April 4, 1939. Y. RUINNET 2,153,342

PATTERN CONTROL MECHANISM

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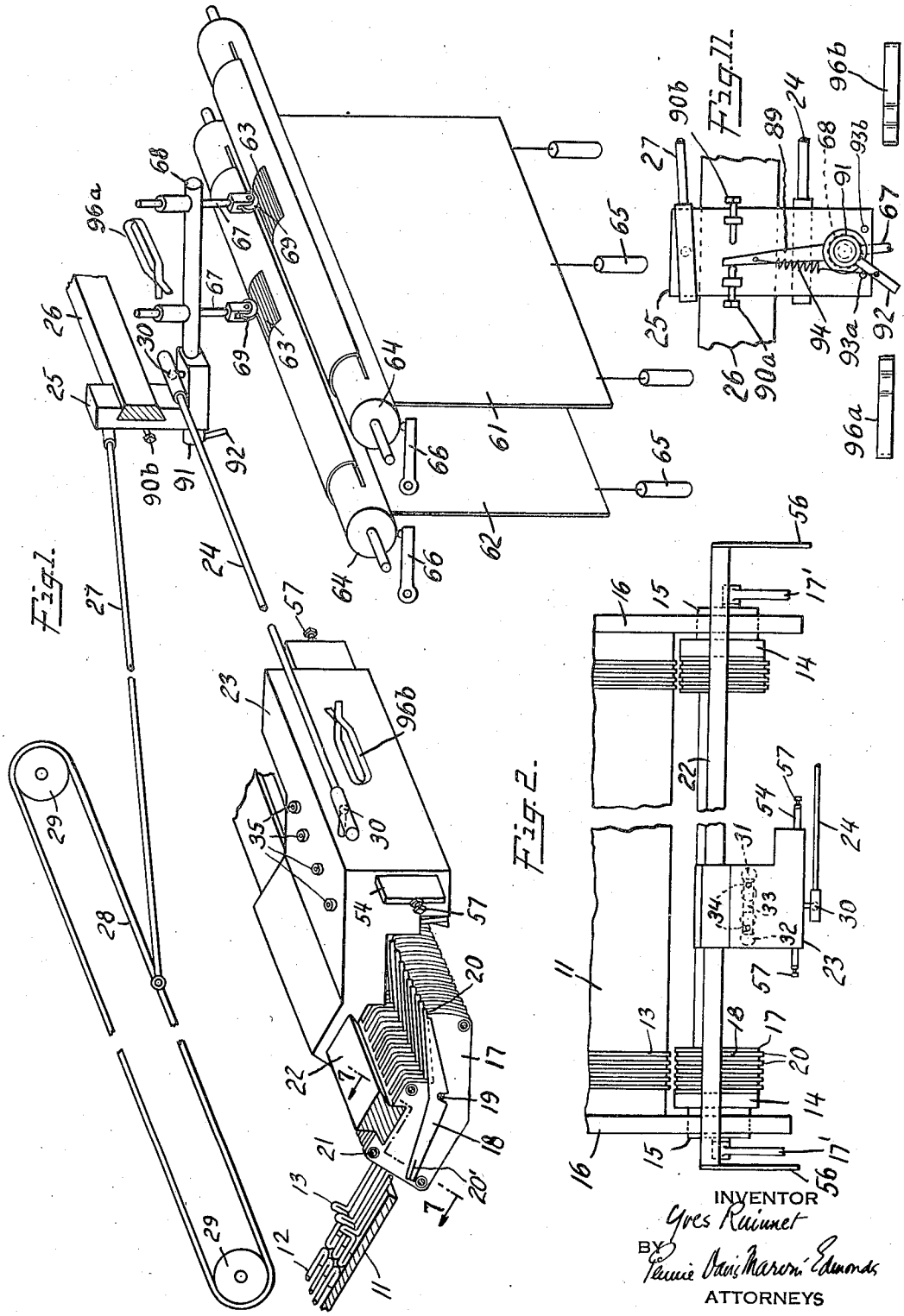


Fig. 1.

Fig. 11.

Fig. 2.

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Fig. 3.

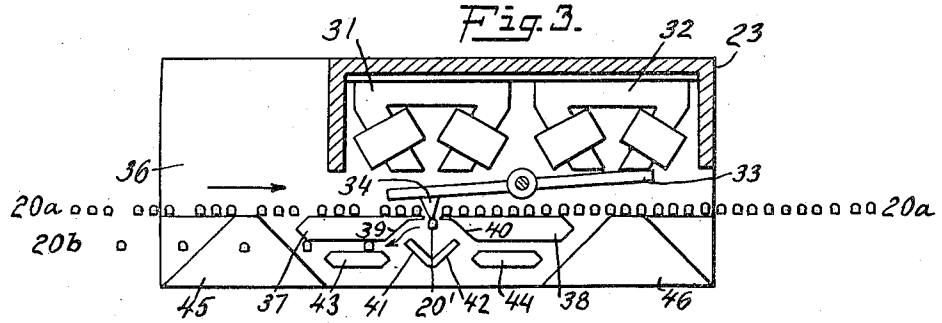


Fig. 4.

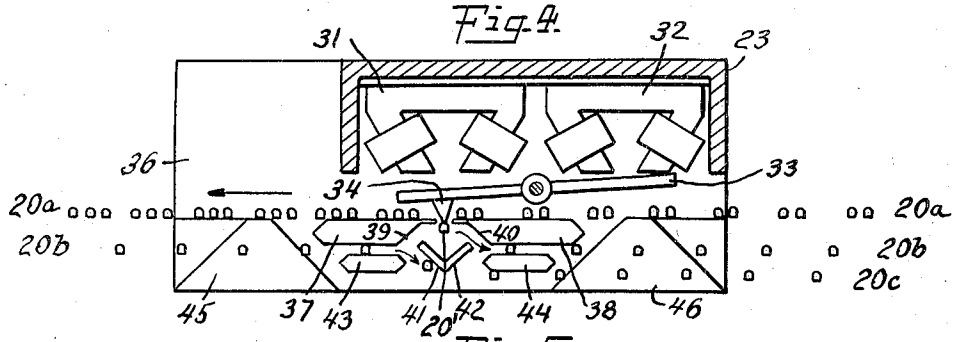


Fig. 5.

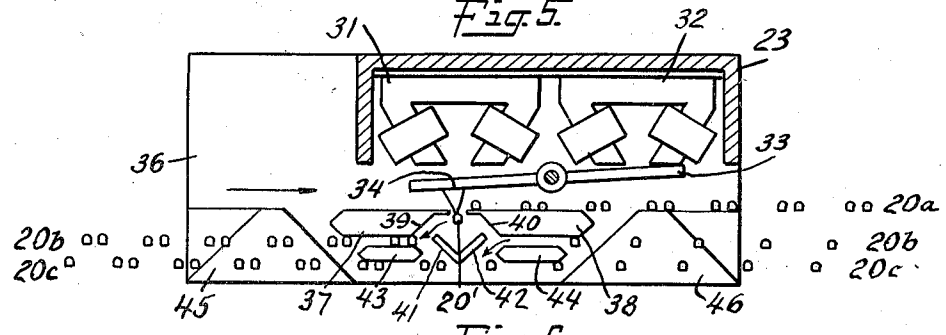


Fig. 6.

