March 1, 1955 C. FUCHS 2,703,112

MEANS FOR THE RECTILINEAR ACCELERATION OF BODIES, MORE ESPECIALLY OF LOOM SHUTTLES

Filed Dec. 28, 1951 3 Sheets-Sheet 1

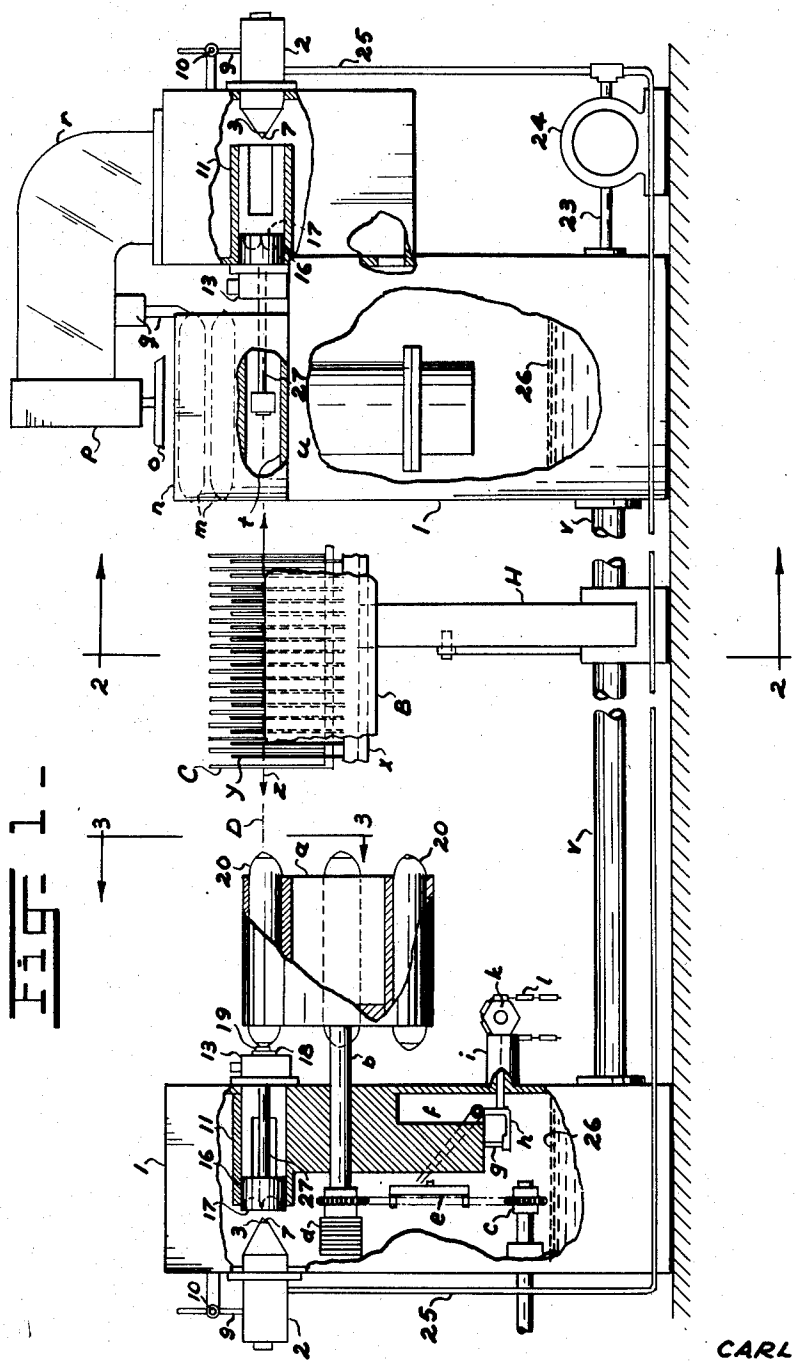


Fig. 1

