

[54] JET OPERATED WEAVING MACHINE

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 848,214, Aug. 7, 1969, abandoned, and a continuation of Ser. No. 135,268, April 19, 1971, abandoned, and a continuation of Ser. No. 179,574, Sept. 10, 1971, abandoned.

[52] U.S. Cl. 139/127 P

[51] Int. Cl. D03d 47/28

[58] Field of Search 139/127 R, 127 P, 188,
139/190

References Cited

UNITED STATES PATENTS

1,721,940	6/1929	Ballou	139/127 P
3,465,791	6/1969	Mullekom	139/127 P

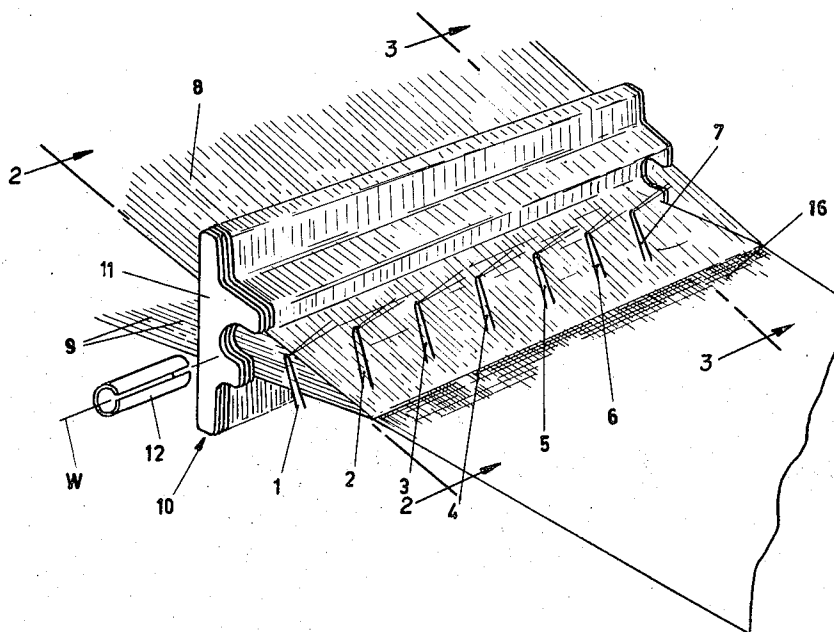
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[57] ABSTRACT

A reed is movable between a beating position and a retracted position, and the warp sheets are maintained momentarily in diverging warp planes to form, with the retracted reed, a shed of generally triangular cross section. Blades movable along with the reed extend between adjacent warp threads and have each a notch which is so shaped that in the retracted position of the reed the upper edge of the notch extends slightly below the upper warp plane and the lower edge of the notch extends slightly above the lower warp plane. A series of hollow fingers are arranged to project between the warp threads into the shed when the reed is retracted. Each finger has near its tip at least one orifice, directed substantially longitudinally of the shed, for discharging a jet to assist in propelling a weft thread through the notches in the blades. The distance between each orifice and the beating edge of the adjacent reed blade is less in the case of orifices more remote from an end of the shed than it is in the case of orifices less remote from such end of the shed.

