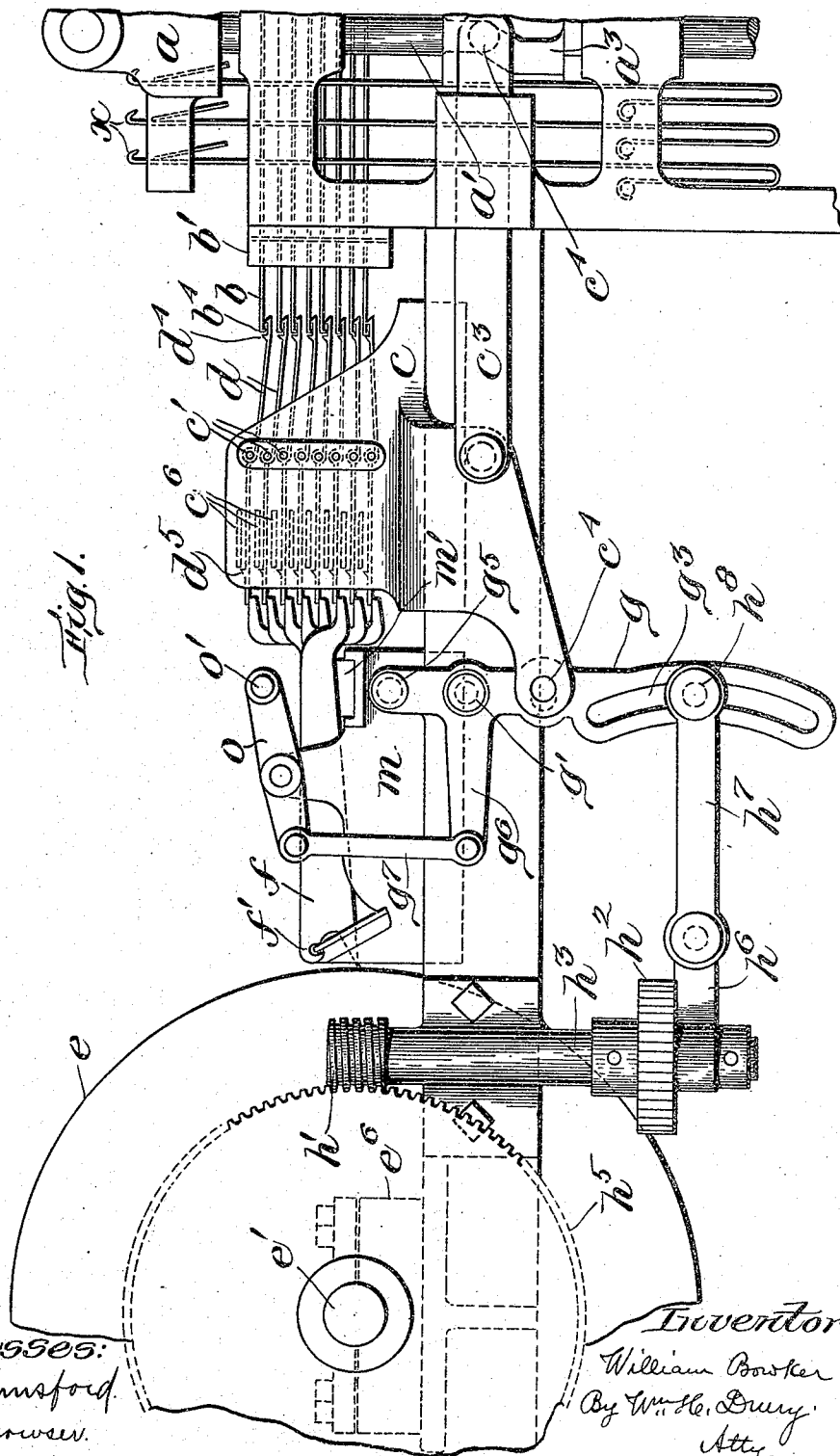


W. BOWKER.
MACHINERY FOR MANUFACTURING TEXTILE FABRICS.
APPLICATION FILED SEPT. 9, 1908.

939,467.

Patented Nov. 9, 1909.

