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Svaty et al.

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[54] **METHOD OF PICKING WEFT YARNS IN SHUTTLELESS LOOMS**

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

[51] **Int. Cl.** **D03d 47/30**

[58] **Field of Search** ..... 139/122 R, 127 P

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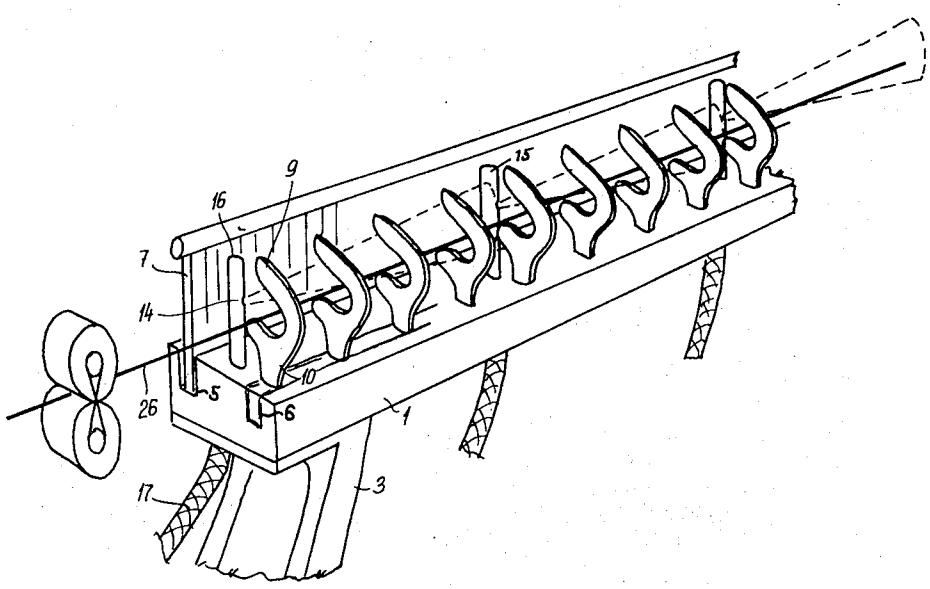
[57] **ABSTRACT**

Method and apparatus for inserting weft threads on a shuttleless loom by picking up the weft thread and carrying it at least through part of the length of the shed by either mechanical means or a pressure fluid flow and subsequently contacting the front part of the weft thread with a flow of a pressurized fluid to carry it through the remaining length of the shed in a selectively controlled and directed manner.

