Feb. 2, 1960 H. O. KAFFINE 2,923,326

FLUID PRESSURE CONTROL MEANS

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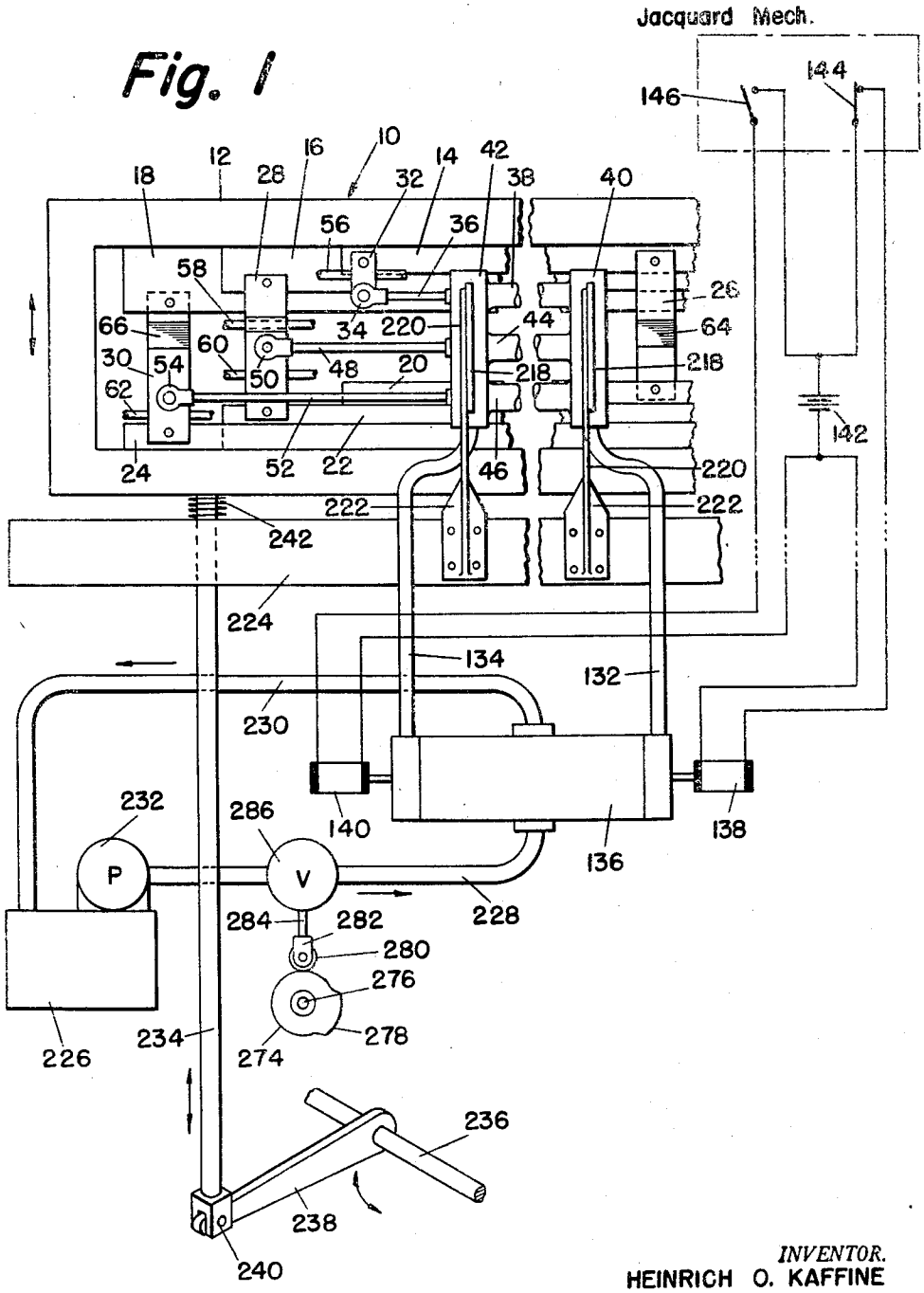
Fig. 1



INVENTOR.
HEINRICH O. KAFFINE

BY

Caesar and Rivise

ATTORNEYS.

