United States Patent

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[31] **1106/68**

[54] **METHOD AND APPARATUS FOR DETECTING AN UNDESIRED CONDITION OF A SHUTTLE-CARRIED WEFT YARN**
8 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **139/371,** 139/273
[51] **Int. Cl.** **D03d 51/34,** D03d 45/10
[50] **Field of Search** 139/371, 370, 273, 275, 205

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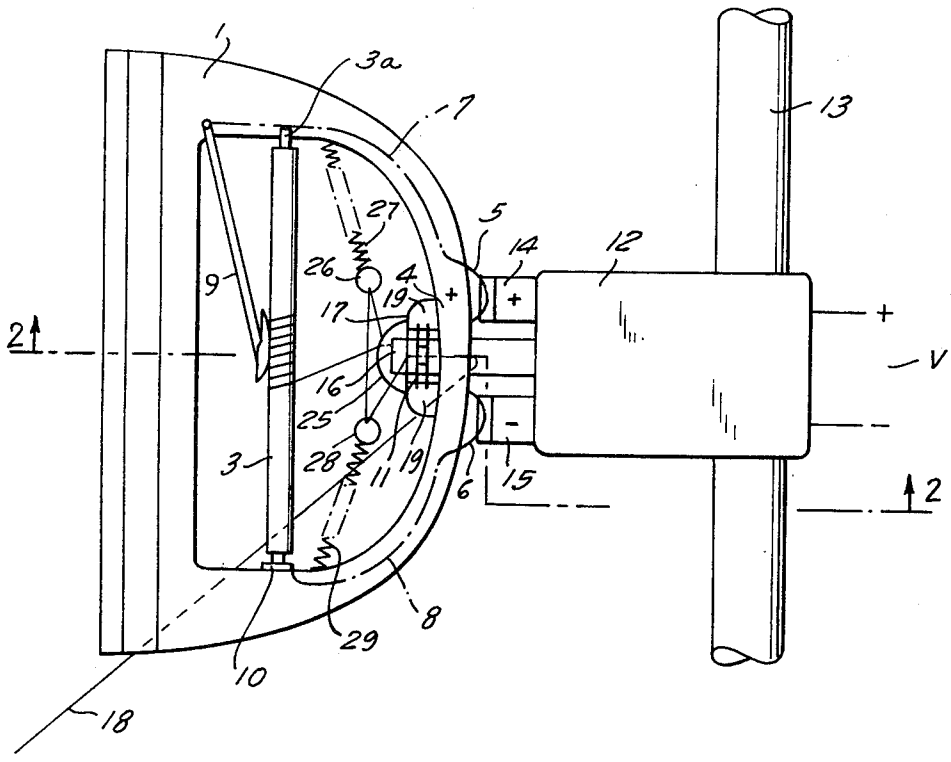
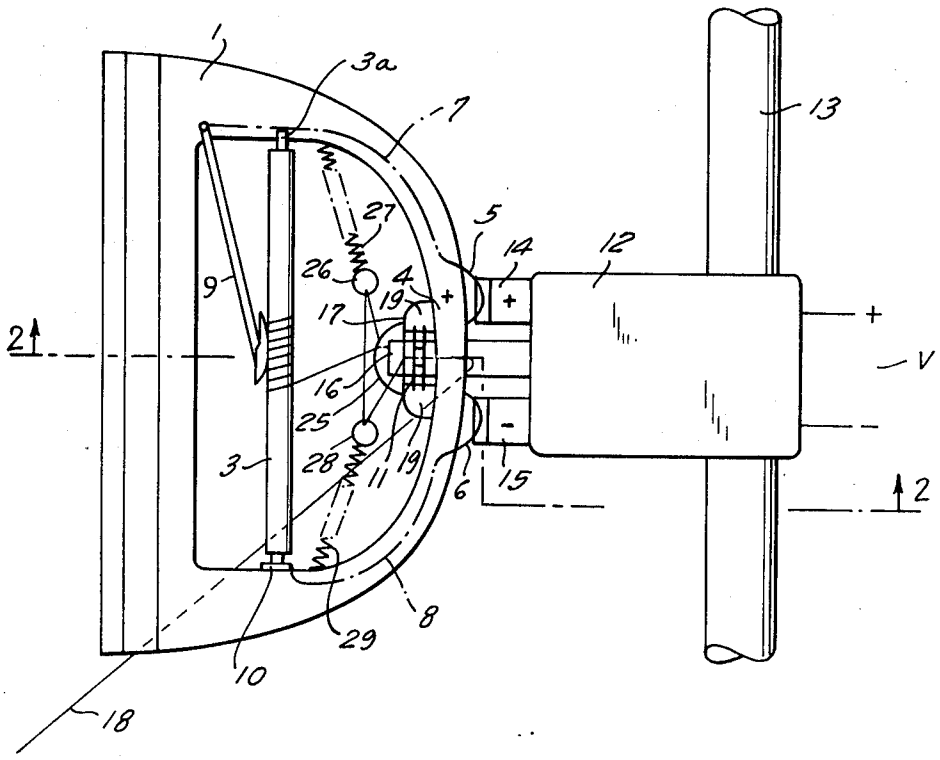
ABSTRACT: Running out of the weft yarn of a bobbin carried by a shuttle, or breakage of the weft yarn, are sensed independently, and upon sensing of such a condition, the respective sensing means moves to a control position. In at least one end position of the shuttle, an actuated sensing means in the control position engages in the beat-up position of the slay, stationary contact means or switch means for closing a control circuit so that a control impulse for stopping the loom is produced.



