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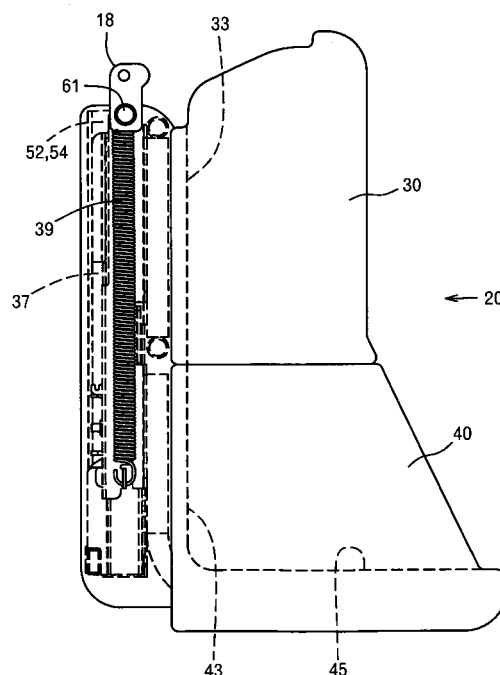
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(54) **Chair-type massage machine**

(57) A chair-type massage machine is provided wherein a leg unit and a foot unit are slidingly movable with good stability. The machine comprises a pivotal frame 60 pivotally movably provided at the front end of a seat 12, and a foot massage unit 20 provided on the pivotal frame. The foot massage unit has a leg unit 30 for massaging the calves and a foot unit 40 for massaging the toes. The pivotal frame has a first slide rail 52 slidably provided with the leg unit, a second slide rail 54 slidably provided with the foot unit, leg biasing means 39 provided between the pivotal frame and the leg unit for pulling the leg unit toward the seat, and foot biasing means 49 provided between the leg unit and the foot unit for pulling the foot unit toward the leg unit.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to massage machines of the chair type comprising a leg unit and a foot unit which are adapted to massage the calves and toes of the user to be treated, and more particularly to chair-type massage machines comprising a leg unit and a foot unit which are slidably connected to each other for giving a massage to the desired affected part of the user to be treated.

BACKGROUND ART

[0002] Massage machines of the chair type are known which are provided at the front end of a seat for the user to sit in with a foot massage unit comprising a leg unit for massaging the calves of the user and a foot unit for massaging the toes of the user.

Chair-type massage machines are proposed wherein a leg unit and foot unit are shiftable so as to be positioned in place in accordance with the length of the legs of the user since users differ in somatotype, especially in the length of the legs (see, for example, Patent Literature 1, JP2004-8257A).

[0003] The chair-type massage machine of Patent Literature 1 has a rail which is pivotally movably attached at the front side of the seat for providing thereon the leg unit slidably. This rail is slidably provided with a slide rail having the foot unit thereon.

The leg unit is slidably moved relative to the pivotable rail, and the slide rail is slidably moved relative to the rail, whereby the foot unit can be slidably moved.

[0004] With the massage machine of Patent Literature 1, the leg unit is provided on the pivotable rail, and the foot unit on the slide rail, and slide rail is slidably fitted to the pivotal rail. Consequently, the pivotal rail is subjected to the weight of the leg unit and the force acting on the leg unit, and further to the weight of the foot unit and the force acting on the foot unit. Especially with the slide rail stretched to the greatest extent relative to the pivotal rail, the force exerted by the foot unit on the pivotable rail through the slide rail is very great because the point of application is a large distance away, permitting the pivotal rail and the slide rail to backlash relative to each other and the foot unit is prone to become unstable when moving slidably.

[0005] An object of the present invention is to provide a chair type massage machine comprising a leg unit and a foot unit which are slidable with stability.

SUMMARY OF THE INVENTION

[0006] To accomplish the above object, the present invention provides a chair-type massage machine comprising a pivotal frame pivotally movably provided at a front end of a seat for the person to be treated to sit in,

and a foot massage unit provided on the pivotal frame, the foot massage unit having a leg unit for massaging the calves of the user and a foot unit for massaging the toes of the user,

5 the pivotal frame having a first slide rail slidably provided with the leg unit, a second slide rail slidably provided with the foot unit, leg biasing means provided between the pivotal frame and the leg unit for biasing the leg unit in a direction to pull the leg unit toward the seat at all times, 10 and foot biasing means provided between the leg unit and the foot unit for biasing the foot unit in a direction to pull the foot unit toward the leg unit at all times.

It is desirable that the foot biasing means be smaller than the leg biasing means in biasing force.

15 **[0007]** With the chair-type massage machine of the present invention, the first slide rail and the second slide rail are connected directly to the pivotal frame, and the leg unit is slidably provided on the first slide rail and the foot unit is slidably provided on the second slide rail.

20 Thus, the leg unit and the foot unit are individually slidably supported by the first slide rail and the second slide rail, respectively, so that the force exerted by the leg unit is delivered only to the first slide rail, and the force exerted by the foot unit acts on the second slide rail alone.

25 Accordingly, even if the leg unit and the foot unit are slidably moved in a stretching direction, the force acting on the foot unit will not be delivered to the first slide rail, permitting the foot unit to slidably move with good stability.

30 **[0008]** The leg unit is biased by the leg biasing means toward the seat at all times, with the foot unit biased by the foot biasing means toward the leg unit. This enables the user to step into the foot unit with his or her soles when so desired, whereby the foot unit is moved away from the leg unit against the biasing force of the foot biasing means, while the leg unit is pulled by the foot unit toward a direction away from the seat against the biasing force of the leg biasing means.

35 Accordingly, the user can be massaged by the leg unit and the foot unit at the desired positions in conformity with the length of the legs.

40 The foot biasing means is adapted to have a smaller biasing force than the leg biasing means according to the present invention, so that when the user steps into the foot unit with the soles, the foot biasing means of the smaller biasing force stretches first, causing the foot unit to start to move before the leg unit. The leg biasing means thereafter stretches to move the leg unit.

45 Since the foot unit only can be moved relatively lightly when the machine is to be used without moving the foot unit and the leg unit greatly, the massage machine is usable by small persons or those having short shanks with a little or no burden.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a side elevation of a chair-type massage machine;
 FIG. 2 is a side elevation of a foot massage unit;
 FIG. 3 is a front view of the foot massage unit;
 FIG. 4 is front view showing the foot massage unit as stretched;
 FIG. 5 is a perspective view of the underside of the foot massage unit as seen from the rear;
 FIG. 6 is a rear view of the foot massage unit;
 FIG. 7 is a rear view showing the foot massage unit as stretched;
 FIG. 8 is a view in section taken along the line B-B in FIG. 7;
 FIG. 9 is an enlarged view showing a lock mechanism in a locking state;
 FIG. 10 is an enlarged view showing the lock mechanism in an unlocked state;
 FIG. 11 is a rear view of a pivotal frame;
 FIG. 12 is a rear view of the pivotal frame having a leg unit attached thereto;
 FIG. 13 is a rear view of the pivotal frame having a foot unit attached thereto;
 FIG. 14 a side elevation showing another embodiment of chair-type massage machine;
 FIG. 15 is a side elevation showing this embodiment of chair-type massage machine with a foot unit stretched;
 FIG. 16 is a side elevation showing the chair-type massage machine in a state ready for moving;
 FIG. 17 is an enlarged view of fixing means indicated at D in FIG. 16 and as released from a locking state; and
 FIG. 18 is an enlarged view of the fixing means indicated at D in FIG. 16 and as shown in the fixing state.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] A chair-type massage machine 10 of the invention will be described below with reference to the drawings.

FIG. 1 is a side elevation of the chair-type massage machine 10. As illustrated, the massage machine 10 has a base 11 to be placed on the floor, and a seat 12 for the user to be treated to sit in, a backrest 14 for the user to bear on, and elbow rests 16, 16 which are provided on or above the base. A pivotal frame 60 is pivotally movably provided at the front end of the seat 12. As shown in FIGS. 1 and 2, a pair of opposite side brackets 18, 18 at the upper end of the pivotal frame 60 is pivoted to the front end of the seat 12 and is pivotally movable. Slidably fitting to the pivotal frame 60 is a foot massage unit 20 for massaging the calves and toes of the user.

The foot massage unit 20 is pivotally movable in the directions of arrows A in FIG. 1.

[0011] As shown in FIGS. 1 to 4, the foot massage unit 20 has a leg unit 30 for massaging the calves of the user, and a foot unit 40 for massaging the toes of the user.

[0012] With reference to FIGS. 3 and 4, the leg unit 30 comprises opposite side walls 31, 31, a center wall 32 and rear walls 33, 33 for defining recesses 34, 34 each open at its upper and lower ends and front side for the calf (the part under the knee to above the ankle) of the user to be placed in. Massage means (not shown) such as air bags or acupressure members are provided on the inner side surfaces of the side walls 31, 31, center wall 32 and/or rear walls 33.

[0013] With reference to FIGS. 3 and 4, the foot unit 40 comprises opposite side walls 41, 41, a center wall 42 and rear walls 43, 43 for defining recesses 44, 44 each open at its upper side and front side for the toes (under the ankle) of the user to be placed in. The bottom of each of the recesses 44, 44 is closed with a bottom wall 45 for the user's sole to come into contact therewith. Massage means (not shown) such as air bags or acupressure members are provided on the inner side surfaces of the side walls 41, 41, center wall 42, rear walls 43 and/or bottom walls 45.

[0014] The leg unit 30 and the foot unit 40 are connected to the aforementioned pivotal frame 60 by a slide mechanism 50. The slide mechanism 50 is actually wrapped with a cover 22 of cushion material, fabric or resin and can not be seen from outside as shown in FIG. 4.

[0015] FIGS. 5 to 8 are views showing the foot massage unit 20 with the cover removed from the rear side thereof for illustrating the slide mechanism 50. FIGS. 5 and 7 show the leg unit 30 and the foot unit 40 as they are spaced apart. FIG. 6 shows the leg unit 30 and the foot unit 40 as they are positioned closest to the seat 12 (the state of FIG. 1). Further FIG. 8 is a view in section taken along the line B-B in FIG. 7, FIG. 11 is a rear view of the pivotal frame, FIG. 12 is a rear view showing the leg unit as attached to the pivotal frame, and FIG. 13 is a rear view showing the foot unit as attached to the pivotal frame.

