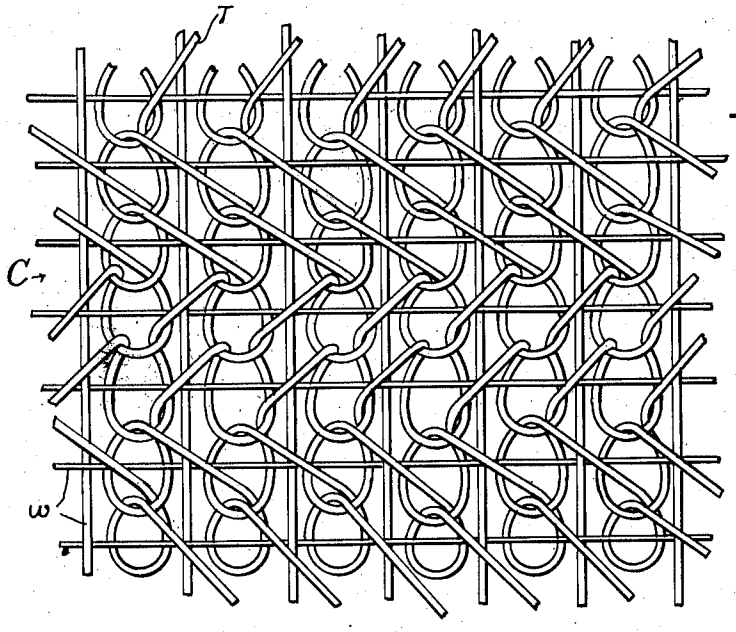


Fig. 23.

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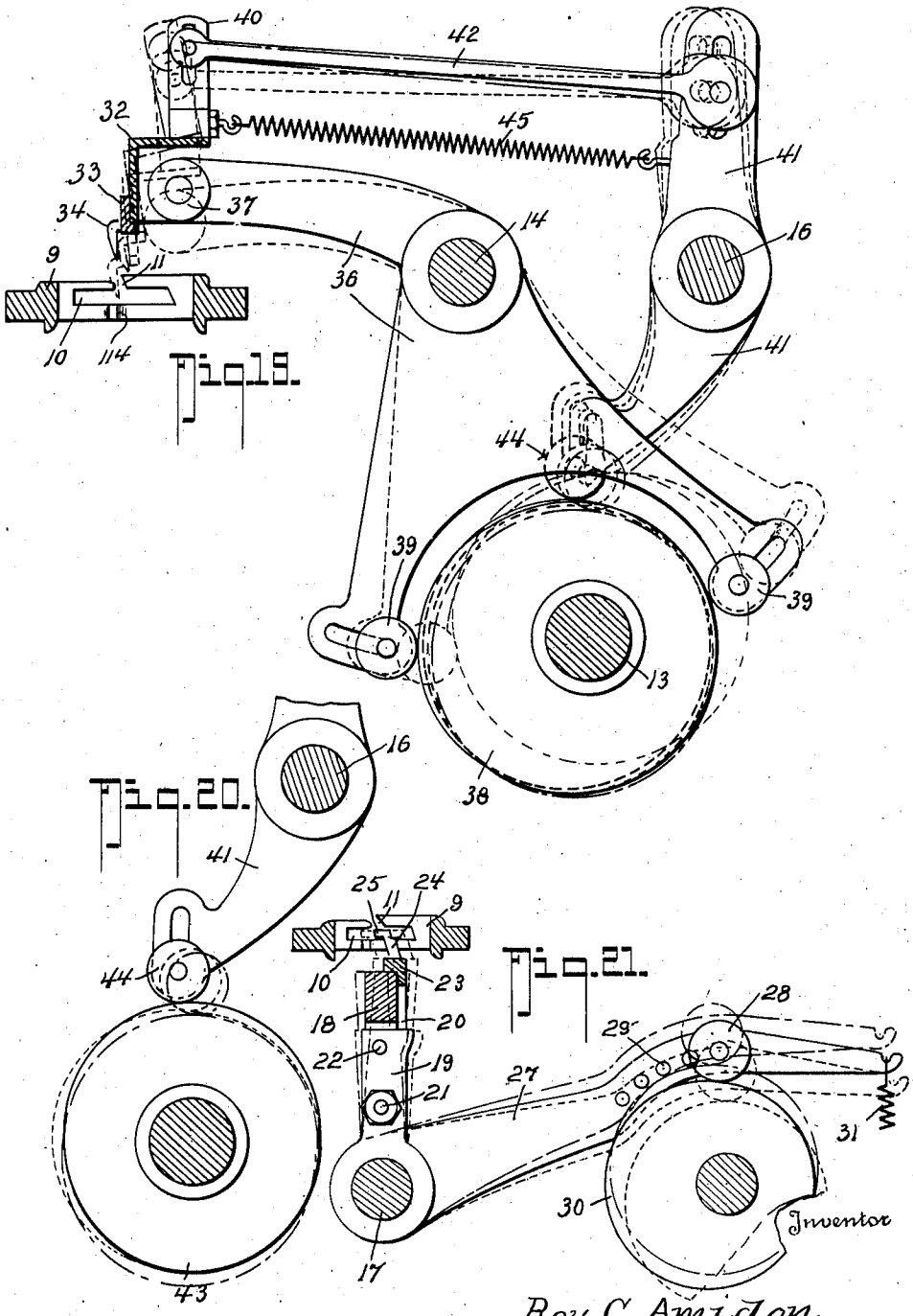


