Broken Weft Thread Detector

A detector device for detecting breakage of a weft thread in a loom utilizes induction between a coil carried by the shuttle and a fixed coil on the thrashboard to provide a signal-indicating thread failure. The coil on the shuttle is effective to induce a signal in the fixed coil only when a circuit is completed through the shuttle coil by contacts which are acted upon by the thread in the shuttle and which close when the tension in the thread relaxes.

ABSTRACT: A detector device for detecting breakage of a weft thread in a loom utilizes induction between a coil carried by the shuttle and a fixed coil on the thrashboard to provide a signal-indicating thread failure. The coil on the shuttle is effective to induce a signal in the fixed coil only when a circuit is completed through the shuttle coil by contacts which are acted upon by the thread in the shuttle and which close when the tension in the thread relaxes.
The invention relates to broken weft thread detector devices on weaving looms.

Insertion of the weft thread on each passage of a loom shuttle across the warp threads conventionally effects a mechanically oscillating weftfeeler which is resiliently urged to a position in which it engages the weft thread. When the latter is present and is duly tensioned, the weftfeeler is prevented from moving into the path of the shuttle. If, however, the weft thread is broken, exhausted, or slack, movement of the weftfeeler is not prevented by the weft thread, and the weftfeeler movement can be utilised to cause stopping of the loom.

A disadvantage of such known detector devices is that the weftfeeler cannot be prevented from causing an undesirable additional tension in the weft thread.

To reduce this additional tension as much as possible, the resilient biasing forces tending to maintain the weftfeeler in engagement with the weft thread should be decreased; such reduction, however, necessarily decreases the speed with which the weftfeeler responds to the loom movement. Even if the mass of the weftfeeler is reduced to keep its inertia as low as possible, the need to keep the resilient biasing force on the weftfeeler low sets a limit to the speed of weaving looms with which such detector devices can be used.

An object of the present invention is to provide a detector device for broken weft thread for use on a weaving loom, which device is not subject to the above-mentioned disadvantages and limitations.

The present invention provides, in a weaving loom having a movable shuttle and a spool carried by the shuttle for supplying weft thread to the loom, an improved detector device for detecting breakage or slackening of the weft thread comprising a movable inductor element carried by the shuttle, a stationary inductor element mounted in the path of movement of the shuttle, and weft thread detecting means responsive to slackening or breakage of the weft thread to cause the movable inductor element to store temporarily a magnetic flux, which flux induces an electrical signal in the stationary inductor element.

The invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a diagrammatic side view of a shuttle box of a weaving loom provided with a conventional weftfeeler;

FIG. 2 is a diagrammatic front view of a shuttle box for a weaving loom provided with a detector device for detecting breakage or slackening of a weft thread according to one embodiment of the invention;

FIG. 3 is a partly sectioned view of the shuttle in the arrangement of FIG. 2;

FIG. 4 is a diagrammatic detail view of the detector device of FIG. 2 and

FIG. 5 is a view similar to FIG. 2 of a modification of the said embodiment of the invention.

Referring to FIG. 1, wherein a conventional weftfeeler is shown, with 1 denoting the warp threads between which a shuttle (not shown) passes and inserts a weft thread 2. A conventional weft-feeler fork 3 is mounted on a shuttle box 4 and is hinged to the shuttle box at 5. The weftfeeler fork 3 is urged downwardly by a spring 6 into engagement with the surface of a cam 7.

Movement of the weftfeeler fork 3 is engaged with the operation of the loom by appropriately profiling and setting the cam 7 so that on each passage of the shuttle the fork 3 is moved upwardly to avoid interfering with the movement of the shuttle; after the shuttle has passed and laid the weft 2 the fork 3 is returned downwardly under the action of the spring 6 to rest on the weft thread 2.

If the weft thread 2 is present and is duly tensioned, the downward movement of the fork 3 is arrested. If, however, the weft thread 2 is absent or is insufficiently tensioned, due, for example, to a breakage therein, the fork 3 moves downwardly and causes the weft thread 2 (if present) to bend between the warp threads 1. The fork 3 engages and closes a pair of normally open electrical switch contacts 28, the closure of which stops the loom.

In the conventional arrangement of FIG. 1, the spring 6 should be weak enough to avoid deflection of the weft thread 2, when the latter is duly tensioned, by the movement of the fork 3; on the other hand, the spring 6 should be strong enough to cause the fork 3 to follow rapidly and without excessive delay the working cycle of the loom during the period in which the movement of the fork 3 is effected by the spring 6.

While it is possible to strike a compromise between these two conflicting requirements, a limit is nevertheless set to the speed of response of the fork 3 and, therefore, to the speed of the loom. Moreover, the stiffness of the spring 6 raises a maintenance problem.