[0016] As illustrated, the pivotal frame 60 has a pivot 61 rotatably fitting to the brackets 18, 18 on the seat 12, vertical frames 62, 62 positioned close to the lengthwise midportion of the pivot 61 and fixed to the pivot 61 with respect to directions orthogonal thereto, first slide rails 52, 52 positioned close to respective opposite ends of the pivot 61 and secured to the pivot 61 with respect to directions orthogonal thereto, second slide rails 54, 54 positioned between the vertical frames 62, 62 and the first slide rails 52, 52 and fixed to the pivot 61 with respect to directions orthogonal thereto, and an end frame 63 connecting together the lower ends of the frames 62, first slide rails 52 and second slide rails 54.

The lock mechanism 70 to be described later is mounted on the vertical frames 62.

[0017] Referring to FIGS. 5 to 8, the first slide rail 52 is in the form of a channel-shaped rail which is open toward the rear side. As shown in FIG. 8, the rail 52 has a ridge 52a extending longitudinally thereof to reduce the resistance to contact with the leg slide frame 37 to de-

scribed later.

[0018] As shown in FIGS. 5 to 8, the second slide rail 54 is in the form of a channel-shaped rail which is open inward (rightward in FIG. 8). The rail 54 has a ridge 54a extending longitudinally thereof for reducing the resistance of contact with the foot slide frame 47 to be described below as shown in FIG. 8.

[0019] The leg unit 30 is mounted on a leg base frame 36, which is provided with leg slide frames 37, 37 slidably fitted to the first slide rails 52, 52. Each of the leg slide frames 37, 37 is a channel-shaped frame which is open inward, and is provided with a ridge 37a for reducing the resistance to contact with the first slide rail 52. Indicated at 53 is a stopper provided on the first slide rail 52. When the leg unit 30 is advanced forward to the greatest extent, the stopper 53 comes into contact with the leg slide frame 37 for preventing the leg unit from moving further forward. The leg base frame 36 is centrally provided with a leg lock plate 38 formed with a plurality of positioning notches 38a, 38a for the lock mechanism 70 to be described later to engage in for positioning the leg unit 30 in place.

[0020] Coil springs 39 or like leg biasing means are provided between the leg base frame 36 and the pivot 61 of the pivotal frame 60, whereby the leg unit 30 in an unloaded state is biased in a direction so as to be pulled toward the pivot 61 (toward the seat 12).

[0021] The foot unit 40 is mounted on a foot base frame 46. The foot base frame 46 is provided with foot slide frames 47, 47 each in the form of a hollow tube of rectangular cross section and slidably fitting to the respective second slide rails 54, 54. The foot slide frames 47, 47 are each provided with a ridge 47a for reducing the resistance to contact with the second slide rail 54. The foot base frame 46 is centrally provided with a foot lock plate 48 formed with a plurality of positioning notches 48a, 48a for the lock mechanism 70 to be described later to engage in for positioning the foot unit 40 in place. The foot lock plate 48 is provided as lapped over the aforementioned leg lock plate 38 longitudinally of these plates (in a direction vertical to the plane of FIG. 6 or 7). As seen in FIG. 5, the leg lock plate 38 is positioned to the front of the other plate.

[0022] Coil springs 49 or like foot biasing means are disposed between the leg base frame 36 and the foot base frame 46. When unloaded, the foot unit 40 is biased in a direction so as to be pulled toward the leg unit 30. The foot biasing means (coil springs 49) to be used are smaller than the leg biasing means (coil springs 39) in biasing force. In the case of coil springs, the foot coil springs 49 may be smaller than the leg coil springs 39 in spring force, or the foot coil springs 49 may be smaller than the leg coil springs 39 in number. It is desirable that the foot biasing means be about 50 to 80% of the leg biasing means in biasing force.

The action and effect of the leg biasing means and the foot biasing means will be described later.

[0023] With reference to FIGS. 6 to 10, the lock mechanism 70 is mounted on one of the vertical frames 62 of

the pivotal frame 60. The lock mechanism 70 has a lock base plate 71 attached to the vertical frame 62 and a lock member 72 pivoted to the base plate 71 as at 74.

[0024] The lock member 72 has a lock piece 73 having a bent end so as to engage in the positioning notches 38a and 48a of the leg lock plate 38 and foot lock plate 48. A tension spring 75 is provided between the lock member 72 and the lock base plate 71 so as to bias the lock member 72 toward the positioning notches 38a and 48a.

The lock member 72 can be manipulated by a wire 76 comprising an inner wire 76a and an outer wire 76b. The outer wire 76b has one end attached to the lock base plate 71 and the other end connected to a lock manipulator 79 provided on the elbow rest 16 or the like. The inner wire 76a has one end connected to the lock member 72 and the other end connected to the lock manipulator 79.

When the inner wire 76a is pulled by using the lock manipulator 79, the lock member 72 is turned about the pivot 74 against the biasing force of the tension spring 75, releasing the lock piece 73 from the positioning notches 38a and 48a. When the inner wire 76a is relieved of the pulling force, the lock member 72 engages in the positioning notches 38a and 48a under the action of the tension spring 75.

[0025] With the lock member 72 engaged in the notches 38a and 48a, the leg unit 30 and the foot unit 40, namely, the leg base frame 36 and the foot base frame 46 are fixed to the pivotal frame 60 and prevented from moving. Conversely if the lock member 72 is disengaged from the notches 38a and 48a, the leg unit 30 and the foot unit 40, namely, the leg base frame 36 and the foot base frame 46 become slidable relative to the pivotal frame 60.

[0026] As shown in FIGS. 9 and 10, the lock piece 73 is preferably provided with a roller 73a having a small diameter and opposed to the notches 38a and 48a. If the lock piece 73 as released from the notches 38a and 48a rides onto a tooth 38b or 48b, failing to engage in the notches again when so attempted, the roller 73a will roll along the tooth 38b or 48b to guide the lock piece 73 into the positioning notches 38a and 48a for engagement. When the roller 73a is molded from a resin, this assures the advantage of suppressing the impact noise to be produced upon the lock piece 73 engaging in the notches 38a and 48a.

[0027] With the user seated in the seat 12, the foot massage unit 20 of the foregoing construction is pivotally moved (in the direction of arrow A in FIG. 1) by unillustrated pivotal moving means so as to move the outer end of the unit 20 upward, and the lock manipulator 79 is used to release the lock member 72 in the state of FIG. 9 from the positioning notches 38a and 48a (see FIG. 10), whereby the leg unit 30 and the foot unit 40 are made slidable. When the user steps into the foot unit 40 with the soles bearing against the bottom walls 45 of the unit 40, the leg unit 30 and the foot unit 40 are subjected to a force in the sliding direction against the biasing force

of the coil springs 39, 49 as shown in FIG. 5 and 7.

[0028] At this time, the coil springs 49 which are the smaller in spring force stretch first, causing the foot slide frames 47 to slidably move first relative to the second slide rails 54 in a direction (stretching direction) away from the pivot 61. The coil springs 49 stretch to some extent, so that if the foot unit 40 further moves in the stretching direction, the coil springs 39 of greater spring force start to stretch, permitting the leg unit 30 to move in the stretching direction to follow the above movement. The length of the foot unit 40 as stretched to the greatest extent is restricted by the contact of the foot slide frames 47 with the end frame 63 of the pivotal frame 60.

[0029] As described above, the foot unit 40 is biased by a smaller force than the leg unit 30, i.e., by the foot coil springs 49 of smaller spring force. Accordingly, when the machine is used with the foot unit 40 only slightly moved, the foot coil springs 49 of small spring force alone stretch to move the foot unit 40 only relatively lightly, with the result that persons having short shanks or small persons can use the machine free of burden.

[0030] When the user relieves the inner wire 76a of tension by handling the lock manipulator 79, with the leg unit 30 and the foot unit 40 slidably moved to the desired position, the lock member 72 is rotated from the position of FIG. 10 by the biasing force of the tension spring 75 to fit the lock piece 73 into the positioning notches 38a and 48a, whereby the leg unit 30 and the foot unit 40 are positioned in place (see FIG. 9).

The user can be given a massage at the desired position in conformity with the length of his or her legs, by operating the massage means provided in the leg unit 30 and the foot unit 40 in this state.

[0031] After the completion of massage, the inner wire 76a is pulled by the lock manipulator 79 with the stepping force of the soles removed from the bottom walls 45 of the foot unit 40 to disengage the lock piece 73 from the positioning notches 38a and 48a, whereupon the leg unit 30 and the foot unit 40 are pulled toward the pivot 61 by the biasing force of the coil springs 39, 49 to resume the state of the shortest assembly as shown in FIGS. 1 and 6.

[0032] According to the present invention, the leg unit 30 and the foot unit 40 are moved to the desired position for the user to be treated to receive a highly effective massage as described above. Since the leg unit 30 and the foot unit 40 are supported respectively by the first slide rails 52 and the second slide rails 54 independently of each other, these units 30 and 40 exhibit high stability during sliding movement and also when in a stretched state.

[0033] The position where the leg unit 30 is to be brought to a stop when the foot unit 40 is slidably moved in the stretching direction is adjustable by suitably adjusting the force of the coil springs 39, 49 serving as the biasing means for the leg unit 30 and the foot unit 40. Stated more specifically, the leg unit 30 can be adjusted to the desired position regardless of the foot unit 40 by pushing the foot unit 40 with the soles for stretching and

pressing the soles against the bottom walls of the foot unit so as to prevent the foot unit 40 from returning from the stretched position toward the pivot 61 by the biasing force of the coil springs 49. Preferably, the force of the coil springs 39, 49 is so adjusted that when the foot unit 40 is slidably moved, the leg unit 30 will slidably move approximately half the sliding distance of the foot unit 40.

[0034] According to the foregoing embodiment, the lock member 72 is used for engagement with the lock plates 38, 48 of the leg unit 30 and the foot unit 40 in common so as to position the respective units 30, 40 in place. This ensures a reduced number of parts.

[0035] With the foregoing embodiment, both the leg unit 30 and the foot unit 40 are provided with the leg lock plate 38 and the foot lock plate 48, respectively, whereas the leg lock plate 38 for the leg unit 30 can be dispensed with. When the foot unit 40 is slidably moved in this case, the tensile force of the coil springs 39, 49 brings the leg unit 30 to a stop at a position corresponding to the force of the springs 39, 49 serving as biasing means so as to give a massage.

