United States Patent

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[54] METHOD AND APPARATUS FOR MONITORING PLURAL WEFT THREADS IN A LOOM

7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **139/370,** 139/122
[51] **Int. Cl.** **D03d 47/34**
[50] **Field of Search** 139/122W, 122, 370, 372, 374, 125, 126, 127

[56] **References Cited**

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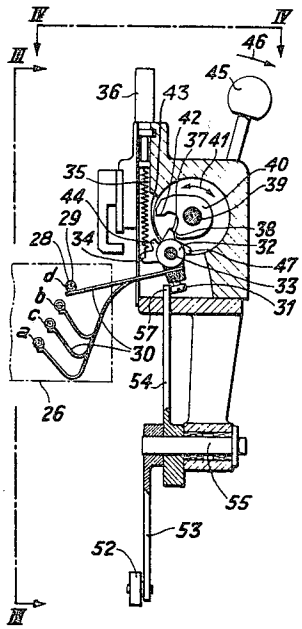
ABSTRACT: A loom having plural weft supplies remaining outside the shed includes on the picking side thereof and for each weft two stationary eyes and a movable eye on a weft sensing lever between the stationary eyes. The levers are pivoted on a common shaft to rotate under the influence of individual springs. A rocker on an adjacent parallel shaft is rocked between one angular position in which it lines up the levers with their stationary eyes and another angular position indicative of no broken wefts among those tested. A comb is movable to different positions in which its teeth restrain different combinations of levers from rotating under influence of their springs when permitted by broken weft threads and by rotation of the rocker from its first angular position toward its other angular position. Any lever which is freed by the comb and which is additionally free to rotate by virtue of a broken or loose weft thread between its stationary eyes arrests motion of the rocker toward its other angular position, thereby initiating a stopping of the loom.



