March 27, 1962 H. HORAK 3,026,913

LOOM EQUIPMENT FOR WEAVING IN SYMBOL SEQUENCES

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Fig.1

| | | |
|---|---|---|
| Fig.5 | Fig.3 | Fig.4 |
| Fig.2 | | |

Fig.2a

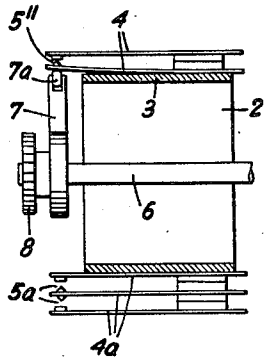



Fig.5

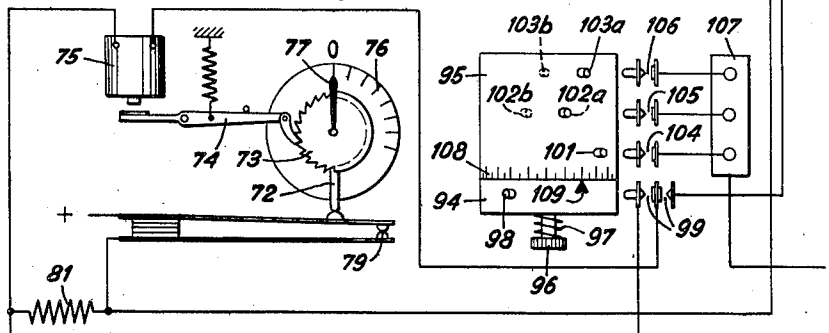
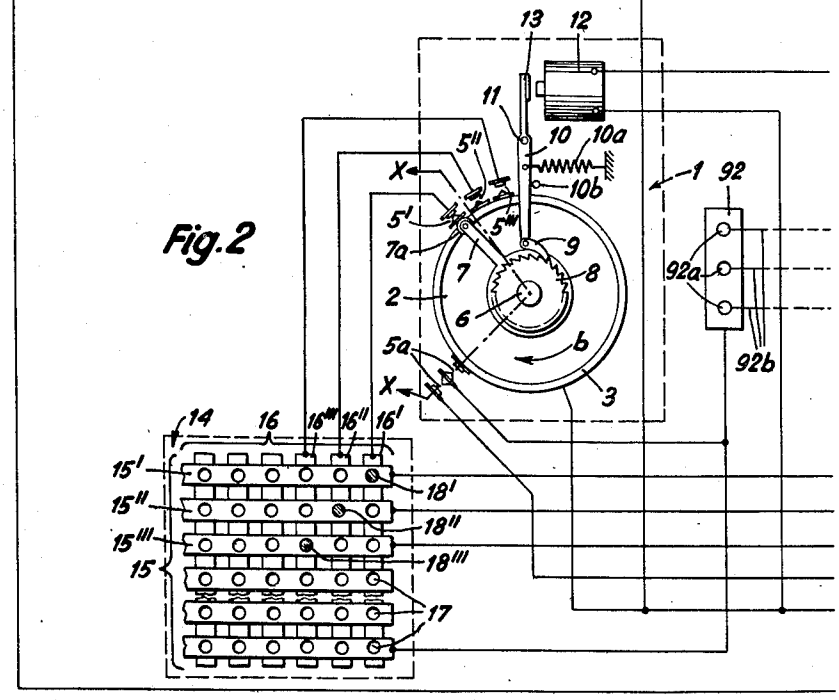



Fig.2



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LOOM EQUIPMENT FOR WEAVING IN SYMBOL SEQUENCES

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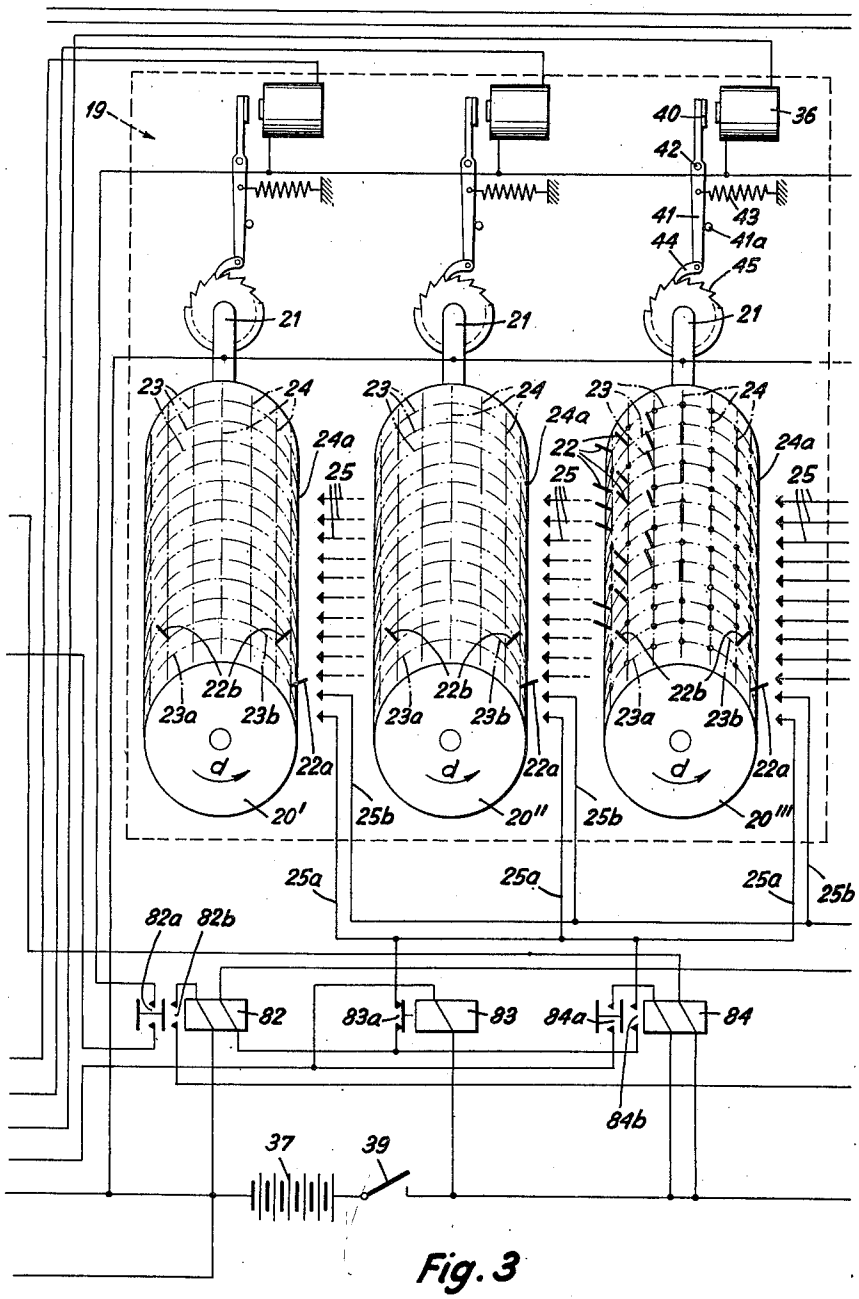