Feb. 2, 1960 H. O. KAFFINE 2,923,326

FLUID PRESSURE CONTROL MEANS

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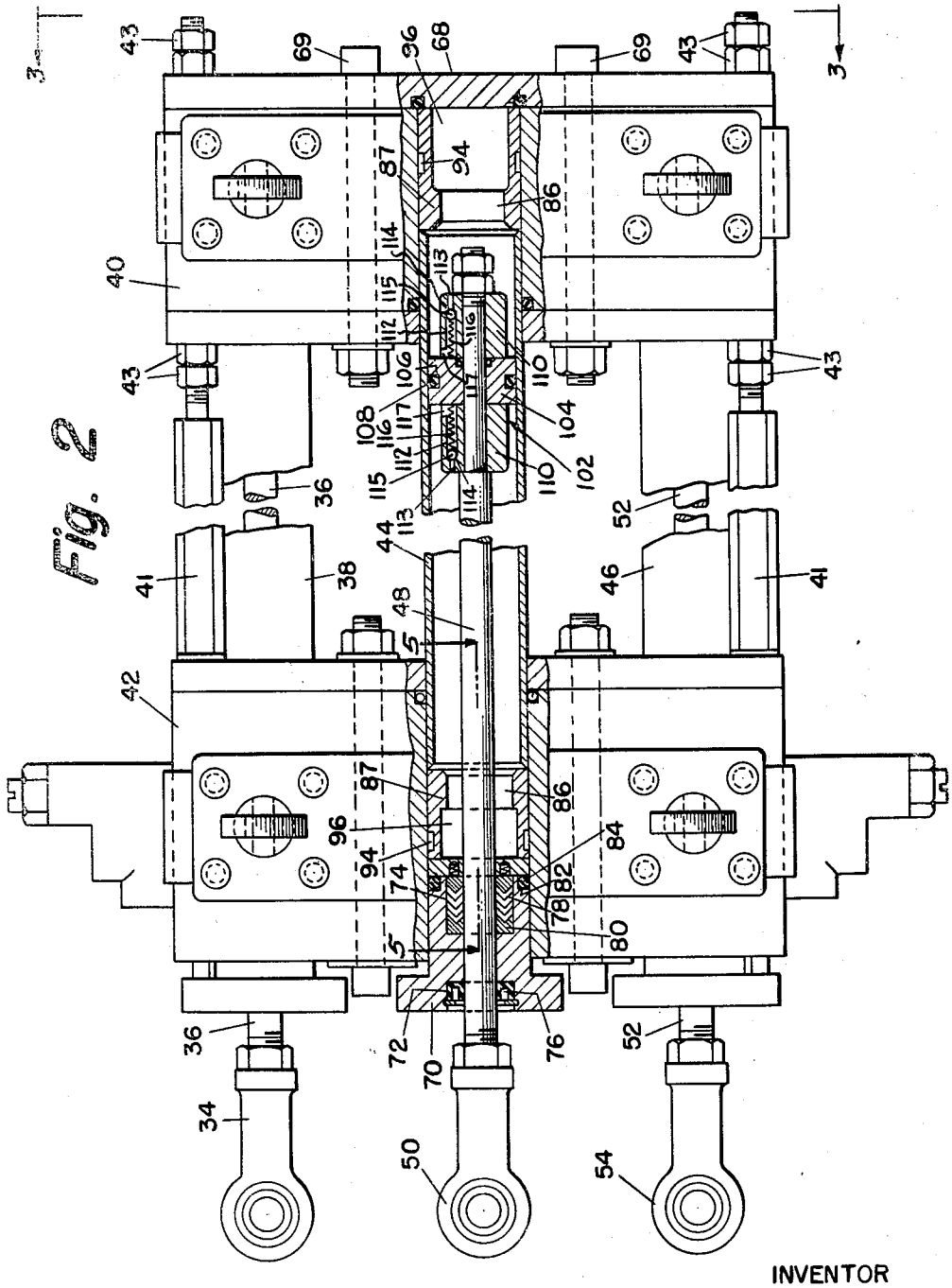

Fig. 2

INVENTOR
HEINRICH O. KAFFINE

BY
Caesar and Rivise

ATTORNEYS.

Feb. 2, 1960 H. O. KAFFINE 2,923,326

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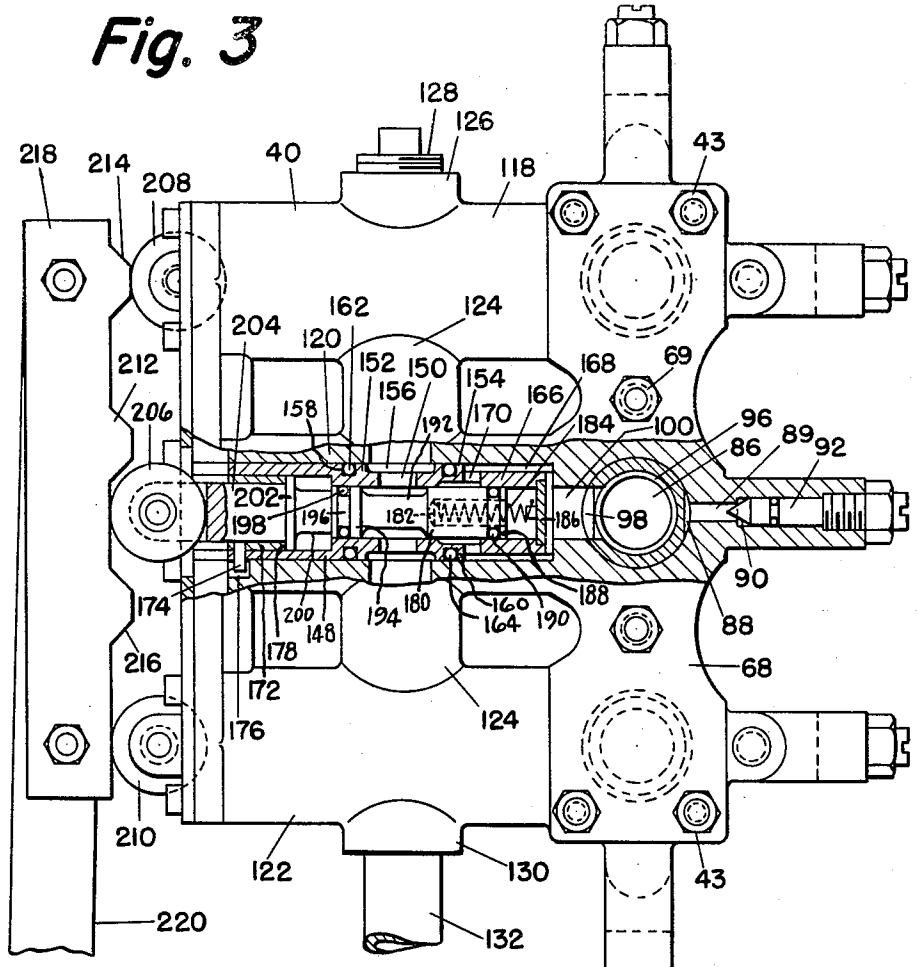
Fig. 3