[0036] With the chair-type massage machine 10 of the invention, it is possible to fix the foot massage unit 20, i.e., the leg unit 30 and the foot unit 40 as stretched and to pivotally move the foot massage unit. Utilizing this construction, the heavy chair-type massage machine can be made easily movable on the floor.

[0037] FIGS. 14 to 16 show another embodiment of chair-type massage machine 10 which is provided with moving means.

As shown in FIGS. 14 to 16, the machine has a base 11 extending rearward at its rear end. The end extension is provided with main rollers 80 at respective opposite sides thereof. The chair-type massage machine 10 is usually moved on the floor after holding the upper end of the backrest 14 and inclining the machine 10 rearward to bring the main rollers 80 only into contact with the floor surface. However, since there is a need to hold the massage machine in good balance in this case, it is not easy to move the machine over a large distance, along a step, slope or floor having indentations and protrusions (including a carpet or tatami mat).

As shown in FIGS. 15 and 16, therefore, subrollers 82 serving as moving means are provided on the bottom of the rear end of the foot unit 40. Also provided is fixing means 90 for fixing the leg unit 30 to the base 11 as seen in FIGS. 17 and 18.

[0038] The subrollers 82 can be rotatably provided on the lower rear end of the foot unit 40, for example, at the lower ends of the foot slide frames 47 which are slidable with the foot unit 40.

[0039] The fixing means 90 has on the base 11 a knob 92 and a stopper 94 rotatable with the knob 92, generally L-shaped and engageable at an outer end thereof with a bracket 96 to be described later. The fixing means has the bracket 96, which is provided, for example, on the first slide rail 52 which will not move toward the stretching direction of the leg unit 30. When the knob 92 is rotated

in the direction of an arrow E from the position of FIG. 17, the stopper 94 fits to the bracket 96, preventing the leg unit 30 from moving pivotally (FIG. 18). Further when the knob 92 is rotated in the opposite direction (the direction of an arrow F) from the state of FIG. 18, the stopper 94 moves away from the bracket 96, rendering the leg unit 30 pivotally movable (FIG. 17). Of course, the fixing means 90 is not limited to the structure described above.

[0040] To move the chair-type massage machine 10, the foot massage unit 20 is turned upward from the position shown in FIG. 14, in this state, the foot unit 40 and the leg unit 30 are moved as by the soles toward the stretching direction as already described (see FIGS. 4, 7 and 15), and the foot and leg units 40, 30 are prevented from stretching by the lock mechanism 70.

[0041] Next, the massage machine 10 is inclined rearward with the hands holding the backrest 14, permitting the foot massage unit 20 to turn downward (in the direction of an arrow C in FIG. 15) under gravity, whereby the leg unit 30 is brought close to or into contact with the base 11 as shown in FIG. 16. In this state, the knob 92 is turned from the position of FIG. 17 to the position of FIG. 18 for the engagement of the stopper 94 with the bracket 96. This renders the foot massage unit 20 pivotally immovable relative to the base 11.

The backrest 14 is then released from the hands. This causes the main rollers 80 and the subrollers 82 only to come into contact with the floor for supporting the massage machine 10. The heavy massage machine 10 is now free to move in a stabilized state as supported by the four opposite rollers 82, 82, 80, 80 at the front and rear.

[0042] After the massage machine 10 is moved, the machine is returned to the state of FIG. 14 by releasing the leg unit 30 and the foot unit 40 from the locking engagement against the stretching movement through the action of the lock mechanism 70, and thereafter turning the knob 92 to disengage the stopper 94 from the bracket 96 as shown in FIG. 17. The foot massage unit 20 is then made pivotally movable relative to the base 11.

[0043] The present invention provides a useful chair-type massage machine comprising a leg unit and a foot unit which are movable to a position desired by the user and which are outstanding in stability even in a stretched state.

Claims

1. A chair-type massage machine comprising a pivotal frame (60) pivotally movably provided at a front end of a seat (12) for the person to be treated to sit in, and a foot massage unit (20) provided on the pivotal frame (60),
the foot massage unit (20) having a leg unit (30) for massaging the calves of the user and a foot unit (40) for massaging the toes of the user,

the massage machine being **characterize in that** the pivotal frame (60) has a first slide rail (52) slidably provided with the leg unit (30), a second slide rail (54) slidably provided with the foot unit (40), leg biasing means provided between the pivotal frame (60) and the leg unit (30) for biasing the leg unit (30) in a direction to pull the leg unit (30) toward the seat (12) at all times, and foot biasing means provided between the leg unit (30) and the foot unit (40) for biasing the foot unit (40) in a direction to pull the foot unit (40) toward the leg unit (30) at all times.

2. The chair-type massage machine according to claim 1 wherein the foot biasing means is smaller than the leg biasing means in biasing force.
3. The chair-type massage machine according to claim 2 wherein the leg biasing means and a foot biasing means are each a tension spring, and the foot biasing means is smaller than the leg biasing means in spring force.
4. The chair-type massage machine according to any one of claims 1 to 3 wherein the leg unit (30) has a lock mechanism (70) which is capable of positioning the leg unit (30) at a plurality of locations relative to the first slide rail (52).
5. The chair-type massage machine according to any one of claims 1 to 4 wherein the foot unit (40) has a lock mechanism (70) which is capable of positioning the foot unit (40) at a plurality of locations relative to the second slide rail (54).

