Dec. 11, 1956 L. J. HOOPER ET AL 2,773,517

LIQUID PICKING MECHANISM

Filed Aug. 3, 1953 2 Sheets-Sheet 1

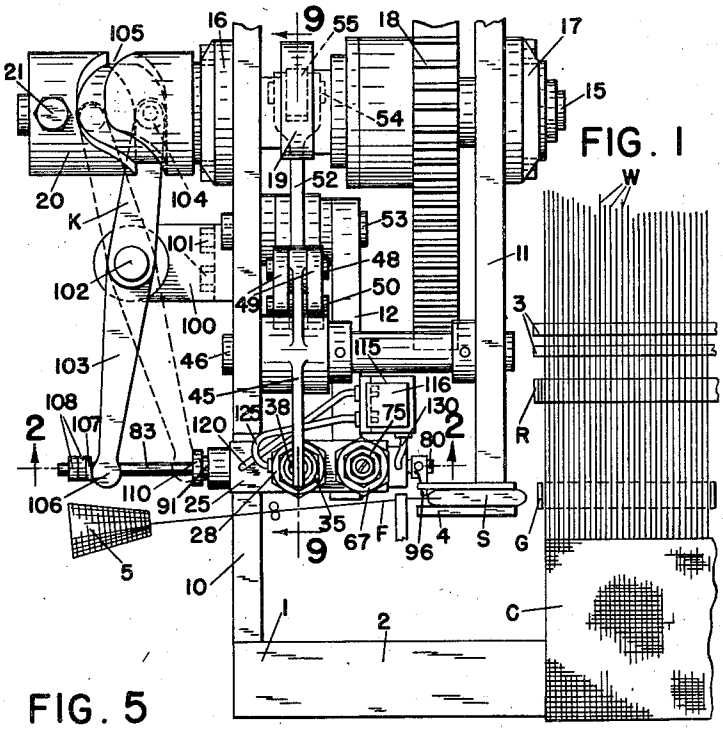

FIG. 1

FIG. 3

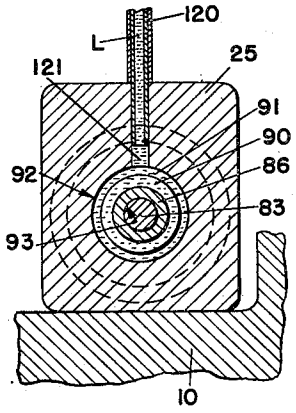

FIG. 4

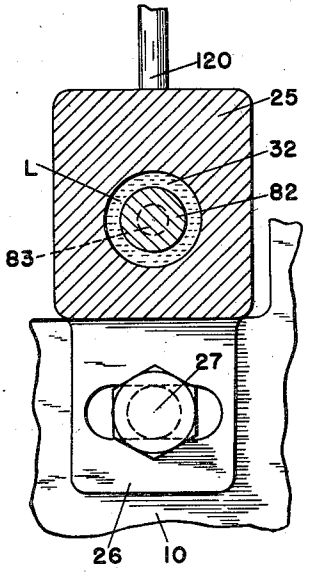

FIG. 5

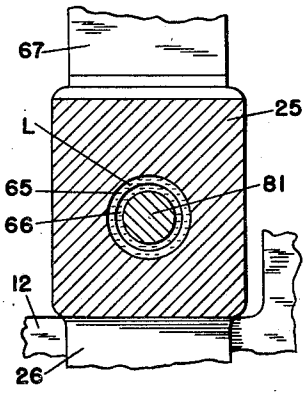

FIG. 6

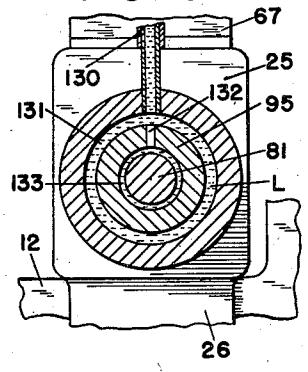

FIG. 7

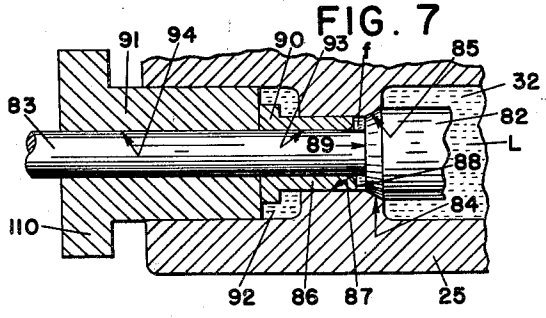

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FIG. 8

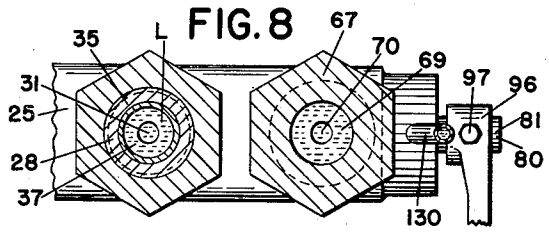


FIG. 9

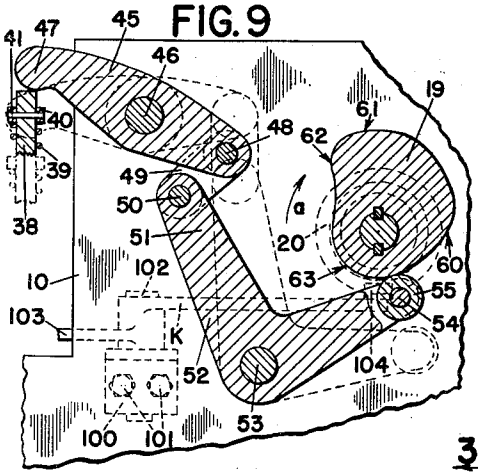


FIG. 2

FIG. 10

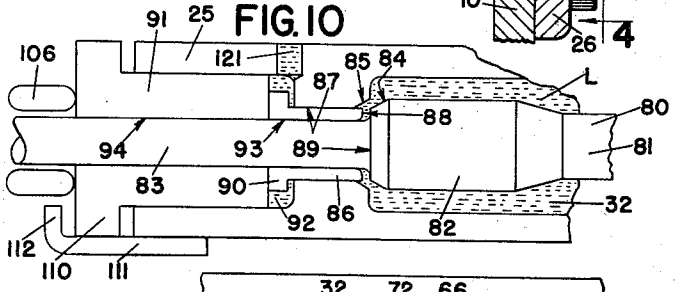
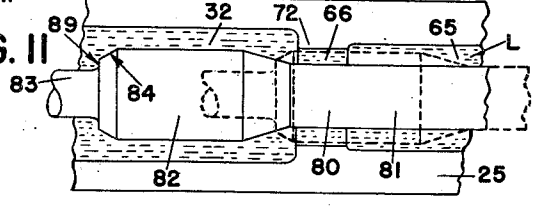


FIG. 11



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2,773,517

LIQUID PICKING MECHANISM

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Application August 3, 1953, Serial No. 371,772

27 Claims. (Cl. 139—142)

This invention relates to improvements in shuttle picking mechanisms for looms and it is the general object of the invention to provide a method and means for accomplishing the picking operation by a compressed liquid.

It is an important object of the invention to effect the picking operation by means of a liquid medium which when compressed only a small amount will have very high pressures developed in it, and utilize these pressures to supply a force to move an actuator which propels the shuttle. It has been found that a heavy mineral oil is satisfactory for this purpose, but the invention is not necessarily limited to this type of liquid, since other liquids, such as liquid silicones, mercury, etc., can be used.

It is a further object of the invention to provide a picking mechanism wherein the pressure built up in the liquid medium is sufficient to cause a considerable increase in its viscosity with resultant reduction in loss of the liquid due to leakage.

It is a further object of the invention to provide a housing containing a firing chamber filled with liquid and mount a picking actuator, such as a plunger, in the firing chamber to be acted on by energy stored in a liquid by a compressor, such as a piston in a cylinder connected to the firing chamber.

It is a further and important object of the present invention to provide the housing which holds the liquid with a seat against which a head on the plunger can be moved by control mechanism, after which increasing pressure in the liquid can be relied upon to hold the plunger in a stable initial position against the seat. To effect picking the head is then moved away from the seat, whereupon the liquid acts on the head to move the plunger on a picking stroke.

It is a still further object of the invention to make the plunger with a head having guide stems extending from opposite sides thereof, one of the stems having a smaller cross sectional area than the other, so that when the plunger is moved from the seat the difference in areas of the opposite ends of the head will enable the liquid to effect the picking stroke of the plunger.