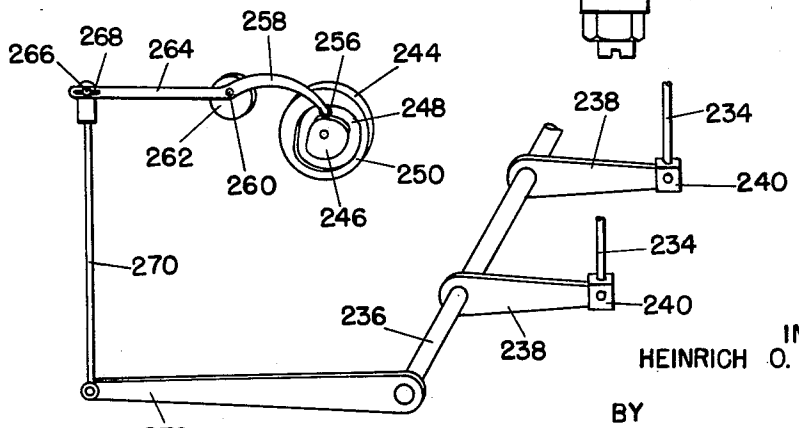


Fig. 4

INVENTOR
HEINRICH O. KAFFINE

BY
Caesar and Rivise

ATTORNEYS

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Fig. 5

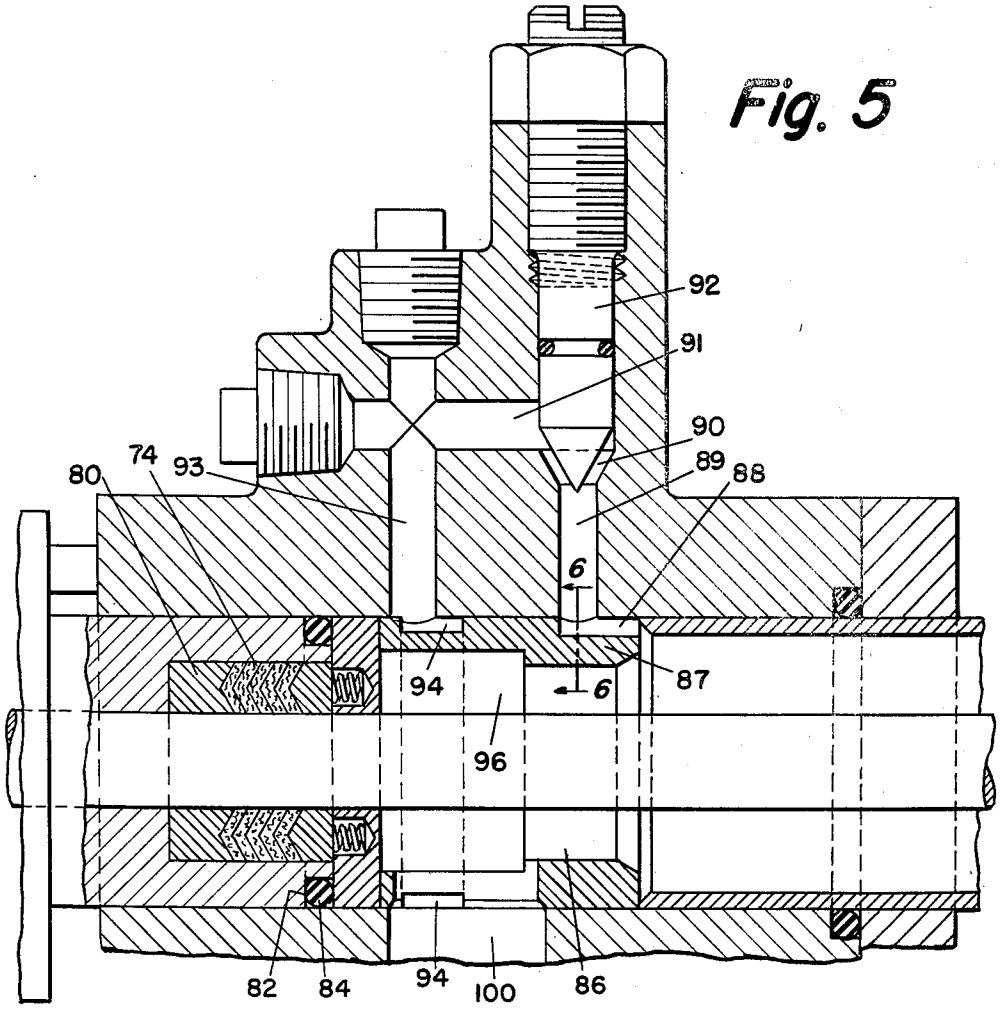
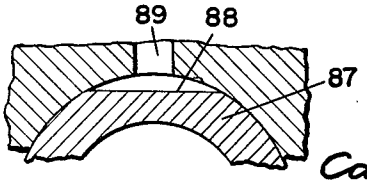