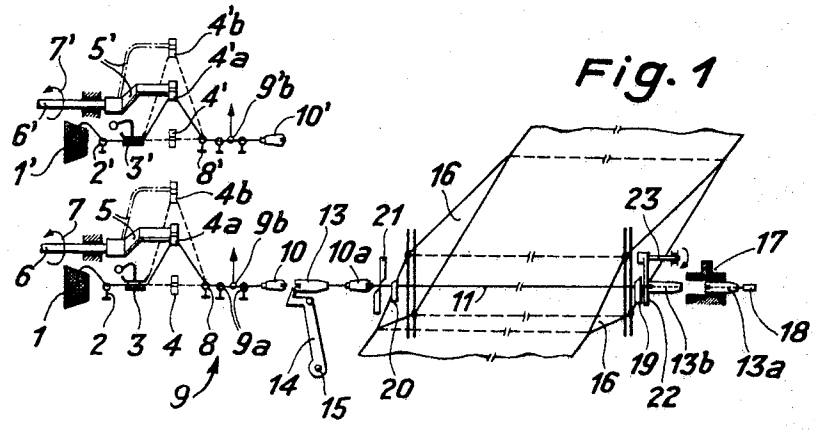


Fig. 1

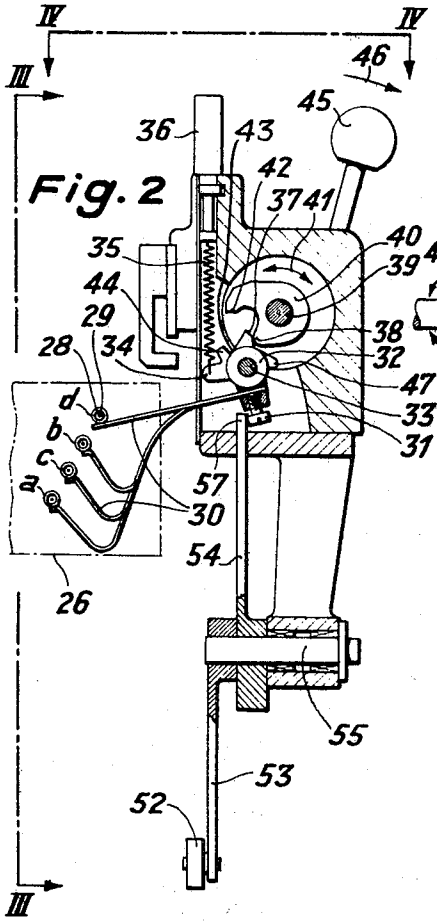


Fig. 2

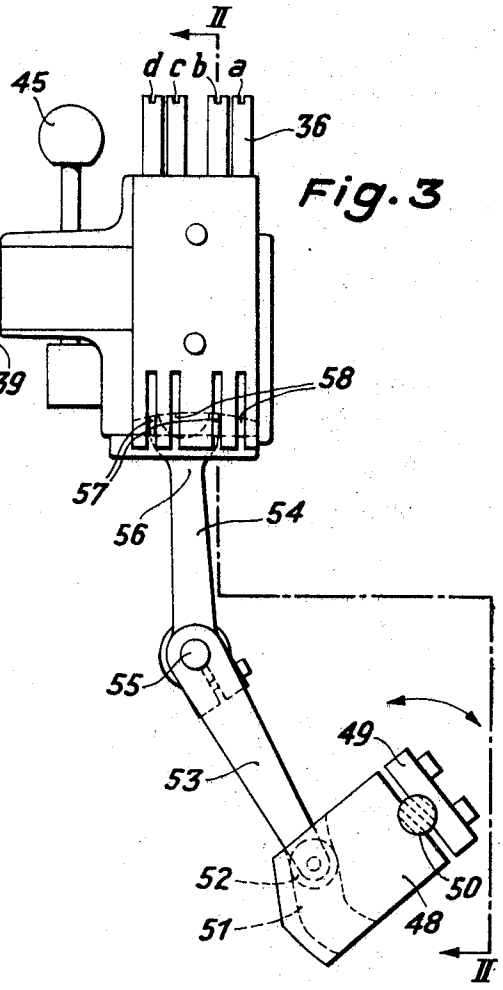


Fig. 3

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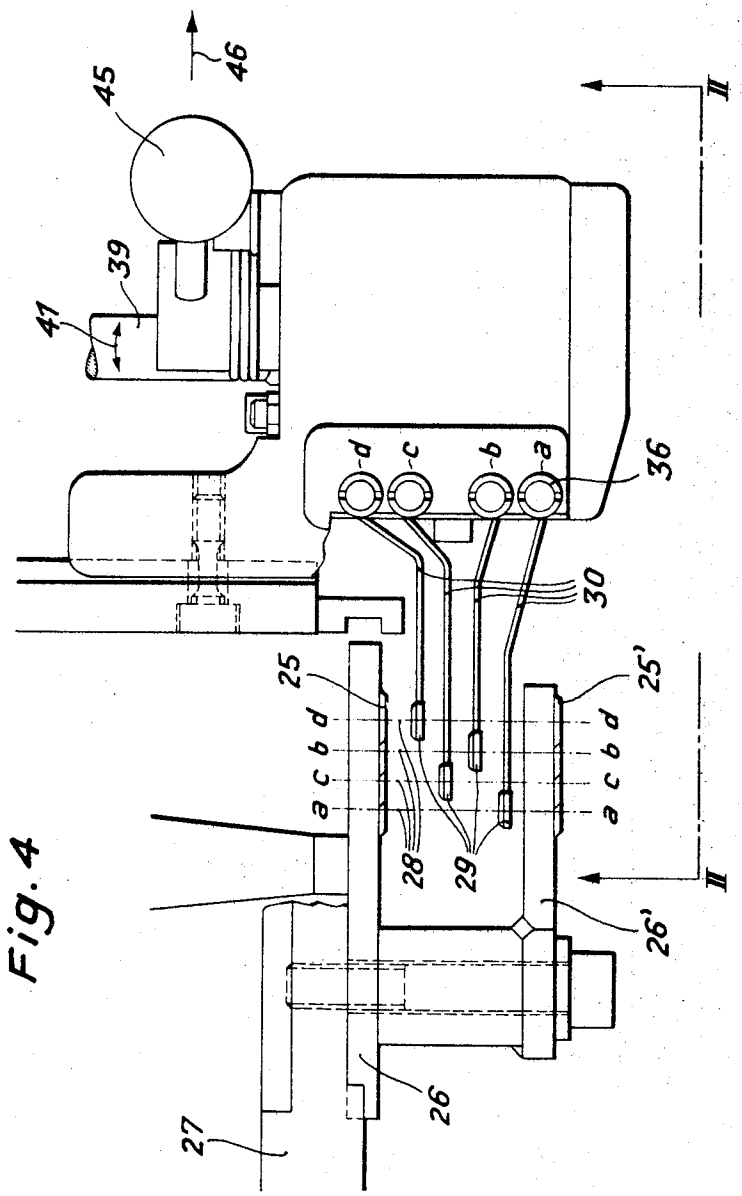