3 SHEETS—SHEET 1.



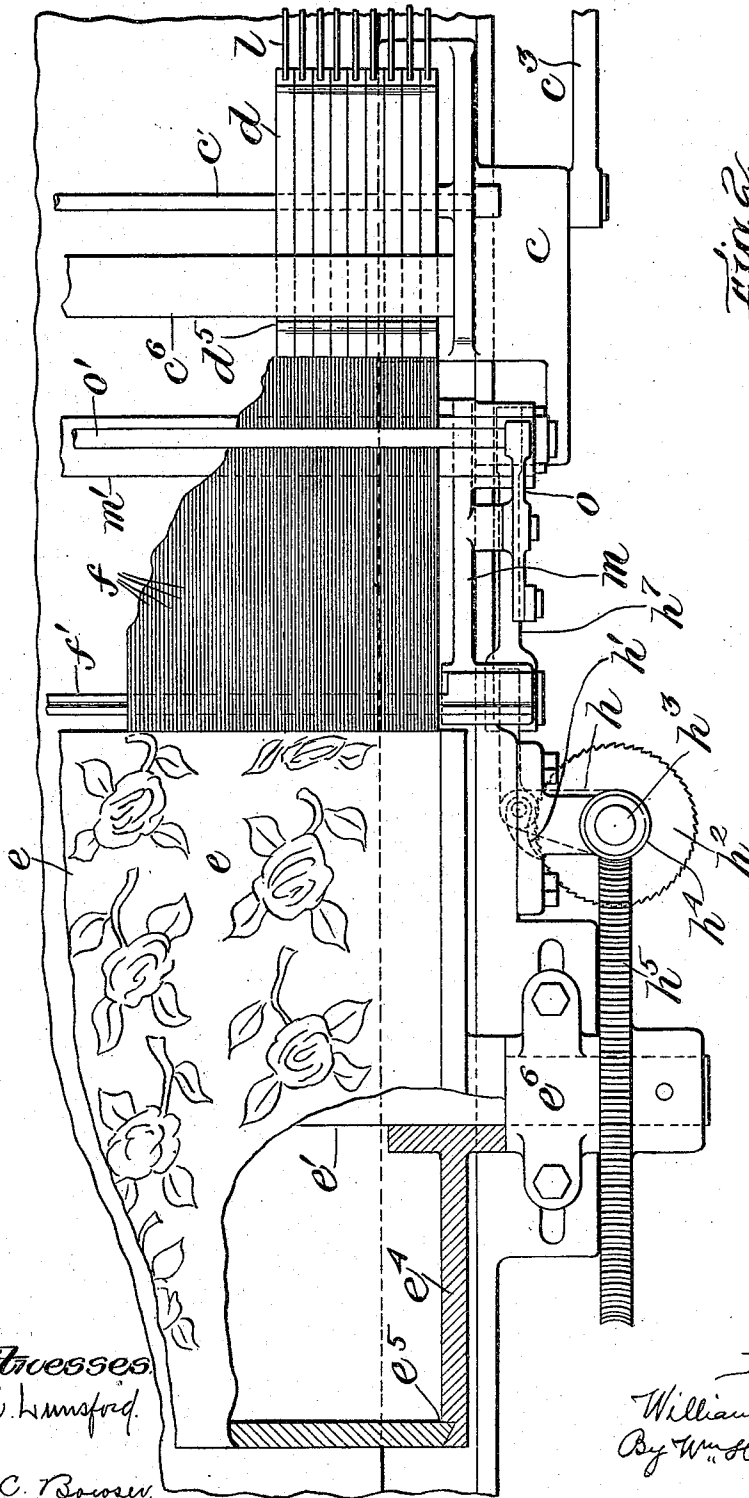
Witnesses:
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Witnesses
W. C. Humphrey.
A. C. Brown.

