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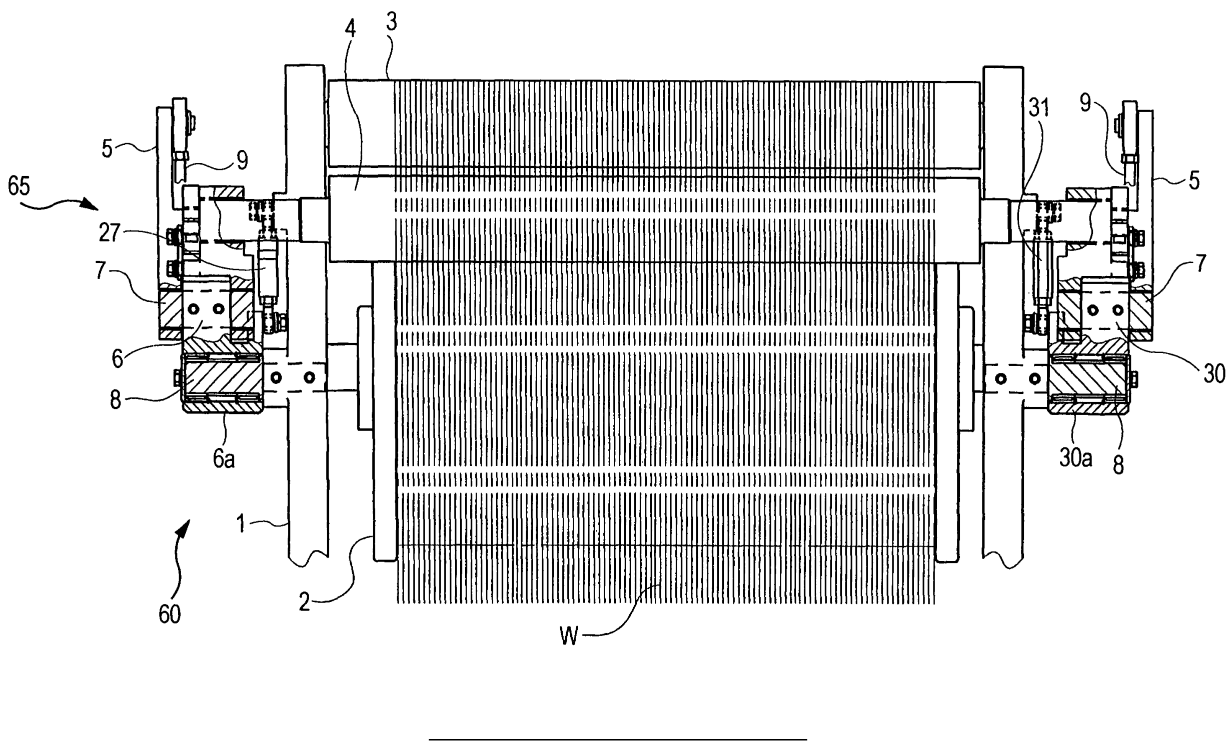
(54) Roll supporting device of loom

(57) A loom roll supporting device (65, 75, 85, 95, 105, 115, 125, 135), in which two shaft sections (4b) of a roll (4) that guides warp (W) drawn out from a let-off beam (2) are supported at respective ends of a pair of levers (5,45,54) through first bearings (13) fitted to the shaft sections (4b), and in which the pair of levers (5) are supported by respective frames (1) through second bearings (14) and shafts (7,46) that are fitted to the second bearings (14), includes an arm (11, 35, 38, 40) that is provided at at least one end of the roll (4), that connects the at least one end of the roll (4) and the corresponding lever (5) to each other, and that sets the roll (4) in an unrotatable state.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a loom roll supporting device that guides warp drawn out from a let-off beam.

2. Description of the Related Art

[0002] In one type of roll supporting device that guides warp drawn out from a let-off beam, both shaft sections of a roll are supported by respective ends of a pair of levers. The roll is rotatably supported through first bearings provided at the shaft sections, and the pair of levers are supported by respective frames through second bearings. The supporting device detects warp tension by detecting through the levers a load applied to the roll. In addition, it swings the roll in a front-back direction to perform what is called an "easing motion," thereby reducing a change in a warp path length, caused by a shedding motion of the warp, as a result of which variation in the warp tension is restricted.

[0003] In Japanese Unexamined Patent Application Publication No. 5-51845, a roll supporting device further comprises a pair of second levers by which the pair of levers are supported through the second bearings. The pair of second levers are supported by the respective frames through third bearings, and one tension detector connects the second lever and the frame to each other. Further, the pair of levers are connected to easing rods. While the roll is rotated by the warp, it is subjected to an easing motion as the pair of levers swing.

[0004] Even if the roll is rotated by the warp, and the warp that is drawn out from the let-off beam reaches in a crossed state the roll, the warp is guided in a direction in which the crossed state is cancelled by the rotation of the roll. This can reduce strong rubbing between portions of the warp, and the occurrence of thread breakage and fluffs.

[0005] However, when a weaving condition specifies the use of a relatively thick warp, it is generally known that the following is desirable: the roll does not rotate, that is, the roll is fixed with respect to the pair of levers. When the roll does not rotate, movement of the warp in a front-back direction is restricted by friction force between the roll and the warp, so that, during a beating-up operation, movement of the warp towards a cloth fell by a reed is restricted. This improves the beating-up performance of the reed, so that a high-quality fabric cloth is obtained.

[0006] Since the roll is switched to a rotatable state or to an unrotatable state depending upon the weaving condition, in Japanese Examined Patent Application Publication No. 60-28941 (hereinafter referred to as JP 60-28941B), two members, each having a semi arc surface, are used to form the pair of levers, which rotatably support the roll through the first bearings provided at the roll shaft sections, at locations where the pair of levers are separated from the first bearings in an axial direction. The semi arc surfaces face each other and surround the roll shaft sections, and the two members are joined through bolts. The bolts are tightened to bring the semi arc surfaces close to each other to clamp the roll shaft sections through brake shoes provided at the semi arc surfaces. This causes the roll to be set in the unrotatable state relative to the two members, that is, the levers, so that this structure is used under a weaving condition that specifies the use of a relatively thick warp. The bolts are loosened to separate the semi arc surfaces from each other to separate the brake shoes from the roll shaft sections. This makes it possible for the roll to rotate and to be used in a weaving condition that specifies the use of a relatively thin warp.

[0007] However, in JP 60-28941B, to maintain the fixed state of the roll against rotational force, produced by warp tension, by friction force between the roll shaft sections and the brake shoes, the roll shaft sections must be satisfactorily clamped by the semi arc surfaces of the two members. When the clamping force is weak, the roll is no longer in the fixed state and rotates due to variation in the warp tension. This causes an ununiform beating-up operation of the reed, thereby impairing the quality of the fabric cloth. Therefore, the bolts are tightened with a large tightening force, and the two members, making up the levers, and the roll shaft sections are firmly integrated to each other. The roll is flexed by the warp tension, causing the roll shaft sections to tilt. Since the levers and the roll shaft sections are integrated to each other in this way, the levers tilt as the roll shaft sections are tilted. The second bearings are fitted to the levers, and shafts, secured to frames, pass through the second bearings, so that the levers are supported by the frames through the second bearings and the shafts. Therefore, the second bearings are tilted as the levers are tilted, so that axial lines of the shafts and the second bearings intersect each other. Since the levers swing without rotating in one direction, lubricating oil is not supplied over the entire peripheral surfaces of the shafts and the entire peripheral surfaces of the second bearings. This results in the supply of lubricating oil to portions of the shafts and portions of the second bearings. As a result, partial wearing quickly occurs, thereby inevitably requiring early replacement of the shafts and the second bearings.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the present invention to make it possible to reduce wearing of bearings, which support a pair of levers, and shafts, which are fitted to the bearings, when a roll is set in an unrotatable state at a loom roll supporting device in which the roll, which guides warp drawn out from a let-off beam, is rotatably supported by the pair of levers.

[0009] To this end, according to the present invention, there is provided a loom roll supporting device in which two shaft sections of a roll that guides warp drawn out from a let-off beam are supported at respective ends of a pair of levers through first bearings fitted to the shaft sections, and in which the pair of levers are supported by respective frames through second bearings and shafts that are fitted to the second bearings. The loom roll supporting device includes an arm that is provided at at least one end of the roll, that connects the at least one end of the roll and the corresponding lever to each other, and that sets the roll in an unrotatable state.

[0010] According to the loom roll supporting device, since an arm is connected to the lever and an end of the roll, the roll is set in the unrotatable state relative to the levers, thereby improving the beating-up performance of a reed, so that a high-quality fabric cloth is obtained. The roll is flexed by warp tension, causing the axial lines of the roll shaft sections to tilt. Since the end of the roll and the lever are connected to each other through the arm, the tilting of the axial line of the roll resulting from the warp tension is absorbed as a result of displacement of the connection portion of the arm with the end of the roll or the connection portion of the arm with the lever, or as a result of deformation of the arm, thereby reducing the effect of the tilting on the lever and, thus, restricting the tilting of the lever. In other words, as a result of the displacement of either connection portion or the deformation of the arm, the arm allows the axial line of the roll to tilt. Therefore, the shaft and the second bearing supporting the lever are such that their axial lines remain matched similarly to when the lever and the end of the roll is not connected to each other by the arm, that is, when the roll is rotatable. Consequently, partial wearing of the shaft and the second bearing supporting the lever is reduced, so that they do not need to be early replaced.

[0011] In one form, the loom roll supporting device further includes an intermediate member that is connected to the at least one end of the roll, wherein the arm connects the at least one end of the roll and the corresponding lever to each other through the intermediate member.

[0012] According to this form, since an intermediate member is connected to an end of the roll, and the arm connects the end of the roll and the lever to each other through the intermediate member, that is, since the intermediate member connected to the end of the roll and integrated to the roll is provided with a connection portion with the arm, the roll-side connection portion can be formed with respect to the arm. Therefore, the connection portion can be more freely provided. For example, the connection portion can be provided radially more outward, so the arm can restrict the rotation of the roll with a smaller force. Therefore, the rigidity of the arm can be reduced. When arms are provided at both ends of the roll, the phases of the connection portions between the arms and the roll, that is, their positions in a circumferential direction need to match at both ends of the roll. Since the roll is long, it is difficult to mechanically process the connection portions so that their phases match at both ends of the roll. However, since intermediate members are connected to the ends of the roll, adjusting the phases of the intermediate members and the roll makes it possible for the phases of the connection portions of the arms and the roll to match at both ends of the roll. Therefore, it becomes technically possible to provide the arms at both ends of the roll. In addition, the rotation of the roll is reliably restricted without the roll being twisted. Further, since two arms are provided, the rigidity can be reduced. A method of connecting intermediate members to the ends of the roll include (1) fitting the intermediate members to the outer peripheral surfaces of the ends of the roll and securing them with, for example, bolts, pins, keys, etc., and (2) securing the intermediate members to the end surfaces of the roll with, for example, bolts, pins, etc. In particular, if the intermediate members are split-fastened by providing one or more slits (which extend in an axial line direction and radially pass through the intermediate members from the inner peripheral surfaces to the outer peripheral surfaces thereof), fitting the intermediate members to the ends of the roll, and securing the intermediate members to the roll with bolts, the phases between the intermediate members and the roll can be arbitrarily adjusted. Therefore, the phases at the connection portions of the arms and the roll can be precisely matched at both ends of the roll.

[0013] In another form, at least one of a connection between the arm and the roll side and a connection between the arm and the corresponding lever is capable of being broken.

[0014] According to this form, since an end of the roll and the lever is disconnected, the roll can rotate. Therefore, it is possible to switch the roll to the rotatable state or to the unrotatable state in accordance with a weaving condition, so that a high-quality fabric cloth can be woven. When an intermediate member is connected to an end of the roll, and the arm connects the end of the roll and the lever to each other through the intermediate member, the arm and the roll are disconnected from each other by either disconnecting the intermediate member and the end of the roll from each other or by disconnecting the intermediate member and the arm from each other.

[0015] In still another form, a direction of extension of a straight line connecting a connection portion of the arm and the roll side and a connection portion of the arm and the corresponding lever intersects a direction of a load from the warp to the roll.

[0016] The roll is flexed by warp tension, causing the axial lines of the roll shaft sections to tilt. The connection portion of the arm with the roll moves as the axial lines tilts, so that this connection portion is displaced relative to the connection portion of the arm with the lever. That is, both connection portions of the arm are relatively displaced. Since one of the connection portions of the arm is connected to the lever, the roll rotates slightly as a result of receiving a force that cancels the relative displacement, through the rigidity of the arm, that is, a force of the arm opposing an external force. According to this form, since the direction of extension of a straight line connecting the connection portion with the roll side and the connection portion with the lever crosses the direction of application of a load from the warp to the roll, the relative displacement is canceled by the slight rotation of the roll. That is, even if the relative displacement amount is the same, the larger the angle of intersection between the extension direction and the load direction, the relative displacement is overcome by a smaller rotation of the roll. Therefore, even if the amount of tilting of the axial line of the roll changes due to a variation in the warp tension, the stationary state of the roll is maintained, so that the movement of the warp in contact with the roll is sufficiently restricted. The intersection angle is desirably equal to or greater than 15 degrees. Even if the warp tension varies, the stationary state of the roll is reliably maintained.

