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(54) **SHED-FORMING MODULE FOR A WEAVING DEVICE**

FACHFORMENDE VORRICHTUNG FÜR EINE WEBVORRICHTUNG

MODULE DE FORMATION DE FOULE POUR DISPOSITIF DE TISSAGE

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EP 3 440 247 B1

Description

[0001] The invention relates to a shed-forming module for the selective movement of shed-forming elements using lifting elements, wherein several shed-forming elements, in projection onto a plane perpendicular to their movement direction, are situated next to each other in a first direction and in a second direction perpendicular to the first direction, wherein the shed-forming module comprises the components as described in the preamble of the first claim. Such a module is used more particularly in open-shed jacquard machines with two or more positions.

[0002] The invention furthermore relates to a weaving machine provided with such a shed-forming module or a jacquard machine provided with such a shed-forming module.

[0003] When weaving a fabric on a weaving machine, the warp threads are positioned during the successive weaving cycles with respect to the level at which a weft thread is introduced in each cycle. The positions of the warp threads in the successive weaving cycles are in this case determined in such a manner that the weaving process results in a fabric with a predetermined weaving pattern. This positioning of the warp threads with respect to the weft insertion level on a weaving machine, known as shed forming, is realized automatically by means of a shed-forming device or shed-forming module.

[0004] The known shed-forming device comprises one or more selection systems which are provided to select or not select one or more hooks. A hook is selectively carried or not carried by a lifting element which is movable in the vertical direction and forms part of a set of lifting elements consisting of at least two lifting elements which move up and down in pairs in antiphase. These lifting elements (knives) are driven in an up and down movement in antiphase with respect to each other, according to an adjustable amplitude, via lifting means such as for example knife grids. A shed-forming device comprises at least two sets of knife grids moving up and down, for example on two opposite sides of the shed-forming device.

[0005] Many mechanisms for driving the movement of these knife grids have already been described. European patent application EP 1 705 272 in the name of the present applicant describes a jacquard device as shown in figure 1, comprising, on two opposing sides of the jacquard device, at least two sets of knife grids moving up and down in antiphase. To drive the movement of these knife grids, on both sides of the jacquard device, at least one drive lever is provided which is driven by a single sided drive. To transfer the movement from the drive side to the driven side, a continuous, oscillating shaft is provided which transfers the movement of the drive lever. To allow the knife grids to perform the up and down movement in antiphase, the device comprises two oscillating levers (41a, 41b; 42a, 42b) placed next to each other (viewed in the warp direction).

[0006] Another mechanism is described in EP 0 297 586; the jacquard device described in this publication comprises at least two sets of knives movable up and down in antiphase, wherein the ends of the knives movable up and down in antiphase are connected to a different oscillating shaft.

[0007] The systems described above however have the disadvantage that the movement amplitude of the lifting elements is in principle a fixed setting; if this is to be changed, then adjustments must be made at various locations (at least three) in the system which are responsible for transferring the movement, without generating undesirable movement deviations and/or movement differences; this is labour-intensive work and leads to substantial time loss.

[0008] German patent publication DE 25 07 486 describes a shed-forming module with several lifting elements which are movable up and down, wherein each lifting element is driven separately. The movement amplitude of the lifting elements in this system can be set separately for each lifting element, whereby changing the movement amplitude for all lifting elements is a very time-consuming activity.

[0009] The object of this invention is therefore to provide a shed-forming module which allows the movement amplitude to be adjusted more easily and unambiguously.

[0010] The object of the invention is achieved by providing a shed-forming module for the selective movement of shed-forming elements using lifting elements, wherein several shed-forming elements, when projected onto a plane perpendicular to their movement direction, are located next to each other in a first direction and in a second direction perpendicular to the first direction, and comprising:

- at least two sets of lifting elements movable up and down in antiphase;
- shed-forming elements which move selectively with the at least two sets of lifting elements;
- at least four oscillating levers which are provided to move the lifting elements up and down in phase and antiphase according to an adjustable movement amplitude;
- first and second transfer mechanisms connected to each of said two sets of the lifting elements,
 - which each comprise at least two said oscillating levers located next to each other in the first direction, and
 - which furthermore each comprise a connecting mechanism which connects the oscillating levers together per transfer mechanism, so that these oscillating levers have the same, virtually the same or a very similar movement amplitude, and
 - which each consist of the components which transfer the movement from one of the at least

- two said oscillating levers to the other,
- wherein the first and second transfer mechanisms are located next to each other in the second direction;
- a drive mechanism connected to the first and second transfer mechanisms,

wherein the drive mechanism does not form part of the transfer mechanism and wherein the lifting elements are coupled via the first and second transfer mechanisms to the drive mechanism such that the movement profile and the movement amplitude of the lifting elements are adjustable via the drive mechanism.

[0011] Such a shed-forming module has the great advantage that the size of the movement amplitude of the lifting elements can be adjusted completely by the drive mechanism, so that without too much time loss, this amplitude of the lifting elements can be adjusted without generating undesirable movement deviations and/or movement differences.

[0012] Depending on the setup, the first direction may be the direction which corresponds to the weft direction or the direction which corresponds to the warp direction. Preferably, the first direction is the weft direction and the second direction is the warp direction.

[0013] In a preferred embodiment of the shed-forming module according to this invention, the drive mechanism comprises at least two adjustment means which are each connected to a different transfer mechanism and which are each provided to adjust the movement amplitude of the associated transfer mechanism independently, and which together determine the movement amplitude of all shed-forming elements such that the movement amplitude of all shed-forming elements in the first direction is the same, and the movement amplitude of all shed-forming elements changes linearly in the second direction. Preferably, the drive mechanism comprises a first and a second adjustment means which are intended to be coupled respectively to the first and second transfer mechanism. Via these two adjustment means, the movement amplitude of the entire shed-forming module can be adjusted. In particular, the movement amplitude of each oscillating lever is unambiguously determined by the movement amplitude of the connected transfer mechanism.

[0014] According to a particular embodiment of the shed-forming module according to the invention, the drive mechanism comprises a first and a second driveable and adjustable four-bar mechanism, wherein the first four-bar mechanism is provided for driving an oscillating lever of the first transfer mechanism and the second four-bar mechanism is provided for driving an oscillating lever of the second transfer mechanism. Preferably, the drive mechanism comprises a main drive shaft, wherein the first and second four-bar mechanisms are mechanically coupled to this main drive shaft.

[0015] For adjusting the amplitude of the lifting ele-

ments, in a more particular embodiment of the shed-forming module according to this invention, each four-bar mechanism comprises an adjustment means. For clarity, the first four-bar mechanism is provided with a first adjustment means, while the second four-bar mechanism is provided with a second adjustment means. Preferably, the adjustment means is configured as a bar of the four-bar mechanism with a slot in which another bar of the respective four-bar mechanism is displaceable for adjusting the amplitude, or the adjustment means is configured as a bar of the four-bar mechanism with a number of different coupling points to which another bar of the four-bar mechanism can be coupled for adjusting the amplitude. By moving the fixing point of the respective bar of the four-bar mechanism in the slot, or by coupling it to another fixing point, the four-bar mechanism changes shape and consequently the transfer of movement from the one bar to the other bar is changed.

[0016] According to a first particular embodiment of the shed-forming module according to this invention, the shed-forming module, on two opposing sides of the module in the first direction, comprises two lifting means which are movable up and down in antiphase for moving the lifting elements up and down, and each oscillating lever is connected to these lifting means via two connecting rods which are movable up and down in antiphase. Preferably, for this each oscillating lever comprises a first and second lever arm which are each intended to be connected to the one end of one of the two connecting rods.

[0017] The lifting means, preferably knife grids, are provided at each side of the shed-forming module so that, on both left and right (viewed from the point of view of the weaver looking in the direction of the warp yarn supplied) in the shed-forming module, two knife grids are present moving up and down in antiphase. In a more particular embodiment of the shed-forming module, the first transfer mechanism comprises a first and second oscillating lever, the second transfer mechanism comprises a third and fourth oscillating lever, wherein the first and third oscillating levers are provided for moving the lifting means up and down in antiphase on one side of the module, the second and fourth oscillating levers are provided for moving the lifting means up and down in antiphase on the other side of the module, and wherein the first four-bar mechanism is provided for driving the first oscillating lever via a first drive rod, and the second four-bar mechanism is provided for driving the third oscillating lever via a second drive rod.