It is desirable that the high velocity imparted by the compressed liquid to the plunger be checked near the end of the picking stroke and in order to accomplish this result it is a further and important object of the invention to provide a checking chamber communicating with the firing chamber through a passage having an area preferably slightly larger than that of the head on the plunger. Both the checking and firing chambers will be closed during the picking operation and as the picking stroke continues the head will enter the passage and checking chamber with two resultant effects both of which serve to check the motion of the plunger. One of these effects is an increase in the pressure of the liquid in the checking chamber and the other effect is due to reverse motion of the liquid through the passage around the plunger in a direction opposite to the motion of the plunger.

It is a further object of the invention to provide adjusting means for varying the volume of liquid in the system. As shown herein this result is attained by changing the liquid holding capacity of the checking chamber.

It is a further object of the invention to provide means whereby, if desired, the liquid compressing operation can be continued during the picking stroke of the plunger to offset partly at least the reduction of pressure in the liquid incident to the picking stroke.

It is a still further object of the invention to operate the compressor in conjunction with a reservoir at atmospheric pressure and enable the liquid in the firing chamber to be hydraulically connected to the liquid in the reservoir prior to each picking operation. This will take care of any expansion of liquid in the firing chamber which results from its increase in temperature, and also make up for any liquid which is lost by leakage.

It is a further object of the invention to provide a method for picking which involves the steps of compressing a liquid to increase its pressure and then effect picking of the shuttle by a force derived from the liquid pressure.

In many types of shuttle picking mechanisms utilizing a medium in which a stress is developed, such as a spring, it is necessary to provide a trigger or its equivalent to hold the picking element during storage of power in the medium and then trip the element in a manner which requires sliding of a trigger across a stop with resultant wear of either the trigger or the stop, or both. In the invention set forth herein the pressure developed within a liquid acts to hold the picking actuator seated in readiness for a picking operation which is initiated merely by moving the actuator slightly to unseat it.