4 Claims, 3 Drawing Figures

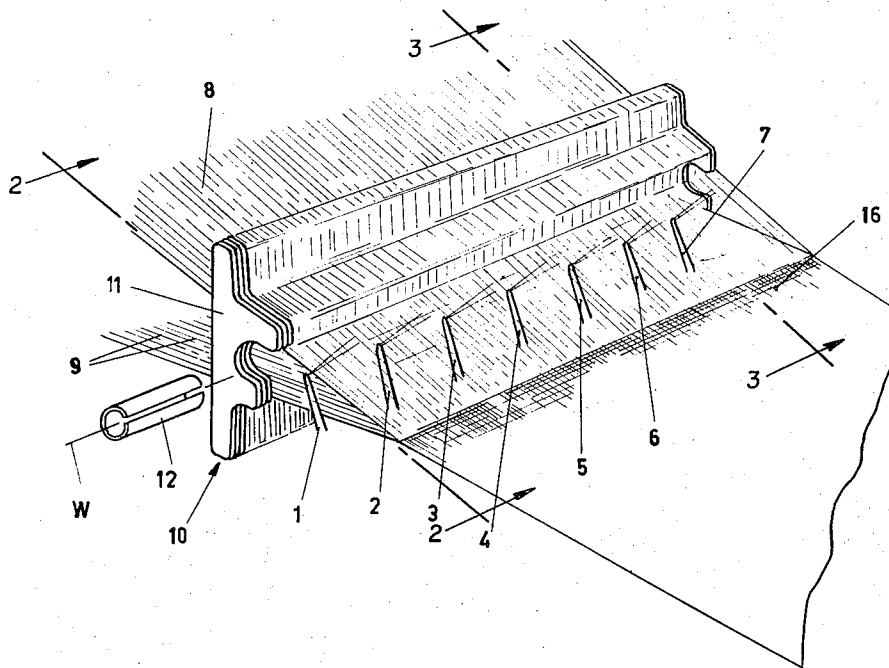


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SHEET 1 OF 2

FIG. 1



JET OPERATED WEAVING MACHINE

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of abandoned application Ser. No. 848,214 filed Aug. 7, 1969, and is a continuation of the following abandoned applications:

Ser. No. 135,268 filed Apr. 19, 1971

Ser. No. 179,574 filed Sept. 10, 1971

BACKGROUND OF THE INVENTION

The invention relates to a weaving machine of the type in which the wefts are pneumatically introduced into the weaving shed by a main blowing nozzle positioned at an end of the shed and by a number of auxiliary blowing nozzles arranged in front of the reed and spaced along the shed across the width of the cloth.

The arrangement of spaced auxiliary blowing nozzles in front of the reed is disclosed in U.S. Pat. No. 3,465,791, which shows a series of hollow tongues or fingers carried on the lower beam of the reed, which are arranged to project between the warp threads into the shed when the reed is retracted. These hollow fingers move out of the shed during the beating stroke of the reed.

The series of auxiliary blowing nozzles may be mounted either on a beam of the reed or on a separately movable rocker beam. In one known arrangement, the auxiliary blowing nozzles are provided on beams which are arranged above and below the shed. Each such beam may be provided with a stepped surface consisting of a series of V-shaped projections having one gently sloping side, and one steeply sloping side in which an orifice is located. When these stepped or V-shaped projections are moved into engagement with a warp sheet, the gently sloping side of each projection presses the warp threads inward so that a blast of air can be discharged along the shed from the orifice in the steeply sloping side of the projection. In order to permit a weft thread to be introduced into the shed from either end, a beam which engages one warp sheet may be provided with auxiliary nozzles facing in one longitudinal direction, while a beam which engages the other warp sheet is provided with nozzles facing in the other longitudinal direction.

In the use of such a series of auxiliary blowing nozzles arranged in front of the reed, it has been found to be desirable to create a fast-moving air column flowing through the shed, the velocity of which is higher than that of the thread. Such an air column must have a very high velocity throughout the entire shed.

One difficulty which has been encountered in the operation of such auxiliary blowing nozzles is the consumption of an excessive amount of compressed air.

Another serious difficulty which has been encountered is frequent entanglement of the thread in the shed, caused by instability in the path of movement of the thread which causes the thread to contact the warp as the thread is propelled through the shed, particularly when the warp threads are of rough material having projecting fluffs.

It is important to maintain a fast-moving air column throughout the shed, the velocity of which is higher than that of the thread, in order to keep the leading end of the thread moving as fast as the remaining part of the weft thread so as to maintain the weft thread in a

stretched condition as it travels through the shed and to prevent tangling.

As the design and performance of jet-operated weaving machines have been improved, it has been found necessary to keep the shed as narrow as possible in order to maintain a rapid flow of air without excessive consumption of compressed air.

However, the necessity of using a narrow shed in order to control the flow and consumption of air has increased the danger that the weft thread may come in contact with the warp as the weft thread travels through the shed.

