

Thread control device

Technical field

- 5 The invention relates to a thread control device for optionally controlling an oscillating transverse movement of a thread in accordance with the preamble of claim 1.

Prior art

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There are many known thread control devices, particularly in shedding mechanisms, for optionally controlling an oscillating transverse movement of a thread.

- 15 In a first type of such thread control devices, the threads are controlled indirectly, the thread being moved only when it is selected. For this purpose, threads are firmly drawn into eyelets of healds and guided, the healds being moved in a programmed fashion via connecting
20 means with the aid of upstream jacquard machines, heald looms and treading machines. It is easy to establish in this case that selective movement of the thread requires a multiplicity of components and a large stroke for them, and this necessarily has a very negative influence in
25 many regards. Thus, in particular, the speed of the shedding mechanism is very limited because of the high mass forces. Further marked disadvantages of the known thread control devices are, for example, a high wear level, strong vibration, loud noise, a large space
30 requirement because of the complicated devices, and poor ergonomics and the like. Finally, they are also relatively expensive, because of the complicated design.

- A second type of such thread control devices is disclosed in WO 97/11215. This thread control device has
35 a lifting device, which can be driven in an oscillating fashion, having at least one driver for the thread, as well as at least one control means which can be actuated by means of an actuator in order to bring the thread

selectively into engagement with the driver of the lifting device. These control means are arranged, assigned directly to the driver, on the lifting device and are moved to go up and down with the latter. This results in various disadvantages. Since the lifting device must contain not only the driver but, in particular, also the control means and the actuator, it has a relatively large volume. This thread control device is little suited to a weaving machine with a high warp count. Moreover, the moving parts are of relatively large mass and must, in addition, be moved over the entire stroke of the lifting device. The co-movement of the actuator further requires a moving interface with the supply of power and program data, which is relatively complicated, expensive and prone to wear. A thread has to be drawn in very carefully, in order to prevent parts from being bent, and thus a functional failure associated with corresponding repair costs. Despite good accessibility, it is time consuming and costly to draw in a thread. Finally, because of the relatively high mass forces and the sensitivity of the electronic system integrated into the moving parts, such a thread control device can be operated only at a relatively low speed.

25 Summary of the invention

It is the object of the invention further to improve a thread control device of the type mentioned at the beginning.

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The object set is achieved according to the invention by the characterizing features of claim 1.

By virtue of the fact that the control means are arranged independently of the driver and thus of the lifting device, the lifting device is relieved of mass and sensitive control elements and can be configured exclusively in accordance with optimal points of view for the lifting movement. The control means, by contrast, are

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arranged virtually fixed, that is to say they must not also execute the lifting movement of the lifting device, but can be exclusively limited and concentrated on executing the switching variable for the purpose of laying in
5 and removing the thread at the driver in an oscillating fashion. The fixed arrangement also permits drive energy and control signals to be fed in a simple way independently of wear, as well as permitting a large degree of flexibility in the control possibilities.
10 Further decisive advantages result from this such as, on the one hand, smaller drive motors for the lifting device and, on the other hand, smaller actuators for the control means, a lesser energy requirement for the drive means, and thus not only a more cost effective production but
15 also a more cost effective operation despite higher power. This also leads to less development of heat, which finally also has the effect of simplifying and lowering the cost of air conditioning for the operating rooms in which such devices are set up. Furthermore, such a device
20 is also easier to access, and this facilitates laying in the thread. This is supported further by the insensitivity of the components.

The use of a novel thread control device in a shedding
25 mechanism for warp thread control in a weaving machine provides substantial advantages there of the type mentioned above.

The substantially lower number, in particular, also of
30 the moving components, and thus a reduction in the moving masses permits higher drive speeds and thus higher production performances, it being the case, nevertheless, that there is a large reduction in wear and in the emission of noise and vibration by comparison with
35 conventional thread control devices, in particular shedding mechanisms of a weaving machine. The invention opens up the possibility of operating the thread control device, in particular the shedding mechanism, and thus

also the connected weaving machine at very high speeds, for example of 5000 revolutions per minute and more.

The elimination of the otherwise customary upstream control devices and of the various connecting elements otherwise required results in further substantial advantages. The fact that a weaving machine equipped with the thread control device according to the invention requires no built-on accessories for upstream shedding mechanisms such as jacquard machines, produces for the weaving machines a large saving in space requirement over the weaving machine, and thus an improvement in the supervision and accessibility of the entire weaving machine, the result being an ergonomically important improvement in the supervision and handling, and thus in the workplace at a thread control device, in particular a shedding mechanism. The work of adjustment and maintenance can therefore be performed more easily, and the risk of accident is likewise reduced.

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The production and maintenance costs of the novel thread control device are low because of the low number of the components, which are relatively simple, into the bargain.

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Advantageous embodiments of the thread control device are described in claims 2 to 27.