The picking mechanism to be described in more detail hereinafter is comparatively small and due to the liquid in the checking chamber acts almost silently. High speeds of a small shuttle have been attained by the use of a small volume of oil and a small plunger. The tripping mechanism which unseats the head from the seat is preferably though not necessarily in the form of a sleeve surrounding the smaller of the aforesaid stems and pushed by the control means against the head in a direction to unseat the latter.

In order that the invention may be clearly understood reference is made to the accompanying drawings which illustrate by way of example the embodiments of the invention and in which:

Fig. 1 is a plan view of one end of a loom showing the invention applied thereto,

Fig. 2 is an enlarged vertical section on line 2—2, Fig. 1,

Figs. 3, 4, 5 and 6 are enlarged vertical sections on lines 3—3, 4—4, 5—5 and 6—6, respectively, Fig. 2,

Fig. 7 is an enlarged detail horizontal section on line 7—7, Fig. 2, showing the picking plunger seated preparatory to a picking operation,

Fig. 8 is a horizontal section on line 8—8, Fig. 2,

Fig. 9 is a vertical section on line 9—9, Fig. 1, showing in full lines the mechanism in the position it assumes at the beginning of a compressing stroke and indicating in dotted lines the position assumed at the end of the compressing stroke, and

Figs. 10 and 11 are diagrammatic views showing the picking plunger at the beginning and end, respectively, of its picking stroke.

Referring to Fig. 1, the loom frame 1 has a breast beam 2 over which passes the cloth C. The warp threads W extend rearwardly from the cloth and pass through a reed R and also through harness frames two of which are shown at 3. Shuttle guide means G are shown forward of the reed in a position to register with a shuttle S which is in a shuttle box 4 and has attached thereto a filling thread F drawn from a stationary weft package 5. At the proper time in the loom cycle the shuttle S will be picked and will pass through the warp shed and

through the guides G, drawing the filling thread F behind it as the thread unwinds from the package 5. It is to be understood that the parts thus far described with respect to the shuttle and weft are for illustrative purposes only and that details with respect to tensioning, pull-back, etc., of the weft thread F are omitted, since the invention is concerned primarily with picking of the shuttle S.

Included in the construction of the loom frame 1 is a loomside 10 and two vertical frame members one of which is indicated at 11 and the other at 12. The latter two members as well as the loomside 10 rest on the floor and represent parts of the rigid structure of the loom frame.

A rear shaft 15 is rotatable in bearings 16 and 17 mounted respectively on the frame members 10 and 11. Shaft 15 is driven by a gear 18 secured thereto and has keyed a cam 19 for compressing the liquid. A barrel cam 20 is preferably not keyed to shaft 15 but is secured thereto by a set screw 21 so that its angular position around the shaft can be adjusted with respect to cam 19. The gear 18 will be connected to driving mechanism not shown and will be rotated either once for each pick of the loom or once every second pick of the loom, depending upon whether the mechanism shown in Fig. 1 is to operate every pick of the loom or on alternate picks of the loom. So far as the mechanism to be described in detail hereinafter is concerned it is a matter of choice whether the gear 18 turns either once for each beat of the loom or once every other beat.

An elongated hollow housing 25 shown more particularly in Fig. 2 rests on the tops of the frame members 10 and 12 and has arms 26 to receive screws 27 which bolt the housing firmly to the frame members which resist downward motion of the housing 25.

A compression member 28 has the lower end 29 thereof screw thread into the upper part of the housing 25, and has a vertical compression compartment or chamber 30 which communicates by means of passage 31 with a horizontal elongated firing chamber 32 in housing 25. A cylinder 35 is screw threaded as at 36 into the upper end of the member 28 and has a vertical bore 37 which receives a closely fitting compressing means shown as a piston 38. A compression spring 39 surrounds the piston 38 between the top of the cylinder 35 and a collar 40 secured by a pin 41 to the upper end of the piston. The purpose of the spring is to exert upward force on the piston tending to lift it to the position shown in Fig. 2.

For operation of the piston there is provided a lever 45 rockable on a pin 46 mounted on the loom frame members 10 and 11, see Figs. 1 and 9. The left end 47 of lever 45, Fig. 9, is positioned to engage the top of the piston 38, while the right end thereof is pivoted as at 48 to the upper ends of links 49 the lower ends of which are pivoted at 50 to arm 51 of an operating lever 52. The latter lever is rockable on a pin 53 supported by the frame members 10 and 12 and has a stud 54 provided with a roll 55 for engagement with the previously mentioned cam 19. The arm 51 of lever 52 and the links 49 serve as a toggle connection between the cam 19 and the lever 45, this toggle, however, never reaching a locked position. The upward force exerted by the spring 39 tends to break the toggle to move the parts to the position shown in full lines in Fig. 9.

Cam 19 has an incline 60 which may end in a slight high dwell designated at 61 in Fig. 9. The cam also has a decline 62 leading to a low dwell 63. The cam turns in the direction of arrow *a*, Fig. 9.

Formed in housing 25 and preferably aligned with the firing chamber 32 is a checking chamber 65 aligned with the firing chamber and connected to it by a circular passage 66. A hollow member 67 has the lower end 68 thereof tapped into the upper part of housing 25 and has therein a compartment 69, which may be considered as part of the checking chamber, connected by a passage 70 with a passage 71 in the housing leading to the checking chamber 65. The passage 66 is in a wall 72 on the housing 25 between the firing and checking chambers.

