June 16, 1942. W. E. RALSTON 2,286,227

KNITTING MACHINE AND METHOD

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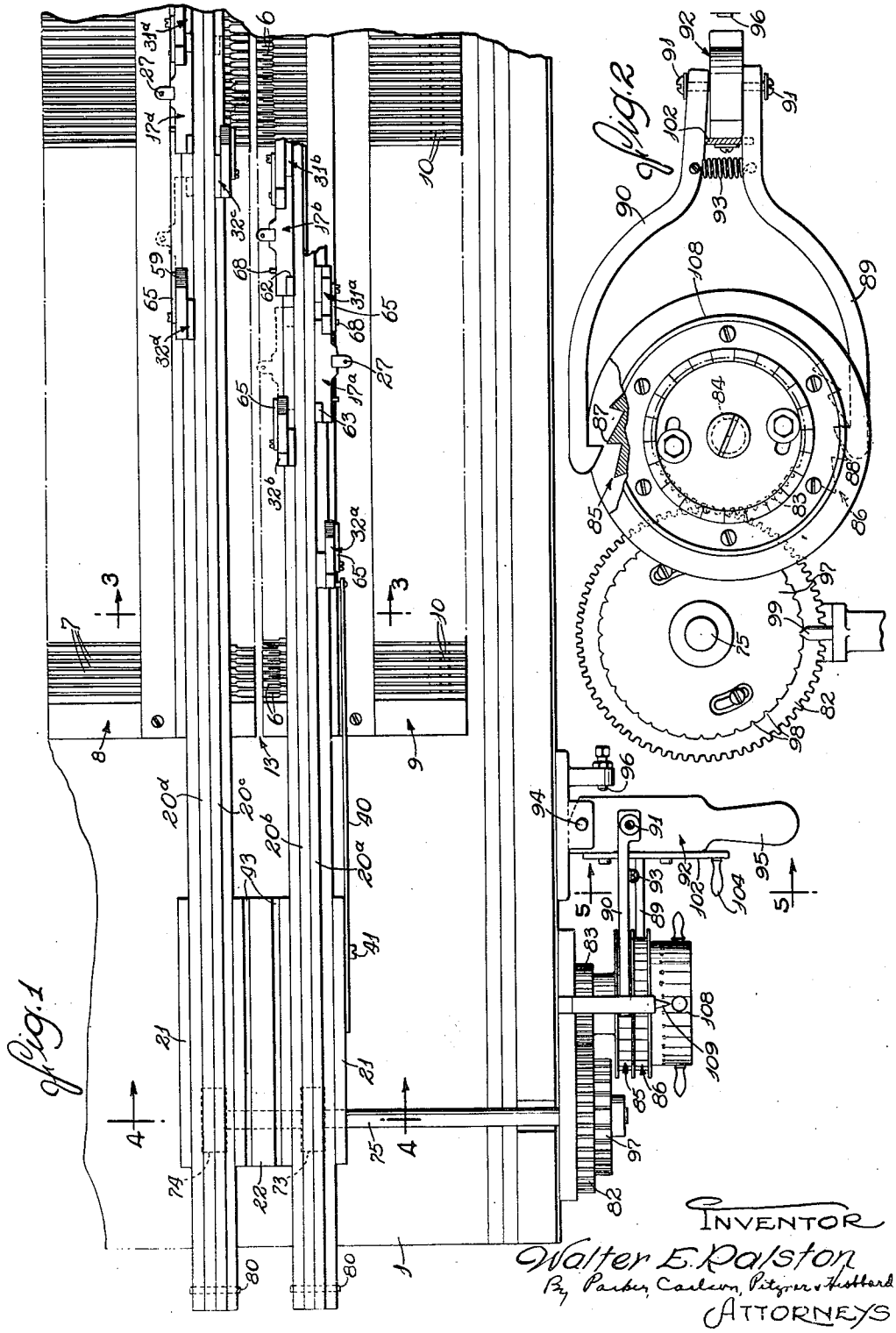


Fig. 1

Fig. 2

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KNITTING MACHINE AND METHOD

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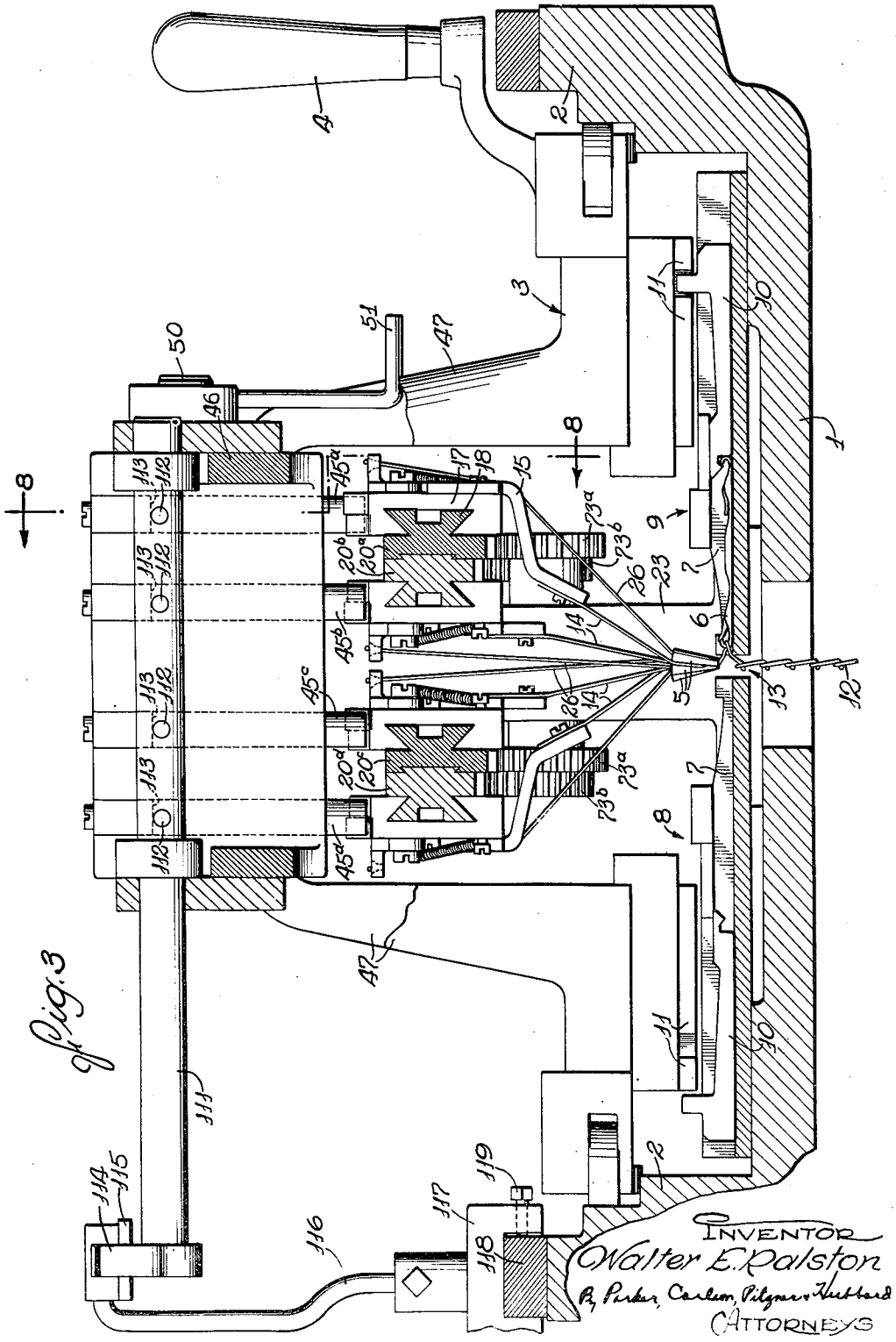