2 Sheets-Sheet 1

FIG. 1



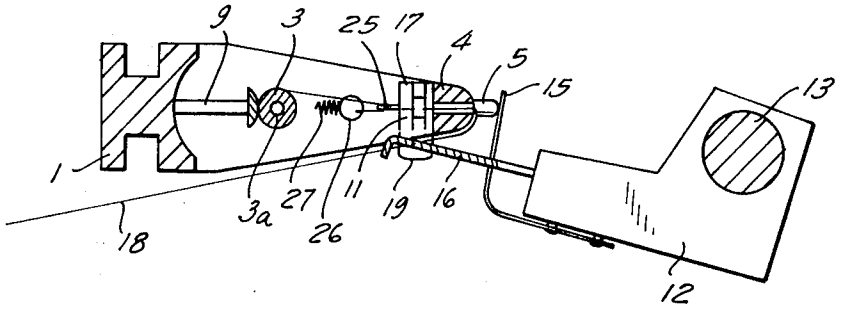


FIG. 2

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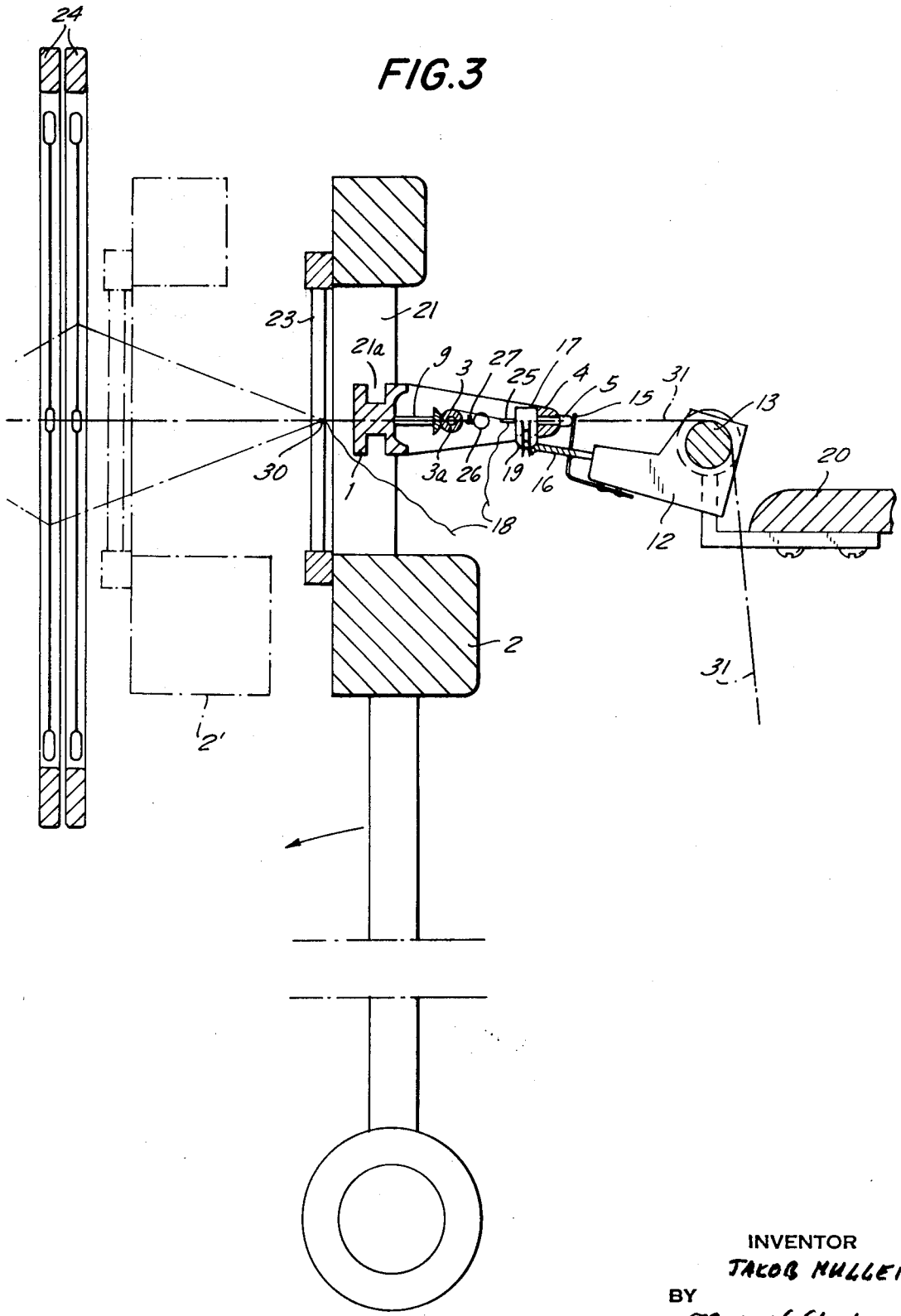
FIG.3