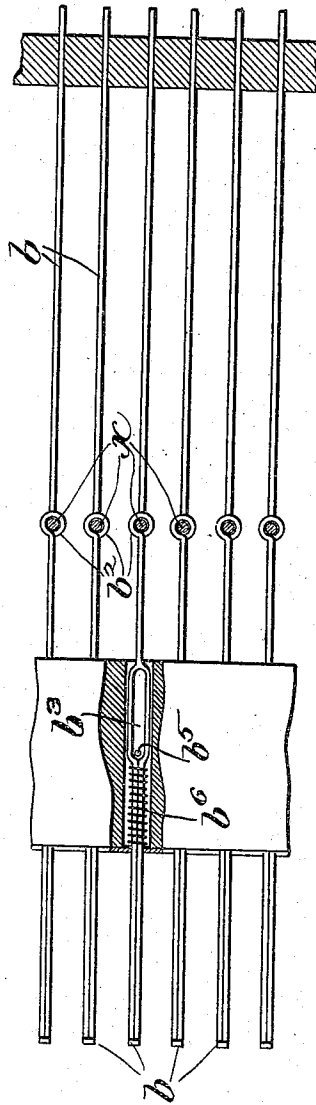
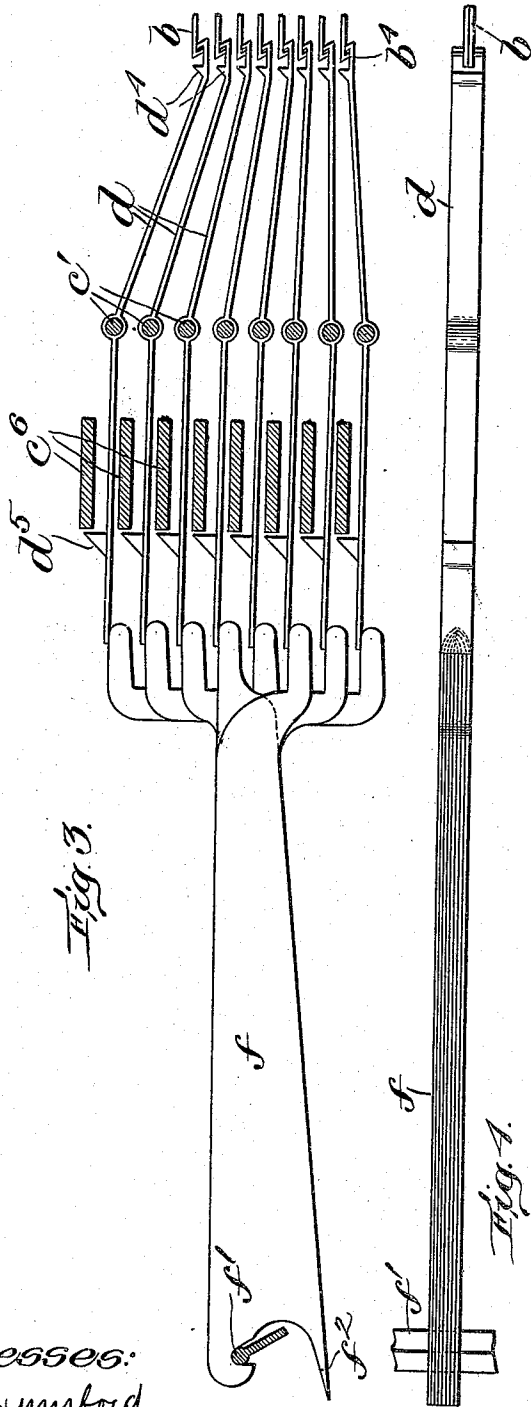
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

WILLIAM BOWKER, OF BOSTON, MASSACHUSETTS.

MACHINERY FOR MANUFACTURING TEXTILE FABRICS.

939,467.

Specification of Letters Patent.

Patented Nov. 9, 1909.

Application filed September 9, 1908. Serial No. 452,242.

To all whom it may concern:

Be it known that I, WILLIAM BOWKER, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented and discovered certain new and useful Improvements in Machinery for Manufacturing Textile Fabrics, of which the following is a specification.

My invention relates to manufacturing textile fabrics in connection with what is known as the "jacquard". It is useful for all purposes for which the jacquard is usable, but it will be sufficient for present purposes if description of its use is confined to weaving.

In weaving in connection with an ordinary jacquard, if its hooks are allowed to govern all the threads of the warp, and each is allowed to govern one thread and one only, the threads can be caused to move up or to stay down separately from and independently of each other in any conceivable combination in forming the shed of the warp for each throw of the shuttle. This can be caused by working the jacquard needles, and thereby any conceivable style of weave and any pattern, figure, picture or character commensurate with the capacity of the jacquard and the loom can be produced in weaving a fabric, without using any other warp than the one governed by the jacquard.

The griffs of the jacquard work up and down in unison with the throw of the shuttle, and when they ascend they raise such hooks as are engaged with them and raise no others, and at the same time they raise the heddles, warp-threads and lingoes which are connected with the raised hooks, and they raise those only.

The outer face of a jacquard needle-board is on a vertical plane and presents a bank of needle-ends which, when in normal position, project outward from the face about $\frac{1}{2}$ inch through holes in the board. The holes are in horizontal and in vertical rows and are equidistant apart both ways. The needles are movable freely lengthwise, but are so confined near one end in the needle-board and near the other end in the spring-box as to be movable lengthwise only. The positions of the needles determine what hooks shall and what ones shall not be engaged with the griffs when the griffs rise. When any needle is in normal position during the

rise of the griffs, the hook corresponding to that needle is engaged with its griff, but when any needle is inward flush with the needle-board or thereabout during that time, the corresponding hook is not engaged with its griff.