Fig. 3

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KNITTING MACHINE AND METHOD

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Fig. 4

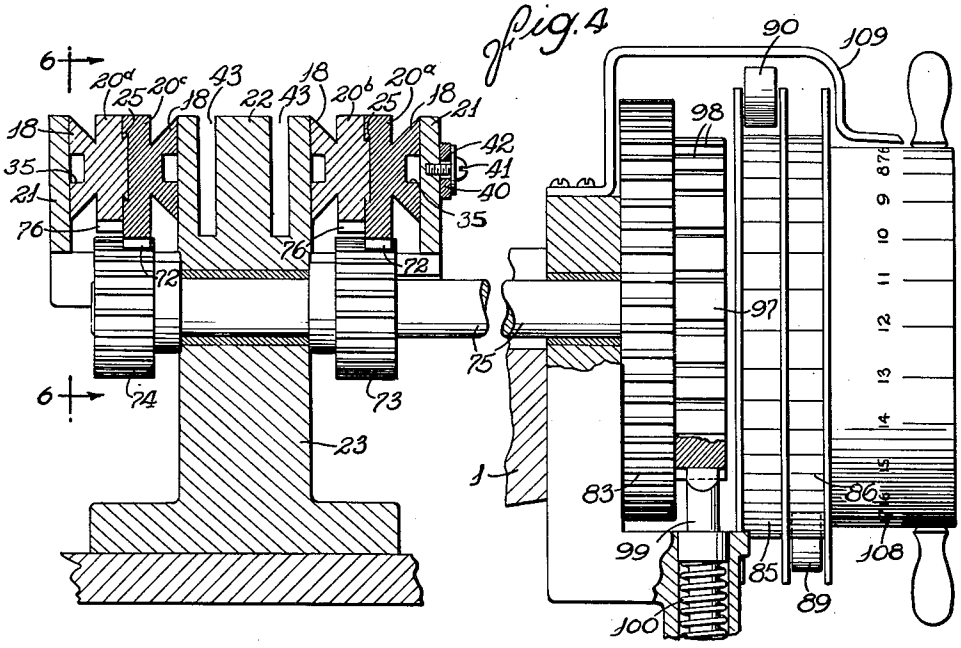


Fig. 5

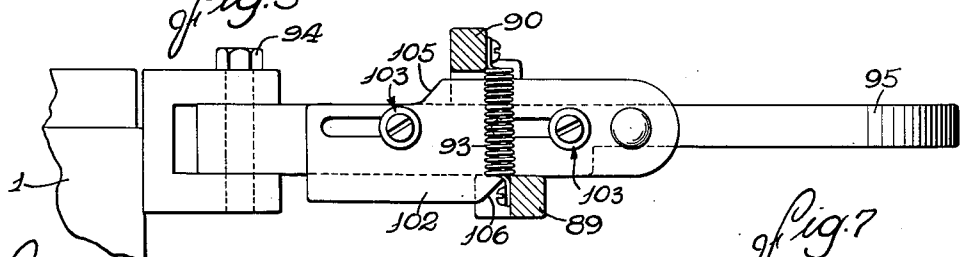


Fig. 6

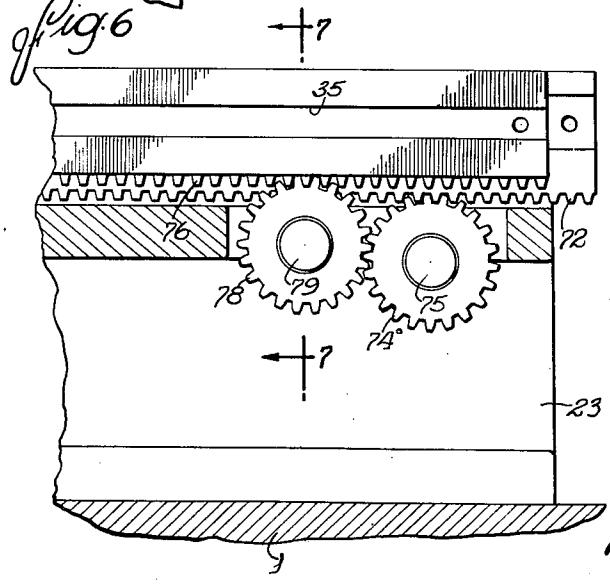
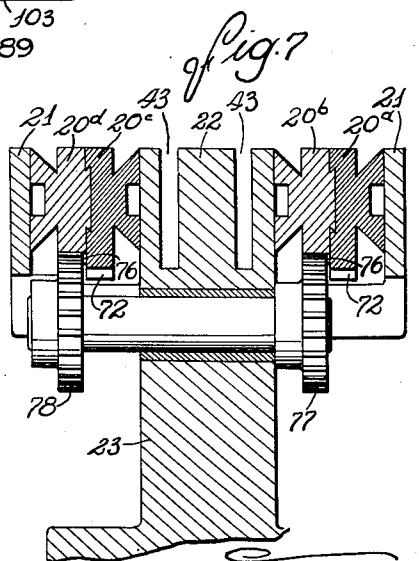


Fig. 7



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Fig. 8

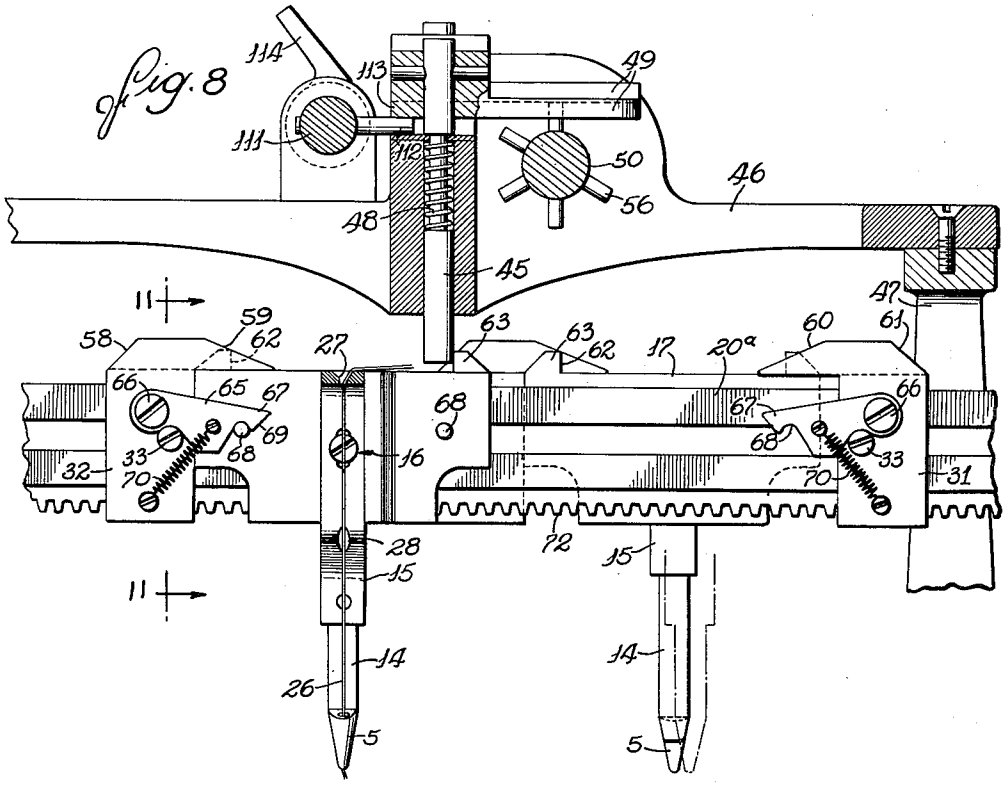
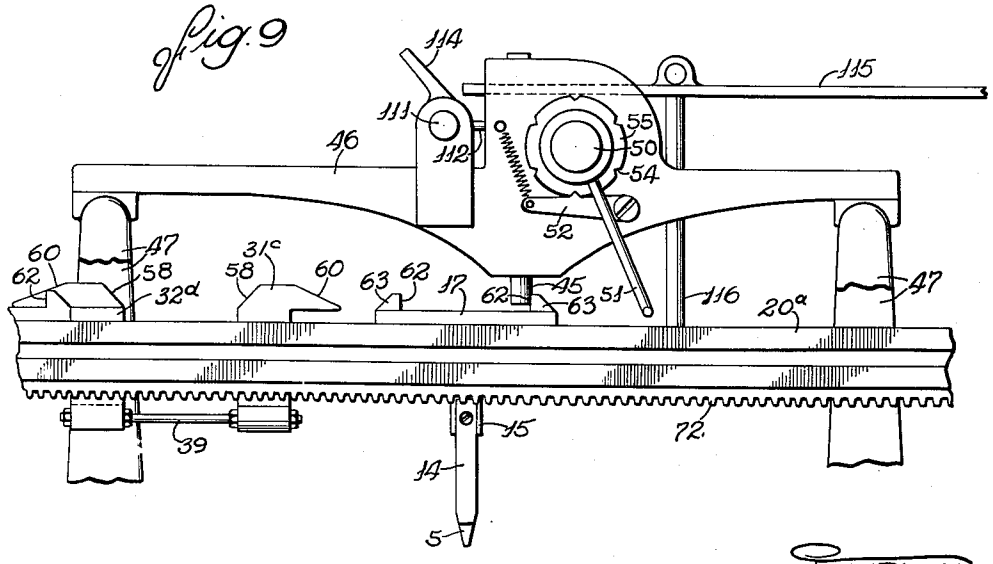


