Feb. 14, 1961 J. O. HETHERINGTON ET AL 2,971,692

SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 1

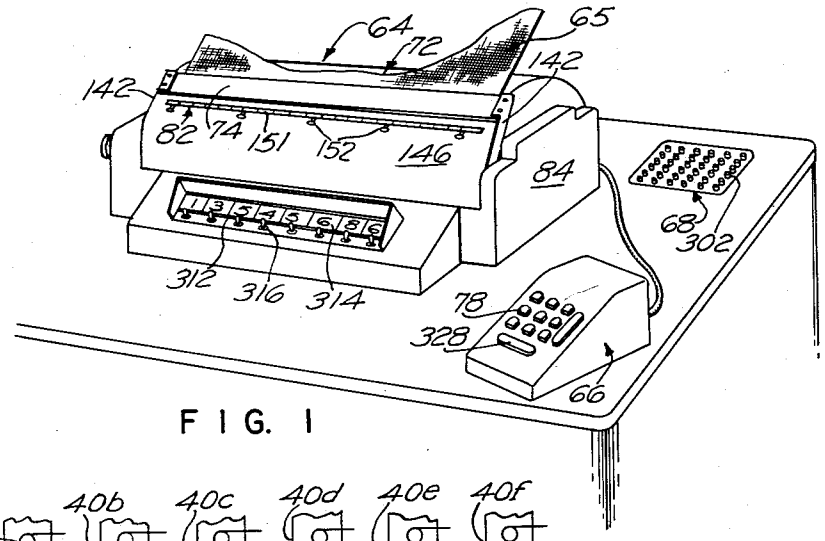


FIG. 1

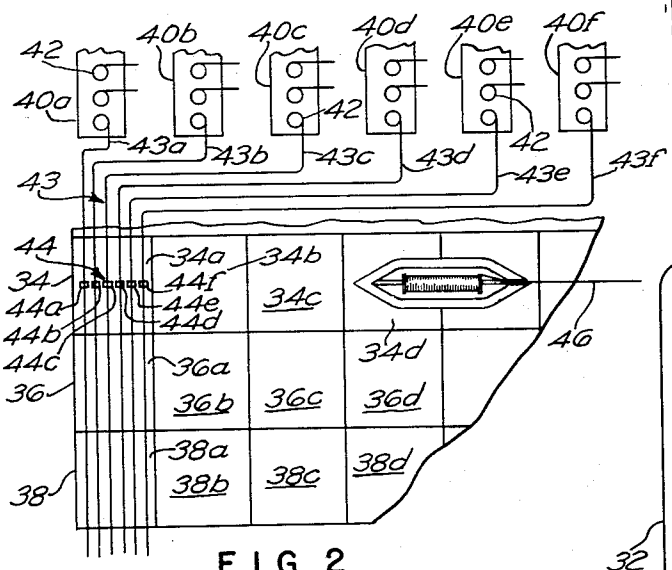


FIG. 2

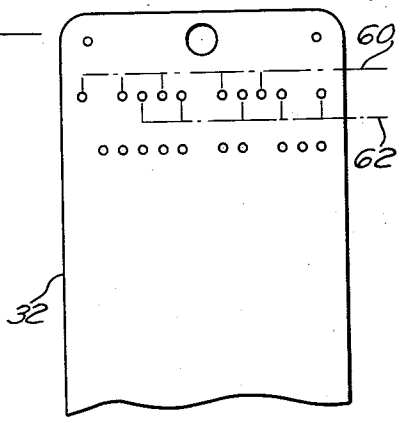


FIG. 4

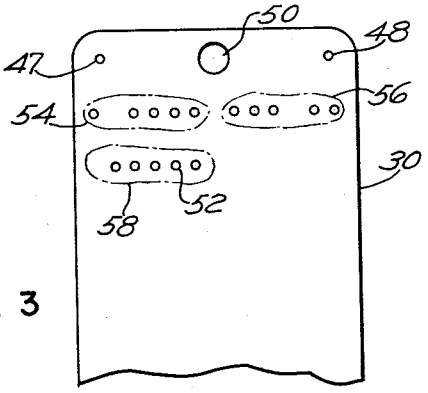


FIG. 3