Tapped into the upper end of the member 67 is a plug 75 provided with an adjusting screw 76 the lower end of which projects into the compartment 69. A lock nut 77 is provided to hold the angular setting of screw 76 with respect to plug 75. By raising or lowering the screw 76 the capacity of chamber 69, and also of the whole system, to hold liquid, can either be increased or diminished, as desired. The plug 75 is normally screwed down tightly against a seat 78 on member 67, and the latter has a hole 79 above the seat 78 for escape of air and excess liquid when the system is being filled and plug 75 has been temporarily raised to open hole 79 to chamber 69.

A picking actuator means or member 80 is shown herein as an elongated plunger of circular cross section having a right hand stem 81, a head 82, and a left hand stem 83 of less diameter than the diameter of stem 81. Head 82 has a bevel surface 84 to fit accurately against a seat 85 formed on the housing 25 and facing the firing chamber. Surrounding the stem 83 is a sleeve 86 fitting closely into a bore 87 in the housing 25 concentric with the axis of the actuator plunger 80. The sleeve has the right end 88 thereof formed for engagement with a surface 89 on the left end of the head, Fig. 10. Sleeve 86 has a flange 90 for engagement with a trip element 91 slidable with a close fit in a bore 92 in the left hand end of the housing 25 as viewed in Fig. 2. If desired, collar 86 and trip element 91 can be made in one piece. Sleeve 86 has a bore 93 closely fitting stem 83 slidable in it so that the sleeve can act as a bearing for the left end, Fig. 2, of the plunger 80. A bore 94 in element 91 also acts as a bearing for stem 83.

The right hand end of the housing 25 has screw threaded thereinto a bearing 95 for guidance of the stem 81. A shuttle engaging arm 96, forming part of the picking actuator means, is secured by screw 97 to the right hand end of stem 81, see Figs. 1 and 2, and extends laterally as indicated in Fig. 1 for engagement with the shuttle.

Control means K is provided for the plunger 80 to move the latter in opposite directions. A stand 100, see Fig. 1, is fastened by screws 101 to loomside frame member 10 and has pivoted thereto at 102 a lever 103 which performs seating or setting and also tripping or release functions with respect to the plunger 80. The upper end of lever 103 carries a roll 104 which fits into a groove 105 in the barrel cam 20 so that rotation of shaft 15 will cause rocking of lever 103 around its pivot 102. The lower end 106 of lever 103 is forked and bridges the stem 83 for engagement with a shock absorbing preferably compressible washer 107 between the lever end 106 and two adjustable nuts 108 threaded to the left end of the stem 83, the left hand nut, Fig. 1, serving to hold the setting of the other nut. The forked end 106 is also operative to engage the left end of the tripping element 91 which may be provided with a flange 110 for engagement with the weft end of the housing 25, Fig. 2, to limit movement of the element 91 to the right. A stop 111 secured to housing 25 has an upturned end 112 at the left of flange 110 to limit motion of the tripping element 91 to the left, see Figs. 2 and 10.

A reservoir 115 open to atmospheric pressure is provided for the liquid used with the system. This reservoir has a chamber 116 for holding the liquid and its lower end is provided with a depending arm 117 which is fastened by screws 118, see Figs. 1 and 2, to the loom frame member 12. Leading from the lower part of the reservoir is a pipe or tube 120 to feed liquid through a passage 121 into the bore 92 at the right hand end of the latter, see Fig. 2. The passage 121 is permanently open and never closed by element 91, so that the bore 92 and any liquid in it will always be at atmospheric pressure.

A second pipe or tube 125 also leading from the lower part of the reservoir 115 is connected to a fitting 126 which is screw threaded into the upper part of the compression

member 28. Fitting 126 has a passage 127 therethrough which communicates with an inlet passage 128 in cylinder 35 opening into the bore 37. Liquid in the passage 128 is always at atmospheric pressure and when required the chamber 30 can receive liquid from the reservoir 115 through the passage 128, providing piston 38 is raised to its high position shown in Fig. 2.

A third pipe or tube 130 is connected to the lower part of the reservoir 115 and communicates with a circular chamber 131 in housing 25 surrounding the bearing 95 near the right hand end of the housing as viewed in Fig. 2. This chamber is connected by passage 132 to a circular groove 133 in bearing 95 open to stem 81. This groove 133 is between the ends of the bearing 95 to allow any liquid leaking along stem 81 to return to the reservoir.

After the mechanism has been constructed and assembled as already described the system will be filled with a fluid comprised solely of a compressible liquid L in any approved manner, such as by removal of the plug 75. It is desirable that the plunger 80 be reciprocated manually during this filling operation so as to agitate the oil and dislodge any air bubbles which may be in the system. To permit this manual operation of plunger the lever 103 should preferably be in the position shown in dotted lines in Fig. 1. After the system has been completely filled with liquid the plug 75 will then be screwed down firmly against the seat 78, and any air bubbles on the underside of the plug, and excess liquid, will escape through hole 79.

The picking mechanism set forth herein has been operated with a light grease SAE90 and also an oil SAE30, but the invention is not limited in its use to these particular liquids, and they are given only as examples of liquids which have operated satisfactorily.