Fig. 18.

Fig. 20.

Fig. 21.

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Patented Mar. 16, 1943

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UNITED STATES PATENT OFFICE

2,313,725

KNITTING MACHINE AND METHOD

Roy C. Amidon, St. Johnsville, N. Y., assignor to Vanity Fair Mills, Inc., a corporation of Pennsylvania

Application March 4, 1941, Serial No. 381,717

40 Claims. (Cl. 66—1)

My invention, which relates to the art of knitting, has especial relation to that branch of the art in which the knitting function is performed through a previously woven base fabric or other suitable sheet material.

The invention has for an object to provide a new and improved machine in which the use of bearded needles is avoided and in which the parts are so designed and co-related that a greater speed of operation may be attained than is possible with tricot machines or other machines employing needles of the bearded types.

Again, it is an object to provide a machine that can be constructed at comparatively low cost and one whose maintenance expense will be at a minimum.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends the invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will be first fully described in the following detailed description, and then be particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which:

Fig. 1 is an elevation of one side of the machine.

Fig. 2 is an elevation of the other side of the machine.

Fig. 3 is a front elevation of a portion of the machine.

Fig. 4 is a cross section on the line 4—4 of Fig. 3.

Fig. 5 is a enlarged detail cross sectional view of a portion of the machine, also taken on the line 4—4 of Fig. 3.

Figs. 6 to 11 inclusive are enlarged diagrammatic cross-sectional views illustrating the movements of the needles, the awls and the loopers.

Fig. 12 is a detail section on the line 12—12 of Fig. 9.

Fig. 13 is a detail section on the line 13—13 of Fig. 10.

Fig. 14 is a front elevation of a portion of a needle.

Fig. 15 is a side view thereof.

Fig. 16 is a detail view in rear elevation of a portion of the machine hereinafter specifically referred to.

Fig. 17 is a perspective view of one awl block and its awls.

Fig. 18 is a front elevation of the same.

Fig. 19 is an enlarged detail view of the awl operating mechanism.

Fig. 20 is a further detail of a portion of the same.

Fig. 21 is a detail view of the looper mechanism.

Fig. 22 is a detail perspective view of one of the looper hooks.

Fig. 23 is a diagrammatic view of a portion of a fabric such as the machine knits.

Fig. 24 is a view similar to Fig. 11, but showing a modification hereinafter specifically referred to.

In the drawings, in which like numerals and letters of reference indicate like parts in all the figures, 1 represents the right end frame standard, 2 the left end frame standard, and 3 the intermediate frame standards of which there may be one or more according to the width of the machine. These standards are connected by brace rods 4 and brace tubes 5 into a rigid frame structure.