There are various possibilities for constructing the control means. Thus, said possibilities can consist, however, in providing an electric pulse to the threads to be controlled in order to deflect the latter toward the driver by the switching variable. However, such a construction is possible only if the thread reacts to a current pulse. An embodiment according to claim 2 is more advantageous, since a control slot ensures self-closed driving of the thread by the switching variable, which is also independent of the property of the thread. A development according to claim 3 is expedient in order to

permit guidance along the entire transverse movement or the stroke of the thread.

5 The lamella-like construction of the control means according to claim 4 produces a particularly space-saving design, which improves its use, in particular concerning the warp thread control of a weaving machine. In this case, the control means can be developed according to claim 5 or 6.

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In accordance with claim 7, the driver can be effective over the entire transverse movement of the thread. However, an embodiment according to claim 8 is more advantageous, providing not only a reduction in the stroke path of a driver, but also an improvement in the control possibilities.

20 Particularly preferred is an embodiment of the thread control device according to claim 9, according to which the driver has a driver hook, effective only in one direction of movement, for self-closed driving of the thread. In the other direction of movement, the return preferably proceeds in a force-closed fashion, it being possible for the residual stress of the thread to be sufficient. If appropriate, further additional tensioning devices can be present. In specific cases, it is possible for the thread control device to be constructed according to claim 10 and to have a driver which permits self-closed driving in both directions of movement of the thread.

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There are numerous possibilities for constructing and arranging the driver, those of claims 11 to 13 being particularly preferred.

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They are also given as possibilities for constructing the actuator, a few which are particularly preferred being specified in claims 14 to 16. In this case, the actuator in accordance with claim 17 can be activated in a drive

direction, and can be returned in the other direction by means of a spring.

5 In accordance with claim 18, the control means can be arranged to be capable of being pivoted by the switching variable, it preferably being possible for this arrangement to be made on a support rail. claims 19 and 20 describe advantageous designs of the pivotable control means.

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However, an embodiment of the thread control device according to claim 21 is particularly preferred. The control element which can be displaced going to and fro in its longitudinal direction permits numerous variants
15 in terms of arrangement and drive. Thus for example, in accordance with claim 22, the actuator can be arranged at the lower end of the control element. It is also possible to design the device according to claim 23. Such a thread control device resembles the existing jacquard device, it
20 being the case, however, that the actuator now does not have to execute the entire stroke path, but only a part corresponding to the switching variable, with the result that the device can be constructed in a substantially simpler and smaller way by contrast with the jacquard
25 device, and that only a smaller amount of energy is required to surmount the switching path by comparison with the existing jacquard devices.

The embodiment according to claim 24 permits a
30 particularly simple and particularly compact design.

According to claim 25, it is expedient for the driver to be arranged on a lifting rail of a lifting device.

35 The thread control device is suitable for the most varied applications and so, for example, for optionally presenting a weft thread insertion member with weft threads of different colors and qualities for gripping. However, it is particularly advantageous if the thread

control device in accordance with claim 26 is components [sic] of a shedding mechanism of a weaving machine, a multiplicity of the thread control device [sic] being present for controlling the warp threads of the weaving machine. A dedicated actuator can be present for each control element in order to achieve the greatest possible multiplicity of control possibilities. The design according to claim 27 can also be advantageous for simpler cases.

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Brief description of the drawings

Exemplary embodiments of the thread control device according to the invention are described in more detail below with the aid of diagrammatic drawings, in which:

- Figure 1 shows a first thread control device in the shedding mechanism of a weaving machine, in side view;
- 20 Figure 2 shows the thread control device of Figure 1 on a larger scale;
- Figure 3 shows the thread control device of Figure 2 in the section III-III of Figure 2;
- 25 Figures 4 to 20 show a diagram of the movement of the thread control device of Figures 1 to 3 in various control phases in accordance with Figures 5 to 20, the drivers being represented in an open fashion in Figures 5 to 20, that is to say for the purpose of better understanding, the part of the control means situated in the foreground has been omitted;
- 30 Figure 21 shows the thread control device of Figures 1 to 20, working from the basic position into a high position;
- 35 Figure 22 shows a third thread control device having a piezoelectric control;