These drawbacks are avoided by the device according to the invention as shown in FIGS. 2, 3 and 4. A shuttle 8 encloses a spool 9 (FIG. 3) which supplies the weft thread 10 to the fabric being formed on the loom. As it unwinds from the spool 9 the thread 10 is braked on unwinding by a brake post 11 provided in the shuttle 8. During operation of the loom the shuttle 8 travels over a threshold 12 of the shuttle box between two end boxes 13A, 13B.

A movable inductor in the form of a coil 14 is embedded in the shuttle 8 and has its ends short-circuited through a pair of normally closed contacts 15. The weft thread 10 is caused to bear on one of the contacts 15 so that the contacts 15 are kept open by the thread 10 when the latter is duly tensioned.

The contacts 15 could be alternatively kept open by a centrifugal switch rotated by sliding of the thread or by a thermally responsive switch device which opens on being heated by the friction of the thread being unwound from the spool 9.

Stationary inductor elements comprising coils 16A, 16B are embedded in the threshold 12 at each end thereof. Respective permanent magnets 17A, 17B are embedded in the threshold 12 inwardly of the respective coils 16A, 16B.

The coil 14 moves with the shuttle 8 over the threshold 12 in operation of the loom. Under the conditions shown by way of example in FIG. 4 in which X denotes the direction of travel of the shuttle 8 (partially shown in broken outline), the coil 14 is caused to cut the flux lines from the magnet 17A.

When the contacts 15 are open, the variation in magnetic flux interlinked in the coil 14 results in an induced voltage across the ends of the coil 14, which is of a half wave, apart from a negligible oscillating current due to the internal capacitance of the coil 14; in this case on further movement the coil 14 travels past the stationary coil 16A without inducing any current therein, since there is no appreciable current flow in the coil 14.

If, however, the coil 14 is short-circuited by closure of the contacts 15 as a result of breakage or slackening of the weft thread 10, the variation in magnetic flux as the coil 14 passes the magnet 17A induces two appreciable current pulses in the coil 14 at the entry of the coil 14 into and at its exit from the field due to the permanent magnet 17. The latter current pulse is of sufficient duration to be still present when the coil 14 travels past the stationary coil 16A, inducing a signal voltage across the ends of the coil 16A.

If the coil 14 travels over the threshold 12 in a direction contrary to the arrow X, no signal is induced in the coil 16A, whether the contacts 15 are open or closed. Thus the system has a directional characteristic which in the specific use in connection with looms is of particular importance as explained hereafter.

Closure and the opening of the contacts 15 is effected in dependence on the tension in the weft thread 10. If the thread 10 is slack during motion of the shuttle 8 and the spool 9 unwinds evenly the contacts 15 are kept open by the tension in the thread (FIG. 3). If the thread 10 breaks, or if the thread 10 slackens, the action of the thread on the contacts 15 ceases and the contacts 15 close.
In FIG. 2, the fabric being woven is indicated by a broken line at 19, the selvages being indicated at 20. When the coil 14 travels past the stationary coil 16A during movement of the shuttle 8 from the box 13A towards the box 13B, no voltage signal can be induced in the coil 16A because the winding 16A precedes the magnet 17A with respect to the direction of movement of the shuttle 8.

This is important in avoiding an incorrect breakage signal being given during the initial movement of the shuttle 8. Even through the weft thread 10 may sound it is not tensioned during this first part of the shuttle movement because slack in the thread portion between the box 13A and the selvage 20 has been tensioned. Thus the contacts 15 will be closed even through the thread 10 is unbroken. The weft thread 10 is subsequently tensioned and then opens the contacts 15.

During the final part of the shuttle movement towards the box 13B the coil 14 travels past the magnet 17B and subsequently past the stationary coil 16B. If the weft thread 10 is sound it is then under maximum tension, and the device is ineffective, as the contacts 15 are held open. If, however, the weft thread 10 is broken and the contacts 15 are closed, a signal voltage is induced in the stationary coil 16B as hereinbefore described.

The coils 16A, 16B are connected to an electronic amplifier 18 which controls the loom movement.

On the next movement of the shuttle 8 in the opposite direction from the box 13B towards the box 13A the operation of the device is repeated in a corresponding manner.

In the modified embodiment shown in FIG. 5 the two stationary inductor coils 16A, 16B are spaced from the respective magnets 17A, 17B by equal distances T which are sufficient to avoid interlinking of the flux induced in the coils 16A, 16B with the flux of the respective magnets 17A, 17B.

The distance T is in fact considerable and conveniently is substantially equal to the axial length of the shuttle 8. Consequently, if only one inductor coil 14 is arranged on the shuttle 8, as in the embodiment of FIGS. 2 to 4, it is no longer possible to store any appreciable magnetic flux in the coil 14 during the time taken for the shuttle 8 to travel the distance T between one of the permanent magnets, such as 17B and its associated stationary coil 16B.

To obviate this the movable inductor element in FIG. 5 comprises a pair of coils 14A, 14A spaced apart longitudinally in the shuttle 8 and connected in a series closed circuit with the normally closed contacts 15.