Ordinarily perforated cards laced together in an endless chain are used to direct the lengthwise movement of the needles, by pushing the cards flatwise successively, one at a time, against the bank of needles, a separate card before each throw of the shuttle. The cards are perforated scientifically to represent the design which has been drawn on design paper ruled in the ordinary manner. Each is treated as having the same number of circular spots as there are needles in the bank, and in the same number of rows and the same distance apart as the needles, so that when pushed flatwise against the bank the needles are in alinement with the spots. In jacquard designing and weaving, the system of spots in a card, the system of needles in the bank, the system of squares in a crosswise row of the design, and the system of warp-threads in the woven pattern are all treated as being numbered correspondingly, the one to the others, so that any unit in one has a corresponding unit numerically the same in each of the others. Relatively, warp-threads appear on the surface of the pattern in the places where warp-squares, usually distinguished by a cross, appear on the design. So also of the weft-threads and the weft-squares, the latter being usually blank. Therefore the cards have the same relation to the pattern as to the design; and the theory of them is that they give to the pattern what they receive from the design. All the warp-squares are represented in the cards by perforations, and all the weft-squares by solid spots. The design is transferred to the cards, one crosswise row of squares per card consecutively. As a crosswise row of squares across the design numbers the same as the warp-threads in the pattern, so, also, a row of squares lengthwise of the design numbers the same as the weft-threads in the pattern. If the design required 1000 weft-threads and 400 warp-threads to complete the pattern without repetition, it would require a chain of 1000 cards and a jacquard of 400 hooks and 400 needles to produce the pattern, and if the pattern had 100 threads of warp and weft per inch, it would measure 4 by 10 inches. When any

one of the cards is pushed flatwise against the needle-board, the needles in alinement with perforations will pass through the perforations without being moved, and the rest will be moved lengthwise out of normal position. Hence with the supposed chain of 1000 cards working in combination with the jacquard and the accompanying loom, a pattern conforming to the supposed design will be produced.

The foregoing explains the principle of the present invention in which the mode of applying the principle is different. The invention involves dispensing with the cards and their mechanism, and also a slight change in the spring-box ends of the needles, at which it works on the needles, but it involves no other change in the jacquard itself. The invention accomplishes the same movements of the needles as the cards do, and everything can be done with it that can be done with cards. In lieu of the cards and their mechanism to direct and accomplish the desired movements of the needles, it employs for that purpose, in combination with the needles, the directive mechanism, the key-mechanism and the needle-working mechanism, which are to be described.

The directive mechanism consists of a rigid design having on its face in relief and intaglio low prominences and shallow depressions of square or rectangle shape and of solid and equal surface-area contained wholly between the face and the back of the design, and means to advance the face of the design step by step a distance equal to that between the middle lines of any two of its adjacent crosswise rows of squares or rectangles at each step and to arrest its advance at the end of each step. The face of the rigid design is essentially the same linearly as if it were drawn on ordinary design paper ruled into squares or rectangles. The design for the woven pattern, like the design before mentioned, may be drawn originally on design paper in the ordinary way and then transferred to a metallic surface prepared for any ordinary etching process and ruled like design paper on the scale required for the rigid design, or it may be drawn originally on such prepared and ruled metallic surface, and in either case the appropriate depressions may be etched by the etching process as deep as required, $\frac{3}{16}$ inch being deep enough. From the surface of such etched metallic design, as many rigid designs as wanted may be molded by the ordinary stereotype process. A quicker way of transferring such paper design to a metallic one is by setting quads in any of the ordinary manners, high ones for the prominences and low ones for the depressions, and otherwise of size to suit the scale required for the rigid design. By setting such quads a suitable metallic design can be prepared even

quicker than ordinary corresponding newspaper work can be done. From this product as many designs as wanted may be made by the stereotype process.

With the needle-working mechanism arranged as illustrated in the accompanying drawings, the supposed paper design is represented by rigid squares in relief located in the same relative position on the rigid design as warp-squares on the paper design, and by rigid squares in intaglio located like the weft-squares on the paper design. Hence the rigid squares in relief correspond to perforations in the cards, and those in intaglio to solid spots on the cards. But with a trifling modification to be mentioned later, the squares in relief and the squares in intaglio may be located and may correspond vice versa. The scale of the rigid design conforms to that of the jacquard needle-board in a way which may be illustrated in connection with the supposed paper design and the supposed 400-hook jacquard. The width of the working part of the face of the rigid design would be 50 times the distance between any two adjacent needles, and this width would be in 400 equal parallel divisions. If the paper design were to be represented on the rigid design by squares, the length of the face would be in 1000 like and equal parallel divisions transverse to the 400. Per the ordinary scale of the needle-board, these divisions would be practically $\frac{1}{16}$ inch wide each both ways, and the face would be covered with $\frac{1}{16}$ inch squares, 400,000 in number, in 400 lengthwise rows of 1000 squares each and 1000 crosswise rows of 400 squares each. By the present invention such rigid design 33 $\frac{1}{3}$ inches long has the equivalent effect of the supposed 1000-card chain 2500 inches long in directing the movements of the needles for weaving the supposed fabric of 4 by 10 inches.