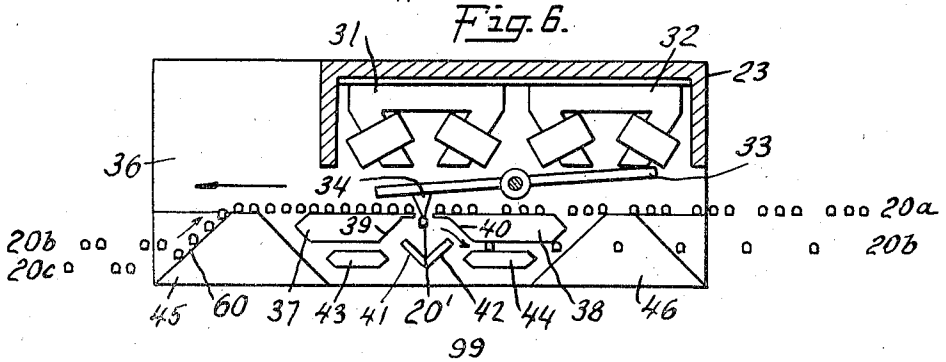
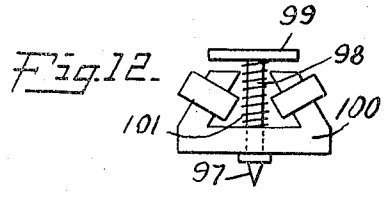


Fig. 12.



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Fig. 7.

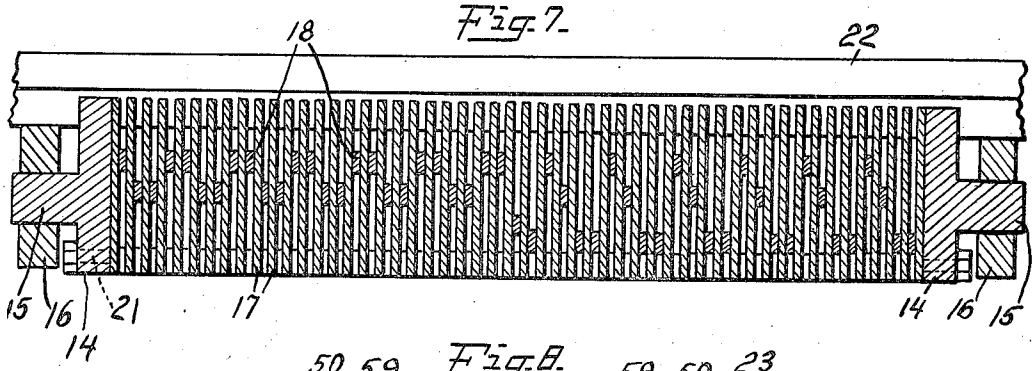


Fig. 8.

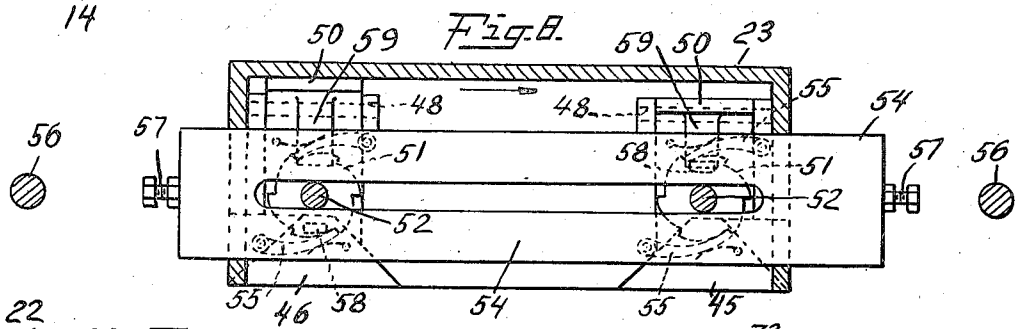
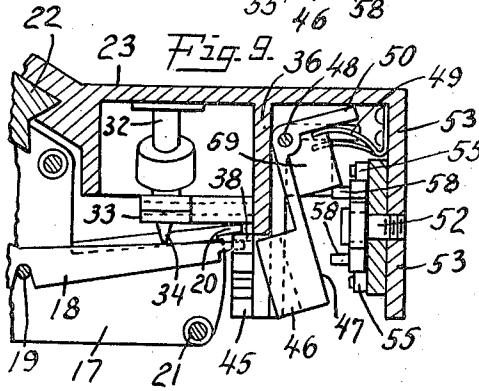


Fig. 9.



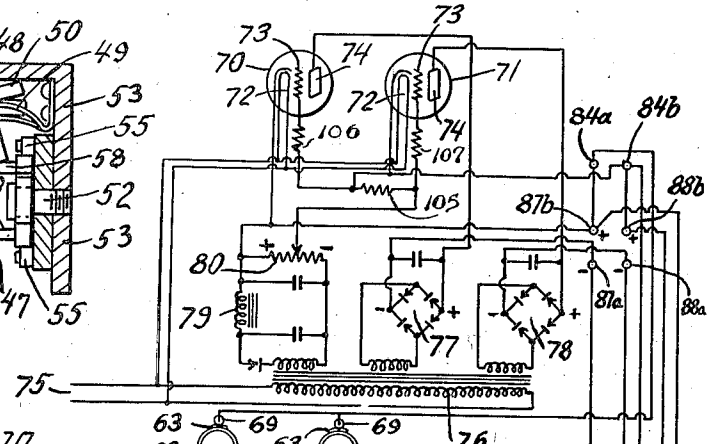
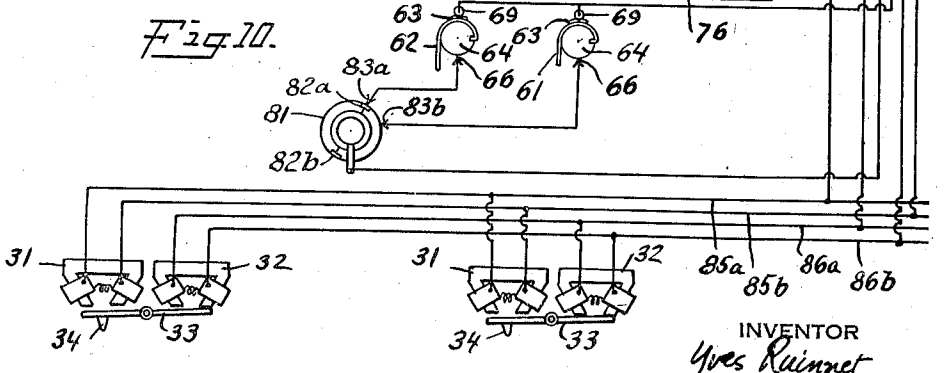


Fig. 10.



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UNITED STATES PATENT OFFICE

2,153,342

PATTERN CONTROL MECHANISM

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Application September 17, 1936, Serial No. 101,251
In France December 31, 1935

40 Claims. (Cl. 66—75)

This invention relates to devices for controlling the operation of knitting frames and weaving looms for the purpose of reproducing designs or patterns in the fabric being knitted or woven. More particularly, the invention is concerned with an electro-mechanical mechanism which may be used in association with a knitting frame or loom to control the operation of the needles or heddle wires in accordance with a pattern so that the fabric being made will contain a reproduction of the pattern. In the new device, the pattern used carries a representation of the design as it is to appear on the fabric, and directly controls the operation of the new mechanism. The cost of manufacture of patterned fabrics is, accordingly, reduced by the use of the mechanism since it is unnecessary to prepare cards from each pattern as is required in the operation of a jacquard mechanism, commonly used heretofore as a pattern control means.