It is considered that for successful operation of the invention certain area relationships should exist. In a form of the invention which has performed satisfactorily the head 82 has a diameter slightly less than the diameter of the connecting passage 66, and for checking purposes the diameter of the stem 81 is somewhat less than the diameter of the head, but for picking purposes stem 81 is larger in diameter than stem 83. The diameter of the seat 85 will be at least equal to that of the head, and for holding purposes the external diameter of that part of the sleeve 86 which slides in the bore 87 is somewhat less than the diameter of the head but larger than the diameter of stem 81. It may not be necessary in all instances to construct the mechanism with the parts having these relationships, but they are given herein as an example of a form of the invention which has operated to pick the shuttle at a high speed.

In describing the operation of the mechanism it may be assumed that the plunger is in the position shown in Fig. 2, that the lever 103 is in full line position shown in Fig. 1, and that the piston 38 is as shown in Fig. 2 with its lower end above the passage 128, being held in this position by the spring 39. Under these conditions the liquid in the system will be at atmospheric pressure except for a slight head due to the location of reservoir 115 above the system. Also, the liquid in the bore 92 and that in the groove 133 in bearing 95 will be at atmospheric pressure.

With head 82 firmly set against the seat 85, turning of shaft 15 will cause the incline 60 of cam 19 to rock lever 52 in a clockwise direction, Fig. 9, and thus give the plunger 38 a working or compressing stroke by a force transmitted through the links 49 and lever 45. During the first part of the down motion of the piston it will pass below the passage 128 and thus seal the latter from the bore 37 to prevent escape of liquid back through passage 128. The liquid below the piston will therefore be trapped in a system formed by chambers 32 and 65 and the compartments 37 and 69 closed to the atmosphere, and as cam 19 continues to depress the piston high presure will be built up in the liquid in the system. Also, the viscosity of the liquid will increase, thereby reducing its tendency to leak through the bearings for the plunger 80.

It is found that as high pressures are developed in the system it is not necessary to keep lever 103 in the position shown in full lines in Fig. 1, the pressure within the firing chamber 32 being sufficient to hold the head against the seat 85 which acts as a shield to keep the liquid from exerting any appreciable force on beveled surface 84. Toward the end of the compression stroke of the piston 38 the barrel cam 20 will move the lower end of lever 103 toward the trip element 91. At this time the sleeve 86 may have its right end, Fig. 2, spaced slightly from the head 82, but the seat 85 will prevent an objectionable amount of liquid under pressure from reaching the sleeve 86.

As the barrel cam 20 continues to turn the lever 103 will eventually reach the dotted line position shown in Fig. 1 and will move the trip element 91 against the flange 90 of sleeve 86 and cause the latter, which is part of the trip or release means, by a right hand motion as viewed in Fig. 2 to move the head slightly away from the seat 85. The liquid in the firing chamber 32, now being able to exert its force on the surface 84 and the thin film of oil between the sleeve and the head, will move the latter away from the sleeve 86 to expose surface 89 of the head to the force of the compressed liquid. The area of the head at its left end which is exposed to pressure of the liquid will then be greater than any effective area at the right hand end of the head and plunger will be moved to the right, Fig. 2 thereby causing the arm 96 to propel the shuttle with a rapid motion. If liquid from the firing chamber gets into bore 87, as at *f*, Fig. 7, it will transmit force from the sleeve to the head to unseat the latter. The unseating of the head can therefore be effected either by direct engagement of the sleeve with the head, or by a hydraulically transmitted force.

As the plunger 80 approaches the end of its picking stroke the head 82 will enter the connecting passage 66 and the liquid in the checking chamber 65, previously subjected to the same pressure as the liquid in the firing chamber 32, will be effectively trapped, although a small amount of it will be able to move in a reverse direction through the passage 66 and around the head 82 into the firing chamber. Entry of head 82 into chamber 65, see dotted lines Fig. 11, increases the volume of the plunger in the checking chamber and there will be a resultant increase in compression and pressure of the liquid in the checking chamber which acts to absorb the momentum of the plunger and bring it to rest very quickly and almost silently. The reverse flow of liquid in passage 66 also assists in stopping the plunger, and when the latter comes to rest it will be given a reverse motion toward seat 85 by the higher pressures in the checking chamber.

During movement of the plunger 80 from the position shown in Fig. 2 to that shown in Fig. 11 the volume of the plunger in the firing and checking chambers will diminish due to the fact that part of the stem 81 is moving out of the system while part of the smaller stem 83 is moving into the system. If it is desired to compensate for the reduction in pressure resulting from this diminution of volume of the plunger in the system the barrel cam 20 can be adjusted angularly on shaft 15 to cause earlier tripping of the plunger so that the incline 60 of cam 19 can continue downward motion of the plunger 38 while the latter is moving on its picking stroke. This may not be essential in all forms of the invention, but can be utilized when desired. During the picking stroke any motion to the left, Fig. 2, on the part of the sleeve 86 will be resisted by the stop 111 and the trip member 91.