Another disturbing factor is the relatively great directional inaccuracy in the launching of the wefts by the main blowing nozzle. Such directional inaccuracy is connected with the circumstance that the area of the aperture of the main blowing nozzle must have a predetermined minimum value because of design considerations. Since the position of the weft at the instant of launching may vary within the area of the blowing aperture, also the location where the leading end of the weft launched by the main blowing nozzle will reach the vicinity of the first auxiliary blowing nozzle will vary. A similar difference in the position or location of arrival of the leading end of the weft in the vicinity of the first auxiliary blowing nozzle has been noted also between the so-called A-thread and B-thread of a hairpin-shaped weft of double length. Another disturbing influence is that a weft launched from the main blowing nozzle generally shows a certain directional instability in the initial phase of its movement through the shed when the weft velocity is still relatively low. Thus even with the same initial position of the leading end of the weft within the launching aperture of the main blowing nozzle, the arrival position of the leading end of the weft in the vicinity of the first auxiliary blowing nozzle may vary. With a relatively narrow shed, there is a correspondingly small spacing between the beating edge of the retracted reed and the first auxiliary blowing nozzle, so that there is a serious danger that the leading end of the launched weft may arrive in an unfavourable position relative to the first auxiliary blowing nozzle. Particularly the leading end of the weft is liable to pass the first auxiliary blowing nozzle on the wrong side so that the weft enters the narrow apex of the shed adjacent to the cloth and is therefore retarded and entangled.

SUMMARY OF THE INVENTION

The present invention provides a structure which stabilizes the movement of the weft through the shed so that the weft cannot touch the upper or lower warp, and yet can be propelled through the shed at a very high speed.

In the apparatus of the present invention, blades moving along with the reed extend between adjacent warp threads and have a recess in the form of a notch which is so shaped that in the retracted position of the reed the upper edge of the notch extends slightly below the upper warp plane and the lower edge of the notch extends slightly above the lower warp plane. A series of nozzles are arranged to project into the shed when the reed is retracted, and each nozzle has at least one orifice, directed substantially longitudinally of the shed, for discharging a jet to assist in propelling a weft thread through the notches of the said blades, the arrangement being such that during transportation of the wefts

through the notches air may freely pass through the spaces between the successive blades.

Thus in the practice of the present invention, the weft thread travels through the notches in the blades e.g. in the beating edges of the reed blades, and is propelled by jets directed substantially longitudinally of the shed, issuing from the auxiliary blowing nozzles. These notches prevent the traveling weft from contacting the warp threads or from engaging fluffs projecting from the warp threads, and the air passing through the spaces between the successive blades keeps the weft free from touching the notches and plays an essential role in providing for the stability in the path of movement of the weft. The auxiliary blowing nozzles not only provide the force to propel a weft through the shed, but also control the path of movement of the weft so as to cause the weft to travel along the notches in the reed blades.

Each jet issuing from an auxiliary blowing nozzle forms a barrier which prevents the weft from entering or approaching the narrow apex of the shed. Each jet from an auxiliary blowing nozzle is in the form of a narrow cone, and the action of the jet is to stretch the weft thread along the surface of the narrow cone. This stretching action keeps the traveling weft in alignment with the narrow conical jets and with the aligned notches in the reed blades.

In accordance with the invention, the spacing between the orifices in each auxiliary nozzle and the beating edge of the adjacent reed blade is less in nozzles that are more remote from an end of the shed than it is in nozzles less remote from such end of the shed.

By arranging the first auxiliary blowing nozzle at a greater spacing from the beating edge of the adjacent reed blade than the spacing which is best adapted to the relatively small effective height of the shed, the launched weft threads will arrive with certainty in a position between the beating edge of the reed blade and the air jet issuing from the first auxiliary nozzle, and therefore will be effectively guided into the tunnel formed by the aligned notches of the reed blades. Since the directional inaccuracy of the launching of the weft from the main blowing nozzle is remedied by the relatively great spacing of the first auxiliary blowing nozzle from the adjacent reed blade, and since the directional stability of the weft increases with the increase in the velocity of the weft as it is launched into the shed, the accuracy of the position of arrival of the leading end of the weft adjacent to the succeeding auxiliary blowing nozzle is considerably greater than the accuracy of the position of arrival of the leading end of the weft adjacent to the first auxiliary blowing nozzle. Accordingly, in the practice of the invention the spacing between the orifices and the adjacent reed blade is less in the case of the succeeding blowing nozzles than it is in the case of the first auxiliary blowing nozzle, in order to concentrate the flow of air to the necessary degree to maintain precise control of the travel of the weft, and to cause the velocity of the stream of air to increase throughout its length, with a minimum consumption of compressed air.

In accordance with a further feature of the invention, the size of the orifices in the auxiliary blowing nozzles decreases in correspondence with the decrease in the spacing of the orifices from the adjacent beating edges of the reed blades. The orifices of lesser diameter produce narrower, more precise jets.