Fig. 9



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KNITTING MACHINE AND METHOD

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Fig. 10

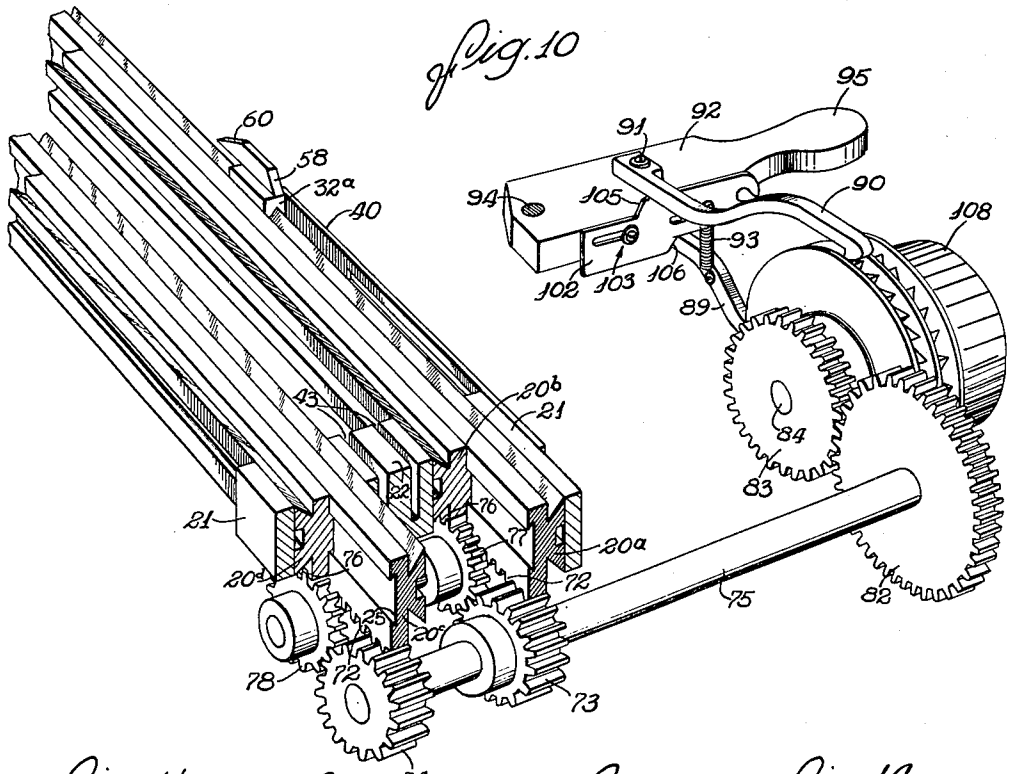


Fig. 11

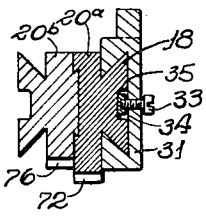


Fig. 12

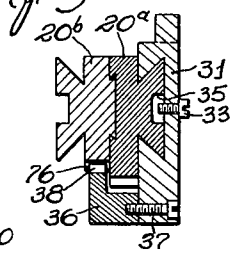


Fig. 13

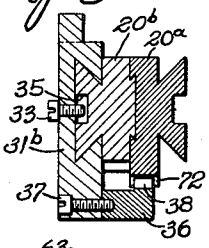


Fig. 14

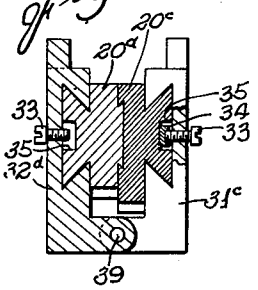


Fig. 15

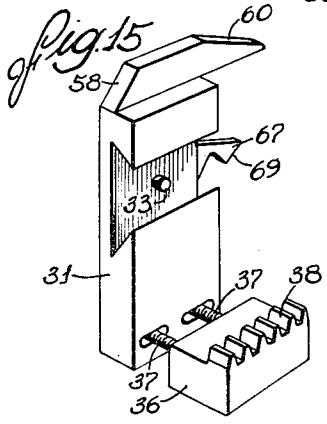
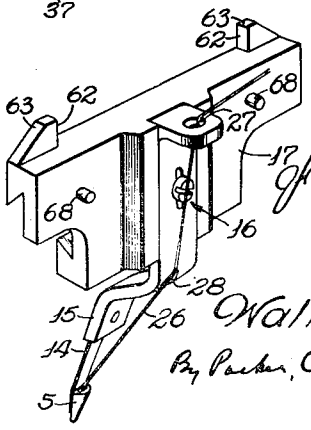


Fig. 16



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Fig. 17

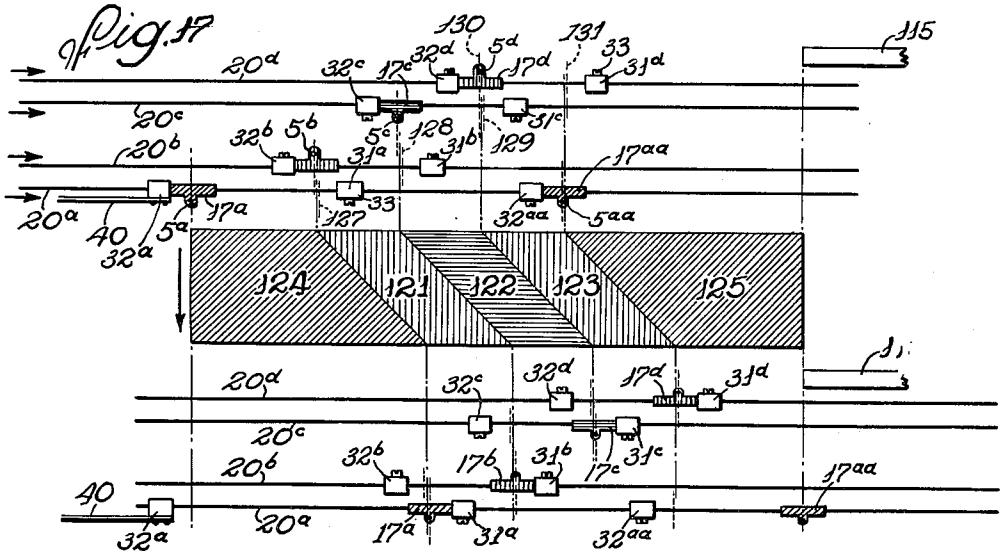


Fig. 18

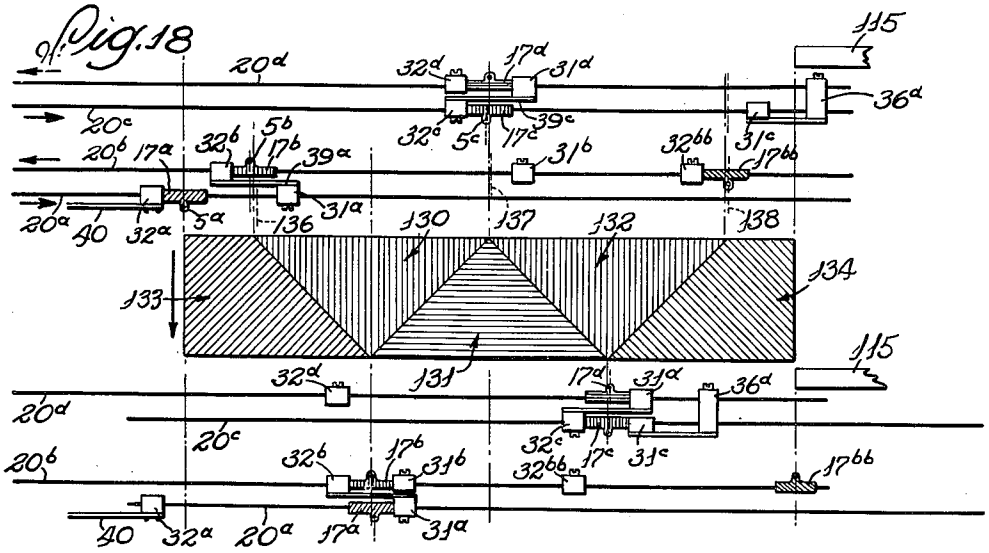
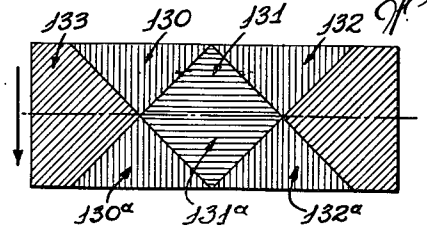


Fig. 19



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Fig. 20

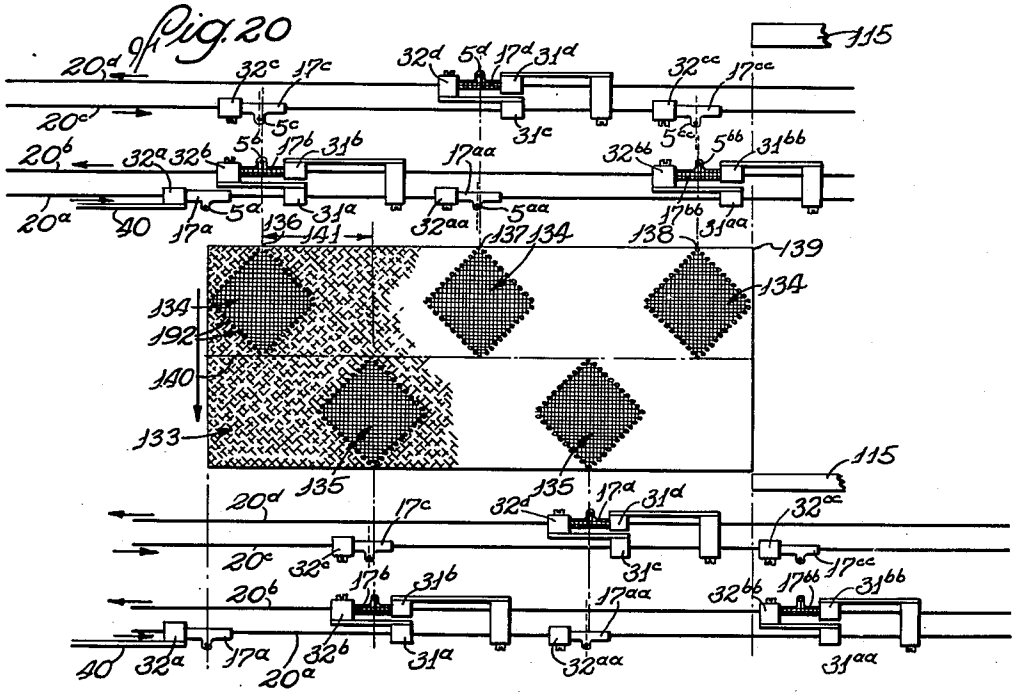


Fig. 21

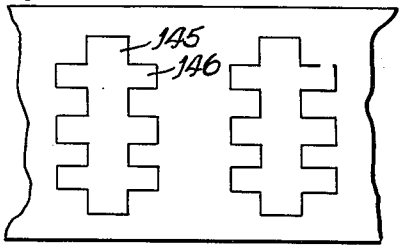


Fig. 22

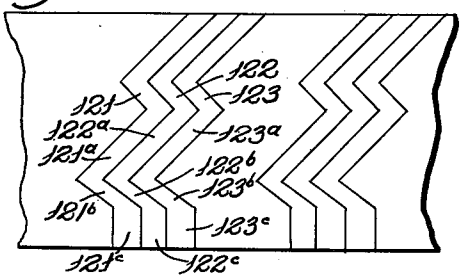


Fig. 23

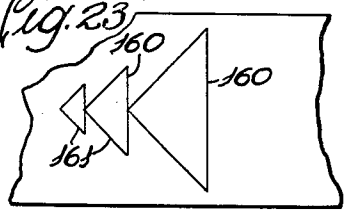


Fig. 24

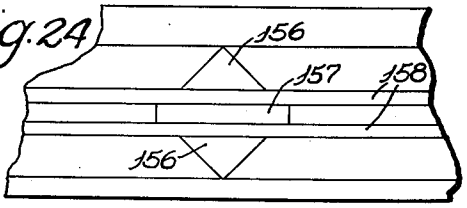


Fig. 25

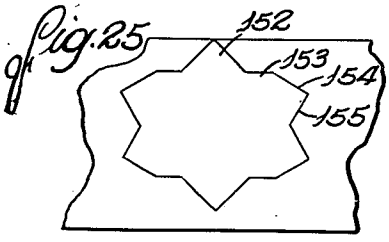
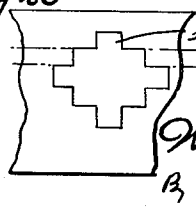


Fig. 26



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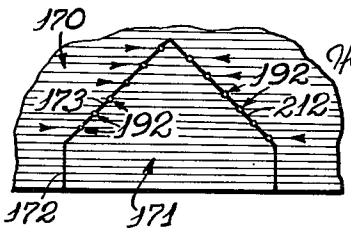


Fig. 28

Fig. 27

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Patented June 16, 1942

2,286,227

UNITED STATES PATENT OFFICE

2,286,227

KNITTING MACHINE AND METHOD

Walter E. Ralston, Delavan, Wis., assignor to The George W. Borg Corporation, Chicago, Ill., a corporation of Delaware

Application May 22, 1939, Serial No. 274,874

11 Claims. (Cl. 66—128)

This invention relates to flat machine knitting and has more particular reference to the manner of controlling the guides for different yarns to produce varied designs in the fabric knitted with such yarns.