[0017] In still another form, the arm is connected to at least one of the roll side and the corresponding lever through a bearing.

[0018] According to this form, the bearing that connects the arm to at least either the roll or the lever absorbs the tilting of the roll shaft section resulting from the flexing of the roll. As a result, the effect the tilting on the lever is restricted, so that the tilting of the lever is restricted. Therefore, partial wearing of the shaft and the second bearing supporting the lever is restricted. The bearing may be a spherical bearing, a self-aligning bearing, or a sliding bearing. The spherical bearing and the self-aligning bearing absorb the tilting of the roll shaft section as a result of a change in an axial core direction. The sliding bearing has a very small gap for interposing a lubricating oil film between it and the shaft that is fitted. The very small gap does not restrict the relative displacement between the axial line of the sliding bearing and the axial line of the shaft. Therefore, the tilting of the roll shaft section is absorbed by the relative displacement between the axial line of the sliding bearing and the axial line of the shaft.

[0019] In still another form, the arm is formed of a flexible material.

[0020] According to this form, since the tilting of the roll shaft section resulting from the flexing of the roll is absorbed as a result of deformation of the arm, the effect of the tilting on the lever is reduced. Therefore, partial wearing of the shaft and the second bearing supporting the lever is reduced. A flexible member is desirably an elastic material such as synthetic resin, rubber, a coil spring, or a leaf spring. By properly setting the elastic modulus, the tilting of the roll shaft section resulting from the flexing of the roll is absorbed, thereby reliably restricting the rotation of the roll.

[0021] In still another form, the pair of levers are supported by the respective frames through the second bearings and the shafts that are fitted to the second bearings, the roll supporting device further includes a tension detector, and at least one of the levers is connected to the corresponding frame through the tension detector.

[0022] According to this form, force applied to the lever is detected by a tension detector, and, from a detection value, force that is applied to the roll, that is, warp tension is calculated. When weaving is performed while the roll is set in the unrotatable state by the arm, the arm allows tilting of the axial line of the roll as a result of displacement of either connection portion or deformation of the arm. Therefore, the roll and the lever are not set in a state in which they cannot be displaced relative to each other, that is, in a rigid-body state. Accordingly, similarly to when weaving is performed while the roll is set in the rotatable state, the roll shaft section becomes or substantially becomes a free end, so that it is supported by the lever through the first bearing. Consequently, calculation of the warp tension from the detection value of the tension detector does not require correction of a formula in accordance with the rigid-body state of the roll and the lever, so that it is possible to use the same formula as that used when the roll is rotatable, to precisely calculate the warp tension. In addition, since the effect of the tilting of the roll shaft on the lever is reduced, the tilting of the lever is reduced. When the lever tilts, the tension detector receives a force from a direction that is different from the detection direction, and deforms in that direction. Therefore, the detection value is not accurate. However, as described above, even if the roll is set in the unrotatable state, the tilting of the lever is restricted. As a result, the force that the tension detector receives from a direction that is different from the detection direction is reduced, so that, similarly to when the roll is set in the rotatable state, the warp tension can be precisely detected.

[0023] In still another form, the pair of levers are swung by easing driving units around the shafts that are fitted to the second bearings as swing centers, at least one of the levers is supported by a second lever through the second bearing and the shaft that is fitted to the second bearing, the second lever is supported by the corresponding frame through a third bearing and a shaft that is fitted to the third bearing, the roll supporting device further includes a tension detector, and the second lever is connected to the corresponding frame through the tension detector.

[0024] According to this form, the pair of levers are swung by easing driving units around the shafts, fitted to the second bearings, as swing centers. Force applied to the roll, that is, force reflecting warp tension is applied to the shafts serving as the swing centers. The force applied to the shafts serving as the swing centers acts upon a second lever as a moment around the shaft, fitted to the third bearing, as a center, and is detected by the tension detector. When weaving is performed while the roll is set in the unrotatable state, the end of the roll and the lever are connected to each other by the arm, as a result of which the roll is set in the unrotatable state. The roll and the lever are not integrated to each other, that is, the roll and the lever are not in a rigid-body state. Similarly to when weaving is performed while the roll is set in the rotatable state, the roll shaft section becomes or substantially becomes a free end, so that it is supported by the lever through the first bearing. Consequently, calculation of the warp tension from the detection value of the tension detector does not require correction of a formula in accordance with the rigid-body state of the roll and the lever, so that it is possible to use the same formula as that used when the roll is rotatable, to precisely calculate the warp tension. In addition, the effect of the tilting of the roll shaft section on the lever is reduced, and the effect of the tilting of the roll shaft section on the second lever is reduced through the second bearing and the shaft fitted to the second bearing, so that the tilting of the second lever is reduced. Even if the roll is set in the unrotatable state, the tilting of the second lever is restricted. As a result, the force that the tension detector receives from a direction that is different from the detection direction is reduced, so that, similarly to when the roll is set in the rotatable state, the warp tension can be precisely detected. The easing driving units swing the levers through easing rods connected to the levers, or swing the levers by swinging the shafts in a structure in which the levers and the shafts, fitted to the second bearings, are integrated to each other with bolts, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 is a plan view of an entire letting-off apparatus 60 including a supporting device 65 of a tension roll 4 according to a first embodiment of the present invention;
Fig. 2 is a plan view of the left side of the letting-off apparatus 60;
Fig. 3 is a side view of the left side of the letting-off apparatus 60;
Fig. 4 is an enlarged view of the main portion of Fig. 2;
Fig. 5 is an enlarged view of the main portion of Fig. 3;
Fig. 6 is a side view of the left side of the letting-off apparatus 60 when the tension roll 4 is switched to a rotatable state from a state shown in Fig. 3;
Fig. 7 is an enlarged view of a main portion of a supporting device 75 of a tension roll 4 according to a second embodiment of the present invention;
Fig. 8 is an enlarged view of a main portion of a supporting device 85 of a tension roll 4 according to a third embodiment of the present invention;
Fig. 9 is an enlarged view of a main portion of a supporting device 95 of a tension roll 4 according to a fourth embodiment of the present invention;
Fig. 10 is a side view of a letting-off apparatus 100 including a supporting device 105 of a tension roll 4 according to a fifth embodiment of the present invention;
Fig. 11 is a side view of a letting-off apparatus 110 including a supporting device 115 according to a sixth embodiment of the present invention;
Fig. 12 is a plan view of a letting-off apparatus 120 including a supporting device 125 according to a seventh embodiment of the present invention; and
Fig. 13 is a plan view of a letting-off apparatus 130 including a supporting device 135 according to an eighth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Embodiments of the present invention will hereunder be described with reference to the drawings. Figs. 1 to 6 illustrate a letting-off apparatus 60 including a roll supporting device 65 according to a first embodiment of the present invention. Fig. 1 is a plan view of the entire letting-off apparatus 60 of a loom, and is partly in cross section. Fig. 2 is a plan view of the left side of the letting-off apparatus 60 as viewed from a side of a take-up apparatus (not shown). Fig. 3 is a side view of the left side of the letting-off apparatus 60. Figs. 4 and 5 and enlarged views of main portions of Figs. 2 and 3. Fig. 6 shows a state in which connection of an end of a roll and a lever is broken, so that the roll is set in a rotatable state.

[0027] The letting-off apparatus 60 includes a let-off beam 2, a back roll 3, and a tension roll 4, which corresponds to a roll according to the present invention. Warp W drawn out from the let-off beam 2 reaches the tension roll 4 through the back roll 3, is bent by the tension roll 4, and is sent to a shedding apparatus, so that a warp shed is formed. Rotation of the let-off beam 2 is controlled to control warp tension. That is, if a detected warp tension is greater than a set value, the rotation of the let-off beam 2 is increased to increase a let-off speed of the warp W. In contrast, if the detected warp tension is less than the set value, the rotation of the let-off beam 2 is reduced to reduce the let-off speed of the warp W.

[0028] To restrict warp tension variation caused by shedding motion during one rotation of the loom, an easing mechanism is provided. In the easing mechanism, easing rods 9 reciprocate in a front-back direction by easing driving units (not shown) using, for example, cam mechanisms, and a pair of tension levers 5, which support both shaft sections 4b of the tension roll 4, are connected to the easing rods 9, so that the tension roll 4 swings in the front-back direction. This reduces a change in warp path length resulting from the shedding motion, so that a variation in the warp tension is reduced. A load cell 27, serving as a tension detector, is provided at the left side of the loom to detect the warp tension.

[0029] Shafts 8 are secured to left and right frames 1 through setscrews 25. Needle bearings 15 are fitted, respectively, to a boss 6a of a tension detecting lever 6 (disposed at the left side of the loom and serving as a second lever according to the present invention) and to a boss 30a of a holding lever 30 (disposed at the right side of the loom). The shafts 8 are fitted to the respective needle bearings 15. By this, the tension detecting lever 6 and the holding lever 30 are supported by the frames 1 through the needle bearings 15 and the shafts 8. The needle bearings 15 and the shafts 8 correspond to third bearings according to the present invention and shafts that are fitted to the third bearings. Shafts 7 are secured to the tension detecting lever 6 and the holding lever 30 with setscrews 24. The tension levers 5, disposed at the left and right sides of the loom and corresponding to a pair of levers according to the present invention, are provided with metals 14, formed by sliding bearings. The shafts 7 are fitted to the metals 14. The metals 14 and the shafts 7 correspond to second bearings according to the present invention and shafts that are fitted to the second bearings. The tension levers 5 are rotatably supported by the tension detecting lever 6 and the holding lever 30, respectively. The tension levers 5 are also provided with metals 13 corresponding to first bearings according to the present invention and formed by sliding bearings. The shaft sections 4b of the tension roll 4 are fitted to the metals 13, and the tension levers 5 support the respective shaft sections 4b of the tension roll 4. The tension detecting lever 6 is connected to the frame 1 with a bolt 21 through the load cell 27 having spherical bearings 16 at both ends thereof. The holding lever 30 is connected to the frame 1 with a bolt 21 through a connecting member 31 having spherical bearings 16 at both ends thereof. The easing rods 9 are connected to the respective tension levers 5 with bolts 22 through spherical bearings 17. The tension detecting lever 6 and the holding lever 30 are connected to the frames 1 through the load cell 27 and the connecting member 31, respectively, so that their displacements are restricted. Consequently, the swing centers of the tension levers 5, that is, the shafts 7 are maintained in position without being displaced. Therefore, the tension roll 4 can perform a predetermined swing motion, that is, an easing motion due to the easing rods 9. The tension roll 4 moves towards a take-up side during shedding of the warp W, and towards a side opposite to the take-up side during closing of the warp W, so that variation in tension caused by shedding of the warp is restricted.

[0030] As shown in Fig. 3, the supporting device 65 of the tension roll 4 according to the first embodiment includes arms 11 and pairs of spherical bearings 12. The arms 11 correspond to arms according to the present invention, and are formed of a plate material. The spherical bearings 12 and both ends of each arm 11 are joined to each other by, for example, caulking. A pair of roll attachments 10, serving as intermediate members according to the present invention, each have one slit extending entirely in an axial line direction and radially passing through the intermediate member from an inner peripheral surface to an outer peripheral surface. The roll attachments 10 that are fitted to the outer peripheral surfaces of the shaft sections of the tension roll 4 are fastened by bolts 23, and secured and split-fastened to both shaft sections of the tension roll 4. A side of each roll attachment 10 is provided with an internal thread 10a, and each tension lever 5 is provided with a seat that is provided with an internal thread 5a. The pair of spherical bearings 12 of each arm 11 are mounted to the internal threads 5a and 10a through bolts 20. The arms 11 are removable with respect to the tension levers 5 and the roll attachments 10 by the bolts 20.

[0031] As shown in Fig. 5, which is an enlarged view of the main portion, warp tension T at the let-off-beam-2 side of the warp W and warp tension T at the take-up side act as forces in a tangential direction of the tension roll 4, and a resultant of these forces acts upon the tension roll 4 as a load P. Since the central portion of the tension roll 4 is flexed in the direction of the load P, and axial lines of the shaft sections 4b at the ends of the tension roll 4 are tilted in a direction opposite to the direction of the load P, axial core positions of the shaft sections 4b are displaced from A0 to A1 by a movement amount e. Therefore, connection portions of the roll attachments 10 try to move similarly from B0 to B1 by a movement amount e. Consequently, a compression force acts upon the arms 11 connected to the internal threads 5a of the tension levers 5, and the arms 11 cause an opposing force to act upon the roll attachments 10 against the compression force produced by the roll attachments 10. As a result, the roll attachments 10 rotate slightly by a rotational angle γ, so that the connection portions of the roll attachments 10 are positioned at B2. The tension roll 4 to which the roll attachments 10 are split-fastened and secured rotates slightly while being kept in a flexed state. Due to the displacement of the roll attachments 10 caused by the flexing of the tension roll 4, force that is applied to each arm 11, more specifically, the force that is applied to each arm 11 through the connection portion B0 with the corresponding roll attachment 10 is divided into a force acting in a direction connecting a connection portion C of the arm 11 and the tension lever 5 and the connection portion B0 and a force acting in a direction perpendicular to the direction connecting the connection portions C and B0. The force acting in the direction connecting the connection portion C and the connection portion B0 acts upon each arm 11 as compression force. Since the larger an intersection angle θ between the direction of the load P and the direction of extension of a line B0-C connecting the connection portions B0 and C, the smaller the compression force and the smaller the rotational angle γ of the tension roll 4, this is desirable. In other words, even if the amount of flexing of the tension roll 4 varies due to variation in the warp tension, the change in the rotational angle γ is small, so that the stationary state of the tension roll 4 is maintained and the movement of the warp W that contacts the tension roll 4 is sufficiently restricted. The intersection angle θ is desirably at least 15 degrees, and is 30 degrees in the embodiment. At the intersection angle θ of 90 degrees, the amount of rotation, that is, the rotational angle γ of the tension roll 4 is a minimum. Although, in the embodiment, the connection portions C of the arms 11 and the tension levers 5 are provided at a side where the tension roll 4 contacts the warp W, the connection portions C may be provided at the opposite side. In this case, the flexing of the tension roll 4 causes a tensile force to act upon the arms 11. To restrict the flexing caused by the warp tension to the extent possible, the tension roll 4 is provided with rigidity. In Fig. 5, for simplifying the explanation, the movement amount e of the axial core of each shaft section 4b resulting from the flexing of the tension roll 4 is shown considerably larger than it actually is. Therefore, the actual rotational angle γ of the tension roll 4 is considerably smaller than that shown in Fig. 5.