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METHOD AND APPARATUS FOR DETECTING AN UNDESIRED CONDITION OF A SHUTTLE-CARRIED WEFT YARN

BACKGROUND OF THE INVENTION

In the weaving of fabrics, and particularly in the weaving of narrow fabrics, such as ribbons or bands, the detecting of running out of the weft yarn of the shuttle bobbin, in addition to the detection of weft yarn breakage, has become of great importance since the speed of the picked shuttle is very high in modern looms so that a visual observation by the operator of the loom is no longer practical.

Mechanical, photoelectrical, and electromechanical devices, including electronic devices and pneumatic or hydraulic means, are known, and in particularly one apparatus of the prior art, an electric control circuit is provided which includes two contacts in the race of the shuttle which cooperate with two contact springs provided on the shuttle. One of the contact springs is connected with a metal ring, and when a tensioned weft yarn tensions the spring, the yarn guide does not make contact with the metal ring, and a control circuit is interrupted. When the weft yarn breaks, or the shuttle bobbin runs out, the yarn guide is pulled back by the spring, makes contact with the metal ring, and closes in one end position of the shuttle, a control circuit including a relay by which the loom is stopped.

This prior art construction has disadvantages, particularly that the loom is stopped only when the shuttle bobbin is completely empty, so that the weft yarn is already without tension, and causes a fault in the woven material. Another disadvantage of the prior art construction is the undesired stopping of the loom by a contact between the yarn guide with the metal ring occuring due to the vibrations of the tension spring, without breakage of the weft yarn, or running out of the shuttle bobbin. It was also found that the contact springs are subject to fatigue so that reliable electric contact in the end position of the shuttle is not obtained.

SUMMARY OF THE INVENTION

It is one object of the invention to overcome these disadvantages of the prior art, and to obtain a stopping of the loom before the weft yarn has completely run out from the shuttle bobbin.

Another object of the invention is to stop the loom not only when the weft yarn begins to run out from the bobbin shuttle, but also when the weft yarn breaks.

Another object of the invention is to stop the loom when the weft yarn breaks or when the weft yarn begins to run out from the shuttle by detecting either undesirable condition by two independent sensing means which independently effect the stopping of the loom in at least one end position of the shuttle.

Another object of the invention is to produce a control impulse for stopping the loom by actuating stationary control means in the beat-up position of the slay.

With these objects in view, the stopping of the loom is produced in accordance with the invention in the beat-up position of the slay while the shuttle is in an end position.

One method of the invention for detecting an undesired condition of a shuttle-carried weft yarn comprises the steps of picking the shuttle with the weft yarn, sensing the condition of the weft yarn during the pick of the shuttle, and producing a control impulse for stopping the loom in an end position of the picked shuttle in the beat-up position of the slay of the loom if an undesired condition is sensed. The control impulse is preferably obtained by moving the shuttle by the slay at the end of the beat-up motion to a position engaging a stationary control means for producing a control impulse for stopping the loom.

