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(54) Retention mechanism.

(57) A heald retention mechanism for a weaving loom comprises a heald member (11) mounted for reciprocatory movement, a retaining member (18) for engagement with the heald member (11) at a predetermined point in its reciprocatory stroke, and electro-active means (21) the change in shape of which occurring as a result of a change in the electrically energised state thereof generates relative movement between the heald member (11) and the retaining member (18) to effect engagement or disengagement of the heald member (11) and the retaining member (18).

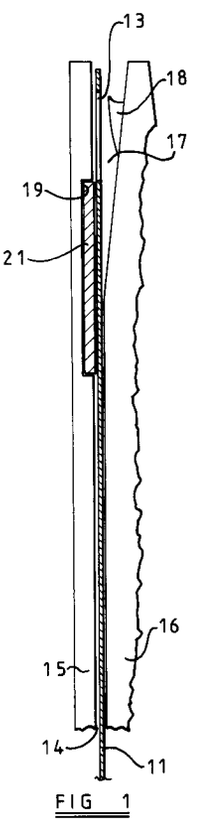

FIG 1

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The present invention relates to a heald member retention mechanism for a weaving loom.

Conventionally in a weaving loom heald members are arranged in pairs each pair controlling the shed position of an associated heald eye, each heald eye being associated in use with a respective warp thread. During weaving the heald members of each pair are raised and lowered sequentially and when both heald members are retained in a raised position the associated heald eye and the associated warp thread is held in a first shed position, but when either of the heald members of the associated pair is not retained in its raised position then the heald eye will reside in its other shed position. It is known to control retention of the heald members in their raised position electronically, and thus to effect electronic control over the woven pattern produced by the weaving loom.

British Patent 2047755 and European Patents 119787 and 188074 all illustrate electromagnetic arrangements for retaining heald members in a raised position. In each case a solenoid is used to produce a magnetic field, and the electromagnetic effect either causes operation of a latching mechanism which cooperates with the heald member, or, where the heald member is ferromagnetic and flexible, the electromagnetic effect deflects the heald member to coact with a stationary latching component. Weaving looms may incorporate very large numbers of sets of heald members and their associated solenoids and there are a number of disadvantages which the present invention seeks to overcome. For example, the power consumption of each solenoid can be in the region of two to three watts and overall therefore the power consumption of a large number of solenoids in a large loom can prove problematic both in providing the necessary power supplies, and in the heat generated by the solenoids. Moreover, each pair of heald members and its associated solenoid arrangement is relatively bulky and thus in a large loom the large number of heald members and their associated solenoids occupy a considerable amount of space. If heald members and their associated solenoids are packed very closely together then heald members may unintentionally be retained in their raised position by stray magnetic fields from adjacent solenoids.

GB 1399615 discloses a number of embodiments in which heald members are raised and lowered by a plurality of draw knives, each draw knife including a hook arranged to slide between a position in which it engages with an upper end of its respective heald member, resulting in the heald member moving with the draw knife, and a position in which such engagement does not occur. A mechanism driven by a rotating cam is arranged to cause sliding movement of the hook, an electro-active member being arranged such that a change in shape thereof as a result of a change in the electric field applied thereto locks the mechanism such that further rotation of the cam does not result in sliding movement of the hook. Such an embodiment is relatively complex and may be expected to operate slowly. Moreover the large number of moving parts results in the device being expensive to produce and maintain.

In accordance with the present invention there is provided a heald retention mechanism for a weaving loom comprising a heald member mounted for reciprocatory movement, a retaining member for engagement with the heald member to retain the heald member at a predetermined point in its reciprocatory stroke, and electro-active means the change in shape of which occurring as a result of a change in the electrically energised state thereof generates relative movement between the heald member and the retaining member to effect engagement or disengagement of the heald member and the retaining member.

The term "electro-active" as used herein is to be taken to include any material which changes its shape with the application thereto of an electric field, for example electro-strictive, piezo-ceramic, and piezo-polymer materials.

Preferably said electro-active means includes an elongate element which flexes along its length as a result of a change in its electrically energised state.

Conveniently the change in shape of the electro-active means causes flexure of the heald member to cooperate with the retaining member.