Fig. 6



INVENTOR.
HEINRICH O. KAFFINE
BY
Caesar and Rivise
ATTORNEY

United States Patent Office

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FLUID PRESSURE CONTROL MEANS

Heinrich O. Kaffine, Wyomissing, Pa.

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16 Claims. (Cl. 139—137)

This invention relates to looms for the weaving of threads, and it more particularly relates to novel control means for such looms.

Looms of the type here involved are multiple looms adapted to weave a number of tapes or the like at one time. Such looms include a batten having a plurality of shuttles which carry the threads. These shuttles, which are aligned in horizontal rows, move back and forth in interrelated arcuate paths at high speeds, interweaving the threads as they move. The shuttles are actuated in these movements by pinions on the batten which are in mesh with appropriate gearing on the shuttle. The pinions are themselves actuated by rapidly reciprocating racks.

Some looms of the aforesaid type are relatively simple and may contain only one set of shuttles. Such looms are used only for weaving materials of a single weave where no pattern is required. However, where a pattern is desired, the looms are of the jacquard type where various sets or rows of shuttles are provided; different rows of shuttles acting in synchronism with each other in predetermined arrangement to form selected patterns. Such patterns may be either simple or quite intricate depending on the motion and interrelationship of the shuttles.

The present invention relates to looms of the Jacquard type. Heretofore, such looms were acutated by purely mechanical means involving relatively heavy and clumsy levers, cranks and the like. These mechanisms, although generally quite efficient, were hampered by an inherent limitation on their speed and were often subject to expensive and time-consuming breakdowns due to frictional wear of the parts. They were also quite expensive both in original cost and in maintenance.

It is one object of the present invention to overcome the above disadvantages by providing a Jacquard type loom which is operated by relatively simple and efficient driving means which eliminate many of the heavy mechanical parts of prior machines of this type.

Another object of the present invention is to provide a loom of the aforesaid type which permits high speed operation while yet being relatively easy to operate and relatively inexpensive to construct and maintain.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a somewhat schematic view showing the general working arrangement of the parts of a mechanism embodying the present invention, with certain parts omitted.

Fig. 2 is a side elevational view, partly broken away to show the fluid-pressure operated piston assembly for actuating the pinion-driving racks.

Fig. 3 is a side elevational view, partly broken away to show the valving arrangement for controlling the pistons of Fig. 2; this view being taken on line 3—3 of Fig. 2.

Fig. 4 is a somewhat schematic, perspective view showing the drive means for vertical movement of the batten.

Fig. 5 is a fragmentary sectional view taken on line 5—5 of Fig. 2.

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5.

Referring now in greater detail to the various figures of the drawings wherein similar reference characters refer to similar parts, there is shown a loom operating assembly, generally designated **10**, which includes actuating means (to be hereafter more fully described) mounted at one end of the framework **12** of a loom batten. The remainder of the loom is not shown since it is of generally standard construction and forms no part, by itself, of the present invention.

The aforementioned actuating means comprises three upper racks designated **14**, **16** and **18** respectively, and three lower racks designated **20**, **22** and **24** respectively. The toothed portions of these racks are not shown but each is arranged to simultaneously actuate a series of pinions in mesh with a row of shuttles in the standard arrangement.

Each rack of the upper group is arranged to act simultaneously with a corresponding rack of the lower group. For this purpose, the racks **14** and **20** are connected by a metal strap or the like indicated at **26** while the racks **16** and **22** are similarly connected by strap **28** and racks **18** and **24** are connected by strap **30**.