In accordance with the invention, the end of the weft yarn is sensed in the shuttle, and the breakage of the weft yarn is independently sensed.

An apparatus in accordance with one embodiment of the invention comprises stationary supporting means on which a slay is mounted for reciprocating movement to and from a beat-up position; a shuttle mounted in a shuttle race of the slay for weft inserting movement between two end positions; sensing means in the shuttle for sensing the weft yarn and assuming a control condition when sensing an undesired condition of the weft yarn; and control means supported by the stationary support means in a position located opposite the shuttle in at least one of the end positions of the same, and being actuated by the sensing means only if the sensing means are in the control condition. The actuated control means produce a control impulse for stopping the loom.

In the preferred embodiment of the invention, the shuttle has a conductive bobbin for the weft yarn and the sensing means include a circuit comprising a conductive resilient sensor contact engaging the package of the weft yarn on the bobbin and making contact with the conductive bobbin when the weft yarn has almost run out. Shuttle contact means are connected in series with the sensor contact and engage corresponding contact means of the circuit of the stationary control means in the beat-up position of the slay so that the control circuit is closed and produces a control impulse for stopping the loom.

The sensing means also include a guide eye through which the weft thread passes, and which is mounted on the shuttle for movement with the shuttle, and for dropping movement relative to the same to a control position. The tensioned weft yarn holds the guide eye in a normal position, but when the weft breaks, the guide eye drops to a control position in which it engages a stationary switch means when the shuttle is in the end position, and the slay moves to the end of the beat-up motion. The actuated switch means closes the control circuit of the stop control means of the loom. The guide eye and the contact means of the shuttle are provided in the region of the shuttle nose.

While electric circuits and contacts are used in the preferred embodiment of the invention, mechanical, electronic, pneumatic, or hydraulic control means may be used instead of the preferred electromechanical means of the invention. Irrespective of the preferred construction, the present invention provides two independent systems for detecting the running out of the weft yarn and the breaking of the same.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary plan view illustrating a shuttle in a position cooperating with a stationary stop control means in the beat-up position of the slay;

FIG. 2 is a side elevation, partially in section along the line 2–2 in FIG. 1; and

FIG. 3 is a vertical sectional view of a part of the loom, and including an illustration corresponding to FIG. 2, but showing the condition after a yarn breakage.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A shuttle **1** is guided in a shuttle race **21***a* forming a guide way in a part **21** of a reciprocable slay **2** which also carries a reed **23** rearwardly of a part **21**. Slay **2** is movable between the beat-up position shown in solid lines in FIG. **3** in which the reed **23** beats a weft yarn into the fell **30** of the fabric **31**, and a retracted position **2'** shown in chain lines. The warps are operated by heddle frames **24** to form warp sheds through which the shuttle **1** is picked before slay **2** arrives in the beat-up position shown in solid lines in FIG. **3**. When slay **2** is in the beat-up position, shuttle **1** is in the end position shown in FIG. **1** located opposite a stationary control means **12**, as best seen in FIG. **1**, which is mounted on a rod **13** secured to the breast

beam 20 or other beam of the stationary supporting means of the loom. Control means 12 includes control circuits by which the stop motion of the loom is operated.

Shuttle contact means in the form of two contacts 5 and 6 are secured to the shuttle nose 4, and engage control contacts 14 and 15 of control means 12 only in the end position of shuttle 1 and in the beat-up position of slay 2. During the pick of the shuttle 1, and while slay 2 has moved out of the beat-up position shown in solid lines in FIG. 3, no engagement between shuttle contacts 5, 6 and control contacts 14 and 15 is possible.

Shuttle contact 5 is connected by a conductor 7 to a resilient sensor 9 which engages a package of the weft yarn 18 wound on a bobbin or quill 3 which is mounted on a pin 3*a* for rotation in the hollow shuttle 1. The other shuttle contact 6 is connected by conductor 8 with the bearing 10 of the pin 3*a*, and since all parts are made of conductive metal, a circuit is established if the sensor 9 engages the conductive bobbin 3 in the event that the yarn package formed by weft yarn 18 on bobbin 3 has almost run out. During normal operation, the sensor 9 abuts the weft yarn package on bobbin 3 so that the circuit between shuttle contacts 5 and 6 is interrupted. In this normal condition, sensor 9 performs the additional function of braking rotation of bobbin 3 due to inertia.