FIG. 1

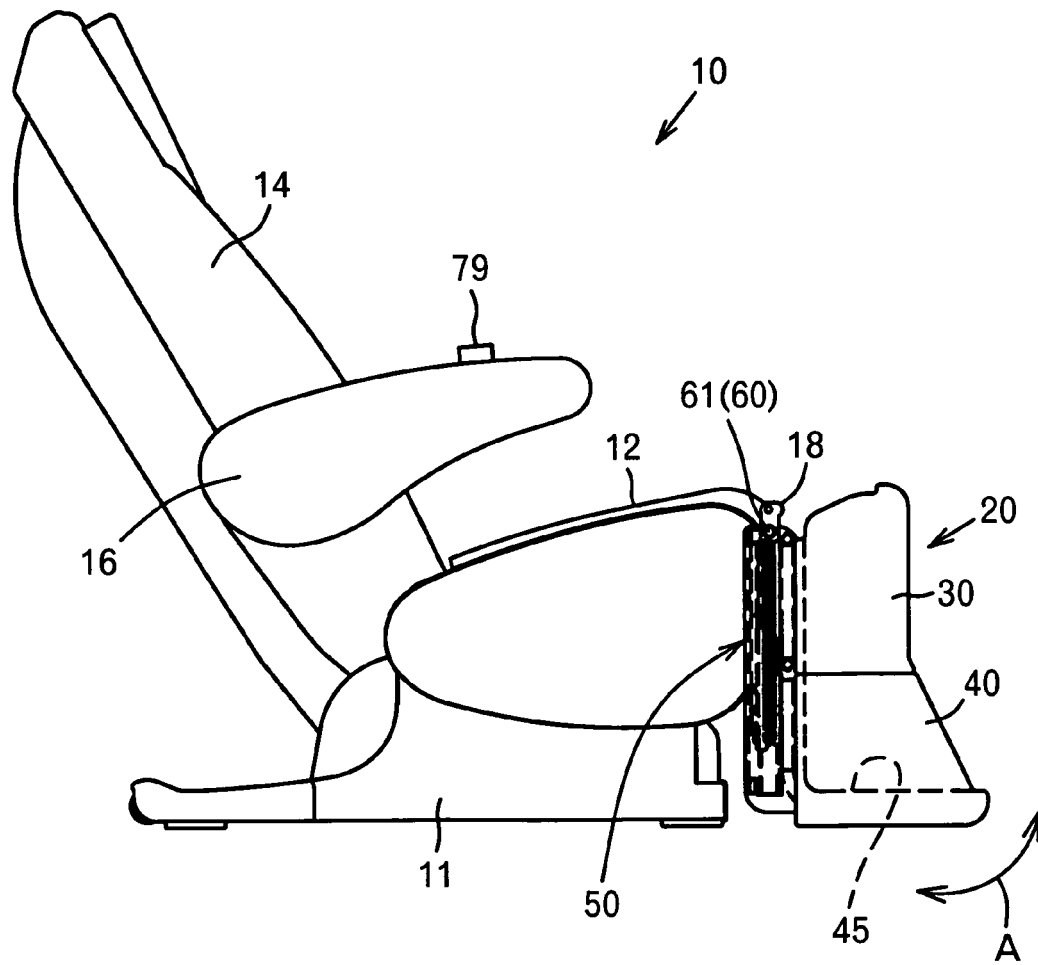


FIG. 2

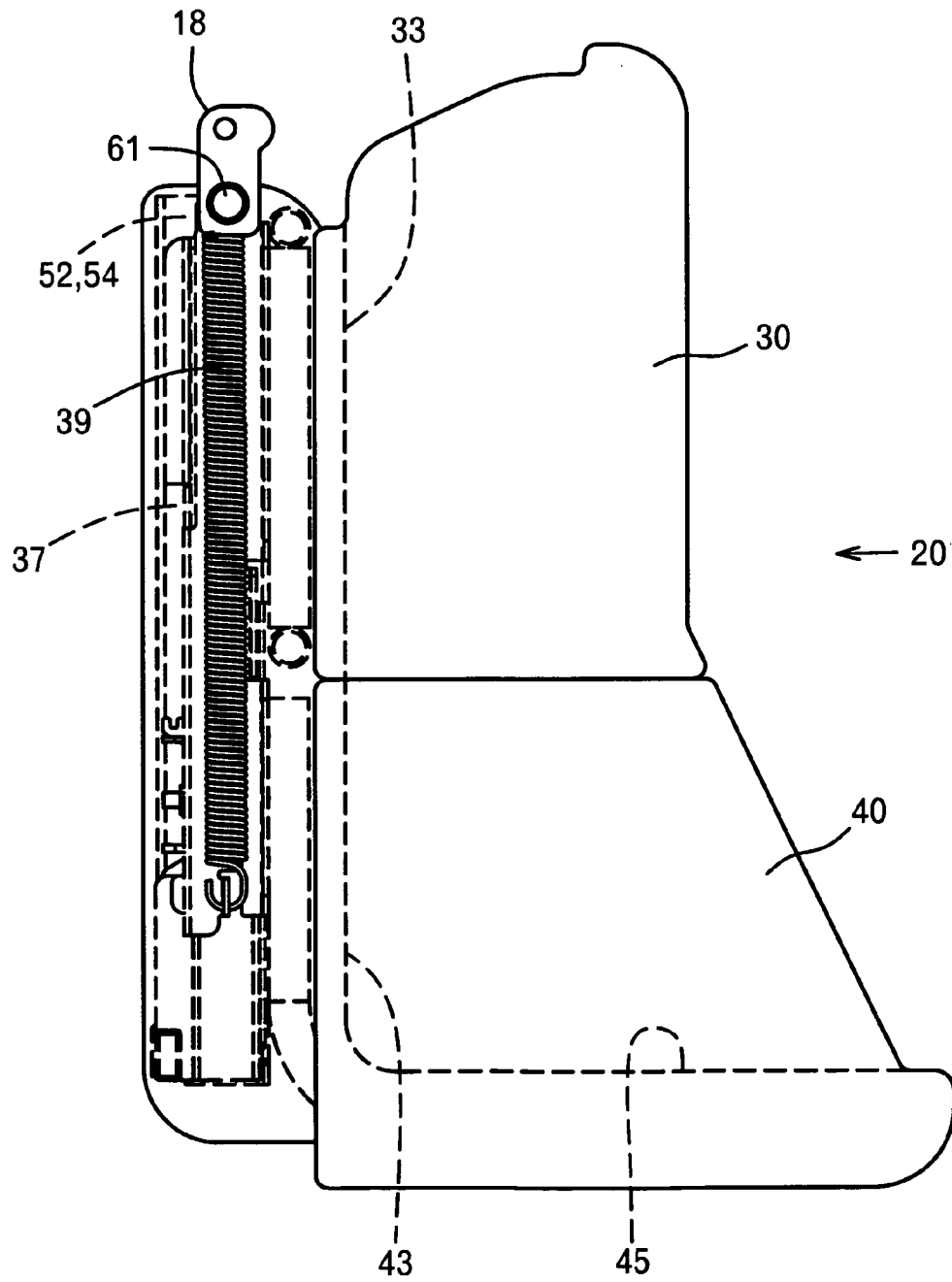


FIG. 3

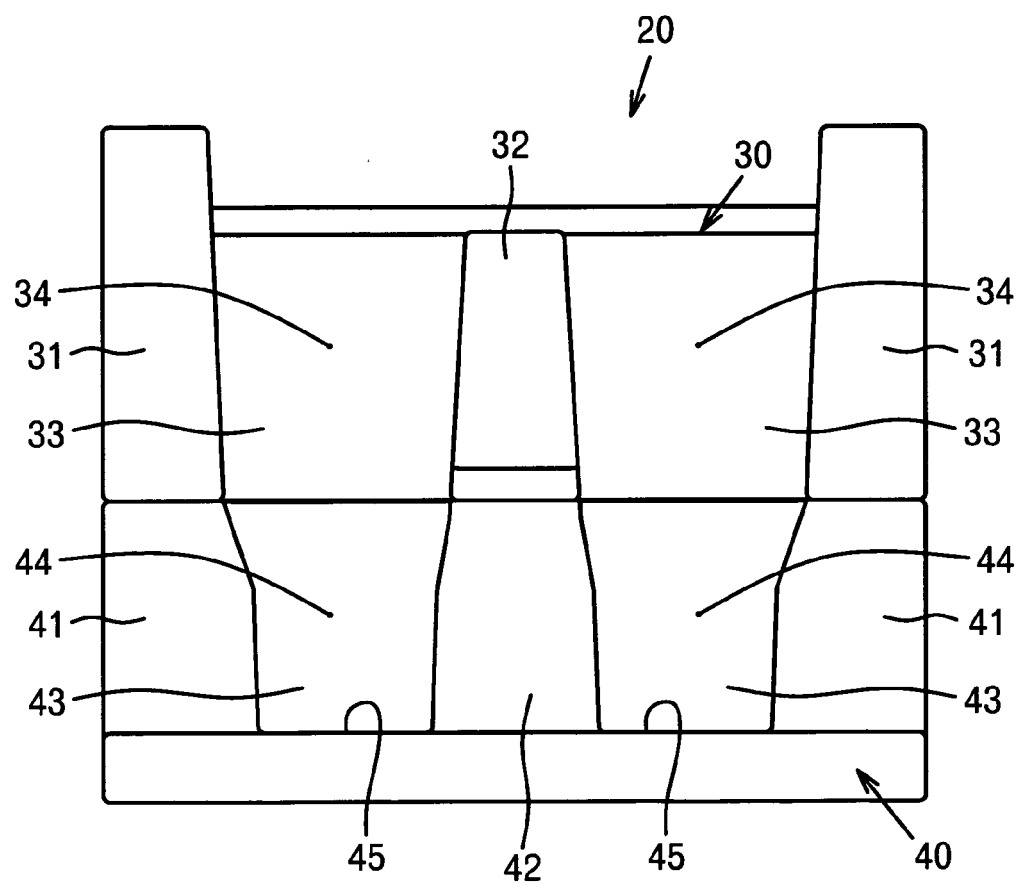


FIG. 4

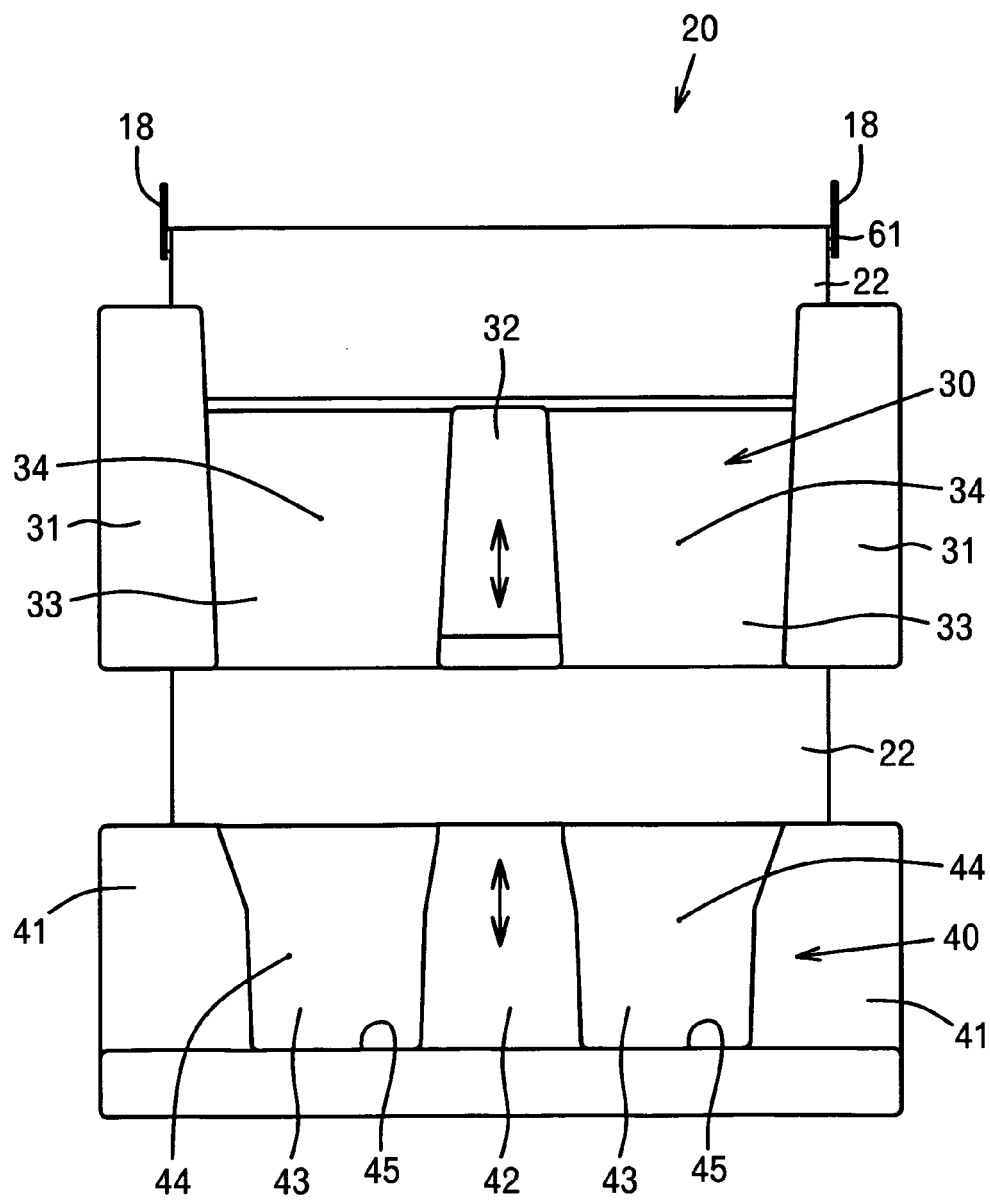