Extending the full width of the machine and secured to the intermediate standards 3 by bolts 115 (Fig. 5) and to the end frames 1 and 2 by end bolts 116, is a main supporting bar 6 to the back of which, at suitable intervals, brackets 7 are attached. The brackets 7 carry bars 8 which support the stationary guides 9. The guides 9 have their blades provided with longitudinal slots 10 and slots 11 which serve to ease the loops around the awls in the upward movement. The blades may also have needle guides 114 (Fig. 13) if desired.

Mounted on the intermediate standards 3 are brackets 12 which have bearings for the cam shaft 13 and rock-shafts 14, 15 and 16. The brackets 7 have bearings for the looper rock-shaft 17 to which a suitable number of arms 19 are secured. The arms 19 carry, adjustably, pins 21 which slide in holes in arms 20 that are secured to the looper bar 18, and also have pins 22 operating in holes in arms 19. In this way arms 19 carry the looper bar 18 while permitting endwise movement of the same, as will later more fully appear. The looper blade units 23 are secured to the bar 18 (see Figs. 5 and 16). Each unit 23 comprises a predetermined number of looper blades 24 whose ends are formed into hooks 25, which hooks have inclined edges 26 (see Fig. 22) to permit the thread to be drawn off the hooks on the up-stroke of the needles.

The looper bar 18 is moved bodily forward and backward by means of one or more arms 27 and cams 30, the arms 27 having cam-engaging rollers 28 and adjustable means 29 therefor.

A spring 31 holds the roller 28 to its cam.

32 designates the awl-carrying bar which is pivotally carried at 37 on arms 36 that are secured to shaft 14 (Fig. 19).

Awl units 33 are suitably secured to the bar 32 and each unit has a predetermined number of awls 34. The awls are grooved at 35 to receive and guide the needles. The awls are raised and lowered by a cam 38 which engages rollers 39 on the arm 36.

Secured to the bar 32 is a short arm 40 to which one end of a connecting rod 42 is adjustably connected; the other end of the rod 42 is adjustably connected to one arm of a rocking lever 41 which is mounted on shaft 16 and has a cam-engaging roller 44 on its other arm to cooperate with the awl bar rocking cam 43. A spring 45 connects arm 40 with lever 41 and keeps roller 44 in engagement with cam 43.

Referring now more particularly to Fig. 5, it will be seen that 46 indicates the needle bar slideway in which the needle bar 47 has endwise movement. The slideway 46 is carried by a suitable number of arms 52 secured on shaft 15 and operated by a suitable cam 53 that engages adjustable rollers 54 on levers 52.

The needle bar 47 carries the needle units, each of which comprises a block 48 having a predetermined number of needles 49.

The needles used in this machine are of the sewing machine needle type, i. e., they are not bearded, but have simple eyes 50. Above the eyes 50 the shanks of the needles are cut away or thinned on one side as at 51 (Figs. 14 and 15) for cooperation with the looper hooks (see Fig. 9).

The looper hooks 25 may, in one position (Fig. 12), lie in a slot 10 of a blade of a guide 9 so as not to interfere with the proper action of the adjacent needle.

The needle bar 47 is shifted endwise to shift the needles at the proper times by means of a lever 62 (Figs. 1 and 3) which is mounted pivotally on a shaft 65 held rigidly in brackets 64 and operated by a pattern wheel 67. The lever 62 has a sliding abutment 63 against which a push rod 60 abuts. The rod 60 is slidably held in a suitable bearing on the end frame 1 and has a head 61 to slidably abut the head 59 on the end of the needle bar 47. A spring 117 serves to keep the parts 59, 61 and 60, 63 in contact at all times while another spring 118 keeps lever 62 in contact with pattern wheel 67. The pattern wheel 67 is mounted on a shaft 66 rotatably journalled in bearings in brackets 64.