Fig. 3

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LOOM EQUIPMENT FOR WEAVING IN SYMBOL SEQUENCES

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Fig. 4

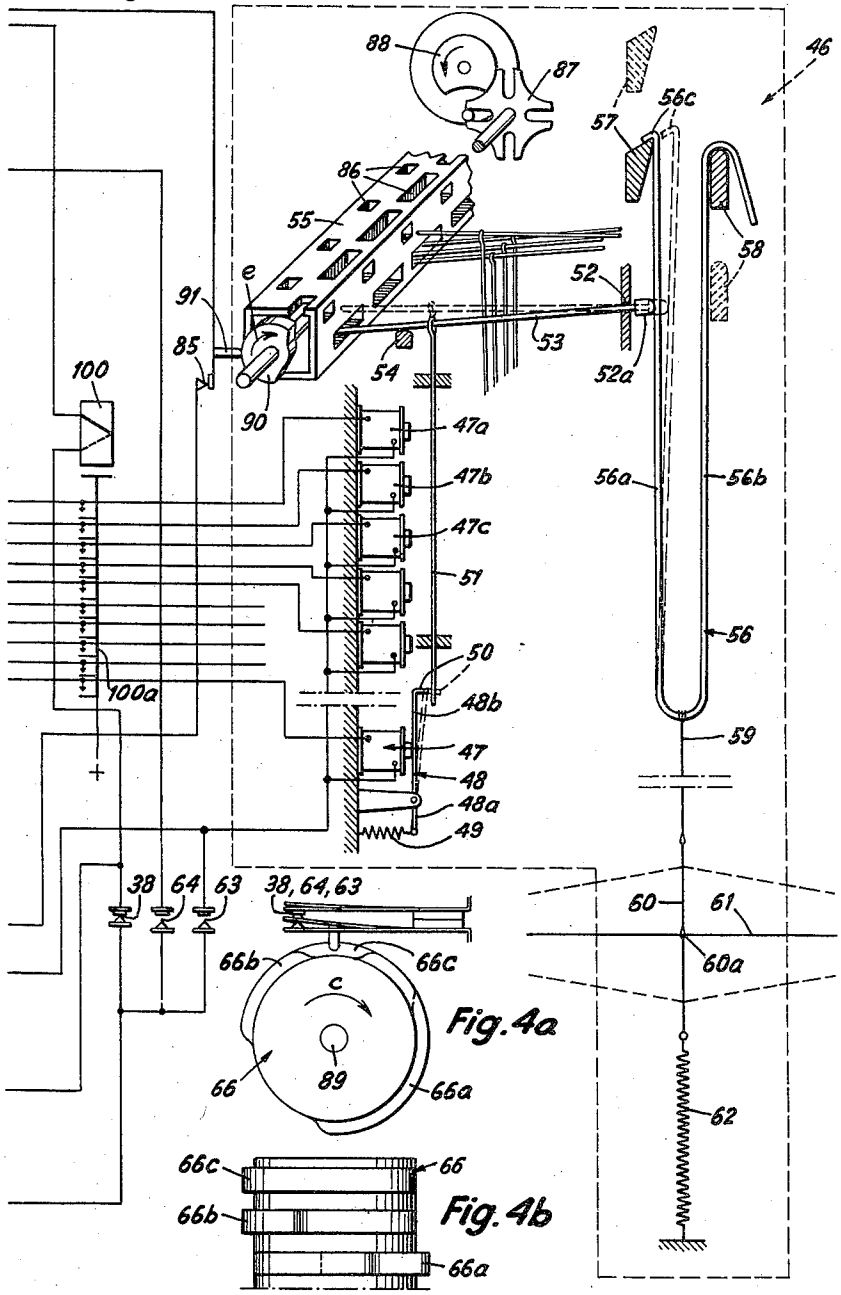



Fig. 4a

Fig. 4b

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LOOM EQUIPMENT FOR WEAVING IN SYMBOL SEQUENCES

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Fig. 7

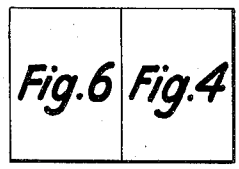



Fig. 6




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United States Patent Office 3,026,913 Patented Mar. 27, 1962



3,026,913

# LOOM EQUIPMENT FOR WEAVING IN SYMBOL SEQUENCES

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Filed Apr. 8, 1957, Ser. No. 651,215
Claims priority, application Switzerland Apr. 10, 1956
14 Claims. (Cl. 139—319)

This invention relates to weaving, and more particularly, to devices for weaving in, sequences of symbols such as characters, figures and punctuation marks.

In the weaving of material involving zones of varying bindings corresponding to sequences of characters, figures or similar symbols, up to now the usual Jacquard looms have been used. These looms use punched cards which for each sequence of symbols must be specially prepared, or at least specially rearranged. Inasmuch as the punching of the cards or the ever-varying rearrangement of these cards is very time consuming, it has not been possible, from an economic point of view, to weave in such sequences of characters, figures, punctuation marks or other symbols, except where production in large quantity was involved.

It is an object of the present invention to provide equipment whereby to weave in very rapidly changing sequences of symbols, provided the type of symbols remains the same, so a time loss for preparing the loom large enough to affect the cost of the operation, is eliminated, and it is therefore possible to manufacture the product even in very small quantities.

Other objects, and the manner in which the same are attained, will become apparent as this specification proceeds.

The invention contemplates providing weaving looms with equipment for weaving in sequences of symbols such as characters, figures, punctuation marks and the like, wherein stencil carriers are scanned and the result from such scanning is transmitted to the warp threads, and wherein a stencil carrier is provided for each symbol to be woven in, the stencil carriers being actuated by a searching instrument in a sequence predetermined by a selector.

In the drawings attached with this specification and forming part thereof, one embodiment of the invention is illustrated diagrammatically by way of example.

In the drawing:

FIG. 1 shows how FIGS. 2–5 should be assembled to show the whole of the installation,

FIG. 2 shows the searching instrument and the selector systems,

FIG. 2*a* shows a detail of FIG. 2, namely a section along line X—X in FIG. 2,

FIG. 3 is a diagrammatic showing the stencil system,

FIG. 4 shows diagrammatically some portions of the weaving in equipment including the correlated control system,

FIG. 4*a* is a side view of the cam shaft,

FIG. 4*b* is a top view of the cam shaft, the contact springs being omitted for clarity,

FIG. 5 is a diagrammatic representation of a metering and cut-off device.