FIG. 5

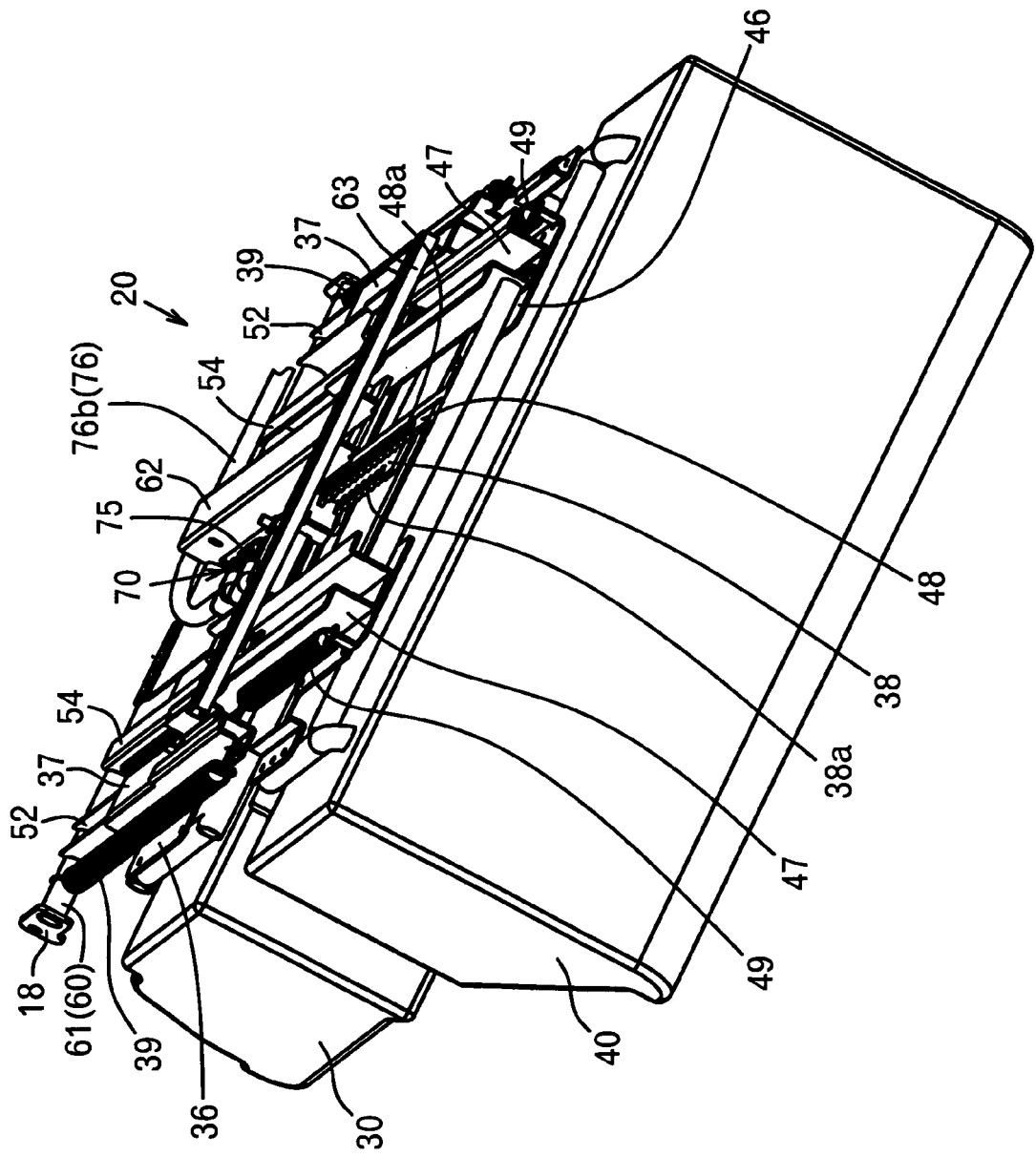


FIG. 6

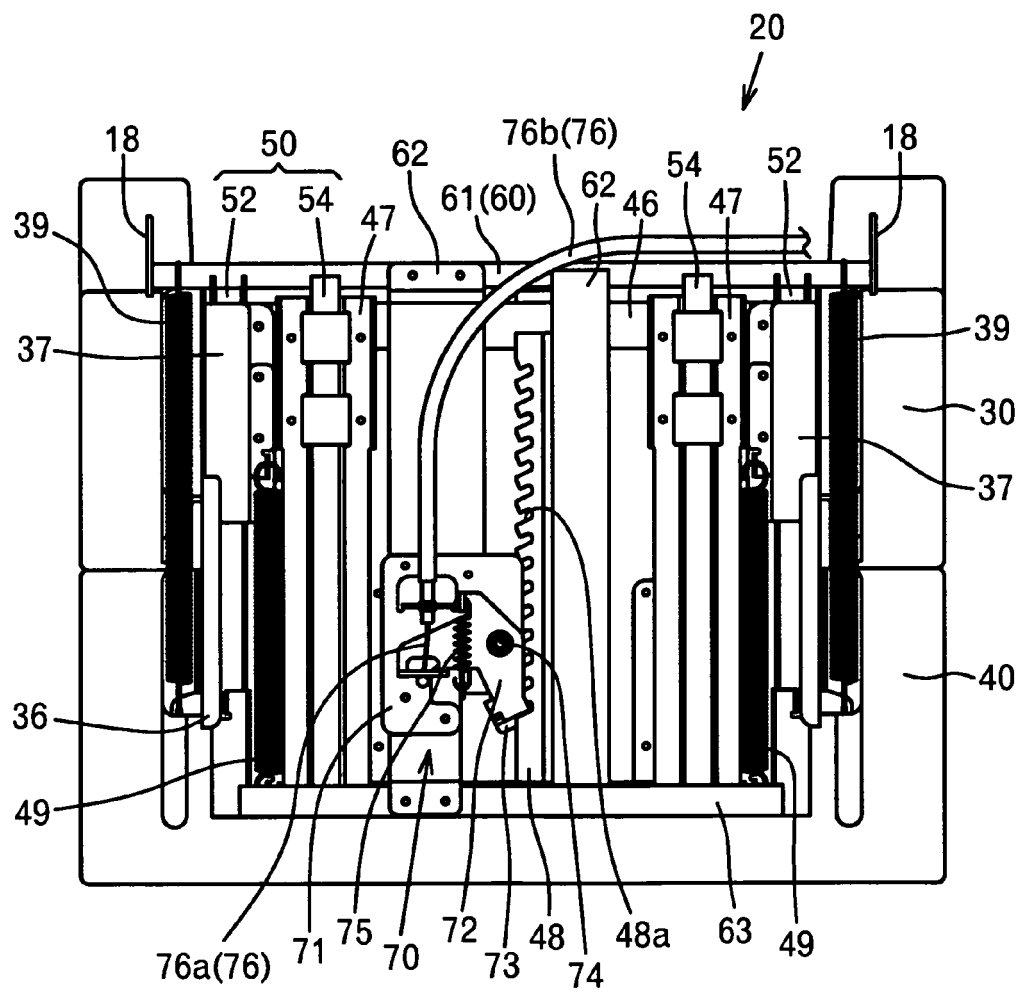


FIG. 7

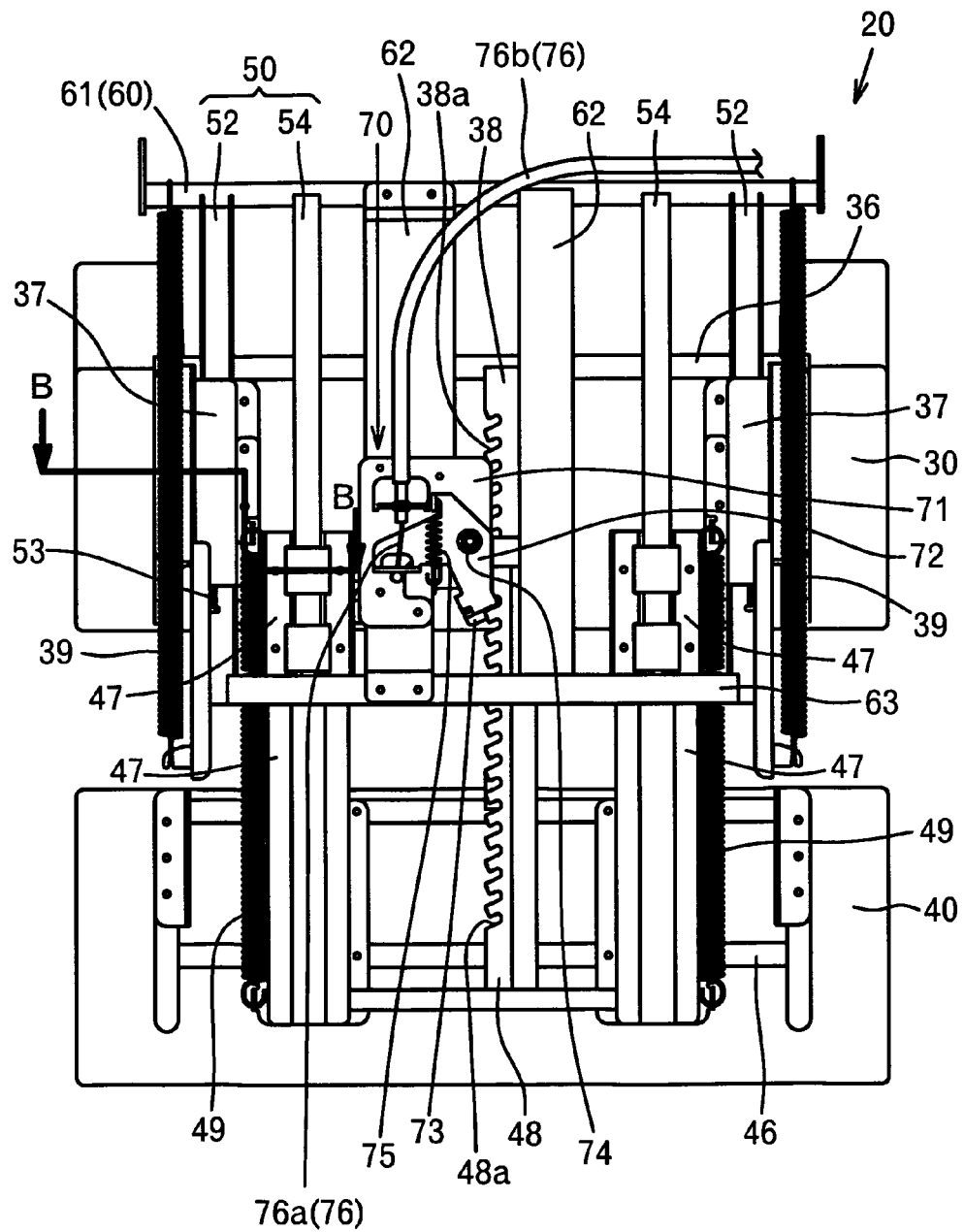


FIG. 8

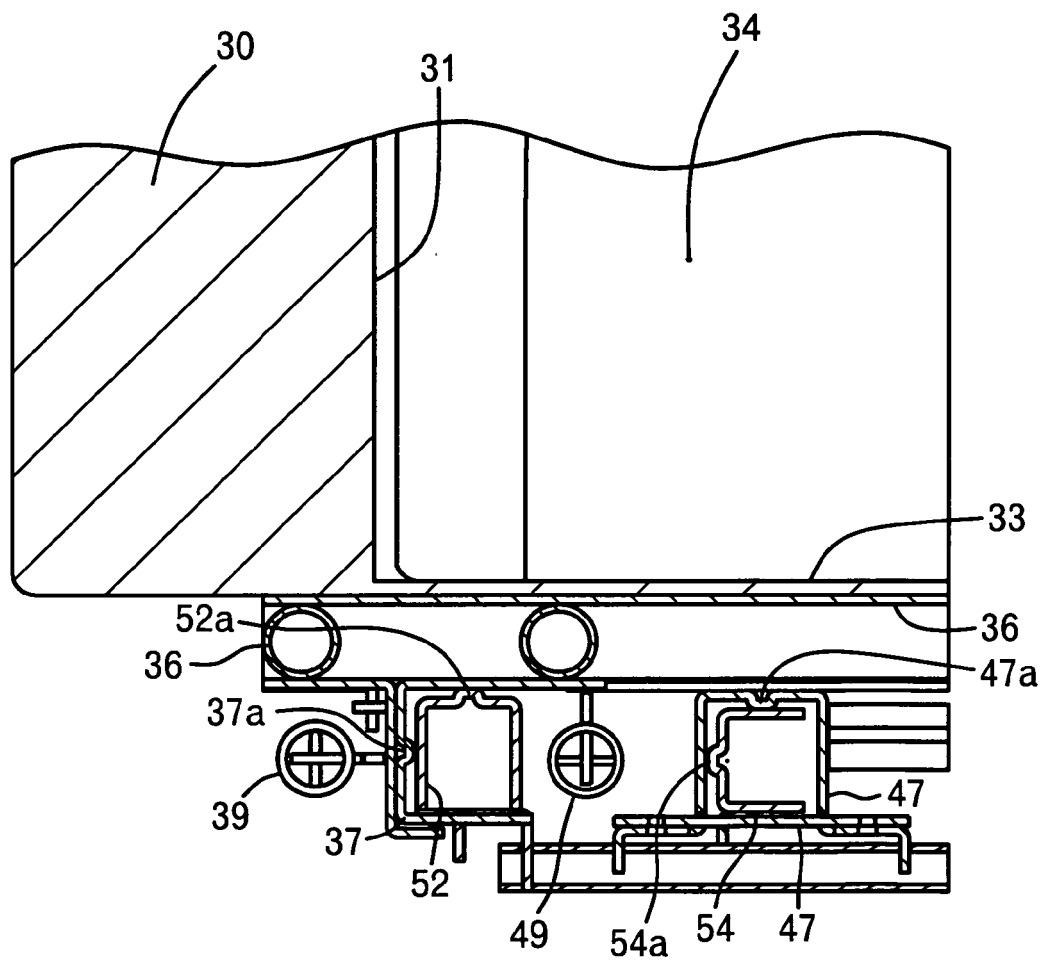


FIG. 9