After the picking and checking have been completed, continued turning of shaft 15 causes the steep decline 62 to engage the roll 55, and the spring 39 will give the piston 38 an idle or return stroke and restore it to the position shown in Fig. 2, so that its lower end will be above passage 128. As soon as the piston rises above passage 128 the pressure of liquid within the system will

again be at atmospheric level. If there has been any leakage in the system liquid can then flow from the reservoir 115 through the passage 128 to restore the original volume of liquid under the piston. In fact, as the piston rises above passage 128 liquid will be drawn into bore 37 from the reservoir to prevent subatmospheric pressures in the system. Liquid thus drawn in will be expelled through passage 128 on the first part of the next down motion of the piston. At this same time cam 20 causes lever 103 to move from the dotted to the full line position, Fig. 1, to reseat the head, and move arm 96 outwardly to permit a shuttle to enter box 4.

The degree of compression of the liquid in the checking chamber can be varied by adjustment of the screw 76. When the screw is raised there is an increased volume available for liquid in the system and the checking force will be reduced, but if it is desired to increase the checking force the screw 76 may be turned down into the compartment 69.

The invention has been described as applicable to the picking of a comparatively small shuttle such as indicated in Fig. 1, but the invention is not limited in its use to small shuttles and with appropriate changes in proportions can be applied to the picking of larger shuttles. Gauges applied to the mechanism during its actual operation indicate that with a volume reduction of considerably less than one-half the pressures attained were of the order from 10,000 to 12,000 pounds per square inch, but the invention is not necessarily limited to this range of pressures, and it has been found that with the same mechanism appreciable variations in pressure can be effected by changing the liquid utilized in the system.

If picking is effected from both sides of the loom then the structure shown in Fig. 1 will be duplicated at the right hand end of the loom, the parts, however, being of opposite hand. Also, certain parts, such as 25, 28, 35 and 67 are shown herein separate from each other, but they can be made integral if desired.

From the foregoing it will be seen that the invention sets forth a compact picking mechanism which is operated by a liquid under pressure, compression of the liquid resulting in a considerable increase in its pressure, after which the head 82 is unseated from the seat 85 to enable the pressure built up in the liquid to move the plunger 80 on a picking stroke. It will also be seen that the increasing pressures of the liquid in the firing chamber 82 tend to hold the head in firmly seated position against the seat 85 and all that is necessary to initiate the picking stroke is to unseat the head as by the lever 103, thus eliminating all need for triggers, catches, etc., such as have been used heretofore in picking systems employing elastic media. It will further be seen that as the head enters the passage 66 the liquid in the checking chamber is subjected to a momentary increase in pressure which promptly stops the head and plunger in an efficient checking operation which is almost silent. Furthermore, the fact that stem 81 has a diameter greater than that of stem 83 results in a diminishing volume of the plunger being in the firing chamber as the plunger progresses on its picking stroke, thereby affording increased volume into which the liquid can expand to exert its force behind the head at the end thereof adjacent to the smaller stem 83. It is preferable to resist left hand motion of the sleeve 86, Fig. 2, and also the tripping element 91 during the picking stroke and this can be accomplished either by the stop 111 or the lever 103 as the latter is controlled by the groove 105 in barrel cam 20. Also, the screw 76 affords means for varying the amount of liquid in the system. The parts 25, 35, 67 and plug 75 provide a closed hollow means or housing of which the piston can be considered a part. The picking operation is effected without substantial change in the amount of liquid in the system, and the force which operates the plunger is derived from the pressures resulting from compression of the liquid. The small reduction in the volume of the liquid, generally less than one-half the volume at atmospheric pressures, results in pressures of several hundred atmospheres. Furthermore, the increase in viscosity of the liquid as its pressures rise reduces the tendency of the liquid to leak out of the system.

The term "liquid" used herein is intended to apply to any non-gaseous medium capable of slight compression accompanied by a crowding of the particles of the medium closer to each other than they are under atmospheric pressure with resultant development of high internal pressure, and wherein release from the compressed to the normal state results in a restoration of the medium to its normal condition with its particles expanded back to their normal spacing. Included in the properties of the liquid is its capacity to flow into a vessel or the like.

Having now particularly described and ascertained the nature of the invention and in what manner the same is to be performed, what is claimed is:

1. In a loom having a shuttle to be picked, closed means containing a fluid comprised of liquid only, means forming part of said closed means to compress said liquid and thereby develop pressures therein, and means forming a different part of said closed means acted upon by a force derived from said pressures due to direct contact with liquid under compression in said closed means to pick the shuttle.

2. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means containing a body of liquid and provided with a seat, picking actuator means extending into and movable with respect to said hollow means having a surface closely fitting said seat preparatory to a picking operation, means operating while the actuating means is against said seat to compress the liquid in said hollow means to develop therein pressures effective to hold the actuator means; against said seat, and means to move said surface away from said seat, whereupon the liquid establishes force exerting relation with said actuator means and causes movement thereof to effect picking of the shuttle.

3. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means defining a chamber containing liquid, a picking actuator for the shuttle comprising a plunger slidable on said hollow means having a part thereof in the chamber, a seat on said hollow means for said part of the plunger, control mechanism to move the plunger to cause said part thereof to move against said seat, compressing means effective subsequent to seating of said part of the plunger on said seat to compress the liquid in said chamber and cause the liquid due to the pressure thereof on the plunger to hold said part of the plunger against said seat, and release means operative while said liquid is compressed to move said part of the plunger away from said seat, whereupon the liquid due to the compression thereof acts on said part to move said actuator to effect picking of the shuttle.