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 2

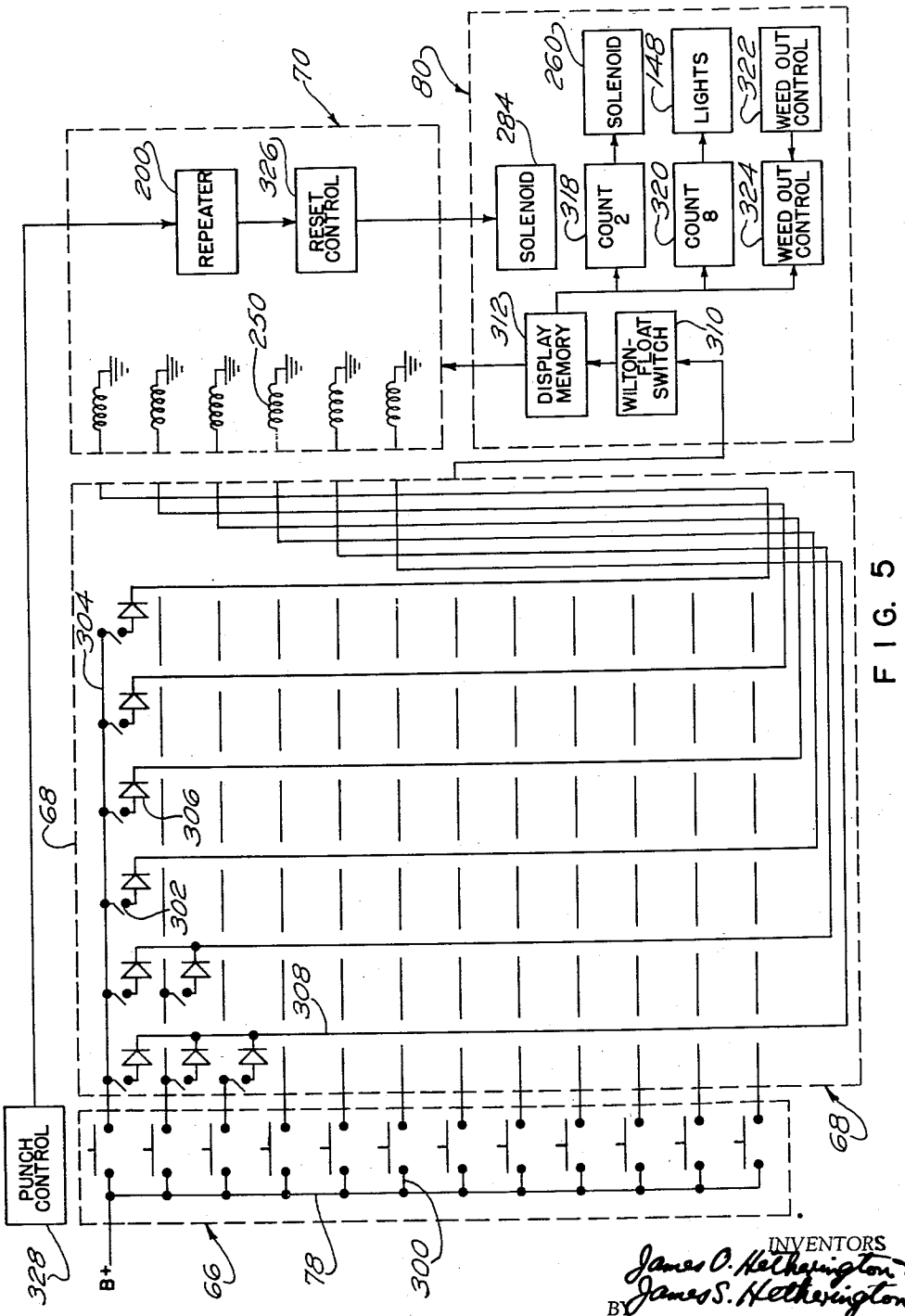


FIG. 5

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 3

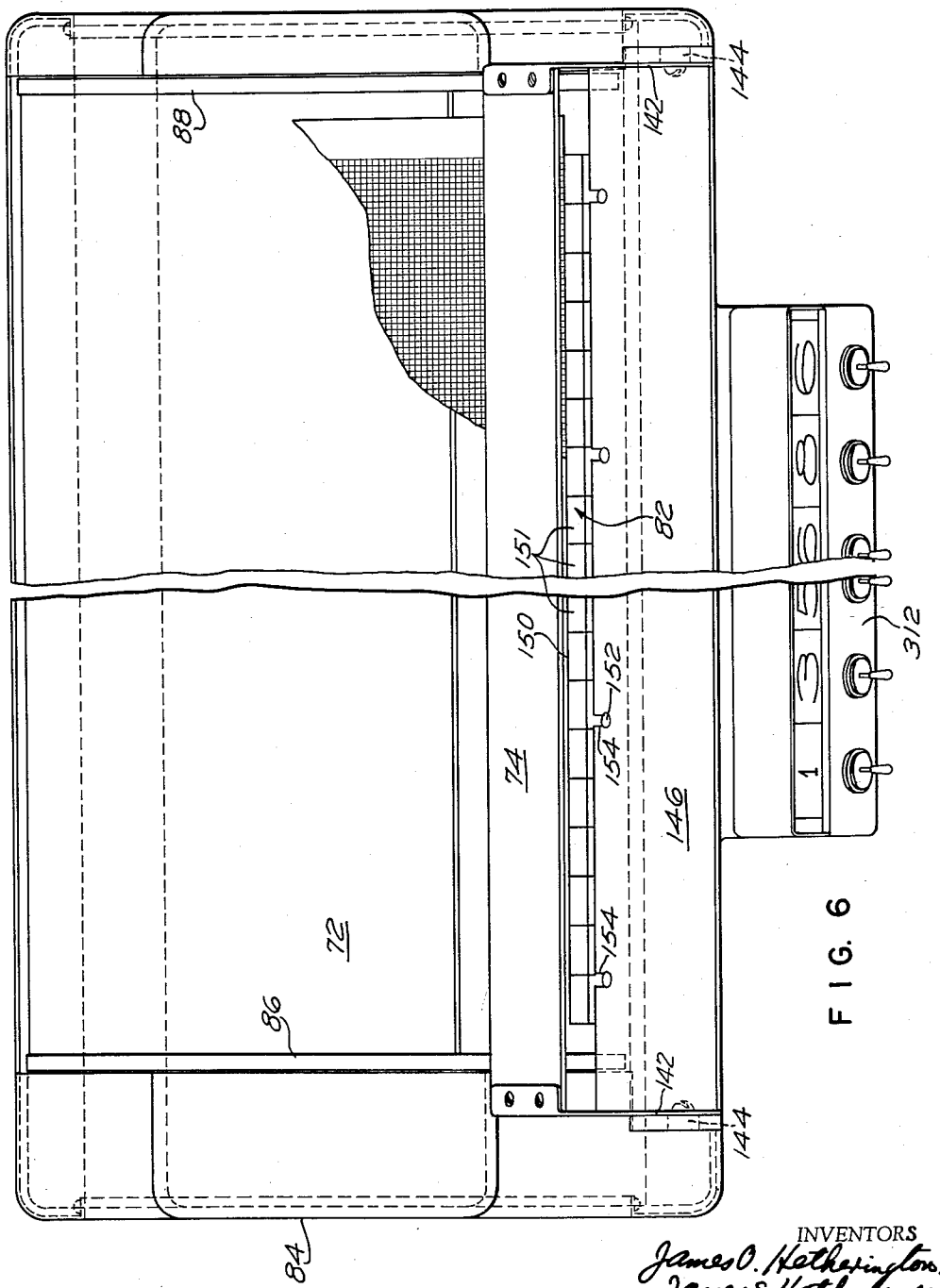


FIG. 6

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 4

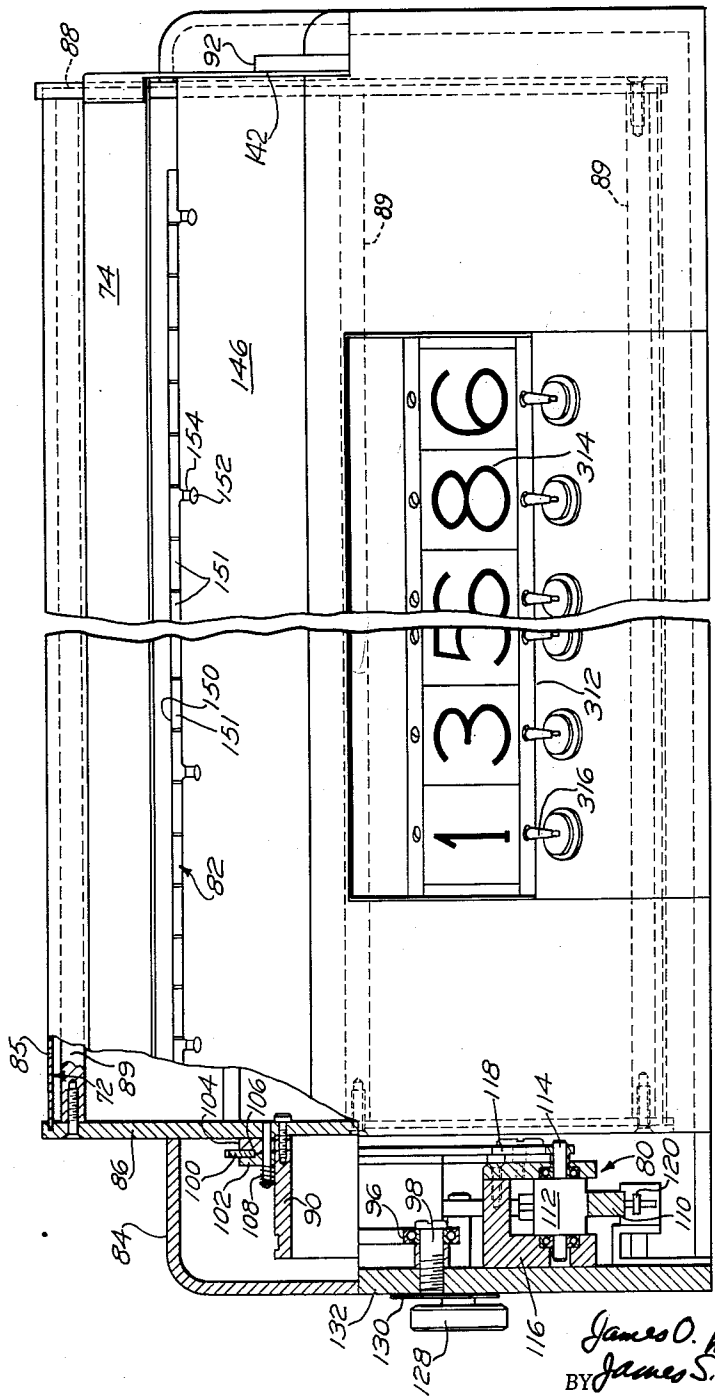


FIG. 7