Fig. 4

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METHOD AND APPARATUS FOR MONITORING PLURAL WEFT THREADS IN A LOOM

The present invention relates to looms of the kind which employ a plurality of weft threads stored on bobbins which remain outside the shed during weaving. The invention relates particularly to such looms in which various kinds of wefts are picked singly or in combination in accordance with a pre-set program.

The present invention provides a method of monitoring a plurality of weft threads on the picking side of such a loom having a sensor for each of the threads to be monitored, the method comprising sensing in accordance with a pre-set program one or more weft threads at a given, adjustable time in the working cycle while the sensors for the remaining threads remain in their idle position.

The invention also provides a loom suitable for carrying out that method. The loom of the invention employs weft bobbins which remain outside the shed during weaving and it has means for selectively changing the weft to be picked. It further has means for monitoring a plurality of wefts on the picking side of the loom, the monitoring means comprising, for each weft to be monitored, a movable thread guide located between two stationary thread guides and mounted on a sensor having a drive mechanism which is independent of the other sensors and is arranged to exert on the movable thread guide a sensing force in a direction approximately perpendicular to the length of a thread extending from one to the other of the stationary thread guides.

With this arrangement, it is possible to monitor the weft threads at a very early stage in the loom cycle, which is not the case with a weft stop motion on the catching side.

The drive mechanism may, for example, comprise a spring which tends to pivot in the direction of sensing a blocking member which carries the sensor and is pivotable about a fixed axis, the blocking member having both a projecting portion, which may be either fixed or released at the time of sensing by a blocking mechanism as required according to a pre-set program, and further raised portions and recesses, which cooperate with edges on a shaped rocker pivotable about a fixed axis and common to all blocking members and controlling the operation of sensing of these members in such a way that in the absence of at least one thread the shaped rocker is prevented from turning and the loom is stopped.

With this arrangement, each of the wefts concerned is monitored individually, regardless of whether it is to be inserted into the shed alone or at the same time as others. Sensing may be brief. To control sensing, the shaped rocker is oscillated periodically, i.e. at the picking rate, about its fixed axis. The rocker may be driven by a linkage operated by a cam. Since each thread to be monitored extends at all times between the two stationary thread guides above-mentioned, sensing on the picking side can take place at any time, before, during or after picking, in contrast to sensing on the catching side. To prevent the working cycle from being delayed and to allow maximum time for stopping the loom if necessary, the rocker drive may advantageously be designed so that sensing takes place shortly after the thread is transferred from the shuttle feeder to the shuttle, i.e. while it is still stationary, or alternatively at the beginning of picking, when the thread is moving.

According to the invention, each of the individual weft threads monitored is guided through its own sensor thread guide. However, the thread sensors are not all operated on every cycle of rocker motion. In looms of the type to which the invention pertains different wefts or combinations of wefts are picked on different picks. Each of the wefts not required on a given pick may be kept in its shuttle feeder, waiting for the next pick in which it is to be included. Repeated sensing of those wefts not required is not only unnecessary but reduces the operational reliability of the loom, since, for example, the clamping of some wefts in the gripper of the shuttle feeder or in a thread brake may gradually loosen with repeated sensing. Preferably, therefore, the loom includes a blocking element by which the sensors for the wefts not required for a given pick are blocked, and only the sensors for the wefts which need checking for the next pick are released.