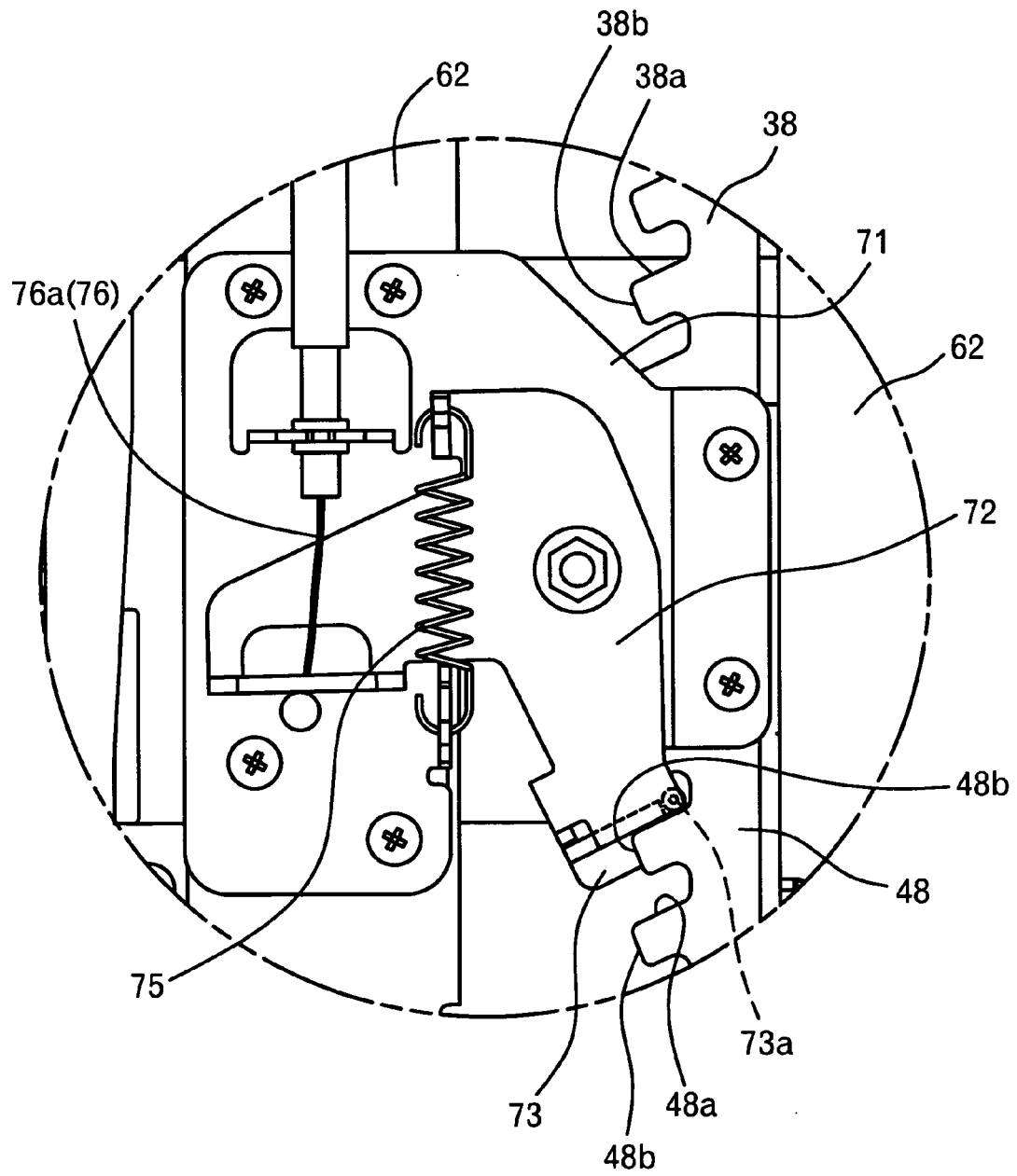


FIG. 10

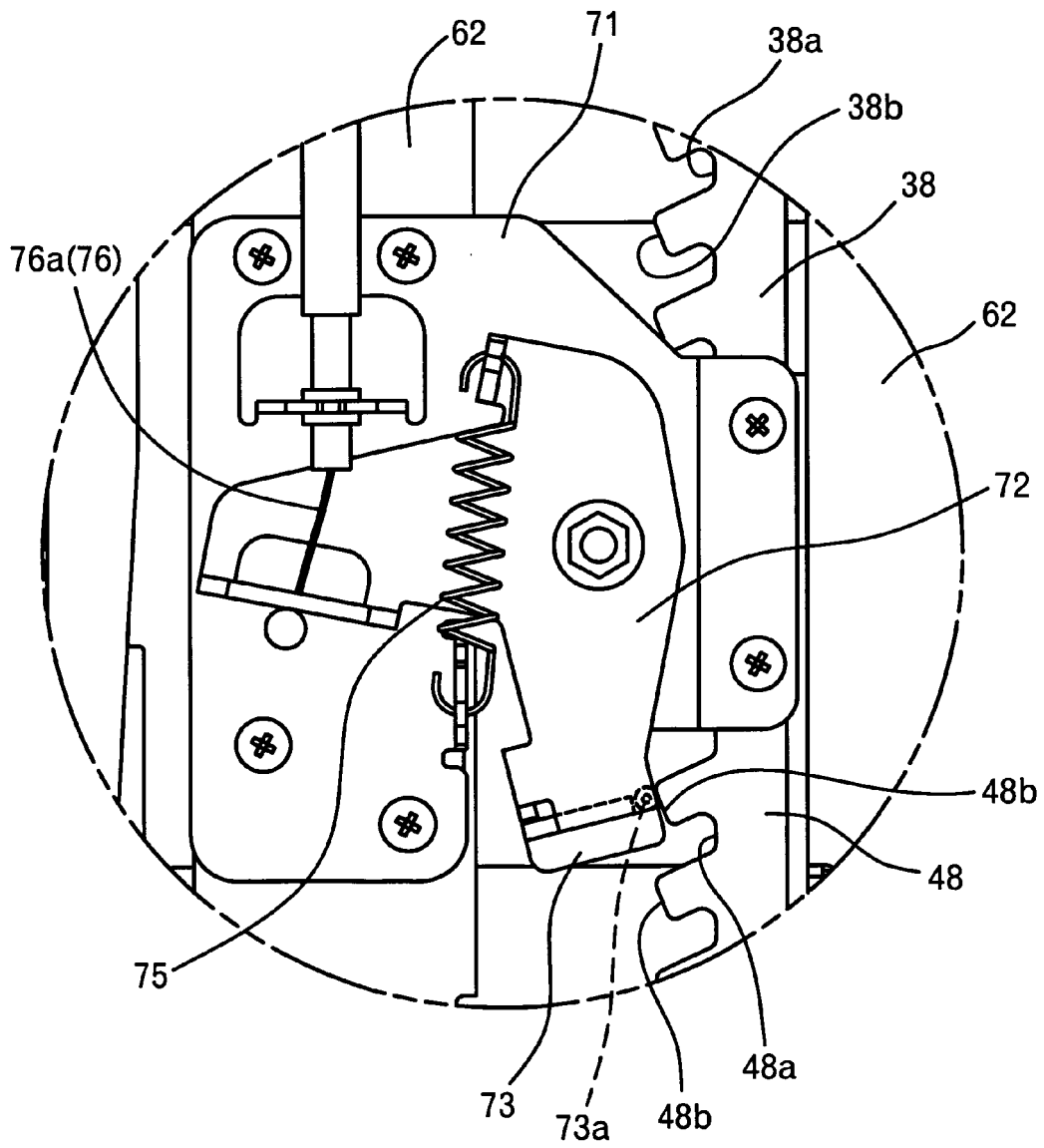


FIG. 11

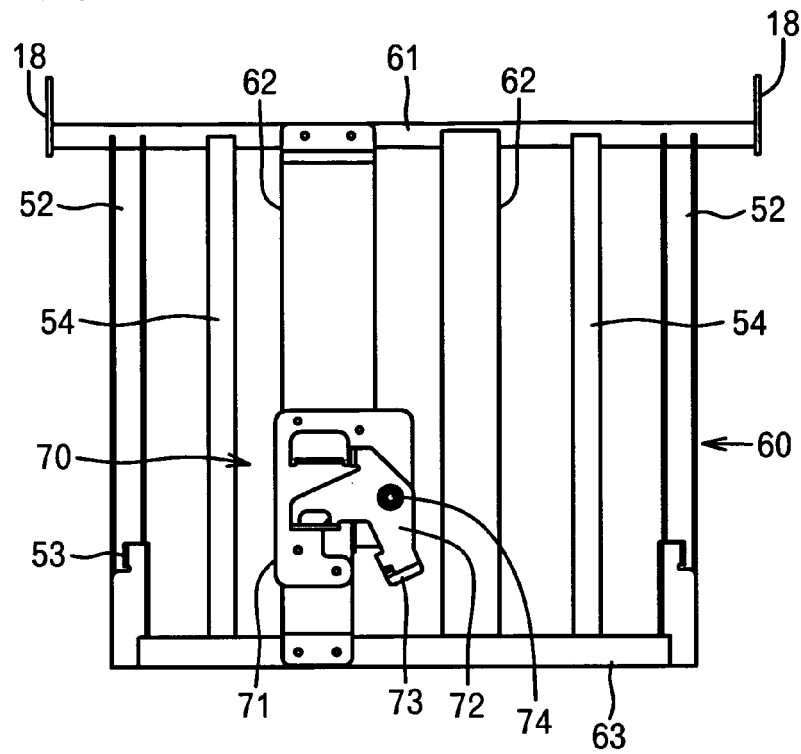


FIG. 12

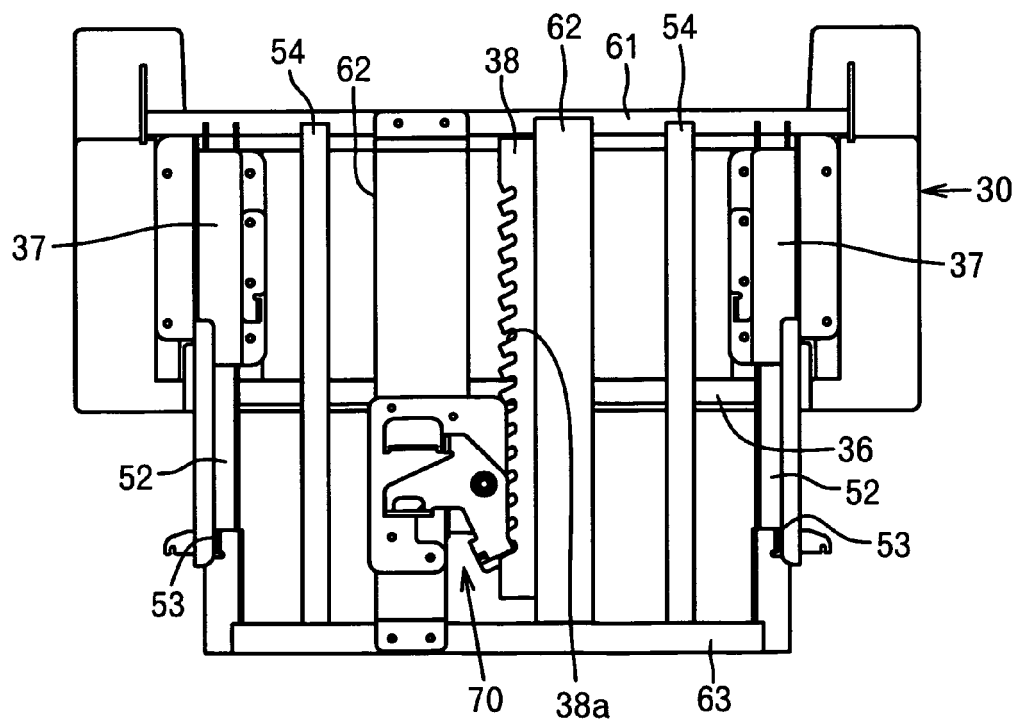


FIG. 13