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 5

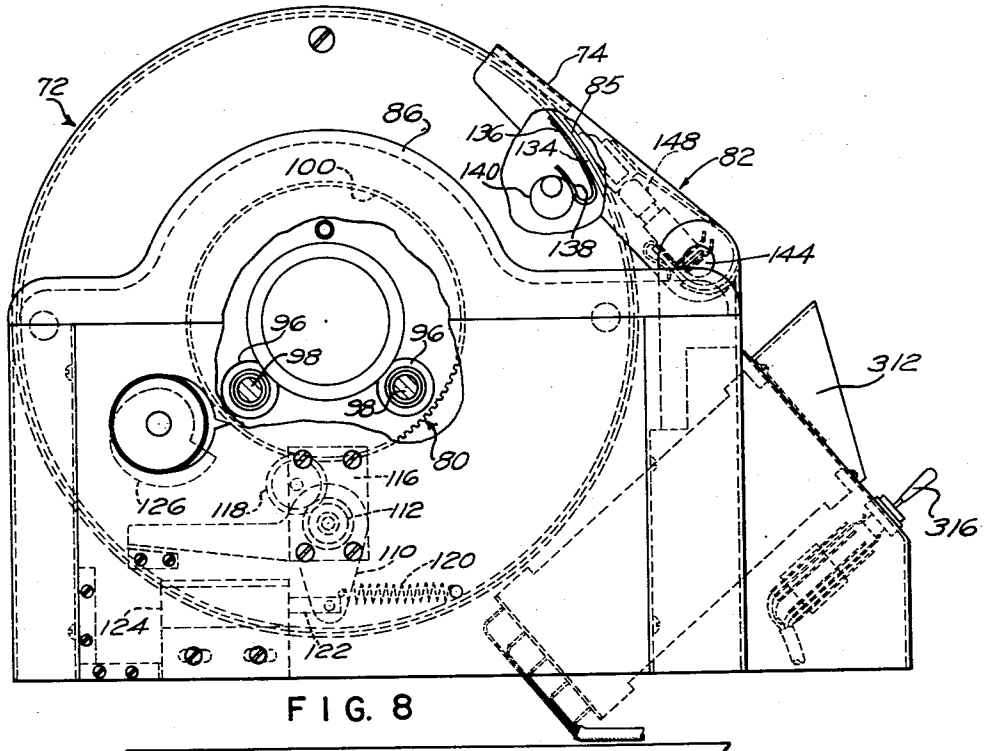


FIG. 8

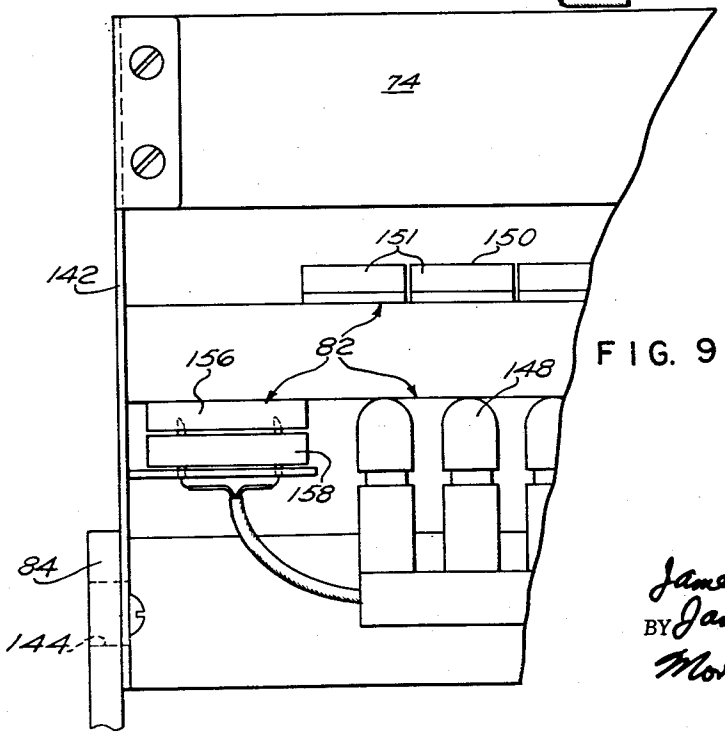


FIG. 9

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 6

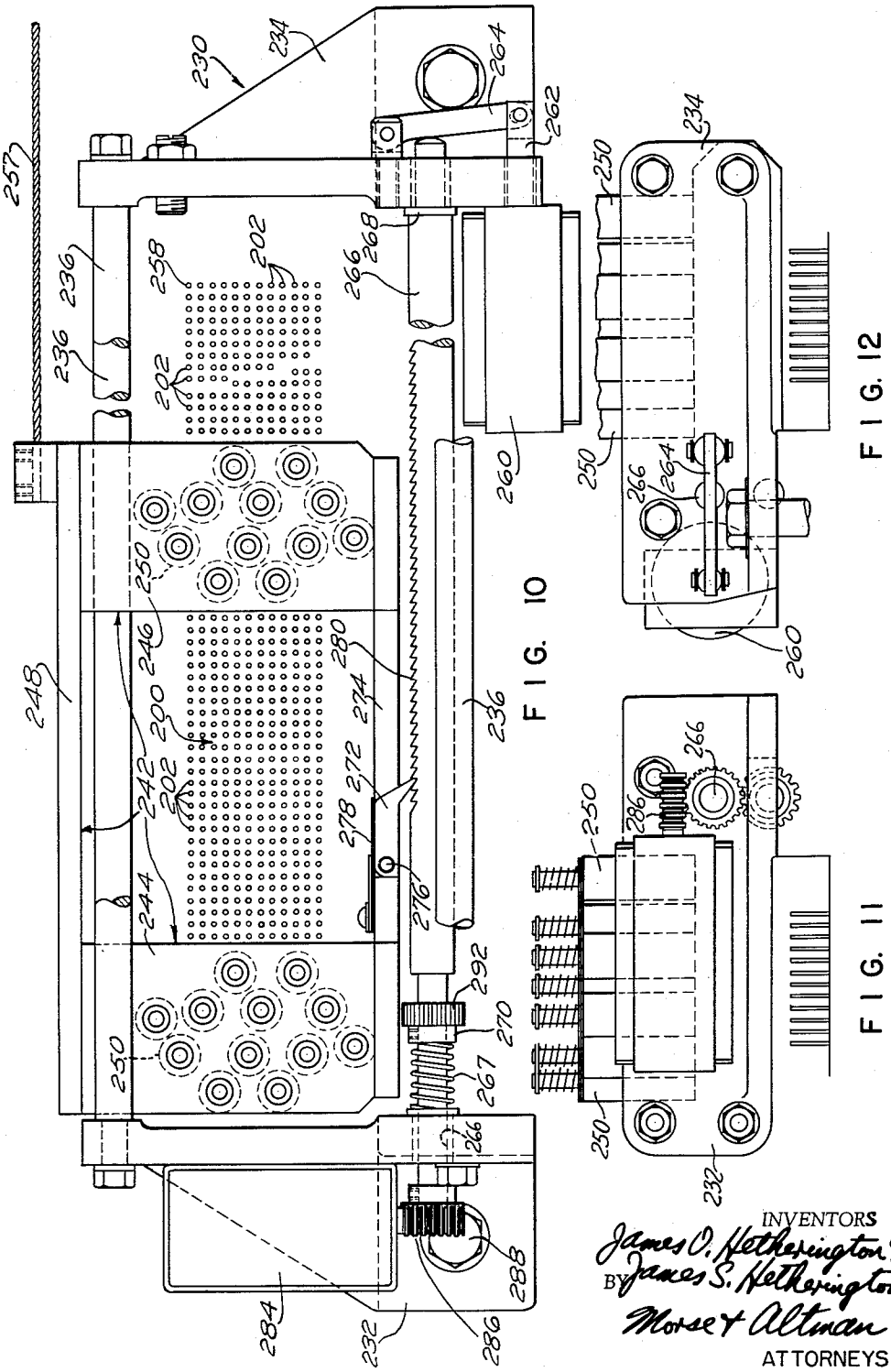


FIG. 10

FIG. 12

FIG. 11