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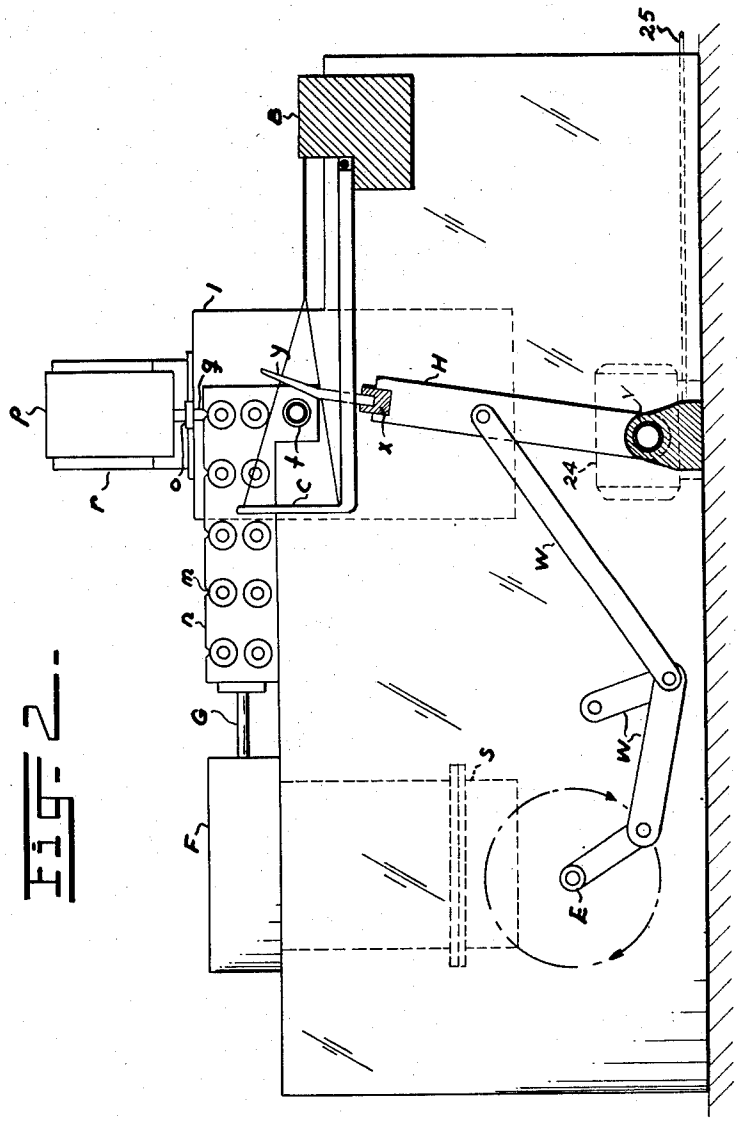


Fig. 2

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Filed Dec. 28, 1951 3 Sheets-Sheet 3

Fig. 3.