Depending from rack **14** is a hanger **32** to which is connected a head **34** positioned at one end of a piston rod **36**. This piston rod **36** extends into a fluid pressure cylinder **38** which is mounted between two manifold housings **40** and **42** connected by tie rods **41** held in place by nuts **43**. In similar manner, two other vertically spaced cylinders **44** and **46** are arranged between the manifold housings **40** and **42**. A second piston rod **48** extends from cylinder **44** and is provided with a head **50** connected to the strap **28** while a third piston rod **52** extends from cylinder **46** and is provided with a head **54** connected to strap **30**.

The longitudinal reciprocatory movements of the piston rods **36**, **48** and **52** act to reciprocate the respective pairs of racks to which they are connected, and guide rods are provided, to guide the movements of the racks. Such guide rods are indicated at **56**, **58**, **60** and **62**; the guide rod **56** extending through a bearing in hanger **32**, the guide rods **58** and **60** extending through corresponding bearings in strap **28** and the guide rod **62** extending through a bearing in strap **30**. The straps **26** and **30** are appropriately offset, as at **64** and **66** respectively, to provide clearance for the parts during relative movements thereof.

The piston rods **36**, **48** and **52** are arranged to be operated individually and selectively by means of appropriate fluid pressure controls. These controls comprise the cylinders **38**, **44** and **46** used in conjunction with the valve assemblies which include the manifold housings **40** and **42** mounted on the frame **12** and their associated elements.

Each piston rod forms part of a piston longitudinally movable in its respective cylinder. Since all three pistons and piston cylinders are substantially identical, only one such piston and cylinder has been specifically illustrated in Fig. 2. As shown in Fig. 2, the cylinder **44** is closed at one end by a plate **68** common to all three cylinders and releasably held on the manifold housing **40** by tie rods **41** and bolts **69** while at its other end, the cylinder **44** is closed by a gland **70**. This gland **70** has a central bore through which the piston rod **48** extends; this bore being provided with counterbores at **72** and **74**. In the counterbore **72** is provided a wiper **76** which wipes foreign matter from the shaft **48** on its return stroke; while in the counterbore **74** are provided packing **78** and pressure rings **80**. An annular recess **82** is

provided around the gland 70 at its inner end and within this recess is an O-ring 84.

At each end of the cylinder, adjacent both the plate 68 and gland 70, the cylinder is provided with a reduced portion, as at 86, defined by internal shoulders 87.

Each shoulder 87 is provided with a flat 88 at one portion of the periphery thereof (as best shown in Figures 5 and 6) and this flat 88 is intersected by a passage 89 leading to a valve chamber 90. The valve chamber 90 is in communication with a passage 91; this communication being closed, opened or partially closed by a screw-threaded needle valve 92.

The passage 91 is connected to a passage 93 which leads into an annular groove 94 surrounding a chamber 96. This groove 94 intersects a flat 98 mating with a transverse passage 100 (see Fig. 3).

The piston rod 48 is formed with a reduced end on which is mounted a piston head generally designated 102 and comprising a central block or disc 104 of substantially the same diameter as the internal diameter of the cylinder. An annular recess 106 is provided in the outer periphery of disc 104 and retains an O-ring 108 therein.

On each side of disc 104 is provided a block or boss 110 of somewhat smaller diameter than disc 104 and of a diameter substantially the same as the internal diameter of the reduced portions 86.

A series of annularly-spaced bores 112, preferably three in number, are provided in each boss 110. Each bore 112 is provided with a restricted passage 113 from which it is separated by a shoulder 114. Within each bore 112 is a check valve comprising a ball 115 urged toward the corresponding shoulder 114 by a spring 116. A lateral passage 117 connects each bore 112 to the cylinder chamber 96.

The manifold housings 40 and 42 are substantially identical, each comprising three vertically spaced valve chambers 118, 120 and 122 formed on a common casting and interconnected by a common vertical fluid chamber 124. This chamber 124 has a filling opening 126 at its upper end; this opening being internally threaded and closed by a threaded plug 128. At its lower end, the chamber 124 is provided with an outlet 130 to which is connected a conduit 132. The housing 42 is similarly provided with a conduit 134.

The conduits 132 and 134 lead to opposite ends of a solenoid valve chamber 136 controlled by opposing alternately operated solenoids 138 and 140. The solenoid 138 is in electrical circuit with a battery, or other source of electrical energy 142 and a microswitch 144 while the solenoid 140 is in circuit with the battery 142 and microswitch 146. These microswitches 144 and 146 are alternately operating and may be actuated by the so-called jacquard mechanism which is controlled by the insertion of punch cards. Since this jacquard mechanism of standard construction and operation, it will not be described in any further detail here.

The valve arrangements in each of the chambers 118, 120 and 122 of each manifold housing are substantially identical so that the description of one, for example that of chamber 120, constitutes a description of all.