[0018] Preferably, the connecting mechanism of the first transfer mechanism comprises a second lever arm of a fifth oscillating lever and a second lever arm of a sixth oscillating lever, connected respectively to the first and second oscillating lever and which are connected together via a connecting rod, and wherein the connecting mechanism of the second transfer mechanism comprises a second lever arm of a seventh oscillating lever and a second lever arm of an eighth oscillating lever, connected respectively to the third and fourth oscillating

lever and which are connected together via a connecting rod. The fifth, sixth, seventh and eighth oscillating levers are each composed of a first and second lever arm.

[0019] In particular, the first four-bar mechanism is formed by the first adjustment means, the first drive rod and the first lever arm of the fifth oscillating lever, and the second four-bar mechanism is formed by the second adjustment means, the second drive rod and the first lever arm of the seventh oscillating lever.

[0020] In this way, the first lever arm of the fifth oscillating lever forms part of the first four-bar mechanism, while the second lever arm of the fifth oscillating lever forms part of the connecting mechanism of the first transfer mechanism. The first lever arm of the seventh oscillating lever forms part of the second four-bar mechanism, while the second lever arm of the seventh oscillating lever forms part of the connecting mechanism of the second transfer mechanism. Both four-bar mechanisms form part of the drive mechanism.

[0021] In a second, more specific embodiment of the shed-forming module according to this invention, the first and second four-bar mechanisms respectively drive a first and a second oscillatable shaft. In a preferred embodiment, the oscillatable shaft is subdivided into two parts. A first part is connected to the first or second four-bar mechanism and is intended to impose the movement. This part forms part of the drive mechanism. Furthermore, the oscillatable shaft has a second part which extends at the shed-forming elements. The second part forms part of the connecting mechanism which connects together the oscillating levers per transfer mechanism, and in this function forms part of the transfer mechanism.

[0022] Preferably, each oscillatable shaft comprises a number of oscillating levers placed next to each other, and each oscillating lever is connected directly or indirectly to the lifting elements via two connecting rods which are movable up and down in antiphase. The lifting elements are preferably knives.

[0023] Another subject of this invention relates to a jacquard machine provided with a shed-forming module according to the invention as described above. The jacquard machine is preferably an open-shed jacquard machine with two or more positions.

[0024] This invention furthermore relates to a weaving machine provided with a shed-forming module according to the invention as described above. The weaving machine preferably comprises a jacquard machine according to the invention.

[0025] The invention will now be explained with reference to the detailed description which follows a number of possible embodiments of the shed-forming module according to the invention. The aim of this description is exclusively to give a clarifying example and to indicate further advantages and features of the invention, and it may therefore not be interpreted as a restriction of the area of application of the invention or the patent rights claimed in the claims.

[0026] In this detailed description, by means of refer-

ence numerals, reference is made to the attached drawings in which:

- figure 1 is a representation of a shed-forming module from the prior art as described in EP 1705272;
- figure 2 is a diagrammatic representation of a first embodiment of the shed-forming module according to this invention, wherein the module comprises two sets of lifting elements movable up and down in antiphase, and wherein the drive means of the drive mechanism are formed by a driveable and adjustable four-bar mechanism;
- figure 3 is a diagrammatic representation of the first embodiment of the shed-forming module according to this invention, wherein the module comprises a number of sets of lifting elements movable up and down in antiphase;
- figure 4 is a diagrammatic representation of a second embodiment of the shed-forming module according to this invention, wherein the module comprises two sets of lifting elements movable up and down in antiphase, and wherein the drive means of the drive mechanism are designed for driving two oscillatable shafts;
- figure 5 is a diagrammatic representation of the second embodiment of the shed-forming module according to this invention, wherein the module comprises a number of sets of lifting elements movable up and down in antiphase;
- figure 6 is a front view of the area A outlined in figure 4, on which the two four-bar mechanisms are visible;
- figure 7 is a representation of another embodiment of the four-bar mechanisms shown in figure 6.

[0027] The shed-forming module (1) according to this invention is configured for selective movement of shed-forming elements using lifting elements, preferably in the form of knives. The shed-forming elements, when projected onto a plane perpendicular to their movement direction, are located next to each other in a first direction and in a second direction perpendicular to the first direction. In the figures shown, the first direction is the weft direction and the second direction is the warp direction. Evidently, in another embodiment or other setups of the module (1), the first direction may be the warp direction and the second direction the weft direction.

[0028] The shed-forming module (1) according to this invention comprises:

- at least two sets of lifting elements movable up and down in antiphase;
- shed-forming elements which move selectively with the at least two sets of lifting elements;
- at least four oscillating levers (4, 5; 6, 7) which are provided to move the lifting elements up and down in phase and antiphase according to an adjustable movement amplitude. Each oscillating lever (4, 5; 6, 7) is in each case connected directly or indirectly to

- the lifting elements by two connecting rods (19) which are movable up and down in antiphase;
- first (12) and second (13) transfer mechanisms connected to the lifting elements, which each comprise at least two said oscillating levers (4, 5; 6, 7) located next to each other in the first direction, and which furthermore comprise a connecting mechanism (14, 15) which connects the oscillating levers (4, 5; 6, 7) together per transfer mechanism (12, 13) so that these oscillating levers (4, 5; 6, 7) have virtually the same movement amplitude, and which each consist of the components which transfer the movement from one of the at least two said oscillating levers to the other, wherein the first (12) and second (13) transfer mechanisms are located next to each other in the second direction;
 - a drive mechanism (16) connected to the first (12) and second (13) transfer mechanisms.

[0029] Within the context of this invention, it is important to note that the drive mechanism (16) does not form part of the transfer mechanism (12, 13). The innovative feature of the shed-forming module (1) according to the invention is that the lifting elements through the first (12) and second (13) transfer mechanisms are coupled to the drive mechanism (16) in such a manner that the movement profile and movement amplitude of the lifting elements are fully adjustable via the drive mechanism (16). The movement amplitude of the two transfer mechanisms (12, 13) can be set via an adjustment means (17, 18) which forms part of the drive mechanism (16). The drive mechanism (16) consequently comprises at least two adjustment means (17, 18). Via the adjustment means (17, 18), it is possible to set the movement amplitude of the associated transfer mechanism independently. The two adjustment means (17, 18) together determine the movement amplitude of all shed-forming elements, such that the movement amplitude of all shed-forming elements in the first direction is the same, and the movement amplitude of all shed-forming elements changes linearly in the second direction. Via these two adjustment means (17, 18), the movement amplitude of the entire shed-forming module can be set.

[0030] In a first embodiment of the shed-forming module (1) according to the invention, as presented in figure 2, the lifting elements (26) are moved up and down in antiphase via two lifting means (2, 3) which are movable up and down in antiphase and which in the present embodiment are configured in the form of knife grids located on two opposing sides of the module (1), on the left and right viewed from the point of view of the weaver looking in the direction of the supplied warp yarn. To move the lifting means (2, 3) up and down in antiphase, each oscillating lever (4, 5; 6, 7) is connected to the lifting means (2, 3) via two connecting rods (19) which are movable up and down in antiphase. For this, each oscillating lever (4, 5; 6, 7) comprises a first (4a, 5a, 6a, 7a) and a second (4b, 5b, 6b, 7b) lever arm, each of which is intended to

be connected to the one end of one of the two connecting rods (19).

[0031] The first transfer mechanism (12) is located on the front of the module (1) (viewed from the point of view of the weaver looking in the direction of the supplied warp yarn) and comprises a first (4) and a second (5) oscillating lever. The second transfer mechanism (13) is located on the back of the module (1) and comprises a third (6) and a fourth (7) oscillating lever. With such an arrangement of the transfer mechanisms (12, 13) and as shown in figure 2, the first (4) and third (6) oscillating levers are provided for moving the lifting means (2, 3) up and down in antiphase on the right side of the module (1), and the second (5) and fourth (7) oscillating levers are provided for moving the lifting means (2, 3) up and down in antiphase on the left side of the module (1).