- Figure 23 shows a fourth control device having a control element and two drivers, working from a middle basic position;
- 5 Figure 24 shows a fifth thread control device having a control element, oscillating in the longitudinal direction, comprising two lamellae and assigned drivers;
- Figure 25 shows the thread control device in section XXV-XXV of Figure 24, on a larger scale;
- 10 Figure 26 shows a sixth thread control device similar to Figures 24 and 25, but having a control element comprising three lamellae and assigned drivers;
- Figure 27 shows the thread control device of Figure 26 in section XXVII-XXVII, on a larger scale;
- 15 Figure 28 shows a seventh thread control device similar to Figures 24 to 27 and having an actuator, in a diagrammatic representation;
- 20 Figures 29 to 33 show various control phases of the thread control device of Figures 24 to 28;
- Figure 34 shows the movement diagram for the movement phases of Figures 29 to 33;
- 25 Figure 35 shows the thread control device of Figures 24 to 33 in the shedding mechanism of a weaving machine in the open shed position;
- Figure 36 shows the shedding mechanism of Figure 35 in closed shed position;
- 30 Figure 37 shows a weaving machine having a thread control device in accordance with Figures 35 and 36 and having individual repeat control, in a view onto the front side;
- Figure 38 shows a further weaving machine having thread control devices in accordance with Figures 35 and 36, the actuators driving a plurality of control elements in terms of repeat;
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- Figure 39 shows an eighth thread control device similar to Figures 24 to 27 and having a modified actuator in a shedding mechanism in open shed position;
- 5 Figure 40 shows the shedding mechanism of Figure 39 in closed shed position;
- Figure 41 shows the actuator of the shedding mechanism of Figures 39 and 40, constructed as a pneumatic piston/cylinder unit;
- 10 Figure 42 shows the actuator of the shedding mechanism of Figures 39 and 40, designed as an electromagnet;
- Figure 43 shows a ninth shedding mechanism having thread control devices similar to Figures 24 to 27, having modified actuators;
- 15 Figure 44 shows the actuators of the shedding mechanism of Figure 43, on a larger scale;
- Figure 45 shows the actuators of Figures 43 and 44 in a modified form in the section XXXXV-XXXXV of Figure 47, in high position;
- 20 Figure 46 shows the actuators of Figure 45 in low position;
- 25 Figure 47 shows the arrangement of the control elements of Figures 45 and 46, in plan view; and
- Figure 48 shows a weaving machine having thread control devices in accordance with Figures 38 to 47 and direct drive of the control elements, in a view onto the front side.
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Ways of implementing the invention

- 35 Figure 1 shows the diagrammatic design of a weaving machine. Warp threads 4 are drawn off from a warp beam 2 and run via a tensioning device 6 to a first warp guide 8, and further to a second warp guide 10, between which warp feelers 12 are arranged. From the second warp guide

10, the warp threads 4 run via a plurality of thread control devices 14, which are combined to form a shedding mechanism 13 and open the warp threads 4 to form a weaving shed 16, to a weaving station 18 at which weft threads 20 are inserted into the open weaving shed 16 and beaten at a fell 24 by means of a weaving reed 22. The woven web 26 thus produced is guided via the fabric guide 28 of a drawing-off device 30 to a fabric roller 32 and wound on there.

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The shedding mechanism 13 is formed from individual thread control devices 14 represented in detail in Figures 2 and 3, and includes a lifting device 34 having a lifting rail 36 which can be moved up and down, for example via a connecting rod 38 by a driven eccentric 40. Lined up on the lifting rail 36 are drivers 42 which are constructed like lamellae and have on mutually averted sides spring tongues 44 at whose free ends there is arranged in each case a drive hook 46, 48 for gripping one warp thread 4a, 4b each. Each driver hook is provided at the free end with a run-on guide 50, in order to facilitate engagement of the warp thread. Positioned upstream of the driver hooks 46, 48 is a thread rejector 52 whose purpose is to prevent undesired engagement of warp threads on the driver hook 46, 48.

For each driver hook 46, 48, each driver 42 is assigned control elements 54, 56 which can be controlled by means of an actuator 58, 60 in order to bring an assigned warp thread 4a, 4b into engagement with the driver hook 46, 48 of the driver. The actuators 58, 60 are connected via a line 62 to a control device 64 which the actuators control in terms of pattern in accordance with the web to be produced, doing so in a way which, although not represented in more detail, is known. Each control element 54, 56 comprises two control lamellae 54a, 54b and 56a, 56b, respectively, which enclose the driver 42 between them. The control elements 54, 56 and/or their control lamellae 54a, 54b and 56a, 56b, respectively, are

- mounted on a common support 66 such that they can pivot about bolts 68, the pivoting path corresponding only to the switching variable required to insert the warp thread into the driver and bring it out of it. The support 66 is
- 5 lined up on a fixed support rail 70 and includes spring arms 72 which operate in each case with a stop 74 between the control lamellae 54a, 54b and 56a, 56b respectively, and pretension the latter against the actuator 58, 60.
- 10 As emerges from Figures 1 and, in particular 2 to 20, the control elements include slots 76 which, in the basic position of the warp threads 4a, 4b are constructed as narrow control slots 78 which merge in the lifting direction into wide guide slots 80.
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- The mode of operation of the shedding mechanism follows very clearly from Figures 1 to 20. The basic position of the warp threads is determined by the straight connection between the second warp guide 10 and the fabric guide 28.
- 20 This basic position also corresponds to the high position of the warp shed from which the warp threads 4, 4a, 4b are brought selectively by the stroke H into the low position, as is to be seen from the figures. A warp thread 4, 4a, 4b is driven only if the warp thread is
- 25 brought by means of the associated control element 54, 56 into engagement with the associated driver hook 46, 48 in the high position thereof (Figures 5, 9 and 17). For this purpose, an appropriate actuator 58, 60 is activated via the control device 64, and pivots the associated control
- 30 element 54, 56 against the associated driver hook 46, 48, with the result that upon the downward movement of the driver 52 said control element is driven by the driver hook 46, 48 and brought into the low position (Figures 1, 2, 7, 11 and 19). The warp thread is returned from the
- 35 low position into the high position with the upward movement of the driver 42 primarily by the residual stress of the warp thread. The upward movement can be further supported by laying the warp thread on the lifting rail, which is arranged directly below the driver