The valve chamber 120, similarly to all the other valve chambers, is open at one end and connected with the passage 100 at the opposite end. It is also provided with an internal sleeve 148 having opposed ports 150 defined by annular shoulders 152 and 154. The ports 150 mate with ports 156 in the chamber; these ports 156 leading to the common vertical chamber 124.

The flanges 152 and 154 are each provided with an annular recess, as at 158 and 160 and in each recess is an O-ring, as at 162 and 164.

At the rearward side of flange 154 the sleeve is reduced in diameter to form reduced portion 166. This provides a peripheral passage 168 around the reduced portion 166; this passage 168 connecting with passage 100. Opposing ports 170 are provided in the reduced portion 166 adjacent the flange 154; these ports 170 leading into passage 168.

At the front end of the sleeve 148 there is provided an internal bushing 172 held in place by a pin 174 extending through the sleeve into a recess 176. This bushing forms an internal shoulder 178.

Positioned for longitudinal movement within the sleeve 148 is a valve 180. This valve 180 is provided with an internal bore 182 at its rear end. In this bore 182 is positioned one end of a coil spring 184, the other end of which is connected to the rear closure plate 186 of the sleeve portion 166. This spring 184 acts to normally bias the valve forwardly.

Adjacent its rear end, the valve 180 is provided with an annular recess 188 in which is positioned an O-ring 190, while at its intermediate portion, valve 180 is reduced, as at 192. The forward end of this reduced portion is defined by a flange 194 which is annularly recessed at 196 to hold an O-ring 198. Forwardly of this flange 194, the valve is again reduced at 200. This portion 200 is forwardly defined by a flange 202 adapted to abut against shoulder 178. Forwardly of flange 202, the valve is slightly reduced, as at 204, to slidably fit within bushing 172. At the forward end of valve portion 204 is rotatably positioned a roller 206. Similar rollers 208 and 210 are provided at corresponding positions for the other valves.

The rollers 206, 208 and 210 are cam rollers adapted to coact with corresponding cams 212, 214 and 216 integral with a cam plate 218. This cam plate 218 is mounted on a stationary support arm 220 which is integral with a bracket 222 connected to the supporting lay beam 224. The lay beam 224 is attached to the machine in any desired manner.

The cams 212, 214 and 216 are so dimensioned and arranged that only one cam roller will be in contact with its corresponding cam at any one time (as clearly shown in Fig. 3). Consequently, vertical movement of the batten 12 is necessary to selectively bring the individual cam rollers into operative alignment with their respective cams.

Upon a cam roller coming into contact with its corresponding cam, the valve associated with that roller is opened to actuate the corresponding pair of racks. For example, when the cam roller 206 is in the position shown in Fig. 3, it is spaced from its corresponding cam 212. In this position, the spring 184 urges the valve 180 into the closed position wherein the rear portion of the valve closes the ports 170 from communication with the ports 150. In this position, there is no fluid flow between the vertical chamber 124 and the piston cylinder 44. However, when the cam roller 206 is moved up into contact with cam 212, the valve 180 is forced back against the bias of spring 184 into the position where the reduced portion 192 of the valve establishes communication between ports 150 and 170. This permits flow in either direction between the vertical chamber 124 and cylinder 44; such flow being directed through peripheral passage 168, passage 100 and chambers 96 of the piston cylinder.

The solenoid valve chamber 136 is in fluid connection with a tank 226 or other source of pressure fluid through a fluid circuit comprising an inlet conduit 228 and an outlet conduit 230. A pump 232 is used to force the fluid through the circuit. The term fluid of course covers both gases and liquids so that, as is obvious, the system may be either pneumatic or hydraulic.

When in the open, or operative position, as described above, fluid pressure flow is through conduits 132 or 134 from solenoid valve chamber 136 to either side of the piston head 102. Alternate operation of the micro switches 144 and 146 acts on their respective solenoids 138 and 140 to alternately open the solenoid valve to pressure in either conduit 132 or 134 while simultaneously opening the other conduit to return flow through conduit 230 to the tank 226. This causes alternate flow through conduits 132 and 134 resulting in reciprocation

of the piston 102 and of its rod 48. The reciprocation of the rod 48 causes a corresponding reciprocation of the racks attached thereto.

During reciprocation of the piston 102, when the piston approaches the reduced portion 86 at either end of the cylinder 44, the boss 110 abuts the reduced portion while the fluid around the boss is entrapped between the peripheral area of the disc portion 104 of the piston head and the shoulder 87. This entrapped fluid acts as a cushioning or dashpot means to prevent slamming of the piston at either end of the cylinder.

The entrapped fluid is partially relieved by flowing through passage 89, valve chamber 90 and passages 91, 93 and 94 into chamber 96. The setting of needle valve 92 will increase or decrease chamber 90, thereby determining the amount of cushioning for the piston at the end of its stroke. However, when the fluid pressure is reversed, the fluid forces the balls 113 away from the shoulders 114. This permits the fluid to pass through bores 112 and through passages 117 to impinge against substantially the entire operative surface of the disc 104. This increased surface area exposed to the fluid pressure permits a faster and surer movement of the piston away from shoulder 87.