FIG. 6 is a diagrammatic showing of those parts of the searching instrument and the selector which are correlated with an ornamenting roller, as well as of the said ornamenting roller, while

FIG. 7 shows the manner in which FIG. 6 should be assembled with FIG. 4 to provide an integrated showing of the part of the installation.

Referring now to the drawings wherein like elements are denoted by identical reference numerals, **1** indicates a searching instrument only such parts of which are shown



in the drawing as are necessary for an understanding of the invention. These parts include a drum **2** having an electrically conductive mantle **3**, on the exterior of which a predetermined number, *y*, of axially extending pairs of contact laminae **4** are mounted by one of their ends, the length of the contact laminae being such that they extend with their free ends beyond one of the faces of the drum **2**.

The number *y* corresponds to the maximum number of symbols of a sequence, which symbols may be characters, figures, punctuation marks or the like. The number *y* may be any number dependent on the particular use to which the installation is to be put. The free ends of the laminae of each pair **4** are provided with mutually juxtaposed contact pieces which together form *y* contacts **5′**, **5″**, **5‴**, etc. All these contacts (three of which only are shown in the drawing) are disposed all around the cylindrical surface of the drum **2**. Also on the exterior of the drum and in the same manner, three laminae **4***a* jointly constituting a double contact **5***a* are provided, and these at a point where they are the last in the direction of travel (indicated by the arrow *b*) of the search arm **7** which is firmly mounted on the shaft **6** of the drum and the free end of which carries a roller **7***a*. The length of the search arm and the diameter of the roller are so dimensioned that whenever the arm extends radially toward a pair of contact laminae, or toward the three laminae **4***a*, the respective contact is closed. Also mounted on the shaft **6** is a ratchet wheel **8**, which collaborates with a resilient ratchet **9**, the ratchet arm **10** being provided as a double lever pivoted at **11**, the other end of which serves as armature **13** for a search magnet **12**. Under the influence of the spring **10***a*, the ratchet arm **10** abuts against the stop **10***b*. When the search magnet **12** pulls, the ratchet **9** glides across the tooth of the ratchet wheel **8** in front of it, into the tooth gap in front of this tooth, whereas following the drop of the search magnet, the spring **10***a* returns the ratchet arm **10** into the position of rest shown in the drawing, so that the ratchet wheel is turned in the direction of the arrow *b* by one tooth pitch. The dimensions are so selected that after each drop of the search magnet **12**, the drum **2** is turned in the direction of the arrow *b* about an angle which corresponds to the angular distance between two adjacent contacts, so that following each drop of the search magnet **12** the next following contact **5″**, **5‴**, etc., or else the contacts **5***a* are closed.

The contacts **5′**, **5″**, **5‴**, are individually connected with contact pieces of a selector **14**, which in the embodiment illustrated in the drawing, is in the nature of a plug-in board but which may be provided in the form of any other type of selector known in the communication industry, such as a dial selector, for example. The plug-in board **14** comprises essentially two rows of parallel, electrically conductive rails disposed at right angles to one another and in spaced superposition.

The two rows are indicated at **15** and **16** in FIG. 2. The number of rails **16** corresponds to the number *y* of contacts **5′**, **5″**, **5‴** . . . , and the number of rails **15** corresponds to the number of symbols which might be woven in (alphabet, figures, punctuation marks, etc.), plus two additional rails. One of these additional rails **15** is correlated with an empty roller, and the other with the ornamenting rollers in a manner to be described below.

Each of the rails **16** is electrically connected with a contact of the search instrument **1**, i.e. the rail **16′** with the contact **5′**, the rail **16″** with the contact **5″**, the rail **16‴** with the contact **5‴**, etc. At the point of intersection of the rails **15′**, **15″** . . . of the upper, and the rails **16′**, **16″** . . . of the lower series, all rails are provided with bores **17** wherein, for the purposes of connecting electrically a rail of the upper series with one of the lower,

plugs 18', 18'', 18''', may be inserted. The electrical connections thus obtained may connect, for example, rails 16' and 15', 16'' and 15'', and 16''' and 15'''.

The stencil equipment 19, as shown in FIG. 3, includes a number of symbol-bearing stencils and ornamenting stencils, as well as an empty or plain stencil. The number of symbol-bearing stencils corresponds to the number of symbols which must be available to be woven in, and each symbol-bearing stencil is correlated with one particular symbol, whereas the number of ornamenting stencils corresponds to the number of ornaments desired. In the embodiment illustrated in the drawing, these stencils are provided in the form of rollers 20', 20'', 20''', etc. As all these rollers, apart from differences to be noted below, are based on the same design, only one roller, namely the roller 20''', has been illustrated with all its essential details, and the correlated description is valid also for all the other rollers. Every roller is electrically conductive and carries conductive control pins 22 which radially project from the roller mantle. These pins 22 are disposed on circumferential rims 23 which extend transversely to the axis of the roller, and in rows 24 which extend in parallel to the roller axis. As will be explained below, apart from two exceptions, each rim of a roller corresponds to a warp thread, and there are provided as many rows as woofs are required for weaving in the particular symbol involved. The pins are so arranged on the rollers and so distributed on the rims, that when they reach a predetermined position, per woof, the correlated warp threads are directed to assume a position which effects a binding corresponding to the symbol to be woven in.

In a manner to be described below, one complete rotation of a roller 20 effects all control procedures required for the weaving in of one symbol; once the rotation is completed, the roller correlated with the next following symbol is set to rotate, as will be explained below. In order that the symbols are woven in so they are properly spaced from one another, a spacing which is not the same for all symbols and which is determined by esthetic considerations, the weaving in of the next following symbol must not commence before the interspace has been woven. In the embodiment of the invention illustrated, this problem is solved by coordinating with each symbol a field which is composed of the area taken up by the symbol itself, and plain, marginal portions on both sides of the symbol, the size of these marginal portions being adapted to the particular symbol flanked thereby. The total field allotted to the symbol, therefore, covers an area varying from one symbol to the other. The symbol is disposed in the center of this area, and marginal portions precede and follow the symbol, adjacent marginal portions of consecutive symbols thus forming the interspace between the symbols.

Inasfar as the control of the weaving operation is concerned, the action of a symbol marking roller is limited to the weaving in of the symbol itself, whereas the weaving of the marginal portions is controlled by means and in a manner to be described below. As, however, the completion of one full rotation of a roller results in the actuation of the roller correlated with the next following symbol, the full rotation of the first-named roller must not be permitted to be completed before the marginal portions are woven. For this purpose, the rows 24 immediately preceding and immediately following the position of rest of each roller, are provided empty, i.e. without any control pins 22. With the roller 20''' the row which in the position of rest illustrated, faces the laminae 25, is denoted with 24*a*. As will be explained below, each row corresponds to a woof. If it is assumed that the marginal portions of the symbol correlated with the roller 20''', have a width of 4 woofs each, it follows that in addition to the row 24*a* defining the position of rest, another seven adjacent rows must be provided empty, i.e. without control pins; more particularly, three empty rows must be provided to one, and four empty rows to the other side of the row defining the rest position.