Illustrating by the supposed 400-hook jacquard whose needles would be on 8 horizontal rows, the needles are represented by a single row of 400 key-points in a line and on a level with each other, and such line is of the same length as a crosswise row of the rigid squares. The key-points are numbered consecutively in correspondence to the warp-threads from one end of the line to the other, and each key-point has the same number as the needle it represents, and is connected with that needle and no other. Such rigid design as described is supported in working position in relation to the line of key-points, confronts them in near proximity, is made to advance lengthwise step by step $\frac{1}{16}$ inch at each step and to come to rest at the end of each step, and is made to present at each stage of rest a crosswise row of the rigid squares along the line of key-points in such position that the middle line of the

crosswise row is on a level with and parallel to the line of key-points. At each such stage of rest the key-points are put into minute encounter with the rigid design and are made to recede from such encounter. At such encounter the rigid design acts upon the key-points the same as the cards do upon the needles, that is to say, the key-points which encounter prominences are moved slightly and those which encounter depressions are not moved at all and remain in normal position.

The needle-working mechanism makes mechanical connection between the needles and the keys, and the needle-workers through which the connection is made are on lines and levels and in rows corresponding to those of the needles, and their numerical order is the same as that of the keys and that of the needles. The needle-workers are made to move, first in one direction and then in the opposite, away from and toward the jacquard, in unison with the throw of the shuttle of the accompanying loom. Normally they have hold of their corresponding needles, and when any of the key-points are moved by slight encounter with prominences their minute movement transmits to the corresponding needle-workers movement sufficiently long to cause them to release their hold and allow the needles to remain unmoved in normal position when the needle-workers are moved away from the jacquard. But with the trifling modification before alluded to, the needle-workers may be normally free from hold on their needles, so that minute movement of any of the key-points will cause the corresponding needle-workers to take hold of their needles and move them out of normal position when they are moved away from the jacquard.

Any comparison between the working of the card system and the working of the present invention will make it plain that the principle of both is the same and their results the same, notwithstanding the difference in the modes of applying the principle. Thus, suppose the paper design requires the raising of only warp-threads 10, 20, 30, etc. at the weaving of any weft-pick. Then only spots 10, 20, 30, etc. on the card for that pick will be perforated, only needles 10, 20, 30, etc. will remain in normal position on pushing the card against the needle-board, and only hooks 10, 20, 30, etc. and only warp-threads 10, 20, 30, etc. will be raised by the griffs. And suppose the rigid design requires the same. Then only squares 10, 20, 30, etc. on the crosswise row for that pick will be prominences, only key-points 10, 20, 30, etc. will be moved on encounter with the design, only needle-workers 10, 20, 30, etc. will let go of the needles, only needles 10, 20, 30, etc. will remain in normal position on moving the needle-workers away from the

jacquard, and so on with the hooks and warp-threads.

The invention is illustrated in the accompanying drawings.

Figure 1 is a side elevation of its elements, with part of the design cylinder and part of the jacquard broken away. Fig. 2 is a plan view of so much of the same as is essential for illustration. Fig. 3, on larger scale, is a side elevation of the keys, the needle-working mechanism and a short portion of the spring-box ends of the jacquard needles. Fig. 4 is a plan view of the same. Fig. 5 is a plan view, partly in section, of the jacquard needles, showing the needle-board at the right, the spring-box pin b^5 in the slot b^3 of the needles, and the coiled springs b^6 in the spring-box b^1 which is lettered in Fig. 1.

Power to operate the several mechanisms comes from the accompanying loom through the lifting rod a^1 which works the griff-frame a and its griffs up and down as usual in unison with the shooting of the shuttle to lift the jacquard hook x when they are engaged with their griffs. Each of the jacquard needles b has on its spring-box end b^4 a catch turned downward to engage with a corresponding catch turned upward on the end of the needle-worker d . Normally these catches are engaged with each other; but if preferred, the needle-catch may be turned upward and the needle-worker catch downward, and with that modification they will be normally disengaged from each other and depressions on the rigid design e will correspond to perforations in cards.

The usual jacquard spring-box is shown at b^1 , Fig. 1, but the usual coiled springs which are always tending to hold the needles in normal position are not shown in Fig. 1, being omitted therefrom to avoid confusion, but they are used, as shown at b^6 , Fig. 5. The needle-workers d are fulcrumed on 8 rods c^1 , which are supported on a sliding carriage c , and their ends at d^5 are enough heavier than their ends at d to keep said workers normally engaged with the needles b . Whenever the longer arm of a key f is out of normal position it tilts up an arm at d^5 of the corresponding needle-worker and causes the catch at the end of arm d to disengage from its corresponding needle.

The rigid design e is illustrated as being cylindrical. Such form is for convenience only, and is not of the essence of the invention, for substantially the same mode of applying the principle can be conducted with a flat design of the same general character of face, fed step by step to confront the key-points f^2 successively with a row of its prominences and depressions at each resting stage.