As in the previously described embodiment the contacts 15 are actuated upon and held open by the tension in the weft thread (not shown in FIG. 5 in the interests of clarity).

The coils 14A, 14A are spaced apart on the shuttle 8 by a distance t slightly smaller than the distance T between each stationary coil 16A, 16B and its associated permanent magnet 17A, 17B, the difference between the two distances t and T ranging typically between 10 and 15 mm.

The device of FIG. 5 operates as follows. Assuming the shuttle 8 to move initially in the direction denoted by the arrow and the coil 14A, 14A is spaced apart on the shuttle 8 by a distance t slightly smaller than the distance T between each stationary coil 16A, 16B and its associated permanent magnet 17A, 17B, the difference between the two distances t and T ranging typically between 10 and 15 mm.

The device of FIG. 5 operates as follows. Assuming the shuttle 8 to move initially in the direction denoted by the arrow and the coil 14A, 14A is spaced apart on the shuttle 8 by a distance t slightly smaller than the distance T between each stationary coil 16A, 16B and its associated permanent magnet 17A, 17B, the difference between the two distances t and T ranging typically between 10 and 15 mm.

The time taken for the coil 14 to reach the coil 16B after a signal has been induced therein is determined by the above-mentioned difference between the distances t and T. This time interval is sufficiently short for the damped oscillating signal exchanged by the windings 14 and 14A through the closed contacts 15 to be of an amplitude such as to induce in the stationary coil 16B a signal capable of stopping the loom through the amplifier 18 when the coil 14 passes the coil 16B.

Where the shuttle 8 moves in an opposite direction to that indicated in FIG. 5, no signal is transferred to stationary coil 16B, whether the contacts 15 are closed or open, because when the coil 14A receives an induced signal on passing the magnet 17B the coil 14 is already beyond the stationary coil 16B.

The device according to FIG. 5 therefore also has a directional characteristic, as described with reference to FIGS. 2 to 4. That is, the device avoids an incorrect breakage signal being given during the initial part of the shuttle movement when the weft thread, though sound, is not tensioned, such as when the slack in the thread portion between the end boxes and the adjacent fabric selvages is being taken up.

The device according to the invention affords the following advantages:

i. a signal-indicating weft thread failure is provided only when the weft thread is absent or broken;

ii. soundness of the weft thread on the exit of the shuttle from the fabric is checked, whereby a safe control is ensured throughout the width of the fabric, while unavoidable anomalies in unwinding of the weft thread when the shuttle has just left an end box are made ineffective to provide a signal;

iii. mechanical contacts with the weft thread outside the shuttle are avoided, and

iv. the effectiveness of the device increases with the speed of the loom, since the induced signal voltages are then higher.

The device is therefore particularly suitable for use with high-speed looms.

I claim:

1. A detector device for detecting broken weft thread in a weaving loom, comprising: a shuttle having means for mounting a spool of thread therein to supply a weft thread to the loom, a first coil assembly carried in said shuttle with means responsive to the presence of a weft thread under tension to disable the coil and responsive to a broken weft to activate the coil, a threshold on the loom to define the path of the shuttle, a second coil assembly mounted in the threshold in the path of the shuttle, a source of magnetic flux mounted in the path of the shuttle, in spaced relation to said second coil, whereby when the shuttle passes the flux source and the weft is broken the means responsive activates the first coil assembly so that said flux will induce a current pulse therein which will in turn induce a signal voltage in the second coil assembly to stop the loom and when the weft is intact and under tension the means responsive will disable the first coil assembly so that there is no current flow therethrough and the second coil assembly will have no signal voltage induced therein.

2. A device as claimed in claim 1 wherein said second coil assembly includes two coils mounted adjacent opposite ends of the path of movement of the shuttle and two respective sources of magnetic flux mounted inwardly thereof beside the respective coils of the second coil assembly, whereby an electrical signal is induced in a coil of the second assembly only by movement of the shuttle towards the end of the said path adjacent which said coil is situated.

3. A device as claimed in claim 2 wherein the source of magnetic flux is a permanent magnet imbedded in the said coil assembly.

4. A device as claimed in claim 1 wherein the first coil assembly comprises a pair of coils spaced apart longitudinally on the shuttle and the means responsive includes normally closed contacts which connect the two coils in series and which are adapted to be held open by tension in the weft thread, the source of magnetic flux being spaced inwardly from the respective coil of the second coil assembly by a distance which exceeds the distance between the two coils of the first coil assembly.

5. A device as claimed in claim 4 wherein the difference between the distance separating the second coil assembly and the magnetic flux source and the distance separating the coils of the first coil assembly lies in the range 10 to 15 mm.
6. A device as claimed in claim 4 wherein said second coil assembly includes two coils mounted adjacent opposite ends of the lay and two magnetic flux sources mounted on the lay and spaced inwardly from the respective coils by equal distances which exceed the distance between the two coils of the first coil assembly.