In addition to the control pins 22 controlling the weaving operation there are provided, on two additional rims 23*a* and 23*b* (foremost in the drawing), pins 22*a* and 22*b* which have other functions, the pins 22*a* being a stepping pin, and the pins 22*b* synchronizing pins.

Of these additional pins, the stepping pin 22*a* is disposed on the foremost rim and in the row 24 which in the direction of rotation (arrow *d*), just precedes the row 24*a* corresponding to the position of rest. The synchronizing pins 22*b* are arranged on the second rim, 23*b*, from the front, mutually displaced by four rows.

With each of the rims 23 of each roller, a contact lamina 25 is coordinated, while with the rims 23*a* and 23*b*, contact laminae 25*a* or 25*b*, respectively, are correlated. The laminae are so arranged with respect to the rollers that when they face a pin 22, 22*a* or 22*b*, an electrical connection between the respective lamina and the roller is established. This connection is referred to below as a "pin contact."

All contact laminae 25 correlated with corresponding rims are electrically connected with one another as well as with a control relay 47. Across the diagrammatically indicated junctions 21, all rollers are connected with the positive pole of a battery 37 so that on closure of a pin contact, the positive potential is transmitted to the correlated relay 47. The same as laminae 25, also all laminae 25*a*, on the one hand, and all laminae 25*b*, on the other hand, are interconnected, the laminae 25*a* being connected with one of the contact pieces of relay contacts 83*a* and 84*b*, respectively, while the laminae 25*b* are connected with the sole contact piece of the synchronizing contact 85.

The stepwise rotation of the rollers is effected by a stepping magnet 36 correlated with each roller. Every stepping magnet, on the one hand, is connected with that rail 15 which is correlated with the roller corresponding to the stepping magnet. Every rail 16, on the other hand, is electrically connected with the corresponding pair of contacts 5', 5'', 5''' etc. of the searching instrument. The center lamina of the double contact 5*a* is connected with a plug-in board 92, and by insertion of a contact plug in any one of the three sockets 92*a*, can be connected with the stepping magnet of any one of three ornamenting rollers (not shown), which rollers mount pins so disposed as to effect, by a control procedure to be described below, the weaving of an ornamental design. A further electrical connection exists between the rail 15 correlated with the ornamenting rollers, and the plug-in board 92. The wires leading to the stepping magnets are shown at 92*b*. The armature 40 of the stepping magnet 36 forms one arm of a two-armed ratchet lever 41 which is pivotally supported at 42, is influenced by a spring 43 and carries, at its free end, a ratchet 44 which collaborates with a ratchet wheel 45 mounted on the shaft of the roller 20''', the spring 43 forcing the ratchet lever 41 against a stop 41*a*. In consequence, whenever the magnet 36 pulls, the roller 20''' is rotated by one tooth pitch of the ratchet wheel, the rotary angle being so selected that consecutive axial rows 24 of control pins 22 are moved into reach of the contact pieces of the contact laminae 25. Accordingly, when the roller has completed a full turn, all control pins have been scanned by the corresponding contact laminae 25.

As shown in FIG. 4, the actuating mechanism for the weaving loom includes a number of control relays 47 corresponding to the number of pin bearing rims 23, and the magnets 47*a*, 47*b* etc. of these control relays are connected with a corresponding lamina 25 of each roller. The armature of each control relay is pivotally supported and influenced by a spring 49; it is provided as a double lever 48 one arm 48*a* of which is influenced by the spring 49, while the other arm 48*b*, the end of which is bent to form an abutment 50, is provided as a magnet armature.

When the control relay 47 is not excited, the abutment 50, under the influence of the spring 49, assumes a position (shown in dashes in FIG. 4) disposed in the path of a searching needle 51 which is supported for sliding vertical displacement; the top of this searching needle forms an eye which is traversed by the thrusting needle 53, this thrusting needle being supported for pivotal and sliding displacement at 52. The free end of the thrusting needle 53 rests on a lifting rail 54 which, as is customary in weaving looms, alternatingly moves up and down so as to move the thrusting needles 53 into or out of range of a control prism 55 which, though replacing the usual thrusting rail, is moved back and forth just the same, in a well known manner, at right angles to the searching needles.

The control prism 55 is provided in the form of a roller having square section which not only can move back and forth but also can rotate. Each lateral surface of the prism displays two rows of perforations 86. The relative position of the control prism 55, the thrusting needles 53 and the lifting rail 54 is so selected that the ends of the thrusting needles facing the prism are disposed at the level of the upper or the lower row of perforations 86 dependent on whether the correlated searching needle is in its upper position (shown in dashes in FIG. 4) or in its lower position (shown in full lines in FIG. 4). This arrangement has the result that with every thrust (toward the right in FIG. 4) of the control prism all those thrusting needles 53 are moved, the prism-facing ends of which cannot enter into a perforation 86 so that they are carried along by the effective lateral wall of the control prism. The distribution of the perforations in the upper and lower rows alternates in the sense that the lower row has perforations wherever no perforations are provided in the upper row. In the embodiment illustrated in FIG. 4, these perforations are arranged in repeated groups of four, of which one perforation always is in the upper row, whereas the remaining three are in the lower row. In the embodiment shown in FIG. 4, the three consecutive perforations in the lower row are combined into a single perforation of correspondingly increased width, i.e. a perforation three times as wide as the usual individual perforation. Inasmuch as the width of any one perforation is so selected that adjacent thrusting needles can enter also adjacent perforations, it results from the arrangement of the perforations in the upper row, as shown in the drawing, that when all the relays 47 are without current so that all thrusting needles are disposed in their upper positions (shown in dashes in FIG. 4), the first, fifth, ninth, etc. needles will enter perforations on a thrusting motion of the control prism, whereas the remaining thrusting needles are pushed. This has the result, as will be apparent from the explanation given below, that of a group of four consecutive warp threads only one, namely the first, is lifted, while the remaining three are dropped from the center position.

The control prism can be stepwise rotated, each step involving an angular displacement of 90°, by means of a Maltese cross transmission 87, the driving disk 88 being driven through a transmission gear (not shown) by the main control shaft 89; in consequence, on each quarter turn the next following lateral surface of the prism is placed into an effective position with respect to the ends of the thrusting needles. From one lateral surface of the prism to the next following in the direction of rotation (arrow *e*), the perforations are mutually displaced by one graduation (toward the right as shown in FIG. 4), so that on the next thrust motion of the control prism the second, sixth, tenth, etc. thrust needle enters a perforation so that it cannot be pushed forward. On completion of the next quarter turn the third, seventh, eleventh, etc. needle enters a perforation, until with the first lateral surface return to the effective position, the cycle recommences. In view of the effect on the warp threads mentioned above, it results that by the described control of the thrusting needles when the control relay 47 is without current, i.e. in the absence of any control impulses of the control rollers, a smooth twill binding is obtained.