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SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

Filed Sept. 3, 1958 9 Sheets-Sheet 7

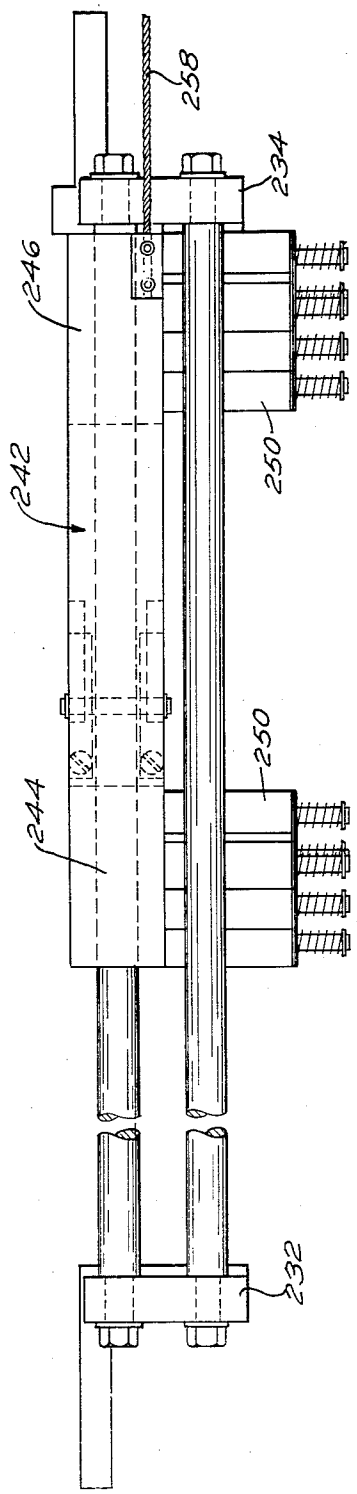


FIG. 13

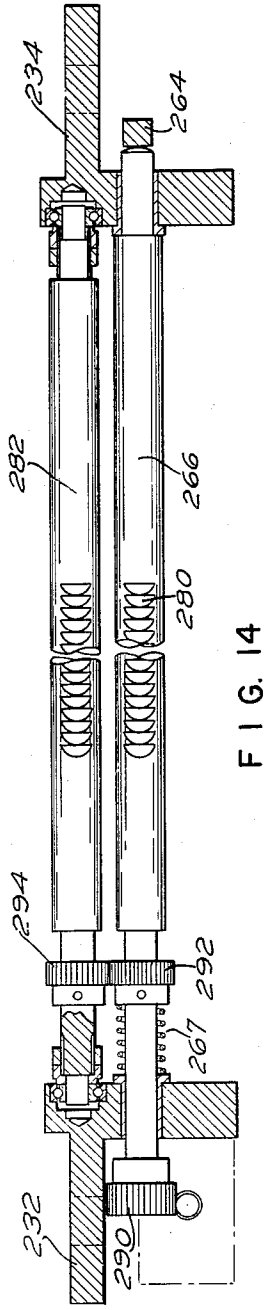


FIG. 14

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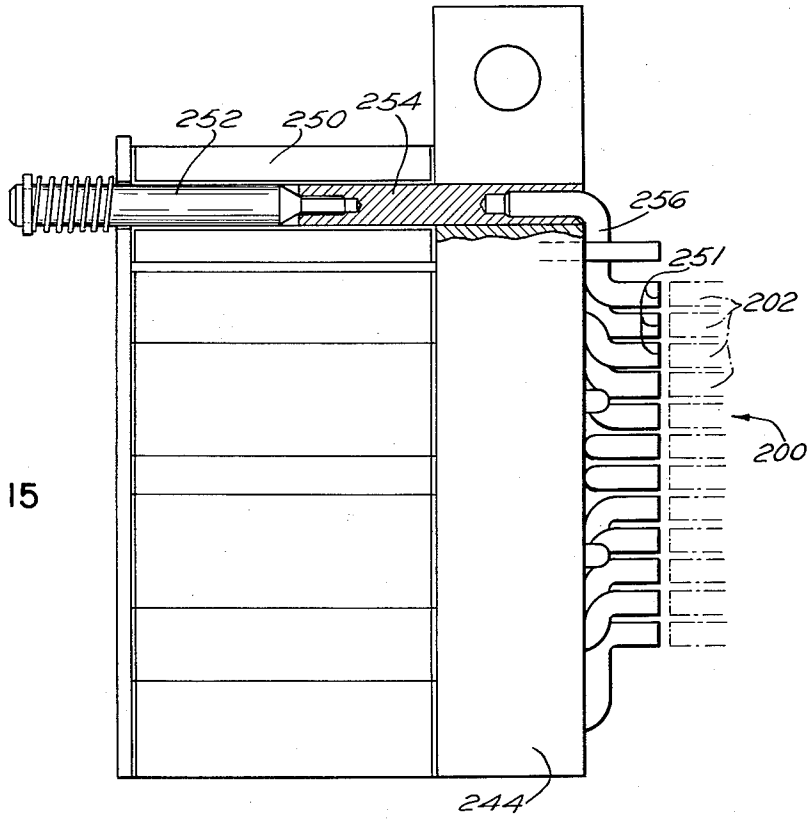


