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PROCESS AND AN APPARATUS FOR CONTROLLING THE WEFT THREADS IN WEAVING LOOMS

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The invention relates to a process and an apparatus for controlling the weft threads in weaving looms. Mechanical methods have hitherto been used for controlling the weft threads in weaving looms. For this purpose, a weaving loom is provided with a weft fork approximately in the middle of the fabric. This fork acts as a feeder for the weft thread and arrests the loom when it detects no weft thread. In the usual loom with a shuttle containing a wound spool, the mechanical weft thread control involves the risk that the weft threads may be pulled out of the fabric by the weft fork, thereby producing faults in the weaving in the form of so-called weft eyes. Moreover, these known mechanical devices do not detect breaks in the weft thread near the edges of the fabric. In a weaving loom operating with gripper shuttles, which have no spool, these disadvantages are even more serious because the weft thread is usually inserted in the shed without tension. In weaving looms operating with gripper shuttles, the use of the known mechanical weft thread controls is therefore practically impossible.

The invention relates to a process and an apparatus for pneumatic weft thread control. In accordance with the invention, air suction is exerted in the region of the edges of the web or close thereto, this suction taking in the weft threads if present, with suction elements provided with suction apertures for taking in the web threads and communicating with a suction pipe being provided for this purpose on the sley of the loom in the region of the edge of the web or close thereto.

In a weaving loom in which weft thread for two throws or only one throw is taken from the spools arranged on both sides, and the weft threads are taken up by a gripper shuttle and inserted in the shed alternately from the right and left so that weft threads originating from the right and left side of the loom respectively alternate in the finished fabric, it is known to provide a suction aperture in the sley path close to the edges of the web, the ends of the weft threads being sucked into these apertures by means of a suction device. This arrangement, however, is intended merely for smoothing out the weft threads and is not a device for controlling the weft threads.

By way of U.S. patent application S.N. 50,420, new Patent No. 3,050,098, a weaving loom is also known in which weft thread for two throws is taken from spools arranged on both sides, and the weft threads are inserted alternately from the right and left into the shed by means of a gripper shuttle, the threads on release from the shuttle being subjected to a tension exerted by the suction produced by suction tubes arranged along both edges of the web. As the shuttle approaches, these tubes enter the shed and the weft threads are sucked into these tubes as they slide off the shuttle and thereby moved out of the shed together with the shuttle. This arrangement is intended merely to smooth out the weft thread.

The basic idea of the process of the invention for controlling the weft thread consists in that the known apparatus for applying suction to the weft threads near the edges of the web is used not only for smoothing out the weft thread but for controlling the thread. This is achieved by the fact that the increase in suction which occurs when the weft thread is sucked into the apparatus is utilised for making an electric contact which keeps the weaving loom in action, whereas when the contact is not made, the weaving loom is put out of action.

The apparatus for carrying out this process comprises, in addition to the known suction elements and pipes, a movable element and pipe subjected to the action of a spring, the vacuum in each suction pipe acting on the corresponding movable element; the apparatus further comprises an electric contact which, when the vacuum in a particular suction pipe is increased beyond a certain value, is either opened or closed by the movable element.

The process and apparatus according to the invention provide a sensitive and reliable means of weft control which cannot impair the fabric in any way. It controls any ruptures in the weft thread occurring in any part of the fabric. In addition, the weft threads are smoothed out by the apparatus. Moreover, it is possible to combine the new process and apparatus for controlling weft threads with the known apparatus for smoothing out weft threads in weaving looms operating with gripper shuttles.