[0032] The roll attachments 10 and the tension levers 5 are connected to each other through the arms 11 and the two spherical bearings 12 provided at the respective ends of each arm 11. The tilting of the axial lines of the ends 4b of the tension roll 4 caused by warp tension is allowed as a result of displacement of the connection portions of the arms 11, that is, a change in an axial center direction of the two spherical bearings 12 of each arm 11. Therefore, the effect of the tilting of the axial lines of the ends 4b of the tension roll 4 on the tension levers 5 through the arms 11 is reduced, so that the tilting of the tension levers 5 is restricted.

[0033] It is desirable that two arms 11 be provided, one at each end of the tension roll 4. The tension roll 4 is not twisted, and, since two arms 11 are provided, the tension roll is kept in the unrotatable state even if the arms 11 have low rigidity. In this case, to prevent the tension roll 4 from becoming twisted, it is necessary to match phases of the connection portions at both shaft sections of the tension roll 4. The roll attachments 10, serving as intermediate members according to the present invention, are secured to the respective shaft sections of the tension roll 4 as a result of being split-fastened by the bolts 23. Therefore, a phase at the connection portion B0 with each arm 11 provided at its corresponding roll attachment 10, that is, a phase at each internal thread 10a with respect to the tension roll 4 can be arbitrarily adjusted continuously by unfastening the corresponding bolt 23. Consequently, it is possible to precisely match the phases of the connection portions at both shaft sections of the tension roll 4.

[0034] As mentioned above, under a weaving condition specifying, for example, the use of a thick warp, it is desirable to set the tension roll 4 in the unrotatable state as a result of connecting the tension roll 4 and the tension levers 5 through the arms 11. However, depending upon a weaving condition specifying, for example, the use of a thin warp, it is desirable to set the tension roll 4 in the rotatable state. To switch the tension roll 4 to the rotatable state, at least one of disconnecting the arms 11 and the tension roll 4 from each other and disconnecting the arms 11 and the tension levers 5 from each other is carried out. To disconnect the arms 11 and the tension roll 4 from each other, at least one of disconnecting the roll attachments 10 and the tension roll 4 from each other and disconnecting the arms 11 and the roll attachments 10 from each other is carried out. To disconnect the roll attachments 10 and the tension roll 4 from each other, the bolts 23 are loosened. To disconnect the arms 11 and the roll attachments 10 from each other, the bolts 20 are removed from the internal threads 10a. To disconnect the arms 11 and the tension levers 5 from each other, the bolts 20 are removed from the internal threads 5a. In Fig. 6, the arms 11 and the roll attachments 10 are disconnected from each other. The bolts 20 are removed from the internal threads 10a of the roll attachments 10, and the spherical bearings 12 at the roll-attachment-10 side of the arms 11 are mounted to the internal threads 5b of the tension levers 5 using the removed bolts 20. In the embodiment, since the arms 11 are not removed from the loom, it is not necessary to store the removed members, so that the tension roll 4 can be quickly switched to the unrotatable state.

[0035] The tension roll 4 is flexed by warp tension, causing the shaft sections 4b to tilt. Very small gaps for interposing lubricating oil film are formed between the shaft sections 4b and the metals 13 fitted to the tension levers 5. Therefore, the effect on the tension levers 5 of the tilting of the shaft sections 4b of the tension roll 4 through the metals 13 is reduced, and the shaft sections 4b of the tension roll 4 are supported as free ends or substantially as free ends by the tension levers 5 through the metals 13. When the tension roll 4 is set in the unrotatable state through the arms 11, as mentioned above, the tilting of the shaft sections 4b of the tension roll 4 is absorbed by the two spherical bearings 12 provided at each arm 11, so that the effect of the tilting on the tension levers 5 through the arms 11 is reduced. Therefore, even if the tension roll 4 is set in the rotatable state or is set in the unrotatable state by the arms 11, the effect on the tension levers 5 of the tilting of the shaft sections 4b of the tension roll 4 through the metals 13 or the metals 13 and the arms 11 is reduced, so that the tilting of the tension levers 5 is restricted. Since the tension levers 5 swing in the front-and-back direction and do not rotate in one direction as a result of having the easing rods 9 connected thereto, the lubricating oil film between the metals 14 and the shafts 7 is often used up. Therefore, if their axial line directions do not match, partial wearing occurs very frequently. However, since, as mentioned above, the tilting of the tension levers 5 is restricted, the axial lines of the metals 14 and the shafts 7 remain matched, so that partial wearing is restricted.

[0036] To detect warp tension, the load cell 27 is provided as a tension detector only at the left side of the letting-off apparatus 60. The tension detecting lever 6 is connected to the corresponding frame 1 through the load cell 27 and the pair of spherical bearings 16, one provided at each end of the load cell 27. The connecting member 31 and the holding lever 30 are provided at the right side of the letting-off apparatus 60 instead of the load cell 27 and the tension detecting lever 6. The holding lever 30 is connected to the corresponding frame 1 through the connecting member 31 and the pair of spherical bearings 16, one provided at each end of the connecting member 31.

[0037] The load on the left shaft section 4b of the tension roll 4 along with a load produced by the easing rod 9 act upon the supporting point of the left tension lever 5, that is, the shaft 7. As a result, a moment centered around the shaft 8 is applied to the tension detecting lever 6, and a load is applied to the load cell 27 connected to the frame 1. The load cell 27 detects the applied load, that is, tensile force, and outputs a detection result to a warp tension calculating device (not shown). The warp tension calculating device calculates the warp tension from the detection value of the load cell 27 using a predetermined formula.

[0038] Since the tilting of the tension lever 5 caused by the flexing of the tension roll 4 is restricted, the tilting of the tension detecting lever 6 through the metal 14 and the shaft 7 is restricted. Therefore, application of force upon the load cell 24 from a direction that is different from the detection direction is restricted. Consequently, the load cell 24 can precisely detect the tensile force of the tension detecting lever 6, so that the warp tension is precisely calculated on the basis of the detection value.

[0039] In the loom, when a weaving width is changed due to a change in a fabric cloth that is set, the position of the load of the warp tension may shifted towards one side instead of being situated at the center of the tension roll 4. If the tension roll 4 is set in the rotatable state, as mentioned above, gaps for interposing lubricating oil film are formed between the shaft sections 4b of the tension roll 4 and the metals 13 fitted to the tension levers 5. Therefore, the shaft sections 4b of the tension roll 4 are supported as free ends or substantially as free ends by the metals 13. When the shaft sections 4b of the tension roll 4 are supported as free ends or substantially as free ends by the metals 13, the load of the tension roll 4 produced by the warp tension is distributed to each shaft section 4b on the basis of the distance between the shaft sections 4b and the load position of the warp tension. Therefore, a large load is applied to the shaft sections 4b whose distance from the load position is small. Consequently, when the tension roll 4 is set in the rotatable state, a formula in which a deflection in a weaving width direction of a warp arrangement is considered is used to calculate the warp tension. Although, in the embodiment, the load cell 27 is provided at only one side of the loom, since the warp tension can be calculated from the detection value of the load cell 27 at one side using the formula in which the deflection of the weaving width direction of the warp arrangement is considered, it is not necessary to provide two load cells 27, one at each side of the loom.

[0040] In the case where the rotation of the tension roll 4 is restricted and made unrotatable, when, as in the related art, the tension roll 4 and the tension levers 5 are firmly integrated to each other as substantially rigid bodies, the load applied to the shaft sections 4b of the tension roll 4 is determined by considering the load in accordance with how rigid the tension roll 4 and the tension levers 5 are, in addition to the load resulting from deflection in the weaving width direction of the warp arrangement. In other words, when the tension roll 4 and the tension levers 5 are integrated to each other as complete rigid bodies, a load corresponding to 1/2 the overall warp tension is applied to each shaft section 4b. However, since the tension roll 4 and the tension levers 5 cannot be completely rigid bodies, the load produced by the warp tension is distributed to each shaft section 4b depending upon the deflection in the weaving width direction of the warp arrangement and the rigidity of the tension roll 4 and the tension levers 5. Therefore, it is very difficult to precisely calculate the warp tension from the tension value of each shaft section 4b. Consequently, it is necessary to calculate the warp tension using an experimentally determined formula. In addition, each time the tension roll 4 is switched from the rotatable state to the unrotatable state, that is, each time the supporting state of the tension roll 4 is switched from the free-end supporting state or the substantially free-end supporting state, achieved by the tension levers 5, to the integrated state, achieved by the tension levers 5, the rigidity of the tension roll 4 and the tension levers 5 may be different from that in a previous switching to the unrotatable state. Therefore, the experimentally obtained formula becomes inevitably inaccurate. Consequently, the setting of the tension is not stabilized, thereby adversely affecting the quality of a fabric cloth. Further, each time the tension roll 4 is switched from the rotatable state to the unrotatable state or from the unrotatable state to the rotatable state, an operator needs to change the formula that is used, thereby placing a burden on the operator. In addition, an error made by the operator, such as forgetting to change or making a mistake about the formula, causes a wrong warp tension to be set, thereby making it possible to impair the quality of the fabric cloth.

[0041] In the embodiment, in the supporting device 65, while the arms 11 restrict the tension roll 4 to the unrotatable state, the arms 11 do not restrict in any way the tilting of the shaft sections 4b of the tension roll 4. Therefore, similarly to when the tension roll is set in the rotatable state, the shaft sections 4b of the tension roll 4 are supported as free ends or substantially as free ends. Therefore, even if the tension roll 4 is set in the unrotatable state, the warp tension is calculated from the detection value of the load cell 27 as a result of using the same formula as that used when the tension roll 4 is set in the rotatable state, that is, when the tension roll 4 is not connected to the tension levers 5.

[0042] In the embodiment, the arms 11 are connected to the tension levers 5 and the roll attachments 10 through the spherical bearings 12 at both ends thereof to connect the tension roll 4 and the tension levers 5 to each other. However, it is possible to provide the spherical bearing 12 at only one end of each arm 11 and to connect the other end of each arm 11 to the corresponding tension lever 5 or the roll attachment 10 through a bolt or a pin. Alternatively, although each arm 11 is formed of a plate material, the two spherical bearings 12 are joined, one to each end of each arm 11 by, for example, caulking, and the arms 11 are connected to the tension levers 5 and the roll attachments 10 through the bolts 20 that are inserted into the spherical bearings 12, the following is possible. That is, the outer peripheral surfaces of the ends of the bolts 20 are spherical, and members having spherical inner peripheral surfaces that are joined to the arms 11 by, for example, caulking are provided. The spherical inner peripheral surfaces of the members and the spherical outer peripheral surfaces of the ends of the bolts 20 are fitted to each other to provide spherical bearings at the ends of the arms 11. Further, it is possible to form the arms 11 using bars, such as round bars or hexagonal bars, and mount rod ends having spherical bearings 12 to the arms 11 by, for example, screwing.

[0043] Fig. 7 is an enlarged view of the main portion of a letting-off apparatus 70 including a supporting device 75 of a tension roll 4 according to a second embodiment of the present invention.

[0044] The supporting device 75 includes arms 35, formed of a plate material, and pairs of spherical bearings 12. The pairs of spherical bearings 12 are joined, one to each end of each arm 35 by, for example, caulking. A pair of roll attachments 36 are secured, one to each shaft end of the tension roll 4 by being split-fastened by bolts 23. An internal thread 36a is provided at a seat formed at the outer peripheral surface of each roll attachment 36, and an internal thread 37a is provided at a seat formed at each tension lever 37. The spherical bearings 12 are mounted to the seats through respective bolts 20. The arms 35 are removable from the tension levers 37 and the roll attachments 36 through the bolts 20.