The new apparatus, with appropriate modifications, may be employed for controlling the operation of knitting machines of either the flat bed or circular types, of looms of the types ordinarily controlled by a jacquard mechanism, and also of machines employed for punching the cards used in connection with jacquard mechanisms. When the new apparatus is employed with a loom of the type referred to, it may operate directly on the heddle wire mechanism, or it may be employed to take the place of the cards of the jacquard mechanism. For purposes of explanation, however, an embodiment of the invention employed in association with a flat bed knitting machine will be illustrated and described in detail, but it is to be understood and will be apparent that the utility of the invention is not confined to that particular adaptation, and that it may be employed in connection with numerous machines in which there are a plurality of control members to be selectively controlled.

In my prior Patent No. 1,795,235, issued May 3, 1931, I have disclosed an apparatus upon which the apparatus of the present invention constitutes an improvement. As used in connection with a flat bed knitting machine, the patented control apparatus includes a grill or framework carrying a plurality of control levers lying side by side in a row with their ends opposed to the extensions or feet of the needles. These levers are initially latched in an upper position, and in order to control the operation of the needles, selected levers are released and fall to their lower positions by gravity. An electromagnet movable along the grill and supplied with current under the control of the master pattern operates to unlatch the levers, and after each traverse of the electromagnet along the grill, the latter is advanced toward the needles so as to move selected needles into knitting position.

In producing a fabric which includes yarns of different colors, the grill of the patented apparatus is shifted to a different position for each color. For example, when two colors are employed, the grill first occupies a position in which each lever in its latched position is effective on the advance of the grill to move its corresponding needles into knitting position, and each unlatched lever is ineffective for that purpose. In the second position of the grill, the operation of the levers is reversed, that is, the latched or elevated levers are ineffective, and those which have been unlatched and moved down by gravity are effective to bring their corresponding needles into operation.

While the device of the prior patent is generally satisfactory in operation, the grill mechanism which includes a lever and a latch for each needle is somewhat complicated and it is not wholly positive in action, since the displacement of a lever from its latched position depends in part on the action of gravity. Also, the necessity of employing a grill, which has as many initial positions as there are colors employed in the fabric, adds to the operating parts of the mechanism.

The present invention is accordingly directed to the provision of an electromechanical pattern control mechanism which operates on the same general principles as that disclosed in my prior patent, but is an improvement thereon in that the control members are positively moved from one position to another and are under complete control at all times. In the new mechanism, the control members are mounted in a support, and in the form preferred for use with a flat bed knitting machine, the support may take the form of a grill. Such a grill, however, is moved toward and away from the needles by movement in a single plane only and the requirements imposed on the mechanism in the production of a fabric containing two or more colors are met by employing control members movable between a plurality of positions in the grill rather than by shifting the grill as a whole. Another feature of the new apparatus is the use of electrical devices for selectively positioning the control members, these devices making it possible to employ a single pattern device to control the operation of a plurality of textile machines, so that in a mill in which a number of different machines

are producing the same product, duplication of the pattern device is avoided, the amount of equipment required is reduced, and the cost of production is decreased.

When employed in one manner, the control members associated with the new apparatus and displaceable to different positions may be used to serve the purpose of a series of jacquard cards, the ends of the members corresponding to the solid portions of the cards. Thus, when such a set of control members is employed with a jacquard mechanism, it takes the place of the series of cards and the card barrel, and for each thread of weft inserted in the fabric, the control members are set in appropriate positions determined by the pattern. Then, when the set of control members is advanced toward the wires, certain of the wires are engaged and displaced by the control members while the others remain at rest, the selection being effected by the pattern. Since the control members can be individually and selectively placed in different relative positions, each such arrangement of the control members corresponds to a single jacquard card, and the use of the new mechanism thus avoids the necessity of punching a set of cards, and the pattern directly controls the weaving operation.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which

Figure 1 is a somewhat schematic representation of the elements of the new apparatus as employed in connection with the flat bed knitting machine;

Figure 2 is a plan view of a portion of the bed of that machine with the control apparatus in place;

Figures 3, 4, 5, and 6 are sectional views through a part of the new apparatus showing the manner in which the selecting operation is carried on;

Figure 7 is a sectional view on the line 7—7 of Figure 1 illustrating the construction of the grill;

Figure 8 is a longitudinal sectional view showing certain details of the control mechanism;

Figure 9 is a transverse sectional view through portions of the apparatus illustrated in Figure 8;

Figure 10 is a diagram of the electrical connections, which also shows the manner in which the pattern mechanism may be employed for controlling the operation of two or more knitting machines;

Figure 11 is a view in front elevation showing one feature of the scanning mechanism, and

Figure 12 is a view in front elevation of a modified electromagnet construction which may be used.

Referring now to the drawings, the device is shown in Figure 1 in association with a flat bed knitting machine of ordinary construction, a portion of the bed of the machine being indicated at 11. On this bed are mounted the needles 12 lying side by side in a row, each needle being provided with the usual extension or foot 13 which projects beyond the rear edge of the bed. As shown in Figure 1, the needles are all out of knitting position and they are advanced thereto by longitudinal movement of their corresponding extensions 13 across the bed.

The control mechanism employed to bring the needles selectively into knitting position includes a plurality of control members mounted in a suitable support at the rear of the needle bed and movable toward and away from the needles thereon. This support may conveniently take the form of a frame-work or grill which is mounted and reciprocated in any suitable manner. In the construction illustrated, the support for the control members is a grill which includes end pieces 14 provided with extensions 15 which enter slots in the side frame members 16 of the knitting machine. Such an arrangement is disclosed in Figures 2 and 3 and, as there shown each extension 15 is connected in any suitable manner to one end of a lever 17' which may be actuated, as, for example, by a cam mechanism to cause the grill to move toward and away from the bank of needles at the proper times. Between the end pieces 14, the grill is provided with a plurality of spaced partition members 17 between which lie the control members 18. Each member as illustrated in Figure 1, may take the form of a lever notched midway between its ends and resting on a rod 19 which extends lengthwise of the grill through openings in the partition members. At its rear end, each control member has a tongue 20 projecting out slightly beyond the rear edge of the group of partition members and at its forward end, the control member is bifurcated, as indicated at 20', and the ends are sprung apart slightly so that they engage the partition members on either side of the control member in order that the control member may be held by light friction in the several positions in which it may be placed. The partition members 17 are supported in position on a plurality of rods 21 extending through them and through the end pieces 14, suitable spacing means being employed between the partition members to hold them in proper relative position.

The upper edge of each partition member 17 is notched to receive the lower portion of a dove tail bar 22 which forms a track for a housing 23. This housing overlies the rear end of the grill and it is moved along the grill once for each row of stitches to be knit. Any suitable drive means for the housing may be used, and in the construction shown, the housing is moved by means of a rod 24 connected to a block 25 which travels along a dove tail bar 26 extending lengthwise of the knitting machine. The block is connected by a rod 27 to a chain 28 which passes around sprocket wheels 29 mounted at any convenient part of the knitting machine. In the operation of the machine, the chain travels continuously and it causes the block and the housing to move lengthwise of the needle bank once for each row of stitches in the fabric. As the grill is moved toward and away from the bank of needles in order to bring selected needles into knitting position and the bar 26 is fixed in position, the rod 24 is connected both to the housing 23 and to the block 25 by swiveling connections, indicated generally at 30.