The three sets of racks are provided, as indicated previously, in order to obtain various patterns in the finished product. These patterns result from the selective use of the various racks, each of which actuates a different set of shuttles. Since the different racks are actuated by their corresponding fluid-pressure operated piston rods, in order to change from one set of racks to another, it is necessary to move the batten up or down until the cam roller associated with the selected position engages its corresponding cam. This selective vertical movement may be provided in any desired manner by appropriate signal from the aforementioned jacquard mechanism. One manner of efficiently accomplishing it, however, is indicated in Fig. 4.

As shown in Figs. 1 and 4, the batten is mounted upon a series of rods 234, spaced from each other along the length of a shaft 236 which extends the length of the machine. The rods 234 are connected to the shaft 236 by means of links 238 pivotally connected to their respective rods 234 by pivot joints 240. The rods 234 extend through corresponding apertures in the lay beam 224 and are provided with cushioning springs 242 between the lay beam and the batten.

The shaft 236 is rotated to rock the links 238 to an extent sufficient to cause the rods 234 to move the batten to the desired position by the mechanism shown in Fig. 4. This mechanism comprises a cam wheel 244 rotatably mounted on the side of the machine. It may be rotatably connected to the frame or any other desired stationary part of the machine.

The wheel 244 is provided with a centrally located cam 246 defining a cam track between itself and a peripheral flange 250 on the wheel.

Movable in the cam track 248 is a cam follower 256 mounted on one end of a curved arm 258. The opposite end of arm 258 is connected to a pin 260 eccentrically positioned on a disc 262 rotatably mounted on a stationary part of the machine. The arm 258 is integrally connected to one end of a link portion 264 adjustably connected at its other end, by means of a pin 266 and slot 268, to one end of a rod 270. The rod 270 is connected at its other end to one end of a lever 272 which is connected at its other end to the shaft 236.

The wheel 244 is operatively connected to the main drive shaft of the loom (not shown) and the wheel 244 is actuated by appropriate signals from the aforementioned jacquard mechanism which controls a one-revolution clutch (not shown) operatively connected to the wheel.

In operation, the wheel 244 is rotated in accordance with the signals received from the jacquard mechanism. As it rotates through a predetermined arcuate extent, it moves the follower 256 to a certain portion of the cam 246. This moves the arm 258 and the remainder of the linkage attached thereto to rotate the shaft 236 a sufficient amount to rock the links 238 to move the rods 234 and the batten carried thereby to a predetermined position wherein one of the cam wheels 206, 208 or 210 is aligned with its corresponding cam. A further rotation of the wheel 244 to its next position will bring the follower 256 to its second position relative to the cam 246 and will align a second cam roller with its cam.

Since the cam 246 is shown as having only two positions, in order to align the third valve-operating roller with its respective cam, the eccentric disc 262 is rotated by an appropriate signal from the jacquard mechanism to provide a third position of adjustment.

Although only three positions of adjustment are necessary in the machine illustrated because only three sets of valves are used, the eccentrically connected disc 262 may be used to provide a fourth position if four sets of valves are used by adding its position to the position of the cam wheel. In this connection, it should be pointed out that the number of valves and consequently of racks and shuttles used, may be varied as desired and feasible and that the three shown are merely for the purpose of illustration.

It is also possible to eliminate the eccentrically connected disc 262 and use only a cam wheel with the desired number of cam positions. It is even within the scope of the invention to utilize any other desired means for raising and lowering the batten in accordance with a predetermined pattern; however, the mechanism of Fig. 4 has been illustrated as a preferable form.

While the batten is being raised or lowered, it is desirable that the racks be restrained from reciprocating. To accomplish this purpose automatically, a cam disc 274 is mounted on the main power shaft 276 of the loom. This cam disc has a cam portion 278 adapted to coact with a cam roller 280 rotatably mounted on a bracket 282 connected to the lower end of a valve stem 284. The stem 284 is connected to a shutoff valve generally indicated at 286. This valve 286 is interposed in the conduit 228 between the pump 232 and the valve chamber 136. As the shaft 276 rotates, it intermittently shuts off the flow of fluid to the solenoid valve as the cam 278 engages the roller 280. The jacquard mechanism is so timed that it provides the actuating signal to the drive for the cam wheel 244 only during the engagement of the cam 278 and roller 280.

It should be noted that the reciprocatory stroke of the pistons may be made adjustable by making the length of the piston rods or the length of the cylinders adjustable.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed as the invention is:

1. A loom assembly comprising a batten movable in a first plane, said batten being adapted to support a plurality of movable shuttles on said batten, actuating means for moving said shuttles, said actuating means including a plurality of parallel, individually reciprocating members on said batten, said members being reciprocable in a second plane transverse to the plane of movement of said batten, fluid pressure means for selectively operating said reciprocating members, and control means for controlling the selective operation of said fluid pressure means, said control means being operatively associated with said batten to vary the selective operation of said fluid pressure means in accordance with selected positions of said batten in said first plane.