In a weaving loom operating with a shuttle containing a shuttle spool, the suction elements according to the invention consist of hollow suction plates fixed to the sley next to the edges of the web. The upper surface of these suction plates are provided with suction slots extending in the direction of the weft threads. For looms operating with gripper shuttles, in which suction tubes are arranged along both edges of the fabric, which tubes enter the shed when the shuttle approaches, suck in the weft thread as it slides from the shuttle, and then leave the shed together with the shuttle, the suction tubes are so arranged that they may be utilised as suction elements for the new weft thread control and are therefore constructed in such a manner that they are tapered in the direction of their suction end and the tapered portion lies substantially parallel to the shuttle, and the wall of the tapered part nearest the shuttle has a number of adjacent suction apertures. This combination of suction element for thread control with suction tubes for smoothing out the weft threads may be used for thick weft threads. For thin weft threads, one or more suction apertures of the tubes are connected to a separate suction pipe which is independent of the main suction pipe. To obtain the necessary suction and utilise the pressures in the suction pipes for control purposes, one embodiment of the invention is provided with a suction pump for each suction element. The cylinder of the pump is swingably attached to the sley, and its piston and piston rod are hingely connected with an arm of a toggle lever which is swingably attached to the framework of the loom. The other arm of the toggle lever is provided with a contact which is situated opposite a slidable contact pin which is under the action of a spring and attached to the frame.
work of the loom. Up to a certain suction value, a spring acting on the toggle lever prevents the piston and piston rod, and hence the toggle lever, being moved by the suction pressure. With an appropriately constructed and arranged toggle lever, the suction provided which limited the movement of the toggle lever to a certain range.

In order that the contact pin may automatically be adjusted to the optimum distance from the arm of the toggle lever which has the contact, the contact pin is preferably so constructed and arranged that it may easily be displaced by the toggle lever but will return to its starting position with some retardation under the action of its spring.

In another embodiment of the apparatus according to the invention, the pressures in the suction pipes are utilized for control purposes by providing in each suction pipe leading to a suction element a housing with a metal membrane dividing it airtightly into two parts. The part of the suction pipe connected with the suction element opens into one half of the housing and a tube with air in one adjustable cross-section to the other half of the housing. The part of the suction pipe leading from the suction device to the housing forks into two arms of equal cross-section before reaching the housing. One arm is connected to one half of the housing and the other is connected to the other half. The membrane is connected to an electric circuit. The half of the housing into which part of the suction pipe connected with the suction element opens contains an adjustable contact which makes contact with the membrane when the pressure in that part of the housing falls to a certain level.

In another embodiment of the apparatus, the contact arrangement in one half of the housing as described above may be replaced by an adjustable contact arranged in that other half of the housing. The membrane may touch this contact when at rest and may move away from it when the pressure in the other half of the housing falls below a certain value.

Various circuits and elements for starting or stopping the loom when the contacts are closed or opened may be used. Various means for producing air suction may be used, except for the construction of the thread control device, in which a suction pump serves also as control. For example, it is possible to use sucking devices which control the web threads of several looms.

Various examples of thread control devices according to the invention are illustrated diagrammatically in the accompanying drawing, in which:

FIGURE 1 is a longitudinal section through a suction plate for weaving looms using shuttles containing shuttle spools;

FIGURE 2 is a side elevation of a suction tube for weaving looms using gripper shuttles;

FIGURE 3 is a side elevation of another suction tube for weaving looms using gripper shuttles;

FIGURE 4 is a side elevation, partly in longitudinal section, of an embodiment of the apparatus comprising a suction pump, a toggle lever and a displaceable contact pin;

FIGURE 5 is a longitudinal section through another form of movable contact pin for the embodiment of FIGURE 4;

FIGURE 6 is a longitudinal section of an apparatus with a housing having membrane arranged in the suction pipe;

FIGURE 7 is a perspective view of a portion of a loom, showing the sley, reed and shuttle, with the suction control of the form shown in FIGURE 4 coupled to the sley, reed and shuttle, and part of a conventional loom stopping mechanism; and,

FIGURE 8 is a perspective view similar to FIGURE 7 but showing the control means illustrated in FIGURE 6.

