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(54) Electronically controlled warp selection system in looms

(57) An electronic apparatus that integrates shaft and Jacquard shedding of warp yarns. Each shaft consists of a split frame with symmetrical top and bottom segments. The healds, suspended on the warp threads, are placed between the segments of the frame. The top segment of the frame moves reciprocally up and back to the neutral position and the bottom segment moves reciprocally down and back to the neutral position. Each heald is engaged by a mechanism like an electro-magnetic unit either to the top segment or to the bottom segment hence it moves up or down respectively. The total movement of the healds is positively controlled by one of the segments of the frame.

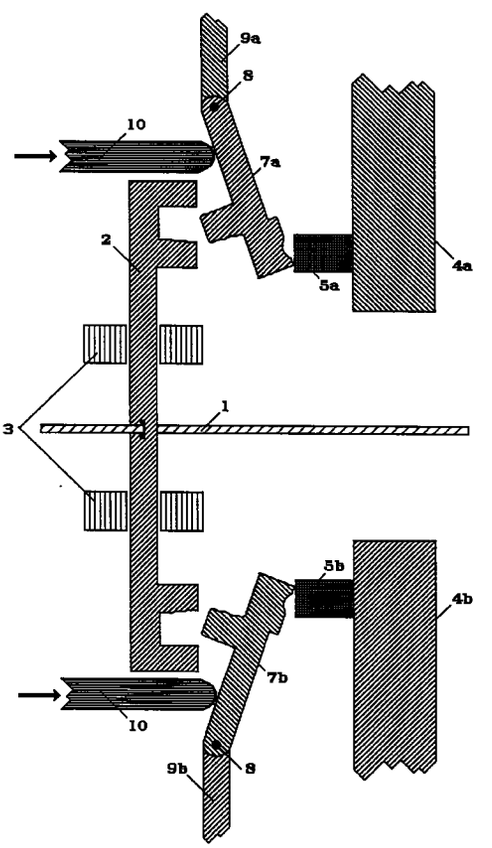

FIG. 2

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Description

FIELD OF THE INVENTION

The present invention relates to an electronically controlled warp selection apparatus which integrates the concept of dobby and Jacquard shedding and enables individual selection of warp yarns.

BACKGROUND OF THE INVENTION

Jacquard mechanisms, mechanical and electronic, require harness cords to lift the healds which need replacing periodically. The oblique angle of the harness cords and the stability of the harness also restrict the speed of the weaving operation and the harness needs replacing periodically.

Large repeating patterns in the weft direction require a large number of hooks which may necessitate a multi-bloc machine with an intricate harness cord arrangement.

Dobby mechanisms do not require harness cords but they are limited in fabric design ability and may require a complicated article change procedure when another design is introduced.

In order to eliminate the harness without losing the ability to select warp yarns individually, an integration of both concepts is proposed.

DISCLOSURE OF THE INVENTION

In accordance with the present invention, applicants provide a shedding apparatus that has no harness cords but is still capable of selecting individual warp yarns in a manner similar to a Jacquard mechanism.

According to one aspect of the present invention the proposed apparatus consists of healds with warp yarns passing through their eyes. The healds are not connected to a frame or to a cord but can engage either in their top section or their bottom section to a reciprocally moving bar that pulls them up or down respectively. The engaging mechanism consists of a stationary electro-magnetic or similar device that induces a linkage between the heald end and the frame section. One way of doing so is by pushing or pulling a swivel arm on the moving bar to clip and engage with the heald. The heald is then pulled up or down and brought back by the arm to the neutral position. Once the movement cycle is completed, a pushing bar disengages the swivel arm from the heald to the other clipped position, towards the electro-magnetic device. The operation of the electro-magnetic or a similar device is controlled by a microprocessor in a similar manner to an electronic Jacquard. Since each heald is controlled separately, the design can extend to the full width of the fabric.

The need to assign an electro-magnetic or a similar unit to each heald imposes some restriction on the linear density of these devices. It may be preferred to stack the electro-magnetic pushing devices in rows of different heights where consecutive swivel arms of different lengths, mounted on the same moving bar, are pushed by electro-magnetic units located in different rows. In addition, several planes of healds may be used together with their moving bars and the electro-magnetic devices, in a similar manner to that used for shafts in a dobby machine. Adjacent warp yarns may then be threaded in different "shafts" of healds.