12 Claims, 5 Drawing Figures



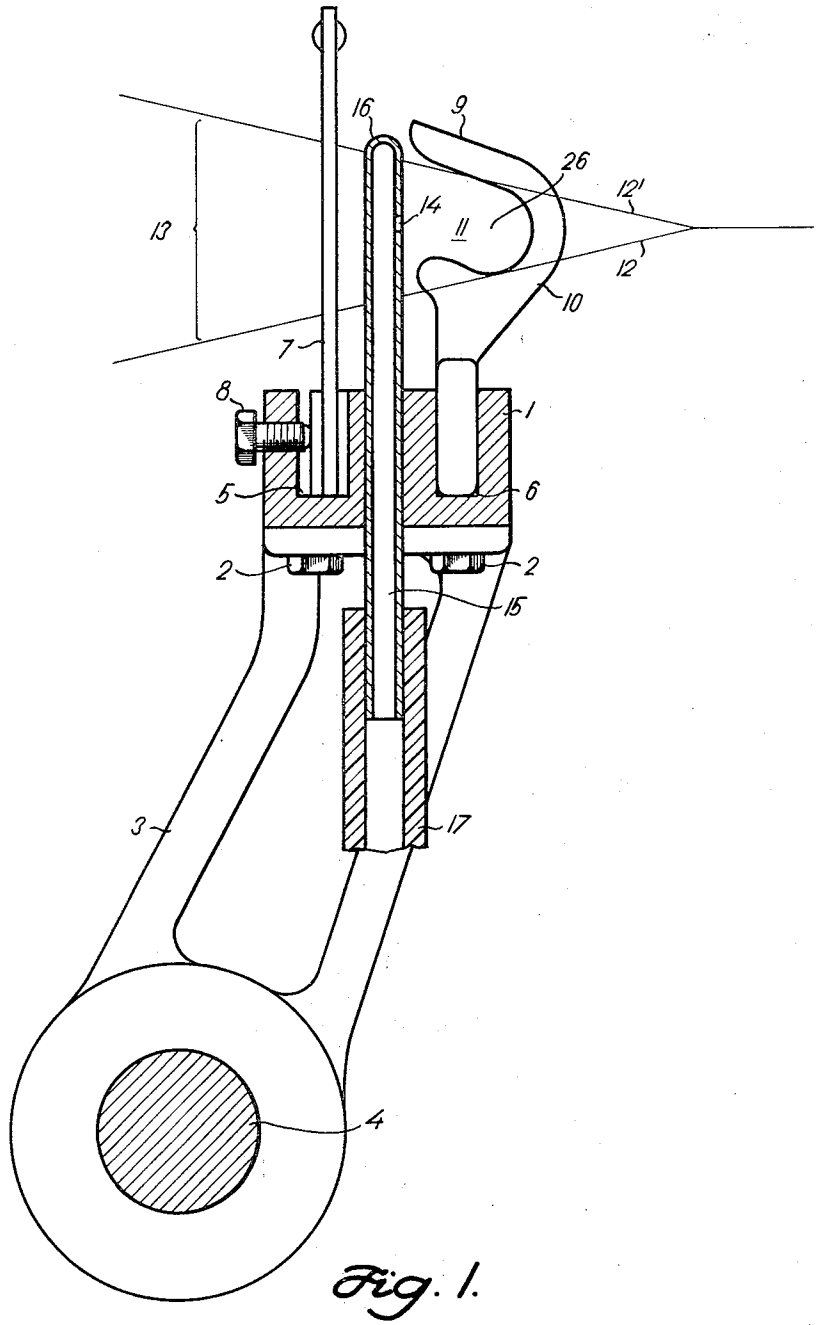


Fig. 1.

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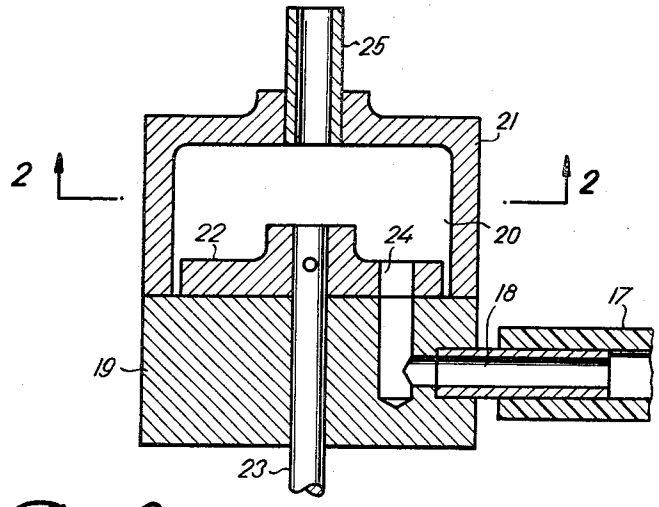

Fig. 2.

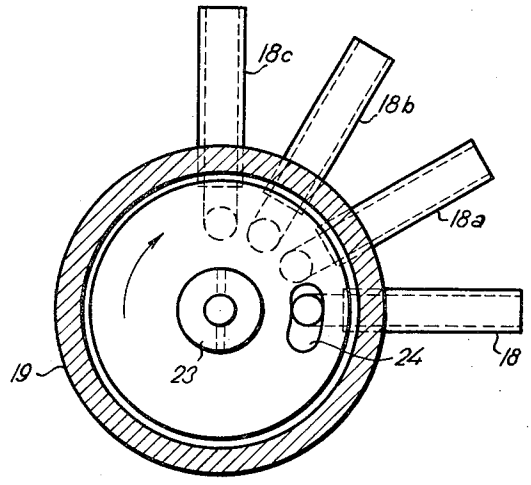

Fig. 3.