The suction plate illustrated in FIGURE 1 and provided for normal weaving looms has an inner cavity.
FIGURE 5 shows another form of contact pin with means for mounting it to provide a dash pot. This contact pin 37 is in the form of a piston at its lower end. Piston portion 38 of this pin 37 is mounted in a cylinder 39 which is filled with a braking fluid, for example thin oil, and which is fixed adjustably to the framework of the loom by means of a support 40. A helical spring 41, which tends to keep the contact pin 37 in its upper position and return it to that position when it has been depressed by the contact 33, is arranged in the cylinder 39 below the piston part 38 of the contact pin 37. The piston part 38 contains a cavity 42. At the top of this cavity are outlet ducts 43 for the braking fluid. Another outlet duct 44 extends from the housing for the piston part 38 below the cavity 42. The wide outlet duct 44 together with a ball 46 arranged in the cavity 42 form a valve for permitting rapid depression of the contact pin 37 into the cylinder 39 by the contact 33. The narrow duct 45 serves to retard the outward movement of the contact pin 37 out of the cylinder 39 under the action of the helical spring 41. This retarded outward movement automatically adjusts the contact pin 37 to the optimum distance to the contact 33.

FIGURE 7 shows a portion of a loom with the control structure of FIGURE 4 connected to the sley 23. Sley 23 is pivotally mounted at its center 85, and T9 is shown in place on the sley. Warp threads T1 form the shed through which the shuttle passes. A rail 72 is mounted on the front of the sley and a suction tube carrier 71 is slidable along the rail. No means for moving the carrier toward and from the shed has been shown, but mechanism for doing this is disclosed in above-mentioned Patent No. 3,050,088. Carrier 71 supports a suction tube, such as the tube 15, and moves it in and out of the shed. The control suction cylinder 24 is connected to the sley as previously described.

FIGURES 4 and 7 shows the apparatus with the sley 23 in its rear position. When the sley 23 moves forward (to the left), it carries the suction cylinder 24 with it. The piston 26 and piston rod 27 are not moved forward at first because they are connected to the toggle lever 28 which is under the influence of the retaining spring 32. A movable 48 with means for positioning in the suction tube 47 and in the suction tube 15 connected to the suction pump. The retaining spring 32 is so adjusted that the toggle lever 28, the piston rod 27 and piston 26, remain in their position of rest when the slots 17 of the suction tube 15 are exposed. If the slots 17 are closed by a weft thread, the weft in the warp increases in value. When the suction pump causes the piston 26 and piston rod and toggle lever 28 to be carried forward by the cylinder 24 or sley 23 against the action of the spring 32. The contact 33 is arranged on the arm 26B of the toggle lever 28 then comes into engagement with the movable contact pin 34 to make contact, and thus operate appropriate switching elements to keep the loom in operation. If on the other hand there is no weft thread and therefore no movement of the toggle lever 28 and no contact between the contact 33 and the contact pin 34, the loom is switched off by a switch relay or the like. Although any conventional control circuit and loom cut-off means may be employed, a simple circuit and cut-off operator have been shown in FIGURE 7. The circuit includes a wire 90 from a suitable source to the lever 28, and a wire 81 from the source to a coil 82. The opposite side of the coil is connected by wire 83 with the movable contact 34. Thus, whenever lever 28 is rocked and contacts 33 and 34 closed, the coil will be energized.

Coil 82 controls a latch lever 90 which is pivotally connected at one end to one arm 91A of a bell-crank 91i, pivotally mounted at 92 for rocking movement. The free end of latch lever 90 is hooked, as at 90A, to engage the end of a cam 84 of a cam follower 84. The cam follower is pivotally mounted at its center 85, and the opposite end 84B carries a cam-following roller 86. Roller 86 is held in engagement with a cam 88 by means of a spring 87 which is connected to arm 84A of the cam follower and to a convenient part of the loom frame. Cam 88 is mounted on a shaft 89 for rotation once each movement of the sley. Arm 91b of bell-crank 91i is connected to a loom cut-off rod 93.

When a weft thread is drawn into, and closes, or partially closes, the openings 17 in suction tube 15, cylinder 24 and piston 26 and its rod 27 will move as a unit with the sley and rock lever 28 to close contacts 33 and 34. This will close the circuit to coil 82 and draw latch lever 90 upwardly out of engagement with cam-follower 84. Therefore, when cam 88 is not in contact with the piston part 38 below the cavity 42. The wide outlet duct 44 together with a ball 46 arranged in the cavity 42 form a valve for permitting rapid depression of the contact pin 37 into the cylinder 39 by the contact 33. The narrow duct 45 serves to retard the outward movement of the contact pin 37 out of the cylinder 39 under the action of the helical spring 41. This retarded outward movement automatically adjusts the contact pin 37 to the optimum distance to the contact 33.