hook. The driver hook could, if appropriate, also be constructed as a double hook 48a, as is indicated by dashes in Figure 2. The warp thread is directed out of the driver hook 46, 48 when the driver 42, and thus the warp thread 4a, 4b, has reached the basic position. The actuator 58, 60 is then switched to be inactive, as a result of which the control element 54, 56 is pivoted back, under the influence of the pretensioning of the spring arm 72, into the basic position (Figures 13 to 16), in which the warp threads cannot be driven by the driver 42.

The driver 42 is equipped in the present example with two driver hooks 46, 48, and two control elements 54, 56 are assigned correspondingly, with the result that one driver can move two warp threads 4a, 4b selectively out of the upper shed position into the lower shed position, as shown, in particular, by the diagram in Figure 4 and the associated phase drawings of Figures 5 to 20. It is therefore necessary to arrange on a lifting rail 36 only half as many drivers 42 as there are warp threads present, and on a support rail 70 a number of control elements 54, 56 which corresponds to the number of the warp threads. The drivers 42 constructed like lamellae and control elements 54, 56 are configured to be correspondingly thin and can, for example, be 0.1 to 0.5 mm thick. If appropriate, it may be expedient to distribute the required number of drivers 42 and control elements 54, 56 over two and more lifting rails 36 and support rails 70.

As shown by the above embodiments, no spring returns are required with the novel shedding mechanism, and the components required to control the warp threads are reduced to a minimum because of the direct control of the warp threads, as a result of which there is a very considerable reduction in the drive forces by comparison with conventional devices. This leads, on the one hand, to a substantial saving in energy and, on the other hand,

it opens up the possibility of operating such a weaving machine with a substantially higher speed of, for example, 5000 or more revolutions per minute.

- 5 Figure 21 describes a thread control device 14a which corresponds essentially to that of Figures 1 to 20, the thread control device being arranged, however, not below the web prescribed by the warp threads 4a, 4b but above it, with the result that the neutral position of the warp
10 threads corresponds to the lower shed position, and the warp threads are deflected into the upper shed position by means of the driver 42.

- In the shedding mechanism represented in Figure 22 and
15 formed from thread control devices 14b, the drivers 82 are lined up on a lifting rail which forms part of a metal heald frame 84 which is moved up and down in a known way. The drivers, in turn, include driver hooks 46, 48 and projections 86, 88 which serve to support the
20 return of the warp threads into the initial position. Assigned to the driver 82 or the driver hooks 46, 48 are control elements 90, 92 which, in turn, include a slot 76 having a control slot 78 and a guide slot 80, and are mounted pivotably on a support rail 94. Each control
25 element has an actuating arm 96 on the side averted from the warp threads 4a, 4b. Each actuating arm 96 includes a control stop 98 and a biasing spring 100, which pretensions the control stop 98 against a switching device 102, a so-called flexural vibrator, which is at an
30 electric potential thereto. If the switching device 102 is not activated, the control stop 98 rests on said switching device and the control device remains in the neutral basic position. If, however, the switching device 102 is activated via a line 104 by means of the control
35 device 64, the switching device 102 pivots into the position shown by dashes, and the switching device 90 can pivot under the influence of the biasing spring 100 and share in the movement of an actuator 106 in the form of a driven control strip which engages in a driving groove

108 at the lower end of the actuating arm 96. This driving groove 108 has a width such that it can move freely when the actuating arm 96 is stopped in the basic position by the switching device 102. With the switching
5 device 102 activated, the biasing spring 100 pretensions the actuating arm 96 against the control strip 106, with the result that the actuating arm shares in the movement of the control strip 106, the control element 90 or 92 thereby engaging the corresponding warp thread 4a, 4b
10 with the associated driver hook 46, 48. The control stops 98a to 98n represented by dashes in Figure 22 correspond in each case to a control element following in the sequence, which respectively cooperates in turn with a dedicated switching device (not represented).