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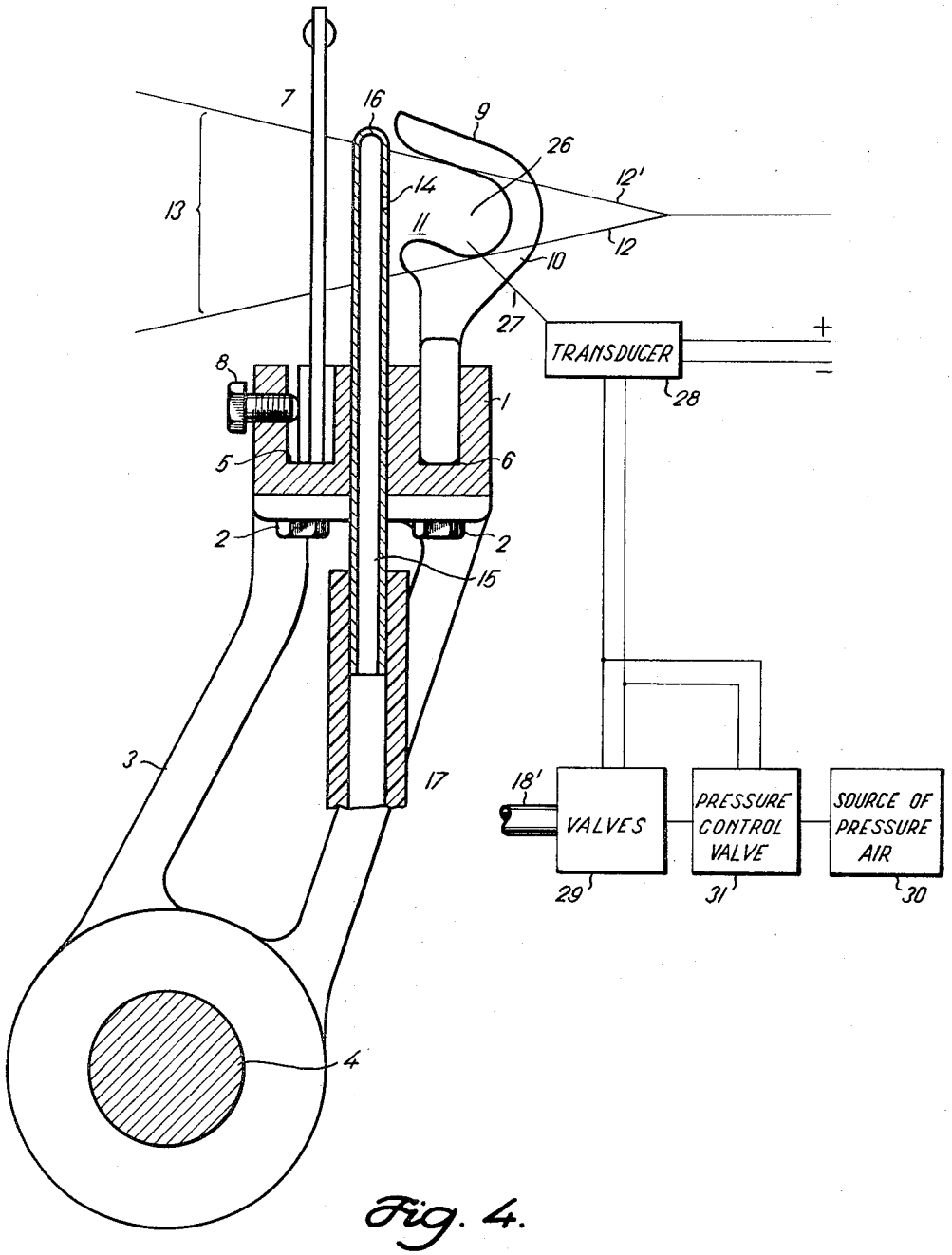

Fig. 4.

