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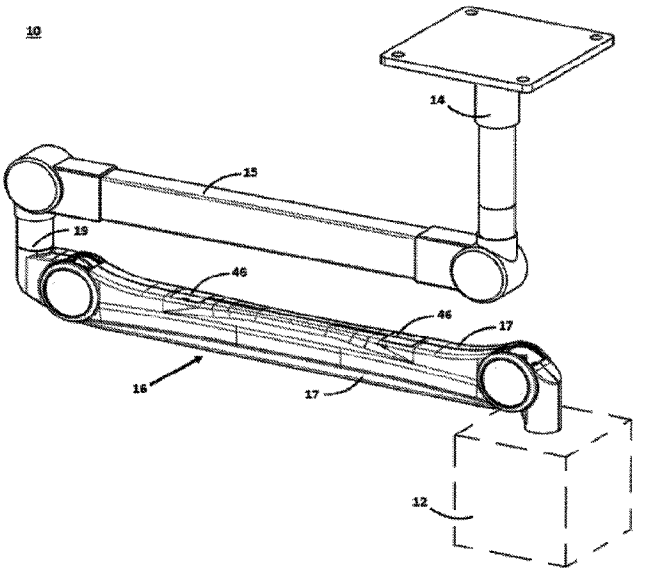

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A fixed positioning mechanism for a spring arm of a pendant system comprises a base link, a load link, and a transfer link. The base link and transfer link share a first pivot. The load link comprises a fine load adjustment adjacent the first pivot. A second pivot at the fine load adjustment. The transfer link comprises a slidable rod assembly having a first end and a second end, a spring situated over the rod assembly, and a third pivot mounted on the first end. The load link comprises a curved or offset body such that rotation of the transfer link below horizontal allows the base link to intersect a plane defined by the second and third pivot.

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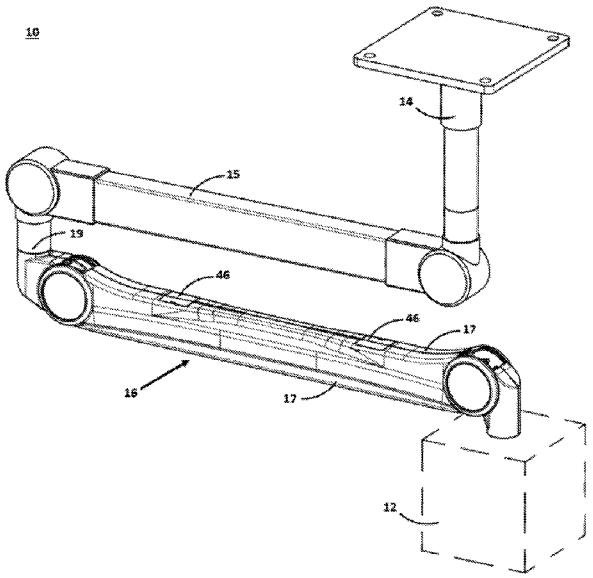

Fig. 1

(57) **Abstract:** A fixed positioning mechanism for a spring arm of a pendant system comprises a base link, a load link, and a transfer link. The base link and transfer link share a first pivot. The load link comprises a fine load adjustment adjacent the first pivot. A second pivot at the fine load adjustment. The transfer link comprises a slidable rod assembly having a first end and a second end, a spring situated over the rod assembly, and a third pivot mounted on the first end. The load link comprises a curved or offset body such that rotation of the transfer link below horizontal allows the base link to intersect a plane defined by the second and third pivot.

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Improved Arm Linkage for Device Bearing Spring Arms

Background

Pendant systems are used in medical settings to hold and position diagnostic equipment, lights, displays and other healthcare equipment. Pendant systems are typically mounted to the ceiling and are typically integrated with power and utility lines which clears up space and removes tripping hazards from the floor. The medical devices are mounted to a spring arm that is movable and allows the positioning of the device where it is required. There is a need to create pendant systems in which the spring arms can be moved in as wide an arc as possible and accommodate a wide range of devices of differing size and weight. What is presented is an improved arm linkage for spring arms that allows an improved range of movement for a wide range of device loads.

Summary

A fixed positioning mechanism for a spring arm of a pendant system is presented. The pendant system for the manipulation and maintained support of a device mounted to the spring arm. The fixed positioning mechanism comprises a base link, a load link, and a transfer link. The base link and the transfer link share a first pivot. The load link further comprises a fine load adjustment adjacent the first pivot. The fine load adjustment is actuatable to be moved towards or away from the first pivot. A second pivot is at the fine load adjustment. The transfer link further comprising a slidable rod assembly having a first end and a second end, a spring situated over said rod assembly, a third pivot mounted on the first end of the rod assembly, and a compression member adjustably attached to the

second end of the rod assembly for coarse adjustment of said spring's preload. The load link extends between the second pivot and the third pivot such that actuation of the fine load adjustment towards or away from the first pivot will respectively increase or decrease the distance between the first pivot and the third pivot corresponding to a fine increase or decrease in said spring's preload. The load link further comprises a curved or offset body such that rotation of the transfer link below horizontal allows the base link to intersect a plane defined by the second pivot and the third pivot regardless of the positioning of the fine load adjustment.