FIG. 15

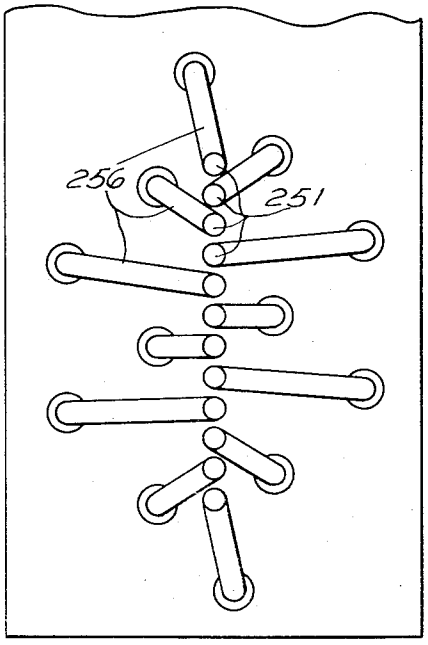


FIG. 16

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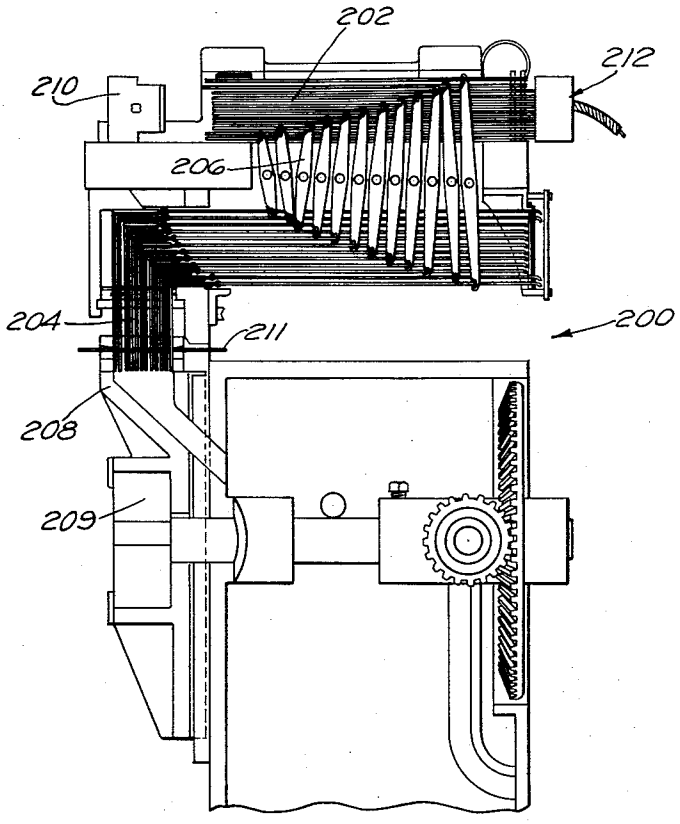


FIG. 17

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United States Patent Office 2,971,692 Patented Feb. 14, 1961

2,971,692

SYSTEM FOR PRODUCING JACQUARD CARDS AND THE LIKE

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Filed Sept. 3, 1958, Ser. No. 758,718
10 Claims. (Cl. 234—40)

The present invention relates to the manufacture of textiles and, more particularly, to the production of Jacquard cards and the like to be used in conjunction with textile machinery. By way of example, the present invention will be described in reference to the manufacture of carpets but it is to be expressly understood that it applies equally well to all Jacquard weaving and the like. As is well known, in automatic looms for weaving textiles such as carpets, a design is produced by the determination of the color of pick (or weft) rows. The selection of the color of any tuft is made by raising a selected one of several warp yarns of different colors available to that tuft in order that the pick yarn be carried under the selected warp yarn and over the remaining warp yarns. In consequence, only the warp yarn of desired color is woven onto the surface of the fabric where it can be viewed and the remaining associated warp yarns of undesired color are woven under the surface of the fabric where they cannot be viewed. The selection of such desired warp yarns is effected automatically by a mechanism under the control of a Jacquard card having certain punched holes that correspond to certain warp yarns. Appropriate holes usually are punched in Jacquard cards with the aid of a squared design sheet on which the squares are in correspondence with the tufts of the ultimate fabric. Since usually one Jacquard card is used for each of the hundreds of pick rows of a design-bearing fabric, it is apparent that the production of Jacquard cards themselves is a major problem in the textile industry. The present invention contemplates an automatic system for producing Jacquard cards and the like.

The primary object of the present invention is the provision of a novel automatic system for reliably, rapidly and readily converting the information available on a squared design sheet to punched hole information on Jacquard cards. Essentially this system comprises: a holder assembly for positioning a squared design sheet before a human operator, fully automatic reader or the like; a selector assembly contiguous with the holder including a vertical stepping component for discriminating among different rows of squares and a horizontal stepping component for discriminating among different squares of a row; an annunciating circuit for translating information from the selector assembly to signals corresponding to information on the design sheet; a punch assembly including a plurality of punch elements which may be designated individually by signals from the selector assembly and of which a plurality of designated elements may be actuated simultaneously by a punch set; and a control circuit for operating the horizontal stepping component, the vertical stepping component and the punch set in appropriate sequence.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the appended claims.

For a fuller understanding of the nature and objects of the present invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

Figure 1 is a perspective view of an exemplary holder assembly of the present invention;

Fig. 2 is a fragmentary schematic illustration of the operation of an automatic loom controlled by Jacquard cards;

Fig. 3 is a fragmentary plan view of a Jacquard card of the type used in the manufacture of Wilton carpeting;

Fig. 4 is a fragmentary plan view of a Jacquard card of the type used in the manufacture of Wilton-float carpeting;

Fig. 5 is a general schematic diagram, partly in block, of the electrical circuitry of an exemplary system embodying the present invention;

Fig. 6 is a top plan view of the holder assembly of Fig. 1;

Fig. 7 is a front view of the holder assembly of Fig. 1;

Fig. 8 is a side elevation, partly broken away, of the holder assembly of Fig. 1;

Fig. 9 is an enlarged fragmentary view of components of the holder assembly of Fig 1;

Fig. 10 is a front elevation of a component of an exemplary punch assembly of the present invention;

Fig. 11 and 12 are opposed side elevations of the component of Fig. 10;

Fig. 13 is a top plan view of the component of Fig. 10;

Fig. 14 is a sectional view of the component of Fig. 10, taken along the line **14—14**;

Fig. 15 is an enlarged side elevation of a part of the component of Fig. 10;

Fig. 16 is a front plan view of the part of Fig. 15; and

Fig. 17 is a cross-sectional view of another component of the exemplary punch assembly partially illustrated in Fig. 10.