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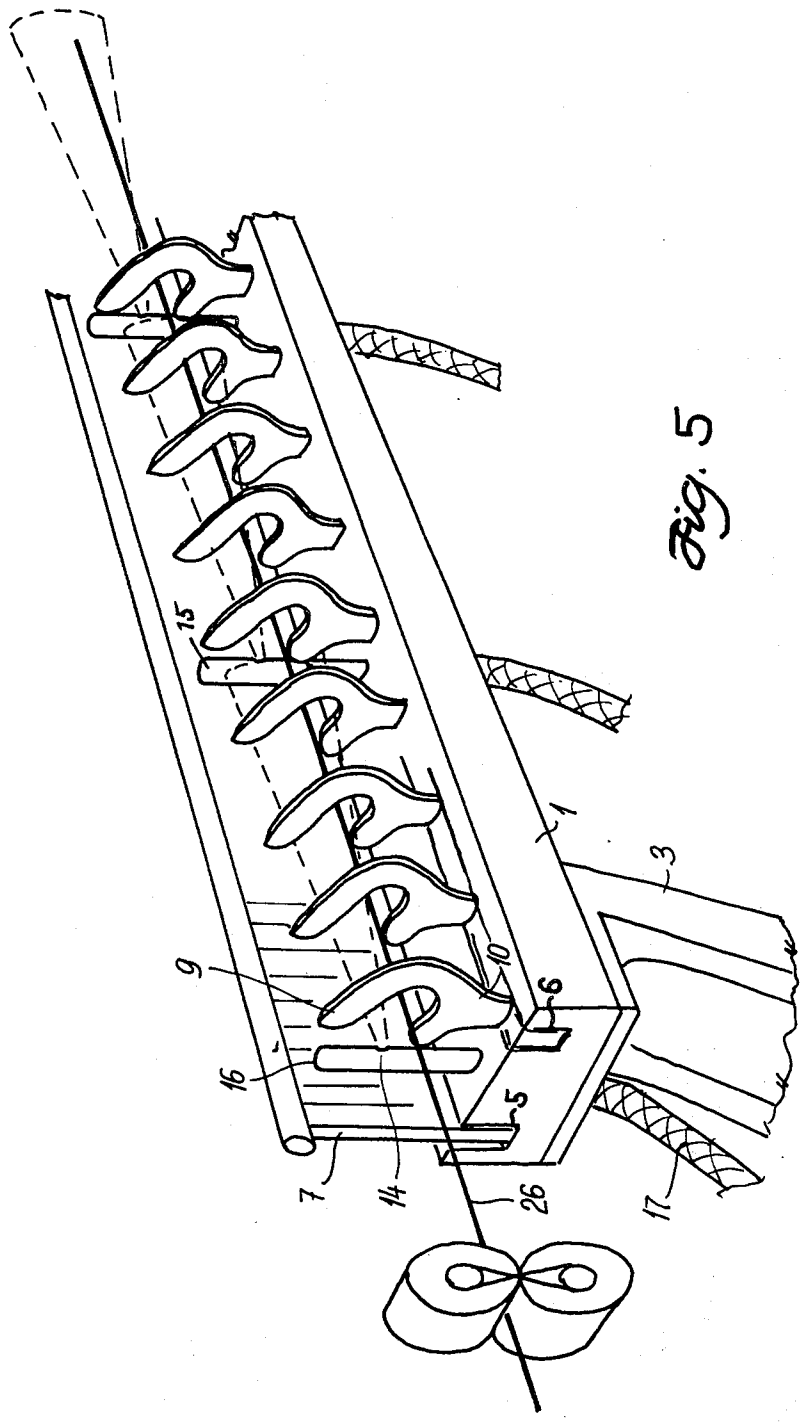

Fig. 5

METHOD OF PICKING WEFT YARNS IN SHUTTLELESS LOOMS

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for inserting weft threads into the shed formed on a shuttleless loom. More particularly, the invention relates to a method and apparatus for inserting weft threads in which initial insertion into the shed is achieved by either a primary pressure fluid flow, such as air flow or rotary feeding rollers which cause the thread to move into a guiding channel formed by a comb having a plurality of plates and openings and then to be subsequently carried through the channel and the shed by a plurality of successive pressure fluid streams in a selectively controlled and directed manner.

In shuttleless weaving machines or looms, the thread end is picked and thrown through the shed with its end free. In those looms employing a pneumatic nozzle to pick up the weft thread, a flow of compressed air is employed to carry the weft thread through the shed by the effect of the air flow. The air leaves a nozzle located on one side of the machine in an abrupt manner and passes through a comb having a plurality of plates and openings inserted into the shed before the weft thread is picked up. The individual plates and openings of the comb form a guiding channel for the weft, as well as for the compressed air flowing from the nozzle, minimizing loss of air due to dissipation. However, with such an arrangement, the pressure and continuity of the air or other suitable carrying fluid is diminished as the distance from the nozzle increases. Consequently, the front part of the weft inserted into the shed is subjected to a fluid flow of continuously diminishing velocity as it is carried through the shed while the rear part continues to be surrounded by a high velocity fluid flow from the nozzle. Therefore, the entraining effect of the fluid on the weft, determined by the difference in relative velocities of the fluid flow, produces a driving force on the rear part of the weft which is higher than that acting upon the front part. Since the strut strength of the weft, that is, the stiffness along its axial dimension, sufficient to resist longitudinal thrust, is neglibible, internal compensation of these forces within the thread cannot be achieved and the rear part of the weft is accelerated more than the front part. Consequently, the picked weft thread or yarn is caused to have a wave shape imparted to it during flight. This often results in the front part of the weft being caught up against the warp threads on the plates of the guiding comb. Incorrect picking, resulting from this condition, very often causes the formation of loops on the weft thread as well as short pickings and other weaving failures.

These disadvantages of weft insertion or picking are partially removed by diminishing the velocity of the fluid flow during the course of picking the weft. However, in such a case, the rear part of the weft is accelerated by a continuously diminishing force, while the front part of the weft continues to be subjected to the velocity drop of the fluid flow. This results in reduction of the mean velocity of the packed weft thread and causes a drop in maximum operating speed and reduced output of the loom.