The apparatus shown in FIGURE 4 is used in conjunction with a suction tube 15 illustrated in FIGURE 2, which serves both for smoothing out the weft thread and for controlling the thread, the suction pump must be sufficiently powerful to smooth out the thread.

In the embodiment shown in FIGURES 6 and 8 a housing 48 arranged in operative position adjacent the sley of a loom. The sley, reed, shuttle, shed and weft thread are similar to those shown in FIGURE 7 and, therefore, are given the same reference characters primed. The electric circuit and loom control mechanism are also the same as in FIGURE 7 and these parts also have the same reference characters as in FIGURE 7, but primed.

The housing 48 is formed by two plates 49 and 50 which are connected together and have a generally lens-shaped central cavity 51. The plates 49 and 50 are made of electrically insulating material. A metal membrane 52 is stretched between these two plates so that it extends through the centre of the housing 48 and its cavity 51. The top end of the membrane 52 has a terminal 53 for an electric conductor and projects beyond the edge of the housing, as shown.

The part 54 of the suction pipe connected with a suction plate 10, a suction tube 15 or a suction tube 18a leads into the half of the housing 43 formed by the plate 50. The part 54 of the suction pipe communicates with the half of the cavity 51 situated on one side of the membrane 52 by a duct 55 in the plate 50. A tube 56 is connected to the other half of the housing 48, which is formed by the plate 49. This tube is connected in such a manner that it communicates with the other half of the cavity 51 on the other side of the membrane 52 through a duct 57 in the plate 49. The tube 56 is closed.
at its outer end and the air inlets 58 are arranged at intervals along it. It has a rubber or plastic sleeve 59 which can be moved to cover or expose the suction plate 60. The part 60 of the suction pipe leading from the suction device to the housing 48 is divided in front of the housing 48 into two arms 61 and 62. One of these arms opens into the plate 49 and the other into the plate 50. The arm 61 communicates with that half of the cavity 51 to which the tube 56 is connected, by means of the plates 48 and 53 and the arm 62 is connected to that half of the cavity 51 which communicates with the part 54.

A contact screw 65 is arranged at the centre of the plate 50 and a terminal 66 for a conductor is connected to the screw. The tip of the screw 65 projects into the cavity 51 so that it is at some distance from the centre of the membrane 52. The distance between the membrane 52 and the tip of the screw may be regulated by adjusting the screw. The plate 49 is provided with a contact screw 67 and a terminal 68. Depending on the desired circuit arrangement, either the contact screw 65 or the contact screw 67 is used.

When using the apparatus shown in FIGURES 6 and 8 the suction pipe 60 sucks in air through the suction pipe 54 connected to the plate 10, suction tube 15 or suction tube 18 and through the regulating tube 56, by way of the housing 48. By exposing or covering the tube 56 by means of the sleeve 59, this suction is previously so adjusted that the same quantity of air is sucked through the part 54 and the regulating tube 56 when the slots 12 of the suction plate 10, the slot 17 of the suction tube 15 or the slot 21 of the suction tube 18 are open. The same vacuum will therefore be produced on both sides of the membrane 52 in the cavity 51, and the membrane 52 will therefore be kept in its central position. When the vacuum is raised in the part 54 by a weft thread sucked in by the suction plate 10 or the suction tube 15 or 18, this increases the vacuum in that half of the cavity 51 which communicates with the part 54 of the suction pipe. The central portion of the membrane 52 is thereby moved out of position towards the plate 50 and comes into contact with the contact screw 65 if the latter is suitably adjusted. A contact is released by the contact between the membrane 52 and the screw 65 so that the loom is kept in operation by the various elements of the circuit. When there is no weft thread, there is no movement of the membrane 52 towards the plate 50 so that there is no contact between the membrane 52 and the screw 65. This results in arrest of the weaving loom through a switch relay or the like.