[0032] The drive mechanism (16) used in this invention comprises a first and a second driveable and adjustable four-bar mechanism, wherein the first four-bar mechanism is provided for driving an oscillating lever of the first transfer mechanism (12), and the second four-bar mechanism is provided for driving an oscillating lever of the second transfer mechanism (13). The drive mechanism furthermore comprises a main drive shaft, wherein the first and the second four-bar mechanisms are mechanically coupled to this main drive shaft.

[0033] In the device shown in figure 2, the first four-bar mechanism is connected to the first oscillating lever (4) and the second four-bar mechanism is connected to the third oscillating lever (6). Because the first oscillating lever (4) is connected to one end of the lifting means (2, 3) which are installed on the one side, e.g. the right-hand side (viewed from the point of view of the weaver looking in the direction of the supplied warp yarn) of the module (1), and because the third oscillating lever (6) is connected to the other end of the same lifting means (2, 3), the two four-bar mechanisms are responsible for driving the movement of these lifting means.

[0034] In the shed-forming module (1) according to the invention, the size of the movement amplitude of the lifting elements is completely set by the drive mechanism (16), so that without losing too much time, the amplitude of the lifting elements can be adapted without generating undesirable movement deviations and/or movement differences.

[0035] As already indicated above, the shed-forming module (1) depicted in figure 2 comprises, on two opposite sides of the module (1), on the left and right viewed from the point of view of the weaver looking in the direction of the supplied warp yarn, two lifting means (2, 3) in the form of knife grids which are movable up and down in antiphase. To drive the movement of these knife grids (2, 3) on the front and back of the module (1), viewed from the point of view of the weaver looking in the direction of the supplied warp yarn, a respective driveable and adjustable four-bar mechanism is used. The four-bar mechanism is here formed on the front by: the first adjustment means (17), a first drive rod (20) and a first lever

arm (8a), connected to the first oscillating lever (4) and belonging to a fifth oscillating lever (8), while the four-bar mechanism located on the back is formed by the second adjustment means (18), a second drive rod (21) and a first lever arm (10a), connected to the third oscillating lever (6) and belonging to a seventh oscillating lever (10). Both the fifth (8) and the seventh (10) oscillating levers are composed of a first (8a, 10a) and a second (8b, 10b) lever arm.

[0036] The first (17, 20, 8a) and the second (18, 21, 10a) four-bar mechanisms initiate the movement; they are coupled mechanically at one end to a main drive shaft which is driven by a motor. The mechanical coupling takes place via an element (17, 18) which is provided with a slot in which the drive rod (20, 21) is held. In an alternative embodiment and as shown in figures 2 and 3, instead of a slot, separate coupling points may be provided to which the drive rod (20, 21) may be coupled. These two elements form the first and second adjustment means (17, 18). The amplitude can be changed by changing the position of the drive rod (20, 21) in the slot, or by fixing the drive rod (20, 21) to another coupling point (23) on the element (17, 18) concerned.

[0037] The two four-bar mechanisms stand via their other end in connection with the first (4) and third (6) oscillating levers respectively. For this, the connecting mechanism (14) of the first transfer mechanism (12) comprises a second lever arm (8b) connected to the first oscillating lever (4) and belonging to the fifth oscillating lever (8), and the connecting mechanism (15) of the second transfer mechanism (13) comprises a second lever arm (10b) connected to the third oscillating lever (6) and belonging to the seventh oscillating lever (10). The first oscillating lever (4), the first lever arm (8a) of the fifth oscillating lever (8) and the second lever arm (8b) of the fifth oscillating lever (8), may be separate components which are rigidly coupled together. They may also be formed integrally as one piece, as shown in figure 2. The third oscillating lever (6), the first lever arm (10a) of the seventh oscillating lever (10) and the second lever arm (10b) of the seventh oscillating lever (10) are preferably produced in the same way: as separate components which are rigidly connected together, or as one piece. The first four-bar mechanism is connected to the second lever arm (8b) of the fifth oscillating lever (8), and the second four-bar mechanism is connected to the second lever arm (10b) of the seventh oscillating lever (10).

[0038] In order to transfer the movement to the other side of the module (1), the second lever arm (8b) of the fifth oscillating lever (8), and the second lever arm (10b) of the seventh oscillating lever (10) are connected via a connecting rod (22) respectively to the second lever arm (9b) of the sixth oscillating lever (9) and the second lever arm of the eighth oscillating lever (11). Thus the sixth oscillating lever (9) forms part of the connecting mechanism (14) of the first transfer mechanism (12), and the eighth oscillating lever (11) forms part of the connecting mechanism (15) of the second transfer mechanism (13).

[0039] The embodiment of the shed-forming module (1) according to the invention shown in figure 3 also uses the four-bar mechanism described above. The difference however is that the lifting elements (26) (knives) are rotated through 90° relative to the structure of the lifting elements used in figure 2. As a result, there are no knife grids, but the lifting elements (26) are connected directly via the connecting rods to the oscillating levers of the transfer mechanisms (12, 13).

[0040] Instead of using two adjustable and driveable four-bar mechanisms to drive the first (4) and third (6) oscillating levers directly, two oscillatable shafts (24, 25) may be used which are each driven by a drive rod of a different four-bar mechanism. This embodiment of the shed-forming module (1) is presented in figures 4 and 5. Here, the shed-forming module (1) depicted in figure 4, on its two opposing sides of the module (1), on the left and right viewed from the point of view of the weaver looking in the direction of the supplied warp yarn, comprises two lifting means (2, 3) which are movable up and down in antiphase, in the form of knife grids. To drive the movement of these knife grids (2, 3) on the front and back of the module (1), viewed from the point of view of the weaver looking in the direction of the supplied warp yarn, the respective oscillatable shafts (24, 25) are used which are connected via an oscillating element and connecting rods (19) to the ends of the knife grids (2, 3).

[0041] Also in the embodiment of the shed-forming module (1) according to the invention shown in figure 5, two oscillatable shafts are used. The difference however is that the lifting elements (26) (knives) are rotated through 90° relative to the structure of the lifting element shown in figure 4. As a result, there are no more knife grids, but the lifting elements are connected via the connecting rods (19) directly to the oscillating levers of the transfer mechanisms (12, 13). In this case, a number of oscillating levers are provided next to each other on the oscillatable shaft (24, 25).

[0042] The oscillatable shafts (24, 25) are subdivided into two parts: a first part which is connected to the first drive means (20) or second drive means (21) and which is intended to impose the movement. The first part of each oscillatable shaft forms part of the drive mechanism (16). Furthermore, each oscillatable shaft (24, 25) comprises a second part which extends at the shed-forming elements and forms the connecting mechanism which connects the oscillating levers together per transfer mechanism. In this function, the second part of each oscillatable shaft forms part of the transfer mechanism (12).

[0043] The two four-bar mechanisms are provided in a housing and enable the oscillatable shafts (24, 25) to move. Figure 6 illustrates the two four-bar mechanisms. Figure 7 shows another embodiment of the four-bar mechanism shown in figure 6. In both embodiments, the amplitude is adjusted by two adjustment means (17, 18) which change the position of the bars in the four-bar mechanism. By such a position change, the oscillating movement of the oscillatable shafts (24, 25) is changed.

In the embodiment shown, the adjustment means are located inside the housing. It is however perfectly possible to provide the adjustment means outside the housing.

[0044] The first part of the oscillatable shaft (24) forms part of the drive mechanism (16) and is driven by the first drive means (20) via the first four-bar mechanism. Via a connecting element which forms part of this first four-bar mechanism, the oscillatable shaft (24) is connected to the first drive means (20), which in turn is connected via a connecting rod containing the two adjustment means (17, 18) to a main drive shaft which is driven by a motor. The mechanical coupling point of this main drive shaft to the above-mentioned connecting rod divides this connecting rod into two parts. The one part contains the adjustment means (17), the other part contains the adjustment means (18). The part connected to the drive means (20) - wherein the drive means (20) is connected thereto by the adjustment means (17) - forms part of the first four-bar mechanism. This part, together with the first drive means (20) and the connecting element between the oscillatable shaft (24) and the first drive means (20), thus forms the first four-bar mechanism. By moving the position of the coupling point of the first drive means (20) on the connecting rod by means of the adjustment means (17), the amplitude of the oscillatable shaft (24) can be adjusted.