[0045] As in the supporting device 65 according to the first embodiment, in the supporting device 75 of the tension roll 4 according to the second embodiment, the tension roll 4 and the tension levers 37 are connected to each other and made unrotatable relative to each other. In addition, the tension roll 4 is supported so that tilting of shaft sections 4b, caused by flexing of the tension roll 4 by warp tension, does not affect tilting of the tension levers 37. When the tension roll 4 is switched to a rotatable state, the spherical bearings 12 mounted to the roll attachments 36 are removed along with the bolts 20, and are mounted through the removed bolts 20 to the seats (not shown) where the internal threads of the tension levers 37 are provided. This disconnects the tension roll 4 from the tension levers 37 and makes it rotatable.

[0046] Fig. 8 is an enlarged view of the main portion of a letting-off apparatus 80 including a supporting device 85 of a tension roll 4 according to a third embodiment of the present invention.

[0047] The supporting device 85 includes arms 40, formed of a plate material, and pairs of holes 40a, one passing through each end of each arm in a thickness direction. A metal 41, which makes up a sliding bearing, is fitted to each hole 40a of each arm 40. A pin 42 is fitted to each metal 41. Through bolts 43, the pins 42 are fixed to respective internal threads 10b and 5a having stepped holes and formed at roll attachments 10 and tension levers 5, respectively. The distance between a flange of each pin 42 and each roll attachment 10 and the distance between a flange of each pin 42 and each tension lever 5 are both greater than the thickness of each arm 40, and each arm 40 is allowed to move slightly in an axial line direction of each pin 42. Slight gaps for interposing lubricating oil film are formed between the metals 41 and the respective pins 42. Therefore, axial lines of the metals 41 can tilt with respect to axial lines of the pins 42. Accordingly, the roll attachments 10 and the tension levers 5 are connected to each other through the arms 40. The tension roll 4 is in an unrotatable state supported by the tension levers 5. In addition, tilting of the arms 40 with the pins 42 prevents tilting of shaft sections 4b of the tension roll 4, caused by warp tension, from affecting the tension levers 5. Therefore, the tension roll 4 is, as when it is set in the rotatable state, supported as free ends or substantially as free ends by the tension levers 5 through metals 13. Each arm may be formed of a flexible elastic material, such as a leaf spring, so that the ends of the tension roll 4 is supported as free ends to a greater extent.

[0048] Fig. 9 is an enlarged view of the main portion of a letting-off apparatus 90 including a supporting device 95 of a tension roll 4 according to a fourth embodiment of the present invention.

[0049] The supporting device 95 includes arms 38, formed of a flexible elastic material, such as a leaf spring. Each arm 38 has two holes 38a at each end in the thickness direction. Bolts 20 are inserted into the respective holes 38a of the arms 38, and are screwed into internal threads 10a, provided at roll attachments 10, and internal threads 5a, provided at tension levers 5. Accordingly, the roll attachments 10 and the tension levers 5 are connected to each other through the arms 38, and the tension arm 4 in an unrotatable state is supported by the tension levers 5. Since the arms 38 are flexible members, they can be easily deformed. By deforming the arms 38, tilting of shaft sections 4b of the tension roll 4, caused by warp tension, does not affect the tension levers 5. Therefore, the tension roll 4 is, as when it is set in a rotatable state, supported as free ends or substantially as free ends by the tension levers 5 through metals 13.

[0050] Fig. 10 illustrates a letting-off apparatus 100 including a supporting device 105 of a tension roll 4 according to a fifth embodiment of the present invention. The supporting device 105 uses the arms 11 according to the first embodiment as arms.

[0051] The letting-off apparatus 100 includes a pair of tension levers 45, which support respective ends of the tension roll 4 and which correspond to levers according to the present invention. Each tension lever 45 is fitted to a metal 14 corresponding to a second bearing according to the present invention and making up a sliding bearing. In addition, shafts 46, secured to frames 1, are fitted to the metals 14, and washers 55 are secured to the shafts 46 through bolts. This causes the tension levers 45 to be supported by the frames 1 through the metals 14 and the shafts 46, fitted to the metals 14, and movement of the shafts 46 in an axial line direction to be restricted by the washers 55. A pair of easing springs 47, which are compression springs, are provided as elastic members. One end of each tension lever 45 engages its corresponding easing spring 47. One of the easing springs 47 is connected a load cell 27, serving as a tension detector, through an easing rod 48, and the load cell 27 is connected to the corresponding frame 1 through a spherical bearing 16. The other easing spring 47 is connected to an easing rod (not shown), and the easing rod is connected to the corresponding frame 1 through a spherical bearing 16 without being connected to a tension detector.

[0052] Each easing spring 47 pushes one end of the tension lever 45 engaging the easing spring 47, and biases the tension roll 4 supported by the tension levers 45 towards a side opposite to the take-up side, to reduce a change in a warp path length, caused by a warp shedding motion, thereby reducing variations in warp tension. That is, when the warp path length is increased due to shedding, the warp tension is increased. When the warp tension becomes larger than a force for pulling warp W as a result of the easing springs 47 biasing the tension roll 4, the tension roll 4 moves towards the take-up side. This reduces the warp path length, thereby reducing an increase in the warp tension. When the warp path length is reduced due to warp closing, the warp tension is reduced. When the warp tension becomes less than the force for pulling the warp W as a result of the easing springs 47 biasing the tension roll 4, the tension roll 4 moves towards the side opposite to the take-up side. This increases the warp path length, thereby reducing a reduction in the warp tension.

[0053] In the supporting device 105 of the tension roll 4, the arms 11 connect roll attachments 10 and the tension levers 45 to each other. Similarly to the supporting device 65 of the tension roll 4 according to the first embodiment, the tension levers 45 support ends of the tension roll 4 as free ends or substantially as free ends. Therefore, partial wearing of the metals 14 and the shafts 46 (fitted to the metals 14), caused by tilting of shaft sections 4b (resulting from flexing of the tension roll 4) affecting the tension levers 5, can be reduced.

[0054] Force for biasing the tension levers 45 by the easing springs 47 acts upon the shaft sections 4b of the tension roll 4 by a force based on a lever ratio of the tension levers 45 and centered around the shafts 46, so that the tension roll 4 pulls the warp W towards the side opposite to the take-up side by a force that is in correspondence with the warp tension. The force acting upon the shaft sections 4b of the tension roll 4 due to the easing springs 47 is detected by the load cell 27. As with the letting-off apparatus 60 according to the first embodiment, using the formula in which the deflection in the weaving width direction of the warp arrangement is considered, the warp tension is calculated from the force applied to the shaft sections 4b of the tension roll 4. Therefore, as with the letting-off apparatus 60 according to the first embodiment, the warp tension can be determined using the same formula regardless of whether the tension roll 4 is set in a rotatable state or an unrotatable state.

[0055] Fig. 11 illustrates a letting-off apparatus 110 including a supporting device 115 of a tension roll 4 according to a sixth embodiment of the present invention. The supporting device 115 uses the arms 11 according to the first embodiment as arms.

[0056] The letting-off apparatus 110 includes a pair of tension levers 54, which support respective ends of the tension roll 4 and which correspond to levers according to the present invention. Each tension lever 54 is fitted to a metal 14 corresponding to a second bearing according to the present invention and making up a sliding bearing. In addition, shafts 46, secured to frames 1, are fitted to the metals 14, and washers 55 are secured to the shafts 46 through bolts. This causes the tension levers 54 to be supported by the frames 1 through the metals 14 and the shafts 46, fitted to the metals 14, and movement of the shafts 46 in an axial line direction to be restricted by the washers 55. One end of each tension lever 54 is connected to its corresponding frame 1. That is, one of the tension levers 54 is connected to one end of a load cell 27 having a pair of spherical bearings 16, one at each end of the load cell 27. The other end of the load cell 27 is connected to its corresponding frame 1 through the spherical bearing 16. The other tension lever 54 is connected to its corresponding frame 1 through a connecting member (not shown) and a pair of spherical bearings 16, one provided at each end of the connecting member.

[0057] Force that is in correspondence with warp tension is applied to the tension levers 54 through the tension roll 4, and a moment that is centered around the shafts 46 acts upon the tension levers 54. Due to the moment, a tensile force acts upon the load cell 27 that connects the tension lever 54 to the frame 1, and the tensile force is detected by the load cell 27. As with the letting-off apparatus 60 according to the first embodiment, in the supporting device 115, shaft sections 4b of the tension roll 4 are supported as free ends or substantially as free ends. The warp tension is calculated from a detection value of the load cell 27 using a formula in which deflection in a weaving width direction of a warp arrangement is considered. Therefore, as with the letting-off apparatus 60 according to the first embodiment, the same formula may be used regardless of whether the tension roll 4 is set in a rotatable state or an unrotatable state.

[0058] Fig. 12 illustrates a letting-off apparatus 120 including a supporting device 125 of a tension roll 4 according to a seventh embodiment of the present invention. The supporting device 125 uses the arms 11 according to the first embodiment as arms.

[0059] The letting-off apparatus 120 includes a tension detecting lever 50 and a holding lever 51 at the left side and the right side of a loom, respectively. Needle bearings 52, which correspond to third bearings according to the present invention, are fitted to a left bearing accommodation hole of a frame 1 and a right bearing accommodation hole of a frame 1. Both ends of a shaft 49 are fitted to the needle bearings 52 so as to pass through the needle bearings 52 in a left-right direction. The tension detecting lever 50 and the holding lever 51 are split-fastened to respective ends of the shaft 49 through bolts 53. The tension detecting lever 50 and the holding lever 51 are firmly integrated to each other through the shaft 49, and are supported by the frames 1 through the needle bearings 52 and the shaft 49. Similarly to the tension detecting lever 6 of the letting-off apparatus 60, the tension detecting lever 50 is connected the frame 1 through a load cell 27. Unlike the holding lever 30 of the letting-off apparatus 60, the holding lever 51 is not connected to the frame 1. Therefore, in Fig. 12, a load of a right shaft section 4b of the tension roll 4 also acts upon the tension detecting lever 50 as a moment through the shaft 49. Consequently, a detection value of the load cell 27 becomes a value that reflects an overall warp tension, so that the warp tension can be measured without using a formula in which deflection in a weaving width direction of a warp arrangement is considered.

[0060] Fig. 13 illustrates a letting-off apparatus 130 including a supporting device 135 of a tension roll 4 according to an eighth embodiment of the present invention. The supporting device 135 uses the arms 11 according to the first embodiment as arms. The letting-off apparatus 130 is provided at a twin-beam loom and has two let-off beams 2.

[0061] In the supporting device 135 of the tension roll 4, tension detecting levers 6 are provided at both the left and right side thereof. The tension detecting levers 6 are connected to frames 1 through load cells 27, each having spherical bearings 16 at two ends. As in the first embodiment, the load cells 27 detect loads of shaft sections 4b of the tension roll 4 that are applied to tension levers 5 through the tension detecting levers 6.

[0062] When, as in a related art, for setting the tension roll 4 in an unrotatable state, the tension roll 4 and the pair of tension levers 5 are integrated to each other in a rigid-body state using, for example, bolts, the left and right load cells 27 each detect 1/2 of an overall warp tension. Therefore, tension cannot be detected for each let-off beam 2. Therefore, in the twin-beam loom, since the warp tension at each let-off beam 2 cannot be controlled, weaving cannot be performed while the tension roll 4 is set in the unrotatable state.

[0063] However, in the embodiment, the tension roll 4 is set in the unrotatable state as a result of being connected to the tension levers 5 through the arms 11 according to the first embodiment. Similarly to when the tension roll 4 is set in a rotatable state, the shaft sections 4b of the tension roll 4 are set as free ends or substantially as free ends by the tension levers 5. Therefore, similarly to when the tension roll 4 is rotatable, from detection values of the two load cells 27, the tensions of the warp drawn out from the let-off beams 2 can be calculated using a predetermined formula in which deflection in a weaving width direction of a warp arrangement is considered. The let-off beams 2 are driven independently on the basis of the calculated warp tensions, so that they are maintained at predetermined warp tensions.

[0064] The present invention is not limited to the above-described embodiments, so that various modifications may be made without departing from the gist of the present invention.

Claims

1. A loom roll supporting device (65, 75, 85, 95, 105, 115, 125, 135) in which two shaft sections (4b) of a roll (4) that guides warp (W) drawn out from a let-off beam (2) are supported at respective ends of a pair of levers (5,45,54) through first bearings (13) fitted to the shaft sections (4b), and in which the pair of levers (5) are supported by respective frames (1) through second bearings (14) and shafts (7,46) that are fitted to the second bearings (14),
wherein the loom roll supporting device (65, 75, 85, 95, 105, 115, 125, 135) is **characterized in** comprising an arm (11,35,38,40) that is provided at at least one end of the roll (4), that connects said at least one end of the roll (4) and the corresponding lever (5) to each other, and that sets the roll (4) in an unrotatable state.

2. The loom roll supporting device according to Claim 1, further comprising an intermediate member (10) that is connected to said at least one end of the roll (4), wherein the arm (11,35,38,40) connects said at least one end of the roll (4) and the corresponding lever (5) to each other through the intermediate member (10).

3. The loom roll supporting device according to Claim 1, wherein at least one of a connection between the arm (11,35,38,40) and the roll (4) side and a connection between the arm (11,35,38,40) and the corresponding lever (5) is capable of being broken.