By a corresponding variation of the control prism it is of course possible to produce other types of bindings. If, for example, the control prism has a regular pentagonal section, the control prism is stepwise rotated about 72° and the perforations of a lateral surface are so disposed that of any group of five, the same is always disposed in the upper row whereas the four others are disposed in the lower row. The control procedure described above results, in an analogous manner, in an atlas binding.

In the situation just mentioned where all that matters is to obtain a certain type of fabric when the control relay 47 is without current, the lower perforations do not play any part. They serve exclusively the purpose of weaving, in collaboration with the control relays 47, any optional design.

The control prism is further equipped with a cam 90 having a circular in section, in the path of which there extends a pin 91 of a resilient contact lamina of the synchronizing contact 85, so that this contact is closed whenever the cam 90 comes within reach of the pin 91. The respective contact lamina is connected via the disconnecting magnet 81, with the negative pole of a battery 37.

As mentioned above, the control prism moves back and forth in the direction of the axis of the thrusting needles so that those needles, which do not enter a perforation when the control prism moves toward the hook 56, abut by means of the head 52*a* against one shank 56*a* of the hook 56 so as to move the bent top end 56*c* thereof out of reach of the knife 57. The free end of the other shank 56*b* of the hook is likewise bent and is disposed within reach of the lower knife 58. As usual, the knives 57 and 58 are driven for vertical back and forth motion, the upper knife moving from the center position shown in full lines, into the upper position (shown in dashes in FIG. 4) and back, whereas the lower knife 58 is arranged to move from the center position to a lower position (shown in dashes in FIG. 4) and back. On each hook 56 a choir thread 59 is secured, and on this strand 60, the loop 60*a* of which is traversed by the warp thread 61. The free end of the strand 60 is connected, through a spring 62, with a stationary part of the installation so that the hook is pulled downward at all times and is subjected to upward displacement only by the upward motion of the knives, overcoming the force of the spring 62.

In addition to their connection with the contact lamina 25, the relays 47 are electrically connected with the switch 63 which, the same as switches 38 and 64, is formed by a pair of contact laminae. The three contact laminae are disposed within reach of a cam roller 66, mounted on the main control shaft 89 and provided on its circumference, with three radially projecting cams 66*a*, 66*b* and 66*c* which are displaced relative to one another in axial direction. In the path of each of the cams 66*a*, 66*b* and 66*c*, one lamina of each of the switches 38, 63 and 64 is disposed, so that when the cams 66*a*–66*c* abut against the respective laminae, the correlated switch is closed. Remaining details of the electrical connections will be apparent from the wiring diagram in the drawing.

It was explained above that every pin-carrying rim 23 is scanned by a contact lamina 25 correlated therewith. The result of the scanning depends on whether in the scanned row 24, a control pin 22 correlated with the respective contact lamina is inserted or not. The contact laminae for corresponding pin-carrying rims 23 of the various rollers 20', 20'', 20''', are electrically interconnected.

The contacts between the contact lamina correlated with each pin-carrying rim of every roller, and a control pin of the respective rim, control through a relay 47 and a hook 56, a warp thread 61 so that, as mentioned above,

the number of rims corresponds to the number of warp threads required for the weaving in of the particular symbol involved, while the number of rows 24 of pins is equal to the number of woofs required.

If, for example, it is intended to weave into a towel the sequences marking up the design in cooperation with plugs 18', 18'' and 18''', then these plugs are plugged into the plug-in board so that the first rail (16') of the series 16 is connected with that rail (15') of the series 15 (plug 18'), which in its turn is connected with the stepping magnet of that roller (20') which corresponds to the first part of the design which is in three parts because of the plugs. In order to facilitate the procedure, the rails of the series 16 are consecutively numbered from the left toward the right corresponding to the sequence of symbols, while the rails of the series 15 are marked from top to bottom with the symbols (A, B, C, etc.). The second rail 16'' of the series 16 is connected by means of the next plug 18'' with that rail (15'') of the series 15, which corresponds to the second roller (20'') and the third (16''') with that (15''') which corresponds to the third roller (20'''). If with respect to the searching instrument, the position shown is assumed to be the starting position, the search arm 7 closes the contact 5', so that when the main switch 39 is closed, the main control shaft 89 revolves and the cam shaft 66 has now rotated to a point where the cam 66*b* closes the switch 64, the stepping magnet 36 of the first roller 20' is connected, on the one hand, through the plug-in board 14, the pair of contacts 5' and the mantle of the drum 2 with the plus pole, and, on the other hand, through the switch 64 with the minus pole of the battery 37. In consequence, the magnet 36 pulls and rotates the first roller to the next row 24. As mentioned above, however, the first four rows contain no pins 22, except for the synchronizing pin 22*b* disposed in the second row counted from the position of rest. In view of the absence of pins 22 in the first row, none of the control magnets 47 pulls and all searching needles 51 remain in their upper position (shown in dashes in FIG. 4). The control prism 55 which is driven by the main control shaft 89 in rotary fashion as well as back and forth in a translatory manner in the direction of the thrusting needles 53, now pushes forward, in the manner described above, the three last thrusting needles of every group of four.

As soon as the main control shaft 89 has been subjected to rotary displacement to a point where the cam 66*b* permits the switch 64 to open, the stepping magnet drops, to rotate again, on a further rotary displacement of the main control shaft, the A-roller 20' by one further row; this new row which now faces the laminae 25, also is not provided with any pins. While this went on, the control prism has moved, in a well known manner, towards the left in FIG. 4 and at the same time, has been subjected to an angular displacement of 90°, so that now the adjacent lateral surface provided with perforations 86 which are displaced by one graduation toward the right in FIG. 4, faces the thrusting needles 53. In the same manner, the thrusting needles, now, however, with the exception of the second one of each group of four, are pushed forward. The same motions and control functions are repeated until the A-roller has rotated to a point where the synchronizing pin 22*b* makes contact with its lamina 25*b*. This condition prevails when the roller 20' has been rotated two steps, during which time the control prism also has been rotated by two steps, whereby the contact pin 91 has been set free by the cam 90, with the result that the synchronizing contact 85 opens. The circuit of the disconnecting magnet 81 thus remains interrupted. On the next but one rotation of the roller 20', the laminae 25 face a row provided with pins 22, and the marginal portion in front of the character A has been completed in the form of a plain twill binding.