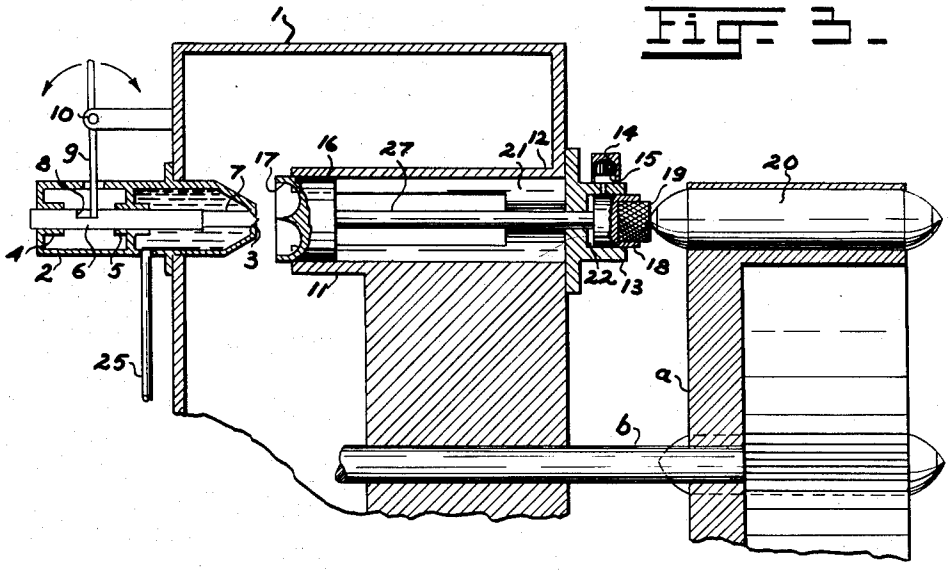
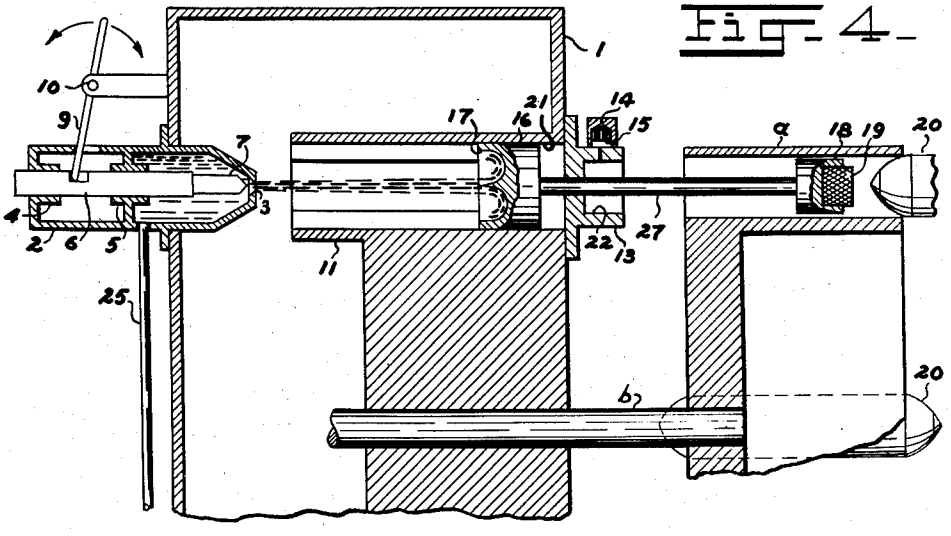


Fig. 4.



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MEANS FOR THE RECTILINEAR ACCELERATION OF BODIES, MORE ESPECIALLY OF LOOM SHUTTLES

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Application December 28, 1951, Serial No. 263,902

Claims priority, application Germany December 28, 1950

16 Claims. (Cl. 139—142)

The invention relates to a means for the rectilinear acceleration of bodies, especially on work-performing machines, which means may be applied particularly advantageously to the acceleration of the shuttles of weaving looms. In such machines, all kinds of different drives for the shuttles are known, but such drives are, however, usually of a purely mechanical nature and have been developed gradually from the hand loom. In addition, however, there are also known various pneumatic shuttle drives. Common to all types, however, is the feature that they do not meet all the requirements which are demanded today of high-speed machines.

The invention is concerned with an entirely novel means by which the acceleration of the bodies, e. g. the shuttles of looms or the like, is effected hydraulically. According to the invention, the means consists of a push member mounted to slide in the desired direction of movement and having a jet bowl arranged at its rear end, as well as a controllable liquid jet nozzle disposed opposite said bowl, and a source of liquid under pressure. The jet bowl is fashioned in the manner of the blades of free-flow turbines, that is to say, in such a manner that, by means of its concave surface, it smoothly reverses and brakes the impinging jet of liquid.

In cases where the invention is applied to looms, one means is arranged on each of the two sides of the machine in such a manner that the shuttles are projected from one side to the other by one of said means, and are sent back from said other side to the initial position by the other of said means.

Further details of the invention, which also include the braking of the acceleration means at the end of the stroke in both directions of movement, will be apparent from the description of the constructional example shown in the drawing.

As compared with the known arrangements, the means according to the invention presents important advantages, more especially in connection with looms, these advantages being, inter alia, as follows:

(*a*) The speed of the shuttle, especially with looms having a wide weaving width, can be improved substantially by up to approximately 50%, the output is increased and thus the cost of the articles which are produced is lowered.

(*b*) The weft thread is subjected to considerably less stressing. As a consequence, it is possible to work with yarns having a lower tensile strength and the loss of time due to stoppages as a result of breakage of the weft thread is practically avoided, in contrast to present-day looms.

(*c*) The accessories, e. g. containers, pumps and the like, employed for the hydraulically effected acceleration and the operating liquid can for the main part also be used for other work on the loom which is today partly done mechanically and partly manually, e. g. for inserting fresh shuttles.