[0045] The first part of the oscillatable shaft (25) is driven by the second drive means (21) via the second four-bar mechanism. The second drive means (21) is connected to the main drive shaft via the same connecting rod as the first drive means (20), the connection being now implemented by the adjustment means (18). The second four-bar mechanism comprises, as well as the second drive means (21), also the connecting element between the oscillatable shaft (25) and the second drive means (21), and the second part of the connecting rod. By moving the position of the coupling point of the second drive means (21) on the connecting rod by means of the adjustment means (18), the amplitude of the oscillatable shaft (25) can be adjusted.

Claims

1. Shed-forming module (1) for the selective movement of shed-forming elements using lifting elements (26), wherein several shed-forming elements, when projected onto a plane perpendicular to their movement direction, are located next to each other in a first direction and in a second direction perpendicular to the first direction, comprising:

- at least two sets of lifting elements (26) movable up and down in antiphase;
- shed-forming elements which move selectively with the at least two sets of lifting elements (26);
- at least four oscillating levers (4, 5; 6, 7) which are provided to move the lifting elements (26)

up and down in phase and antiphase according to an adjustable movement amplitude;

- first (12) and second (13) transfer mechanisms connected to each of said two sets of lifting elements,

- which each comprise at least two said oscillating levers (4, 5; 6, 7) located next to each other in the first direction and
- which furthermore each comprise a connecting mechanism (14, 15) which connects the oscillating levers (4, 5; 6, 7) together per transfer mechanism (12, 13), so that these oscillating levers (4, 5; 6, 7) have virtually the same movement amplitude, and
- which each consist of the components which transfer the movement from one of the at least two said oscillating levers to the other,
- wherein the first (12) and second (13) transfer mechanisms are located next to each other in the second direction;

- a drive mechanism (16) connected to the first (12) and second (13) transfer mechanisms,

wherein the drive mechanism (16) does not form part of the transfer mechanism (12, 13), **characterised in that** the lifting elements are coupled via the first (12) and second (13) transfer mechanisms to the drive mechanism (16) such that the movement profile and the movement amplitude of the lifting elements are adjustable via the drive mechanism (16).

2. Shed-forming module (1) according to Claim 1, **characterised in that** the drive mechanism (16) comprises at least two adjustment means (17, 18) which are each connected to a different transfer mechanism (12, 13), and which are each provided to adjust the movement amplitude of the associated transfer mechanism independently, and which together determine the movement amplitude of all shed-forming elements such that the movement amplitude of all shed-forming elements in the first direction is the same, and the movement amplitude of all shed-forming elements changes linearly in the second direction.

3. Shed-forming module (1) according to Claim 2, **characterised in that** the movement amplitude of each oscillating lever (4, 5; 6, 7) is unambiguously determined by the movement amplitude of the connected transfer mechanism (12, 13).

4. Shed-forming module (1) according to any of the preceding claims, **characterised in that** the drive mechanism (16) comprises a first and a second driveable and adjustable four-bar mechanism,

wherein the first four-bar mechanism is intended to drive an oscillating lever (4, 5) of the first transfer mechanism (12), and the second four-bar mechanism is provided for driving an oscillating lever (6, 7) of the second transfer mechanism (13).

5. Shed-forming module (1) according to Claim 4, **characterised in that** each four-bar mechanism comprises an adjustment means (17, 18).
6. Shed-forming module (1) according to Claim 5, **characterised in that** the adjustment means (17, 18) is configured as a bar of the four-bar mechanism with a slot in which another bar (20, 21) of the respective four-bar mechanism is displaceable for adjusting the amplitude, or the adjustment means is configured as a bar of the four-bar mechanism with a number of different coupling points (23) to which another bar (20, 21) of the four-bar mechanism can be coupled for adjusting the amplitude.
7. Shed-forming module (1) according to claim 4, **characterised in that** the shed-forming module (1), on two opposing sides of the module (1), comprises two lifting means (2, 3) which are movable up and down in antiphase for moving the lifting elements (26) up and down, and each oscillating lever (4, 5; 6, 7) is connected to these lifting means (2, 3) via two connecting rods (19) which are movable up and down in antiphase.
8. Shed-forming module (1) according to Claim 7, **characterised in that** each oscillating lever (4, 5, 6, 7) comprises a first (4a, 5a, 6a, 7a) and second (4b, 5b, 6b, 7b) lever arm which are each intended to be connected to the one end of one of the two connecting rods (19).
9. Shed-forming module (1) according to Claim 7 or 8, **characterised in that** the first transfer mechanism (12) comprises a first (4) and a second (5) oscillating lever, the second transfer mechanism (13) comprises a third (6) and a fourth (7) oscillating lever, that the first (4) and third (6) oscillating levers are provided for moving the lifting means (2, 3) up and down in antiphase on one side of the module (1), the second (5) and fourth (7) oscillating levers are provided for moving the lifting means (2, 3) up and down in antiphase on the other side of the module (1), and that the first four-bar mechanism is provided for driving the first oscillating lever (4) via a first drive rod (20), and the second four-bar mechanism is provided for driving the third oscillating lever (6) via a second drive rod (21).
10. Shed-forming module (1) according to any of Claims 7 to 9, **characterised in that** the connecting mechanism (14) of the first transfer mechanism (12) com-

prises a second lever arm (8b) of a fifth oscillating lever (8) and a second lever arm (9b) of a sixth oscillating lever (9) connected respectively to the first and second oscillating lever and which are connected together via a connecting rod (22), and that the connecting mechanism (15) of the second transfer mechanism (13) comprises a second lever arm (10b) of a seventh oscillating lever (10) and a second lever arm of an eighth oscillating lever (11), connected respectively to the third (6) and fourth (7) oscillating lever which are connected together via a connecting rod (22).

11. Shed-forming module (1) according to Claim 10, **characterised in that** the first four-bar mechanism is formed by the first adjustment means (17), the first drive rod (20) and the first lever arm (8a) of the fifth oscillating lever (8), and that the second four-bar mechanism is formed by the second adjustment means (18), the second drive rod (21) and the first lever arm (10a) of the seventh oscillating lever (10).
12. Shed-forming module (1) according to any of Claims 4 to 7, **characterised in that** the first and second four-bar mechanisms respectively drive a first (24) and a second (25) oscillatable shaft.
13. Jacquard machine provided with a shed-forming module (1) according to any of Claims 1 to 12.
14. Weaving machine provided with a shed-forming module (1) according to any of Claims 1 to 12.
15. Weaving machine according to Claim 14, **characterised in that** the weaving machine comprises a jacquard machine according to Claim 13.

Patentansprüche

1. Fachbildendes Modul (1) für die selektive Bewegung von fachbildenden Elementen unter Verwendung von Hubelementen (26), wobei mehrere fachbildende Elemente, wenn auf eine Ebene senkrecht zu ihrer Bewegungsrichtung projiziert, in einer ersten Richtung und in einer zweiten Richtung senkrecht zur ersten Richtung nebeneinander befindlich sind, das Folgendes umfasst:
 - mindestens zwei Sätze von Hubelementen (26), die gegenläufig nach oben und unten bewegbar sind;
 - fachbildende Elemente, die sich selektiv mit den mindestens zwei Sätzen von Hubelementen (26) bewegen;
 - mindestens vier Schwinghebel (4, 5; 6, 7), die bereitgestellt sind, um die Hubelemente (26) gleichläufig und gegenläufig entsprechend ei-

ner einstellbaren Bewegungsamplitude nach oben und unten zu bewegen;
 • erste (12) und zweite (13) Übertragungsmechanismen, die mit jedem der zwei Sätze von Hubelementen verbunden sind,

- die jeweils mindestens zwei Schwinghebel (4, 5; 6, 7) umfassen, die in der ersten Richtung nebeneinander befindlich sind und
- die ferner jeweils einen Verbindungsmechanismus (14, 15) umfassen, der die Schwinghebel (4, 5; 6, 7) pro Übertragungsmechanismus (12, 13) miteinander verbindet, sodass diese Schwinghebel (4, 5; 6, 7) praktisch die gleiche Bewegungsamplitude aufweisen, und
- die jeweils aus den Komponenten bestehen, die die Bewegung von einem der mindestens zwei Schwinghebel auf den anderen übertragen,
- wobei der erste (12) und der zweite (13) Übertragungsmechanismus nebeneinander in der zweiten Richtung befindlich sind;
- einen Antriebsmechanismus (16), der mit dem ersten (12) und dem zweiten (13) Übertragungsmechanismus verbunden ist, wobei der Antriebsmechanismus (16) keinen Teil des Übertragungsmechanismus (12, 13) bildet, **dadurch gekennzeichnet, dass** die Hubelemente über den ersten (12) und den zweiten (13) Übertragungsmechanismus mit dem Antriebsmechanismus (16) gekoppelt sind, sodass das Bewegungsprofil und die Bewegungsamplitude der Hubelemente über den Antriebsmechanismus (16) einstellbar sind.