2. The loom assembly of claim 1 wherein said reciprocating members comprise pistons connected to corresponding shuttle-actuating racks.

3. The loom assembly of claim 1 wherein said control means comprises a plurality of valves arranged in series and movable with said batten in said first plane, said valves being provided with individual cam followers and being normally closed, said cam followers being movable against corresponding cams for opening said valves upon movement of said valves to selected positions in said first plane.

4. A loom assembly comprising a batten movable in a first plane, said batten being adapted to support a plurality of movable shuttles thereon, actuating means for moving said shuttles, said actuating means being movable in a second plane transverse to said first plane, and control means for said actuating means, said control means comprising two spaced, parallel valve manifolds, a series of valves in each manifold, the valves in each manifold being arranged in series in the direction of said first plane, each of the valves in each manifold being aligned with a corresponding valve in the other manifold, a fluid pressure cylinder extending between each pair of aligned valves, a piston in each cylinder, said pistons including piston rods connected to corresponding shuttle-actuating means, conduit means connecting each manifold to a source of fluid pressure, and means for applying fluid pressure through said conduit means to each manifold alternately.

5. The loom assembly of claim 4 wherein a cut-off means is provided between said source of fluid pressure and said manifolds, said cut-off means being operatively synchronized with the movement of said batten in said first plane to cut off the application of pressure fluid to said manifolds while said batten is moving in said first plane.

6. The loom assembly of claim 4 wherein said means for applying fluid pressure alternately comprises a solenoid-actuated valve interposed between said source of fluid pressure and said manifolds, the solenoids of said valve being connected to alternately move the valve from a pressure-applying position relative to one manifold to a pressure-applying position relative to the other manifold, and switch means connected to said solenoids for effecting alternate actuation thereof.

7. The loom assembly of claim 4 wherein said cylinders are adjustable in length to vary the stroke of the corresponding pistons.

8. A loom assembly comprising a support, a batten adapted to support a plurality of shuttles vertically movable on said support, means for moving said batten vertically, a plurality of racks for actuating said shuttles, said racks being arranged for horizontal reciprocating movement on said batten, pistons operatively connected to said racks, said pistons being horizontally movable in corresponding cylinders arranged in vertical series on said batten, said cylinders extending between a pair of manifolds connected to said batten, a vertical series of normally closed valves in each manifold, each valve being associated with a corresponding inlet at one end of the corresponding cylinder, each valve having a cam roller thereon extending out of the manifold, a pair of cam plates connected to said support in alignment with said pair of manifolds, each cam plate having a vertical series of cams for engaging the cam rollers to open the valves, said cams being so spaced relative to said cam rollers that only one cam roller of each manifold is in alignment with its corresponding cam at any one time, said cam rollers being vertically movable relative to said cams by the vertical movement of said batten, and a source of fluid pressure connected to said manifolds.

9. The loom assembly of claim 8 wherein said batten is mounted on vertically movable rods pivotally connected to an oscillating linkage, said linkage being connected to a lever having a cam follower operatively associated with a cam, said cam being movable by selected actuating means.

10. The loom assembly of claim 9 wherein said lever is eccentrically connected to a rotatable carrier, said carrier being rotatable by selected actuating means to provide compound movements of said linkage.

11. The loom assembly of claim 8 wherein said racks are operatively combined in pairs for simultaneous movement, each piston being operatively connected to one pair of said racks.

12. The loom assembly of claim 8 wherein said control means comprises a solenoid valve connected to each of said manifolds by separate corresponding conduits, said solenoid valve being actuatable to apply fluid pressure through said conduits individually upon the application of selected electrical signals to the solenoid mechanism thereof.

13. The loom assembly of claim 8 wherein cut-off means are provided between said control means and said source of fluid pressure, said cut-off means being driven in timed relationship with said means for moving said batten vertically to effect a stoppage of fluid pressure during vertical movement of said batten.

14. The loom assembly of claim 8 wherein the horizontal strokes of said pistons are adjustable.

15. In a loom assembly having movable shuttles and actuating means for moving said shuttles, said actuating means comprising at least one fluid-pressure operated piston movable in a cylinder, said cylinder having a reduced portion at each end defined by an internal shoulder, said piston comprising a piston rod and a piston head on said rod, said piston head having a central portion of greater diameter than the internal diameters of said shoulders and a pair of oppositely disposed bosses on either side of said central portion, said bosses having a diameter larger than the internal diameters of said shoulders, each of said bosses having at least one bore mating with an aligned passage opening out of that end of the boss which is remote from said central portion, the bore being separated from its mating passage by an internal shoulder, a passage leading out from each bore against the adjacent face of said central portion, and a check valve in each bore, said check valve being adapted to seat against the corresponding internal shoulder separating the bore from its mating passage.

16. The loom assembly of claim 15 wherein said check valve is a spring-pressed ball within the bore.

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