Generally, the illustrated system is designed to produce Jacquard cards of the type shown at **30** and **32** in Figs. 3 and 4 for use in an automatic loom that operates in the manner shown in Fig. 2. This loom produces a design by determining warp tufts that appear in successive pick rows. By way of illustration, the successive pick rows are designated **34**, **36**, **38**, etc. and the successive warp tufts of these rows, respectively, are designated **34***a*, *b*, *c*, etc., **36***a*, *b*, *c*, etc. and **38***a*, *b*, *c*, etc. The loom comprises a plurality of frames **40***a*, *b*, *c*, *d*, *e*, and *f*, each including a plurality of bobbins **42** of yarn of selected color. Figs. 2 shows one group of strands **43***a*, *b*, *c*, *d*, *e*, and *f*, extending from bobbins in a plurality of frames through a group **44** of selectively movable heddles **44***a*, *b*, *c*, *d*, *e*, and *f* which select the color of any tuft by raising a selected one of the group of strands in order that a pick yarn **46** may be carried under the selected strand and over the remaining strands. For clarity, the drawing shows only the group of strands designated **43***a*, *b*, *c*, *d*, *e*, and *f* although similar groups of strands extend through similar groups of heddles at the other tuft positions.

Card **30**, which is of the specific type used in the manufacture of Wilton carpeting, has at each of its opposite ends (only one end shown) a pair of corner holes **47** and **48** of relatively small diameter and a medial hole **50** of relatively large diameter. Corner holes **46** and **48** permit successive cards to be laced together with their longitudinal edges parallel. Medial hole **50** serves to permit the card to be positioned on the loom as well as in the punch assembly to be described in detail below. Information appears on card **30** in the form of punched holes **52** aggregated into groups shown within dot-dash lines **54**, **56**, **58**, etc. Each of these groups includes five holes punched in five out of six possible positions. This five out of six selection constitutes a code by which one or more heddles are selected for each tuft to be formed.

The arrangement is such that one card contains all of the groups of positions, arranged in pairs therealong, of one weft row of the fabric. Of course, a variety of alternative coding arrangements are possible. For example, information may appear on card **30** in the form of a single hole punched in one out of six possible positions. Another possible alternative arrangement, of the type usually used in the production of Wilton-float carpeting, is shown in Fig. 4, as having groups of interspersed positions, one so-called "top" group being shown connected by dot-dash line **60** and another so-called "bottom" group by dot-dash line **62**.

As shown in Figs. 1 and 5, the illustrated system comprises: a holder assembly **64** (Fig. 1) for positioning a squared design sheet **65** before a human operator; a selector assembly **66** including a vertical stepping component for advancing the design sheet row-by-row and a horizontal stepping component for indicating successive groups of squares in any row; an annunciating circuit **68** for translating information from the selector assembly to signals on the design sheet; a punch assembly **70** (Fig. 5) including a plurality of punch elements which may be designated individually by signals from the selector assembly and of which a plurality of designated elements may be actuated simultaneously by a punch set; and a control circuit **80** for operating the horizontal stepping component, the vertical stepping component, the punch set, and other auxiliary components in appropriate sequence.

The holder and selector assemblies

As shown in Figs. 1, 6, 7, 8 and 9, holder assembly **64** includes: a rotatable drum **72** for positioning a squared design sheet **65** before a human operator; and a guide **74** for retaining the guide sheet thereon. As shown in Figs. 1 and 5, selector assembly **66** includes: a keyset **78** for manually converting information from design sheet **65** to signals representing the information: a vertical stepping component **80** for intermittently rotating drum **72** in incremental arcs in order to advance design sheet **65** vertically row by row; and a horizontal stepping component **82** having sequentially operable illuminating elements for indicating successive groups of squares in any pick row of design sheet **65**.

Components of the holder assembly and the selector assembly that are designed to operate in conjunction with design sheet **65** are mounted in and enclosed by a housing **84**. Drum **72** includes a hollow plastic cylinder **85** the extremities of which are received by annular grooves in a pair of opposed end plates **86** and **88** which are secured to each other by four equally spaced tie rods **89**. Extending outwardly from end plates **86** and **88** are opposed trunnions **90** and **92** respectively. The extreme periphery of trunnion **90** is provided with an annular track **94** that serves to receive the outer races of a pair of bearings **96**. The inner races of bearings **96** are secured to housing **84** by bolts **98**. Trunnion **92** rests upon a pair of idler bearings not shown. Drum **72** is driven, when trunnions **90** and **92** are resting upon the bearings with which they are associated, through a drive gear **100** in the form of an annulus about trunnion **90**. The inner periphery of gear **100** is gripped between a pair of friction discs **102** and **104** that are carried upon end plate **86** by a series of radially disposed stub shafts **106**. The inner ends of stub shafts **106** are secured to end plate **86** and the outer ends of tsub shafts **106** are provided with helical springs **108** that press friction discs **102** and **104** against end plate **86** with gear **100** therebetween. The compression of springs **108** is adjusted to permit drum **72** to be rotated manually independently of drive gear **100** for adjustment purposes although drive gear **100** is in mesh with the stepping mechanism **80** now to be described.

Stepping mechanism **80** (Fig. 7 and 8) includes a bell crank **110**, the apex of which is carried by an overrunning clutch **112**. The inner ratchet member of overrunning clutch **112** is secured to a shaft that is journaled on a support block **116**. The outer ratchet member of overrunning clutch **112** is secured to an apex of bell crank **110**. The inner extremity of shaft **114** carries a pinion which meshes with an idler gear **118**. Idler gear **118** in turn meshes with gear **100** when drum **72** is in operating position with trunnions **90** and **92** upon their bearings. Bell crank **110**, as shown in Fig. 8, normally is pivoted into an extreme counter-clockwise position by a tension spring **120**, one end of which is connected to housing **84** and the other end of which is connected to the vertical arm of bell crank **110**. Bell crank **110** is actuated by the reciprocable core **122** of a solenoid **124** that is actuated by control circuit **80** in a manner to be described more fully below. The clockwise motion of bell crank **110** is limited by a cam **126**. The rotational position of cam **126** is controlled by a manually adjustable knob **128** and is indicated by a pointer **130**, which rotates with knob **128** and coacts with indicia **132** on the outer surface of housing **84**. As shown in Fig. 8, motion of the horizontal arm of bell crank **110** is adjustably limited by the profile of cam **126**. The purpose of rendering stepping component **80** adjustable is to permit design sheets having squares of different sizes to be accommodated by drum **72**. Design sheet **65** is secured to drum **72** in the following way. Extending longitudinally along drum **72** is a slot **134** in plastic cylinder **85**. In contact with the inner surface of plastic cylinder **85** is a base leaf **136** of a spring having a reverse leaf **138**. The free extremity of base leaf **136** is secured to plastic cylinder **85**. Reverse leaf **138** bears against a manually adjustable cam **140**, which when in open position, relieves the spring so that design sheet **65** may be inserted through slot **134** into position between the spring and plastic cylinder **85**. Cam **140**, when in closed position, compresses the spring so that the design sheet becomes locked between the spring and the inner surface of plastic cylinder **85**.