As long as there is a sufficiently great length of weft yarn 18 wound in a package on bobbin 3, the package holds the resilient sensor 9 spaced and insulated from the metal bobbin 3. When only the end of the weft yarn remains on bobbin 3, sensor 9 makes contact with metal bobbin 3, and an electric current impulse from a voltage source V can flow through the control circuit in control means 12, shuttle contact 5, conductor 7, metal sensor 9, metal bobbin 3, bearing 10, conductor 8, shuttle contact 6, and control contact 15 while the shuttle 1 is in the end position illustrated in FIG. 1, and slay 2 is in the beat-up position shown in FIG. 3 so that contacts 5, 6 and 14, and 15 engage each other. The electric impulse flowing through the control circuit of control means 12 energizes a relay, not shown, to cause stopping of the loom and switching off of the motor driving the same in a conventional manner which is not an object of the invention.

The sensor 9 will make contact with bobbin 3 when the end portion of weft yarn 18 is still wound in a helical winding on bobbin 3 so that the control impulse for stopping the loom is given while the end portion of the weft yarn is still on bobbin 3. In this manner, the loom is stopped before the weft thread has run out from bobbin or quill 3, which would have caused a fault in the woven fabric 31.

In addition to this system for detecting the running out of the weft yarn from the bobbin, another system for detecting weft yarn breakage is provided. Rearward of the shuttle nose 4, and in the interior of the shuttle 1, a U-shaped mounting member 17 is provided in which a guide eye 11 is mounted. Mounting member 17 has two lateral downwardly projecting lugs 19 curved towards each other and permit a dropping of guide eye 11 from the normal position shown in FIG. 2 to the control position shown in FIG. 3.

The weft yarn 18 is guided from the package on bobbin 3 to and through a yarn guide 25, from there through an eye 26 of a spring 27, another eye 28 of a spring 29, from there through the guide eye 11, and to the warp shed in the region of the fell 30 of the band-shaped fabric 31.

The weft yarn portion passing through guide eye 11 is tensioned during the insertion into the warp shed, so that the light guide eye 11 is held in the normal higher position shown in FIG. 2.

When the weft yarn breaks, guide eye 17 drops in mounting member 11 to a lower control position shown in FIG. 3 where it is retained by the lugs 19. The breaking of the weft yarn, and the dropping of the guide eye 11 may occur during the pick of the shuttle in which event the movement of the shuttle to the end position shown in FIG. 1 is completed while the slay 2 moves with shuttle 1 to the beat-up position shown in FIGS. 1 and 3.

The control means 12 includes a switch means having an actuator 16 which cooperates with guide eye 11. Guide eye 11 arrives in a position opposite actuator 16 before slay 2 has completed its beat-up motion. If guide eye 11 is in the normal higher position as shown in FIG. 2, corresponding to an uninterrupted weft yarn supply, the final movement of the slay with shuttle 1 to the beat-up position will cause movement of guide eye 11 above the end of the actuator 16 so that the switch means in control means 12 is not operated by actuator 16.

However, if due to a weft yarn breakage, the guide eye 11 has dropped to a lower position shown in FIG. 3, it is located aligned with actuator arm 16 while slay 2 still moves towards the beat-up position, so that the dropped guide eye 11 in the control position shown in FIG. 3, couples the slay and the shuttle with the actuator 16 whereby the same is pushed to the right as viewed in the drawing until the slay arrives in the beat-up position shown in FIG. 3 so that the switch means operated by the actuator 16 completes a control circuit in control means 12 and causes stopping of the loom. It will be understood that instead of a switch means provided with actuator 16, a microswitch can be provided and actuated by the dropped guide eye 11.

The guide eye 11 is not only capable of detecting weft breakage, but will drop to the control position of FIG. 3 if the weft yarn becomes slack for any reason. For example, if the weft yarn runs out from bobbin 3 completely, guide eye 11 will drop, and the loom will be stopped in the beat-up position of the slay.

The mounting of the guide eye 11 as shown in the drawing may be modified, and any other weft yarn guide capable of dropping to a control position when the weft yarn breaks, may be used. It is also possible to provide an arrangement in which the dropped guide eye effects closing of a circuit through the cooperating shuttle contact 5, 6 and control contacts 14 and 15 for stopping the loom. Also, the sensing circuit between shuttle contact 5, 6 may be differently connected. Instead of an electric switch operated by actuator 16, a pneumatic or hydraulic valve could be operated by actuator 16 to stop the loom by a pneumatic or hydraulic servomotor.

It will be understood that first sensing means 5 to 10 have a control position in which sensor 9 makes contact with bobbin 3, and that in this control position, control means 12 produces a control impulse for stopping the loom when the slay 2 arrives in the beat-up position.