2. Fachbildendes Modul (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Antriebsmechanismus (16) mindestens zwei Einstellmittel (17, 18) umfasst, die jeweils mit einem unterschiedlichen Übertragungsmechanismus (12, 13) verbunden sind, und die jeweils bereitgestellt sind, um die Bewegungsamplitude des zugehörigen Übertragungsmechanismus unabhängig einzustellen, und die zusammen die Bewegungsamplitude aller fachbildenden Elemente bestimmen, sodass die Bewegungsamplitude aller fachbildenden Elemente in der ersten Richtung die gleiche ist und sich die Bewegungsamplitude aller fachbildenden Elemente in der zweiten Richtung linear ändert.
3. Fachbildendes Modul (1) nach Anspruch 2, **dadurch gekennzeichnet, dass** die Bewegungsamplitude jedes Schwinghebels (4, 5; 6, 7) eindeutig durch die Bewegungsamplitude des verbundenen Übertragungsmechanismus (12, 13) bestimmt ist.

4. Fachbildendes Modul (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Antriebsmechanismus (16) einen ersten und einen zweiten antreibbaren und einstellbaren Vier-Stangen-Mechanismus umfasst, wobei der erste Vier-Stangen-Mechanismus dazu dient, einen Schwinghebel (4, 5) des ersten Übertragungsmechanismus (12) anzutreiben und der zweite Vier-Stangen-Mechanismus bereitgestellt ist, um einen Schwinghebel (6, 7) des zweiten Übertragungsmechanismus (13) anzutreiben.

5. Fachbildendes Modul (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** jeder Vier-Stangen-Mechanismus ein Einstellmittel (17, 18) umfasst.

6. Fachbildendes Modul (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** das Einstellmittel (17, 18) ausgelegt ist als eine Stange des Vier-Stangen-Mechanismus mit einem Schlitz, in dem eine andere Stange (20, 21) des entsprechenden Vier-Stangen-Mechanismus zum Einstellen der Amplitude versetzbar ist, oder dass das Einstellmittel ausgelegt ist als eine Stange des Vier-Stangen-Mechanismus mit einer Anzahl unterschiedlicher Kopplungspunkte (23), mit denen eine andere Stange (20, 21) des Vier-Stangen-Mechanismus zum Einstellen der Amplitude gekoppelt werden kann.

7. Fachbildendes Modul (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** das fachbildende Modul (1), auf zwei gegenüberliegenden Seiten des Moduls (1), zwei Hubmittel (2, 3) umfasst, die gegenläufig nach oben und unten bewegbar sind, um die Hubelemente (26) nach oben und unten zu bewegen, und wobei jeder Schwinghebel (4, 5; 6, 7) über zwei Verbindungsstangen (19), die gegenläufig nach oben und unten bewegbar sind, mit diesen Hubmitteln (2, 3) verbunden ist.

8. Fachbildendes Modul (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** jeder Schwinghebel (4, 5, 6, 7) einen ersten (4a, 5a, 6a, 7a) und zweiten (4b, 5b, 6b, 7b) Hebelarm umfasst, die jeweils dazu gedacht sind, mit dem einen Ende einer der zwei Verbindungsstangen (19) verbunden zu werden.

9. Fachbildendes Modul (1) nach Anspruch 7 oder 8, **dadurch gekennzeichnet, dass** der erste Übertragungsmechanismus (12) einen ersten (4) und einen zweiten (5) Schwinghebel umfasst, wobei der zweite Übertragungsmechanismus (13) einen dritten (6) und einen vierten (7) Schwinghebel umfasst, dass der erste (4) und der dritte (6) Schwinghebel bereitgestellt sind, um die Hubmittel (2, 3) auf einer Seite des Moduls (1) gegenläufig nach oben und unten zu bewegen, dass der zweite (5) und der vierte (7) Schwinghebel bereitgestellt sind, um die Hubmittel

(2, 3) auf der anderen Seite des Moduls (1) gegenläufig nach oben und unten zu bewegen, und dass der erste Vier-Stangen-Mechanismus bereitgestellt ist, um den ersten Schwinghebel (4) über eine erste Antriebsstange (20) anzutreiben, und dass der zweite Vier-Stangen-Mechanismus bereitgestellt ist, um den dritten Schwinghebel (6) über eine zweite Antriebsstange (21) anzutreiben.

10. Fachbildendes Modul (1) nach einem der Ansprüche 7 bis 9, **dadurch gekennzeichnet, dass** der Verbindungsmechanismus (14) des ersten Übertragungsmechanismus (12) einen zweiten Hebelarm (8b) eines fünften Schwinghebels (8) und einen zweiten Hebelarm (9b) eines sechsten Schwinghebels (9) umfasst, die mit dem ersten bzw. zweiten Schwinghebel verbunden sind und die über eine Verbindungsstange (22) miteinander verbunden sind, und dass der Verbindungsmechanismus (15) des zweiten Übertragungsmechanismus (13) einen zweiten Hebelarm (10b) eines siebten Schwinghebels (10) und einen zweiten Hebelarm eines achten Schwinghebels (11) umfasst, die mit dem dritten (6) bzw. dem vierten (7) Schwinghebel verbunden sind, die über eine Verbindungsstange (22) miteinander verbunden sind.
11. Fachbildendes Modul (1) nach Anspruch 10, **dadurch gekennzeichnet, dass** der erste Vier-Stangen-Mechanismus durch das erste Einstellmittel (17), die erste Antriebsstange (20) und den ersten Hebelarm (8a) des fünften Schwinghebels (8) gebildet ist, und dass der zweite Vier-Stangen-Mechanismus durch das zweite Einstellmittel (18), die zweite Antriebsstange (21) und den ersten Hebelarm (10a) des siebten Schwinghebels (10) gebildet ist.
12. Fachbildendes Modul (1) nach einem der Ansprüche 4 bis 7, **dadurch gekennzeichnet, dass** der erste und der zweite Vier-Stangen-Mechanismus eine erste (24) bzw. eine zweite (25) oszillierbare Welle antreiben.
13. Jacquard-Maschine, bereitgestellt mit einem fachbildenden Modul (1) nach einem der Ansprüche 1 bis 12.
14. Webmaschine, bereitgestellt mit einem fachbildenden Modul (1) nach einem der Ansprüche 1 bis 12.
15. Webmaschine nach Anspruch 14, **dadurch gekennzeichnet, dass** die Webmaschine eine Jacquard-Maschine nach Anspruch 13 umfasst.