4. The loom roll supporting device according to Claim 1, wherein a direction of extension of a straight line connecting a connection portion (B0) of the arm (11,35,38,40) and the roll (4) side and a connection portion (C) of the arm (11,35,38,40) and the corresponding lever (5) intersects a direction of a load from the warp (W) to the roll (4).

5. The loom roll supporting device according to any one of Claims 1 to 4, wherein the arm (11,35,40) is connected to at least one of the roll (4) side and the corresponding lever (5,45,54) through a bearing (12).

6. The loom roll supporting device according to either

Claim 1 or Claim 2, wherein the arm (38) is formed of a flexible material.

7. The loom roll supporting device according to any one of Claims 1 to 3, wherein the pair of levers (45,54) are supported by the respective frames (1) through the second bearings (14) and the shafts (46) that are fitted to the second bearings (14), the roll supporting device further comprises a tension detector (27), and at least one of the levers (45,54) is connected to the corresponding frame (1) through the tension detector (27).

8. The loom roll supporting device according to any one of Claims 1 to 3, wherein the pair of levers (5) are swung by easing driving units around the shafts (7) that are fitted to the second bearings (14) as swing centers, at least one of the levers (5) is supported by a second lever (6) through the second bearing (14) and the shaft (7) that is fitted to the second bearing (14), the second lever (6) is supported by the corresponding frame (1) through a third bearing (15) and a shaft (8) that is fitted to the third bearing (15), the roll supporting device further comprises a tension detector (27), and the second lever (6) is connected to the corresponding frame (1) through the tension detector (27).