The keys f fulcrumed on the bar f^1 , which is supported on the carriage m , normally

rest by weight of their longer arms on the resting-bar m^1 supported by carriage m . The key-points f^2 are blunted to endure wear and not deface design e , and are normally in a line with each other parallel to the general face of the design. When carriage m moves the key-points f^2 into encounter with the design, those keys f whose points encounter prominences will be moved out of normal position and those whose points encounter depressions will remain in normal position. Minute movement of the key-point f^2 results in relatively long movement of the weight-lifting point of the longer arm of the key f where it acts on the end d^5 of the needle-worker, as power acts on key f horizontally through the point f^2 in a line about an inch from fulcrum f^1 , and the weight at the weight-lifting point acts vertically in a line about 9 inches from fulcrum f^1 . Key-point f^2 is illustrated as being in one piece with the associate weight-lifting arm of key f and as being a constituent part of one lever. But it would be within the principle of the invention if the two parts were separate from and compounded with each other, and did the same thing as is done with the single lever, and I desire to include any modification which would in principle act substantially the same and produce substantially the same result. Toward the ends of their weight-lifting arms the keys f are illustrated in Fig. 3 as being of varying form to admit of acting at points on 8 levels, and also as being slender. The slender portions are fashioned to act at their lifting points aside from the general lines of the lengths of the keys, as shown in Fig. 4 which illustrates a group of 8 keys with their slender ends so fashioned that the weight-lifting points are in the same vertical plane. The like is done with each group of eight keys corresponding to a vertical row of needles. Key-points f^2 are slender, being fashioned to act selectively in the sense that they will enter small-sized depressions in design e without being moved.

Power to operate carriages c and m comes through lifting-rod a^1 . A link c^3 fastened at one end to carriage c carries at its other end a cam-roller c^2 which engages an angular cam-slot a^2 in the adjacent face of lifting-rod a^1 . As rod a^1 rises the roller is acted on by the inclined face of cam-slot a^2 , thereby advancing carriage c toward design e , and at the same time carriage c and the needle-workers pull out of normal position all the needles engaged with the workers. Carriage c has about $\frac{1}{2}$ inch range of movement. It bears pin c^4 which acts in a short horizontal slot in lever g , as shown by dotted lines. Carriage c actuates lever g fulcrumed at g^1 by a pin which is fastened to the frame of the machine, but owing to said slot in which pin c^4 moves, carriage c bearing that pin does not act on lever g until it has ad-

vanced about half way of its range of movement. In the rest of its advance it acts on lever g and causes carriage m , attached to lever g by a pin at g^5 , to move toward carriage c , and this causes key-points f^2 to recede from encounter with design e . The range of carriage m is short, and $\frac{1}{8}$ inch is plenty, or enough to keep key-points f from touching the design while the latter is advancing.

The descent of lifting rod a^1 after the throw of the shuttle causes carriage c to move backward from design e . During the first half of this movement, owing to the slot before mentioned in which pin c^4 moves, carriage m remains at rest, but during the next half carriage m , connected at g^5 as aforesaid, is moved toward design e , and key-points f^2 encounter the design.

The working of the invention involves the motions of carriages c and m about $\frac{1}{2}$ inch and $\frac{1}{8}$ inch respectively, both ways, forward and return. When carriage c moves backward it carries the needle-workers with it, and the coiled springs before mentioned restore to normal position the needles which have been pulled from that position. Besides, the safety devices d^4 on the workers force those needles into normal position, if the springs are sluggish.

Adjustable step-by-step advance of the face of design e is provided as follows: Carriage c during the second half of its advance acts on lever g , and hence on the connection h^8 , thus turning the ratchet-wheel h^2 (Fig. 2). Hence worm h^4 rotates and causes worm gear h^5 to rotate and carry with it design-cylinder e fixed to the same shaft as the gear. The design-cylinder is stationary during all the backward movement of carriage c , but during the second half thereof carriage c carries the ratchet-pawl with it, which is made ready to repeat moving the worm. Adjustableness of the worm-movement is provided by the long slot in which connection h^8 is fastened, and by using ratchet-wheels of different diameters and worms and worm-gears of varying pitch.

When carriage m recedes, arm g^6 rises, carrying upward link g^7 and the left hand end of lever o and causing righthand end of lever o to move downward and carry down safety-rod o^1 (Fig. 2) so that the latter will force into normal position on the resting-bar m^1 any keys which fail to go down by gravity. When the keys go down into normal position, they are followed by the left-hand ends d^5 of the corresponding needle-workers, owing to their being heavier than the right-hand ends d . When the needle-workers go toward the jacquard, those disengaged from needles engage therewith automatically, owing to the inclined shape of the outer ends of the catches on the needles and on the needle-workers and to the action

of gravity on the ends d^5 which causes the catches to engage when they come into position for engagement.