Revendications

1. Module de formation de foule (1) pour le déplace-

ment sélectif d'éléments de formation de foule à l'aide d'éléments de levage (26), plusieurs éléments de formation de foule étant, lorsqu'ils sont projetés sur un plan perpendiculaire à leur direction de déplacement, situés les uns à côté des autres dans une première direction et dans une seconde direction perpendiculaire à la première direction, comprenant :

- au moins deux ensembles d'éléments de levage (26) déplaçables vers le haut et vers le bas en opposition de phase ;
- des éléments de formation de foule qui se déplacent de manière sélective avec les au moins deux ensembles d'éléments de levage (26) ;
- au moins quatre leviers oscillants (4, 5 ; 6, 7) qui sont prévus pour déplacer les éléments de levage (26) vers le haut et vers le bas en phase et en opposition de phase selon une amplitude de déplacement réglable ;
- des premier (12) et second (13) mécanismes de transfert reliés à chacun desdits deux ensembles d'éléments de levage,

- qui comprennent chacun au moins deux desdits leviers oscillants (4, 5 ; 6, 7) situés à côté l'un de l'autre dans la première direction et
- qui comprennent en outre chacun un mécanisme de liaison (14, 15) qui relie ensemble les leviers oscillants (4, 5 ; 6, 7) pour chaque mécanisme de transfert (12, 13), de telle sorte que ces leviers oscillants (4, 5 ; 6, 7) aient pratiquement la même amplitude de déplacement, et
- qui sont chacun constitués des composants qui transfèrent le déplacement de l'un des au moins deux desdits leviers oscillants à l'autre,
- les premier (12) et second (13) mécanismes de transfert étant situés l'un à côté de l'autre dans la seconde direction ;

- un mécanisme d'entraînement (16) relié aux premier (12) et second (13) mécanismes de transfert,

le mécanisme d'entraînement (16) ne faisant pas partie du mécanisme de transfert (12, 13), **caractérisé en ce que** les éléments de levage sont accouplés par le biais des premier (12) et second (13) mécanismes de transfert au mécanisme d'entraînement (16) de telle sorte que le profil de déplacement et l'amplitude de déplacement des éléments de levage soient réglables par le biais du mécanisme d'entraînement (16).

2. Module de formation de foule (1) selon la revendi-

- cation 1, **caractérisé en ce que** le mécanisme d'entraînement (16) comprend au moins deux moyens de réglage (17, 18) qui sont chacun reliés à un mécanisme de transfert (12, 13) différent, et qui sont chacun prévus pour régler de manière indépendante l'amplitude de déplacement du mécanisme de transfert associé, et qui déterminent conjointement l'amplitude de déplacement de tous les éléments de formation de foule de telle sorte que l'amplitude de déplacement de tous les éléments de formation de foule dans la première direction soit la même, et que l'amplitude de déplacement de tous les éléments de formation de foule varie de manière linéaire dans la seconde direction.
3. Module de formation de foule (1) selon la revendication 2, **caractérisé en ce que** l'amplitude de déplacement de chaque levier oscillant (4, 5 ; 6, 7) est déterminée de manière non ambiguë par l'amplitude de déplacement du mécanisme de transfert (12, 13) relié.
 4. Module de formation de foule (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le mécanisme d'entraînement (16) comprend des premier et second mécanismes à quatre barres pouvant être entraînés et réglés, le premier mécanisme à quatre barres étant destiné à entraîner un levier oscillant (4, 5) du premier mécanisme de transfert (12), et le second mécanisme à quatre barres étant prévu pour entraîner un levier oscillant (6, 7) du second mécanisme de transfert (13).
 5. Module de formation de foule (1) selon la revendication 4, **caractérisé en ce que** chaque mécanisme à quatre barres comprend un moyen de réglage (17, 18).
 6. Module de formation de foule (1) selon la revendication 5, **caractérisé en ce que** le moyen de réglage (17, 18) est conçu comme une barre du mécanisme à quatre barres comportant une fente dans laquelle une autre barre (20, 21) du mécanisme à quatre barres respectif peut être déplacée afin de régler l'amplitude, ou le moyen de réglage est conçu comme une barre du mécanisme à quatre barres comportant un certain nombre de points d'accouplement (23) différents avec lesquels une autre barre (20, 21) du mécanisme à quatre barres peut être accouplée afin de régler l'amplitude.
 7. Module de formation de foule (1) selon la revendication 4, **caractérisé en ce que** le module de formation de foule (1), sur deux côtés opposés du module (1), comprend deux moyens de levage (2, 3) qui sont déplaçables vers le haut et vers le bas en opposition de phase afin de déplacer les éléments de levage (26) vers le haut et vers le bas, et chaque levier oscillant (4, 5 ; 6, 7) est relié à ces moyens de levage (2, 3) par le biais de deux bielles (19) qui sont déplaçables vers le haut et vers le bas en opposition de phase.
 8. Module de formation de foule (1) selon la revendication 7, **caractérisé en ce que** chaque levier oscillant (4, 5, 6, 7) comprend des premier (4a, 5a, 6a, 7a) et second (4b, 5b, 6b, 7b) bras de levier qui sont chacun destinés à être reliés à une extrémité de l'une des deux bielles (19).
 9. Module de formation de foule (1) selon la revendication 7 ou 8, **caractérisé en ce que** le premier mécanisme de transfert (12) comprend des premier (4) et deuxième (5) leviers oscillants, le second mécanisme de transfert (13) comprend des troisième (6) et quatrième (7) leviers oscillants, **en ce que** les premier (4) et troisième (6) leviers oscillants sont prévus pour déplacer les moyens de levage (2, 3) vers le haut et vers le bas en opposition de phase sur un côté du module (1), les deuxième (5) et quatrième (7) leviers oscillants sont prévus pour déplacer les moyens de levage (2, 3) vers le haut et vers le bas en opposition de phase sur l'autre côté du module (1), et **en ce que** le premier mécanisme à quatre barres est prévu pour entraîner le premier levier oscillant (4) par le biais d'une première bielle d'entraînement (20), et le second mécanisme à quatre barres est prévu pour entraîner le troisième levier oscillant (6) par le biais d'une seconde bielle d'entraînement (21).
 10. Module de formation de foule (1) selon l'une quelconque des revendications 7 à 9, **caractérisé en ce que** le mécanisme de liaison (14) du premier mécanisme de transfert (12) comprend un second bras de levier (8b) d'un cinquième levier oscillant (8) et un second bras de levier (9b) d'un sixième levier oscillant (9) reliés respectivement aux premier et deuxième leviers oscillants et qui sont reliés l'un à l'autre par le biais d'une bielle (22), et **en ce que** le mécanisme de liaison (15) du second mécanisme de transfert (13) comprend un second bras de levier (10b) d'un septième levier oscillant (10) et un second bras de levier d'un huitième levier oscillant (11) reliés respectivement aux troisième (6) et quatrième (7) leviers oscillants qui sont reliés l'un à l'autre par le biais d'une bielle (22).
 11. Module de formation de foule (1) selon la revendication 10, **caractérisé en ce que** le premier mécanisme à quatre barres est formé par le premier moyen de réglage (17), la première bielle d'entraînement (20) et le premier bras de levier (8a) du cinquième levier oscillant (8), et **en ce que** le second mécanisme à quatre barres est formé par le second

moyen de réglage (18), la seconde bielle d'entraînement (21) et le premier bras de levier (10a) du septième levier oscillant (10).

12. Module de formation de foule (1) selon l'une quelconque des revendications 4 à 7, **caractérisé en ce que** les premier et second mécanismes à quatre barres entraînent respectivement des premier (24) et second (25) arbres aptes à osciller. 5
13. Machine Jacquard pourvue d'un module de formation de foule (1) selon l'une quelconque des revendications 1 à 12. 10
14. Machine à tisser pourvue d'un module de formation de foule (1) selon l'une quelconque des revendications 1 à 12. 15
15. Machine à tisser selon la revendication 14, **caractérisé en ce que** la machine à tisser comprend une machine Jacquard selon la revendication 13. 20