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Figure 23 describes a thread control device 14c, in which a warp thread 4 is assigned two drivers 110 and 112 which move the warp thread from the neutral position of the warp threads, which corresponds to the middle shed
20 position, into the upper shed position or into the lower shed position, respectively. The drivers 110, 112 are arranged on corresponding lifting rails 114, 116 and in each case have a driver hook 120, 122 at the end of a spring tongue 118. Assigned to the two drivers 110, 112
25 is a common control element 124 which is mounted pivotably on a support rail 126 and has on the side averted from the warp thread 4 an actuating arm 128 which cooperates with two actuators 130, 132 which act opposed to one another and pivot the control element 124 against
30 one or other of the drivers 110, 112. The control element 124 is provided, in turn, with a slot 134 for controlling the warp thread, which is constructed in the neutral position of the warp thread 4 as a narrow control slot 136 which then merges both upward and downward into wide
35 guide slots 138, 140. This thread control device functions similarly to the thread control device described at the beginning.

Figures 24 and 25 show a further thread control device 14d having a control element 140 to which drivers 142, 144 having driver hooks 146 are assigned on each side. The drivers 142, 144 run in opposite directions and
5 move downward or upward, respectively, from the middle position shown in Figure 24. The control element 140 includes a slot 148 which is constructed in the middle position as a control slot 150 and which is adjoined by guide slots 152 on both sides. The control slot 150 is
10 arranged obliquely relatively to the longitudinal direction of the control element 140 in such a way that when the latter moves longitudinally in an oscillating fashion, the control element is moved by the switching variable S, as is represented by dashes in Figure 24.
15 When the control element is moved from the position represented by full lines in Figure 24 into the position represented by dashes, the warp thread 4 is transferred from the driver region of the left-hand driver 142 into the driver region of the right-hand driver 144, with the
20 result that when executing its lifting movement by means of the lifting rail 154 of the lifting device (not represented in more detail) the latter driver can be transferred from the middle position into the upper shed position. As emerges, in particular, from Figure 25, the
25 control element 140 is constructed like a lamella and comprises the control lamellae 140a and 140b which enclose between them over a portion of their width the drivers 142, 144 which are likewise constructed like lamellae.

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Figures 26 and 27 show a thread control device 14e which corresponds to that of Figures 24 and 25, the control element having a further control lamella 140c, with the result that the drivers 142, 144 are respectively
35 arranged between mutually separated control lamellae 140a, 140b or 140b and 140c. Consequently, the control lamellae can be of wider design and can have a larger degree of coverage with the control lamellae, and thus an improved guidance. In this case, the drivers 142, 144 can

have a section 156 which covers the driver hook 146 and which cooperates in the manner of a double hook 146a to return the warp thread 4 from the upper or lower shed position and thus support the active control of the warp
5 thread. In the middle shed position represented in Figure 26, the widened sections 156 of the drivers 142, 144 form a gap 158 which supports the transfer of the warp thread along the control slot 150 out of one switching position into the other switching position.

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Figures 28 to 33 show the further design and driving of the thread control devices 14f according to Figures 24, 25 and 26, 27, respectively, on the one hand, and different phases of the movement cycle during control of
15 the warp thread, on the other hand. In the case of the control elements 140 shown in Figures 28 to 32, the control element 140 is controlled by means of an actuator 160 which is driven pneumatically and to which the control element 140 is connected via a harness cord
20 162 which is guided from the actuator 160 via a cord board 164 to the control element 140. The actuator serves primarily for the upward stroke, while the return movement is performed by a return spring 166 which is connected to the lower end of the control element 140,
25 which end is guided by a guide 168. The movement cycle of the drivers 142, 144 is represented in the movement diagram of Figure 34. In accordance with Figure 29, the warp thread 4 is moved out of the middle shed position into the lower shed position in accordance with Figure 30
30 by means of the left-hand driver 142. From this position, it then passes again into the middle shed position in accordance with Figure 31 when the driver 142 moves back, the warp thread 4 being transferred in the right-hand driver 144 by means of the control slot 150 of the
35 control element 140. Said driver 144 drives it into the upper shed position in accordance with Figure 32, from which it then passes again into the middle shed position in accordance with Figure 33 by means of the right-hand driver 144.

Figures 35 and 36 show the arrangement of a plurality of thread control devices 14f in accordance with Figures 28 to 33 in a shedding mechanism 170 of a weaving machine, it being possible for such thread control devices to be arranged both in a row one behind another and in a plurality of rows next to one another, depending on the count of the web 26 to be produced or on the count of the warp threads 4a, 4b to be controlled. Figure 35 shows the shedding mechanism in open shed position, the weft thread 20 being inserted into the weaving shed 16 and then beaten at the fell 24 by means of the weaving reed 22. The shedding mechanism is represented in the closed shed position in Figure 36.