It is evident that the synchronizing of the movements of the rollers and the control prism has a signal importance. The synchronism is controlled, on the one hand, by synchronizing pins 22*b* and the correlated contact laminae 25*b*, and on the other hand by the cams 90 and the synchronizing contact 85. The angle of about 270° at the center of the cam 90 has the result that the contact 85 remains open during one back and forth movement of the control prism, but is closed during three such movements. The synchronizing pins 22*b* are arranged, as mentioned above, in each fourth row of every roller and this in a manner such that they establish contact with their laminae 25*b* when the contact 85 is open. As long as these conditions, and consequently synchronism, prevail, the circuit: plus pole—roller—pin 22*b*—lamina 25*b*—contact 85—disconnecting magnet 81—minus pole, is always open. Whenever the rotary motions of the rollers and the control prism fall out of step, sooner or later a condition is reached where both contacts (22*b*/25*b*, 85) are closed and the disconnecting magnet pulls. This magnet is designed to effect in a manner of a relay the stop of the loom by the coupling, the warp thread guard, the woof thread guard, the driving circuit for the loom motor or by any other known stop mechanism.

When the roller has been rotated by four steps so a row provided with pins 22 faces the laminae 25, an electrical connection is established between every pin and the laminae correlated therewith. This remains without significance until the cam roller 66 has been rotated to a point where the cam 66*a* closes the switch 63, which has the effect that wherever a control pin 22 faces a contact lamina 25, from the negative pole of the battery through the main switch 39, the switch 63, the winding of the respective control relay 47, the respective contact lamina 25, the respective pin 22, the roller 20' and back to the positive pole of the battery, the circuit for the magnets 47*a*, *b* . . . is closed. The rotation of the roller thus effects the preparation of the circuit for the motions to be released by the control relay 47, which circuit is closed only when the cam shaft 66, or the cam 66*a*, closes the switch 63.

When the control relays 47 pull, this results in the withdrawal of the supporting surfaces 50 for those searching needles 51, which corresponds to the relay switch being pulled. Except for the replacement of the thrusting rail by the control prism 55, the remaining functions correspond to those known from traditional weaving in looms. The searching needles are moved up and down by the lifting rail 54. The motions of the lifting rail 54 and the control prism 55 are so coordinated that the control prism 55 moves toward the right in the drawing, as soon as the lifting rail is in the lower region of its path.

Those searching needles which have their supporting surfaces 50 withdrawn by the pulling of the relays 47, follow the lifting rail 54 by dropping from the region of the upper row of perforations 86 into the region of the lower row of perforations. Whether a thrusting needle corresponding to a searching needle is pushed forward by the control prism or not, depends on whether the end of the thrusting needle facing the control prism enters a perforation, or abuts against a lateral wall of the control prism as soon as the thrusting motion of this control prism commences. It results from this that the pins must be so arranged on the rollers that with the given arrangement of the perforations on the lateral walls of the control prism, the desired type of binding is obtained. It derives further from this dependence of the arrangement of the pins on the disposition of the perforations, that the desired result can only be obtained if the rotary motions of the rollers and the control prism are in perfect synchronism.

The stroke of the thrusting needle results, as usual, in a pivotal motion of the shank 56*a* of the hook 56 out of reach of the knife 57 (into the position shown in dashes in FIG. 4) with the result that the respective hook does not take part in the upward motion of this knife and only

follows the knife **58** from the center into the lower position.

As soon as the cam **66***a* has left the region of the contact laminae of the switch **63**, the previously excited control relays **47** drop and their armatures return under the influence of the springs **49** into their starting position (shown in dashes in FIG. 4). The further rotation of the cam shaft **66** closes the switch **64**, which causes the stepping magnet **36** to pull and the energized first roller to rotate about the angular distance between two rows of pins so that now the next following row of control pins is subjected to scanning. The cam **66***a* thereupon again effects closing of the circuits of the control relays **47**, which results in the manner already described, in the corresponding control of the hooks **56** and consequently, the warp threads **61**. The successive scanning of the rows of control pins of the stepping magnets, selected by the selector **14** and energized by the searching instrument **1**, of a roller renders possible to so control the warp threads, that on principle any optional binding can be produced, and in particular one where a woven in symbol appears. When in the manner described above, all rows of control pins of the first roller have been scanned, the laminae are again faced by a succession of empty rows, i.e. rows containing no pins, and the control prism controls directly and with no pull of the relays **47**, the weaving of the second marginal portion of the field allotted to the first part of the design which is in three parts because of the plugs.

In the row preceding the position of rest, the stepping pin **22***a* is disposed which now makes contact with the lamina **25***a*. As soon as by the rotation of the cam shaft **89** (arrow *c*), the cam **66***a* closes the switch **63**, the relay **82** is energized by the circuit: negative pole of battery—main switch **39**—switch **63**—second winding of relay **82**—contact **83***a*—lamina **25***a*—stepping pin **22***a*—roller **20'**—positive pole of battery, and closes the contacts **82***a* and **82***b*. On further rotation of the cam shaft, the cam **66***c* closes the switch **38** and this, as derives from the angles at the centers of these cams shown in FIGS. 4*a* and 4*b*, without any previous opening of the switch **63**. The switch **38** now closes the circuit: negative pole of battery—main switch **39**—switch **38**—contact **82***b*—first winding of relay **82**—positive pole of battery, so that the relay **82** is held even if now the switch **63** opens, and the cam **66***b* closes the switch **64**, which causes the stepping magnet **36** of the first roller to pull so as to rotate the same into its position to rest. When the relay **82** pulls, however, the closing of the switch **64** further results in the pulling of the search magnet **12** by the circuit: negative pole of battery—main switch **39**—switch **64**—contact **82***a*—search magnet **12**—positive pole of battery, but this does not effect the rotation of the search arm as this pivots, because of the ratchet arrangement selected, only when the search magnet drops. A further rotation of the main control shaft **89** with the cam shaft displaces the cams **66***b* and **66***c* simultaneously out of reach of the correlated contact laminae, so that the switches **64** and **38** both open. This causes the relay **82** to drop, the search magnet **12** is deprived of current and the search arm is pivoted about the angle between two adjacent pairs of contact laminae. In the embodiment of the invention described, the search arm now closes the contact **5''**, whereby the rail **16''** and with it, by the plug **18''**, the rail **15''** of the **15** series is energized, so that in place of the stepping magnet of the first roller, now that of the second roller **20''** is energized, so that this roller is driven and scanned to control, corresponding to the arrangement of its pins, the hooks **56**.

The control procedures described above are repeated until the sequence making up the design from the plugs which are selected on the plug-in board is woven, by causing the search arm to effect the operation of the rollers corresponding to these characters, the marginal portions of the letter fields being woven in the absence of relay control, by means of the control prism. If, for example, an inscription consisting of several words is to be woven in, a plug **18** is so plugged in on the board that the rail **16** following the rail **16** corresponding to the last letter of the first word, is connected with the rail **15** correlated with the empty or plain roller with the result that when the first word is finished this empty or plain roller is rendered operative. This empty roller is provided with no pins other than the stepping pin **22***a* and the synchronizing pins **22***b*, so that the control of the thrusting needles is assumed by the control prism exclusively, the same as in the weaving of the marginal portions. Otherwise the empty roller operates the same as any symbol-bearing roller, its diameter, i.e. the number of rows, necessarily being adapted to the desired width of the empty space between successive words, in the inscription to be woven in.