One object is to provide a novel machine for and method of flat knitting by controlling the movements of a plurality of yarn guides so as to produce stripes or other designs bounded by lines at least a part of which extend diagonally of the direction of knitting.

Another object is to provide for the flat knitting of contiguous areas of different yarns bordered by stepped lines of juncture.

A further object is to provide for the flat knitting of different fabric areas with individually different yarns with the contiguous edges of adjacent areas interlocked with each other in a novel manner.

Still another object is to provide for the formation of small spaced holes or openings along the borders of the designs above referred to so as to produce a hand decked effect.

A more detailed object is to provide a flat knitting machine in which the mountings for the yarn guide stops are supported for controllable step-by-step movement along the path which the yarn guides traverse during knitting.

Another object is to provide for racking of the yarn guide stops in a novel manner such as to produce designs of double diagonal or V-shape.

A further object is to provide a novel yarn guide mounting which enables vertical stripes of different yarns to be formed in the fabric.

Still another object is to provide a novel mechanism for controlling the yarn guides to define the parallel edges of the fabric while permitting formation of the diagonal and other borders above referred to.

The invention also resides in the novel mechanisms employed for racking the yarn guide stops, for preventing rebounding of the yarn guide carriers from an engaged stop, and in the novel construction of the supports for the yarn guides.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a fragmentary plan view of the left hand portion of a links and links knitting machine.

Fig. 2 is a front view of a portion of the actuating mechanism shown in Fig. 1.

Figs. 3, 4, and 5 are sectional views taken respectively along the lines 3—3, 4—4, and 5—5 of Fig. 1.

Fig. 6 is a section taken along the line 6—6 of Fig. 4.

Fig. 7 is a section taken along the line 7—7 of Fig. 6.

Fig. 8 is a section taken along the line 8—8 of Fig. 3.

Fig. 9 is a fragmentary front elevational view of the yarn carriage.

Fig. 10 is a fragmentary perspective view of the rail supporting the yarn guide stops together with their actuating mechanism.

Fig. 11 is a section taken along the line 11—11 of Fig. 8.

Figs. 12, 13, and 14 are sections similar to Fig. 11 showing modified forms of stops.

Fig. 15 is a perspective view of the stop shown in Fig. 13.

Fig. 16 is a perspective view of one of the yarn guides.

Figs. 17, 18, and 20 are diagrammatic views showing the arrangement of the stops and yarn carriers for forming several different fabric patterns.

Figs. 19 and 21 to 26 are fragmentary views of other fabric patterns which may be formed.

Fig. 27 is an enlarged and expanded view of a piece of fabric knit under different conditions.

Fig. 28 is a view of a fabric design embodying in part the stitched formation shown in Fig. 27.

While the invention is applicable to various types of flat knitting machines, it is shown in the drawings and will be described herein in connection with a so-called links and links machine. It is to be understood that I do not intend to limit the invention by such disclosure but aim to cover all modifications and alternative constructions and uses falling within the spirit and scope of the invention as expressed in the appended claims.

A links and links knitting machine of the character illustrated includes a base 1 providing ways 2 supporting a carriage 3 which, through the medium of a handle 4, may be shifted back and forth to move yarn guides 5 past selected groups of double ended needles 6. The latter are slidable endwise in grooves defined by upstanding teeth 7 in two beds 8 and 9 supported by the base 1. Through the medium of jacks 10 actuated by cams 11 on the carriage 3, the needles are actuated in synchronism with the movements of the yarn guides so as to render different ends of the needles active selectively and knit successive courses of a fabric 12 disposed in the chan-

nel 13 between the needle beds. By various mechanisms with which the present invention is not concerned, the needles may be transferred back and forth between the beds 8 and 9 and actuated in different ways well known in the art to knit the fabric with rib, purl, and flat stitches.

The yarn guides 5, which are of special construction, comprise cone shaped metal tubes each having a lower pointed end substantially smaller in diameter than the width of the space between adjacent needles 6. A guide may thus be disposed at any position along the channel 13 opposite a tooth 7 of the needle bed comb without interfering with the movements of the adjacent needles. Along one side, each guide is fastened as by soldering or welding to the lower tapered end of a finger 14 in the form of a leaf spring attached at its upper end to a depending arm 15. Through an adjustable screw and slot connection 16, each arm is secured to one side of a box or carrier 17 the other side of which is dovetailed to fit a way 18 along one side of a horizontal rail. The connection 16 permits of vertical adjustment of the yarn guides 5 relative to the needles 6 for a purpose that will appear later.

In the present instance, there are four rails 20^a, 20^b, 20^c, and 20^d arranged in two pairs respectively disposed between guide plates 21 and 22 upstanding from standards 23 at opposite ends of the machine bed. Gears meshing with rack teeth on the rails for a purpose later to be described serve to support the rails at opposite ends. The rails are positioned above the two needle banks with the rails of each pair arranged back to back and connected by a dove-tail joint 25 which permits the rails to slide longitudinally relative to each other. The two pairs are spaced apart to provide ample space for the carriers 17 of the inner rails. In view of the rail spacing, the arms 15 are differently shaped to provide for convergence of the springs 14 toward the channel 13 as shown in Fig. 3. By virtue of the spring mounting of the yarn guides 5 and their rounded external contour, one guide may move along the channel 13 past an adjacent guide. Thus, as a moving guide engages one which is stationary, the two will yield apart and permit the moving guide to pass without causing tangling of the yarns or moving either guide out of proper operative association with respect to the needles. The yarns 26 are of course led to their respective guides 5 in the usual way through various devices including eyes 27 and slots 28 on the carriers 17.

The limits of travel of each yarn guide carrier 17 along its rail are determined by right and left hand stops 31 and 32 (Figs. 8, and 11–15) supported by and spaced along the rail on opposite sides of the carrier for abutment with the ends thereof. Each stop comprises a metal block dove-tailed onto the way 18 of the rail. Its position may be determined in several different ways. The stop shown in Fig. 11 is fixed to the rail 20^a by a screw 33 threading through the stop and pressing a button 34 into a groove 35 in the rail so as to thereby clamp the stop in a selected position along the rail. In Figs. 12 and 13, the stops 31 and 31^b, although slidable along the rails 20^a and 20^b respectively are fixed to the other rail of the pair. To this end, L-shaped plates 36 disposed below the two rails are secured to the stop by screws 37 and are formed with upstanding rack teeth 38 which interengage with teeth (later to be described) on the underside of the other rail. As shown in Figs. 9 and 14, a stop 31^c fixed to the rail 20^c is connected to a stop slidable along the rail 32^d by a threaded rod 39 of adjustable length clamped by nuts to the lower ends of the two stops. The stop 32^a shown in Figs. 1 and 10 is fastened to one end of a bar 40 which extends parallel to the rails and is adjustably clamped to the stationary plate 21 by a screw 41 extending through a longitudinal slot 42 in the bar. Similar bars may be extended through slots 43 in the plate 22 when it is desired to establish a fixed position for stops on the rails 20^b and 20^c. By any one of these different ways, the stops 31 and 32 may be located accurately in different selected positions so that the movements of each yarn guide 5 may be arrested with the guide accurately disposed between any desired pairs of needles 6. If desired, coacting serrations or other gripping means may be provided to insure more effective locking of the stops to the rails.

The carriers 17 are shifted back and forth between their stops 31 and 32 in the usual way by vertical plungers 45 (Figs. 3 and 8) mounted for endwise sliding movement in a frame 46 bridging U-shaped posts 47 at opposite ends of the carriage 3. Each plunger is urged downwardly by a spring 48 and carries a lifter 49 projecting horizontally above a rotary drum 50. The latter is journaled at opposite ends in the frame 46 and may be turned by an arm 51 (Fig. 9) into different predetermined angular positions in each of which it is held by a detent 52 urged by a spring into a corresponding notch 54 on a disk 55 fast on the drum. For each lifter, the drum carries a series of radially projecting pins 56 engageable with the lifter in certain positions of the drum to hold the associated plunger raised with its lower end out of operative association with respect to the corresponding yarn carrier. In other positions of the drum, the plunger is disposed in a lower or active position as in the case of the plunger shown in Fig. 8. By shifting the drum to different angular positions, the plungers may be rendered active in different combinations.

During each stroke of the carriage, each lowered or active plunger 45 moves into engagement with cam surfaces 58 and 59 on the upper end of the left hand stop 32, similar but reversely positioned surfaces 60 and 61 on the right hand stop 31, and spaced lugs 62 and 63 upstanding from the associated yarn carrier 17. The height of the lugs is such that when the carrier is at its opposite right and left hand limits, the lugs 62 and 63 will not project above the cam surfaces 60 and 59. Thus, as the active plunger moves to the right, it rides over the surfaces 58 and 59 past the lug 62 and then engages the lug 63 as shown in Fig. 8. The carrier is picked up and advances with the carriage 3 until the carrier comes into full abutment with the stop 31. In the approach to this stop, the plunger 45 rides up the surface 60 and is cammed upwardly out of engagement with the lug 63 just as the carrier reaches its limit position. The associated yarn guide 5 is thus advanced from the position shown in full lines at the left of Fig. 8 to that shown in dot-dash lines.