(*d*) The loom width can be appreciably increased as compared with the width usual at the present time and in addition the loom speed can be stepped up.

(*e*) The machine is more simple and runs more quietly, since there are fewer mass forces.

(*f*) Supervision is simplified and thus the labour costs per loom are reduced.

(*g*) The loom functions without noise.

(*h*) The wear on the parts subjected to impact is practically negligible, since these run entirely in liquid, the acceleration force is produced by a jet of liquid and the moving parts are resiliently received at the end of their stroke.

(*i*) The likelihood of interruptions is reduced by avoiding the use of the mechanical transmission linkages which are usual at the present time.

In order to explain the construction and operation of the proposed hydraulic drive for parts to be moved in a straight line, more especially for the movement of shuttles on looms, reference is made to the accompanying diagrammatic drawings, in which:

Figure 1 is a general view of those parts of the loom which are important for the purpose of understanding the invention,

Figure 2 is a section on the line II—II of Figure 1,

Figure 3 shows the hydraulic arrangement in the position shortly before the despatch of the shuttle, i. e. in starting position,

Figure 4 shows the hydraulic arrangement when the shuttle has completed its travel, i. e. when it is in its final position.

In these figures:

Letters are used to indicate those parts of the loom which are shown generally and for the purpose of understanding the general arrangement, whilst numerals are used to indicate those parts of the loom which are directly concerned with the subject-matter of the invention.

a is a drum magazine serving for the shuttle selection.

b is a shaft for the drum magazine *a*.

c is a rotary servo-motor for the drum magazine *a*.

d is a means for automatic indication of the coloured shuttle.

e is a return slide.

f is a control device for the drum magazine *a*.

g is a feeler lever for the control device *f*.

h is a pivoted lever for the control device *f*.

i is a feeler pin for a perforated card *l*.

k is a perforated card drum.

l is the perforated card which controls the shuttle selection.

m are shuttles in the reserve shuttle magazine *n*.

n is a reserve shuttle magazine for the shuttles which have not yet been introduced into the weaving operation.

o is an ejector plunger.

p is an ejector device for changing the shuttles.

q is an adjusting device for the reserve shuttle magazine *n*.

r is a housing for the control lines to the reserve shuttle magazine *n*, the ejector device *p* and the adjusting device *q*.

s is a control device for the reserve shuttle magazine *n*.

t is a shuttle-changing cell.

u is a bottom flap of the shuttle-changing cell *t*.

v is an overflow conduit for the operating liquid leading from one side of the loom to the other.

w is a linkage for actuating the reed which beats up the warp threads.

x is the slay.

y are the blades of the reed.

z indicates the direction of movement of the shuttle 20 which is thrown backwards and forwards.

B is the breast beam.

C indicates the blades of the breast beam.

D indicates the path of the shuttle in the breast beam blades C.

E is a crank-shaft.

F is a displacement servo-motor.

G is a piston rod for the servo-motor F.

H is the pivoted lever which carries the reed.

J is a collecting trough for the ejected empty shuttles.

1 is a container for the operating liquid.

2 is a nozzle housing.

3 is a jet nozzle.

4 and 5 are slide-ways.

6 is the nozzle stem.

7 is the pointed end of the stem.

8 is a control slot in the stem 6.

9 is a control lever for controlling the jet device 6 to 7.

10 is a pivot for the control lever 9.
11 is a guide for the jet bowl 16.
12 is a cylinder for the air brake.
13 is a guide flange for the bowl stem 27.
14 is a valve housing.
15 is a check valve.
16 is a jet bowl, rigidly connected with the picker support 18 by the bowl stem 27.
17 is the surface of the jet bowl, said surface being so curved that the jet of liquid can flow away smoothly as with a Pelton wheel.
18 is the picker support.
19 is the picker.
20 is the shuttle.
21 is an inner air chamber for the air brake.
22 is an outer air chamber for the air brake.
23 is the suction pipe for the liquid pump 24.
24 is a liquid pump.
25 is a pressure pipe for the liquid pump 24.
26 is a liquid bath in the lower part of the container 1.
27 is the bowl stem or rod.