It may be required to weave an ornamental design following the sequence of symbols woven in. For this purpose, a corresponding plug is plugged into the board **14** so as to connect the next following pair of contacts **5** through a rail **16**, with the rail **15** correlated with the ornamenting rollers. The ornamenting rollers, on principle, are constructed in precisely the same manner as the symbol rollers, so each has associated with it a stepping magnet **36**, a synchronizing pin **22***b* and a stepping pin **22***a*, with the last-named pin designed to cooperate with a lamina **25***a* in the same manner as explained above with reference to the symbol rollers. This lamina **25***a* is connected with other parts of the device exactly the same as the corresponding laminae of the symbol rollers. The only difference in the control of these rollers resides in that with the ornamenting rollers, the stepping magnet is not directly connected with a rail **15**, as is the case with the symbol rollers, but is connected with a plug-in board **92** which in turn is connected with a rail **15** as well as with the center contact of the double contact **5***a*. The respective rail **15** is connected with another plug-in board **92** each of whose sockets **92***a* is connected with the stepping magnet of an ornamenting roller. By plugging a plug into one of the sockets **92***a* it is thus possible to effect the connection of the respective rail **15** with the stepping magnet of a selected one of a number of ornamenting rollers. This renders possible to select any one of a whole series of ornamental designs. In the direction of travel of the search arm **7**, in the last place on the circumference of the drum **2**, the double contact **5***a* is provided the closing of which by the search arm and the insertion of the above-mentioned plug (not shown) into the plug-in board **92**, have the result that the positive potential of the drum mantle is transmitted directly to the stepping magnet of one of several (three as shown in the drawing) ornamenting rollers, which operate much the same as the symbol-bearing rollers described above. It results that the search arm successively closes the contacts **5'**, **5''** . . ., whereby the individual rollers are set to operate. When the sequence of symbols to be woven in is completed, the remaining, unused rails **16** are connected by a corresponding insertion of plugs, with the rail corresponding to the ornamenting rollers. When all these contacts **5'**, **5''** . . . of the series of symbols have been actuated by the search arm, the search arm encounters finally the contact **5***a* the closure of which results in establishing a direct connection to the plug-in board **92**. The closure of the contact **5***a* further results in the pulling of relay **83** and the consequent opening of the contact **83***a*. The effect, to be explained below in detail, of the pull of relay **83** consists in that the ornamenting roller selected by insertion of a plug into one of the sockets **92***a* of the plug-in board **92** can effect an optional number of rotations while when the stepping magnet is energized by a rail **16**, the search arm effects further stepping following each full rotation of the ornamenting roller. This continuous further stepping is also the reason for the fact that when an ornamental design is to be woven before the search arm has actuated all pairs of contacts, the continuation of the weaving of

the ornamental design must be effected by the introduction of plugs.

FIG. 5 illustrates a stopping and metering mechanism which permits determining the lines of separation between continuously woven yet later to be separated cloth (such as towels, for example), as well as the disposition of the woven in inscription between these lines of separation, and which permits moreover a stopping of the loom following completion of a certain number of pieces of material.

The metering device comprises two co-axial drums **94** and **95**, of which the drum **95** is firmly mounted on their joint shaft, which may be driven by any appropriate component of the loom, whereas the drum **94** is merely forced against the face of the first mentioned drum by a spring **97** which may be adjusted by a screw **96**, this drum **94** being carried along by the first mentioned drum yet being capable also of rotary displacement relative thereto. The drive of these drums is so selected that a complete rotation of these drums corresponds, for example, to the length of a towel to be made. The drum **94** is provided with a radially projecting contact pin **98**, which during each rotation of this drum closes once the double contact **99**. The closure of the contact **99** effects the pulling of the relay **100**, the winding of which is connected to the negative pole of the battery while the innermost lamina of the double contact **99** is connected with the positive pole of the battery. The armature **100***a* connected with the positive pole of the battery, of the relay **100**, is so designed that when the relay pulls, all laminae **25** are short-circuited, and thus all relays **47** are caused to pull. This results in a pivoting of all thrusting needles into their lower position so that only the lower rows of perforations on the control prism are operative. Thus, as long as the contact **99** is closed, which because of the continuous rotation of the drum **94** does not last long, faulty bindings are produced which are visible in the finished goods in the form of markings indicating where the length of cloth is to be cut, for example, into individual towels. As soon as the contact **99** opens again the relay **100** drops and the normal weaving operation is resumed. A further consequence of the closure of contact **99** is the pulling of the metering relay **75** the armature of which is provided in the form of a ratchet lever **74**, which whenever the metering relay **75** pulls, rotates the ratchet wheel **73** including a pointer **77** firmly mounted thereon, by one tooth pitch. The pointer **77** moves across a dial **76**. In the beginning of the weaving operation, the pointer is adjusted to the number of pieces, e.g. towels, to be produced, and on every rotation of the drum corresponding to the length of the towel, it approaches by one dial division equalling one tooth pitch, the zero position represented in FIG. 5, in which a contact pin **72** mounted on the ratchet wheel **73** closes the contact **79**. This causes the stopping magnet to pull, with the result that the loom is stopped.

The drum **95** has disposed on three rims, a pin **101** and two pairs of pins **102***a* and **102***b*, and **103***a* and **103***b*, the single pin as well as the two pairs of pins being designed to collaborate with correlated resilient laminae of contacts **104**, **105** and **106**, respectively. These resilient laminae are all connected with the positive pole of the battery, while the counter-laminae of these contacts are connected with the plug-in board **107** where they can be connected, by insertion of a plug, across a second winding of the relay **84** with the negative pole of the battery. Adjacent marginal portions of the mantles of the drums **95** and **94**, are provided with a scale **108** and a marker **109**, respectively.

When the pin **101** abuts against the correlated contact spring lamina, which happens once during each rotation of the drum **95**, and if a plug is inserted in the bottom socket of the plug-in board **107**, as shown in FIG. 5, the relay **84** is energized by the circuit: positive pole of the battery—plug-in board—second winding of the relay **84**—negative pole of the battery, and closes the contacts **84***a* and **84***b*. The contact **84***a* is a self-holding contact for the relay **84**. This self-holding contact serves the purpose of making sure that the relay **84** is energized until a stepping pin **22***a* of the ornamenting roller is rendered operative regardless whether the contact **104** remains closed during this time. The closure of the contact **84***b* effects, when the switch **63** is closed, the contact **83***a* is open and when a stepping pin **22***a* of the ornamenting roller contacts the corresponding lamina **25***a*, the pulling of the relay **82** by the circuit: negative pole of battery—main switch **39**—switch **63**—second winding of relay **82**—contact **84***b*—lamina **25***a*—stepping pin **22***a*—roller **20'''**—positive pole of battery. This has as consequence, however, as previously remarked, that with the switch **38** closed, the search magnet **12** can pull and the search arm **7** can be rotated. Thus, the closure of the contact **104** has the result that when an ornamenting roller is operative and therefore, by pulling of the relay **83**, the contact **83***a* is opened, i.e. a stepping of the searcher by a stepping pin cannot occur, this stepping across relay **84** is now initiated so the weaving in of symbols can commence.