To overcome these disadvantages, various types of pneumatic systems have been developed to contribute to a correct weft picking. For example, one system consists of a plurality of nozzles for guiding a secondary fluid or air flow, the nozzle being arranged transversely to the warp threads and having on their surface a row of saw-toothed means which spread the warp threads after opening the shed and thus partially penetrate the shed so that the pressure fluid flow excaping from these secondary nozzles assists in the weft thread insertion. Another known system consists of spouts to guide a secondary pressure air flow and in which the spouts are equipped with a set of obliquely mounted and chambered nozzles for easy spreading of the warp threads. In this system the nozzles are usually concentrated at the side opposite to the main pickup nozzle which commits the primary pressure fluid. In addition, some known systems utilize a set of semi-circular rotary nozzles which are chambered at their ends to facilitate penetrating the warp threads, the nozzles being arranged below the warp on pivots which simultaneously supply the secondary pressure fluid and includes means attached to the nozzles to impart to them a reversing rotary motion synchronously with the drive of the machine, thus opening a passage for the fluid into the nozzles.

A disadvantage of these devices resides in the fact that a plurality of these necessarily relatively large nozzles cannot be arranged alongside of each other and so they must be widely spaced. Thus, the effect of the secondary carrying fluid flow escaping therefrom is relatively small. It is further suppressed by the flow of the secondary carrying pressure fluid being directed into a space which is limited only by the opened warp threads. Thus, the dissipation of the flows is immediate. Each penetration of the rotary nozzles, as well as the other nozzles, of the afore-mentioned pneumatic systems into the warp thread system manifests itself by leaving a visible, undesired stripe in the fabric.

A common disadvantage of all pneumatic weft inserting systems such as those mentioned above resides in the fact that the weft is not acted upon by the flow of the secondary carrying pressure medium in such a manner as to be continuously drawn into the shed by its front part; but rather the weft is acted upon throughout the overall length by a system of plural, longitudinally arranged nozzles into which the secondary pressure fluid is fed either periodically, simultaneously or continuously. This manner of distributing the secondary carrying pressure fluid is disadvantageous since it does not supply the needed air and does not insure that the weft, upon its advancement through the shed, will not take up a wave shape and will not be caught by the warp threads or the plates of the guiding comb. There exists, therefore, a need for an improved method and apparatus which overcomes these disadvantages.

It is, therefore, a primary object of this invention to provide a method for inserting weft threads in a shed formed on a shuttleless loom by contacting a weft thread with means to pick it up and carry it through at least part of the length of the shed and then contacting the front part of the weft thread with a plurality of successive pressure fluid flows and carrying the weft thread in a selectively controlled and directed manner through the remaining portion of the length of the shed.

It is another object of the invention to provide a method for inserting weft threads wherein a weft thread is picked up and carried through at least part of the

length of the shed by a primary pressure fluid and then by successive secondary pressure fluid flows.

It is still another object of the invention to provide a method for inserting weft threads wherein a weft thread is picked up and carried through at least part of the length of the shed by rotating feed rollers and then by successive pressure fluid flows.

It is still a further object of the invention to provide a method for inserting weft threads wherein a weft thread is carried into a guiding channel formed by a comb which is periodically merged into the shed.

It is still a further object of the invention to provide apparatus for inserting weft threads in a shed formed on a shuttleless loom having a batten, a comb having a plurality of plates and openings supported on the batten and forming a guiding channel for the weft thread upon periodic merging of the comb in the shed, and including a plurality of means supported on said batten for diverting a plurality of pressure fluid flows into the guiding channel and means to successively activate and deactivate the flows of pressure fluid in a selectively controlled and directed manner.

It is still a further object of the invention to provide an apparatus for inserting weft threads wherein nozzles are mounted on the batten of a loom and directed to guide a plurality of pressure fluid flows obliquely into a guiding channel formed by a comb which is periodically immerged in the shed.

It is still another object of the invention to provide apparatus for inserting weft threads which includes sensing elements located in the plates of the guiding comb to selectively control activation and deactivation of nozzles which direct a plurality of pressure fluid flows in a guiding channel formed by the comb.

It is still another object of the invention to provide apparatus for inserting weft threads which includes a distributor for a pressure fluid connected to nozzles mounted on the batten of a loom and adapted to successively and selectively direct a plurality of pressure fluid flows in a guiding channel formed by a guiding comb.

SUMMARY OF THE INVENTION

According to the present invention, a system for weft insertion is provided wherein the forces acting upon the weft as driving forces are at a maximum at the front part of the weft and gradually disappear in the direction towards its rear part so that the weft is straightened and pulled during its picking so that the front part of the weft picked by a primary system is taken over in the course of its movement through the shed by secondary flows of a pressure carrying fluid which are selectively controlled to operate successively and are oriented substantially longitudinally in the direction of movement of the weft through the shed.