Figure 37 shows the front view of a weaving machine having thread control devices 14f in accordance with Figures 35 and 36 and the shedding mechanism 170. As emerges from Figure 37, the weaving machine includes a machine frame 172, in which the shedding mechanism 170 is arranged with the thread control devices 14d, 14e and 14f, and which serves to control warp threads (not represented in more detail) directly in terms of repeat. Each control element 140 is pretensioned downward via the return spring 166 and connected, via the harness cord 162, which is guided through the cord board 164, to a selecting device 174 which contains the actuators 160. Figure 38 shows a further weaving machine, in which an actuator 160a of the selecting device 174a and the shedding mechanism 170a simultaneously operates a plurality of control elements in accordance with a warp repeat T.

Figures 39 to 42 show a further exemplary embodiment of a shedding mechanism 176 having thread control devices 14g which are designed according to the principle of the thread control devices 14d and 14e in Figures 24 to 27, but have modified actuators 178. For this purpose, the control elements 140 are arranged at the lower end in a

guide 180 and connected via connecting elements 182 to the actuators 178, which are situated lower down. These then drive the control elements. In accordance with Figure 41, such an actuator 178a can be constructed as a pneumatic piston/cylinder unit. A piston 184 connected to the connecting element 182 is pretensioned in the low position in the cylinder 186 by means of a return spring 188. Compressed air is supplied via the feed line 190 and the piston, and thus the control element, are raised. A further example of an actuator 178b is shown in Figure 42. In this case, the actuator is constructed as an electromagnet and has in a housing 192 a coil 194 to which control current is applied via lines 196. A permanent magnet 198 is arranged displaceably in the coil 194 and connected to the control element 140 via the connecting element 182. The shedding mechanism is represented in open shed position in Figure 39, and in closed shed position in Figure 40.

Figures 43 and 44 show a further shedding mechanism 200 having thread control devices 14h according to the principle of the thread control devices of Figures 24 to 27, but with further modified actuators 202. For this purpose, the control elements 140 each have at the lower end a guide element 204 which is guided moving up and down in a guide 206. Lease knives 208 which move up and down and in each case cooperate with a driver part 210 on the control element 140 serve to drive the control elements. The biasing spring 212 in the guide 206 pretensions the control element 140, and thus the driver part 210, against the lease knife 208, with the result that the control element 140 can follow the oscillating movement of the lease knife. Arranged on the underside of the guide 206 is a control plate 214 which carries piezoelectric switching devices 216 which, in the unswitched state, ensure the free movement of the guide element 204, and thus of the control element, and in the switched, that is to say activated state cooperate with a shoulder 218, with the result that the driver part 210

and thus the control element 140 can no longer follow the lease knife 208. This retains the control element in one switching position, with the result that an associated warp thread 4 can no longer be passed on from one driver 142 to the other driver 144, and can thus no longer change from the low position into the high position, and vice versa.

Figures 45 to 47 show a further embodiment of a thread control device 14i, which corresponds to the thread control device 14h of Figures 43 and 44, although in this case the actuators 202a have control plates 214a with two rows, situated one under another, of switching devices 216, 216a which come into use alternately viewed in the longitudinal direction of the lease knife 208. Consequently, the guide elements 204a differ and have shoulders 218, 218a at appropriately offset positions. This permits a high package density of the thread control devices, and thus a high porter per centimeter. The lease knives are represented in high position in Figure 45 and in low position in Figure 46, individual switching devices 216, 216a being shown in the activated, that is to say deflected state in which they cooperate with the shoulders 218, 218a of the guide elements 204a.

The weaving machine represented in Figure 48 includes a shedding mechanism 200 in accordance with Figures 39 to 43 having thread control devices 14g, 14h, 14i in accordance with Figures 39 to 47. In this case, the guide 206 with the actuators 202 is arranged below the weaving region 220 in the machine frame 222, with the result that the weaving region is freely accessible from the top side.

In the above exemplary embodiments, the thread control devices are shown in each case in conjunction with the control of warp threads for shed formation in a weaving machine. The thread control devices can, however, also serve to control other threads for other purposes, in

particular for selecting weft threads which are either fed separately from the warp threads or, in particular, similarly to the warp threads.

List of reference numerals

	H	Stroke of a thread or of a driver
	S	Switching variable
5	T	Warp repeat
	2	Warp beam
	4	Warp thread
	6	Tensioning device
	8	First warp guide
10	10	Second warp guide
	12	Warp feeler
	13	Shedding mechanism
	14	First thread control device (Figures 1-20)
	14a	Second thread control device (Figure 21)
15	14b	Third thread control device (Figure 22)
	14c	Fourth thread control device (Figure 23)
	14d	Fifth thread control device (Figures 24-25)
	14e	Sixth thread control device (Figures 26-27)
	14f	Seventh thread control device (Figures 28-36)
20	14g	Eighth thread control device (Figures 39-42)
	14h	Ninth thread control device (Figures 43-44)
	14i	Tenth thread control device (Figures 45-47)
	16	Weaving shed
	18	Weaving station
25	20	Weft thread
	22	Weaving reed
	24	Fell
	26	Web
	28	Fabric guide
30	30	Drawing-off device
	32	Fabric roller
	34	Lifting device
	36	Lifting rail
	38	Connecting rod
35	40	Eccentric
	42	Driver
	44	Spring tongue
	46	Driver hook
	48	Driver hook