The looper carrying bar 18 is shifted lengthwise by means of a lever 55, also pivoted on shaft 65 and operated by a cam wheel 119. Bar 18 has a rod 56 connected to it, which rod 56 has its free end projected into a hole in lever 55 where it is held by means of a spring 58 and an adjustable stop 57 (see Fig. 3). Wheel 119 is fixed to shaft 66.

Power is applied to the shaft 66 by means of a gear 70 on the cam shaft, which meshes with a gear 69 on a sleeve that also has a sprocket 68 and is loosely mounted on shaft 65. Sprocket 68 drives a chain which passes over another sprocket 68 fixed on shaft 61.

Shaft 13 is driven in any suitable way, as, for example, by pulley and belt 71 (Fig. 3).

Referring now particularly to Figs. 2 and 3, it will be seen that 72 and 73 are the woven-cloth-feeding rolls and their shafts. The shafts are operated by a reducing sprocket and chain drive 74 from a ratchet wheel 76 on a stub shaft 75. Step-by-step motion is imparted by means of a pawl-carrying lever 78, pivoted at 79 and operated by a cam 80 against which the roller on the lever 78 is held by a spring 81. A back check pawl 77 also engages ratchet wheel 76.

82 represents the cloth-wind-up roll and shaft, which shaft is journalled in end bearing brackets 97. A drum 83 is loose on shaft 82, while a ratchet 84 is fast on the shaft. A pawl 85 on the drum engages the ratchet 84.

The drum 83 is turned by means of a cable 86, one end of which is anchored at 90 to the drum and the other end is attached to a lever 87, pivoted at 88 and operated by the cam 89. The lever 87 is held in engagement with the cam by a suitable spring 89.

Tension on cable 86 is effected by a second cable 93 anchored at 94 to the drum and connected to a spring 92 which is adjustably anchored to a bracket 91. A second ratchet 95 is secured to roll shaft 82 and an arm 98 carries a back check pawl 96 for engaging ratchet 95 (Fig. 2).

99 is a hand wheel shaft having a sprocket and chain connection 100 with cam shaft 13, the chain passing over an idler sprocket 101.

Brackets 102 support the thread spool shaft 104 in bearings 103, a suitable tension device 105 being provided (Fig. 2).

Brackets 106 carry thread-guide spring-loaded rollers 107, best shown in Figs. 1, 2 and 3.

It will be seen that each end standard 1, 2 has a support 108, 108, respectively, for the shaft of the woven base fabric roll. The support 108 on standard 1 is fixed, while support 108 on standard 2 is pivoted at 109 and has a slot 110 over a stop pin 111. The standard 2 has an opening sufficiently large to permit insertion of the roll of base fabric through it when support 108 is swung down out of the way.

A spring-loaded adjustably held cable 112 passes around the base fabric roll shaft 113 to tension the same (Fig. 2) as well as to hold support 108 against swinging on its pivot.

Operation

It will, of course, be apparent that the machine may be used as an ordinary flat knitting machine or it may be used to knit through a base fabric to produce a composite fabric such for example as that depicted in Fig. 23. The machine, however, has been especially designed for the latter use and to produce such composite fabric at high speed and economically.

Referring now particularly to Figs. 6 and 11 inclusive, let us assume that the machine is in operation. The needles reciprocate rapidly down and up into and out of the stationary guides, and are shifted according to the pattern as is usual practice. The movements of the needles are continuous, i. e., without substantial periods of dwell at any point in the paths of movement of the same, thus increasing the speed of the machine considerably over that which can be obtained in machines where periods of dwell must occur in the operation of the needles.

Further, since sinker nibs and beard pressers are eliminated from the machine, the up and down strokes of the needles can be very materially shortened over those which take place in machines of the tricot type; hence, this is an important factor in increasing the speed at which the machine can be operated, and consequently increasing the output.