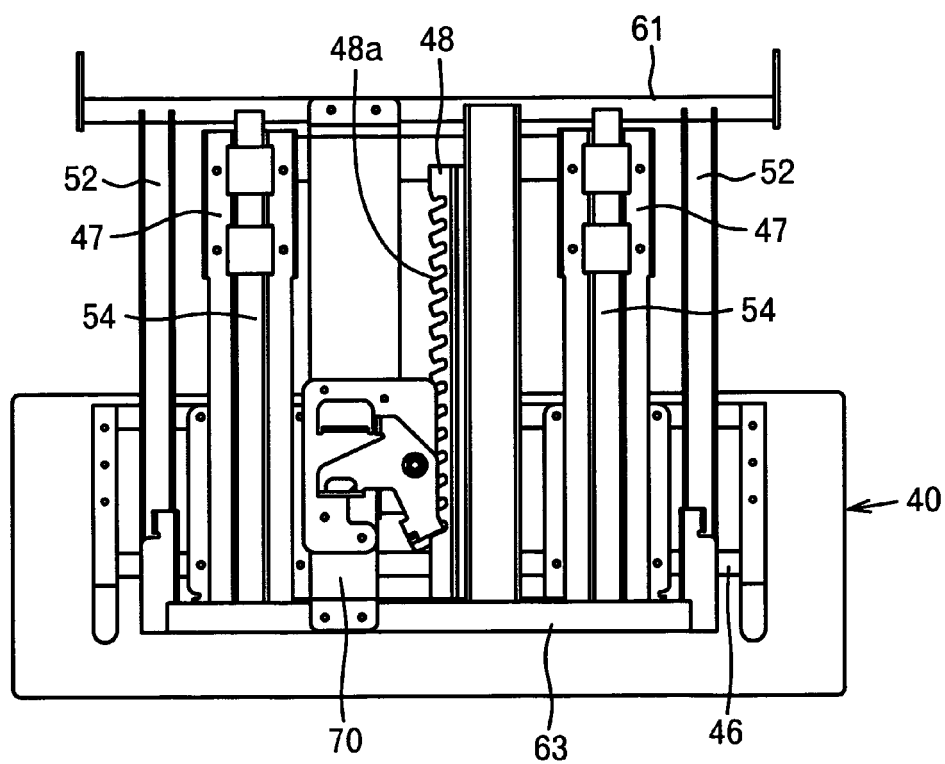


FIG. 14

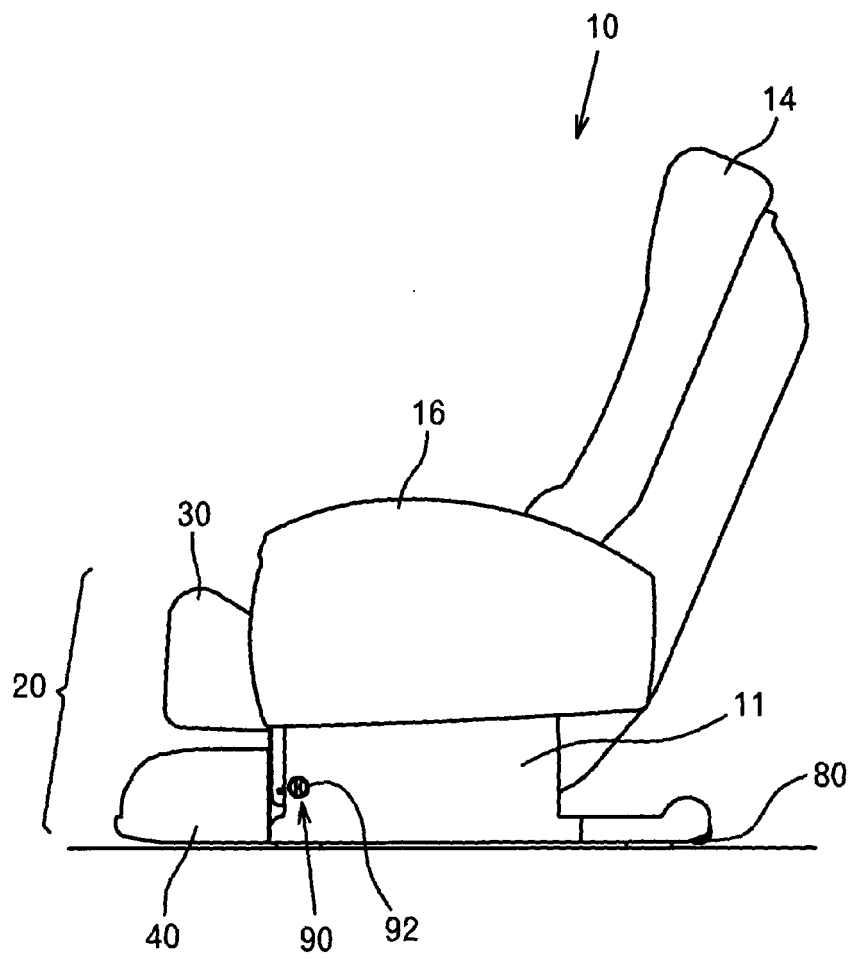


FIG. 15

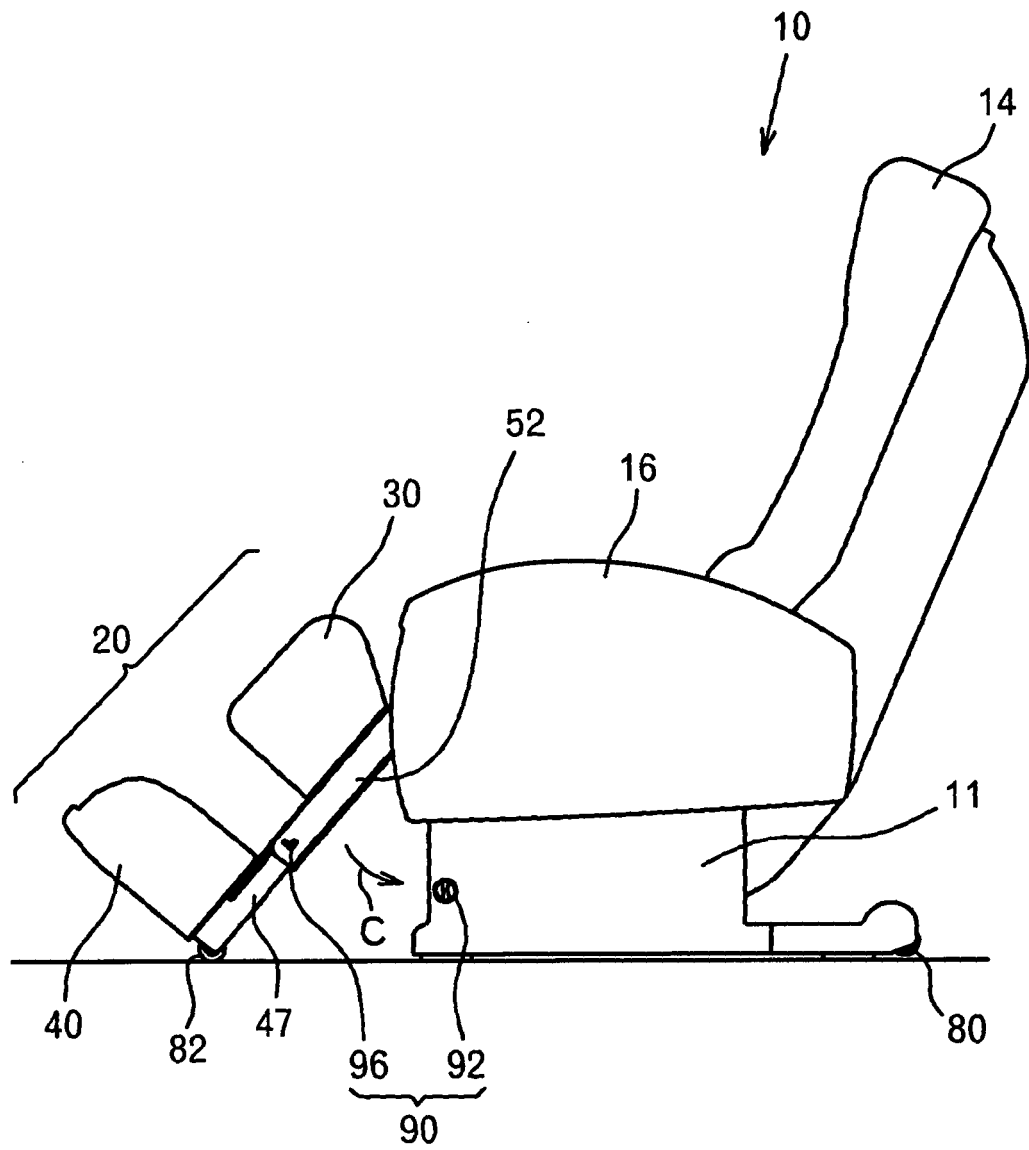


FIG. 16

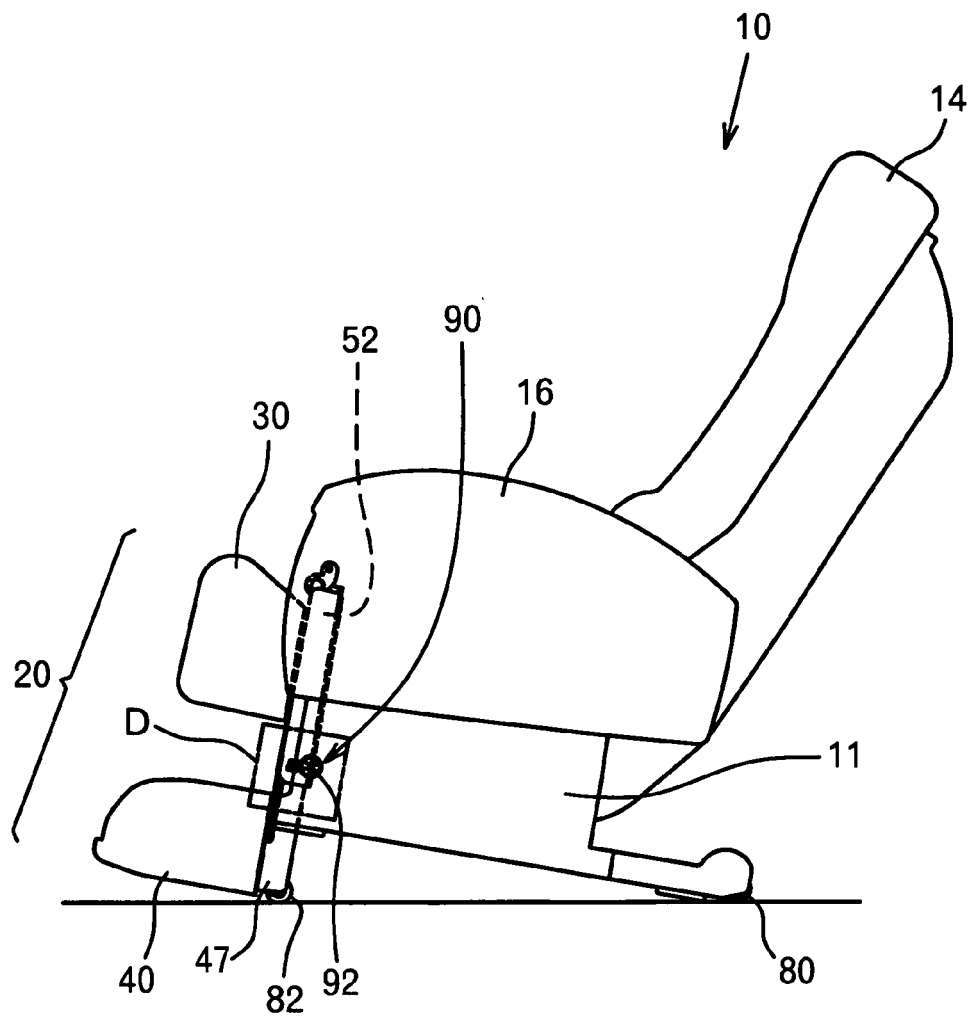