The blocking element, which may take the form of a comb, has blocking projections and is movable into various positions as desired according to a pre-set program so that the blocking projections engage projecting portions on the appropriate blocking members, every desired combination of threads to be sensed having a corresponding blocking element position with the appropriate combination of blocking projections or teeth.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described in terms of a presently preferred non-limitative exemplary embodiment and with reference to the accompanying drawings, in which:

FIG. 1 illustrates diagrammatically a weft picking motion in a loom for picking two wefts of different types, with apparatus for monitoring the weft on the picking side;

FIG. 2 is a simplified view in elevation, partly in section, of the monitoring apparatus of the invention, taken on the line II—II in FIGS. 3 and 4;

FIG. 3 is a view in elevation of the apparatus of FIG. 2, in the direction of the line III—III in FIG. 2; and

FIG. 4 is a plan view of he apparatus of FIG. 2, taken in the direction of the line IV—IV in FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENT

FIG. 1 shows one of the weft supply bobbins **1**, from which the weft **10** is taken off over the end thereof and drawn through a fixed guide eye **2** and a thread brake **3**. The thread then passes through a movable eye **4** forming part of thread retraction means which pull back and tension the picked thread as soon as the shuttle **13** has been braked to a stop on the catching side of the loom by a catching brake **17** and returned into the thread release position **13*b*** by a push-back member **18**. The eye **4** rotates to position **4*a*** and then to **4*b*** when its arm **5** carries out its thread retraction movement upon rotation of the shaft **6** in the direction of arrow **7**. Another fixed eye **8** is followed by the sensor of the invention, generally indicated at **9**. This device includes two stationary thread guides in the form of eyes **9*a*** and one movable thread guide in the form of a sensor eye **9*b*** which tests or senses the thread as indicated by an arrow. A weft thread shuttle feeder **10** including a thread gripper and movable along the direction of picking transfers the end of the thread to the shuttle **13**.

A corresponding set of components **1'** to **11'** is provided for a second weft of a different type, for example a different color. A multi-color loom will have as many sets of these components as there are yarns of different colors or types to be monitored and to be picked successively or simultaneously, according to a pre-set program.

A weft picking lever **14** can be pivoted about its axis **15**, for example by the release of the energy of a stressed torsion spring, to propel the shuttle **13** along its path through the shed **16** when a pick is to be made. The shuttle **13** is caught and stopped in the position shown therefor at **13*a*** by the catching brake **17**, and is then returned by the restoring member **18** into the thread release position **13*b***, where the weft or wefts picked are gripped by a selvage thread gripper **19** on the catching side, after being tensioned by the thread draw-back means **4** on the picking side. The thread from bobbin **1** is also held on the picking side by a selvage thread gripper **20**. The weft is gripped by the shuttle feeder **10** in the position shown therefor at **10*a***, and is severed by cutters **21** between **10*a*** and the gripper **20**.

When the shuttle has been returned into the position **13*b*** and the weft has been tensioned, the weft may be sensed by a stop motion **22** on the catching side. This motion **22** may for example comprise a needle pivotable about an axis **23**.

The picking side weft stop motion of the invention, diagrammatically indicated at **9** in FIG. **1**, is illustrated in a simplified manner in FIGS. **2** to **4** for a four-color loom. Fixed thread guide members, e.g. pairs of guide eyes, **25*a*** to **25*d*** and

25'*a* to 25'*d* are mounted in plates **26** and **26'** (FIG. **4**) attached to the loom frame. Movable sensor eyes **29***a* to **29***d* attached to the free ends of sensors **30***a* to **30***d* sense the wefts **28***a* to **28***d* which are to be monitored. Each of these sensors is clamped by means of a screw **31** to a separate blocking member **32** pivotable about a fixed shaft **33**. A spring **35** acting on a lug **34** on each blocking member tends to pivot each blocking member clockwise in FIG. **2**. Its spring tension is adjustable by means of a set screw **36**, so that the sensing power of the sensor eye can be adapted to the material of the weft to be monitored.