The compression member is actuated to set a load range followed by actuation of the fine load adjustment to set an exact weight within the load range to accommodate the weight of the device attached to the spring arm such that the gravitational force acting on the device will be balanced by the spring for maintaining the position of the device. In some embodiments, the compression member and the fine load adjustment are covered by removable windows for easy user access.

In some embodiments, the base link has a pivotable mounting shaft for 360-degree rotation of the spring arm about a fixed base or other member of the pendant system. In some embodiments, the spring arm has a 120-degree range of motion which could be +45-degrees to -75-degrees from horizontal.

Those skilled in the art will realize that this invention is capable of embodiments that are different from those shown and that details of the devices and methods can be changed in various manners without departing from the scope of this invention. Accordingly, the drawings and descriptions are to be regarded as including

such equivalent embodiments as do not depart from the spirit and scope of this invention.

Brief Description of Drawings

For a more complete understanding and appreciation of this invention, and its many advantages, reference will be made to the following detailed description taken in conjunction with the accompanying drawings.

FIG. 1 shows a perspective view of a pendant system bearing a generic device on a spring arm in a horizontal position;

FIG. 2 is the pendant system of FIG. 1 with part of the outer cover of the spring arm removed to show its inner components;

FIG. 3 is a side view of the spring arm of FIG. 1;

FIG. 4 is a side view of the spring arm of FIG. 3 with part of the outer cover removed to show the inner components;

FIG. 5 is a cross-section view of the spring arm of FIG. 3 with the fine load adjustment in the fully lowered position;

FIG. 6 is a close up of the cross-section view of the fixed positioning mechanism of the spring arm of FIG. 5;

FIG. 7 is a cross-section view of the spring arm of FIG. 3 with the fine load adjustment in the fully raised position;

FIG. 8 is a close up of the cross-section view of the fixed positioning mechanism of the spring arm of FIG. 7;

FIG. 9 is a cross-section view of the spring arm of FIG. 3 rotated to its fullest extent below horizontal with the fine load adjustment in the fully lowered position;

FIG. 10 is a close up of the fixed positioning mechanism of the cross-section view of FIG. 9;

FIG. 11 is a cross-section view of the spring arm of FIG. 3 rotated to its fullest extent below horizontal with the fine load adjustment in the fully raised position;

FIG. 12 is a close up of the cross-section view of FIG. 11;

FIG. 13 is a top view of the spring arm of FIG. 3;

FIG. 14 is the spring arm of FIG. 13 with the removable window showing access to the adjustment nut;

FIG. 15 is a close up bottom view of the fixed positioning mechanism of the spring arm of FIG. 3 showing access to the adjustment screw;

FIG. 16 is a schematic illustrating the range of adjustment of the coarse and fine adjustment of the spring preload;

FIG. 17 is a schematic showing an example spring preload adjustment scenario;

FIG. 18 shows the example spring preload adjustment scenario of FIG. 17 after the fine adjustment has been set;

FIG. 19 shows the example spring preload adjustment scenario of FIG. 18 after the coarse adjustment has been set;

FIG. 20 shows a close up cross-sectional view of the fixed positioning mechanism of another embodiment of spring arm in which the base link has an offset shape;

FIG. 21 is a cross-section view of another embodiment of spring arm; and

FIG. 22 is a close up of the cross-section view of the fixed positioning mechanism of the spring arm.

Detailed Description

Referring to the drawings, some of the reference numerals are used to designate the same or corresponding parts through several of the embodiments and figures shown and described. Corresponding parts are denoted in different embodiments with the addition of lowercase letters. Variations of corresponding parts in form or function that are depicted in the figures are described. It will be understood that variations in the embodiments can generally be interchanged without deviating from the invention.

As shown in FIG. 1, pendant systems **10** are commonly used in healthcare applications to hold devices **12** within a room where they are needed and they can be easily moved and held in position. Pendant systems **10** are typically mounted on a fixed base **14** and mounted to a ceiling mounted mechanism, as shown in the Figures or onto a wall mounted mechanism, a mobile mounted mechanism (Floor Stand or cart) or even fixed to a floor mounted mechanism. Pendant systems **10** have a series of pivot arms **15** and spring arms **16.** A device **12** is mounted to the end of a spring arms **16** allowing the device **12** to be manipulated and remain supported in positions as needed. The pendant systems **10** may incorporate power, electronics, sensors, fluid lines, etc. which could be used to connect to whatever device **12** is mounted to the pendant system. Devices **12**

that could be mounted to pendant systems **10** include but are not limited to lights, display screens, monitors, gas or fluid supply, etc. There are many types of pendant systems **10** with a variety of pivot arms **15** and spring arm **16** types which provide a variety of options for maneuvering and positioning whatever device **12** is mounted to the spring arm **16**.