Another aspect of the present invention suggests that in the neutral position all the warp yarns would be at the top or at the bottom position of the shed and only pulling down or up operations would be performed. According to this aspect, the moving bar with the swivel arms must travel twice the distance of the moving bars of the previous aspect.

This may result in slowing the weaving operation but it simplifies the mechanism in having only one moving bar and eliminates the need for warp tension compensation during the shedding cycle.

Yet another aspect of the present invention is to connect the bar with the electro-magnetic or similar devices to the moving bar. Having the electro-magnet traveling with the healds up and down by either of the above aspects, simplifies the engaging mechanism of the moving bar to the healds but imposes some strain on the fast vibrating electromagnetic devices and adds weight to the moving mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the key to the numerical designated parts of the following figures,

FIG. 2 shows a schematic side view of a heald at neutral position disengaged from both rocking hooks,

FIG. 3 shows a schematic side view of the bottom part of a heald being engaged to the rocking hook by the pushing pin of the electro-magnet unit,

FIG. 4 shows a schematic side view of a heald being pulled down by the bottom connector bar connected to the rocking hook and forming a shed,

FIG. 5 shows a schematic side view of a heald being pushed back to its neutral position by the connector bar and the rocking hook to its neutral position,

FIG. 6 shows a schematic view of hooks directly connected to the electro-magnets bar and moving together with it.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is illustrated as embodied on a conventional weaving machine having an electronically controlled warp selection apparatus which enables each of the warp yarns to be controlled. Unlike Jacquard mechanisms, this invention does not necessitate harness cords and all the operations of shedding are performed by positive movements. It is possible to achieve the individual selection of the warp yarns by ascribing an electro-magnetic or a similar unit to each heald. The electro-magnet is actuated by a processor that determines the shedding pattern, hence the design of the fabric.

According to one technique of the present invention there are stationary bars with electro-magnets or similar devices mounted on them in a row. Opposite to each electro-magnet there is a hook that can rock on a fulcrum. Each heald has at each end an electro-magnet and a hook. When the hook is rocking it engages or disengages with the heald end. Each hook moves up and down reciprocally at a frequency equal to the weft insertion rate. The electro-magnet activates the hook and induces its engagement to the heald end. If the hook engages with the top of the heald, the heald is lifted. If it is the bottom of the heald, it pulls it down. Then the hook returns the heald back to its neutral position.

This technique is illustrated in **FIGS 1** to **5**. where **FIG. 1** shows the key to the numerical designated parts shown in the following figures. At the end of the cycle, when the heald is in its neutral position, a clearing bar disengages all the hooks from the healds.

Referring to **FIG. 2**, there is shown the warp yarn **1** in a neutral position and clearing bars **10** pushing the latched rocking hooks **7a** or **7b** to disengage from the heald **2**.

In **FIG. 3** the stationary electromagnetic unit **5b**, mounted on an electro-magnetic mounting bar, at the bottom end of the heald, is actuated by the processor (not shown) to eject the pushing pin **6b** which in turn pushes the bottom rocking hook **7b** around its fulcrum **8** from its latched disengaged position to the other latched position where it is engaged with the heald **2**.

In **FIG. 4** the top connector bar (not shown moves up and the bottom connector bar **9b** pulls the bottom rocking hook and the engaged heald down forming a shed. At this point, the weft arm (not shown) is inserted above the warp yarn.

In **FIG. 5** both connector bars return to their neutral position. The bottom connector bar **9b** pushes back the bottom rocking hook together with the heald. **FIG. 2** illustrates also the completion of the cycle when the clearing bar **10** pushes the bottom rocking hook **7b** from its engaged position with the heald **2**.

The lifting of the warp yarn is performed in an analogous method when the top electro-magnetic unit **5a** is actuated, ejecting the top pushing pin (not shown).

The number of healds per linear length in one frame of rocking hooks and connector bars is limited by the size required for the electro-magnetic unit. This number can be increased if adjacent rocking hooks have different lengths which must correspond to the position of the interceptor section of the hook in the heald. Adjacent electro-magnets would then be situated at different heights and will then have more space.

Another technique that may allow for higher warp density is to arrange the sets of healds with their rocking hooks, the connector bars and the electro-magnetic units, in planes, in a similar pattern to shafts on a conventional dobby machine.