Within the housing 23 are electromagnetic means for selectively moving the control members, and in one form, the means comprise a pair of electromagnets 31 and 32 beneath which is pivotally mounted a lever 33 having a projection 34 from its lower face beneath the electromagnet 31 and serving as a hammer. The electromagnets are supplied with current through wires not shown, which are connected to binding posts 35 at the top of the housing, and the electromagnets are energized in alternation to swing the lever 33 between effective and ineffective positions. Thus, when the electromagnet 31 is energized and electromagnet 32 deenergized, the lever 33 is swung in a clockwise direction to inef

fective position, while when the electromagnet 32 is energized and the electromagnet 31 deenergized, the lever is swung in a counter-clockwise direction to operating position, as illustrated in Figures 3 to 6, inclusive. The lever 33 lies directly above the extensions 20 from the control members 18, and as the housing 23 is moved along the grill, current is supplied to the electromagnet 32 under control of the pattern as the hammer 34 on the lever lies above the extensions 20 of selected control members. The energization of the electromagnet 32 at each such instant results in the swinging of the lever to cause its hammer 34 to strike the tail of a control member and move it positively downward a short distance. Such movement need not be sufficient to place the control member in operating position and, in that case, the completion of the movement of the control member is effected mechanically. Preferably, all the control members have the same effective mass and the lever 33 and hammer 34 have an effective mass substantially the same as that of one of the control members. This results in the optimum exchange of energy during the operation of the hammer.

Within the housing is a longitudinal partition 36 which lies just to the rear of the grill and on the face of the partition opposed to the grill are a number of cams arranged in pairs. The cams 37, 38 constitute the upper pair and each cam has an inclined surface 39, 40. As the housing travels in one direction along the grill and the hammer 34 engages the tail of a particular control member in upper ineffective position, indicated at 20*a*, the tail is moved downward as indicated at 20', into the path of one or the other of the cam surfaces 39, 40, so that as the casing continues to move, the tail slides down the inclined surface and the control member is swung to effective position with its tail occupying the position indicated at 20*b*, Figure 4. In this position, the control member is effective on advance of the grill toward the bank of needles to engage its corresponding needle and move it to knitting position.

The cams 41, 42 on the partition wall are so placed that they operate alternately, dependent upon the direction of movement of the casing, to engage the tails 20 of control members which have previously been effective and move them downward to lower ineffective position with the tails then lying in the row indicated at 20*c*. Another pair of cams 43, 44 on the partition 36 serve to insure that the tails of control members, which have been engaged by either cams 39, 40 or cams 41, 42, will be moved to their proper positions by those cams without over-travel.

In addition to the cams previously described, the housing contains a pair of movable cam members 45, 46, each of which is mounted on the end of a lever, such as that designated 47, Figure 9, the lever being pivoted on the partition 36 at 48 and biased to one position by a spring 49 engaging one arm 50 of the lever. The cams 45, 46 come into action alternately, after rows of stitches of each of the yarns employed in the fabric have been knitted, and restore all of the control members to their initial positions indicated at 20*a*.

In the construction illustrated, a ratchet wheel 51 is provided for each lever 47 and each wheel is mounted on a pin 52 threaded into the rear wall 53 of the casing 23. A slotted bar 54 is mounted in the housing against the inner face of the wall 53 with the pins 52 passing through the slot in the bar and the ends of the bar projecting out of the housing at each end thereof. This bar is provided with a pair of spring pressed pawls 55 engaging each ratchet wheel 51, and on movement of the bar relative to the housing, the ratchet wheels are caused to advance by the pawls.

Such movements of the bar are effected by means of stop members 56 mounted in any convenient manner at the ends of the track 22, and engageable by adjustment screws 57 in the ends of the bar. When the housing 23 approaches the ends of its path of travel, one or the other of the screws 57 engages a stop 56 and holds the bar 54 as the housing continues to move. As illustrated in Figure 8, the previous movement of the housing toward the left has caused the bar 54 to be stopped while the housing continues, and the bar has, accordingly, been moved relatively to the housing toward the right. In this movement, each of the pawls 55 has passed behind a tooth on each of the ratchet wheels. When the housing then returns toward the right hand end of the machine, the adjustment screw at that end of the bar 54 engages the stop, and as the housing continues to move, the relative movement of the bar and housing results in the ratchet wheels being turned angularly by the amount of one tooth.

Each ratchet wheel is provided on its inner face with a cam projection 58, and as the wheel rotates stepwise, its cam projection is ultimately brought into a position such that, upon a further movement of the wheel, the projection engages a plate 59 mounted on the lever 47 associated with the ratchet wheel. The movement of the cam projection past the plate causes the lever to swing clockwise on its pivot, and that brings its cam 45 or 46 into operating position. Each of the cams 45, 46 has inclined cam faces 60 extending from the lower edge of the casing 23 upward to a point corresponding to the initial position 20*a* of the tails of the control members, and thus when either of the cams 45, 46 is in effective position, the movement of the housing 23 causes the cam surface of the effective cam to engage all of the tails of the control members in the position 20*c*, and swing the control members back to their initial 20*a* position. The timing of the operation of the cams 45, 46 depends on the number of colors in the pattern being produced, and the construction illustrated is appropriate for controlling the knitting of a fabric which contains two colors in the pattern and a ground color. The cams 45, 46 accordingly come alternately into operation at the completion of three rows of stitches, and the ratchet wheel controlling the operation of each cam is, therefore, provided with six teeth and the cam projections on the two ratchet wheels are 180 degrees apart.

In the operation of the parts so far described, the control members 18 initially lie with their tails in row 20*a*, as shown in Figure 3, and as the housing 23 moves along the grill to the right, the electromagnet 32 is energized from time to time under the control of the master pattern and its hammer forces down the tails 20 of selected control members. Each tail so displaced is engaged by the surface 39 of cam 37 as the housing moves along, and the control member is thus swung so that its tail occupies a position in the row 20*b*. When the casing has completed its traverse, the grill is set up for the selection of the needles which are to knit stitches in the next row, and the levers 17' are thereupon swung by their cams to advance the grill to the needle bed so that the levers in the 20*b* position will engage the extensions of the selected needles and move those

needles to knitting position. As soon as the needles have thus been selected and placed in operating position, the grill is moved back and the housing moves along the grill to the left, as shown in Figure 4. In this movement, the tails of the control members in the 20*b* position are engaged by the cam 41 and moved down to the row 20*c*, while the tails of the control members selected by the master pattern are forced down by the hammer of lever 33 to a position in which they are engaged by the cam surface 40 of cam 38 and moved into the row 20*b*. When this traverse of the casing has been completed, the grill is again advanced toward the bank of needles and the needles selected for knitting the second row of stitches are moved into knitting position.

The two selecting operations described are employed in the knitting of stitches of the two different colored yarn appearing in the design, and the third row of stitches is of yarn of the ground color. The control members which have not previously been selected must now be moved to the row 20*b* and the levers previously in that position must be moved to the lower inoperative position. Accordingly, when the housing moves again to the right, as shown in Figure 5, the electromagnet 32 is continuously energized and the lever 33 remains in operative position throughout the traverse of the housing. The hammer 34, accordingly, engages all the tails in row 20*a* and forces these tails downward into the path of the cam surface 39 on cam 37. At the same time, cam 42 engages all of the tails of the control members in the 20*b* position, and move these control members down into the row 20*c*.

At the completion of the knitting of the row of stitches of the ground color, the next row is knitted of yarn of the first pattern color, and for this operation, all of the control members must be restored to their initial positions and thereafter, and in the same traverse of the housing, selected control members must be moved from the initial or upper inoperative position to the intermediate or operative position. Accordingly, at the completion of the ground row, the cam 45 is brought into action (Figure 6) and its sloping cam surface 60 engages all of the tails of the previously displaced control members and moves these control members to the 20*a* position. The cam is in advance of the lever 33 in the direction of travel of the housing during this operation, so that the cam first moves all the control members to their initial positions and thereafter and in the same traverse of the casing, the lever 33 is actuated to engage the tails of selected control members and move those members to the effective position. At the end of this traverse of the housing, the cam 45 is moved back out of operating position, and the knitting proceeds, as has been described, until the next ground row has been knitted. The cam 46 then becomes operative to restore all of the control members to their initial position, and in the same movement of the casing, selected control members are brought into action to control the operation of the needles in the knitting of a row of stitches of the first pattern color.