FIG. 2 shows the pendant system **10** of FIG. 1 with the outer covers **17** removed from the spring arm **16** to show its internal components. FIGs. 3 and 4 shows a side view of the spring arm **16** and a side view of the spring arm with the outer covers **17** removed, respectively. FIG. 5 is a cross-section view of the spring arm. FIG. 6 shows a close up cut out view of a fixed positioning mechanism for a spring arm **16**. As best understood by comparing FIGs. 3 through 6, the fixed positioning mechanism of the spring arm **16** comprises a base link **18**, a load link **20**, and a transfer link **22**. The base link **18** has a pivotable mounting shaft **19** for 360-degree rotation of the spring arm **16** about the fixed base **14** or other member of the pendant system **10**. The base link **18** and the transfer link **22** share a first pivot **24**. The load link **20** comprises a fine load adjustment **26** adjacent the first pivot **24**. The fine load adjustment **26** is actuatable to be moved towards or away from the first pivot **26** by the use of an adjustment screw **28**. A second pivot **30** is located at the fine load adjustment **26**.

The transfer link **22** comprises a slidable rod assembly **32** having a first end and a second end. As best seen in FIG. 5, a spring **34** is situated over the rod assembly **32**. A third pivot **36** is mounted on the first end of the rod assembly. A compression member **40** is adjustably attached to the second end of the rod assembly **32** for coarse adjustment of the spring's **34** preload.

As best understood by comparing FIGs. 5 through 8, the load link **20** extends between the second pivot **30** and the third pivot **36** such that actuation of the fine load adjustment **26** towards or away from the first pivot **24** will respectively increase or decrease the distance between the first pivot **24** and the third pivot **36** corresponding to a fine increase or decrease in the spring's **34** preload. As discussed in more detail below, the compression member **40** is actuated by adjusting the adjustment nut **42** to set a load range followed by actuation of the fine load adjustment **26** to set an exact weight within the load range to accommodate the weight of the device **12** attached to the spring arm **16** such that the gravitational force acting on the device **12** will be balanced by the spring **34** for maintaining the position of the device **12**.

In this embodiment, the load link **20** comprises a curved body such that rotation of the transfer link **22** below horizontal allows the base link **18** to intersect a plane **44** defined by the second pivot **30** and the third pivot **36** regardless of the positioning of the fine load adjustment **26**. FIGs. 9 and 10 show the spring arm **16** rotated to its fullest extent below horizontal with the fine load adjustment **26** at its fully lowered position. FIGs. 11 and 12 show the spring arm **16** rotated to its fullest extent below horizontal with the fine load adjustment **26** at its fully lowered position. In both extremes, the base link **18** intersects the plane **44** defined by the second pivot **30** and the third pivot **36**. The configuration of the load link **20** is such a way allows the movement of spring arm **16** in arcs that prior art configurations are not able to achieve. The curved body of the load link **20** allows the rotation of the spring arm **16** to not be blocked by the base link **18** which would otherwise have stopped such movement. This allows the spring arm **16** to have a range of motion that exceeds typical pendant systems in the prior art. Spring arms **16** incorporating such load

links **20** have a 120-degree range of motion. The spring arm **16** shown in the figures has a range of motion of +45-degrees to -75-degrees from horizontal.

As can be seen in FIGs. 13 and 14, there are openings **45** in the outer cover **17** of the spring arm **16** which may be covered by removable windows **46** for easy user access to the adjustment nut **42** of the compression member **40**. FIG. 15 shows how the adjustment screw **28** of the fine load adjustment **26** can be accessed from the bottom of the spring arm **16**. As discussed earlier, the spring **34** can be preloaded – i.e. have its load capacity preset – so that the spring arm **16** is able to hold its position at any point within its range of motion while bearing the load of a device **12** mounted to it (shown in FIG 1 and 2).

FIG. 16 is a conceptual depiction of the levels of adjustment using a double box analogy. The outer box **48** represents the total range of adjustment the spring **34**. Actuation of the adjustment screw **28** moves the fine load adjustment **26** and moves the conceptual inner box **50** within the outer box **48**. Actuation of the adjustment nut **42** represents coarse adjustment of the compression member **40** and moves the diamond **52** within the inner box **50**. Please note that the double box is purely conceptual; there is no physical double box. It is also important to note that the diamond **52** moves with the inner box **50** when adjusting the adjustment screw **28**. However, adjusting the adjustment nut **42** moves the diamond **52** independently from the inner box **50**. Thus, there are many possible ways to achieve a given target. Furthermore, the range of the diamond **52** is not strictly bound by the inner box **50**; it is possible to move it beyond the limits of the inner box **50** as long as the adjustment nut **42** can be reached by the adjustment tool. However, the inner box **50** imposes a constraint on the effectiveness of adjusting the diamond **52**. If the adjustment nut **42** is turned to the point where the diamond **52** is outside the inner

box **50**, any further adjustment of the adjustment nut **42** in that direction will not correctly calibrate the spring **34**, despite the possibility of the diamond **52** aligning with the target capacity. The upper depiction shows the minimum setting for the spring **34** preload and the lower depiction shows the maximum setting for the spring **34** preload.