Alternatively the change in shape of the electro-active means generates movement of the retaining member to engage the heald member.

One example of the present invention is illustrated diagrammatically in the accompanying drawings wherein:-

Figures 1 and 2 are side elevational views in section illustrating a heald member retention mechanism in its inoperative, and operative positions respectively, and

Figure 3 is a diagrammatic perspective view of a heald member.

The basic construction and operation of a weaving loom is not of importance to an understanding of the present invention and is assumed to be known. The disclosure of British Patent 2047755 is convenient in providing an understanding of the basic operation of a Jacquard loom and it is to be understood that the present invention can be applied to control of the heald retention of a wide variety of loom constructions.

Figures 1 and 2 illustrate only one of a pair of associated heald members there conveniently being a mirror image of the mechanism illustrated in

Figures 1 and 2 operated in association with the second heald member of the pair.

The heald member 11 is an elongate strip of resiliently flexible material conveniently, but not essentially, a ferromagnetic material such as a spring steel. At one end, the lower most end in use, each heald member 11 is formed with a hook, the hooks of the heald members of an associated pair of heald members providing the means for connecting the two heald members to the associated heald eye (not shown) conveniently in the manner illustrated in British Patent 2047755. Adjacent its opposite end each heald member 11 is formed with a rectangular aperture 13. A plurality of pairs of heald members and their associated retention mechanisms are positioned side-by-side in the loom such that the heald member are parallel to one another. A pair of sequentially operable lifting knives of the loom cooperate in known manner with the heald members so that each first heald member of each pair can be raised by one of the knives and subsequently each second heald member of each pair can then be raised by the other knife. Heald members can be retained in their raised position and when both heald members of a particular pair are in a raised position the associated heald eye and warp thread occupy a first shed position. When either of the heald members of a pair is not retained in a raised position then the associated heald eye and warp thread are in the other shed position. Retention of the heald members in their raised position can be controlled electronically, and of course the shed positions of the heald eyes and associated warp threads determines the pattern which is being woven during each pass of the weft.

Each heald member 11 is slidable in a guide channel 14 between fixed moulded synthetic resin guide member 15, 16, the channel 14 guiding the respective heald member 11 for rectilinear sliding movement. Throughout the majority of its length each channel 14 is parallel sided, but adjacent its upmost end the wall of the guide member 16 presented to the guide member 15 is inclined away from the guide member 15 so that the upper end of the channel 14 includes a region 17 of wedge-shaped cross-section. Within the region 17 of the channel 14 and projecting outwardly from the guide member 16 is an integral hook member 18. The extent by which the hook member 18 protrudes from the guide member 16 is such that it lies wholly below the level of the remainder of the channel 14 so that in the absence of any lateral deflection of the heald member 11, the heald member 11 can slide back and forth along the channel 14 without touching the hook member 18. The aperture 13 of the heald member 11 is large enough to accommodate the hook member 18.

Adjacent the region 17 of the channel 14 the wall of the guide member 15 presented to the channel 14 is formed with an elongate rectangular recess 19 within which a heald member deflector 21 is accommodated. The deflector 21 is defined by a elongate rectangular strip of an electro-active material, that is to say a material which will change shape, in this case by deflecting out of its rest plane when an electrical field is applied thereto. A range of such electro-active materials is known, and a particularly convenient class of such materials are piezo-ceramic materials having a bi-morph structure. Philips Components Limited of Mullard House, Torrington Place, London, WC1E 7HD offer a range of such materials for sale, and the piezo-ceramic material offered for sale by Philips under their code "CMBA" exhibits properties particularly suited to use as a heald deflector. The deflector 21, in the form of a rectangular strip of the "CMBA" material mentioned above is housed within the recess 19, the outer face of the deflector 21 in its rest state being substantially co-extensive with the face of the guide member 15 forming one wall of the channel 14. At its end remote from the hook member 18 the end of the deflector strip 21 is rigidly secured to the guide member 15, conveniently by means of an adhesive, and at the fixed end appropriate electrical connections are made to the strip 21. When an appropriate voltage is applied by means of the electrical connections to the deflector strip 21 the strip assumes a curved configuration so that the free, upper end of the strip flexes out of the recess 19 and towards the guide member 16. The heald member, which is resiliently flexible is thus deflected within the region 17 of the channel 14 towards the guide member 16 and the heald member thus engages the outer face of the hook member 18. Subsequently, as the heald member 11 is moved to its raised position a point will be reached at which the aperture 13 of the heald member aligns with the hook 18 and the deflection of the strip 21 and thus the heald member 11 is such that the aperture 13 of the heald member will pass over the hook member 18 so that the hook member 18 is received within the aperture 13. Subsequently any downward movement of the heald member 18 will result in abutment of the hook member 18 and the end of the aperture 13 and thus the heald member will be retained in its raised position.