The mechanism for controlling the operation of the electromagnets includes one or more pattern sheets, depending on the number of colors of the yarn used in the figured portions of the pattern, and means for scanning the pattern sheets and causing the operation of the electromagnetic selecting means in a manner determined by the sheets. In the form illustrated, the apparatus is suitable for controlling the operation of a knitting machine in the production of a fabric containing two colors in the figured portions of the pattern and a ground color. The pattern mechanism accordingly includes two pattern sheets 61, 62, each formed of electroconductive material, with the figures in the pattern to be reproduced such as that indicated at 63, formed of insulating material. The pattern sheets and the figures carried thereby may be of any suitable material, as, for example, the sheets may be of thin copper and the figures may be areas on the sheets covered by a suitable insulating paint. Each pattern sheet is mounted on a roll 64 of electroconductive material supported for rotation in suitable bearings, and the rolls are simultaneously rotated with a step-by-step movement by ratchet and pawl devices not illustrated. Each pattern sheet has the same width as the fabric being produced and the length of each sheet is sufficient to carry a repeat of the pattern.

In the operation of the device, the pattern sheets are effective successively, and they form part of an electrical circuit of which a diagram appears in Figure 10, current being supplied to the rolls 64 through contact members 66. The means for scanning the pattern sheets comprises a pair of arms 67, one for each sheet, mounted in a rod 68 extending through a portion of the block 25 and rotatably supported therein. At the lower end of each arm 67 is a roller 69 which rests on the pattern sheet, and the arms 67 are connected in the electrical circuit by connections not illustrated in Figure 1.

Current is supplied to the electromagnets 31, 32 through the electron-discharge tubes 70, 71, each of which contains a cathode 72, preferably of the indirectly heated type, a grid 73, and a plate 74, the tubes employed in the circuits shown being of the type in which no current flows when there is a negative bias on the grid, and full current flows when there is a zero bias, although other suitable types of tubes may be employed. If the device is operated from an alternating current source, current from a power line 75 is supplied through a transformer 76 to rectifier networks 77, 78, one for each tube, these networks being of the customary type and delivering direct current to the plate 74 of each tube. A rectifier and filter network 79 receives current from the transformer 76 and is connected through the potentiometer 80 to the grid of each tube, so that a negative bias in an amount controlled by the potentiometer can be applied to each grid.

The application of a bias voltage to the grids is controlled by a circuit which includes the distributor 81 which is provided with a pair of terminals 82*a*, 82*b*, located 180° apart. By means of the distributor, the rolls 64 and the pattern sheets 61, 62 are alternately placed in or cut out of the distributor circuit, and for this purpose, the contact members 66 for the two rolls are connected, respectively, to fixed contacts 83*a*, 83*b* which bear against the periphery of the distributor 60° apart. The distributor is rotated with a step-by-step movement in synchronism with the pattern rolls 64, and with the construction shown, the distributor is advanced by angular increments of 60°.

The distributor circuit is connected to terminals 84*a* and 84*b*, respectively, and in the diagram, pattern sheet 62 is shown as in circuit by reason of its contact 83*a* bearing against the terminal 82*a* of the distributor, while the contact

83b for pattern sheet 61 bears against a blank portion of the distributor. In this condition, the application of the negative bias to the grids of the two tubes is controlled by pattern sheet 62, and whenever a figure of the pattern lies beneath the scanning roller 69, the distributor circuit is open, since the figure is of insulating material.

The diagram illustrates the connections by which the operation of two textile machines may be controlled by a single pattern mechanism, and the electromagnets 31 in each housing 23 associated with a frame are connected across lines 85a, 85b, while the electromagnets 32 are connected across lines 86a, 86b. The lines 85a, 85b are connected to terminals 87a and 87b, respectively, and the lines 86a, 86b are connected to the terminals 88a and 88b, respectively. Terminals 87a and 88a are connected to the rectifying networks 77 and 78, respectively, and terminals 87b and 88b are connected to the terminals 84a and 84b, respectively.

The connections between the tubes and the electromagnets are such that electromagnet 31 of each pair is energized by tube 70, and electromagnet 32 of each pair is energized by tube 71. The connections for applying negative bias to the grids of the two tubes through the distributor circuit, which includes the pattern rolls, are such that when that circuit is open, a negative bias is applied to the grid of tube 70 and at the same time, the grid of tube 71 is kept at zero bias. When the circuit is closed, a negative bias is applied to the grid of tube 71 and at the same time, the grid of tube 70 is kept at zero bias. Thus, for example, when the circuit is closed, the voltage developed across the resistor 105 produces a negative bias on the grid of tube 71. While the grid of tube 70 is directly connected to the cathode of that tube through the protective resistor 106 and thus the grid of the tube is at zero bias. Accordingly, whenever the distributor circuit is closed, current is supplied through tube 70 to each of the electromagnets 31, and when that circuit is open, current is supplied to each of the electromagnets 32 through tube 71.

As previously described, the apparatus illustrated is suitable for controlling the knitting of a fabric in which the design contains two colors, and each of the pattern sheets controls the knitting of a row of stitches with yarn of one of these two colors. The two pattern sheets are accordingly successively effective for controlling the knitting of two successive rows, following which, a row of stitches of the ground color is knitted, while the two pattern sheets are ineffective. The distributor is employed for bringing the pattern sheets successively into operation for the knitting of the two color rows and for putting both pattern sheets out of operation for the knitting of the ground row. With the distributor in the position illustrated in Figure 10, pattern sheet 62 is in action and as the scanning roller 69 travels over the pattern sheet, the electromagnets 31 and 32 are energized alternately depending on whether the roller is in contact with an insulating or a conductive portion of the pattern sheet. In the diagram, the roller 69 is in contact with an insulated area 63 on pattern sheet 62, and the contact 83b for pattern sheet 61 bears against a blank spot on the distributor. The distributor circuit is, therefore, open, and each electromagnet 32 is energized and swings its lever 33 counter-clockwise. Whenever the roller 69 comes in contact with a conductive portion of pattern sheet 62, the distributor circuit is closed and this results in each electromagnet 31 being energized to swing its lever 33 clockwise.

After the scanning rollers have traveled lengthwise in one direction along the pattern sheets, the distributor 81 is advanced one step of 60°, for example, in a clockwise direction. This moves the terminal 82a out from beneath the contact 83a and under contact 83b. Pattern sheet 61 is now effective, and in the return movement of the scanning rollers along the sheets, the electromagnets 31 and 32 are energized under the control of pattern sheet 61. At the completion of the second traverse of the pattern sheets by the rollers, the distributor is advanced another step of 60° to a position in which both contacts 83a and 83b bear against insulated portions of the distributor, so that the distributor circuit is open and both pattern sheets are out of action. Since with the distributor circuit open, no bias is applied to tube 71, each electromagnet 32 is now energized and continues in that condition until the rollers have traveled the length of the pattern sheets again. During this traverse of the rollers, the levers 33 are held in operative position by their electromagnets 32 and the hammer on each lever engages all of the tails of the control members which lie in the upper ineffective position 20a and moves these control levers toward effective position 20b, the movement of the levers to this position being completed by the cams 37, 38 as previously described. The control members are then in proper position for controlling the knitting of the row of ground stitches, and when this row has been completed, the distributor is advanced another step, bringing terminal 82b beneath contact 83a, so that the pattern sheet 62 controlling the first color is again brought into operation. The sequence of operations is then repeated throughout the weaving of the fabric with two rows of pattern color stitches knitted into the fabric followed by a row of ground stitches.