FIGs. 17-19 illustrate an example scenario for calibration of the spring **34** preload. Comparing to FIG. 5, in this scenario, FIG. 17 shows the spring arm **16** is expected to bear a device **12** that weighs 15kg and the spring **34** preload must be set to that target weight **54** and it is currently set to 12kg. A spring **34** that is improperly calibrated will cause the spring arm **16** to drift upwards or downwards. If the spring **34** has insufficient tension, the spring arm **16** will drift downwards. If the spring's **34** compression is too high, the spring arm **16** will drift upwards. As the target weight **54** is outside the range of what can be met solely by turning the adjustment nut **42**, the solution would be to turn the adjustment screw **28** to move the inner box **50** as shown in FIG. 18 and if that adjustment overshoots the target weight **54**, then turn the adjustment nut **42** to move the diamond **52** within the inner box **50** to go back to the target weight **54** as shown in FIG. 19.

FIG. 20 shows another embodiment of spring arm **16a** with another embodiment the load link **20a**. In this embodiment, the load link **20a** comprises an offset body rather than a curved body such that rotation of the transfer link **22a** below horizontal allows the base link **18a** to intersect a plane **44a** defined by the second pivot **30a** and the third pivot **36a** regardless of the positioning of the fine load adjustment **26a**. Other designs of load links **20a** are possible so long as the body is shaped to allow the base link **18a** to intersect a plane **44a** defined by the second pivot **30a** and the third pivot **36a** regardless of the positioning of

the fine load adjustment **26a** and to allow the rotation of the spring arm **16a** to not be blocked by base link **18a**.

FIGs. 21 and 22 show another embodiment of spring arm **16b** having a different internal configurations or linkages showing the improvements to the fixed positioning mechanism disclosed herein.

This invention has been described with reference to several preferred embodiments. Many modifications and alterations will occur to others upon reading and understanding the preceding specification. It is intended that the invention be construed as including all such alterations and modifications in so far as they come within the scope of the appended claims or the equivalents of these claims.

Claims:

1. A fixed positioning mechanism for a spring arm of a pendant system, the pendant system for the manipulation and maintained support of a device mounted to the spring arm, the fixed positioning mechanism comprising:

a base link, a load link, and a transfer link;

said base link and said transfer link share a first pivot;

said load link further comprising a fine load adjustment adjacent said first pivot, said fine load adjustment actuatable to be moved towards or away from said first pivot;

a second pivot at said fine load adjustment;

said transfer link further comprising a slidable rod assembly having a first end and a second end, a spring situated over said rod assembly, and a third pivot mounted on said first end of said rod assembly;

said load link extending between said second pivot and said third pivot such that actuation of said fine load adjustment towards or away from said first pivot will respectively increase or decrease the distance between said first pivot and said third pivot; and

said load link further comprising a curved or offset body such that rotation of said transfer link below horizontal allows said base link to intersect a plane defined by said second pivot and said third pivot regardless of the positioning of said fine load adjustment.

2. The fixed positioning mechanism of claim 1 further comprising said base link has a pivotable mounting shaft for 360-degree rotation of the spring arm about a fixed base or other member of the pendant system.

3. The fixed positioning mechanism of claim 1 further comprising said spring arm has a 120-degree range of motion.

4. The fixed positioning mechanism of claim 1 further comprising said spring arm has a range of motion of +45-degrees to -75-degrees from horizontal.

5. The fixed positioning mechanism of claim 1 further comprising said fine load adjustment is covered by removable windows for easy user access.

6. A fixed positioning mechanism for a spring arm of a pendant system, the pendant system for the manipulation and maintained support of a device mounted to the spring arm, the fixed positioning mechanism comprising:

a base link, a load link, and a transfer link;

said base link and said transfer link share a first pivot;

said load link further comprising a fine load adjustment adjacent said first pivot, said fine load adjustment actuatable to be moved towards or away from said first pivot;

a second pivot at said fine load adjustment;

said transfer link further comprising a slidable rod assembly having a first end and a second end, a spring situated over said rod assembly, a third pivot mounted on said first end of said rod assembly, and a compression member adjustably attached to said second end of said rod assembly for coarse adjustment of said spring's preload;

said load link extending between said second pivot and said third pivot such that actuation of said fine load adjustment towards or away from said first pivot will respectively increase or decrease the distance between said first pivot and said third pivot corresponding to a fine increase or decrease in said spring's preload; and

said compression member is actuated to set a load range followed by actuation of said fine load adjustment to set an exact weight within said load range to accommodate the weight of the device attached to the spring arm such that the gravitational force acting on the device will be balanced by said spring for maintaining the position of the device.