According to the present invention a method and apparatus provided by which the weft thread is picked up and caused to be carried through a portion of the shed by a primary device and through the remaining portion of the shed by a plurality of successive, pressurized fluid flow streams in a selected and predetermined manner acting on the front end of the thread.

Preferably, the secondary flow streams are directed through the combs of the shed and act on the weft as the weft is guided through the channel formed by the combs.

Additional advantages and features of the invention as well as full details will be apparent from the following description thereof which is to be taken in conjunction with the accompanying drawings.

THE DRAWINGS

In the drawings:

FIG. **1** is a schematic, cross-sectional view in elevation illustrating a batten on a shuttleless loom and showing the comb and a nozzle for supplying a secondary pressure fluid, both being mounted along with the reed on the batten in accordance with the present invention;

FIG. **2** is a schematic, cross-sectional view in elevation of an embodiment of a distributor for the secondary pressure fluid;

FIG. **3** is a schematic, cross-sectional plan view of the distributor shown in FIG. **2** and taken across line **2—2** thereof; and

FIG. **4** is a schematic, cross-sectional view in elevation of the embodiment shown in FIG. **1** employing individual sensing means and valves to activate and deactivate the secondary pressure fluid, and

FIG. **5** is a perspective view of weaving shed with a plurality of jet nozzles schematically shown.

It is to be understood that the drawings and description set forth hereinafter give only those details of a loom which are necessary for understanding the present invention. It will be obvious that certain well known details are omitted. Reference is directed to conventional looms, well known texts and literature and particularly to the shuttleless looms disclosed in pending U.S. Patent applications, Ser. Nos. 79,035 and 79,478 filed on Oct. 8, and 9, 1970, respectively, by V. Svaty and which are incorporated into the present case.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In accordance with the invention there is provided a method for inserting weft threads in the shed formed on a shuttleless loom which comprises contacting a weft thread with means for picking up and carrying the thread through at least part of the length of the shed in a substantially longitudinal direction and then contacting the front part of the thread with a plurality of successive pressure fluid flows and carrying the weft thread in a selectively controlled and directed manner in a substantially longitudinal direction through the remaining portion of the length of the shed.

Referring now to FIG. **1**, apparatus for accomplishing the method comprises a batten **1** which is fastened by means of screws or bolts **2** on the slay arms **3** of a shuttleless loom in a known manner. The batten swings on a batten shaft **4** and is provided with longitudinal grooves **5** and **6**. Groove **5** supports a reed **7** which is fastened therein by bolts **8**. Groove **6** supports a guiding comb **9** having a plurality of separate plates, one being shown at **10** which form openings. The plates constitute a continuous channel **11** which is interrupted only by the gaps between the separate plates and which are penetrated by warp threads **12** as soon as the guiding comb **9** is immerged into the shed **13** when the batten **1** moves from front dead center to rear dead center.

The supply of the weft by a primary pneumatic fluid source and the operation of the loom per se are set forth in the aforementioned copending applications to

which reference can be made. In lieu of a pneumatic primary picking and throwing system, shuttleless looms have employed contrarotating roller mechanisms which pick up and throw the weft. These also are well known and suitably described in known literature.

Pneumatic nozzles **14** are located serially from one end of channel **11** to the other in the space between the reed **7** and the guiding comb **9** and are each oriented obliquely with respect to the guiding channel **11.** Each of the nozzles **14** are constituted by openings **14** in tubes **15** to supply a secondary carrying pressure fluid, such as air, serially along the channel **11.** The tubes **15** are closed at their upper ends **16** and are fastened in any suitable manner into the batten **1,** each tube being connected by a flexible hose **17** to the separate outlets **18, 18***a*, **18***c*, etc. of a distributor **19** which functions to distributed the secondary carrying pressure fluid from a source of fluid under pressure. The distributor has as many outlets **18,** etc. as the number of nozzles **14** arranged along the length of the channel **11.**

The distributor **19,** which is situated aside batten **1,** is constituted in the embodiment shown by a pressure vessel having a hollow interior **20** covered by a lid **21.** A rotary slide valve **22** is disposed in the interior **20.** Rotary motion is imparted in the slide valve through shaft **23,** which is synchronized with the conventional main shaft of the weaving machine via a suitable gear train. The rotary slide valve **22** is provided with a bypass opening **24** which is of sufficient size to cover at least two outlets **18, 18***a*, etc. situated beside each other in the distributor **19.**

For supplying the secondary carrying pressure fluid from a source to the distributor **19,** an extension conduit **25** mounted on the lid **21** of distributor **19** is provided. The source of pressure may be a pump or a container of compressed air. Preferably it is provided with pressure control means by which tee pressure flow may be regulated as to volume and degree of pressure. In some embodiments, it may be helpful to regulate the degree of pressure successively to each of the serially arranged nozzles **14.** The embodiment shown, thus far, operates synchronously with the loom being responsive to the main drive shaft via the connecting gear train.