According to another aspect of the present invention, the neutral position of the warp yarns is arranged in a plane forming an obtuse angle with the plane of the fabric. Such configuration results in a movement of the healds in one direction only; up and back or down and back which utilizes only one set of electro-magnets and hooks located next to the top or the bottom end of the healds respectively.

Yet, another aspect of the present invention refers to a mechanism which consists of a spring loaded hook with its connector bar linked to the bar of the electromagnetic units and moves together with it. Such a technique is illustrated schematically in **FIG. 6**. where the bottom end of the heald is engaged to the hook and moves down with it and with the electromagnetic unit. This apparatus simplifies the engagement mechanism of the hook to the heald It necessitates a fast reciprocating movement of the electro-magnets.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. An electronically controlled warp selection mechanism which comprises a plurality of healds supported by a plurality of brackets and provision for hooking or engaging at one or both ends thereof and a reciprocally moving bar provided with two sets of engaging means adapted to engage the ends of said heald and an electronically controlled mechanism adapted to engage or disengage the said engaging means.

2. The mechanism as claimed in claim 1 where one mechanism is adapted to pull said heald upwardly and bring it back and the second mechanism to pull said heald down and bring it back.

3. The mechanism as claimed in claim 1 where there is only one mechanism that pulls the said heald upwardly or downward and bring it back.

4. The mechanism claimed in claims 2 or 3 where the mechanism pulls the said heald and a spring or a weight brings it back.