7. The fixed positioning mechanism of claim 6 further comprising said base link has a pivotable mounting shaft for 360-degree rotation of the spring arm about a fixed base or other member of the pendant system.

8. The fixed positioning mechanism of claim 6 further comprising said spring arm has a 120-degree range of motion.

9. The fixed positioning mechanism of claim 6 further comprising said compression member and said fine load adjustment are covered by removable windows for easy user access.

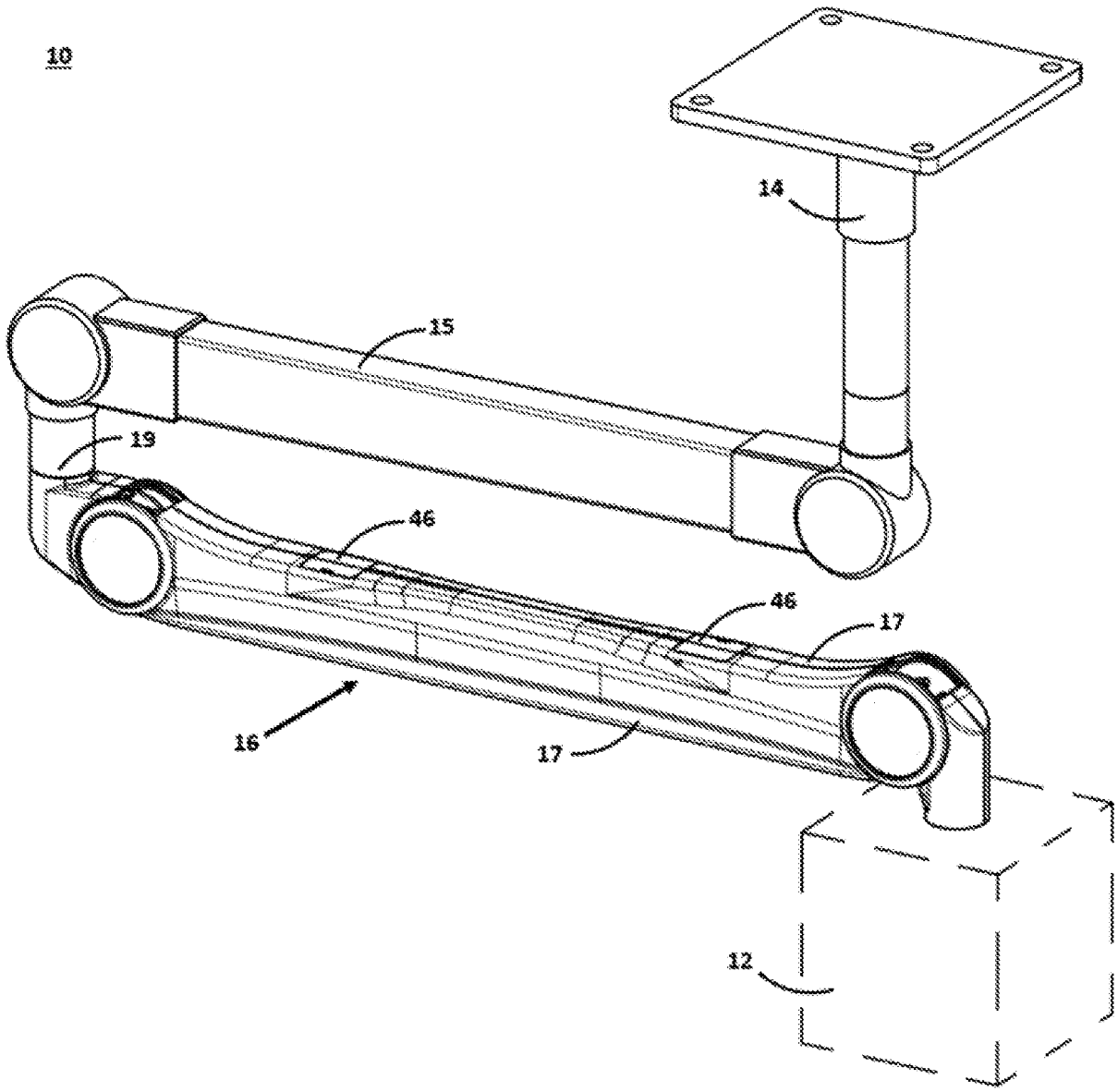


Fig. 1

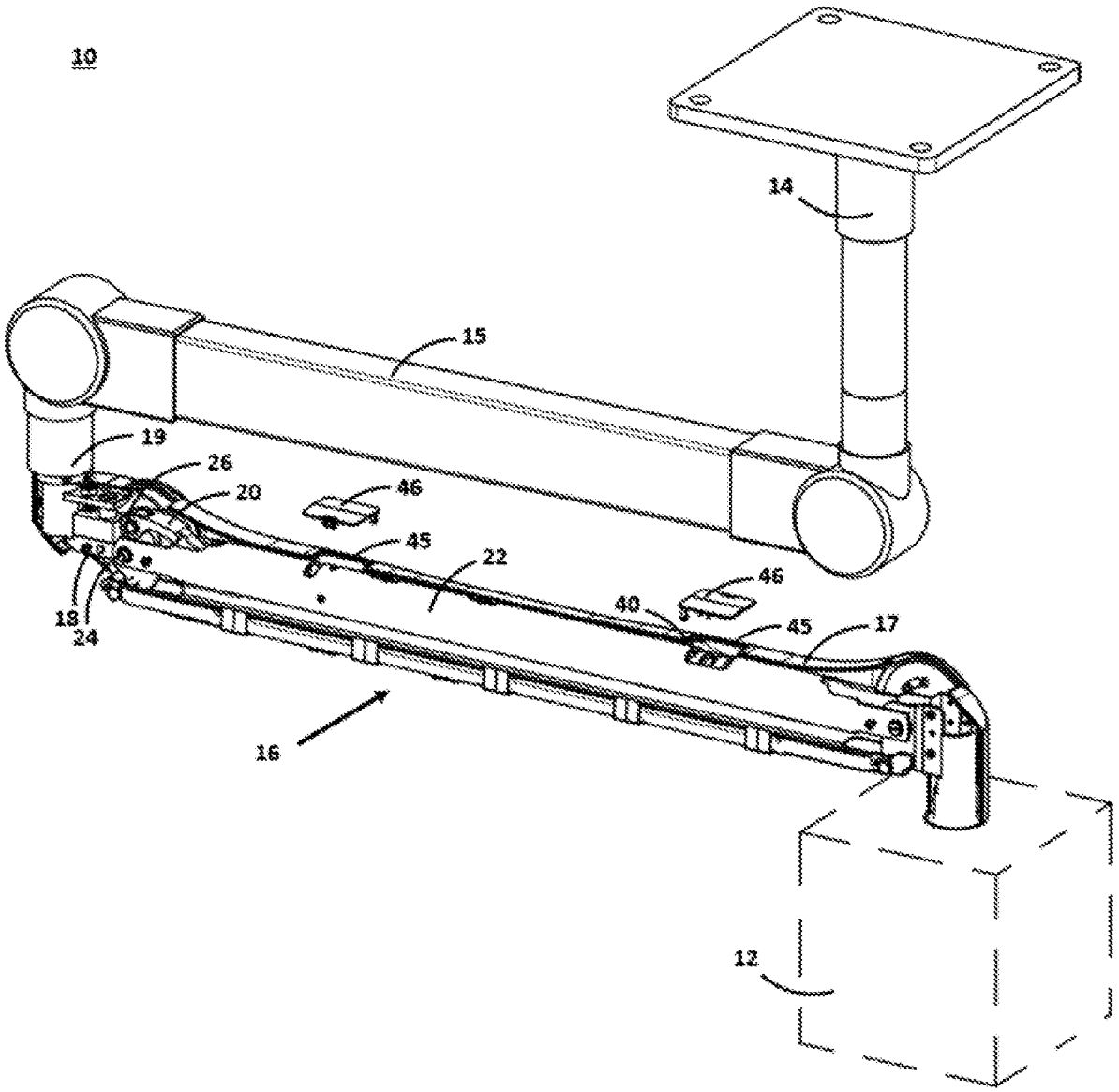


Fig. 2

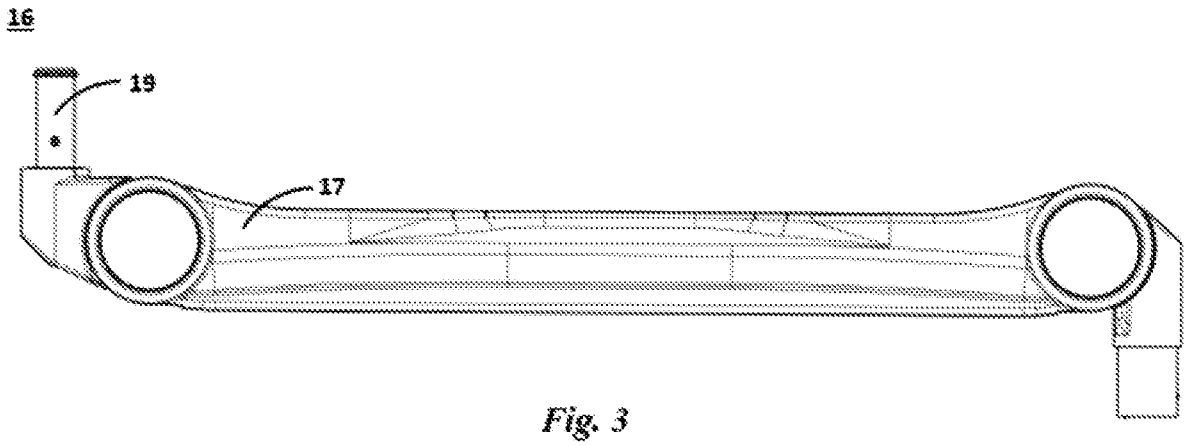