The shape of the hook member 18 is such that while the heald member 18 is pulled downwardly it will be retained in its raised position even if the voltage applied to the deflector strip 21 is removed so that the deflector 21 flexes back to its rest configuration within the recess 19. A release of the downward force, and a fractional lifting movement of the heald member 11, is required in order to

disengage the hook member 18 from the aperture 13 whereupon of course the flexed region of the heald member 11 flexes back to its straight configuration and no longer cooperates with the hook member 18. Thereafter the heald member 11 can be returned to its lowered position.

Conveniently the opposite face of the guide member 16 will be presented to a mirror image of the guide member 15 so that a second guide channel 14 is defined for guiding the second heald member of the associated pair of heald members. Thus the opposite face of the guide member 16 will have a further integral hook member 18 for cooperating with the second heald member and the other guide member 15 will similarly support an identical deflector strip 21 for cooperation with the second heald member of the pair. The two deflector strips 21 would be electrically interconnected so that both would be energised, and thus moved to and from their deflected state, simultaneously.

It is to be recognised that there is a variety of different mechanical configurations in which an electro-active member can be used to operate the retention mechanism of a heald member. For example, rather than the deflector strip 21 being fixed to the guide 15 it could, if desired, be carried by the heald member so as to move therewith, the deflector strip then being deflected against a wall of the guide channel 14 to produce the corresponding deflection of the heald member. Both the arrangement where the strip 21 is carried by the guide 15, and the alternative arrangement where the strip 21 is carried by the respective heald member 11, require a sliding contact between the strip 21 and a further component of the mechanism. In order to avoid the wear inherent in such an arrangement it might be preferable to interpose a wear resistant shoe between the deflector strip 21 and either the wall of the channel or the heald member. In a further modification no deflection of the heald member 11 is required, and instead the hook member 18 or an equivalent retaining abutment is moved towards and away from the heald member by the deflector strip 21. Thus in a simple version of such an arrangement the deflector strip 21 is carried by the guide member and at its free end carries a hook member 18. In the rest configuration of the deflector strip the hook 18 is held spaced from the plane of reciprocatory motion of the heald member 11, but upon energisation of the deflector strip the associated deflection of the strip moves the hook member against the heald member so that at an appropriate point in the reciprocatory movement of the heald member 11 the hook 18 enters the aperture 13 of the heald member to retain the heald member in its raised position.

As mentioned above the deflector strips of each heald member of a pair of heald members are energised and de-energised simultaneously. Thus it is will recognised that by choice of a suitable mechanism a single electro-active element could be used to operate simultaneously the retention mechanisms of both heald members of a pair.

By comparison with electromagnetic arrangements the use of an electro-active element to operate the heald retention mechanism has many advantages. For example, the electro-active element can be considerably smaller and more compact than known solenoid arrangements and thus the heald arrangements and their retention mechanisms can be considerably more compact than is the case with the known electromagnetic arrangements. Moreover since no magnetic field is involved in the operation of the retention mechanism there are no stray magnetic fields to cause unintentional operation of adjacent heald retention mechanisms notwithstanding the fact that the mechanisms may be very closely packed together. Moreover, whereas a convenient solenoid may consume between two and three watts during operation the power consumption of the equivalent electro-active arrangement can be of the order of 0.1 watt, and so both the overall power consumption of the loom, and the heating effect are dramatically reduced. The maximum operating frequency of a conventional Jacquard loom is of the order of 16 Hz. Tests have shown that a retention mechanism utilising a "CMBA" electro-active element can operate satisfactory at 50 Hz. In the test arrangement the voltage applied to the "CMBA" element was 60 volts and this produced a deflection of between 100 and 200 micrometres. The deflection point (fulcrum) of the heald member 11 was 30 mm from the point of the hook 18 and thus by appropriate positioning of the element the deflection of the element was sufficient to give the necessary 1 mm lateral displacement of the heald member to engage the hook 18.