FIG. 1

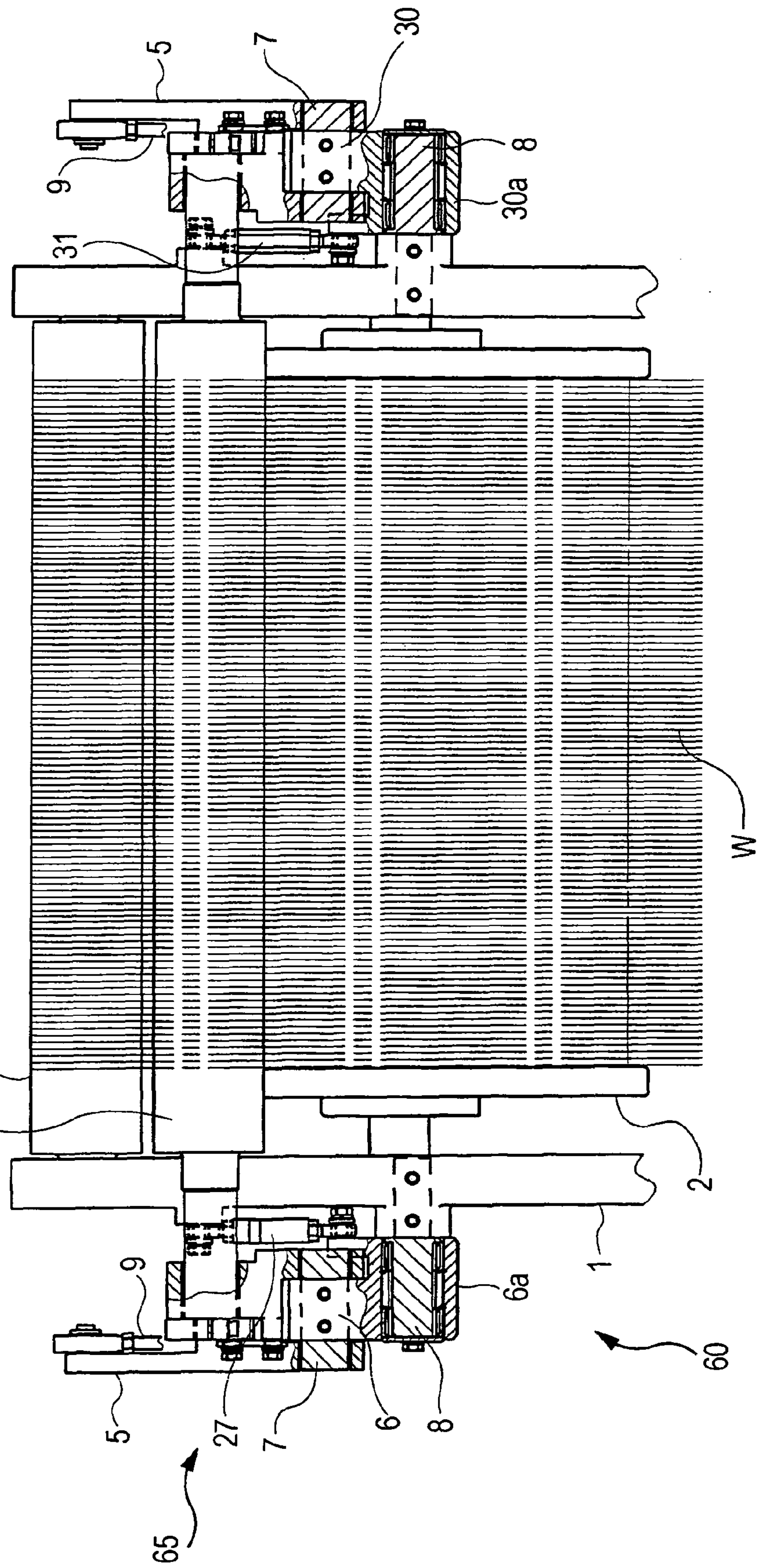


FIG. 2

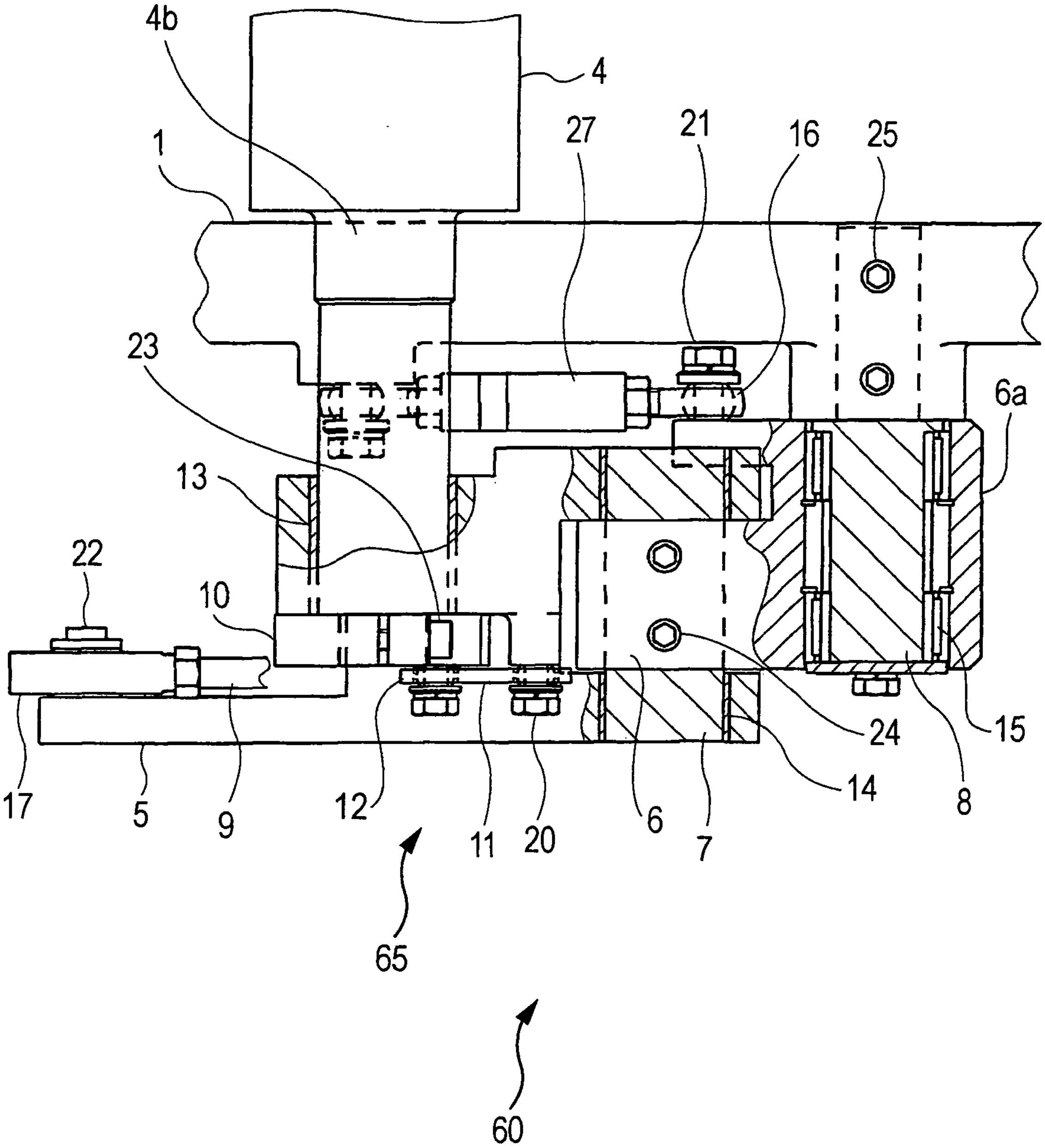


FIG. 3

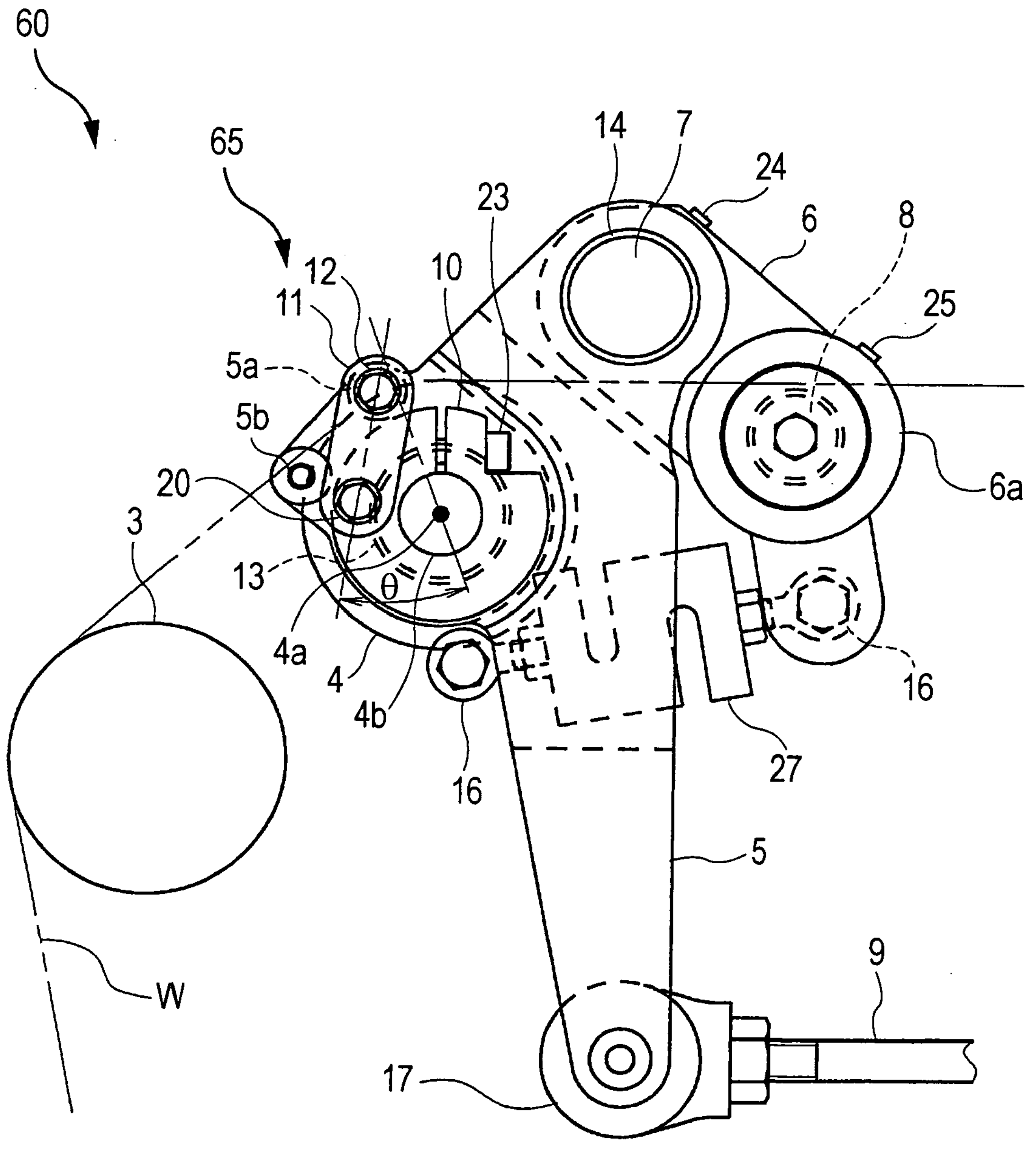


FIG. 4

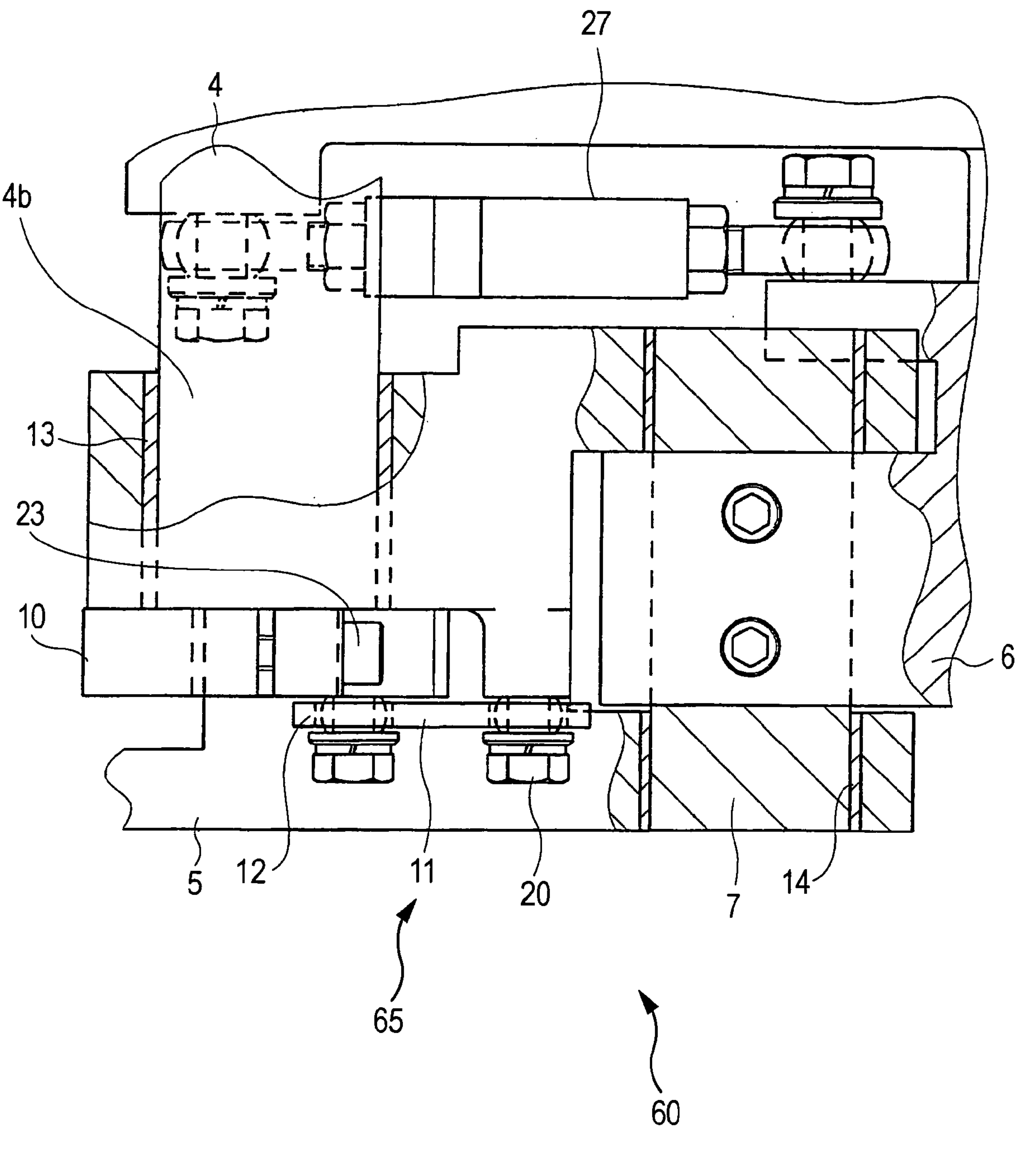


FIG. 5