If the contact screw 67 is used instead of the contact screw 65, the tip of the contact screw 65 is moved out of the cavity 51 and the tip of the contact screw 67 is moved into the cavity 51 so that it is in contact with the membrane 52 when the latter is in its central position. When the membrane 52 moves towards the plate 50 as a result of a weft thread being sucked in through the suction plate 10, the suction tube 15 or the suction tube 18, the connection between the membrane and the suction 67 is opened, and the loom is thereby kept in operation. When on the other hand no weft thread is sucked in through the plate 10 or tube 15 or 18, no movement of the membrane 52 takes place and there is no interruption of the contact between the membrane and the contact screw 67, with the result that the loom is arrested.

We claim:

1. Process for controlling weft threads in a weaving loom having a step motion normally operable each time of the shuttle to stop the loom comprising, arranging suction passages having open inlets in the region of the edges in the path of weft threads laid by the shuttle to grip the weft threads, utilizing weft threads being led to restrict the inlets to increase the vacuum in the suction inlets, and employing the vacuum increase in the suction inlets as a motivating force to render the stop motion inoperative.

2. In a weaving loom having a sley, suction elements arranged on the sley adjacent to the edges of the web, each said suction element being provided with suction apertures for grasping the weft threads and communicating with a suction pipe, means to apply suction to each suction pipe, a spring controlled movable element for each suction element and each suction pipe, on which movable element the vacuum prevailing in the corresponding suction pipe is effective for engaging the suction element and suction pipe, operated by the associated movable element when the vacuum in the suction pipe is increased above a certain level.

3. In a weaving loom according to claim 2, wherein the suction elements are hollow suction plates fixed to the sley close to the edges of the web and each provided on its upper surface with suction slots extending in the direction of the weft threads.

4. In a weaving loom according to claim 2, wherein the suction elements are movable suction tubes arranged on the sides of the edges of the web, which tubes are movable to enter the shed when the shuttle approaches, suck in the weft thread when the latter slides from the shuttle, and leave the shed together with the shuttle holding the weft thread, the suction tubes being tapered towards their suction end, with their tapered portion substantially being in a suitable position so that the suction apertures are provided on the wall of the tapered portion facing the shuttle.

5. In a weaving loom according to claim 4, wherein at least one of the suction apertures of the suction tubes is connected to a suction pipe separate from the main suction pipe to function as a weft thread control.

6. In a weaving loom according to claim 2, wherein said movable element comprises a suction pump communicating with each suction element, said pump having a cylinder, a piston and a piston rod, said cylinder being pivoted to said sley; a toggle lever rockingly mounted on said loom, one arm of said toggle lever being hingedly connected to said piston rod; said switch contacts comprising a contact on the other arm of said toggle lever and a disposable, spring-controlled contact pin mounted on said loom and disposed opposite said first mentioned contact; a spring connected to said toggle lever and to said loom to prevent movement of said piston, piston rod and toggle lever by suction below a predetermined value in said cylinder upon motion of said sley and cylinder; and stops for limiting motion of said toggle lever to a given range.

7. In a weaving loom according to claim 6 wherein the free end of said contact pin is a piston movable in a cylinder to provide a dash pot, said dash pot cylinder being filled with a bracing fluid and said dash pot piston including a valve for permitting rapid inward movement of said dash pot piston into said dash pot cylinder under the action of said toggle lever, a spring urging said dash pot piston out of said dash pot cylinder, and said dash pot piston also including a duct for retarding its movement out of said dash pot cylinder.

8. In a weaving loom according to claim 2 comprising a housing arranged in each suction pipe leading to said suction elements, said housing including a metal membrane as the said spring controlled movable element, said membrane dividing said housing hermetically into halves, the part of said pipe leading from said housing to said suction element opening into one said half of said housing, a tube connected to said other half of said housing, said tube having air inlet means of adjustable area, said pipe having a second part leading to said housing remote from said first-named part, said second part having two forks, said forks being connected to said halves of said housing, an electric circuit, said membrane being connected in said electric circuit, an adjustable contact in one of said halves of said housing, said membrane and said contact engaging and disengaging
through movement of said membrane under pressure changes in one of said halves of said housing.

9. In a weaving loom according to claim 8, wherein said tube is closed at its outer end, said air inlet means include spaced air inlets and a sleeve, and said sleeve is movable to expose and cover said air inlets.

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