In accordance with another feature of the invention, the width of the notches in the blades movable along with the reed is less in blades that are more remote from an end of the shed than it is in blades that are less remote from such end of the shed. In this way, the width of the notch in the blade adjacent to the first auxiliary blowing nozzle is made wider to compensate for the inaccuracy of the position in which the leading end of the weft arrives adjacent to the first auxiliary blowing nozzle. At the same time, the width of the notches in succeeding blades is less than the width of the notches in the blades that are less remote from the end of the shed, so that the effective height of the shed, corresponding to the width of the notches in the blade, is less in the location where the travel of the weft becomes more accurate as its speed increases.

Thus in accordance with the preferred embodiments of the invention, the space through which the weft must travel is relatively wide-open at the point where the weft enters the shed, and in succeeding portions of the shed is relatively narrow, where the weft travels through a series of aligned notches of reduced width in the blades and where the auxiliary jets are spaced relatively close to the blades. Accordingly, in the portion of the shed other than the end portion where the weft enters the shed, the weft is conveyed by a relatively high velocity stream of air traveling through a relatively narrow path, to provide rapid and precise travel of the weft without consuming an excessive quantity of compressed air.

It is advantageous also to energize the auxiliary blowing nozzles successively by supplying air to the auxiliary blowing nozzles successively in advance of the approach of the leading end of the weft, as disclosed in U.S. Pat. No. 3,705,608.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the shed of a weaving machine embodying the invention, showing only the reed blades, a main blowing nozzle and a series of auxiliary blowing nozzles.

FIG. 2 is a vertical section of the reed, taken along the line 2—2 of FIG. 1, at a short distance from the main blowing nozzle.

FIG. 3 is a similar vertical section of the reed, taken along the line 3—3 of FIG. 1, at a greater distance from the main blowing nozzle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a warp sheet made up of warp threads 8 and another warp sheet made up of warp threads 9. These warp sheets are maintained momentarily in diverging warp planes as shown in FIG. 1. In accordance with conventional loom operation, the positions of the warp sheets are reversed periodically, but between reversals one of the warp sheets is maintained momentarily in the upper warp plane and the other warp sheet is maintained momentarily in the lower warp plane.

FIG. 1 shows the reed 10 in its retracted position so that the diverging warp planes form, with the retracted reed 10, a shed of generally triangular cross section.

FIG. 1 shows a series of nozzles 1 through 7, which in the illustrated embodiment are in the form of hollow fingers, and which are arranged to project into the shed when the reed is retracted.

A main blowing nozzle 12 is arranged to discharge a blast of air into the open end of the shed, so as to propel a weft W longitudinally through the shed. The jets discharged from the auxiliary blowing nozzles 1-7 assist in propelling the weft through the shed.

In the structure shown in detail in FIGS. 2 and 3 the reed 10 comprises individual blades 11, each of which extends between adjacent warp threads. On the beating side of each reed blade, a notch is formed between the upper and lower portions 11a and 11b of the blade 11.

In the retracted position of the reed 10, as shown in FIG. 2, the upper warp plane intersects approximately the mid-point of the upper projecting portion 11a of the reed blade, and the lower warp plane intersects approximately the mid-point of the leading edge of the lower projecting portion 11b of the reed blade.

Thus in the retracted position of the reed, the upper edge 14 of the notch extends slightly below the upper warp plane, and the lower edge 15 of the notch in the reed blade extends slightly above the lower warp plane. Accordingly, the edges 14 and 15 of the notches in the successive reed blades form in effect a tunnel for the passage of the weft, and prevent the weft from coming into engagement with any fluffs which project from the warp threads.

The spacing *s* between the upper edge 14 and the lower edge 15 of the notch in a reed blade determines the height of the tunnel through which the weft must be propelled, and may be considered to be the effective height of the shed. An example of an effective height for use in the practice of the invention is 6 mm.

The reed blades 11 at their upper ends are secured in a longitudinal clamp 17, as shown in FIGS. 2 and 3. At their lower ends, the reed blades 11 are secured in a groove formed in the reed beam 18.

A block 19 secured to the reed beam 18 contains a conduit for supplying compressed air, and serves as a mounting for the auxiliary blowing nozzles 1-7.