As a result of the action of the spring **35**, a tooth **37** on each blocking member **32** bears on a retaining edge **38** on a shaped rocker **40**. This rocker, which is common to all the blocking members, is pivotable about a fixed shaft **39**. If, at the time allocated to sensing in the working cycle, the rocker is turned anti-clockwise in FIG. **2**, the blocking members **32** tend to follow this movement by rotating clockwise. The sensors **30** carried by the blocking members tend to pivot upwards in FIG. **2** out of their idle positions there shown. If however the thread **28** monitored by the sensor is intact, the sensor and therefore the blocking member **32** are held in their idle positions. During the continued counter-clockwise movement of the rocker **40**, a testing edge **42** on the rocker enters a gap **43** between teeth **37** and **44** on member **32**, and rotation of the rocker can continue without interruption. If however the thread **28** is missing, for example because it has broken or has not been correctly gripped by the shuttle feeder **10** or shuttle **13**, the sensor **30** and its eye **29** can pivot upwards more or less freely. A blocking tooth **44** on the member **32** then comes in the way of the edge **42** on the rocker and stops the latter from rotating. As a result, the rocker operates a stopping device (not shown) in a known manner (e.g. as shown in British Pat. No. 577,981 or in FIG. **1** of British Pat. No. 823,872), and the loom stops. The stopping device has a cam drive and linkage which control rotation of the rocker **40** and which operate a switch as soon as the rocker is arrested in its anti-clockwise rotation.

To re-start the loom, a re-set lever **45** is operated manually in the direction of arrow **46** (FIG. **2**). A cam (not shown) fixed to a shaft on which the lever **45** is mounted thereby engages a re-set lug **47** on the blocking member **32** and pushes it upwards, rotating the member **32** anti-clockwise in FIG. **2** out of its blocking position. The rocker can then finish its anti-clockwise movement, and during its clockwise return movement its retaining edge **38** again engages the retaining lug **37** on the blocking member **32**, again holding the latter in its idle position. The thread sensor is ready to operate, and the loom can be switched on again.

To prevent sensing of wefts not being inserted during a given pick (such sensing might loosen the weft in the shuttle feeder or pull it partly out of a thread brake, making subsequent picks unsatisfactory), a blocking mechanism is provided which releases only the sensors required for the wefts to be included in the next pick, holding the others in their idle positions. This blocking mechanism (FIG. **3**) includes a control cam **48** adjustably attached to a control shaft **50** by means of clamps **49**. The control shaft is operatively connected by a linkage (not shown) to the weft selector mechanism for the various wefts which are to be picked as desired according to a program. A roller **52** is positively guided in a groove **51** on the cam **48**. This roller operates a lever **53** which is fixed to a shaft **55** to which a blocking lever **54** is also fixed. Shaft **55** rotates about a fixed axis. The free end of the blocking lever carries a blocking element in the form of a comb **56**. In the position shown in FIG. **3**, this comb presents blocking teeth in positions *b* and *d* and gaps **58** at positions *a* and *c*. In the idle position of the blocking members **32** to be disabled by the comb, the upper ends of the teeth **57** (FIG. **2**) engage projecting portions on those members **32**, namely the screws **31** for attachment of the sensors **30**, so that these blocking members cannot rotate clockwise, in FIG. **2**, under the influence of the springs **35** when the retaining edge **38** on the shaped rocker **40** releases those members for sensing. In the position shown in FIG. **3**, the sensors for threads **28***a* and **28***c* are released for sensing, but the sensors for threads **28***b* and **28***d* are blocked. In the embodiment illustrated two positions of the blocking comb **56** are provided, on the assumption that the loom is to pick either the pair of threads *a* and *c* simultaneously or the pair of the threads *b* and *d* simultaneously, according to a pre-set program.