FIG. 17

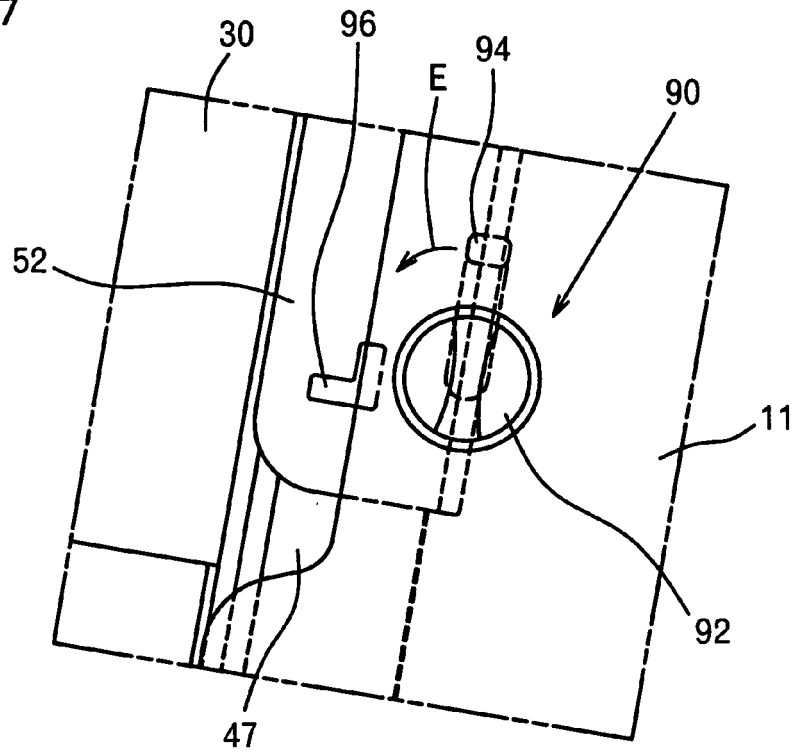
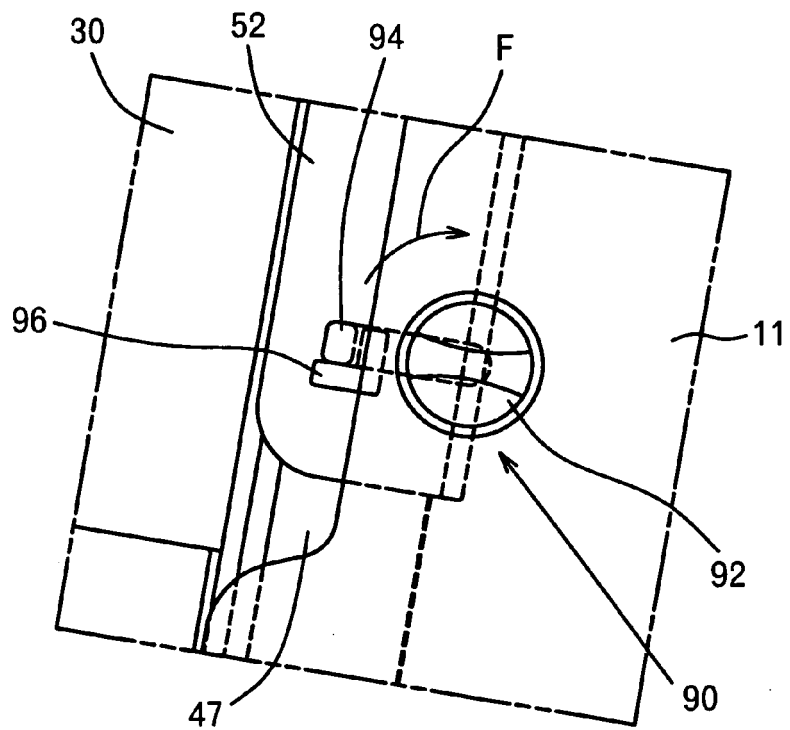


FIG. 18



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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