Each of the auxiliary blowing nozzles 1-7 has an orifice 1'-7' directed substantially longitudinally of the shed and disposed closely adjacent the end of the lower edge of a blade notch, for discharging a jet to assist in propelling a weft thread through the notches in the beating edges of the reed blades 11.

For the sake of simplicity, the present drawings show an arrangement for propelling a weft thread in only one direction through the shed.

The reed 10 is movable with a conventional stroke, between a beating position and the retracted position shown in FIG. 1. During the beating operation, the bottom of the notch 13 operates as the beating edge to beat the weft thread against the edge of the cloth, while the finger-like nozzles 1-7 emerge from the shed. Then when the reed 10 returns to the retracted position shown in FIG. 1, the finger-like nozzles 1-7 penetrate between the warp threads in the lower warp plane, as indicated in FIG. 1.

As shown by FIGS. 2 and 3, the spacing *P* between the orifice 1' in the first nozzle 1 and the beating edge of the notch 13 is greater than the corresponding spacing between the orifice of the last nozzle 7 and the beating edge of the adjacent notch 13.

For example, the spacing *P* from the beating edge of the orifice 1' closest to the entrance of the shed may be 13mm, whereas the spacing of the orifices which is most remote from the open end of the shed may be only

9 mm. from the beating edge of the notch 13. The spacing of the orifices 1'-7' from their respective beating edges may decrease gradually from 13 to 9 mm. However, in practice, it is preferable to employ successive groups of identical nozzles, all of the orifices of the nozzles in one group being identically spaced from their respective beating edges. For example, with a weaving width of 1.8 meters and with the auxiliary blowing nozzles located at intervals of 5 cm, the auxiliary blowing nozzles may be arranged in six groups, each consisting of six nozzles whose orifices are spaced identically from their respective beating edges.

As the space *P* decreases from one group of blowing nozzles to the next, it is desirable that the size of the orifices in the blowing nozzles decrease also. For example, the aperture 1' of the first auxiliary blowing nozzle may have a diameter of 1.2 mm, while the aperture 7' of the last blowing nozzle may have a diameter of 0.6 mm.

The blowing nozzles preferably are adjusted so that they discharge conical air jets having an apex angle of about 15°. Preferably each of the jets discharged from the nozzles 1'-7' is so directed that the axis of the jet is aimed at a point which lies in the plane of the notch of blade 11, which corresponds to the next succeeding blowing nozzle, at a distance of 2 to 3.5 mm. from the beating edge of the notch 13. In other words, the jet issuing from each nozzle preferably is directed into the notch of the blade 11, which corresponds to the next succeeding blowing nozzle.

We claim:

1. A jet-operated weft inserting apparatus for a weaving machine having (a) a pair of warp sheets which are reversibly movable between two diverging warp planes, (b) a reed which is movable between a beating position and a retracted position in which it forms with the warp sheets a plurality of successive sheds of generally triangular cross-section, and which comprises blades each of which extends between adjacent warp threads and has a beating edge in the form of a notch the upper edge of which extends slightly below the upper warp plane and the lower edge of which extends slightly above the lower warp plane in the retracted position of the reed, (c) a series of substantially rectilinearly arranged nozzles which are adapted to be supplied with fluid under pressure, and (d) a mounting which is movable in synchronism with the movement of the reed and which supports each nozzle relative to the reed in such a position that it projects into each shed in the retracted position of the reed, wherein the improvement comprises an orifice which is located in each nozzle adjacent to the lower edge of a notch in a reed blade, and is directed substantially longitudinally of the shed, the distance between each orifice and the beating edge of the adjacent reed blade being less in the case of orifices more remote from one longitudinal end of the shed than it is in the case of orifices less remote from such end of the shed.

2. A jet-operated weft inserting apparatus according to claim 1, wherein the width of the notches in the blades is less in blades that are more remote from such longitudinal end of the shed than it is in blades that are less remote from such end of the shed.

3. A jet-operated weft inserting apparatus according to claim 1 wherein the size of the orifices in the nozzles is less in nozzles that are more remote from such longitudinal end of the shed than it is in nozzles that are less remote from such end of the shed.

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tudinal end of the shed than it is in nozzles that are less remote from such end of the shed.
4. A jet-operated weft inserting apparatus according to claim 3 wherein the width of the notches in the

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blades is less in blades that are more remote from such end of the shed than it is in blades that are less remote from such end of the shed.
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