Design sheet **65** is held in reading position against the surface of drum **72** by guide **74** in the form of a translucent plastic strip above. The ends of guide **74** are secured to arms **142**, **142**, which are pivoted to housing **84** as at **144**. Also mounted at its opposite extremities for pivotable movement at **144** is horizontal stepping component **82**. Horizontal stepping component **82** includes a housing panel **146** which carries therealong and covers a sequence of lights **148** and an indicating element **150** having sequential segments **151**. A selected light **148** is designed to illuminate a selected segment **151** when the remaining lights are off. Element **150** is connected to panel **146** by pins **152** extending therefrom and gripping slots **154** in panel **146**. Element **150** is interchangeable with other similar elements having segments of different lengths. In order that lights **148** be properly associated with appropriate segments of different elements **150**, each of elements **150** is associated with an adaptor plug **156** (Fig. 9) that may be mated with a control plug **158** for lights **148**. In other words, plugs **156** and **158** serve to properly conform the operation of lights **148** to a chosen one of different elements **150** associated with different design sheets having squares of different sizes and/or organizations. In operation, the squares of the illustrated design sheet **65** are visible between guide **74** and element **150** and a particular group of eight squares in a pick row of the design sheet is indicated by an illuminated segment **151** of element **150**. As information contained in the squares of this particular group is injected into the system by an operator, the initially illuminated segment **151** of element **150** is darkened and the next segment **151** of element **150** is illuminated. In this way the eye of the operator is directed toward a single group of eight squares under consideration.

The punch assembly

As indicated above, punch assembly **70** includes a plurality of punch elements which may be designed

individually by signals from the selector assembly and of which a plurality of designated elements may be actuated simultaneously by a punch set. In the illustrated embodiment the punch elements and punch set are components of a conventional Jacquard card repeater of the type shown in Fig. 17. The repeater generally designated by **200** includes a plurality of pins **202** distributed in vertical rows of twelve. These pins are operatively connected to a plurality of similarly disposed punches **204** through a plurality of linkages **206**. Punches **204** are operatively associated with a punch set **208** that is reciprocated by a suitably driven rotating cam **209**. Jacquard cards **211**, suitably laced together, sequentially are positioned between punches **204** and punch set **208**. When all pins **202** have been set up, or designated, punch set **208** may be actuated in order to produce the coded holes in a Jacquard card **211**. Thereafter, a reset bar **210** may be actuated in order to render the system available for receipt of new information.

The components of the punch assembly that are responsive to information transmitted from the holder and selector assemblies are shown generally at **212** in Fig. 17 and specifically in Figs. 10, 11, 12, 13, 14, 15 and 16. These components are mounted upon a frame **230** including brackets **232** and **234** at its opposite extremities and tie rods **236** that secure the brackets together. One tie rod **236**, which is splined slidably supports a pin designating unit **242**. Pin designating unit **242** includes a pair of mounts **244** and **246**, which are connected by a tie **248**. Each of mounts **244** and **246** carries twelve solenoids **250**. As is best shown in Figs. 15 and 16, each of solenoids **250** includes a core **252**, the forward end of which is connected by a splined (spline not shown) element **254** to a double reverse rod **256**. It will be observed in Fig. 16 that the forward extremities **251** of the double reverse rods of each group of twelve solenoids lie in a vertical column. This column is intended to register with the pins of repeater **200** lying in a vertical column. In other words, solenoids **250** are designed to actuate the pins of successive columns of the repeater in succession. As will be described in detail below, six of the solenoids of one of mounts **244** and **246** are operated at a given time before switching to another group of six occurs. This arrangement is economical from the point of view of overall space occupied.

In operation initially, unit **242** is drawn to its extreme position at the right end of frame **230** (as shown in Fig. 10) by a cable **257**, which has a weight attached to its free end. At this point, the free forward extremities of rods **256** are aligned with the pins of the first row **258** of repeater **200**. After six solenoids **250** on mount **246**, in response to signals received from the holder and selector assemblies, have actuated appropriate pins in row **258**, the other six solenoids **250** on mount **246** operate similarly. Thereafter a drive solenoid **260** is actuated. The reciprocable core **262** of drive solenoid **260** is pivotably connected to one end of a link **264** the other end of which is pivoted to frame **230**. Link **264** is in slidable and pivotable contact with an extremity of a reciprocable rod **266**. One extremity of rod **266** is slidably and rotably received by an opening in bracket **234**. The other extremity of rod **266** is slidably and rotatably received by an opening in bracket **232**. Rod **266** is urged into an extreme right position, by a helical compression spring **267**. This extreme right position is determined by a collar **268**.

Motion from link **264** is transmitted to unit **242** through a pawl **272**, which is carried by a tie **274** connecting mounts **244** and **246**. Pawl **272** is pivoted to tie **274** at **276** being urged toward rod **266** by a leaf spring **278**. Pawl **272** meshes with a straight ratchet **280** which can be disengaged from pawl **272** by rotation of rod **266**. Parallel to rod **266** is an axially stationary rod **282** which meshes with a second pawl (not shown) for the purpose of preventing undesired movement of unit **242** when rod **266** is returned to its initial position after each stepping movement. After the solenoids **250** of mount **246** have designated appropriate pins in half of the columns, a release solenoid **284** is actuated. Release solenoid **284** includes a core **286** that is provided with a circular rack **288** in mesh with a pinion **290** at the extremity of rod **266**. In consequence, rod **266** is rotated and its rotational motion is transmitted through a pair of meshing pinions **292** and **294** to rod **282**. Accordingly, the racks on rods **266** and **282** are disengaged from their respective pawls and unit **242** is drawn by cable **258** back to its extreme right position. Thereafter the solenoids **250** on mount **244** are actuated in the manner described above in connection with the solenoids **250** on mount **246**. The result is that all of the pins necessary to set up the punch elements of the repeater have been designated and punch set **208** may be actuated in order to complete the Jacquard card.

The annunciating and control circuits

As shown in Fig. 5, keyset **66** includes a plurality of switches **300** that are operated manually for the purpose of sequentially actuating a selected combination of solenoids (shown mechanically in Figs. 10 through 16 and electrically in Fig. 5). A particular combination of solenoids is selected by a plurality of switches **302** in the form of a matrix that constitutes annunciating circuit **68**. Switches **302** are set manually and latched automatically, by conventional means not shown, for the purpose of retaining the particular code desired. In operation, current flows from a source B+ through a selected switch **300**, through an associated bus bar **304**, and through selected switches **302** and their associated diodes **306** to designated bus bars **308**. Diodes **306** prevent reverse current flow and possible energization of undesired solenoids. The terminals of bus bars **308** are shown in Fig. 5 aligned with a set of six solenoids **250** selected in the manner described above. However, signals from bus bars **308**, before being applied to solenoids **250**, are processed by transmission through what may be termed a Wilton-float switch **310** and a display memory **312** (shown electrically in Fig. 5 and mechanically in Figs. 1, 5, 6 and 7). Wilton-float switch **310**, as will be apparent to persons skilled in art, enables the operator to connect bus bars **308** either to six consecutive solenoids associated as at **70** in Fig. 5 for the production of holes of the type shown in Fig. 3 or six top solenoids or six bottom solenoids for the production of holes of the type shown in Fig. 4. Display memory **312** serves to record temporarily a limited sequence of eight signals transmitted from matrix **68** so that any one signal of the eight may be cancelled before being recorded permanently by solenoids **250**. Display is accomplished by a digital read-out **314** and cancellation by leaf spring switches **316**.