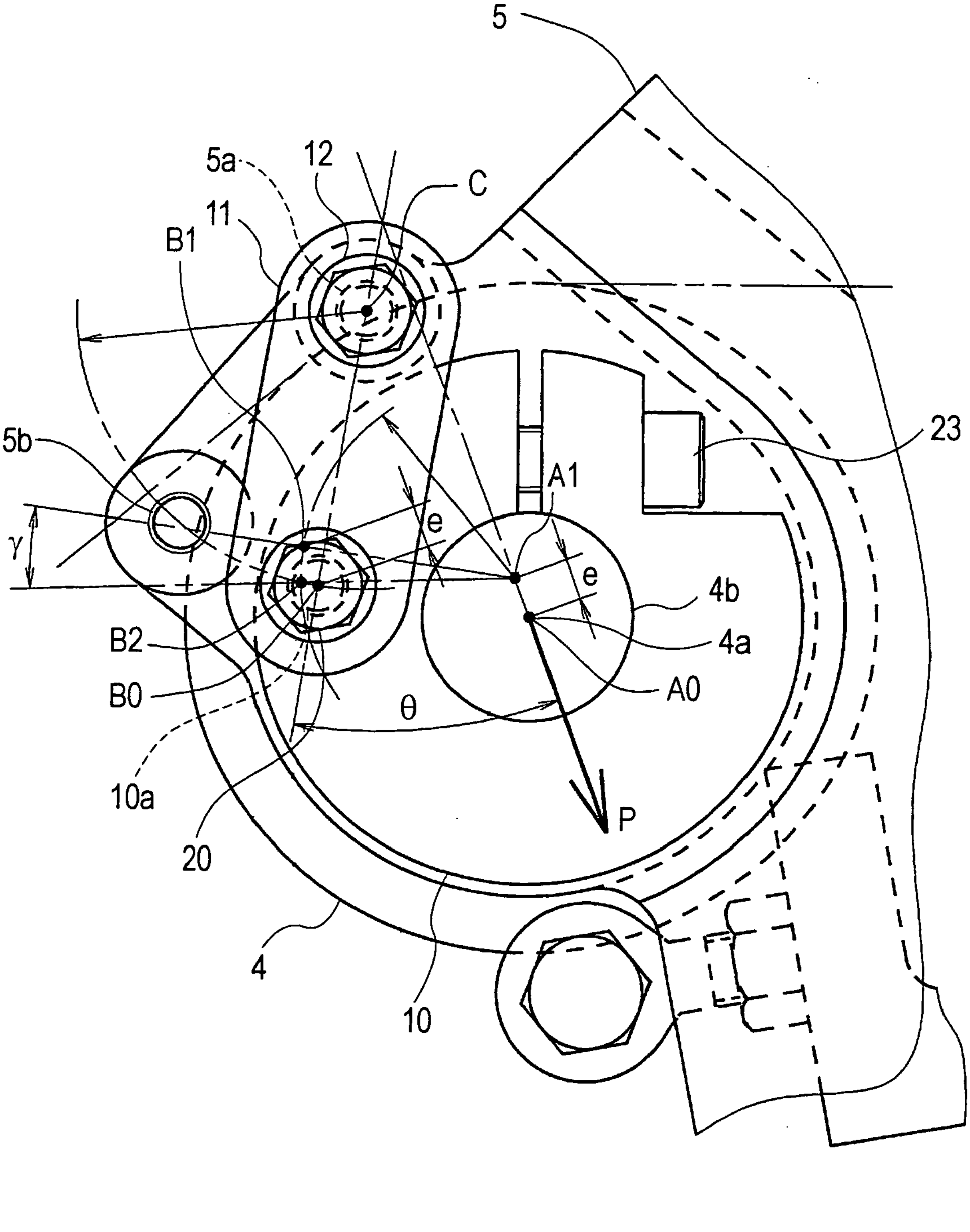


FIG. 6

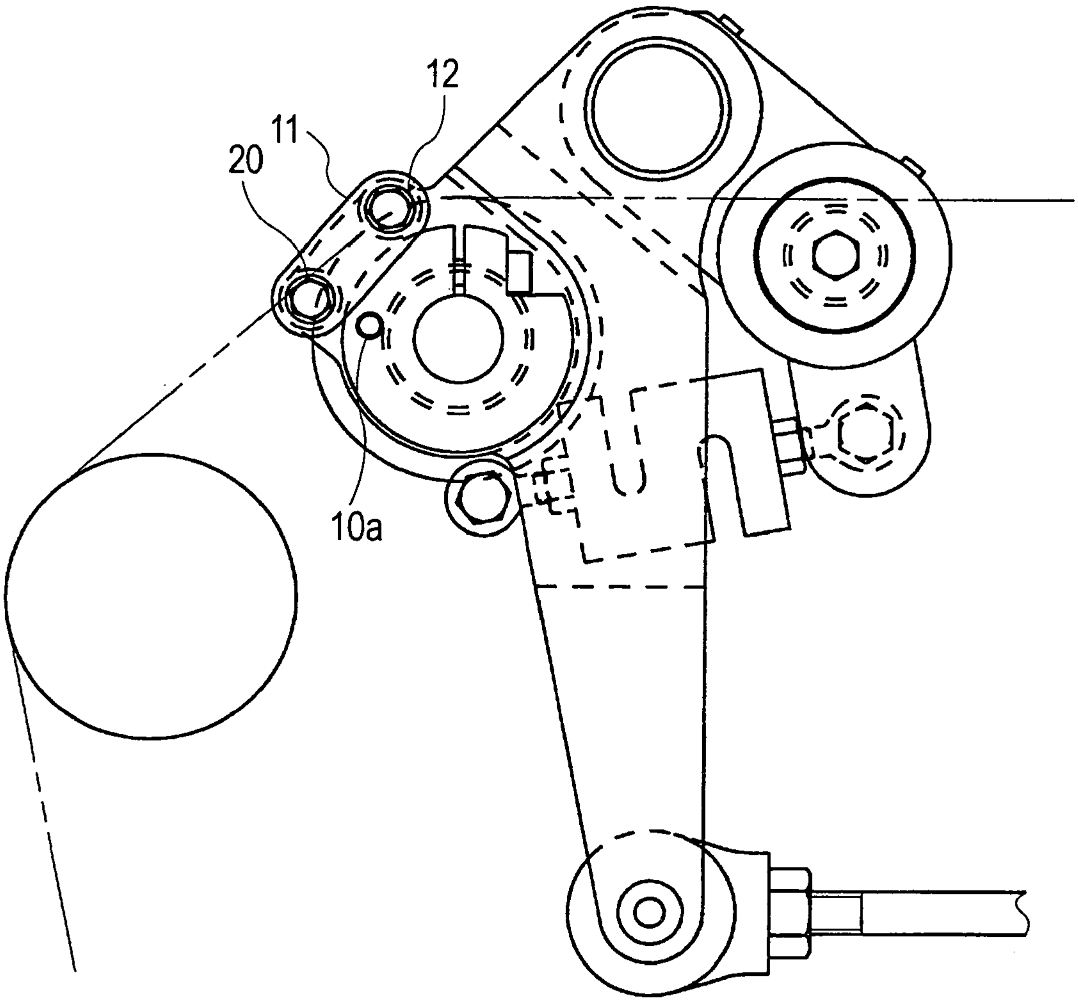


FIG. 7

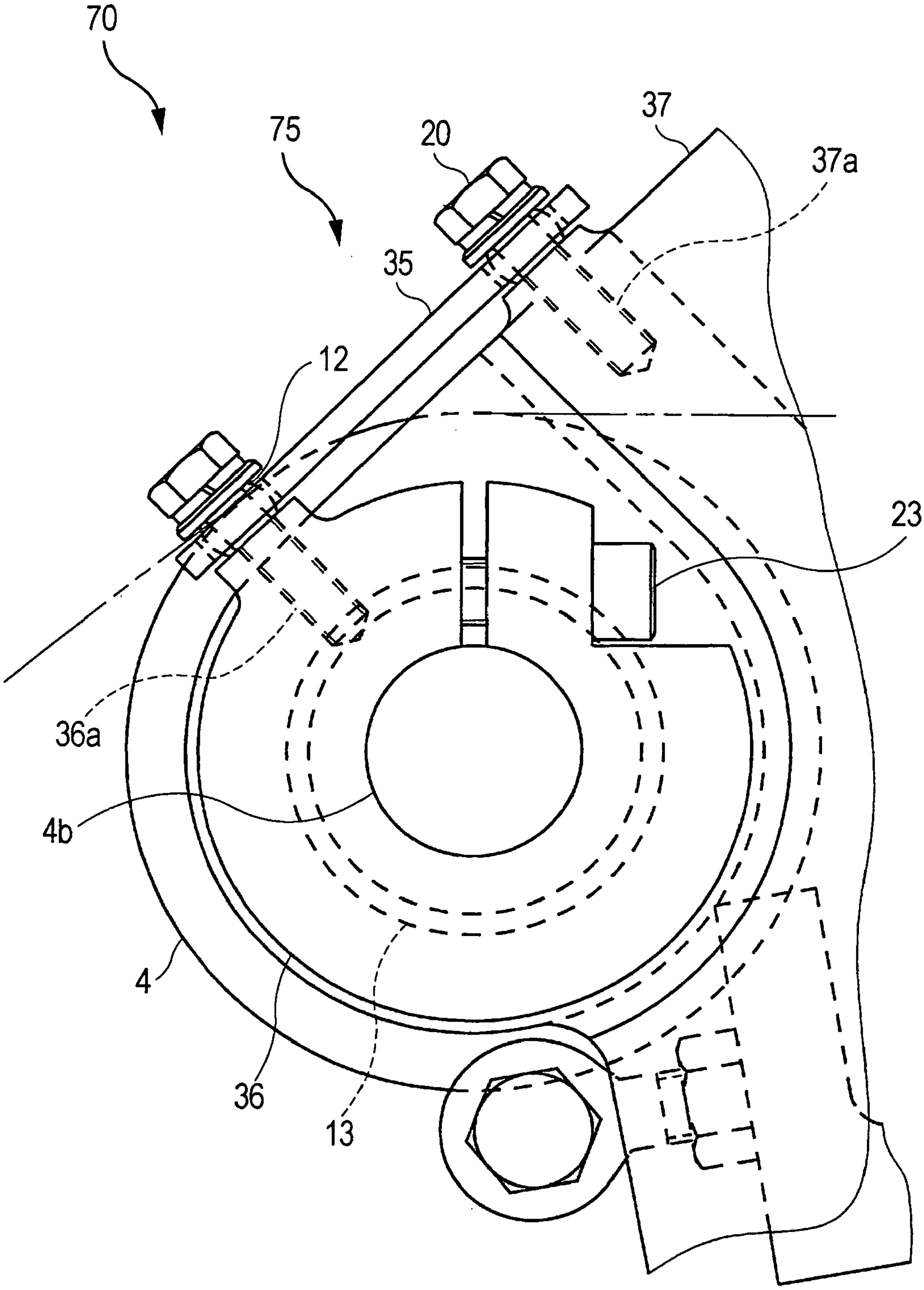


FIG. 8

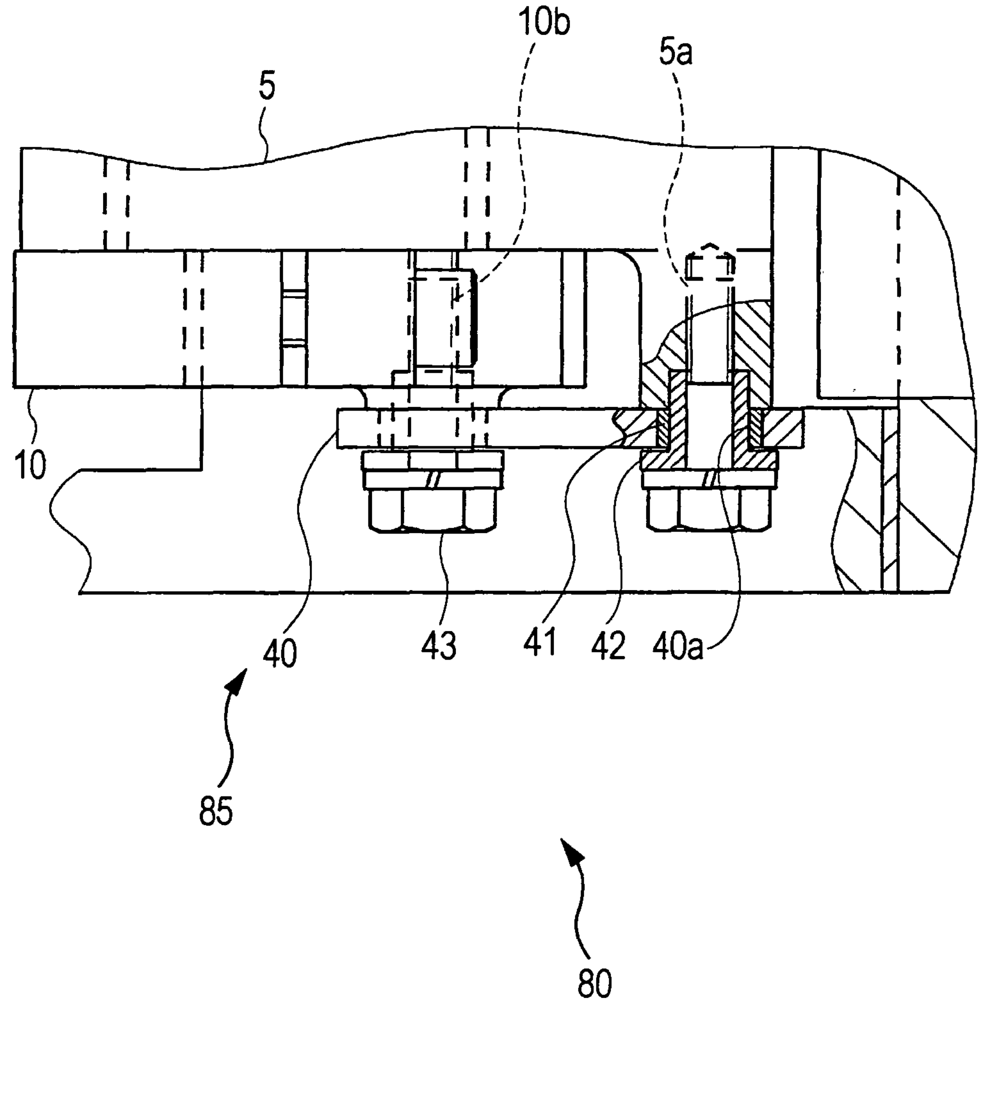
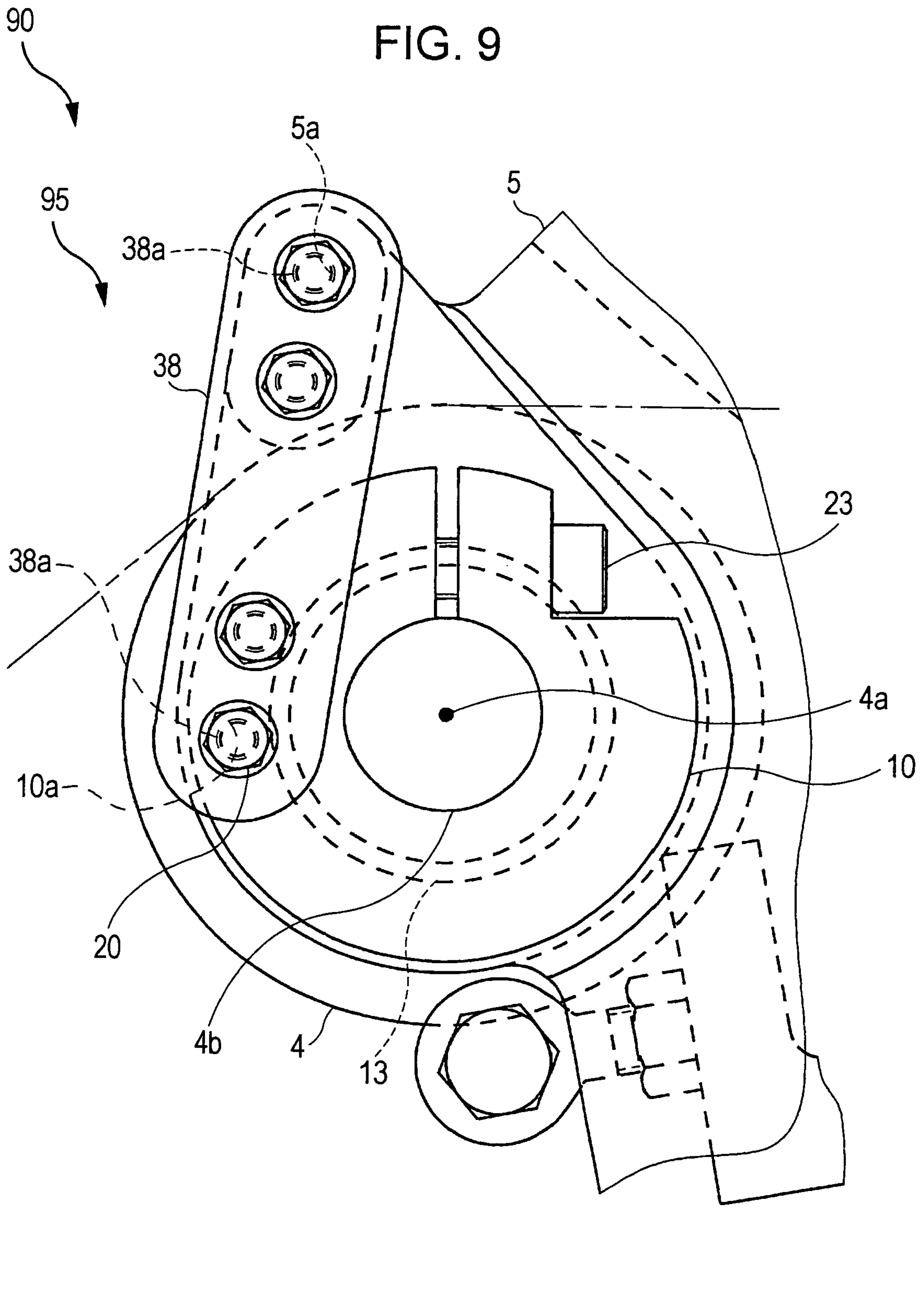