The distributor **19** can be replaced by a system of valves for each or for one or more of the nozzles. The operation of the valves is controlled by various detecting elements which would respond not to the main loom drive but to the movement of the weft **26** in the shed **13.** The detecting elements can be sensors of any known construction. For example, pneumatic, capacitor, photoelectric or similar types which emit impulses corresponding to the presence and/or movement of weft **26.** The impulses may be supplied to the separate valves which secure the serial operation of the appropriate nozzles **14** distributed at suitable distances along the guiding channel **11** in the guiding comb **9.** The nozzles may also act simultaneously as weft stop motions. A schematic showing such a system is seen in FIG. **4,** in which a sensor **27** is placed within the comb plate **10** and is connected to a transducer or similar device **28** which in turn produces a signal impulse responsive to the sensing by sensor **27** of the weft **26.** The transducer signal impulse is transmitted to a valve **29** operated by a solenoid or other convenient device to pass a burst of air from the source **30** into the appropriate conduit, such as **18.** The pressure regulating or control valve **31** may be inserted between the source **30** and each of the valves **29.** This latter valve **31** is also connected to the sensors **27** so that the degree of pressure may be varied in accordance with the nozzle **14.** The sensors **27,** the pressure control valve and other features may also be used with the distributor system shown in FIGS. **2** and **3.** The transducer **28** amplifies and produces a signal impulse and controls the length and timing of the signal so that a selective one or more of the valves **29** are open to let air pass into the nozzles **14** in a selected and predetermined manner.

The devices described operate as follows:

At the moment at which, by any of the known methods, weft **26** is abruptly ejected into the guiding channel **11** in the guiding comb **9,** such as by means of an air nozzle (not shown) for the primary carrying pressure fluid, or with rotating feeding rollers or any other similar device, the distributor port **18** in the distributor **19** is opened by means of the rotary slide valve **22.** The carrying pressure fluid passes through tube or hose **17** into the nozzle **14,** which is arranged at immediate proximity of the primary weft picking system. Thus, the front end of weft **26** is surrounded by a secondary carrying stream which entrains the front part of weft **26** and carries it longitudinally to the next following nozzle **14.** At the moment the front part of weft **26** reaches the following nozzle, the next escape outlet **18**a is opened by means of opening **24** in the rotary slide valve **22** (or the valves **28**). Thus, the secondary carrying pressure streams continuously passing through the succeeding nozzle to maintain the entraining of the front part of weft **26,** while air through the preceding nozzle **14** is about to or has already stopped. Since the supply of secondary carrying pressure stream is already partially or completely stopped due to the turning of slide valve **22** in the distributor **19** (on action of valve **28**), the major force and thus the carrying force acts solely on the front end of the weft, stretching and attenuating the weft through the loom.

The action as specified above repeats steadily and thus weft **26** is gradually handed over and seriation from one nozzle **14** to the next following nozzle, etc. by the substantially longitudinally directed flow of the secondary carrying pressure stream until the weft reaches the end of the guiding channel **11** in the guiding comb **9.** The oblique direction of nozzle **14** enhances the forward flow.

The spacing of the exits **18,** the width of the bypassing opening **24** in the rotary slide valve **22** of distributor **19** and the distance of nozzles **14** along the guiding channel **11** of the guiding comb **9** are all synchronized relative to each other to achieve a flow wave of the secondary pressure stream congruent with the velocity of the front end part of weft **26** so that only the front part of weft **26** is surrounded by the flowing secondary carrying pressure fluid. Thereby, the maximum traction effect of the secondary carrying pressure fluid is concentrated at the front part of weft **26** and it is pulled during the whole picking course by its front part, being straightened and attenuated during its entire run through shed **13.** After picking weft **26** through shed **13,** further weaving phases are carried on in the currently known manner. Reed **7** beats up weft **26** to the fabric, is cut off and the batten **1** is returned to the picking position, whereupon the whole cycle is repeated for the next weft.

The coordination of the correct inlet of air through the nozzle **14** (and successive similar nozzles) into

channel **11** with the picking of the weft through the channel so that the maximum driving effect acts always upon the front part of weft **26** can be achieved by monitoring the picking of the front part of weft **26** by the system shown in FIG. **4.** The photocell, a pneumatic sensor, a capacitory sensor or other sensor **27,** etc. which emits a signal upon the picking of the front end may be transformed and amplified to control the valves in order to admit air into the nozzles at that moment, at which weft **26** runs with its front end beside the appropriate nozzle.