The operation of this hydraulic drive is as follows:

In the initial position, the parts are as shown in Figure 3. The pump 24 forces the liquid through an air chamber (which is not shown and which is connected with the pressure pipe 25) into the front chamber of the nozzle housing 2. The control lever 9 is now freed at its upper end by an electrical or a mechanical control and the like. Owing to the liquid pressure, since the nozzle stem 6 has a larger diameter than the pointed end 7, the stem 6 and thus the pointed end 7 are now moved to the left and uncover the jet nozzle 3. The liquid under pressure, for example, oil, an emulsion, water or the like, can now issue from the jet nozzle 3 and can impinge on the surface 17 of the jet bowl 16 and exert a force on the latter in accordance with known physical laws. This force imparts to the jet bowl 16 and, by means of the bowl stem 27, also to the picker support 18, the picker 19 and the shuttle 20, an accelerated movement towards the right. The shuttle 20 is released from the picker 19 at the commencement of the braking of the striking or driving parts 16 to 19 and 27 and flies over the shuttle track D to the opposite side of the loom. When the jet bowl 16, sliding in the guide 11, reaches the cylinder 12, an air cushion is provided in the chamber 21 by which the energy of movement of the parts 16 to 19 and 27 is absorbed. The braking could obviously also be effected in any other manner, such as by using compressed air, fluid under pressure, or a mechanical or an electrical arrangement. The compressed air can subsequently escape through a special valve (not shown) from the chamber 21, so that the parts 16 to 19 and 27 remain in the moved-out position (Figure 4). If desired, this air cushion can also serve to initiate the return movement of the parts 16 to 19 and 27. With the movement of the picker support 18 towards the right, air could pass through the valve housing 14 into the guide flange 13. The movement towards the right is therefore not impeded thereby and noises are avoided (no exit report).

After the dispatch of the shuttle, the drive is in the position indicated in Figure 4. The jet nozzle 3 is closed by the pointed end 7 under the action of the control lever 9 in conjunction with the nozzle needle 6. The parts 16 to 19 and 27 remain in the moved-out position (Figure 4) until the impact of the shuttle 20 short from the other side of the loom. This shuttle strikes on the picker 19, displaces the parts 16 to 19 and 27 towards the left again into the initial position as shown in Figure 3. The energy of movement of the shuttle 20 is first nullified by the acceleration of the masses of the parts 16 to 19 and 27, but then mainly by compression of the air in the chamber 22. The air cannot escape from here, since the check valve 15 closes during the compression. The braking cylinder 22 is provided with a throttled opening for the slow release of the air thus entrapped, for instance with the aid of a suitable design of the valve body and/or valve seat at 15. This braking arrangement could also naturally be constructed in any other manner. When the positions of the parts as shown in Figure 3 are reached again, the operation is repeated periodically in the manner set forth.

This hydraulic drive may obviously also be employed when details of the construction are carried out in different ways. For example, the pointed end 7 can also be actuated otherwise than by the nozzle stem 6, for example, hydraulically or electrically by pistons and lifting magnets. Furthermore, springs or rubber buffers may be employed for braking the movement. What is essential for the present invention is the periodic acceleration of parts moved in a straight path by a jet of liquid, such as has been employed hitherto only for driving turbine rotors having a constant movement.

By employing suitably high liquid pressures, by free selection of the path lengths of the moving parts and by suitable dimensioning of their masses, the acceleration can be accurately adapted to the required operational conditions. Despite the high speed which is reached, the acceleration ratios with the jet drive is, on account of the long path of acceleration, considerably more favourable than the suddenly operating mechanical shuttle drives which are customary at the present time. By this means, it is now possible to weave warp yarns having a lower tensile strength.

I claim:

1. Means for the rectilinear acceleration of the shuttle of a power loom, comprising a push member guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a liquid jet nozzle disposed facing said jet bowl, a source of liquid under pressure connected with said nozzle, and means for controlling the supply of liquid from said source to said nozzle, said jet bowl being continuously drained whereby the jet from the nozzle impinges directly on the jet bowl in all positions of the jet bowl.

2. An arrangement according to claim 1, characterized in that the means for controlling the supply of liquid to the jet nozzle is a valve member having a part that closes said nozzle in one position of the valve member, said valve member comprising an area exposed to the pressure liquid operable to urge said member away from said one position thereof, and means for selectively holding said member in said one position or releasing it therefrom.