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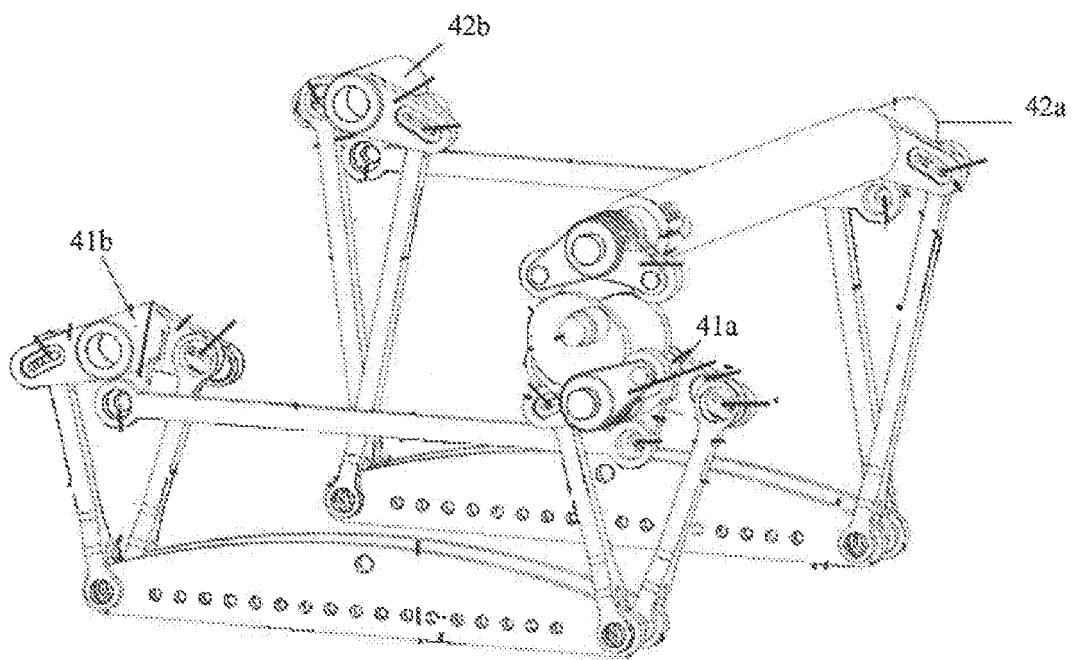