It will thus be seen that according to the present invention the weft thread need only be thrown through a portion of the shed by the primary picking means (be it pneumatic, roller or other means). The rest of the throw or pick is effected by the action of the successively actuated flow streams on the front end of the weft. Thus, the front end of weft is always under the influence of a pressurized entraining fluid which has greater force or velocity than the flow streams acting on any other part of the weft. The valve distributor system of FIGS. **2** and **3** and the sensor-valve control system of FIG. **4** insure an efficient, selective and predetermined flow stream at the front end of the weft whenever required. To insure, further, a stream of air sufficient to carry the weft thread and/or to overcome any drag, the nozzles **14** may be varied in size, the valve openings **18** may be varied in size and/or the pressure regulated by increasing or decreasing pressurizing means so that the flow along channel **11** is regulated.

The advantage of the instant method of picking weft resides in the fact that the weft is pulled by its front end during the entire time of its travel through shed **13** and thus cannot form loops or waves; nor can it be caught up by warp **12** or by the plate **10** of guiding comb **9.** This results, consequently, in a higher quality of fabric. A further advantage resides in the fact that weft threads can be carried through greater distances and larger widths since the driving effect of the secondary carrying pressure fluid upon the weft lasts for the entire time it moves through shed **13.** Moreover, the picking velocity is also faster in comparison to conventional picking methods since the velocity of the driving flow of the secondary carrying pressure fluid does not diminish during the whole time and length of weft picking.

The increase of picking width and picking velocity results in increased efficiency of the weaving machine. The successive supply of the secondary carrying pressure fluid to the separate nozzles such as nozzle **14** is advantageous since it accomplishes the supply of needed fluid which is not so in hitherto known methods, or by the continuous supply of carrying pressure fluid simultaneously to all nozzles **14.**

Numerous other advantages of the method and apparatus of this invention may be made without departing from the spirit and scope of this invention. Accordingly, it is to be understood that the invention is not to be limited to the disclosed embodiments thereof except as defined in the appended claims.

What is claimed is:

1. A method for inserting weft threads through the shed formed on a shuttleless loom comprising the steps of contacting a weft of thread with means for picking up and carrying said weft thread through at least part of the length of the shed in a substantially longitudinal direction and subsequently serially contacting the front part of the weft thread with pressure fluid flow streams, selectively controlling the serial flow streams to convey the weft thread in a selectively controlled and directed manner in a substantially longitudinal direction through the remaining portion of the length of the shed.

2. The method as defined in claim **1** wherein the weft thread is initially picked up and carried through at least part of the length of the shed by a primary pressure fluid.

3. The method as defined in claim **1** wherein the weft thread is initially picked up and carried through at least part of the length of the shed by rotating feeding rollers.

4. The method as defined in claim **1** wherein the weft thread is carried into a guiding channel formed by a comb having a plurality of plates and openings and which is periodically immerged into the shed.

5. The method as defined in claim **4** including means for regulating the pressure of the flow of fluid along the longitudinal length of the shed.

6. The method as defined in claim **5** wherein the plurality of successive, pressure fluid flows are directed obliquely into the guiding channel of the guiding combs.

7. Apparatus for inserting weft threads in the shed formed on a shuttleless weaving loom having a batton comprising means for picking up and carrying a weft thread through at least part of the length of the shed, a comb having a plurality of plates supported on said batten, said comb forming a guiding channel for said weft thread upon being periodically inserted in said shed, a plurality of nozzle means supported on said batten for directing a plurality of individual pressure fluid flows into said guiding channel, valve means connected to the nozzle means for activating and deactivating the individual nozzle means and means for successively controlling said valves to exert a fluid flow on the leading end of said weft thread whereby said weft thread may be pulled from its leading end in a selectively controlled and directed manner through said shed.

8. Apparatus as defined in claim **7** wherein the nozzle means for directing a plurality of pressure fluid flows into the guiding channel comprises, a plurality of independent nozzles serially mounted on the batten, each being directed obliquely into said guiding channel.

9. Apparatus as defined in claim **8** including sensing elements located adjacent the plates of the guiding comb to selectively control activation and deactivation of the nozzles.

10. Apparatus as defined in claim **9** including means for regulating the pressure in each of said nozzles.

11. Apparatus as defined in claim **7** wherein the valve means for activating and deactivating the nozzle means for directing the plurality of pressure fluid flows is a distributor connected to a source of pressure fluid and connected through hoses to the nozzle means and includes a rotary slide valve synchronized with the movement of the main shaft of the shuttleless loom.

12. Apparatus as defined in claim **10** wherein the rotary slide valve is of a size sufficient to cover at least two exits to the hoses at the same time.

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