FIG. 9



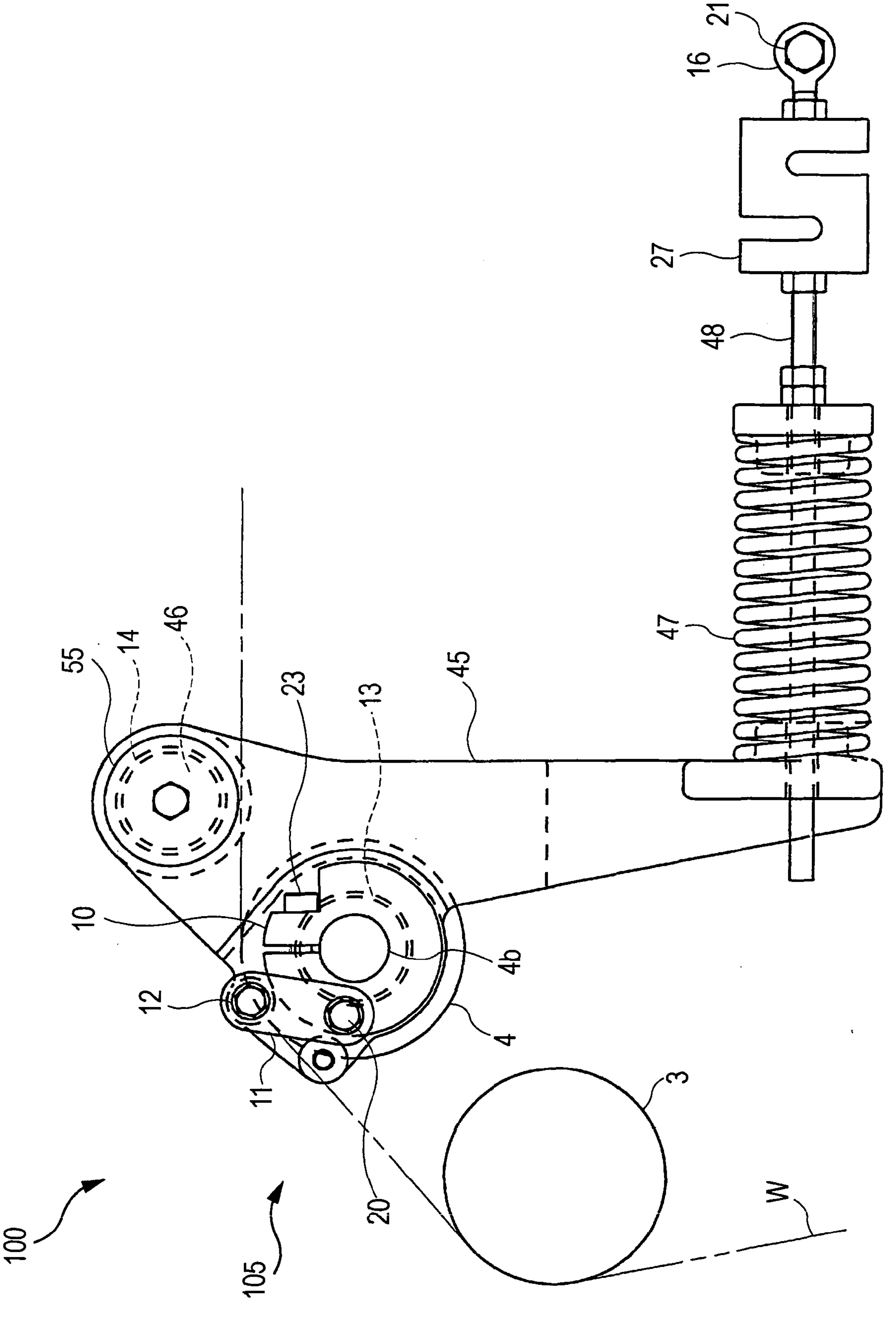


FIG. 10

FIG. 11

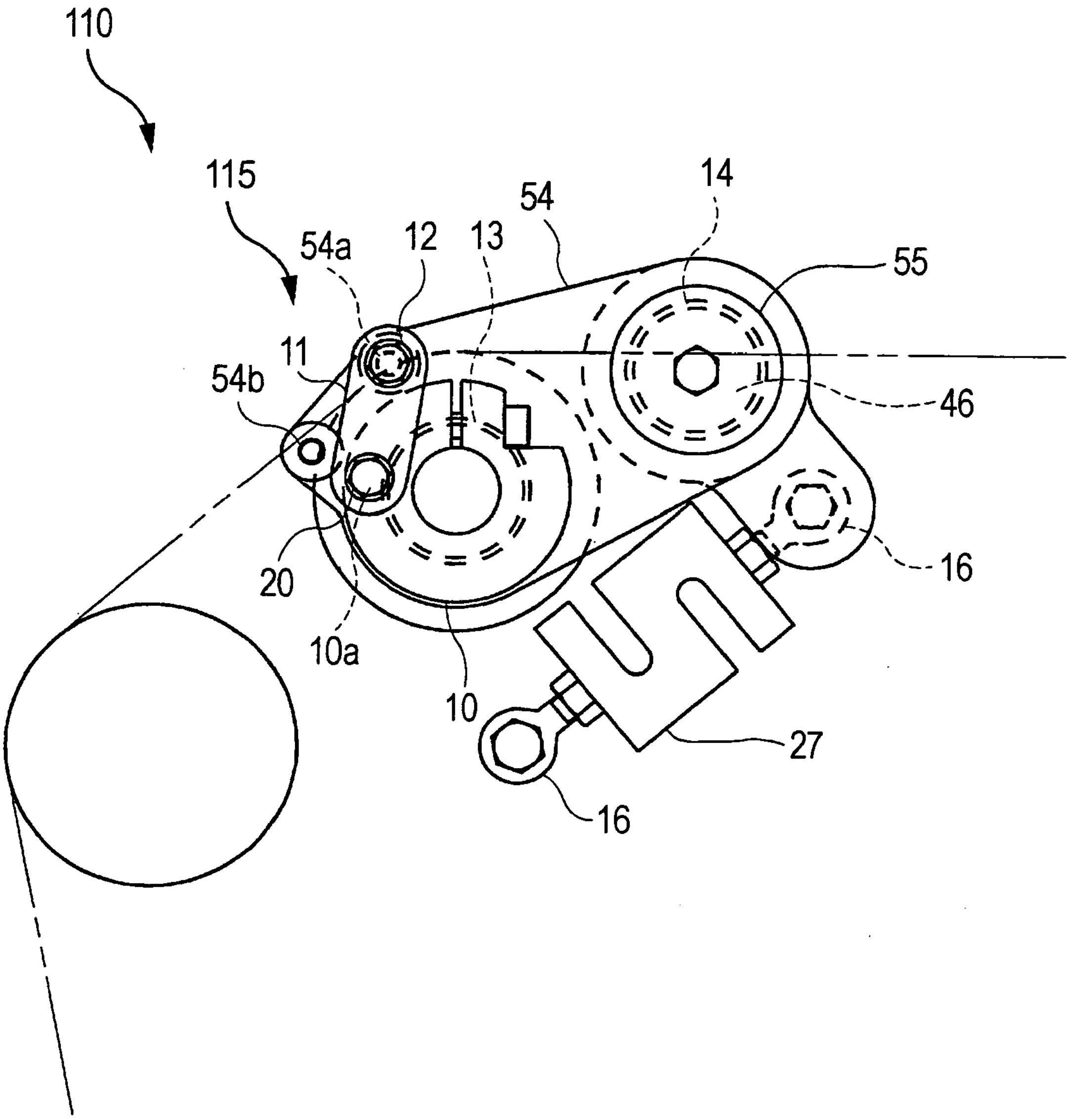


FIG. 12

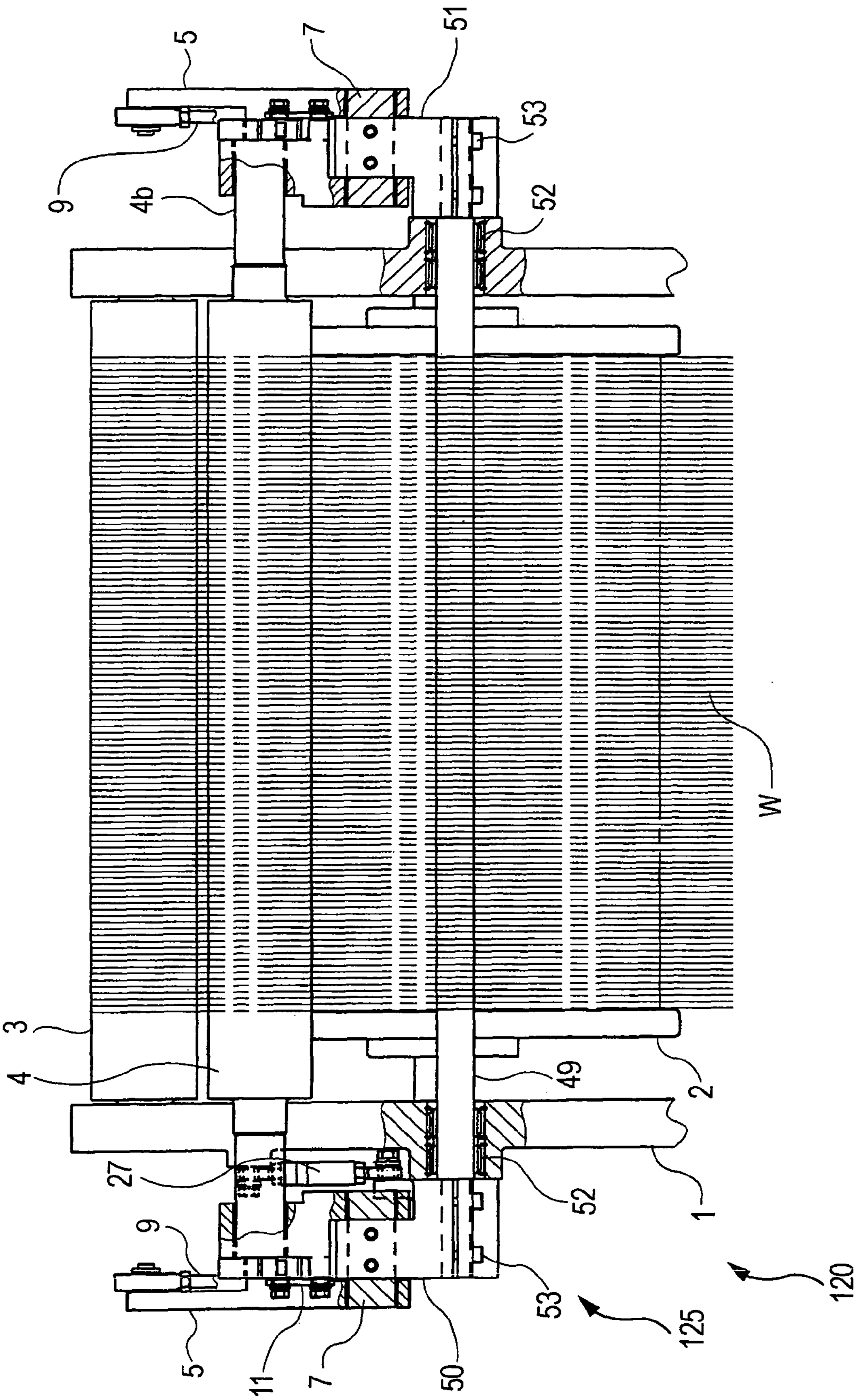
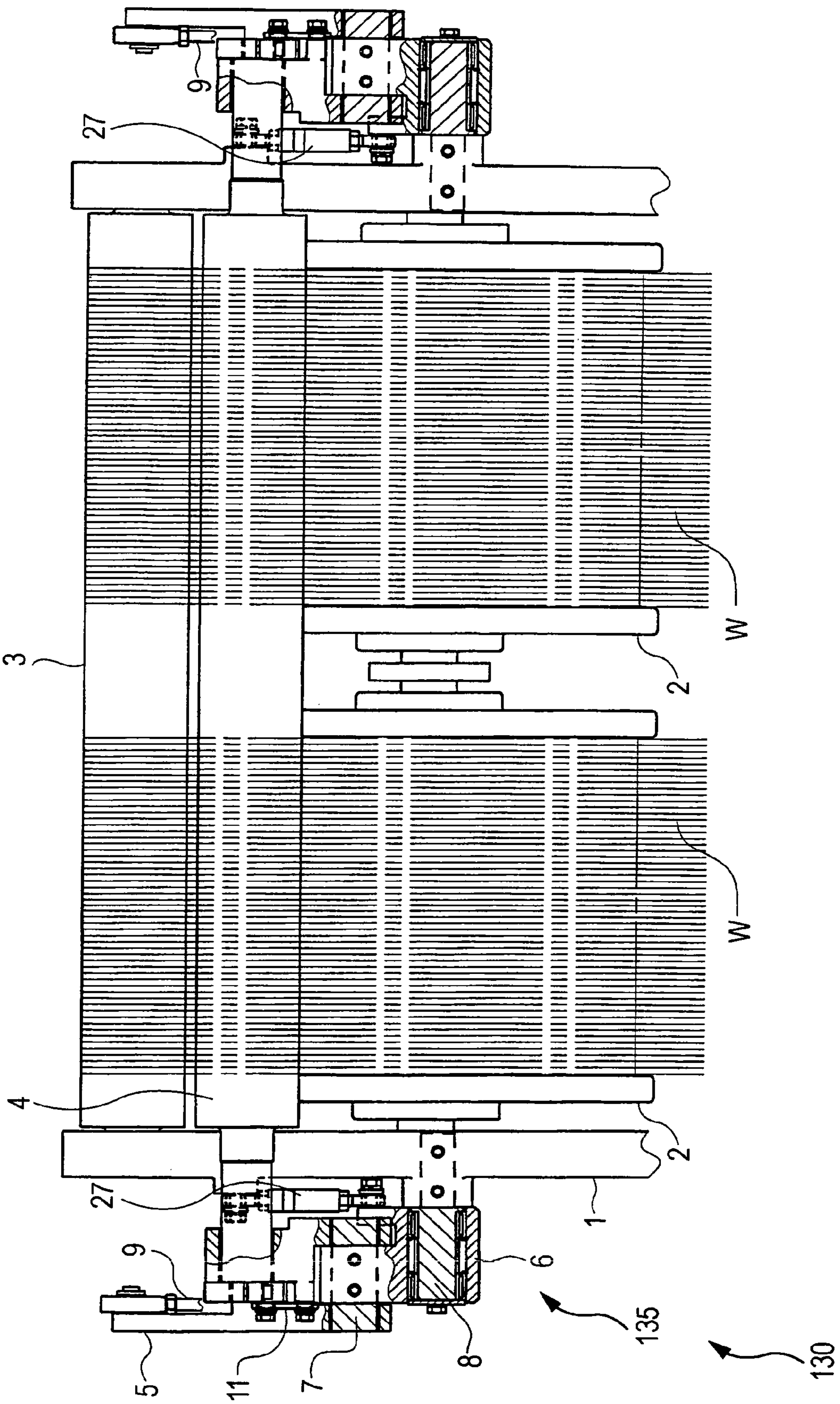


FIG. 13



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EUROPEAN SEARCH REPORT

Application Number
EP 07 01 1052

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 0 527 705 A (TOYODA AUTOMATIC LOOM WORKS [JP]) 17 February 1993 (1993-02-17) * columns 1-4; figures 1-3 * -----	1-8	INV. D03D49/22 D03D49/12
Y	US 1 868 152 A (SMITH HENRY N) 19 July 1932 (1932-07-19) * pages 1-2; figures 1-5 * -----	1-8	
Y	US 1 765 322 A (BROWN CARL D) 17 June 1930 (1930-06-17) * pages 1-2; figures 1-3 * -----	1	
A	US 4 320 784 A (SEIFERT EBERHARD) 23 March 1982 (1982-03-23) * columns 1-3; figures 1,2 * -----	1-8	
A	EP 0 547 003 A (TOYODA AUTOMATIC LOOM WORKS [JP]) 16 June 1993 (1993-06-16) * figures 1-3 * -----	1-8	
A	EP 1 544 338 A (TOYOTA JIDOSHOKKI KK [JP]) 22 June 2005 (2005-06-22) * columns 3-8; figures 1-5,7,8 * -----	1-8	TECHNICAL FIELDS SEARCHED (IPC) D03D D02H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 July 2007	Iamandi, Daniela

CATEGORY OF CITED DOCUMENTS

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25-07-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0527705 A	17-02-1993	JP 5051845 A	02-03-1993
US 1868152 A	19-07-1932	NONE	
US 1765322 A	17-06-1930	NONE	
US 4320784 A	23-03-1982	AT 360922 B	10-02-1981
		AT 227079 A	15-06-1980
		CH 635627 A5	15-04-1983
		CS 219268 B2	25-03-1983
		DE 2911863 A1	04-09-1980
		FR 2450301 A1	26-09-1980
		GB 2044303 A	15-10-1980
		IT 1141901 B	08-10-1986
		JP 55116840 A	08-09-1980
		SU 952112 A3	15-08-1982
EP 0547003 A	16-06-1993	JP 2534202 Y2	30-04-1997
		JP 5051988 U	09-07-1993
EP 1544338 A	22-06-2005	CN 1523147 A	25-08-2004
		JP 2004250817 A	09-09-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5051845 A **[0003]**
- JP 60028941 B **[0006] [0006] [0007]**