3. An arrangement according to claim 1, characterized in that there is an enclosure surrounding the jet nozzle and the jet bowl, said enclosure including a liquid sump, and the said source of liquid under pressure connected with said nozzle comprising a pump having a suction conduit leading from said sump and a pressure conduit leading to said nozzle.

4. An arrangement according to claim 1, characterized by the provision of means for braking the push member at the end of its forward movement.

5. An arrangement according to claim 4, in which the said means for braking the push member comprises a stationary cylinder, and a piston on the push member fitting in the cylinder, whereby air is entrapped and compressed in the cylinder as the push member approaches the said end of its forward movement.

6. An arrangement according to claim 5, in which the said jet bowl is integral with the said piston on the rear face thereof.

7. An arrangement according to claim 5, in which the said cylinder is slotted so as to be freely vented to the atmosphere over that portion of the travel of said piston therein that the push member is to travel without being braked during the forward movement thereof.

8. Means arranged on both sides of a power loom for the rectilinear movement in both directions of the shuttle of said loom, comprising on each side thereof a push member guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a liquid jet nozzle disposed facing said jet bowl, a source of liquid under pressure connected with said nozzle, and means for controlling the supply of liquid from said source to said nozzle, said jet bowl being continuously drained whereby the jet from the nozzle impinges directly on the jet bowl in all positions of the jet bowl, means for braking the push member at the end of its forward movement, and means provided in association with the push member for braking the final part of the return movement thereof.

9. An arrangement according to claim 8, in which the said means for braking the return movement of the push member takes the form of a braking piston movable with the push member, and a stationary cylinder positioned to receive said piston as the push member approaches the final part of its return movement, where-

by the air entrapped in the cylinder will brake the push member to a halt.

10. In an arrangement according to claim 9, wherein the braking cylinder is provided with a throttle opening for the slow release of the said entrapped air.

11. In an arrangement according to claim 10, wherein said throttled opening is provided with a check valve opening toward the cylinder so that no resistance is offered by the braking means to the initiation of the forward movement of the pusher member.

12. In a power loom of increased width, the combination of a shuttle and jet means mounted on both sides of said loom for driving said shuttle back and forth across said loom, each of said jet means comprising a push member guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a liquid jet nozzle disposed facing said jet bowl, a source of liquid under pressure connected with said nozzle, and means for controlling the supply of liquid from said source to said nozzle, said jet bowl being continuously drained whereby the jet from the nozzle impinges directly on the jet bowl in all positions of the jet bowl.

13. In a power loom having a shuttle, jet means mounted on both sides of said loom for driving said shuttle back and forth across said loom, each of said jet means comprising a push member guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a liquid jet nozzle disposed facing said jet bowl, a source of liquid under pressure connected with said nozzle, and means for controlling the supply of liquid from said sources to said nozzle, said jet bowl being continuously drained whereby the jet from the nozzle impinges directly on the jet bowl in all positions of the jet bowl.

14. In a loom, a shuttle, push members at opposite sides of the loom, each of said push members being guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a slotted cylinder in which each bowl is reciprocable, stationary means comprising jet nozzles directed for each of said bowls, a source of liquid under pressure, conduit means connecting said source of liquid with said jet nozzles, and means for controlling the supply of liquid passing through said conduit means to said nozzles for alternately actuating said push means to drive said shuttle back and forth across the loom.

15. In a loom of increased width, a shuttle, push members at opposite sides of the loom, each of said push members being guided in straight line movement and adapted for abutting engagement with the shuttle to be moved, a jet bowl in the form of an annular concavity with a central tapering projection mounted on the rear end of said push member, a slotted cylinder in which each bowl is reciprocable, stationary means comprising jet nozzles directed for each of said bowls, a source of liquid under pressure, conduit means connecting said source of liquid with said jet nozzles, and means for controlling the supply of liquid passing through said conduit means to said nozzles for alternately actuating said push means to drive said shuttle back and forth across the loom at high speed.

16. In a loom, a shuttle, a push member as described in claim 1 at one side of said loom, jet means for driving said push member solely by jet reaction in rectilinear movement to drive the shuttle across the loom, and means for returning the shuttle, said shuttle being operable on its return movement to return said push member to its starting position, and means for cushioning the final portion of the travel of said push member in both directions of movement thereof.

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