5. The mechanism as claimed in claim 1 where the machine is controlled by microprocessor.

6. The mechanism as claimed in claim 1 where said engaging mechanism is an electro-magnet.

1 --- WARP YARN

2 --- HEALD

3 --- HEALD BRACKET

4a --- TOP ELECTROMAGNET MOUNTING BAR

4b --- BOTTOM ELECTROMAGNETIC MOUNTING BAR

5a --- TOP ELECTROMAGNETIC UNIT

5b --- BOTTOM ELECTROMAGNETIC UNIT

6b --- BOTTOM PUSHING PIN

7a --- TOP ROCKING HOOK

7b --- BOTTOM ROCKING HOOK

8 --- FULCRUM

9a --- TOP CONNECTOR

9b --- BOTTOM CONNECTOR

10 --- CLEARING BAR

11 --- SPRING

FIG. 1

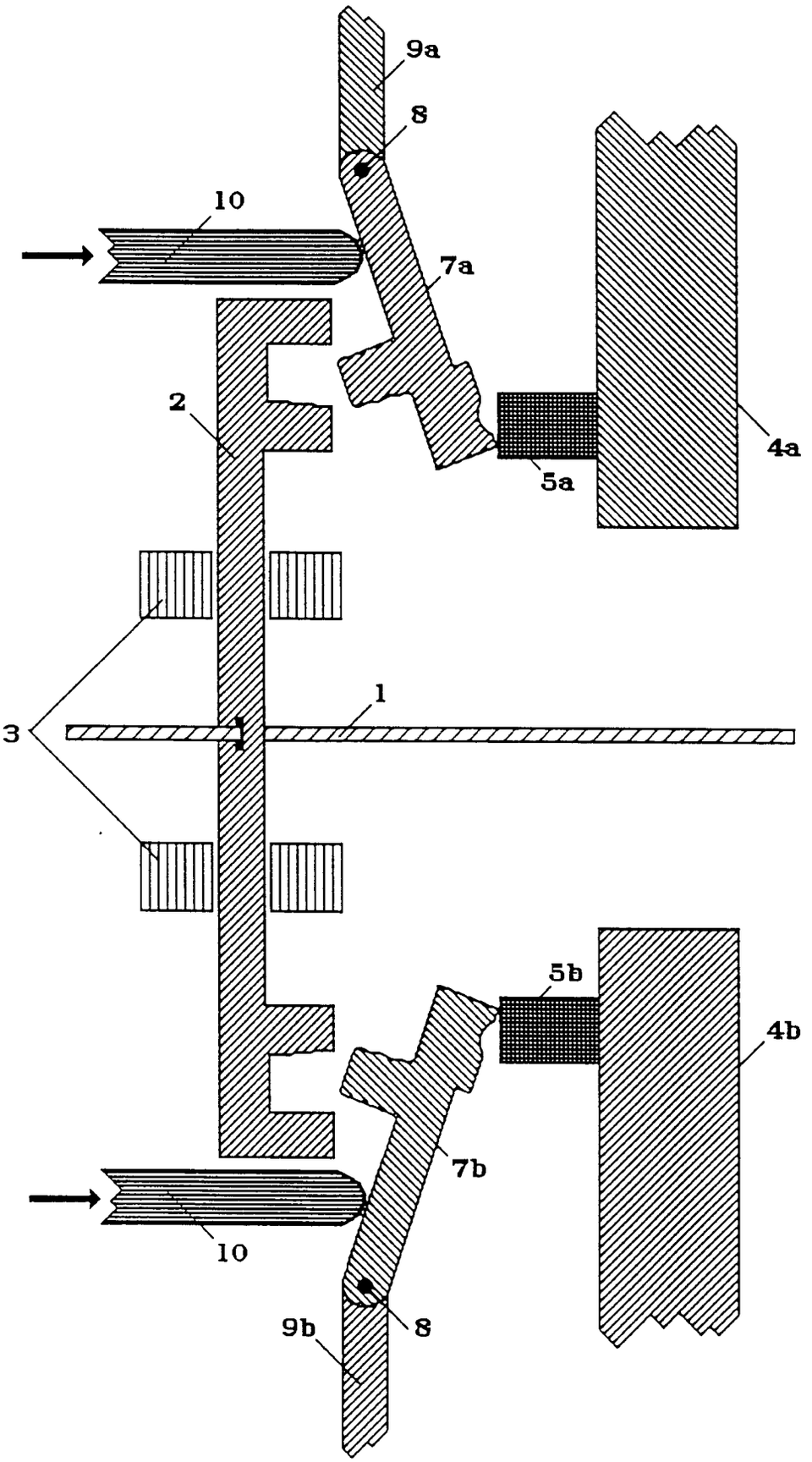