Should it be desired to obtain a signal indicating that flexure of the element has occurred then this can be obtained in a bi-morph element by incorporating conductors in the layer of the bi-morph element which is not, in use, subjected to the application of an electric field to cause bending. All of the layers of course bend together even though only one layer has the field applied thereto. Thus by the piezo-electric effect a voltage is generated in the or other layers and the application of conductors thereto permits the detection of such voltages generated as a result of bending of the element. Thus a voltage appearing across such conductors can be used to confirm that bending has occurred.

Claims

1. A heald retention mechanism for a weaving loom comprising a heald member (11) mounted for reciprocatory movement, a retaining member (18) for engagement with the heald member (11) at a predetermined point in its reciprocatory stroke, and electro-active means (21) and characterized in that the change in shape of the electro-active means (21) occurring as a result of a change in the electrically energised state thereof generates relative movement between the heald member (11) and the retaining member (18) to effect engagement or disengagement of the heald member (11) and the retaining member (18).

2. A heald retention mechanism as claimed in Claim 1, characterized in that said electro-active means (21) includes an elongate element which flexes along its length as a result of a change in its electrically energised state.

3. A heald retention mechanism as claimed in Claim 1 or Claim 2, characterized in that the heald member (11) is mounted for sliding movement in a channel (14) between two guide members (15, 16).

4. A heald retention mechanism as claimed in Claim 3, characterized in that an end region (17) of the channel (14) is of wedge shaped cross-section.

5. A heald retention mechanism as claimed in Claim 4, characterized in that the retaining member (18) comprises a hook provided at the end region (17) of the channel (14), the hook being arranged to engage in an aperture (13) provided in the heald member (11).

6. A heald retention mechanism as claimed in any one of the preceding claims, characterized in that the change in shape of the electro-active means (21) causes flexure of the heald member (11) to cooperate with the retaining member (18).

7. A heald retention mechanism as claimed in Claim 6, characterized in that the electro-active means (21) is connected to the heald member (11).

8. A heald retention mechanism as claimed in Claim 6, characterized in that the electro-active means (21) slidably engages the heald member (11).

9. A heald retention mechanism as claimed in any one of claims 1 to 5, characterized in that the change in shape of the electro-active means (21) generates movement of the retaining member (18) to engage the heald member (11).

10. A heald retention mechanism as claimed in any one of Claims 1 to 9, characterized in that the electro-active means (21) comprises an electro-strictive, piezo-ceramic or piezo-polymer material.