Beginning at the instant when the awl has moved down into the stationary guide 9 (Fig. 6)

and is carrying a loop from a previously operated needle, it will be seen that when the awl has reached the position shown in Fig. 6, it will dwell in this position while the needle is moving down into the groove **35** of the awl **34** and through the loop *i* (Fig. 2). After the needle has passed the thread T through the loop *i*, the awl rises from the stationary guide **9** (Fig. 8, the awl has just reached the upper limit of its stroke) while the needle is still going down.

While the needle and awl are passing from the position of Fig. 6 to that of Fig. 7, the looper is moving from the position shown in Fig. 5 to its forward position (Fig. 7) where it dwells while the needle moves through the position of Fig. 8 to that shown in Fig. 9. After the eye of the needle has passed the looper hook, the looper begins its return or backward stroke (Fig. 9) to catch the thread and pull it into the form of a loop. As soon as the hook of the looper has passed back of the needle, the awl moves down again into the stationary guide 9 (Fig. 10) whereupon the looper moves laterally in back of the awl to carry the thread about the awl and form the loop. The needle, now moving on its return stroke (Fig. 10) slips the thread from the hook of the looper (Fig. 10 to Fig. 11) and pulls it up through the loop. After the needle has passed up through the loop and out of the stationary guide **9**, it is shifted according to the pattern to be produced.

The awl, in passing from the position of Fig. 7 to that of Fig. 8 frees the previously formed loop *i* (Fig. 6) which is now caught by the needle (Fig. 8) and the awl tilts away from the needle (Fig. 9) so as not to interfere with that loop as the awl is moved down again (Fig. 10) ready to receive the next loop i^2 (Fig. 11).

The provision of the slots **11** in the looper blades, allows the loops to clear the guides **9** and pass up the awls as they straighten out on the finish of the upstroke of the needles in passing from the position of Fig. 11 back to that of Fig. 6.

While the hook of the looper is pulling the thread to form the loop (Fig. 9), the eye end of the needle is braced against the pulling force by means of the braces or abutments **114** on the blades of the guides **9** (Figs. 9 and 10).

When knitting to produce the composite fabric (Fig. 23), the base fabric *w* (Fig. 4) is fed in timed relation to the movements of the needles and awls, etc., by means heretofore described.

When the machine is used as an ordinary knitting machine, some way should be provided to hold the cloth down so the needles will pass up out of the loops i^1 without tightening or drawing the loops. This may be accomplished in a number of ways, one of which is indicated in Fig. 24. In that construction I place one or more taut rods or wires **120** above the guides **9**. Piano wires may be used and anchored at their ends to the side frames in any well known manner.

Other modifications of the invention will readily occur to those skilled in the art and I do not wish to be limited to the precise details of construction shown and described.

What I claim is:

1. The method of knitting through woven fabrics, which comprises passing awls into the fabric to make openings in the same, passing threaded needles into said openings to carry thread below the fabric, looping the thread around the awls below the fabric and holding the loops open until a succeeding passage of needles through the fabric and loops occurs, then withdrawing the awls from the fabric to complete their cycle of operation, and shifting the needles in accordance with a pattern to be knit.

2. In a knitting machine, in combination, closed-eye needles, awls, and loopers, guides for receiving and guiding said needles, said awls and said loopers, and means to operate the same in cooperative relation to effect a knitting operation.

3. In a knitting machine, in combination, guides, closed-eye needles, awls cooperative with said needles and entering the guides in advance of the needles, loopers operating in the spaces between the elements of the guides for looping the thread from the needles around the awls when they are in the guides, and means for operating said needles, said awls and said loopers in timed relation.

4. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, and means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements.

5. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, and means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements, said needle guiding elements comprising awls.

6. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements, said needle guiding elements comprising awls, and means for passing over the guides a base sheet to be knit through.

7. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements, said needle guiding elements comprising awls, and means for passing a base sheet over the guides, said needle moving means and said guiding-element moving means being timed so that the awls open passages for the needles through the base sheet.

8. In a knitting machine, in combination, guides, closed-eye needles, awls cooperative with

said needles and entering the guides in advance of the needles, loopers operating in the spaces between the elements of the guides for looping the thread from the needles around the awls when they are in the guides, and means for operating said needles, said awls and said loopers in timed relation, said needle operating means including means to shift the needles according to the pattern to be followed in knitting.

9. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, and means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements, said needle operating means including means to shift the needles according to the pattern to be followed in knitting.

10. In a knitting machine, the combination with needles having eyes, guides, means for moving the needles into and out of the guides, needle guiding elements, means to move said guiding elements into the guides in advance of the needles, means operating within the guides for looping the threads of the needles around said guiding elements while the needles are in the guides, the needle moving means and the guiding-element moving means being timed to move the needles out of the guides while the threads remain looped around the guiding elements, said needle guiding elements comprising awls, and means for passing a base sheet over the guides, said needle moving means and said guiding-element moving means being timed so that the awls open passages for the needles through the base sheet, said needle operating means including means to shift the needles according to the pattern to be followed in knitting.

11. In a knitting machine, guides having blades, needles operating up and down into and out of the spaces between the blades of the guides, awls operating up and down into and out of the spaces between the blades of the guides, loopers operating in the spaces between the blades of the guides to loop the thread from the needles around the awls, while they are in the guides, and means to operate the aforesaid parts in timed relation to effect a knitting operation.

12. In a knitting machine, guides having blades, needles operating up and down into and out of the spaces between the blades of the guides, awls operating up and down into and out of the spaces between the blades of the guides, loopers operating in the spaces between the blades of the guides to loop the thread from the needles around the awls, while they are in the guides, and means to operate the aforesaid parts in timed relation to effect a knitting operation, said awls having needle guiding and receiving grooves.

13. In a knitting machine, guides having blades, provided with needle guiding and bracing elements, needles operating up and down into and out of the spaces between the blades of the guides, awls operating up and down into and out of the spaces between the blades of the guides, loopers operating in the spaces between the blades of the guides to loop the thread from the needles, while they are in the guides, around the awls, and means to operate the aforesaid parts in timed relation to effect a knitting operation.

14. In a knitting machine, guides having blades, needles operating up and down into and out of the spaces between the blades of the guides, awls operating up and down into and out of the spaces between the blades of the guides, loopers operating in the spaces between the blades of the guides to loop the thread from the needles around the awls, while they are in the guides, and means to operate the aforesaid parts in timed relation to effect a knitting operation, said blades having slots, and said loopers having hooks, said operating means including means to reciprocate said hooks back and forth alongside said slots and laterally into and out of said slots.

15. In a knitting machine, guides having blades, needles operating up and down into and out of the spaces between the blades of the guides, awls operating up and down into and out of the spaces between the blades of the guides, loopers operating in the spaces between the blades of the guides to loop the thread from the needles around the awls, while they are in the guides, and means to operate the aforesaid parts in timed relation to effect a knitting operation, said blades having slots, and said loopers having hooks, said operating means including means to reciprocate said hooks back and forth alongside said slots and laterally into and out of said slots, said blades having spaced lateral projections constituting braces for the needles while the loopers are in action.

16. In a knitting machine, needles having eyes for constantly carrying the threads, guides having blades between which the needles may be projected, awls cooperating with the needles and also being projectable between the blades of the guides, loopers having blades with hook portions operating between the blades of the guides, and means for operating the needles, the awls and the loopers in timed cooperative relation to effect the knitting operation.

17. In a knitting machine, needles having eyes for constantly carrying the threads, guides having blades between which the needles may be projected, awls cooperating with the needles and also being projectable between the blades of the guides, loopers having blades with hook portions operating constantly between the blades of the guides, and means for operating the needles, the awls and the loopers in timed cooperative relation to effect the knitting operation.

18. In a knitting machine, needles having eyes for constantly carrying the threads, guides having blades between which the needles may be projected, awls cooperating with the needles and also being projectable between the blades of the guides, loopers having blades with hook portions operating between the blades of the guides, and means for operating the needles, the awls and the loopers in timed cooperative relation to effect the knitting operation, the needle operating means including means to move the needles into and out of the spaces between the blades of the guides and to shift the needles while they are out of the guides.