The electrical connections illustrated and described provide a convenient means for controlling the action of the electromagnets by means of the pattern sheets, but it is to be understood that various other electrical apparatus may be employed for this purpose, if desired. When tubes of the type described are employed, the current flowing through the pattern sheets may be relatively small, while that supplied to the electromagnets is substantially greater. It is desirable to employ a light current passing through the pattern sheets to avoid arcing, but substantially greater currents should be used in the electromagnets in order to get the desired positive action during selection.

Regardless of the electrical connections and apparatus used, the electromagnets 31, 32 in the control mechanism associated with each textile machine may be controlled by a single pattern device with a separate pattern sheet for each color in the figured portions of the design. If the pattern includes a single color in the design or more than two colors, a distributor of a construction different from distributor 81 must be employed in order that proper control may be exercised. Thus, if the design includes three colors, the three pattern sheets must be brought successively into operation following which all pattern sheets are out of action while a row of the ground color is knitted. The construction of the distributor therefore depends on the number of colors in the design, and the modifications necessary for different conditions of operation will be apparent.

In the new pattern control mechanism as illus-

trated and described, the electromagnet housing for each group of control members is moved along the group by means actuated by the driving means for the knitting frame or loom with which the control members are associated, and the pattern sheets and their associated mechanism are likewise driven by the driving means of one of these frames or looms. It will be apparent, however, that it is not necessary to place the pattern sheet mechanism in proximity to any knitting frame or loom, but if desired, this mechanism may be disposed at a central point from which connections lead to the electromagnets of the different frames or looms to be controlled. When this arrangement is employed, the scanning rollers are caused to traverse their pattern sheets in synchronism with the electromagnets moving along the groups of control members, and all of the knitting frames or looms being controlled by a single pattern mechanism are operated in synchronism. Such synchronization of operation can be achieved without difficulty by the use of proper electrical drives, and the new control mechanism may thus be readily employed to control the operation of a large number of machines without duplication of pattern sheets and of the devices by which current is supplied under the control of these pattern sheets to the electromagnets of the several machines.

In the mechanism illustrated, it has been found that there is a time lag between the contact of a scanning roller with a conductive portion of its pattern sheet, and the operation of the electromagnetic selecting means, this lag resulting from the necessity of building up current in the effective electromagnet, the inertia of the parts, etc. It is, therefore, necessary that the scanning rollers should be given a lead in their reciprocating movement along their associated pattern sheets, so that the lag in the operation of the selecting mechanism will not cause a distortion of the pattern in the fabric being produced. This result is obtained by advancing the scanning rollers slightly in the direction of their movement at each reversal in that movement, and for this purpose, the rod **68** is rotatably mounted in the block **25**, and on the end remote from the arms **67**, the rod is provided with an arm **89**, the end of which lies between adjustment screws **90***a*, **90***b* mounted on the face of the block **25**. A sleeve **91** is mounted loosely on the end of the rod **68** adjacent the arm **89** and this sleeve is provided with an arm **92** which may move between stop pins **93***a*, **93***b* on block **25**. A spring **94** connects the arms **89** and **92** as indicated in Figure 11.

At opposite ends of the path of travel of the block **25**, spring clips **96***a*, **96***b* are mounted on any convenient part of the machine, and as the block moves to one end or the other of its path, the arm **92** on the sleeve **91** enters one of these clips. Thus, as illustrated in Figure 1, when the block travels to the end of its path to the left, the arm **92** enters clip **96***b*, and when the block begins to return to the right, the arm **92** is held momentarily by the clip until the movement of the block causes the arm so held by the clip to strike stop pin **93***b*, after which the arm passes clear of the clip. The movement of sleeve **91** relative to rod **68** caused by the action of the clip on arm **92** and by the movement of the block results in spring **94** pulling arm **89** fast on rod **68** away from engagement with screw **90***a* and into contact with screw **90***b*. This causes the rod **68** to shift slightly, so that the scanning rollers **69** are advanced along the pattern sheets in the direction of movement of the block **25**. The extent of the advance or lead thus given the scanning rollers is determined by the movement of the arm **89** which is in turn controlled by the setting of the screws **90***a*, **90***b*. By proper adjustment of these screws, the scanning rollers are given a lead upon each reversal in their movement, which is just sufficient, under the conditions of operation, to correct for the lag in the operation of the selecting electromagnets.

In the construction illustrated in Figures 3 to 6, inclusive, for example, the hammer lever **33** is swung on its pivot by a pair of electromagnets **31**, **32** which are energized in alternation. If desired, one of these electromagnets may be dispensed with and the construction illustrated in Figure 12 may be employed. As shown in that figure, the hammer **97** is mounted on the end of a rod **98** attached to the armature **99** of an electromagnet **100** which is mounted with its pole faces at the top. The rod **98** passes through an opening in the core of the electromagnet, and a spring **101** encircles the rod and bears at one end against the armature **99** and at the other end against the upper face of the core. With this arrangement, upon energization of the electromagnet, the armature is drawn down and the hammer strikes the tail of a control member and moves it in the same manner as the hammer **34**. This movement of the hammer is against the action of the spring **101** which is compressed, and when the electromagnet is deenergized, the spring raises the hammer, rod, and armature so that the hammer is in inoperative position. With an electromagnetic selecting means of this construction, one electromagnet is dispensed with and the electrical circuits are correspondingly simplified.

In the apparatus above described, which is appropriate for use in connection with a knitting machine of the flat bed type, the control members remain at rest and the electromagnets of the selecting means move along the group of control members. In other kinds of textile machines, as, for example, in one form of circular knitting frame, the group of needles continuously rotates. In that type of machine, it will be apparent that the control members will move and the electromagnetic selecting means will remain at rest. Similarly, in a flat bed knitting frame, it is most convenient to provide control members which may be considered as part of an attachment for controlling the action of the needles, whereas in other textile machines, as, for example, in a circular knitting frame with a rotating needle bed, the frame itself contains control members, the action of which may be controlled by the electromagnetic selecting means. Accordingly, in the appended claims, the term "control members" is intended to include control members which form an integral part of the machine being controlled as well as control members which are used only with the pattern control mechanism of the invention.

I claim:

1. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and positively engaging and moving the selected members, a pattern, and means controlled by the pattern for actuating the device in conformity with the pattern.

2. In a textile machine having a plurality of elements to be controlled, respective control

members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and positively engaging and moving the selected members, a pattern, a source of electrical energy connected to the device, and means for scanning the pattern and controlling the supply of energy from the source to the device in conformity with the pattern.

3. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and positively engaging and moving the selected members, a pattern, a source of electrical energy, a circuit from the source including the device, and means for scanning the pattern and controlling the circuit through the device in conformity with the pattern.

4. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and rendering the selected members effective, a pattern, a source of electrical energy, circuits from the source including the pattern and the device, respectively, and means for scanning the pattern and controlling the circuit through the device in conformity with the pattern, the current flowing through the circuit through the device being greater than that flowing through the circuit through the pattern.

5. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and rendering the selected members effective, a pattern, a source of electrical energy, a circuit from the source including the device, means in the circuit through the device for amplifying the energy derived from the source, and means for scanning the pattern and controlling the circuit through the device in conformity with the pattern.

6. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members and engaging and moving the selected members toward effective position, mechanical means for completing the movement of the selected control members to effective position, a pattern, means controlled by the pattern for controlling the operation of the device, and means for giving the device and mechanical moving means and the control members a relative movement during which the members are selected by the device and the selected members moved to effective position by the mechanical moving means.

7. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to a plurality of positions in one of which said member is effective, a pattern, means controlled by the pattern for positively effecting movements of the members, said means including an electromechanical translating device operable to engage and move selected members, and means for causing said device and series of control members to have a relative movement along the said series.

8. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to a plurality of different positions in one of which the member is effective, a pattern, an element operable to engage selected control members and move them positively from ineffective toward effective position, electrical means controlled by said pattern for actuating said element, and means for producing a relative movement of said element and the series of control members in a direction along said series.

9. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members mounted in a series, a support therefor, each member being movable to a plurality of different positions in one of which the member is effective, a pattern, an element operable to engage selected members and move them positively from ineffective toward effective position, a mounting for said element, means for producing a relative movement of the mounting and the series of control members in a direction along the series, and electrical means controlled by the pattern for actuating the element, said means including an electromechanical translating device carried by the mounting.

10. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable in the support to a plurality of different positions in one of which the member is effective, a pattern, an element operable to engage selected members and move them positively from ineffective toward effective position, a mounting for the element, mechanical means on the mounting cooperating with the element for moving the selected members to effective position, means for producing a relative movement of the mounting and the series of control members in a direction along the series, and electrical means controlled by the pattern for actuating the element.

11. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions in one of which the member is effective, an element operable to engage selected members and move them positively from ineffective toward effective position, a mounting for the element, means for producing a relative movement of the mounting and the series of control members in a direction along the series, a plurality of cams on the mounting cooperating with the element to move members selected by the element to effective position, a pattern, and electrical means controlled by the pattern for actuating the element.

12. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions in one of which the member is effective, an element operable to engage selected members and move them positively from ineffective toward effective position, a mounting for said element, means for producing a relative movement of the mounting and the series of control members in a direction along the series, means on the mounting for positively moving control members selected by the element

to effective position and for moving previously effective members from effective to ineffective position, a pattern, and electrical means controlled by the pattern for actuating the element.

13. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions in one of which the member is effective, an element operable to engage selected members and move them positively from ineffective toward effective position, a mounting for the element, means on the mounting cooperating with the element for positively moving control members selected thereby to effective position, means on the mounting operable in alternation with the selecting operations of said element to restore all said control members to their initial positions, means for producing a relative movement of the mounting and the series of control members in a direction along the series, a pattern, and electrical means controlled by the pattern for actuating the element.

14. In a control mechanism for controlling the operation of a textile machine, the combination of a series of control members, a support therefor, said support being movable in a single plane only and each member being movable in the support to a plurality of different positions in one of which the member is effective, a pattern, means controlled by the pattern for positively effecting the movements of the members in the support, and means operable in alternation with said pattern-controlled means for causing a reciprocation of the support in its plane of movement.

15. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable in the support to different positions in one of which positions said member is effective, an element operable to engage selected members and positively move them from ineffective toward effective position, a mounting for the element, electrical means for actuating the element, a part of said means being carried upon said mounting, means for producing a relative movement of the mounting and the series of control members in a direction along the series, a pattern controlling the operation of the electrical means, and mechanical means on the mounting cooperating with the element for positively moving the control members selected thereby to effective position.

16. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions relative to said support, an element operable to engage selected members and positively move them relative to said support, a mounting for the element, an electromagnet for actuating the element and carried by the mounting, means for producing a relative movement of the mounting and the series of control members along the series, electrical means for energizing the electromagnet, and a pattern controlling the operation of the electrical means.

17. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to at least three different positions in the support in one of which positions the member is effective, a plurality of patterns one for each color (exclusive of the ground color) appearing in the design to be reproduced, means for bringing said patterns alternately into action, and means controlled by the pattern in action for positively causing movements of the members in the support.

18. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions in the support in one of which positions the member is effective, a plurality of patterns, means for bringing said patterns alternately into action, and means controlled by the effective pattern for causing the movements of selected members in the support, said means including an electromechanical translating device, and means for producing a relative movement of said device and the series of members in a direction lengthwise of the series, said device positively moving said members.

19. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable in said support to a plurality of said positions in one of which positions the member is effective, a pattern, means controlled by the pattern for positively moving the members in the support, said means including an element operable to engage and move said members, means for causing relative movement of said element and said support along the series of control members, an electromagnet associated with the element for actuating the latter, and an electrical circuit controlled by the pattern for supplying current to the electromagnet.

20. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in series, a support therefor, each member being movable to a plurality of positions in said support, in one of which positions the member is effective, an element operable to engage selected members and move them from ineffective toward effective position, a mounting for the element, a pair of electromagnets on the mounting operable alternately to render the element effective and ineffective, respectively, means for producing a relative movement of the mounting and the series of control members in a direction along the series, a pattern, and means for controlling the pattern by means of the electromagnets.

21. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to a plurality of positions in said support in one of which positions the member is effective, an element operable to engage selected members and move them from their initial ineffective position toward their effective position, a mounting for the element, means for producing a relative movement of the mounting and the series of control members alternately in opposite directions along the series, a plurality of cams on the mounting operable during relative movement in either direction to engage selected members and move them positively to their effective position and to engage previously effective members and move them to a second ineffective position, a pair of cams on the mounting operable alternately, depending upon the direction of relative movement, to restore all the members to their initial ineffective position, and means operable on the completion of a predetermined number

of relative movements of the support and the series of control members for rendering one cam of the pair effective during the next relative movement.

22. In a textile machine having a plurality of elements to be controlled, respective control members associated therewith for controlling the operation thereof, a support for the control members, the members being pivotally mounted in the support, means on the support for holding the members frictionally in position, an electromechanical translating device for progressively engaging selected control members and positively moving the selected members toward effective position, a pattern, electrical means controlled by the pattern for controlling the operation of the device, and means for producing a relative movement of the device and the series of control members in a direction along the series.

23. In a control mechanism for controlling the operation of a textile machine to cause it to reproduce a design, said machine having a plurality of elements to be controlled, control members associated therewith to control the operation thereof, an electromechanical translating device for selecting control members and rendering the selected members effective, a source of energy connected to the device, a plurality of pattern sheets, one for each color in the design (excluding the ground color), means for individually scanning the pattern sheets and controlling the supply of energy to the translating device in conformity therewith, and means for bringing said sheets into action, said means operating on a cycle in which said sheets are successively in action and then all are out of action, said translating device selecting and rendering all the control members effective during each stage in the cycle of operations of said means during which all the pattern sheets are out of action.

24. In a control mechanism for controlling the operation of a textile machine to cause it to reproduce a design, said machine having a plurality of elements to be controlled, control members associated therewith to control the operation thereof, an electromechanical translating device for selecting control members and rendering the selected members effective, a source of energy, a plurality of pattern sheets one for each color in the design (excluding the ground color), circuits including the source and the individual pattern sheets, respectively, means for individually scanning the pattern sheets and controlling the flow of energy through the circuit through the translating device in conformity therewith, a commutator operating to close the circuits through the pattern sheets, said commutator operating on a cycle in which the circuits through the individual sheets are closed successively and then all circuits through the sheets are open, said translating device selecting and rendering all the control members effective during each stage in the cycle of operations in said commutator during which all the circuits through the pattern sheets are open, and means for operating said commutator.

25. In a control mechanism for controlling the operation of a textile machine having a plurality of elements to be controlled, control members associated therewith to control the operation thereof, means for selecting control members and thereby selectively determining the action of said elements, said means including an electromagnet, an armature therefor, said armature being operable by the electromagnet to strike and positively move selected members and resilient means opposing the movement of the armature produced by energization of the electromagnet, a source of power connected to the electromagnet, a pattern, means including means for scanning said pattern for controlling the supply of energy from the source to the electromagnet in conformity with said pattern, and means for producing a relative movement of the control members and selecting means in which the control members are successively in position to be acted on by said armature.