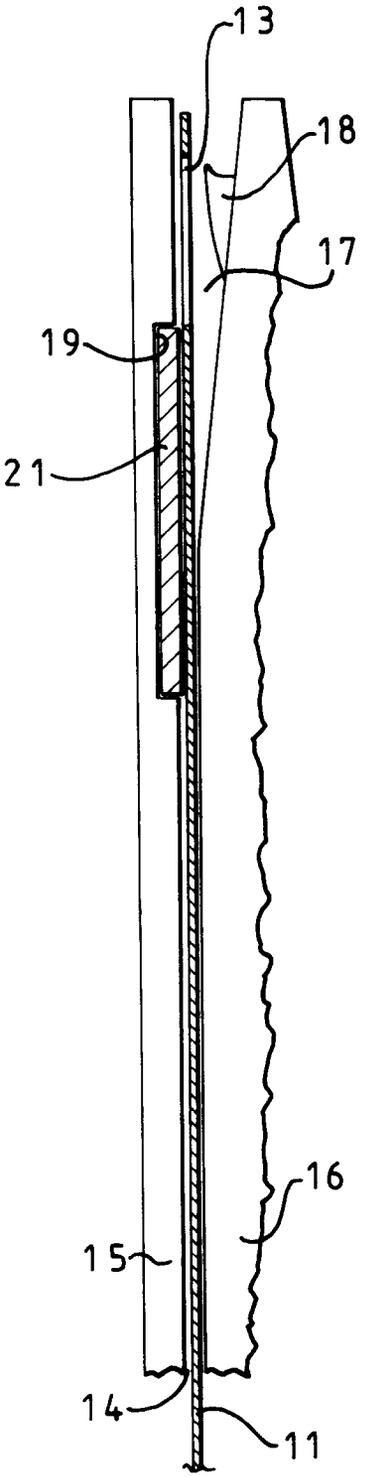

FIG 1

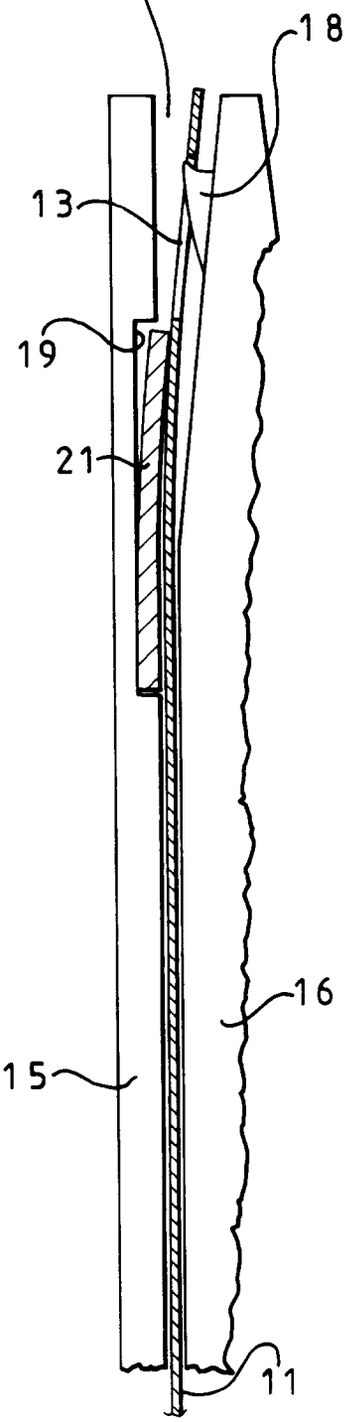

FIG 2

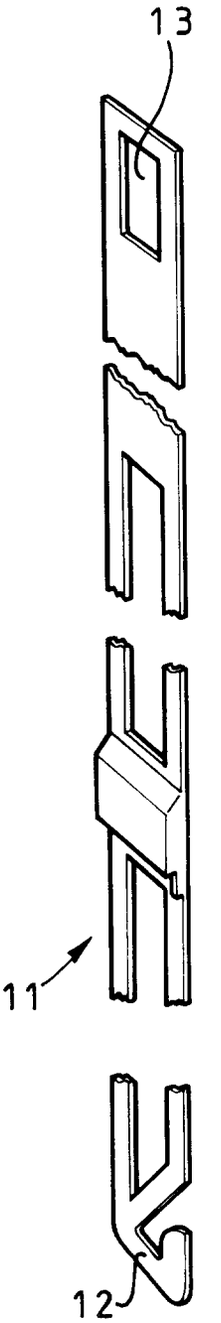

FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 1441

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-9 301 337 (BONAS) * page 6, line 23 - page 10, line 23; figures 3-6 *	1-10	D03C3/20
X	PATENT ABSTRACTS OF JAPAN vol. 14, no. 149 (C-705)22 March 1990 & JP-A-20 19 534 (TAKEMURA SEISAKUSHO) 23 January 1990 * abstract *	1,2,9,10	
E,X	EP-A-0 544 527 (WAC DATA SERVICES) * column 2, line 47 - column 3, line 5; figures 7A-7C *	1,2,9,10	
D,A	EP-A-0 119 787 (BONAS MACHINE COMPANY)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 JULY 1993	REBIERE J.L.

CATEGORY OF CITED DOCUMENTS

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