Means is provided for preventing rebounding of the yarn carriers 17 from their stops so as to thereby maintain an accurate positional relation between each idle guide 5 and the needles 6 and prevent interference between the two. Herein, this means comprises a detent or latch 65 piv-

oted on a screw 66 on each stop 31 and 32 with its free hook-shaped end 67 projecting toward the associated carrier 17 for engagement with a pin 68 thereon. In the approach of the carrier to its limit position, one pin 68 engages a surface 69 on the latch and rides in under the latter whereupon a spring 70 urges the latch toward the head of the screw 33. The latch thus provides the necessary detent action for overcoming any tendency of the carrier 17 to rebound from its stop due to quick stopping of the carrier and at the same time is adapted to yield and permit reverse movement of the carrier under the positive driving action of the associated plunger. The yieldable detent also locks the carrier to the stop last encountered so that the carrier is racked along with the stop in a manner later to be described. Therefore, there is no danger of any yarn guide 5, when disconnected from the carriage, becoming displaced accidentally out of the spaces between adjacent needles 6.

To enable various designs with diagonal or stepped margins to be knitted into the fabric using different yarns as contemplated by the present invention, the rails 20^a to 20^d are mounted for endwise movement in one or both directions and in selectively variable increments correlated with the spacing of the needles 6. Herein, the rails 20^a and 20^c are formed along their lower edges with rack teeth 72 which mesh with gears 73 and 74 fast on a shaft 75 which is journaled in the standard 23 at the left hand end of the machine. Where the adjacent rails are intended to be shifted simultaneously in opposite directions, rack teeth 76 are provided on the rails 20^b and 20^d and these mesh with gears 77 and 78 on a shaft 79 also journaled on the standard 23. The gears 77 and 78 mesh with the gears 73 and 74 respectively so that when the shaft 75 is turned to advance the rails 20^a and 20^c in one direction, the rails 20^b and 20^d are simultaneously shifted an equal distance in the opposite direction.

These gears 73, 74, 77, and 78 and idler gears 73^a and 73^b (Fig. 3) mounted on the standard 23 at the right hand end of the machine support all of the rails as well as actuators for the rails 20^a and 20^c. The two pairs of rails may be raised between their guides 21 and 22 out of mesh with the gears and shifted endwise independently of the gears for a purpose to appear later.

In knitting designs which involve shifting of the two adjacent rails in the same direction simultaneously, the gears 77 and 78 are omitted and the rails 20^b and 20^d are connected rigidly to the rails 20^a and 20^c. This may be accomplished in various ways as by the use of suitable dowel pins 80 (Fig. 1) inserted through registering holes in the rails of the two pairs.

Mechanism is provided for turning the shaft 75 selectively in either direction to move the rails in accurately gauged increments which are equal to the pitch of the needles 6. Preferably, this mechanism comprises a reversing clutch of the pawl and ratchet type and is adapted for hand actuation. As shown, it comprises a gear 82 on the shaft 75 meshing with a smaller gear 83 on a shaft 84 which carries two ratchet wheels 85 and 86 with oppositely projecting teeth 87 and 88 spaced to correspond accurately to the pitch of the needles 6.

Associated with the respective ratchet wheels 85 and 86 are two pawls 89 and 90 disposed on opposite sides of the wheels and pivoted at 91 on a lever 92, the pawls being urged toward each other by a tension spring 93. The lever is fulcrumed on a vertical pin 94 on the machine frame and has a handle 95 which may be grasped and the operator may swing the lever back and forth horizontally to actuate the pawls. The active stroke of the lever is limited by a screw stop 96 which is adjusted to arrest the movement of the lever to the right as viewed in Fig. 1 after the rails 20 have been advanced a distance equal to the pitch of the needles 6.

To locate and hold the rails in accurately defined positions with the tips of each yarn guide disposed midway between adjacent needles, the shaft 75 carries a disk 97 with notches 98 into which a detent 99 is urged by a spring 100. Thus, with the stops 31 and 32 properly located on the rails 20, the yarn guides 5 will always be stopped with their lower ends disposed between adjacent needles irrespective of the number of stepping movements imparted to the rails on the directions of such movements.

To render the pawls 89 and 90 operable selectively and thereby determine the direction of advance of the rails in response to actuation of the hand lever 92, a cam plate 102 is disposed between the pawls adjacent the lever and has pin and slot connections 103 with the lever. When the plate is shifted by a handle 104 rearwardly to the position shown in Figs. 1 and 10, a cam surface 105 lifts the pawl 90 disabling the latter while the pawl 89 encounters a depressed portion of a cam surface 106, permitting this pawl to move into and remain in active engagement with the teeth 87. With the parts thus conditioned, the rails 20^a and 20^c will be shifted to the right and the rails 20^b and 20^d will be shifted to the left in response to successive actuations of the lever. In the other or retracted position of the cam plate, the pawl 89 is moved away from the ratchet wheel 86 and the pawl 90 is rendered active. Then, when the lever 92 is actuated, the rails 20^b and 20^d will move to the right and the rails 20^a and 20^c to the left.

Fast on the ratchet shaft 84 is a drum 108 formed with numbered indicia which cooperate with a stationary pointer 109 to indicate the stepping movements of the rails. By reference to this scale, the number of actuations of the lever may be counted and the rails can always be advanced or returned to predetermined positions during the knitting of a given fabric design.

To facilitate extension of diagonal lines of a fabric pattern clear to the edge of the fabric in a manner later to be described, provision is made for stopping all of the yarn guides 5 at such edge. Herein, this is accomplished in the case of the right hand edge by disabling all of the active plungers 45 simultaneously at a selected point in the advance of the carriage 3. For this purpose, a rockshaft 111 (Figs. 3, 8, and 9) supported on the frame 46 adjacent the plungers carries a row of pins 112 which underlie projecting ends 113 of the lifters 49. At its rear end, the shaft 111 carries an upstanding arm 114 which, when the carriage reaches a predetermined position in traveling to the right, encounters the end of a fixed horizontal bar 115 and is cammed downwardly thereby raising the pins 112 and lifting the lower ends of the plungers 45 above any of the carrier lugs 62 and 63 so as to stop the yarn guides 5 that may then be in motion. The bar 115 is supported by posts 116 upstanding from blocks 117 which are slidable along a rail 118 on the rear side of the machine frame. Through the medium of set screws 119, the blocks and therefore the cam bar

115 may be adjusted longitudinally and thus adapted to become effective at any desired point in the travel of the carriage 3.

The improved method will now be explained in connection with the knitting of certain typical fabric designs, reference first being made to the fundamental manner in which the stitches are formed to effect interlocking of the adjacent margins of contiguous areas of different yarns and to vary the angles and shape of these lines to produce different designs. Figs. 27 and 28 show a piece of fabric as it hangs on the needles 6 and illustrate the manner of interlocking two yarns 26^a and 26^b, for example, white and black, along a line of juncture between two contiguous areas 170 and 171, the junction line extending parallel to the direction of knitting for several courses as indicated at 172 and then diagonally as indicated at 173.

Let it first be assumed that the guides 5^a and 5^b for the white and black yarns are mounted on the rails 20^a and 20^b with the right hand stop 31^a for the guide 5^a located to arrest movement of this guide in the position 174 during the right strokes 176 of the carriage 3 and with the left hand stop 32^b positioned to stop the guide 5^b at 177 during the left hand strokes 175. It will be observed that the stop positions 174 and 177 are spaced apart a distance equal to the pitch of the needles 6 and that in their rest positions, the guides 5^a and 5^b are disposed midway between adjacent needles.

At the beginning of the right strokes 176, the black yarn guide is disposed in position 177 and the white guide is at the left hand end of the machine. During the stroke, the white yarn is carried to the right and as it reaches the position 177, the black yarn guide 5^b is picked up, and the two guides move simultaneously to the position 174 where the movement of the white yarn is interrupted, the black yarn continuing on to the right hand end of the machine. Then, in the reverse movements 175 of the carriage, the guide 5^a is picked up at the position 174 and moves with the black guide to the position 177 following which the white guide continues on to the left. As a result of the overlapping of the ranges of movement of the guides by an amount equal to the pitch of the needles 6, the two yarns become interlocked along one wale as shown in the lower part of Fig. 27 to form the junction line 172. The marginal loops 178 of black yarn are interlocked with and disposed on opposite sides of the marginal loops 179 of white yarn in successive courses. By maintaining the adjacent stops for the two different yarns stationary during the knitting of successive courses, the line of interlocking of the areas 170 and 171 extends parallel to the direction of knitting. While the stitches of the fabric are doubled along this line, there is no noticeable bulkiness.

Formation of the inclined line 173 of juncture between the areas 170 and 171 is effected by racking both rails 20^a and 20^b to the right while the carriage 3 dwells at the end of its left hand stroke, the positions of these rails remaining fixed during the knitting of the next round, that is, during the succeeding right and left hand strokes 180 and 181. Such racking is effected by movement of the hand lever 92 first to the left and then to the right while the cam plate 102 is in its rearward position (Figs. 2, 5, and 10) so as to render the pawl 89 active. If, as shown, the rails are racked one step, the stops carried thereby will be shifted a distance equal to the needle pitch and conditioned for stopping of the guides 5^a and 5^b in the positions 182 and 174 respectively during the right and left hand strokes 180 and 181 of the carriage 3.