In order to cause the sequence of symbols to be woven in to be disposed in the center of the towel, i.e. in the center between two cutting marks produced by means of the pin **98**, it is necessary to provide for the possibility, dependent on the length of this sequence of symbols, of varying the relative positions of the pins **98** and **101**, i.e. of the drums **94** and **95**. This possibility is afforded by the rotary displaceability of the drum **94** relative to the drum **95**, the extent of this relative rotary displacement of the two drums being visualized by a reading of the marker **109** on the scale **108**. A table should be provided indicating for given lengths of material and varying numbers of symbols to be woven in, the scale value of the rotary displacement.

The pins **102***a* and **102***b* of the second rim, and the pins **103***a* and **103***b* of the third rim determine, the same as pin **101**, the commencement of the weaving in of symbols and this in cases, where, in contrast to the pin **101** which merely permits one weaving in operation per length of a piece of fabric, such as a towel, the sequence of symbols is to be woven in twice. The pins **102***a* and **102***b* are displaced relative to one another by 180°, so that the sequence of symbols is woven in at regular intervals. The pins **103***a* and **103***b*, however, are displaced about an angle deviating from 180° so that the distance between the first and second sequence of symbols is smaller than that between the second and third sequence.

This latter arrangement is useful in connection with relatively short sequences of symbols, which are disposed in the vicinity of one another, e.g. on a towel near the center thereof.

From a purely electrical point of view, all these pins serve the same purpose, namely to initiate the beginning of the weaving in of the symbols. Dependent on whether per length of the individual piece of fabric produced, a single sequence of symbols, or two regularly distributed sequences of symbols, or finally two irregularly distributed sequences of symbols are to be woven in, a plug is inserted in the plug-in board **107** in the bottom, center or top sockets respectively.

It is apparent from the above description that the time consuming punching operations on punched cards used up to now, are eliminated by the invention which simply requires an appropriate connection of the rails **15'**, **15''**, etc. and **16'**, **16''**, etc., respectively, i.e. by a corresponding insertion of the plugs **18'**, **18''**, etc., renders operative the appropriate stencil carriers in a predetermined and readily selectable sequence. The time gain obtained by the invention is so material that in contrast to the equipment known up to now, the invention renders commerically feasible to weave in inscriptions or any other sequences of symbols even in small quantity.

It is evident that the stencil carriers are not necessarily provided in the form of rollers but may be of any other

well known type. Thus, the rollers might be replaced by a continuous paper roll or an endless metal foil with perforations, a pin-carrying disk or a correspondingly premagnetized ribbon which corresponds to a predetermined symbol. It is essential, however, that means are provided which permit the energizing of the control magnets at the right time and in the correct sequence.

I wish it to be understood that I do not desire to be limited to the details of construction, design and operation shown and described as numerous variations falling within the scope of the following claims and involving no departure from the spirit of the invention nor any sacrifice of the advantages thereof, may occur to persons skilled in the art.

I claim:

1. Equipment for weaving looms for interweaving warp and weft threads to form sequences of symbols, including stencil carriers correlated with each symbol, means for scanning the stencil, and means for transmitting the scanning result to the warp threads, comprising in combination, a searching instrument for rendering the stencil carriers operative, and a selector for predetermining the sequence in which said searching instrument renders the stencil carriers operative.

2. The device according to claim 1, wherein the stencil carriers comprise rollers and control pins on said rollers, and the scanning means comprise contact laminae adapted to make contact with said control pins.

3. The device according to claim 2, wherein the rollers comprise stepping pins, the searching instrument comprises a search magnet, said stepping pins being adapted, when scanned by the correlated contact laminae, to cause pulling of said search magnet.

4. The device according to claim 2, wherein the stencil rollers are subdivided into circumferential rims with said rims carrying said control pins in rows arranged parallel to the roller axis, one control pin being insertable at the intersection of each rim and row, one contact lamina being correlated with each rim, whereby to scan all control pins disposed in any one row simultaneously.

5. The device according to claim 4, comprising control relays, windings on said relays, raising and lowering means for the warp threads controlled by said relay windings, and wherein the contact laminae of corresponding rims of all stencil rollers are electrically connected with one another, and with the winding of one of said relays.

6. The device according to claim 5, comprising a control prism having an equilateral polygonal cross-section, the number of sides of said prism depending on the prevailing number of picks required to repeat the weave, and thrusting needles extending toward said prism so as to be controlled by said prism.

7. The device according to claim 6, wherein each lateral face of the control prism comprises two rows of perforations, said thrusting needles being arranged in groups, the number of needles in each group corresponding to the number of warp threads in one pattern, and the number of groups of needles corresponding to the number of repeats, warpwise of the pattern, said rows of perforations being spaced apart and arranged to alternately control said needles.

8. The device according to claim 7, wherein the two rows of perforations on the respective lateral faces of the control prism are superposed and disposed in levels corresponding to the positions of the thrusting needles as displaced by said raising and lowering means.

9. The device according to claim 6, including an electrical loom shut-off means, contacts in the circuit of said loom shut-off means, the stencil carriers and the control prism comprising control means, said control means being adapted to influence said contacts to actuate said loom shut-off means.

10. The device according to claim 1, wherein the selector comprises a plug-in board, two series of intersecting, yet spaced rails on said board, means for electrically connecting said rails at the points of intersection; the searching instrument includes a plurality of contacts, and means are provided for electrically connecting each rail of one series with a stencil carrier, and each rail of the other series with a contact of said searching instrument.

11. The device according to claim 10, including a stepping magnet for actuating each stencil carrier, the stencil correlated series of rails being connected with said stepping magnets.

12. The device according to claim 1, wherein the stencil carriers include ornamenting rollers, stepping means are provided for actuating said ornamenting rollers, and the searching instrument includes contacts correlated with said ornamenting rollers, said contacts, when closed, being adapted to render said stepping means inoperative.

13. Equipment for weaving looms for interweaving warp and weft threads to form sequences of symbols, including stencil carriers correlated with each symbol, means for scanning the stencil, and means for transmitting the scanning result to the warp threads, comprising in combination, a searching instrument for rendering the stencil carriers operative, and a selector for predetermining the sequence in which said searching instrument renders the stencil carriers operative, and further including means for determining the position of the symbol to be woven in, on the fabric, comprising two members jointly driven by the loom yet displaceable relative to one another, one of said members including means for initiating the weaving in of a symbol, and the other member including means for producing cutting marks.

14. The device according to claim 13, comprising a metering means and a loom shut-off means, the cutting marks producing means on one of said loom driven members being adapted to actuate said metering and said loom shut-off means.

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