Fig. 3 shows the bars c^6 supported by carriage c and shows the shoulders d^5 on the needle-workers. If rods c^1 spring any while the needles are being pulled out of normal position, the shoulders d^5 will come against the wide, strong and stiff bars c^6 which will pull out the needles engaged with the needle-workers and relieve rods c^1 of any detrimental strain.

The circumferential grooves e^5 in the cylinder-heads e^4 receive the edges of the rigid design e , so that its surface will run true, the design being clamped between the two heads. These heads are adjustable to their shaft and easily removable therefrom. The bearing-blocks e^6 which support the journals of the shaft may be adjusted toward or away from the key-points f^2 with any desired nicety, so that the key-points will encounter the design as much or as little as desired, and so that cylinders of varying diameter may be used.

The design-cylinder during its operation moves circumferentially only, with its axis stationed permanently in one position, the system of key-points being moved into encounter with the design. But if preferred, the axis may be moved a little at each resting stage to put the design into encounter with the system, or to put the design and the system into encounter with each other. The design-cylinder is stationed on the same general level as the system of needles, and selective connection of the design with the needles is effected through the keys and the needle-workers with directness and simplicity on that level, in combination, arrangement and mode of operation whereby results are accomplished as unlimited as those ordinarily accomplished by the card system.

Any ordinary jacquard with ordinary needles can be adapted easily to this invention by substituting suitable needles in place of the ordinary ones. With that change the jacquard can be worked either with cards or with this invention, as the invention can be worked at the spring-box end and need not involve any change in the needle-board end of the jacquard, and the cards can be worked thereat the same as without the change.

In working the invention, a good rule is to do the same as when cards are used. Although illustration has been confined to the case of governing but one warp-thread with each jacquard hook, each hook may govern several warp-threads in the ordinary way. Threads of several colors in the fabric can be woven with the invention in substantially the same way as with cards. As the number of threads per inch in the fabric has nothing to do with the rate of feeding

cards, so also it has nothing to do with the rate of feeding the rigid design. With the same design the rate of feed at each throw of the shuttle is the same in weaving 10 threads per inch as in weaving 100 or any other number per inch, just as it is with the same chain of cards. A rule mathematically exact in all cases for finding the rate to feed the design at each throw of the shuttle is to divide the length of the design in inches by the number of weft-threads in the pattern conforming to the design, or by the number of cross rows of prominences and depressions in the design. The result in either case will give the rate expressed in a fraction of an inch.

The prominences and depressions on the rigid design may be in the shape of rectangles, longer in direction of the length of the design than across, or their middle points may be farther apart lengthwise than across.

The ordinary distinction between design and pattern is intended where those words occur in the specification and claims,—design as expressing something separate from the fabric and planned before the fabric is made, and pattern as expressing something produced in the structure of the fabric in conformity to the design which has been planned for it.

I make the following claims:

1. In machinery to produce in a textile fabric any given pattern, the combination of jacquard needles; a rigid design to which the pattern shall conform having on its face in relief and intaglio respectively, and in parallel rows transverse to its length and equidistant apart between the middle lines of the rows, low prominences and shallow depressions located in predetermined relative order in each row, for representing the needles severally and respectively and for selecting which of them shall and which of them shall not be moved out of normal position; means to advance the face of the design step by step a predetermined distance at each step and to arrest its advance at the end of each step; lever-acting pointed keys adapted to swing on their fulcrums and be operated by pressure against their points; fulcrums of the keys located relatively near the key-points and distant from the lifter points; means to support the fulcrums and keys in position for acting in connection with the design and the needles; means to effect selective connection of the design with the key-points and the needles at each resting-stage of said advance and to sever the connection thereat; and means to move out of normal position the needles selected to be moved; substantially as and for the purposes set forth.

2. The combination of the key-points; the lever-acting keys; the key-fulcrums located

relatively near the key-points and distant from the lifter points; the sliding carriage supporting and bearing the keys and key-fulcrums; the needle-workers and the sliding needle-worker carriage; the jacquard needles; the rigid design and its prominences and depressions in relief and intaglio respectively; means to advance the face of the design step by step a predetermined distance at each step; means to work the sliding carriage of the key-mechanism and put the key-points into and out of encounter with the face of the design at predetermined instants; and means to move the sliding needle-workers carriage and the needle-workers away from and toward the jacquard at predetermined intervals; all cooperating to move such of the jacquard needles as desired lengthwise out of normal position between each resting stage of said advance and the next, substantially as set forth.