19. In a knitting machine, needles having eyes for constantly carrying the threads, guides having blades between which the needles may be projected, awls cooperating with the needles and also being projectable between the blades of the guides, loopers having blades with hook portions operating between the blades of the guides, and means for operating the needles, the awls and

the loopers in timed cooperative relation to effect the knitting operation, the looper operating means including means to move the looper hooks back and forth and laterally in timed relation to the actions of the needles and awls to hook the thread carried by the needles and loop it around the awls.

20. In a knitting machine, needles having eyes for constantly carrying the threads, guides having blades between which the needles may be projected, awls cooperating with the needles and also being projectable between the blades of the guides, loopers having blades with hook portions operating between the blades of the guides, means for operating the needles, the awls and the loopers in timed cooperative relation to effect the knitting operation, and means to pass a base sheet over the guides to be knit through by the awls and needles.

21. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, the needle operating means comprising rocker arms, a needle bar slideway secured to and carried by said arms, a needle bar in said slideway, said needles being mounted on said bar, means for rocking said arms to effect movement of the needles into and out of the guides, and means to reciprocate said needle bar in said slideway to shift the needles while they are out of the guides.

22. In a knitting machine, guides, needles having eyes, awls and loopers, means to operate the same, the needle operating means comprising rocker arms, a needle bar slideway secured to and carried by said arms, a needle bar in said slideway, said needles being mounted on said bar, means for rocking said arms to effect movement of the needles into and out of the guides, means to reciprocate said needle bar in said slideway to shift the needles while they are out of the guides, said last named means comprising a pattern wheel, a lever rocked by said wheel, a push rod engaged by said lever and engaging said needle bar, and means to maintain contact between said push rod and said needle bar and said lever respectively.

23. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, the awl operating means comprising rocker arms, an awl carrying bar pivoted to said arms and carried thereby, the awls being mounted on said bar, means to rock said arms to effect movement of the awls into and out of the guides, and means to rock said awl-carrying bar on its pivot.

24. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, the awl operating means comprising rocker arms, an awl carrying bar pivoted to said arms and carried thereby, the awls being mounted on said bar, means to rock said arms to effect movement of the awls into and out of the guides, means to rock said awl-carrying bar on its pivot, said last named means comprising a lever, means to rock the lever, and a connection between said lever and said awl-carrying bar, by virtue of which as said lever is rocked on its pivot said awl-carrying bar will be rocked on its pivot.

25. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, said loopers including blades, the looper operating means comprising a rock shaft, arms carried by and secured to said rock shaft, a looper-blade carrying bar, means to mount said bar on said arms to be moved bodily with the arms and to be moved parallel to said shaft independently thereof, and means to move said bar parallelly to said shaft to effect the lateral movement of the looper blades.

26. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, said loopers including hooks, the looper operating means comprising means to move the looper hooks back and forth in the spaces between the elements of the guides, and means to move the hooks laterally in said spaces.

27. In a knitting machine, guides, needles having eyes, awls and loopers, and means to operate the same, said loopers including blades, the looper operating means comprising a rock shaft, arms carried by and secured to said rock shaft, a looper-blade carrying bar, means to mount said bar on said arms to be moved bodily with the arms and to be moved parallel to said shaft independently thereof, and means to move said bar parallelly to said shaft to effect the lateral movement of the looper blades, said last named means comprising a lever, a connection between said lever and said bar and means to rock said lever in timed relation to the action of the needles.

28. In a knitting machine, guides, awls having needle guide grooves, needles each having a closed eye and a recess or groove above the eye in the side of the needle, loopers having blades with hooks movable past the needles across the grooves therein, and means to operate the needles, the awls and the loopers in timed relation to effect their cooperation.

29. In a knitting machine, guides, awls having needle guide grooves, needles each having a closed eye and a recess or groove above the eye in the side of the needle, loopers having blades with hooks movable past the needles across the grooves therein, and means to operate the needles, the awls and the loopers in timed relation so that the awls will enter the spaces between the elements of the guides in advance of the needles, and the loopers will take the thread at the needles within said spaces and loop the same about the awls, and the awls and needles will leave the guides with the thread still looped about the awls.