	48a	Double hook
	50	Run-on guide
	52	Thread rejector
	54	Control element
5	54a	Control lamella
	54b	Control lamella
	56	Control element
	56a	Control lamella
	56b	Control lamella
10	58	Actuator
	60	Actuator
	62	Line
	64	Control device
	66	Support
15	68	Bolt
	70	Support rail
	72	Spring arm
	74	Stop
	76	Slot
20	78	Control slot
	80	Guide slot
	82	Driver
	84	Metal heald frame
	86	Projection
25	88	Projection
	90	Control element
	92	Control element
	94	Support rail
	96	Actuating arm
30	98	Control stop
	98a-n	Control stop
	100	Biasing spring
	102	Piezoelectric switching device
	104	Line
35	106	Actuator (control strip)
	108	Driving groove
	110	Driver
	112	Driver
	114	Lifting rail

	116	Lifting rail
	118	Spring tongue
	120	Driver hook
	122	Driver hook
5	124	Control element
	126	Support rail
	128	Actuating arm
	130	Actuator
	132	Actuator
10	134	Slot
	136	Control slot
	138	Guide slot
	140	Control element
	140a	Control lamella
15	140b	Control lamella
	140c	Control lamella
	142	Driver
	144	Driver
	146	Driver hook
20	146a	Double hook
	148	Slot
	150	Control slot
	152	Guide slot
	154	Lifting rail
25	156	Widened section
	158	Gap
	160	Actuator
	160a	Actuator
	162	Harness cord
30	164	Cord board
	166	Return spring
	168	Guide
	170	Shedding mechanism
	170a	Shedding mechanism
35	172	Machine frame
	174	Selecting device
	174a	Selecting device
	176	Shedding mechanism
	178	Actuator

	178a	Actuator
	178b	Actuator
	180	Guide
	182	Connecting element
5	184	Piston
	186	Cylinder
	188	Return spring
	190	Feed line
	192	Housing
10	194	Coil
	196	Line
	198	Permanent magnet
	200	Shedding mechanism
	202	Actuator
15	202a	Actuator
	204	Guide element
	204a	Guide element
	206	Guide
	208	Lease knife
20	210	Driver part
	212	Biasing spring
	214	Control plate
	214a	Control plate
	216	Switching device
25	216a	Switching device
	218	Retaining stop
	218a	Retaining stop
	220	Weaving region
	222	Machine frame

CLAIMS

1. Thread control device for optionally controlling an oscillating transverse movement of a thread (4, 4a, 4b), in particular of a warp thread of a weaving machine, having at least one lifting device (34, 36, 154), which can be driven in an oscillating fashion, having at least one driver (42, 82, 110, 112, 142, 144) for the thread, further having at least one control means (54, 56, 90, 93, 124, 140) which can be actuated by means of an actuator (58, 60, 106, 130, 132, 160, 160a, 178, 178a, 178b, 202, 202a) in order to bring the thread selectively into engagement with the driver, characterized in that the control means (54, 56, 90, 93, 124, 140) is arranged independently of the lifting device (34) for the driver (42, 82, 110, 112, 142, 144), all of this being such that the control means (54, 56, 90, 93, 124, 140) moves the thread (4, 4a, 4b) selectively directly toward and away from the driver (42, 82, 110, 112, 142, 144) in an oscillating fashion by a switching variable (S).
2. Thread control device according to claim 1, characterized in that the control means (54, 56, 90, 93, 124, 140) has a control slot (78, 136, 150) in order to move the thread (4, 4a, 4b) by the switching variable (S).
3. Thread control device according to claim 2, characterized in that the control means (54, 56, 90, 93, 124, 140) has a slot (76, 134, 148) which extends over the entire transverse movement of the thread (4, 4a, 4b) and which preferably expands outside the control slot (78, 136, 150).
4. Thread control device according to one of claims 1 to 3, characterized in that the control means (54, 56, 90, 93, 124, 140) is constructed like a lamella and at least partially covers the driver (42, 82,

110, 112, 142, 144), likewise constructed like a lamella, at the wide end.