The invention is of course not limited to the monitoring of four wefts as in the embodiment which has been illustrated and described. Any number of wefts may be monitored by means of a weft stop motion of this kind. This requires a corresponding number of blocking members **32** with sensors **30** and eyes **29** with tension springs **35** and set screws **36** and they must cooperate with a correspondingly extended shaped rocker **40**. Instead of only four wefts **28***a* to **28***d* of different types, in principle any number of monitored wefts may be provided, and these may be sensed individually (only one gap **58** suitably situated in the edge of the blocking comb **56**) or as a freely selected group, as required. The blocking comb **56**, instead of having two teeth **57** and two gaps **58** as in FIG. **3**, may have any number of teeth **57** combined as desired with gaps **58**. The control shaft **50** and therefore the control cam groove **51**, double lever **53**, **54** and blocking comb **56** may have, instead of the two blocking positions shown, any number of blocking positions, in each of which it is brought into engagement with the appropriate blocking members **32** for sensing of a given weft thread combination.

In general, while the invention has been described hereinabove in terms of a presently preferred embodiment of the apparatus thereof and in terms of the presently preferred practice of the method thereof, the invention itself is not limited thereto but rather comprises all modifications on and departures from that embodiment and presently preferred practice properly falling within the spirt and scope of the appended claims.

I claim:

1. In the operation of a loom having plural weft thread supplies remaining outside the shed, a separate thread feeder for the weft from each supply, and separate weft thread sensors for each weft supply, and in which the wefts from the plural supplies are picked selectively, either singly or simultaneously in groups of variable combination according to a pre-set program, the method of monitoring the wefts on the picking side of the loom which comprises actuating said sensors selectively in accordance with that program to test on each cycle of the loom only those wefts being picked.

2. In a loom having plural weft thread supplies which remain outside the shed and means for selectively changing the weft or wefts to be picked on each cycle of the loom, apparatus for monitoring the wefts on the picking side of the loom, said apparatus comprising, for each weft to be monitored, two stationary thread guides, a movable sensing thread guide disposed between said stationary thread guides, and drive means to displace said sensing thread guide transversely of a thread extending between said stationary guides, said apparatus further comprising means to restrain selectively response of said movable sensing thread guides to said drive means.

3. In a loom having a plural weft thread supplies which remain outside the shed and means for selectively changing the weft or wefts to be picked, apparatus for monitoring the wefts on the picking side of the loom, said apparatus comprising, for each weft to be monitored, two stationary thread guides, a movable thread sensing element engageable against a thread extending between said guides, and resilient means stressing said element transversely out of the path extending between said guides, said apparatus further including a member reciprocable between limit positions, said member being arrested between said limit positions upon displacement of any of said elements from alignment with the path extending between its associated guides, and means for selectively retaining said elements in aligned position.

4. In a loom having plural weft thread supplies which remain outside the shed and means for selectively changing the weft or wefts to be picked, apparatus for monitoring the wefts on the picking side of the loom, said apparatus comprising, for each weft to be monitored, two stationary thread guides, a pivoted lever swingable across the path extending between said guides, and resilient means to rotate said lever, said levers being mounted on a common shaft, said apparatus further comprising a rocker engageable in one direction of rotation against all of said levers to rotate them against their respective resilient means into alignment with their said respective paths, said rocker being arrestable in the other direction of rotation thereof by any of said levers swung by its resilient means out of

alignment with its path, and means to restrain said lever selectively against rotation under influence of their associated resilient means irrespective of the position of said rocker.

5. Monitoring apparatus according to claim 4 wherein said restraining means comprise a comb.

6. Monitoring apparatus according to claim 5 including means to move said comb to plural positions in each of which the teeth of said comb restrain a separate combination of said levers.

7. Monitoring apparatus according to claim 4 wherein said levers are disposed between thread restoring and shuttle feeding means for their respective weft threads.