Signals from bus bars **308**, processed as indicated above, are transmitted to counters **318** and **320**. Counter **318** actuates solenoid **260** when signals from bus bars **308** have been applied to the two groups of six solenoids **250** required to actuate a single row of pins **258**. Counter **320** causes lights **148** and consequently segments **151** of element **150** to be illuminated in step-by-step fashion at intervals determined when signals from bus bars **308** have been applied to the eight groups of six solenoids **250** required to actuate four rows of pins **258**. When it is desired to omit selected sets of six holes from the Jacquard card, i.e to omit selected warp threads for the purpose of producing less expensive fabrics, a so-called weed-out skip circuit **322** may be energized by a manual weed-out control **324** for the purpose of automatically actuating solenoid **260** in order to step solenoids **250** past selected positions without operation.

Operation

In operation a design sheet **65** is inserted through

opening 134 (Fig. 8) and cam 140 is rotated so that the design sheet is locked between spring 136 and plastic tube 85 of drum 72. Thereafter guide 74 and panel 146 are pivoted rearwardly until a pick row of design sheet 65 appears therebetween. With the system fully energized, the extreme left segment 151 of panel 150 is illuminated. The operator now sequentially presses the keys 78 (Fig. 1) of keyset 66 (Fig. 5) that correspond to the eight squares of design sheet 65 indicated by that extreme left segment 151. Each time two keys 78 are pressed, counter 318 (Fig. 5) actuates solenoid 260 in order to step pin designating unit 242 (Fig. 10) from one row of pins 258 in repeater 200 to the next. Each time eight keys 78 are pressed, counter 320 actuates plugs 156 and 158 in order to deenergize one light 148 and to energize the next light 148. At appropriate predetermined intervals a reset control 326 switches bus bars 308 from one group of six solenoids 250 to the next and energizes solenoid 284 for the purpose of releasing pin designating unit 242 (Fig. 10) for movement to its extreme right position under the direction of cable 257 and the weight attached to it.

In consequence of this sequence all appropriate pins 202 (Fig. 10) of repeater 200 (Fig. 17) are designated and Jacquard card 211 (Fig. 17) is punched by actuation of punch set 208 (Fig. 17) under the manual control 328 of an operator.

It is of course to be understood that the disclosed system may be used in conjunction with various auxiliary components that increase its effectiveness and applicability. For example, a recorder may be utilized to punch all information processed by the system as perforations on a tape. Also, a randomizer may be substituted for the keyboard to inject the information necessary for a random textile pattern.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted in an illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for producing Jacquard cards or the like, said apparatus comprising: holder means for positioning a squared design sheet for reading; selector means contiguous with said holder means including vertical designating means for discriminating among different rows of squares of said design sheet and horizontal designating means for discriminating among different squares of ones of said rows; vertical stepping means for moving said vertical designating means with respect to said holder means; to sequential vertical positions; horizontal stepping means for moving said horizontal designating means with respect to said holder means to sequential horizontal positions; an annunciating circuit for translating representations of indicia at said sequential positions to signals corresponding thereto; and a punch assembly including a plurality of punch elements which may be designated individually by said signals and a punch set for actuating punch elements so designated simultaneously.

2. The apparatus of claim 1 wherein said holder assembly comprises a rotatable drum and said vertical stepping component is operatively connected to rotate said drum through incremental arcs.

3. The apparatus of claim 1 wherein said annunciating circuit constitutes a matrix including a plurality of input key switches and a plurality of routing holding switches, said holding switches determining the output of said matrix when one of said input switches is actuated.

4. The apparatus of claim 1 wherein said holder assembly comprises a rotatable drum and said vertical stepping component is operatively connected to rotate said drum through incremental arcs, and adjustable means for predetermining the lengths of said incremental arcs.

5. The apparatus of claim 1 wherein said punch assembly includes a plurality of control elements in association with a plurality of punch elements, a punch set for actuating selected ones of said punch elements when designated by their associated control elements, and means for actuating said associated control elements, said means for actuating said associated control elements including a mount movable in contiguity with said control elements, and a plurality of solenoids having cores registrable with said control elements.

6. The apparatus of claim 5 wherein said control circuit includes weed-out switch means for causing said mount to move past certain of said control elements without actuation of said solenoids.

7. The apparatus of claim 1 wherein said punch assembly includes a plurality of control elements in association with said plurality of punch elements, a punch set for actuating selected ones of said punch elements when designated by their associated control elements, means for actuating said associated control elements, said means for actuating said associated control elements including a mount movable in contiguity with said control elements, and a plurality of solenoids having cores registrable with said control elements.

8. Apparatus comprising base means, a drum affixed to shaft means rotatable on said base means about a horizontal axis, said drum presenting a surface for carrying a design sheet having rows of squares parallel to said axis and columns of squares normal to said axis, elongated straight edge means disposed on said base means along the periphery of said drum in parallelism to said axis in order to indicate a selected one of said rows, a series of illuminating elements disposed on said base means along said straight edge means in order to indicate the series of columns, certain of said illuminating elements being adjacent to certain of said columns in order to indicate said certain of said columns when iluminated, overrunning clutch means having clutch inner means and clutch outer means rotatable with respect to each other in one direction and locked with respect to each other in the other direction, said clutch inner means being affixed to said shaft means, a lever affixed to said clutch outer means, vertical stepping means responsive to first signals for reciprocating said lever in order to rotate said drum through incremental arcs, horizontal stepping means responsive to second signals for energizing said illuminating elements in sequence, a plurality of punch elements arrayed in rows and columns on said base means, a punch set on said base means, each of said punch elements being movable between an inoperative position and an operative position, said punch set when actuated coacting with punch elements in operative positions to perforate a card positioned between said punch elements and said punch set, a mount constrained in parallelism to said columns of said punch elements for movement along said rows of said punch elements, a column of core means registrable with a selected column of punch elements, a plurality of solenoids, one each of said plurality of solenoids encompassing at least a portion of one each of said core means, punch set selecting means responsive to third signals energizing selected solenoids in order to move selected punch elements into operative positions, and control means for generating said first, second and third signals in conformity with representations in said squares.

9. The apparatus of claim 8 wherein said first, second and third signals are simultaneous electrical pulses transmitted by manually operable keys.

10. The apparatus of claim 9 wherein the paths of said electrical pulses from said keys to said solenoids are determined by a matrix of switches.

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