During such racking, the guide 5^b will be shifted by its stop 32^b from position 177 to position 174 thereby carrying the black yarn from the dotted position 183 to the dot-dash position 184. As a result, the black yarn 26^b is moved to the right past the needle 6^a so that the first loop 185 that will be formed by the black yarn during the ensuing right hand stroke 180 will be by the needle 6^b, the black yarn being extended angularly between adjacent ways of successive courses as indicated at 186. In the same stroke, one additional loop 187 is formed by the white yarn adjacent the black loop 185. In the next left hand stroke 181 of the carriage, overlapping loops 188 and 189 of the black and white yarns are formed by the needle 6^b. Formation of similar interlocked loops 188^a and 189^b extending diagonally to the right as shown will take place in the knitting of successive rounds while racking the rails one step to the right at the end of each left stroke 181 of the carriage. As a result of such racking, the stopped positions of the guide 5^b are shifted to the right as indicated at 182 and 190 while the guide 5^a will be stopped successively in positions 190 and 191.

Considering the manner in which the stitches are formed to produce a diagonal junction line, it will be apparent that the angle of such line relative to the direction of knitting may be controlled by the number of steps through which the rails are racked during each round. For example, if the rails are racked two steps instead of one at the end of each left stroke of the carriage, the angle of the diagonal junction line relative to the direction of knitting will be increased. This angle may be decreased, if desired, by racking only at the end of the alternate rounds of knitting or by skipping any desired number of rounds between successive rackings.

Where each racking does not exceed about three steps, the diagonal junction line which is formed will, in the finished fabric, appear substantially straight. Racking in steps of greater numbers will impart a stepped shape to the junction line, thereby further enlarging the wide variety of designs which may be produced.

When the rails are racked in multiple steps, the length of the portion 186 of the black yarn will be increased in length and will extend across more than one wale. Since this portion lies loosely on the back of the fabric, it may be desirable, when the racking is effected in a relatively large number of steps, to cut the portions 186 and tie them into the fabric.

In the course of knitting to produce diagonal junction lines 173 as described above, it may be desirable to provide for the formation of fashioning marks in the form of small openings 192 to give the effect of hand decking. This may be accomplished by causing a needle, that would otherwise form one of the double loops 188 and 189 previously described, to skip one of the yarns during the knitting of certain of the courses whereby to avoid interlocking of the two yarns at the junction line along such courses and thereby permit the two adjacent loops of different yarns to be separated and a hole to be formed. To do this in the continued knitting of the areas 170 and 171 with the yarn guides 5 disposed at the normal height relative to the needles, it is only necessary to rack the rails 20^a and 20^b to the right when the carriage 3 is dwelling at

the end of its right strokes 203 and 204 instead of at the end of its left hand stroke as described above. At the end of the stroke 203, the yarn guide 5^a is in the position indicated at 191. By moving the rails one step to the right, this guide and its stop 31^a are shifted to the position 193. As this movement is in a direction opposite to which the carriage 3 will next be moved, the white yarn will now lie across and above the next adjacent needle 6^e to the right. Therefore, as the carriage 3 is moved to the left as indicated at 206, the white yarn will be carried to the left away from the needle 6^e before the needle is retracted so that no loop will be formed with the white yarn. However, the black yarn, in the movement of the guide 5^b from the positions 193 to 191, will be carried across the top of the needle 6^e so that only a black loop 194 will be formed as the needle is retracted. The first white loop formed in the stroke 206 is indicated at 195. When these two loops 194 and 195 are formed, the preceding white and black loops 207 and the preceding block loop 208 are cast off the needles 6^d and 6^e and these, being unconnected by white yarn, are free to separate under the tension on the yarn. Such spreading of the unconnected loops results in the formation of a hole 192.

Without altering the position of the rails, the carriage 3 is then again returned to the right. In this movement indicated at 204, the white yarn carrier 5^a crosses over to the point 193 during which a white link 196 is formed connecting the loops 194 and 195. The black yarn guide 5^b is picked up when the white yarn guide 5^a is at the point 191 and therefore a double loop 209 is formed in the regular way on the needle 6^e.

In order to form another fashion mark 192, the rails are then shifted to the right one step as before. To more clearly show the conditions under which this mark is formed, the course which will be knit as the carriage moves to the left as indicated at 210 has been shown in dotted outline. Thus, when the yarn guide 5^a is shifted to the position indicated at 197, the white yarn will be in the position 198 which will be slightly above the needle 6^f. In the ensuing movement of the yarn guide 5^a to the left, the white yarn will be carried from the position 198 over to the needle 6^e without effective engagement with the needle 6^f. At the same time, the yarn guide 5^b is moved to the left to the position 193 where its motion is arrested, the position of the black yarn being indicated at 199 and the last black loop formed being at 200. The continued movement of the yarn carrier 5^a will form its first loop at 201 and the subsequent loops as previously described. Thus, it will be seen that two adjacent loops 200 and 201 have been formed which are not interconnected and which will spread apart as above described when they are cast off from the needles 6^e and 6^f.

It is possible to adjust the parts and control the racking in a manner such that no fashioning holes are formed under the conditions mentioned above. As an example, it may be desirable at times to omit the fashioning holes when knitting a diagonal line of an angle which requires racking when the carriage 3 reaches the end of each stroke. One way of accomplishing this is to lower the yarn guides 5 relative to the needles so that the yarn which is led across a needle at the junction line as an incident to racking will not miss the needle in the ensuing stroke of the carriage. As shown in Fig. 27, lowering the yarn guide 5^a in position 197 will lower the yarn to the position indicated at 205 which is below the needle 6^f. Thus, when the carriage 3 is moved to the left, the needle 6^f will be projected above the yarn. Subsequent movement of the yarn guide 5^a to the left will leave the yarn on the needle so that a white loop is formed together with the black loop 200. Also, skipping of the yarn will not occur when the stops are racked through two steps instead of one. The tendency of a needle to skip one yarn and cause a fashion hole to be formed may also be overcome by increasing slightly more than the needle pitch the distance which the movements of the yarn guides overlap during the knitting of one course.

Since the conditions under which a hole 192 will be formed are fixed, such holes may be located at any selected points along diagonal junction lines. Thus, a hole will be formed whenever the rails supporting the stops controlling the yarns that interlock to form a diagonal junction line are racked one step in the direction toward the carriage 3, or, in other words, in the direction in which the carriage last traveled, the yarn guides 5 being set at the proper height relative to the needles. By racking the rails 20^a and 20^b to the right at the end of each right hand stroke of the carriage 3, a fashion hole 192 will be formed along the junction line in the alternate courses, that is, during each left hand stroke of the carriage. If it is desired to space the fashion marks 192 more than two courses apart, for example, four courses, then the rails will be racked when the carriage is on the left hand side for the required number of courses after which the rails will be racked again on the right to form the fashion marks.

A diagonal junction line 212 (Fig. 28) inclined in a direction opposite the line 173 may be formed by racking the adjacent stops for the two yarns to the left instead of to the right. If, in such a case, the racking is effected when the carriage 3 is at the right hand limit of its travel, the stitches would be formed in the same manner as described in connection with the formation of the junction line 173. When it is desired to form the fashion holes 192 along such a diagonal, the racking would be effected at the left hand limit of the carriage travel.

By arranging two sets of stops to control different junction lines, for example 173 and 212, these lines may be caused to converge in the direction of knitting as shown in Fig. 28. This is effected by racking the two sets of stops in the manner above described simultaneously but in opposite directions. By effecting such rackings at each end of travel of the carriage 3, the fashion holes 192 will be formed along both lines. As shown in Fig. 28 in which the horizontal lines represent successive courses, a hole will be formed on the line 173 as the carriage moves to the right and on the line 212 as the carriage moves to the left as indicated by the arrow heads. Now, if the directions of racking are reversed, that is, when the stops producing the line 173 are racked to the left and the stops for the line 212 are racked to the right, the lines will diverge in the direction of knitting. The fashioning holes will then be made on the line 173 when the carriage moves to the left and on the line 212 when the carriage moves to the right.

Fig. 17 illustrates more in detail the method of knitting a series of contiguous diagonal stripes 121, 122, and 123 of different colors, for example, red, blue and red, bordered by different colored areas 124 and 125 which may, for ex-

ample, be brown and which has straight edges defining the width of the fabric. The stop set up for knitting this pattern involves leading different brown, red, blue, red and brown yarns to the yarn guides indicated diagrammatically at 5^a, 5^b, 5^c, 5^d, and 5^{aa} respectively. The rails 20^b and 20^d are connected by the pins 80 to the rails 20^a and 20^c respectively, the gears 77 and 78 being omitted. The cam plate 102 is pushed inwardly rendering the pawl 89 active. The stop 32^a is loose on the rail 20^a and its position is fixed by the bar 40 so as to define the left hand edge of the fabric. The right hand edge is determined by the location of the cam plate 115. All of the other stops are fixed to their supported rails by screws 33. The pin drum 50 is positioned to lower all of the plungers 45^a to 45^d. The direction of knitting, that is, the direction in which the successive courses are formed is indicated by the arrow.

Starting with the parts positioned as shown in the upper part of Fig. 17, the course constituting the upper margin of the fabric shown is knit by movement of the carriage 3 from left to right. The brown yarn carrier 17^a is first moved into abutment with the stop 31^a carrying the yarn guide 5^a across the needles 6 which knit the area 124, the lower end of the guide moving to the position indicated at 127. The carrier 17^b is picked up by its plunger 45^b when the guide 5^a is directly opposite the guide 5^b. Both guides therefore move across at least one needle together after which the guide 5^b continues to the position 128, the red yarn being advanced across the area 121. The plunger 45^c picks up the carrier 17^c when the guide 5^b is opposite the guide 5^c and moves the blue yarn across the needles which knit the area 122, the yarn stopping at 129. The carrier 17^d is engaged by the plunger 45^d when the guide 5^c is opposite the guide 5^d. The second red yarn is thus advanced from the position 130 to 131 where it is stopped by the stop 31^d. The carrier 17^{aa} is advanced in the final part of the carriage stroke to carry the second brown yarn guide 5^{aa} across the area 125 leaving it at the right hand margin of the fabric as a result of the action of the cam plate 115 in raising the plunger 45^a. Instead of the cam plate, a stop held fixed as by a bar 40 could be used to define the right hand margin of the fabric. Then the carriage is moved to the left to complete the first round bringing the stops back to their original positions.