5. Thread control device according to claim 4,
5 characterized in that the control means (54, 56, 90, 93, 124, 140) has at least two parallel lamellae (54a, 54b, 56a, 56b, 140a, 140b, 140c) which enclose the lamella-like driver (42, 82, 110, 112, 142, 144) between them.
- 10 6. Thread control device according to claim 5, characterized in that the control means (140) has at least one further lamella (140c) and encloses a further driver (144).
- 15 7. Thread control device according to one of claims 1 to 6, characterized in that the driver (42, 82) can be moved over the entire transverse movement (H) of the thread (4, 4a, 4b).
- 20 8. Thread control device according to one of claims 1 to 6, characterized in that the driver (110, 142) can be moved along a first segment of the transverse movement of the thread (4), and there is present for the remainder of the transverse movement of the
25 thread a second driver (112, 144) which is oppositely directed with respect to the first driver, the control means (124, 140) being effective for the selective transfer of threads at the
30 crossing point of the first and second drivers.
- 35 9. Thread control device according to one of claims 1 to 8, characterized in that the driver (42, 82, 110, 112, 142, 144) has a driver hook (46, 48, 120, 122, 146) for driving the thread (4, 4a, 4b) in a self-closed fashion in one direction of movement, it being possible for the thread to be returned in the other direction of movement in a force-close

fashion, preferably by the residual stress of the thread.

- 5 10. Thread control device according to one of claims 1 to 8, characterized in that the driver (48) has a double hook (48a, 146a) for self-closed driving of the thread in both directions of movement.
- 10 11. Thread control device according to claim 9 or 10, characterized in that the driver hook (46, 48, 120, 122) is arranged at the end of a spring tongue (44) and has preferably one run-on guide (50) outside the driver part.
- 15 12. Thread control device according to one of claims 9 to 11, characterized in that the driver hook (42) has a thread rejector at the free end.
- 20 13. Thread control device according to one of claims 1 to 12, characterized in that the driver (42, 82) has two driver hooks (46, 48) which point away from one another and to which in each case a control means (54, 56, 90, 92) for laying in a thread (4, 4a, 4b) is assigned.
- 25 14. Device according to one of claims 1 to 13, characterized in that the actuator (106, 202) includes a piezoelectric switching device (102, 216, 216a).
- 30 15. Device according to one of claims 1 to 13, characterized in that the actuator (178a) is constructed as a piston/cylinder unit (184, 186) which can be actuated by a fluid and is preferably
- 35 16. Thread control device according to one of claims 1 to 13, characterized in that the actuator (178b) is constructed as an electromagnet (194, 198).

17. Thread control device according to one of claims 1 to 16, characterized in that the actuator (58, 60, 106, 160, 160a, 178, 178a, 202) can be activated in one drive direction and can be returned in the other direction by means of a spring (72, 100, 166, 188, 212).
18. Thread control device according to one of claims 1 to 17, characterized in that the control means (54, 56, 90, 93, 124) is constructed as a control element which can be pivoted by the switching variable (S) and is preferably arranged on a support rail (70, 94, 126).
19. Thread control device according to claim 18, characterized in that control elements (54) arranged in pairs are mounted pivotably on a common support (66) which is fastened to a support rail (70) and has a spring arm (72) which pretensions the control elements (54, 56) against the actuator (58, 60).
20. Thread control device according to claim 18, characterized in that the control element (90, 92) mounted pivotably on a support rail (94) has a control stop (98) and a biasing spring (100) which pretensions the control stop (98) against the preferably piezoelectric switching device (102) which releases the path of the control stop (98) in the switching state and brings the control element (90, 92) into engagement with an oscillating actuator (106).
21. Thread control device according to one of claims 2 to 17, characterized in that the control means (140) is constructed as an elongated control element which is arranged to move to and fro in its longitudinal direction, the control slot (150) extending in the control region at an angle to the displacement direction of the control element from one switching

position of the thread (4) into the other switching position of the thread.

22. Thread control device according to claim 21, characterized in that the control element (140) moving to and fro in the longitudinal direction is preferably connected at the lower end directly to the actuator (178, 178a, 178b, 202).
23. Thread control device according to claim 21, characterized in that the control element (140) moving to and fro in the longitudinal direction is pretensioned in one direction at the lower end by means of a return spring (166), and is connected at the upper end with the actuator (160, 160a) via a connecting element (162), preferably a cord.
24. Thread control device according to claim 21, characterized in that the control element (140) moving to and fro in the longitudinal direction cooperates with a drive element (208), moving to and fro in the longitudinal direction of the thread control element, against which drive element the latter is pretensioned by means of a spring (212), the control element being provided with a retaining stop (218, 218a) with which a controllable switching device (216, 216a), preferably a piezoelectric switching device, can cooperate in such a way that the control element (140) follows the movement of the drive element (208) in the event of an ineffective switching device, and is retained in a position in the event of an effective switching device (216, 216a).
25. Thread control device according to one of claims 1 to 24, characterized in that the driver (42, 82, 110, 112, 142, 144) is arranged on a lifting rail (36, 154) of the lifting device (34).

26. Thread control device according to one of claims 1 to 25, characterized in that it is a component of a shedding mechanism (13, 170, 170a, 176, 200) of a weaving machine, a multiplicity of the thread control devices being present for controlling the warp threads of the weaving machine.
27. Thread control device according to claim 25, characterized in that control elements combined into groups can be driven in each case by a common actuator (160a).