FIG. 2

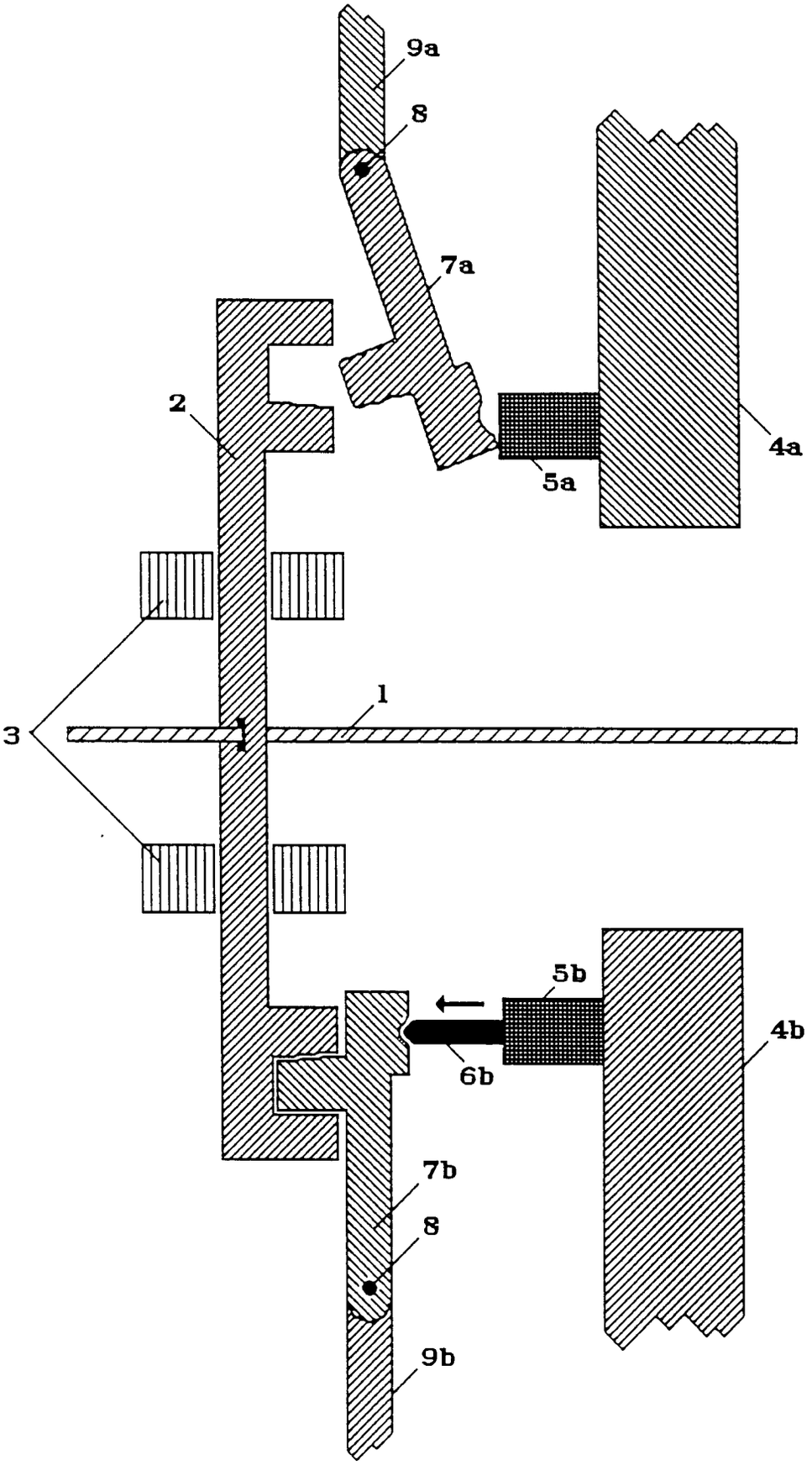

FIG. 3

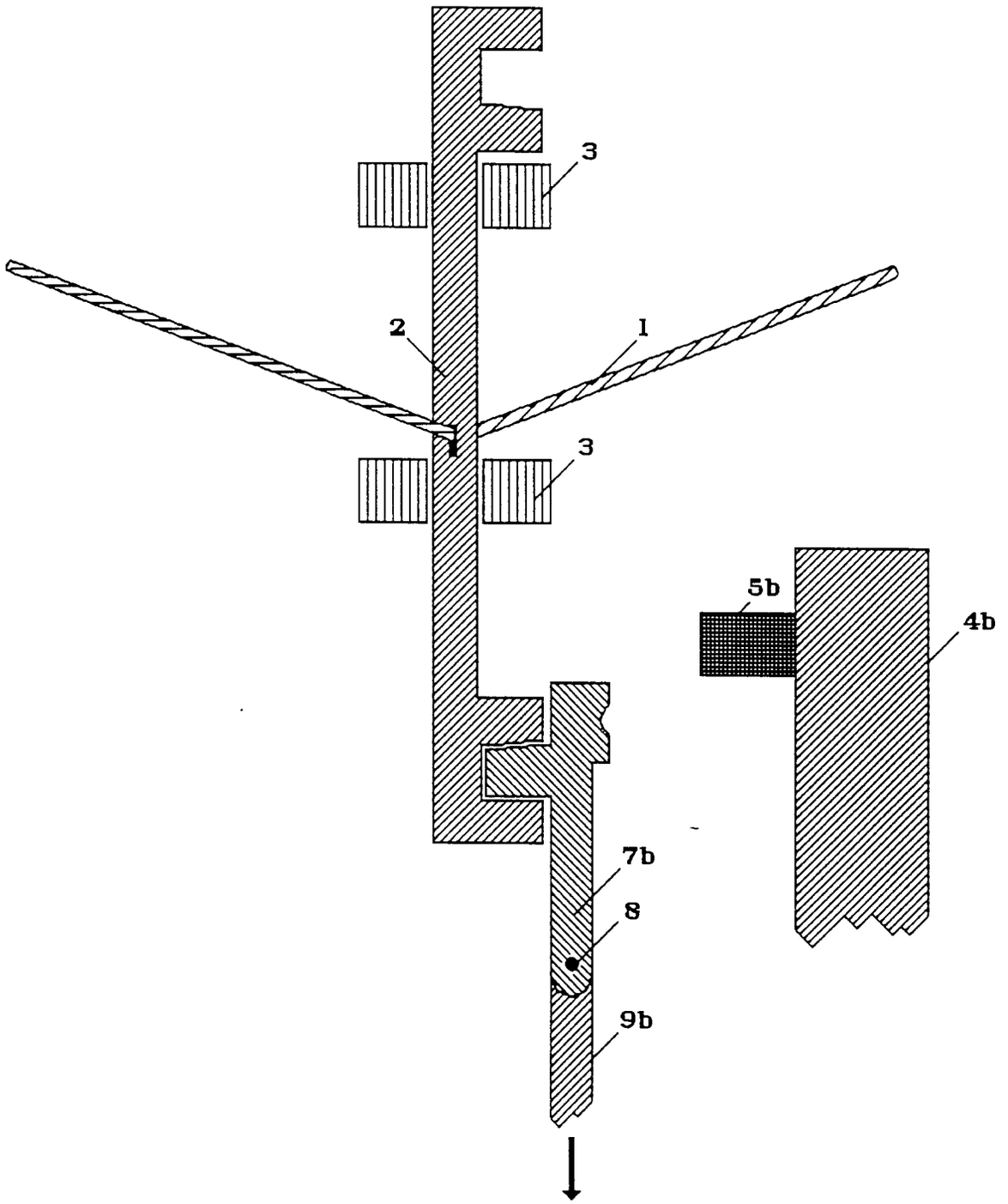

FIG. 4

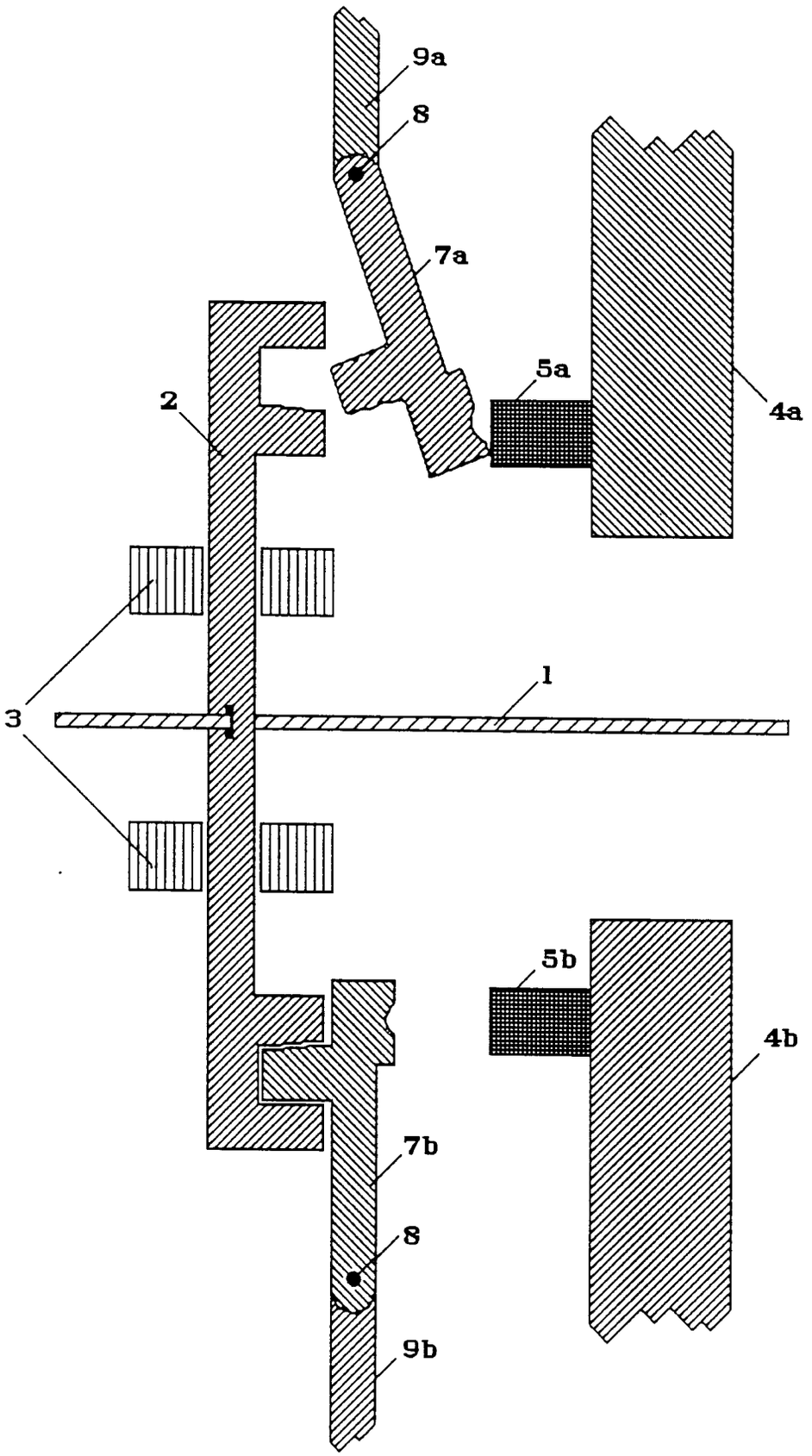

FIG. 5

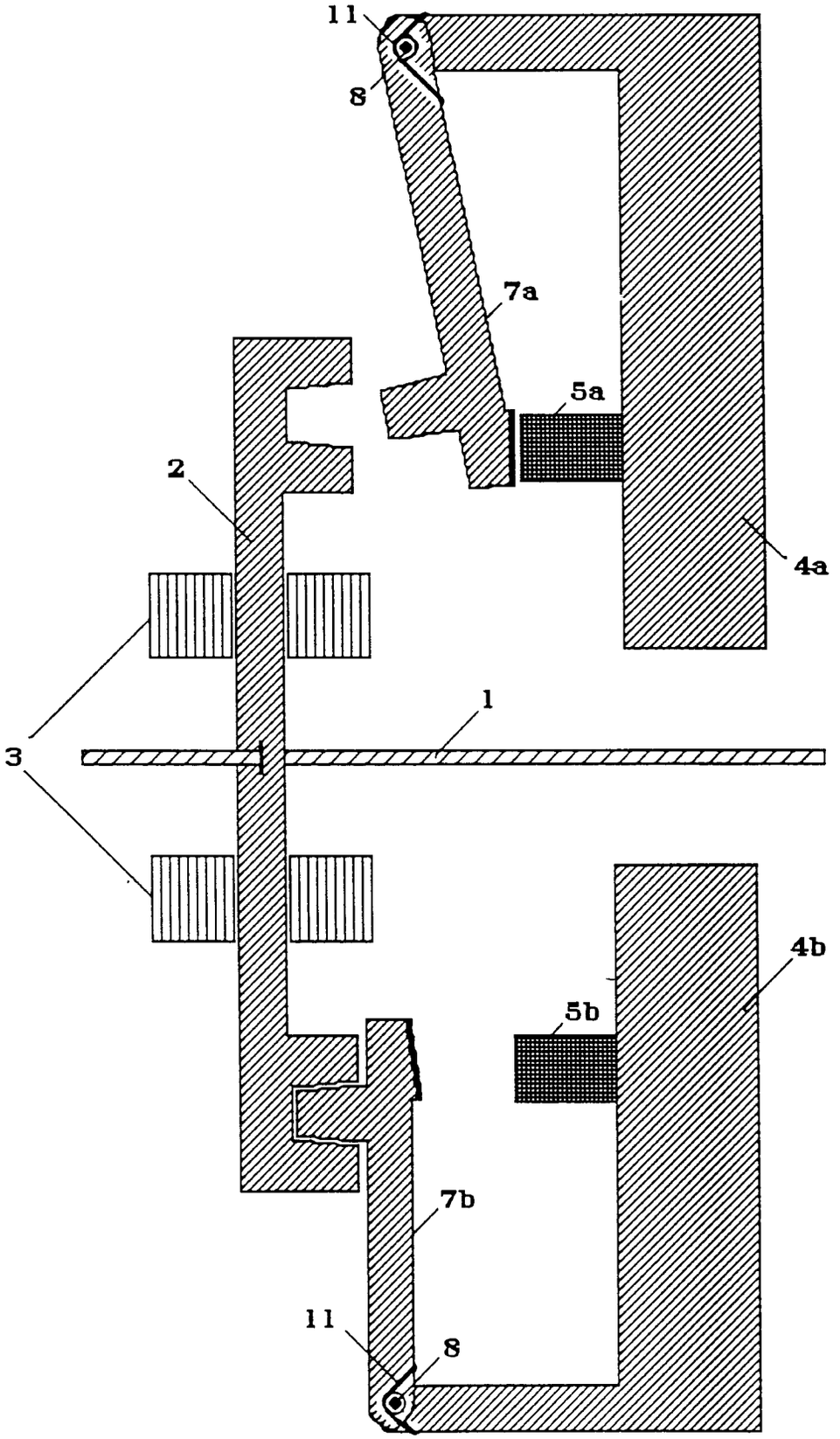

FIG. 6