The second sensing means 11, 26 to 29, assume upon weft yarn breakage or slackening, a control position in which weft guide 11 is dropped for actuating control means 12 in the beat-up position of slay 2.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus for detecting an undesirable condition of a weft yarn differing from the types described above.

While the invention has been illustrated and described as embodied in a method and apparatus for detecting running out of a weft yarn from a shuttle bobbin, and breaking or slackening of the weft yarn by sensing means and control means producing a control impulse in the beat-up position of the slay of the loom, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

What I claim as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. The method of detecting in a loom an undersired condition of a weft yarn wound on a quill of a shuttle, comprising the steps of picking the shuttle with the would up weft yarn; sensing during the picking the weft yarn on the quill and also a quill portion uncovered by the unwound weft yarn; independently sensing during picking the tension of the weft yarn; and producing a control impulse only in an end position of the picked shuttle and in the beat-up position of the slay of the

loom when an uncovered portion of said quill is sensed during the pick, and also when low tension and slackness of the weft yarn is sensed during the same pick so that the loom is stopped after the pick when either running out of the weft yarn on the quill of the shuttle, or breakage of the weft yarn is sensed during the pick.

2. The method of claim 1 wherein the step of producing said control impulse includes moving the shuttle by the slay at the end of the beat-up motion to a position engaging a stationary control means for producing a control impulse for stopping the loom.

3. Apparatus for detecting in a loom an undersired condition of a shuttle-carried weft yarn, comprising stationary support means; a slay mounted on said supporting means for reciprocating movement to and from a beat-up position, and having a shuttle race; a shuttle mounted in said shuttle race for weft-inserting picks between two end positions, and having a quill on which a package of the weft yarn is wound; first sensing means on said shuttle for sensing the yarn wound on said quill and moving to a first control position when sensing a portion of the quill uncovered by the unwound weft yarn; second sensing means on said shuttle for sensing the tension of a portion of said weft yarn and moving to a second control position when said weft yarn is slack or breaks; and control means supported by said stationary supporting means in a position located opposite said shuttle in at least one of said end positions of the same and being actuated by said first and second sensing means in said first and second control positions, respectively, when said slay has moved with said shuttle and first and second sensing means to said beat-up positions, said actuated control means producing a control impulse for stopping the loom.

4. Apparatus as claimed in claim 3 wherein said control means include a first stop control device engaged and actuated by said first sensing means in said first control position, and a second stop control device engaged and actuated by said second sensing means in said second control position when said slay is in said beat-up position.

5. Apparatus as claimed in claim 3 wherein said guide includes conductive material; wherein said first sensing means includes a circuit comprising a conductive resilient sensor contact engaging the package of the weft yarn on said quill and making contact with said conductive quill in said first control position, and shuttle contact means connected in series with said sensor contact; and wherein said control means comprises contact means engaged by said shuttle contact means in said beat-up position.

6. Apparatus as claimed in claim 3 wherein said second sensing means include a guide eye through which said weft yarn passes; wherein said shuttle includes mounting means mounting said guide eye for movement with said shuttle, and for dropping movement relative to the same to said second control position; comprising means for tensioning the weft yarn wherein the tensioned weft yarn holds said guide eye while a broken weft yarn releases said guide eye so that the same drops said second control position; and wherein said control means include a switch means engaged and actuated by said guide eye in said second control position in said end position of said shuttle at the end of the movement of said slay to said beat-up position.

7. Apparatus as claimed in claim 3; wherein said guide includes conductive material; wherein said first sensing means includes a circuit comprising a conductive resilient sensor contact engaging the package of the weft yarn on said quill and making contact with said conductive quill in said first control position, and shuttle contact means connected in series with said sensor contact; wherein said second sensing means include a guide eye through which said weft thread passes; wherein said shuttle includes mounting means mounting said guide eye for movement with said shuttle, and for dropping movement relative to the same to said second control position; comprising means for tensioning the weft yarn; wherein the tensioned weft yarn holds said guide eye while a broken weft yarn releases said guide eye so that the same drops said second control position; and wherein said control means include a switch means engaged and actuated by said guide eye in said second control position in said end position of said shuttle at the end of the movement of said slay to said beat-up position, and a stop control circuit having contact means engaged by said shuttle contact means in said beat-up position of said slay.

8. Apparatus as claimed in claim 7 wherein said contact means of said shuttle and of said stop control circuit each include two contacts.