Fig. 1

Prior Art

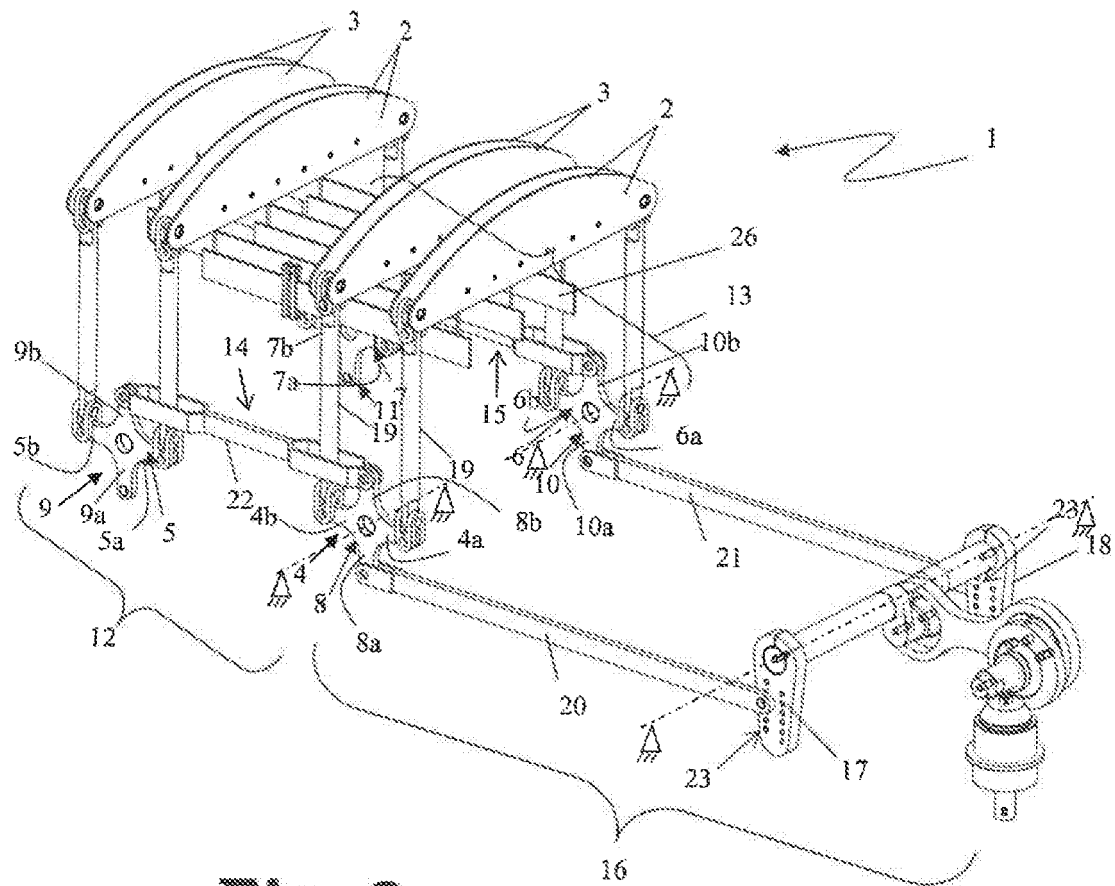


Fig. 2

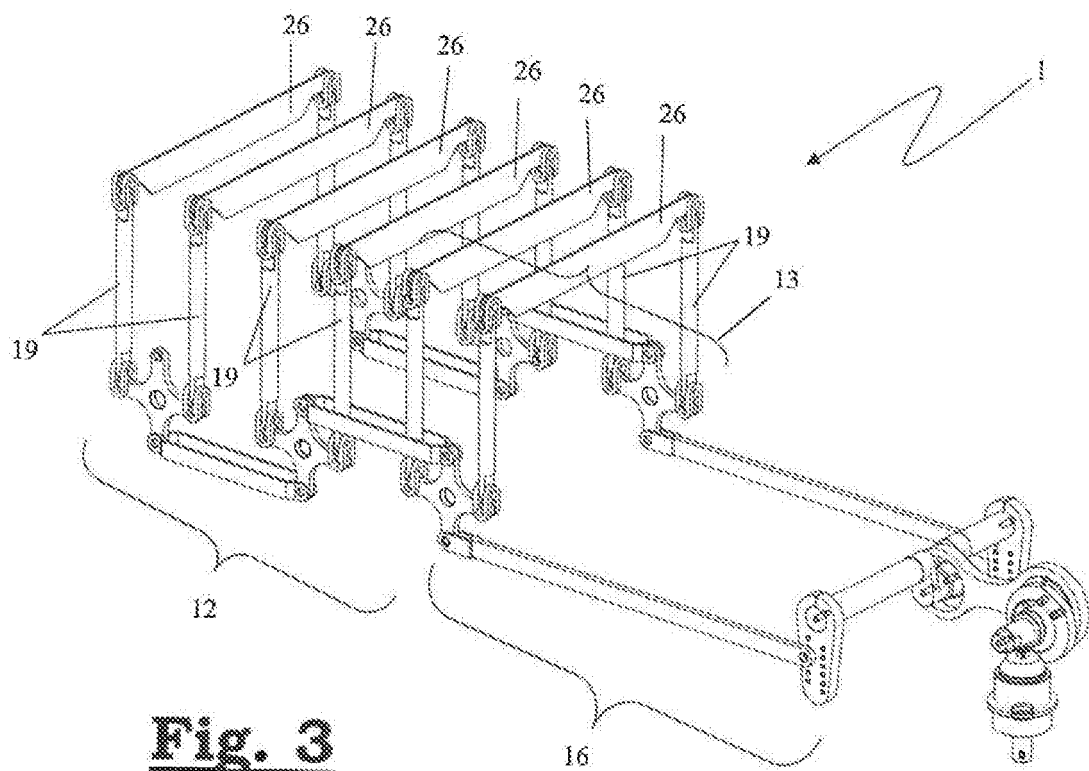
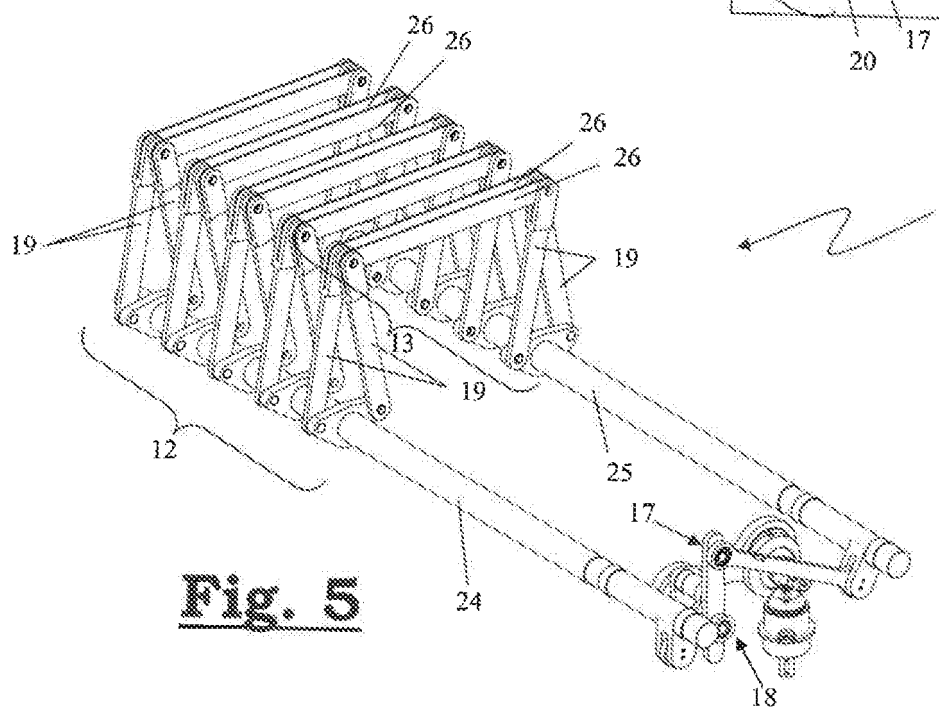
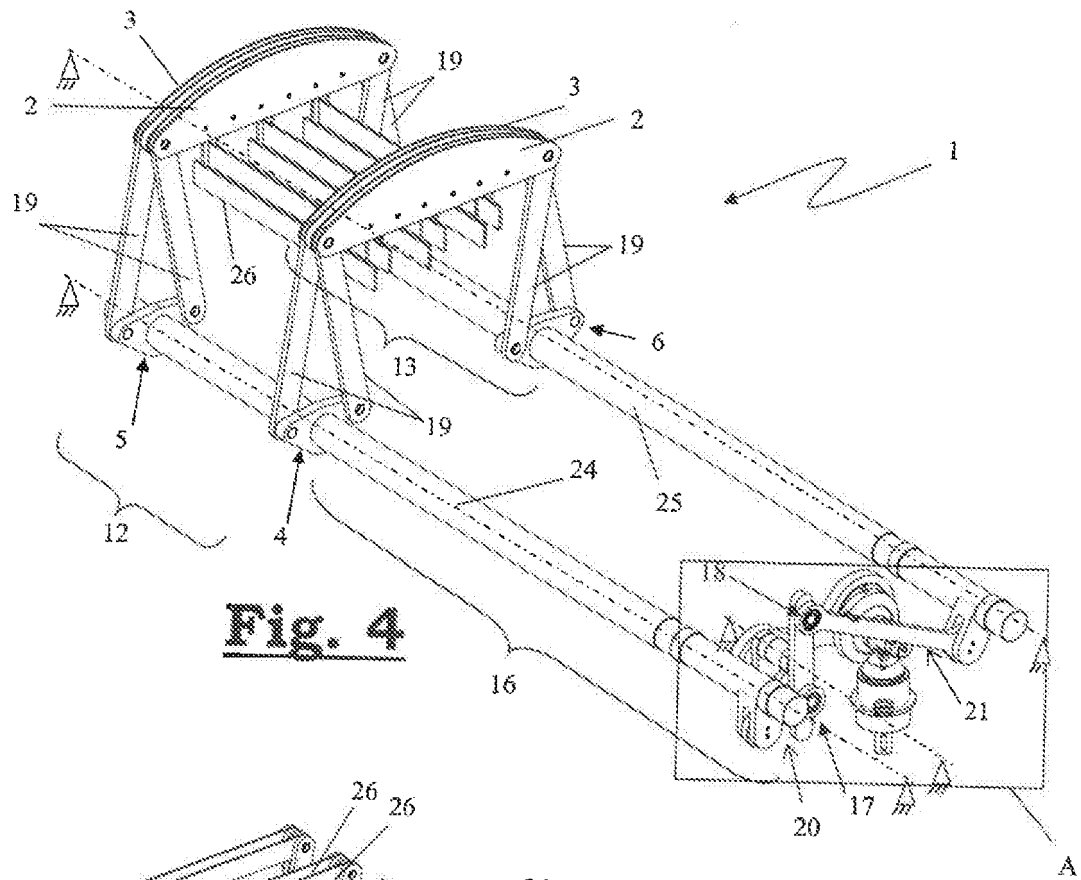


Fig. 3



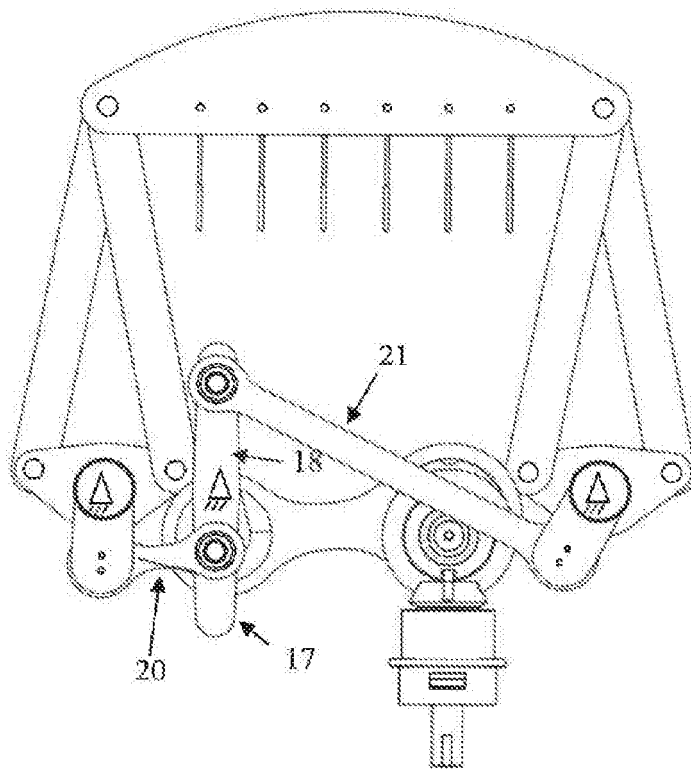


Fig. 6

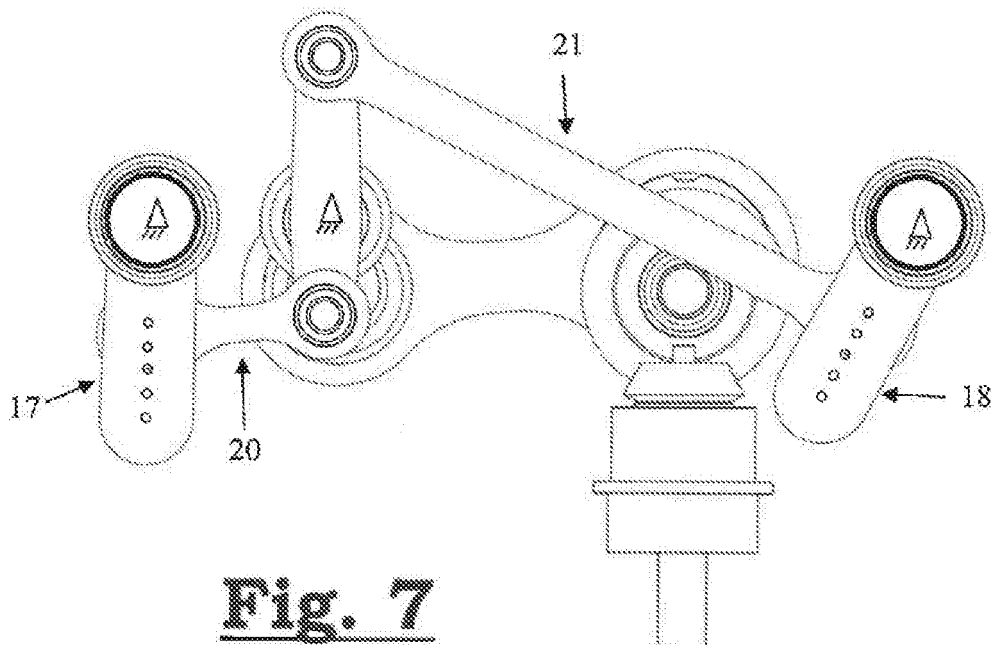


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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