If, as assumed, no fashion holes are to be formed along the junction lines between adjacent stripes, the racking must be effected with the carriage 3 dwelling in its left hand position. While in this position, the hand lever 92 is actuated, that is, moved first to the left and then to the right. This results in racking all of the rails 20 to the right a distance equal to the pitch of the needles 6 so that stops 31^a, 31^b, 31^c, 31^d, 32^b, 32^c, 32^d, and 32^{aa} are shifted past one needle, the carriers 17^a, 17^b, 17^c, and 17^d moving with the stops 31 by virtue of their connection with these stops through the detents 65. The stops 32^a and the cam plate 115 remain stationary.

Now as the carriage is moved to the right to knit the next course, the yarn carriers are picked up and moved successively as described above except that the carriers 17^a, 17^b, 17^c, and 17^d are moved one needle pitch further to the right with the result that the red and blue areas along this course are shifted and the areas 124 and 125 lengthened and shortened respectively. In the return or left stroke of the carriage, the brown yarn carrier 17^{aa} is first moved from the right margin into engagement with the stop 32^{aa} which will position the guide 5^{aa} one needle pitch to the right of the position it assumed in the first round of knitting. In a similar way, the carriers 17^d, 17^c, 17^b, and 17^a are picked successively and are moved across the areas 123, 122, and 121, being stopped one needle pitch short of their first round positions owing to the shifted positions of the stops 32^d, 32^c, and 32^a. Thus, in each course of the second round, the areas 121, 122, and 123 will be of the same width measured longitudinally of the second course, but all of them will be shifted one needle pitch to the right. For the same reason, the area 125 will be correspondingly shortened and the area 124 lengthened.

Preparatory to the next right stroke of the carriage 3, the lever 92 is again actuated to advance all of the rails and the stops locked thereto one step to the right. Except for this change in stop position, knitting of the third round is effected as described above, the area 124 being lengthened, the areas 121, 122, and 123 being shifted one step further to the right and the area 125 being shortened.

Owing to the movement of each yarn guide 5 past the adjacent guide in coming against its stop, two different yarns forming contiguous areas of the fabric will interlock with each other and the edges of such areas will overlap each other and be knitted together effectually in the manner previously described and shown in Fig. 27. The thickening of the fabric due to such overlapping is unnoticeable and the different threads in the overlapped areas are so well blended that the borders of the different color areas are quite sharply defined.

After the length of fabric shown in Fig. 17 has been knitted with the lower end left hanging on the needles 6, the stops 31^a, 31^b, 31^c, 31^d, 32^{aa}, 32^b, 32^c, and 32^d will have been advanced to the right to the positions shown in the lower part of the figure, the yarn carriers 17 and guides 5 coming to rest in the positions shown at the end of the right stroke of the carriage 3. It may be desired to reverse the inclination of the stripes 121, 122, and 123 as the knitting is continued so as to form a zig-zag pattern of the character shown in Fig. 22. To condition the machine for this, it is merely necessary to retract the cam plate 102 thereby disabling the pawl 89 and render the pawl 90 active. The carriage 3 is now shifted back and forth to knit successive courses and the lever 92 is actuated once each round. In order to avoid forming fashion holes, the racking will be effected while the carriage 3 is dwelling in the right hand end of the machine. Such racking results in shifting all of the rails 20 to the left so that in each successive round, the stripes 121^a, 122^a, and 123^a will be inclined downwardly and to the left. If these operations are continued, the stops anchored to the rails will, after knitting a second length of fabric equal to that shown in Fig. 17, be racked back to the positions shown in the upper part of Fig. 17.

For some pattern designs, it may be desirable to form diagonal stripes 121^b, 122^b, and 123^b disposed at a greater angle to the length of the fabric than the stripes 121, 122, and 123. This may be accomplished by knitting the fabric in the same manner as described in connection with the formation of the stripes 121, 122, and 123

except that the hand lever 92 is actuated two or more times at the end of each carriage stroke depending on the stripe angle desired. Thus, if the bars 20 are racked through two steps at the end of each carriage stroke, the stops attached to the rails and therefore the yarn guides will be shifted to the right through a distance equal to double the pitch of the needles 6.

The stop set-up shown in Fig. 17 also lends itself to the knitting of stripes 122c and 123c (Fig. 22) extending in the direction of knitting in parallel to the sides of the fabric. Such stripes are formed simply by shuttling the carriage 3 back and forth without actuating the lever 92 before each stroke. In such an operation, all of the stops remain stationary and the yarn carriers are picked up successively by the carriage the same as during the knitting of diagonal stripes.

The procedure of forming a plurality of interconnected areas formed of different yarns with lines of juncture which converge toward each other or diverge in the direction of knitting will now be explained with reference to Fig. 18. Let it be assumed that the fabric is to be formed with contiguous triangles 130, 131, and 132 which may, for example, be of red, blue, and red colors within the width of fabric having marginal areas 133 and 134 which may, for example, be brown and green. It may also be assumed that the yarn guides 5 are set so that no fashion holes will be formed along the juncture of contiguous areas even though the rails are racked at the end of each carriage stroke.

To condition the machine for this pattern, the gears 77 and 78 are placed in mesh with the rails 20b and 20d, these gears in turn meshing with the gears 73 and 74. As before, the stop 32a is fixed by the stationary bar 40 to define the left margin of the fabric and the cam plate 115 is located to render all of the plungers 45 ineffectual at the right marginal edge. The stops 31a, 31b, 32c, 32d, and 32bb are fastened by screws 33 to the rails on which they are supported. The two stops which operate to define an inclined junction line between contiguous areas of different colors are interconnected so as to move in unison. Thus, the stop 31a is connected to the stop 32b by a rod 39a in a manner previously described and shown in Fig. 15. The stop 31c is connected to a stop 36d by a rod 39d and is of the kind shown in Fig. 13, being supported on the rail 20c but locked by a member 36 to the rail 20d. Also, the cam plate 102 would be pushed inwardly so as to render the pawl 89 active. Similarly, the arm 51 would be shifted to a position rendering all of the plungers 45 active.

The first course is knit during movement of the carriage 3 to the right. In the initial movement, the brown yarn carrier 17a is picked up by its plunger 45a and moved into abutment with the stop 31a carrying the brown yarn to pass the guide 5b to a position indicated at 136. The carrier 17b is then moved through its stroke into abutment with the stop 31b during which the red yarn guide 5b is moved to the position 137. Since the stops 31c and 32d are disposed in abutment with opposite ends of the carrier 17d, this carrier does not move. The carrier 17c, however, moves into abutment with the stop 31c thereby carrying the other red yarn across the area 132 to a position 138. In the final movement, the green yarn is carried to the right hand margin of the fabric by the carrier 17bb. At this time, the lever 92 is actuated to advance the shaft 75 in a clockwise direction as viewed in Fig. 2 with the result that the rails 20a and 20c are advanced to the right through a distance equal to the pitch of the needles 6, thereby correspondingly repositioning the stops 31a, 32b, 32c, and 31d. Simultaneously, the rails 20b and 20d are shifted an equal distance to the left moving with them the attached stops 31b, 32bb, 32d, and 31c. During such repositioning of the stops, the yarn carriers 17 move with the stops to which they are then latched by the detents 65.

Now as the carriage 3 is moved to the left to knit the second course, the green yarn is carried a greater distance in moving against the stop 32b, thereby increasing the width of the area 34 along the second course. Since the stops 31c and 32c are now closer together, the yarn guide 5c moves through a shorter distance, the area 32 being shortened at opposite margins along the second course. The same is true of the area 130 across which the other red yarn is carried. The stops 31d and 32d having been separated as an incident to actuation of the lever 92, the blue yarn carrier 17 will move through a short distance to begin the formation of the apex of the area 131.

Successive single actuations of the lever 92 before each succeeding stroke of the carriage effect similar repositioning of the adjustable stops with the result that in the knitting of successive courses, the opposite sides of the areas 130 and 132 converge toward each other in the direction of knitting while the marginal edges of the area 131 diverge in this direction, and the inner margins of the green and brown areas converge toward the center of the fabric. After the length of fabric shown in Fig. 18 has been knitted, the triangles 130, 131, and 132 will have been completed and the various stops will have been racked into the position shown in the lower part of this figure.

If now it is desired to reverse the design as the knitting is continued so as to extend the area 131 as indicated at 131a and thereby form a diamond or square bounded by the red triangles, it is only necessary to disable the pawl 89 and render the pawl 90 effectual by retracting the cam plate 102. Then, in response to actuation of the lever 92, the rails 20a and 20c will be shifted to the left while the rails 20b and 20d are moved to the right. As a result, the stops 31a, 32b, 32d, and 31c will be advanced step-by-step to the left, and the other movable stops will be shifted in corresponding increments to the right. As the knitting continues, the margins of the blue area 131a will converge toward each other while the red areas 132a will increase in width until the pattern shown in Fig. 19 has been completed.

By repositioning the rails 20 in still a different way, it is possible to knit a variety of designs involving spaced triangles, diamonds, or other shapes. Such a design is shown in Fig. 20 having spaced horizontal rows of diamonds 134 and 135 of one color, for example, black, each surrounded by an area 133 of a different color such as orange and bordered on sides by spaced fashion holes 192. Also, the machine is conditioned as previously described to produce the holes 192 including location of the guides 5 at the proper height relative to the needles. For this pattern, the rails 20b and 20d are arranged to be racked by the gears 77 and 78 and the pawl 89 is first rendered operative. The stops and carriers are set as shown in the upper part of Fig.