26. In a control mechanism for controlling the operation of a textile machine having a plurality of elements to be controlled, a group of control members associated respectively therewith for controlling the operation thereof, an electromechanical translating device for progressively selecting control members from the group and rendering the selected members effective, means scanning the pattern for controlling the operation of the translating device, means for giving the pattern and scanning means a relative movement during which the pattern is scanned from side to side first in one direction and then in the opposite on successive traverses, and means operating prior to the normal return traverse of the scanning means to cause a limited relative movement of the pattern and scanning means to advance the scanning point in the direction of the relative movement to occur on the next traverse.

27. In a control mechanism for controlling the operation of a textile machine having a plurality of elements to be controlled, a group of control members associated respectively therewith. for controlling the operation thereof, an electromechanical translating device for progressively selecting control members from the group and rendering the selected members effective, means scanning the pattern for controlling the operation of the translating device, means for moving the scanning means to cause it to scan the pattern from side to side first in one direction and then in the opposite on successive traverses, and means operating prior to the normal return traverse of the scanning means to move the scanning means and advance the scanning point to a limited extent on the pattern in the direction in which the scanning means is to travel on the next traverse.

28. In a textile machine having a plurality of elements to be controlled, a series of control members associated respectively therewith for controlling the operation thereof, means for selecting said control members and thereby determining the operation of said elements, said means including an electromagnet, an armature therefor operable on energization of said magnet to cause control members to be positively moved, resilient means resisting the movement of the armature when the electromagnet is energized and restoring it to initial position when the electromagnet is deenergized, pattern means for controlling the energization of the electromagnet, and means for producing a relative movement of the control members and armature in which the control members are successively in position to be acted on by said armature.

29. The combination in a textile machine having a plurality of elements to be controlled, of a group of control members associated respectively therewith for controlling the operation thereof, an electromechanical translating device operable to select control members and render the selected members effective, said device, when operating freely, rendering effective all the control mem-

bers in the group, means for giving the group of control members and device a succession of relative movements in each of which said device is brought into operating relation to all control members in the group successively, a pattern, means scanning the pattern for modifying the action of the device in conformity therewith, and means operated on synchronism with the scanning means for rendering the scanning means alternately effective and ineffective during successive relative movements of the device and the group of control members.

30. The combination in a textile machine having a plurality of elements to be controlled, of a group of control members associated respectively therewith for controlling the operation thereof, an electromechanical translating device operable to select control members and render the selected members effective, said device, when operating freely, rendering effective all the control members in the group, means for giving the group of control members and device a succession of relative movements in each of which said device is brought into operating relation to all control members in the group successively, a pair of patterns, means for modifying the action of said device under the control of a pattern including individual means for scanning the patterns, and means for bringing the individual scanning means into operation and operating on a three-stage cycle in the first two stages of which said scanning means are successively effective for two successive relative movements of the device and group of control members and in the third stage of which both scanning devices are ineffective for a third such relative movement.

31. In a textile machine having a plurality of elements to be controlled, a series of control members associated respectively with said elements for controlling the operation thereof, and means for selecting control members in the series and thereby determining the operation of their associated elements, said means including an electromagnet, a pivotally mounted armature for the electromagnet operable on energization of said electromagnet to engage and move control members, means for restoring the armature to initial position when the electromagnet is deenergized, pattern means for controlling the energization of the electromagnet, and means for producing a relative movement of the control members and electromagnet in which the members are successively in position to be acted on by said armature.

32. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of members arranged in a series, a support for the members, each member being movable to different positions relative to the support, pattern means for positively effecting movements of the members relative to the support, said means including an electromechanical translating device controlled by the pattern, and an element actuated by the device and operating to strike and shift members in the series, and means for effecting relative movement of said element and members during which the members are successively brought into position to be acted on by the element.

33. In a textile machine having a plurality of elements to be controlled, the combination of a series of control members associated with respective elements for controlling the operation thereof, and means for selecting said control members and thereby determining the operation of said element, said means including an electromagnet, an armature to be operable on energization of said electromagnet to strike and move control members, means for restoring the armature to initial position when the electromagnet is deenergized, means for controlling the energization of the electromagnet including a pattern and means for scanning the pattern, and means for giving the selecting means and control members a relative movement in which the means and members come successively into cooperating relation.

34. In a knitting machine having a plurality of needles, the operation of which is to be controlled, the combination of a series of control members associated with respective needles, an electromagnet, an armature for the electromagnet operable on energization of the electromagnet to strike and move control members, means for restoring the armature to initial position when the electromagnet is deenergized, a pattern, means responsive to variations in the pattern for controlling the operation of the electromagnet, and means for giving the electromagnet and armature and the control members a relative movement during which the armature and members come successively into cooperating relation.

35. In a knitting machine having a plurality of needles knitting stitches of yarns fed from a plurality of supplies, the combination of a plurality of control members for respective needles, and arranged in a series, a support for the members, said members being movable to different positions relative to said support, a pattern for each yarn feed except one, means for scanning the patterns, electromechanical translating means controlled by the scanning means and operable to engage and move said members relative to the support, means for causing relative movement of said members and translating means to bring the members successively into operative relation with said means, and means for shifting members which have been moved relative to said support under the control of one pattern to a position wherein said members are out of the range of action of the translating means in response to every other pattern.

36. In a knitting machine having a plurality of needles knitting stitches of yarns fed from a plurality of supplies, the combination of a plurality of control members for respective needles and arranged in a series, a support for the members, said members being movable to different positions relative said support, a pattern for each yarn feed except one, means for scanning the patterns, electromechanical translating means controlled by the scanning means and operable to engage and move said members relative to the support, means for causing relative movement of said members and translating means to bring the members successively into operative relation with said means, and cam means for shifting members which have been moved relative to the support under the control of one pattern to a position wherein said members cannot be acted on by the translating means in response to any other pattern.

37. In a knitting machine having a plurality of needles, the operation of which is to be controlled, the combination of a series of control members associated with respective needles, an electromagnet, a pivotally mounted member operable upon energization of the electromagnet to strike and positively shift selected control members, a pattern, means responsive to variations in the pat-

tern for controlling the operation of the electromagnet, and means for giving the electromagnet and pivoted member and the control members a relative movement in which the pivoted member and control members come successively into cooperating relation.

38. In a textile machine having a plurality of elements to be controlled, the combination of control members for the respective elements, a pattern-controlled electromechanical translating device including an electromagnetically operated hammer lever acting to strike and positively shift selected members, and means for causing a relative movement of the members and device in which the members come successively into operative relation with the device.

39. In a control mechanism for controlling the operation of a textile machine having a plurality of elements to be controlled, the combination of a plurality of control members, a support therefor, each member being movable to a plurality of positions in one of which the member is effective, a pattern, means for scanning the pattern, electromechanical means for effecting movements of the members relative to the support including an electromagnetically actuated hammer operable to strike and shift selected members, means for actuating the electromechanical means under the control of the scanning means, and means for producing a relative movement of the members and hammer to bring the members successively into cooperating relation to the hammer.

40. In a control mechanism for controlling the operation of a textile machine, the combination of a plurality of control members arranged in a series, a support therefor, each member being movable to different positions relative to the support in one of which positions the member is effective, a pattern, means for scanning the pattern, an electromagnetically operated hammer operable under control of the scanning means to strike and shift selected members relative to the support, mechanical means for completing the movement of selected members struck by the hammer, and means for producing a relative movement of the hammer, mechanical means, and control members in which the latter are successively in position to be acted on by the hammer and mechanical means.

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