4. The picking mechanism set forth in claim 3 wherein the compressing means continues to compress the liquid after the release means moves said part of the plunger away from said seat.

5. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means defining a chamber containing liquid, a picking actuator for the shuttle comprising a plunger slidable on said hollow means having one part thereof in the chamber of a given cross sectional area and having another part thereof partly in the chamber and partly outside the hollow means having a cross sectional area less than said given area, a seat on said hollow means for said one part of the plunger, control means for the plunger moving first in one direction and then in the opposite direction and when moving in said one direction causing said one part of the plunger to move against said seat, compressing means thereafter effective to compress the liquid in said chamber, the liquid due to the compression thereof and the difference in cross sectional area of said parts of the plunger in the chamber

holding said one part of the plunger against said seat, and said control means thereafter moving in said opposite direction to move said one part of the plunger away from said seat, whereupon the liquid causes said plunger to move relative to said hollow means in a direction to cause said part of the plunger outside the means to effect picking of the shuttle.

6. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means defining a chamber containing liquid, a picking actuator for the shuttle comprising a plunger slidable on said hollow means having one part thereof formed with a surface in the chamber of a given area transverse of the axis of the plunger to be exposed to the pressure of the liquid and having another part thereof in the chamber of less cross sectional area than said given area, a seat on said means extending around said plunger and facing the chamber, control means for the plunger moving the latter in a direction to cause said surface of said one part to have a close fit with said seat, means thereafter effective to compress the liquid in said chamber, the compressed liquid due to the difference between said given area and said cross sectional area holding said one part against said seat, and said control means thereafter effective to move said plunger in a direction to move said surface away from said seat, whereupon the liquid under compression acts on said surface of given area and moves the plunger in a direction to pick the shuttle.

7. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means defining a chamber containing liquid, a picking actuator for the shuttle comprising a plunger slidable on said hollow means having one part thereof in the chamber of a given diameter and having another part of a smaller diameter, a seat on said hollow means for said one part of the plunger, control means to move the plunger to cause said one part thereof to move against said seat and move said other part out of the chamber, compressing means thereafter effective to compress the liquid in said chamber, and said control means operative while said liquid is compressed to move said one part of the plunger away from said seat and move said other part of the plunger into the chamber, whereupon the liquid, due to the compression thereof and the difference in diameter of said parts of the plunger in the chamber, causes said picking actuator to move relative to said hollow means in a direction to effect picking of the shuttle.

8. In liquid operated picking mechanism for a loom having a shuttle, hollow means defining an elongated chamber containing liquid, a picking actuator slidable on said hollow means extending through said chamber and having a head within the chamber, a seat on one of said hollow means at one end of said chamber to engage said head, said actuator having a stem at said one end of the chamber extending in one direction from said head through said one end of the hollow means and having a second stem extending from the head in the opposite direction through the opposite end of said hollow means, control means for said actuator to move said head into close fitting engagement with said seat, means thereafter to compress the liquid in said chamber, picking means on one of said stems for cooperative picking relation with the shuttle, and said control means thereafter acting on said actuator to move said head away from said seat, whereupon the liquid under compression acts on said head and causes said actuator to move in a direction to cause said picking means to effect picking of the shuttle.

9. The picking mechanism set forth in claim 8 wherein the head has a cross sectional area greater than that of either stem and the cross sectional area of the first named stem is less than that of the second named stem.

10. In shuttle picking means and checking means therefor, a housing having aligned and communicating firing and checking chambers therein containing liquid under compression, a shuttle picking plunger slidable on the

housing in said chambers formed with a head normally at the end of the firing chamber remote from the checking chamber, and means causing the liquid in the firing chamber to move the plunger to cause the head to move from the firing chamber into the checking chamber, the head due to the momentum of the plunger thereupon subjecting liquid in the checking chamber to additional compression which effects stoppage of the plunger.

11. The structure set forth in claim 10 wherein the additional compression of liquid in the checking chamber causes liquid in the latter chamber to flow toward the firing chamber in a direction the reverse of the direction of movement of the plunger tending to arrest the plunger.

12. The structure set forth in claim 10 wherein upon stoppage of the plunger the additional compression of liquid in the checking chamber acts to reverse the direction of movement of the plunger and move the latter into the firing chamber.

13. In a liquid operated shuttle picking mechanism for a loom, closed hollow means defining firing and checking chambers connected by a passage having a given area, an actuator plunger mounted on said hollow means for movement in said chambers and said passage, a head on said plunger having a cross sectional area slightly less than said given area and located at the end of the firing chamber remote from said passage prior to a picking operation, a liquid completely filling said chambers and passage except for the part of the plunger in said chambers and passage, means compressing said liquid in the chambers and passage, and means thereafter causing the liquid due to the compression thereof to move said plunger on a shuttle picking stroke and move said head into said passage and checking chamber, said head when moving into said passage increasing the compression of the liquid in said checking chamber and the liquid in the checking chamber due to the increased compression thereof arresting motion of the head and plunger.

14. In liquid operated shuttle picking mechanism for a loom, means defining firing and checking chambers filled with liquid under compression and connected by a passage, a seat on said means in the firing chamber, a shuttle picking actuator plunger having a head normally in the firing chamber and engaging said seat and held against the seat by the pressure of the liquid, part at least of said head being movable through said passage into the checking chamber, and means to move said head away from said seat and cause the liquid in the firing chamber to give the actuator a shuttle picking stroke and to move said part of the head through said passage into the checking chamber, the head thereupon subjecting the liquid in the checking chamber to additional compression to arrest motion of the actuator.