20 with the orange yarn led to the guides 5a, 5c, 5aa, and 5cc. The first course is knitted by a right movement of the carriage 3 during which the yarn guides 5a, 5c, 5aa, and 5cc are moved successively to the points 136, 137, 138, and 139 respectively. Then, the lever 92 is actuated to rack the rails 20a and 20c to the right one step, thereby correspondingly shifting the stops 31b, 32c, 32aa, 31d, 32cc, and 31bb. At the same time, the rails 20b and 20d are shifted to the left thereby shifting the stops 31a, 32b, 31c, 32d, 32bb, and 31aa. Now, as the carriage is moved to the left, the carriers 17cc, 17bb, 17aa, 17d, 17c, 17b, and 17a are moved and picked up successively in knitting the second course during which the tips of the diamonds 134 are started.

Under the conditions assumed, a hole 192 will be formed on the right side of each square 134 during the course knit during the left stroke of the carriage. The holes on the left are formed during the other strokes.

By repeating these operations, successive courses are knitted until the upper halves of the diamonds 134 are complete whereupon the cam plate 102 is shifted to render the pawl 90 active. Thereafter, the movements of the rails 20 are reversed in response to actuation of the lever 92 and during the knitting of successive courses, the lower and remaining portions of the diamonds 134 are formed, these being completed by knitting of the course 140 all of which is of the background color.

Preparatory to knitting of the diamond areas 135, the rails 20 are disengaged from the gears 73, 74, 77, and 78 and while so disengaged are shifted endwise and to the right a distance 141. This distance is a multiple of the needle pitch and such that the gears and rails will be in full accurate mesh when they are reengaged. As a result of this shifting of the rails, the stops 32cc, 32bb, 31bb, and 31aa are moved out of the active knitting range as determined by the cam plate 115. The other stops are moved to the positions shown in the lower part of Fig. 20.

Before proceeding with the knitting, the pawl 89 is rendered active and the lever 92 is actuated once to separate the stops 32b and 31b and the stops 32d and 31d as previously described as well as to move the stops 32aa and 32c to the right. Now, as the carriage is shuttled back and forth, the upper halves of the diamonds 135 are knit and then the pawl 90 is rendered operative to reverse the racking in subsequent actuations of the lever 92. Then, as the knitting is continued, the remainder of the diamonds are formed the same as were the diamonds 134. If it is then desired to repeat the pattern, the rails 20 would be disengaged from the gears 73, 74, 77, and 78 and all of the parts returned to their initial positions shown in the upper part of Fig. 20.

Fig. 21 illustrates another type of design capable of being formed with the present invention and involving the formation of alternate vertical stripes 145 and 146 of different widths in one color, for example, blue, on a background of a second color which might be green. The arrangement of the stops for knitting this design will be obvious from the foregoing. Thus, successive rounds 147 of the green yarn would be knit by advancing one or more yarn guides across the active needles, the guides for the blue yarn being held stationary by maintaining their plungers 45 in raised or in active positions. To start the stripes 145, the pin drum 50 is turned to render the proper plungers active so as to move the blue yarn across the proper parts of the course as determined by the proper stops. Of course, the rails 20 would be held stationary during knitting of the stripes 145.

With the pawl 89 active and the gears 73, 74, 77, and 78 all in mesh with the rails 20, the lever 92 is actuated a number of times corresponding to the width of the stripes 146. Thus, the stops 31 and 32 controlling the guides for the blue yarn would be spread apart, the yarn carriers 17 moving with one of these stops. Then, the wider stripes would be formed by knitting the proper number of courses. To again reduce the stripe width, the ratchet mechanism would be reversed and actuated to return the stops and yarn carriers to their previous positions. By thus changing the stop positions after knitting the required number of courses, alternate wide and narrow stripes may be formed. As an incident to such shifting of the stops, a length of blue yarn corresponding to the distance one stop is moved will be left on the back of the fabric. Usually, this need not be broken although when it is of substantial length, it may be desirable to break the yarn and tie the ends into the fabric.

The design shown in Fig. 26 is a modification of that of Fig. 21. In this, the stops controlling the blue yarn, after knitting of the part 148, are separated in successive increments prior to knitting the courses 149 and 150. Thereafter, those stops are moved together in similar steps to reverse the design. From this it will be apparent that various designs involving the formation of stepped borders may be formed, the steps being of any desired lengths and heights depending on the extent to which the controlling stops are racked and the number of courses knitted between rackings.

Fig. 25 illustrates still another design which may be formed by a combination of stop racking movements of different lengths. The triangle 152 would be knit as previously described by single step racking at each end of the carriage stroke. Then, after shifting the coacting stops in opposite directions through several steps, for example, five, the stops would be positioned for knitting the area 153, the differently inclined borders 154 being obtained by racking two steps at the end of each carriage stroke. After reversing the ratchet mechanism, knitting would be continued with single step racking to form the borders 155.

By proper setting of the stops and racking of the supporting rails at the proper times, a design such as shown in Fig. 22 may be formed. This comprises triangles 156 and a rectangle 157 separated by horizontal stripes 158 and surrounded by areas of different colors.

In the design shown in Fig. 23, vertical and diagonal border lines are combined in still another way to form triangles with base lines 160 extending longitudinally of the fabric. For this pattern, the stops for defining these base lines would be supported on different rails and held stationary by bars similar to the bar 40 disposed in the grooves 43 or along the rear plate 21. The positions of these stops would thus remain fixed during racking of the associated stops to define the inclined borders 161.

The designs described above are merely typical of the many which may be produced by a combination of the fundamental features capable of being obtained with the present invention, namely, contiguous interconnected areas of different

yarns having borders extending either horizontally or vertically, diagonally in different directions and at various angles, or converging or diverging either in the direction of knitting or perpendicular thereto. With proper stop arrangements, it is possible to combine these fundamental characteristics in different ways, and obtain innumerable other designs not capable of being produced on prior flat knitting machines. By racking the stops for the yarn guides relative to the needle beds, these fundamental actions are obtained while at the same time leaving all of the needles of the beds available for effective knitting. With the more complicated designs using a larger number of different yarns, it may of course be necessary to increase the number of rails 20 or to make other provisions for reducing the length of the rail which must be allotted to each yarn carrier and its associated stops for a given width of design.

I claim as my invention:

1. In a flat knitting machine, the combination of a bank of needles, a plurality of guides for carrying yarns to said needles, rails supporting the respective guides for movement along the rails, stops on said rails controlling the limits of the guide movements, means supporting said rails for endwise movement, a manually operable member, and mechanism connecting said member and said rails and operable automatically during successive actuations of said member to shift two of said rails in opposite directions in fixed increments correlated with the spacing of said needles.

2. In a flat knitting machine, the combination of a plurality of yarn guide stoppers, a pair of rails supporting the stoppers for selective adjustment of the stoppers in a direction longitudinally of the rails, means supporting said rails for bodily endwise movement, and means for shifting said rails endwise simultaneously through equal distances in opposite directions.

3. A flat knitting machine having, in combination, a plurality of rails, yarn carriers slidable therealong, a carriage slidable longitudinally of said rails, plungers on said carriage movable between active and inactive positions relative to the carriage and each adapted when in active position to connect the carriage to one of said carriers and cause the latter to advance with the carriage, and means operating automatically upon movement of said carriage to and beyond a predetermined position to shift all of the active plungers to inactive position.

4. A flat knitting machine having, in combination, a plurality of rails, yarn carriers slidable therealong, a carriage slidable longitudinally of said rails, plungers on said carriage movable between active and inactive positions relative to the carriage and each adapted when in active position to connect the carriage to one of said carriers and cause the latter to advance with the carriage, and means acting automatically to disable all of said plungers during movement of said carriage through a predetermined range.

5. In a flat knitting machine, the combination of, a rail mounted for endwise movement, a pair of spaced stops supported by said rail, one being fixed on and the other being slidable relative to the rail, a yarn carrier movable between said stops, means for shifting said rail endwise to change the position of the stop fixed thereto, and means for holding the other stop stationary while permitting shifting of the rail relative thereto.

6. In a flat knitting machine, the combination of, a pair of rails disposed side by side and mounted for relative longitudinal movement, means for shifting at least one of said rails endwise, a yarn guide stopper supported by and having a slidable connection with one of said rails, and means connecting said stopper to the other rail whereby the position of the stopper is determined by the latter rail.

7. In a knitting machine the combination of, a yarn carrier, a rail adjustably supporting said yarn carrier for movement therealong, means supporting said rail for endwise movement, a manually operable member, a pair of ratchet wheels having driving connection with said rail, pawls operated by said member and engageable with the respective ratchet wheels, and manually operable means to render said pawls active selectively.

8. In a flat knitting machine, the combination of, a plurality of parallel rails having rack teeth thereon, pairs of stops each supported by and spaced along one of said rails, yarn guides each slidable along one of said rails between the stops of one pair, gears meshing with the teeth on the respective rails, a manually operable member adapted when actuated to turn said gears in opposite directions, and selectively operable mechanism for reversing the direction of turning of said two gears in response to actuation of said member.

9. In a flat knitting machine, the combination of, a plurality of yarn guides, a pair of parallel racks each carrying stops and supporting one of said guides for sliding movement therealong between limits determined by said stops and the longitudinal position of said racks, gears meshing with said racks, and a manually operable member adapted when actuated to turn said gears and cause movement of said racks in opposite directions.

10. In a flat knitting machine, the combination of a rail having longitudinal way surfaces thereon, a yarn guide slidable along said way surfaces, stops also slidable along the same way surfaces and adapted to be fastened to the rail at selected points of adjustment therealong to determine the extent of movement of the yarn guide, rack teeth rigid with said rail, and means engageable with said teeth to shift said rail longitudinally.

11. In a flat knitting machine, the combination of a rail having longitudinal way surfaces thereon, a yarn guide slidable along said way surfaces, stops also slidable along the same way surfaces of said rail and adapted to be fastened to the rail to determine the extent of movement of the yarn guide thereon, rack teeth formed on said rail immediately adjacent one of said way surfaces, and means engageable with said teeth to shift said rail longitudinally.

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