3. In machinery to produce in a textile fabric any given pattern, key-mechanism having the combination of a supporting carriage; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level associated with the keys respectively and adapted to be operated by pressure against the points; an equal plurality of lifter points of the keys adapted to move with and by operation of the key-points respectively and located in divisions on several lines and levels, one division on one line and level and the others on other lines and levels; and an equal plurality of fulcrums of the keys in a line with each other on the carriage; all cooperating so that pressure against the key-points on the single line and level imparts movement to the corresponding lifter points on the several lines and levels, substantially as set forth.

4. In machinery to produce in a textile fabric any given pattern, key-mechanism having the combination of a supporting carriage; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level, associated with the keys respectively, adapted to be operated to enter depressions in the face of any resisting body brought into encounter with the points; an equal plurality of lifter points of the keys adapted to move with and by operation of, and always either in or out of normal position mutually with, their respective associate key-points; and an equal plurality of fulcrums of the keys in a line with each other on the carriage; all cooperating so that the key-points and the lifter points, according as the key-points encounter slight prominences and depressions on meeting the face of the resisting body, move out of or remain in normal position in any combination predetermined by the character and relative positions of the promi-

nences and depressions, substantially as set forth.

5. In machinery to produce in a textile fabric any given pattern, key-mechanism having the combination of a supporting carriage; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level, associated with the keys respectively and adapted to be operated by pressure against the points; an equal plurality of lifter points of the keys adapted to move with and by operation of their respective associate key-points; and an equal plurality of fulcrums of the keys in a line with each other on the carriage relatively near the key-points and distant from the lifter points; all cooperating so that minute movement of the key-points imparts relatively long movement to the lifter points, substantially as set forth.

6. In machinery to produce in a textile fabric any given pattern, the combination of a carriage for supporting key-mechanism; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level associated with the keys respectively and adapted to be operated by pressure against the points and fashioned and adapted to enter depressions in the face of a resisting body put into encounter with the points; an equal plurality of lifter points of the keys adapted to move with and by operation of, and always either in or out of normal position mutually with, their respective associate key-points; an equal plurality of fulcrums of the keys in a line with each other on the carriage relatively near the key-points and distant from the lifter points; and means to push operating pressure against predetermined combinations of the key-points in succession at predetermined instants; all cooperating to produce successively at desired instants weight-moving action of desired combinations of the lifter points, substantially as set forth.

7. In machinery to produce in a textile fabric any given pattern, the combination of a carriage for supporting key-mechanism; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level associated with the keys respectively and adapted to be operated by pressure against the points and fashioned and adapted to enter depressions in the face of a resisting body put into encounter with the points; an equal plurality of lifter points of the keys adapted to move with and by operation of, and always either in or out of normal position mutually with, their respective key-points; an equal plurality of fulcrums of the keys in a line with each other on the carriage relatively near the key-points and distant from

the lifter points; a resisting plate adapted to confront the line of key-points intermittently with successive lines of its face; prominences and depressions in predetermined relative order on said confronting lines of the face for selecting which of the key-points and lifter points shall and which of them shall not be moved out of normal position when any one of said lines of the face is confronting; means to advance the face of the plate step by step the distance between one of said confronting lines and the next at each step; and means to put the line of key-points into and out of encounter with a line of said prominences and depressions at each resting-stage of said advance; all coöperating to produce successively at desired instants weight-moving action of desired combinations of the lifter points, substantially as set forth.

8. In machinery to produce in a textile fabric any given pattern, the combination of a carriage for supporting key-mechanism; a plurality of lever-acting keys on the carriage; an equal plurality of key-points normally on a single line and level associated with the keys respectively and adapted to be operated by pressure against the points and fashioned and adapted to enter depressions in the face of a resisting body put into encounter with the points; an equal plurality of lifting points of the keys adapted to move with and by operation of, and always either in or out of normal position mutually with, their respective key-

points; an equal plurality of fulcrums of the keys in a line with each other on the carriage relatively near the key-points and distant from the lifter points; a resisting plate adapted to confront the line of key-points intermittently with successive lines of its face; prominences and depressions in predetermined relative order on said confronting lines of the face, for selecting which of the key-points and lifter points shall and which of them shall not be moved out of normal position when any one of said lines of the face is confronting; means to advance the face of the plate step by step the distance between one of said confronting lines and the next; means to put the line of key-points into encounter with a line of said prominences and depressions at each resting-stage of said advance; warp-holders normally on a level with each other for holding the warp-threads of the fabric to be woven; means for effecting selective connection of the prominences, depressions, key-points and lifter points with the warp-holders at each resting-stage of said advance; and means to raise out of normal position the warp-holders selected to be raised; all coöperating to raise out of normal position successively at desired intervals desired combinations of the warp-holders, substantially as set forth.

WILLIAM BOWKER.

Witnesses:

WILLIAM H. DRURY,
J. ALFRED ANDERSON.