30. In a knitting machine, guides, awls having needle guide grooves, needles each having a closed eye and a recess or groove above the eye in the side of the needle, loopers having blades with hooks movable past the needles across the grooves therein, said hooks having inclined edges constituting thread-slip-off elements, and means to operate the needles, the awls and the loopers in timed relation to effect their cooperation.

31. The method of knitting in machines employing guides, which method comprises passing loop-holding elements into the guides, passing threaded needles into and out of the guides adjacent the loop-holding elements, looping the thread in the guides about said elements while said elements are in the guides, and withdrawing the needles from the guides through said loops and shifting the needles according to a predetermined pattern.

32. As a new article of manufacture, a looper comprising a block having upstanding spaced blades each carrying a blade-like hook member whose free end is curved as a hook and is provided with a tapered thread-slip-off edge.

33. As a new article of manufacture, a guide having parallel blades spaced apart, and each blade being provided with a slot that includes a

longitudinal slot portion and a slot portion leading from the longitudinal slot portion to the top edge of the blade.

34. As a new article of manufacture, a guide having parallel blades spaced apart, and each blade being provided with a slot that includes a longitudinal slot portion and a slot portion leading from the longitudinal slot portion to the top edge of the blade, said blades having opposed spaced lugs constituting needle braces.

35. The method of knitting in machines employing guides having spaced blades and threaded needles, which comprises moving the needles down and up into and out of the spaces between the blades of the guides, moving loop-holding elements down and up into and out of said spaces in timed relation to the needle movements, and while the needles and loop-holding elements are in said spaces, looping the threads from the needles about said loop-holding elements, and withdrawing the loop-holding elements and needles from said spaces and, after the threads have been pulled through the loops and the needles enter the loops on the next down strokes, releasing the loop-holding elements from said loops to be held by the needles while the next succeeding loops are being formed.

36. In a knitting machine, in combination, guides having spaced elements, closed-eye needles, awls cooperative with said needles and entering the guides in advance of the needles, loopers operating in the spaces between the elements of the guides for looping the thread from the needles around the awls when they are in the guides, and means for operating said needles, said awls and said loopers in timed relation, and means for holding down the knitting beyond and adjacent the needles.

37. In a knitting machine, in combination, guides having spaced elements, closed-eye needles, awls cooperative with said needles and entering the guides in advance of the needles, loopers operating in the spaces between the elements of the guides for looping the thread from the needles around the awls when they are in the guides, and means for operating said needles, said awls and said loopers in timed relation, and means located above and spaced from the guides and under which the knitting passes for holding down the knitting while the needles are rising out of the loops.

38. In a knitting machine, in combination, stationary guides having spaced-apart elements, needles having eyes, movable needle guiding elements cooperative with said needles and entering the stationary guides in advance of the needles, loopers operating in the spaces between the elements of the guides for looping the thread from the needles around the movable needle guiding elements when those elements are in the stationary guides, and means for operating said needles, said movable needle guiding elements and said loopers in timed relation to effect a knitting operation.

39. In a knitting machine, in combination, a stationary needle guide having spaced-apart walls, a needle having an eye, means for moving the needle into and out of the stationary guide between the walls thereof, a movable needle guiding element, means to move said movable guiding element into said stationary guide in advance of the needle, and means operating within the stationary guide for looping the thread of the needle around said needle guiding element while the needle is in the stationary guide, the needle moving means and the needle guiding element moving means being timed to move the needle and the needle guiding element out of the stationary guide while the thread remains looped around the needle guiding element.

40. In a knitting machine, stationary guides, knitting needles, movable needle guides and loopers, and means to operate the same, said stationary guides having spaced-apart plates between which the needles and movable needle guides are operable, said loopers including hooks operating within said stationary guides, the looper operating means comprising means to move the looper hooks back and forth in the spaces between the elements of the guides, and means to move the hooks laterally in said spaces.

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