15. The structure set forth in claim 14 wherein means is provided to vary the volume of liquid in the checking chamber.

16. The structure set forth in claim 14 wherein the head is cylindrical and the passage is circular in cross section and has an area slightly greater than the cross sectional area of the head to permit flow of the liquid around said head from the checking chamber into the firing chamber to resist motion of the head toward the checking chamber.

17. In liquid operated picking mechanism for a loom having a shuttle to be picked, hollow means defining a liquid containing chamber, bearing means at one end of the hollow means having a relatively large bore, other bearing means at the opposite end of the hollow means having a smaller bore, an elongated plunger having a head intermediate its ends located in the chamber between said bores and having a stem extending from one end of the head fitting and slidable through said large bore and having a second stem at the opposite end of the head fitting and slidable through said smaller bore, each stem movable partly into the chamber and the stems being of such size that as the head moves from the smaller bore toward the larger bore the volume of the plunger in the chamber

diminishes, a seat on said hollow means around the smaller bore against which the head can establish a close fit, control means to move said plunger in a direction to move the head against said seat, compressing means thereafter effective to compress the liquid in the chamber to increase the pressure thereof and cause the liquid to hold the head against said seat, trip means thereafter effective to move the head away from the seat, whereupon the liquid moves the head toward said larger bore, and means on one of said stems to pick the shuttle as said head moves toward said larger bore.

18. The picking mechanism set forth in claim 17 wherein said smaller bore is in a sleeve having a diameter larger than that of the first and named stem and is slidable in said opposite end of the hollow means and is part of said trip means.

19. The picking mechanism set forth in claim 18 wherein the diameter of said sleeve is less than that of said head.

20. In a housing for liquid operated shuttle picking mechanism of a loom operating with a plunger having a head intermediate the ends thereof, hollow means inclosing aligned firing and checking chambers, a wall between said chambers having a passage therethrough to receive said head and permitting a continuous volume of liquid to extend from one chamber through the passage to the other chamber, a bearing for the plunger on one end of the hollow means adjacent to the firing chamber, a second bearing for the plunger on the housing adjacent the checking member, and means on said hollow means closing said chambers to the atmosphere.

21. A housing set forth in claim 20 wherein a cylinder to receive a compressing piston is mounted on the housing and communicates with one of the chambers.

22. A housing set forth in claim 20 wherein the housing is provided with an inclosed compartment communicating with one of the chambers, and means are provided for varying the liquid holding capacity of said compartment.

23. In a housing for liquid operated shuttle picking mechanism including a plunger having a head thereon, hollow means inclosing aligned firing and checking chambers and inclosing also a compartment for holding liquid communicating with each of said chambers, a wall on said hollow means between said chambers having a passage therethrough for said head and interconnecting said chambers, said hollow means having a cylinder and a piston therein communicating with one of said compartments for compressing liquid in said chambers and compartments, and means on the other of said compartments for varying the total liquid holding capacity of said compartments, chambers and passage to the end that the pressure developed in the liquid by the piston may be varied.

24. In liquid operated picking mechanism for a loom having a shuttle to be picked, closed hollow means containing a liquid the viscosity of which increases when pressure within the liquid is increased, aligned bearings on said hollow means opening into the hollow means, a picking actuator slidable on said bearings and partly surrounded by the liquid, means to compress the liquid to increase the pressure within the liquid and thereby increase the viscosity of the liquid to reduce the tendency of the liquid to leak at said bearings, and means by which the increased pressure is caused to move said actuator to pick the shuttle.

25. In liquid operated picking mechanism for a loom having a shuttle to be picked, closed hollow means including a compressing cylinder and a firing chamber in communication with said cylinder, a compressible liquid in said hollow means, a piston in said cylinder effective to compress said liquid, a shuttle picking plunger separate from said piston, movable in the hollow means independently of the piston and extending through the firing chamber, and means causing the liquid subsequent to compression thereof by the piston to move said plunger on a shuttle picking stroke.

26. In liquid operated picking mechanism for a loom having a shuttle to be picked, closed hollow means including a piston having compressing and return strokes, liquid inclosed in said hollow means subject to compression by said piston on the compressing stroke thereof, a reservoir of liquid at atmospheric pressure communicating with said liquid through an opening in said hollow means near the end of the return stroke of the piston, the piston on a compressing stroke closing said opening to seal the liquid within said hollow means from the liquid in said reservoir, shuttle picking means acted upon by the liquid in said hollow means when under compression to pick the shuttle, and the piston when approaching the end of its return stroke uncovering said opening to permit liquid to flow from said reservoir into said hollow means to compensate for any liquid lost incident to the compressing stroke of the piston.

27. In a shuttle picking mechanism for a loom, closed means containing fluid comprising liquid only, two means permanently in direct contact with said liquid forming dfferent parts of said closed means movable independently of each other, mechanism to move one of said means to a position preparatory to picking, other mechanism independent of the first mechanism to move the other means to put the liquid in contact with the first of said two means under compression to develop high pressures therein, and means thereafter effective to cause the first of said two means to be acted upon by a force derived from said pressures to effect picking of the shuttle.

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