Fig. 3

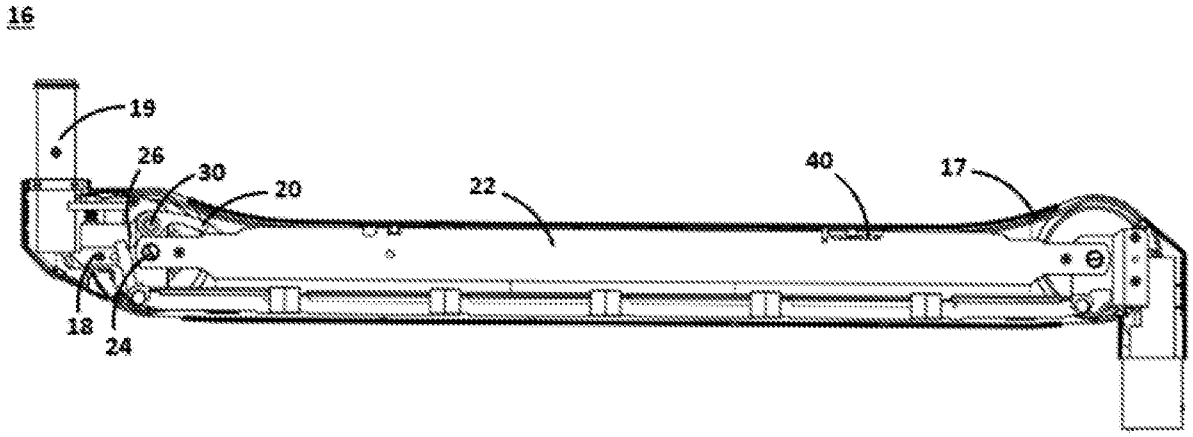


Fig. 4

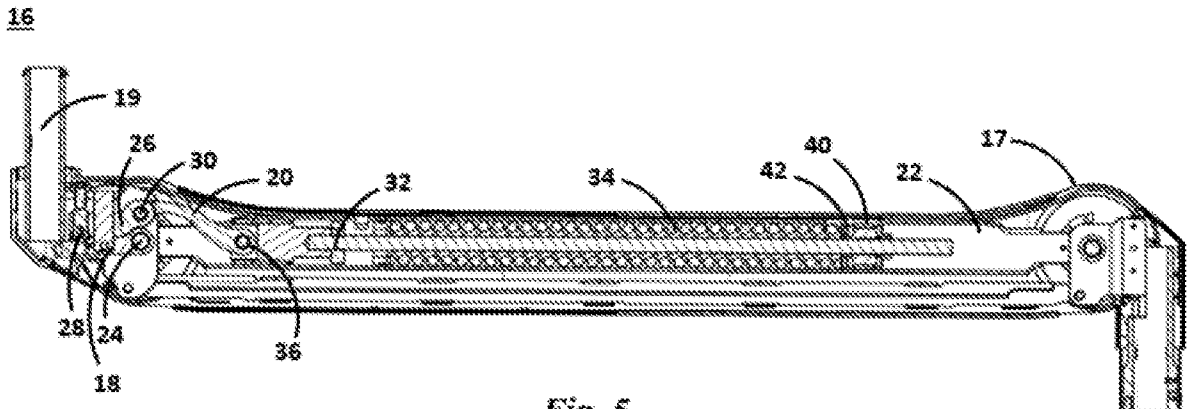


Fig. 5

16

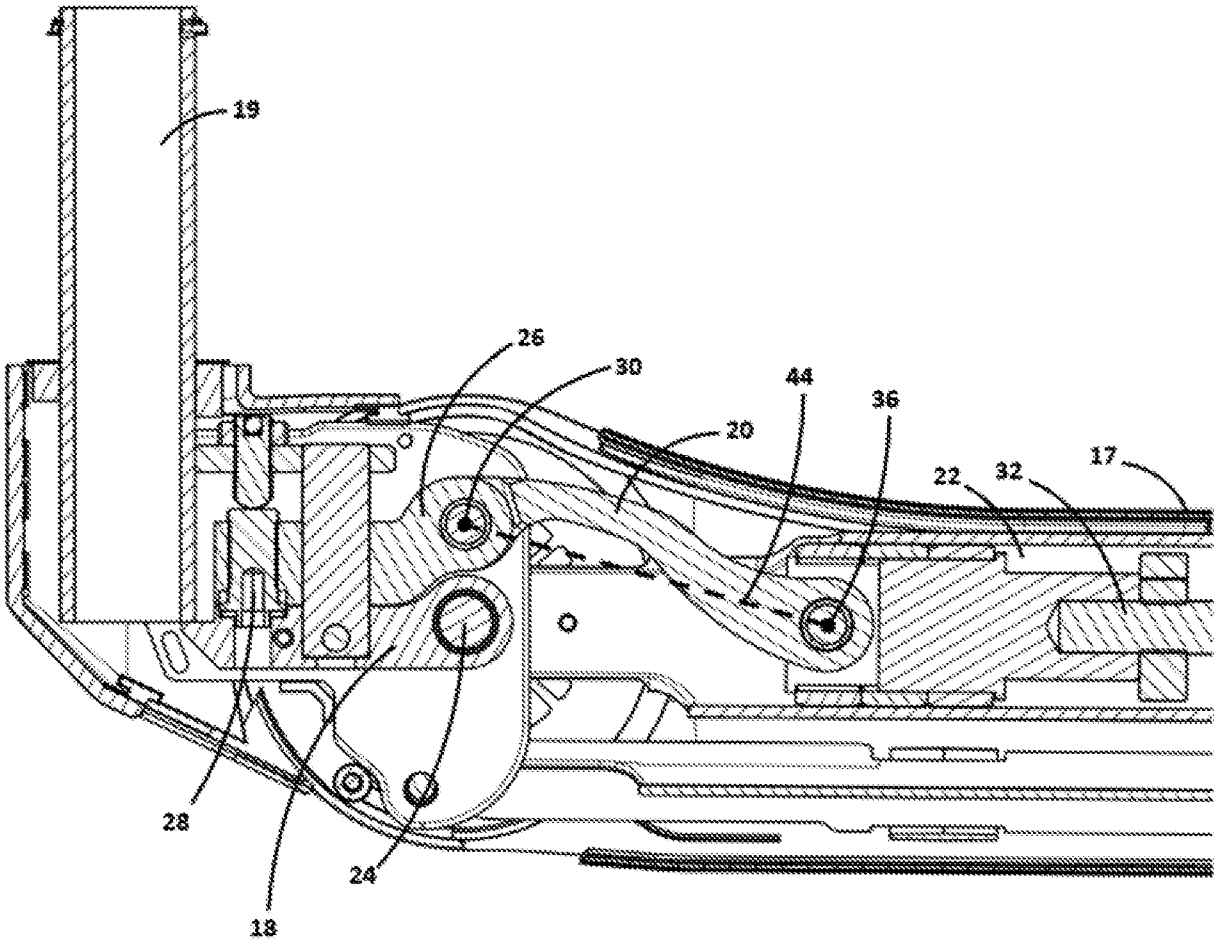


Fig. 6

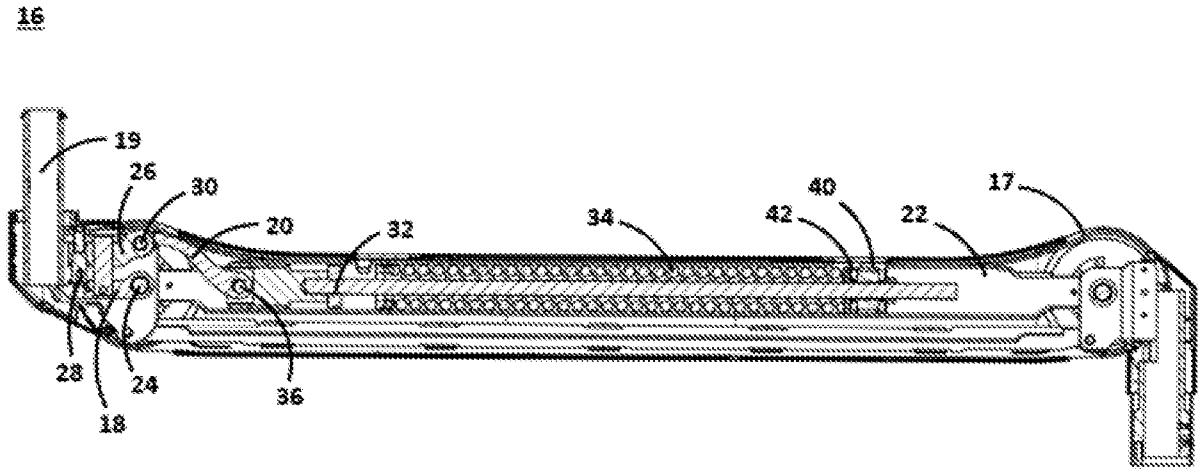


Fig. 7

16

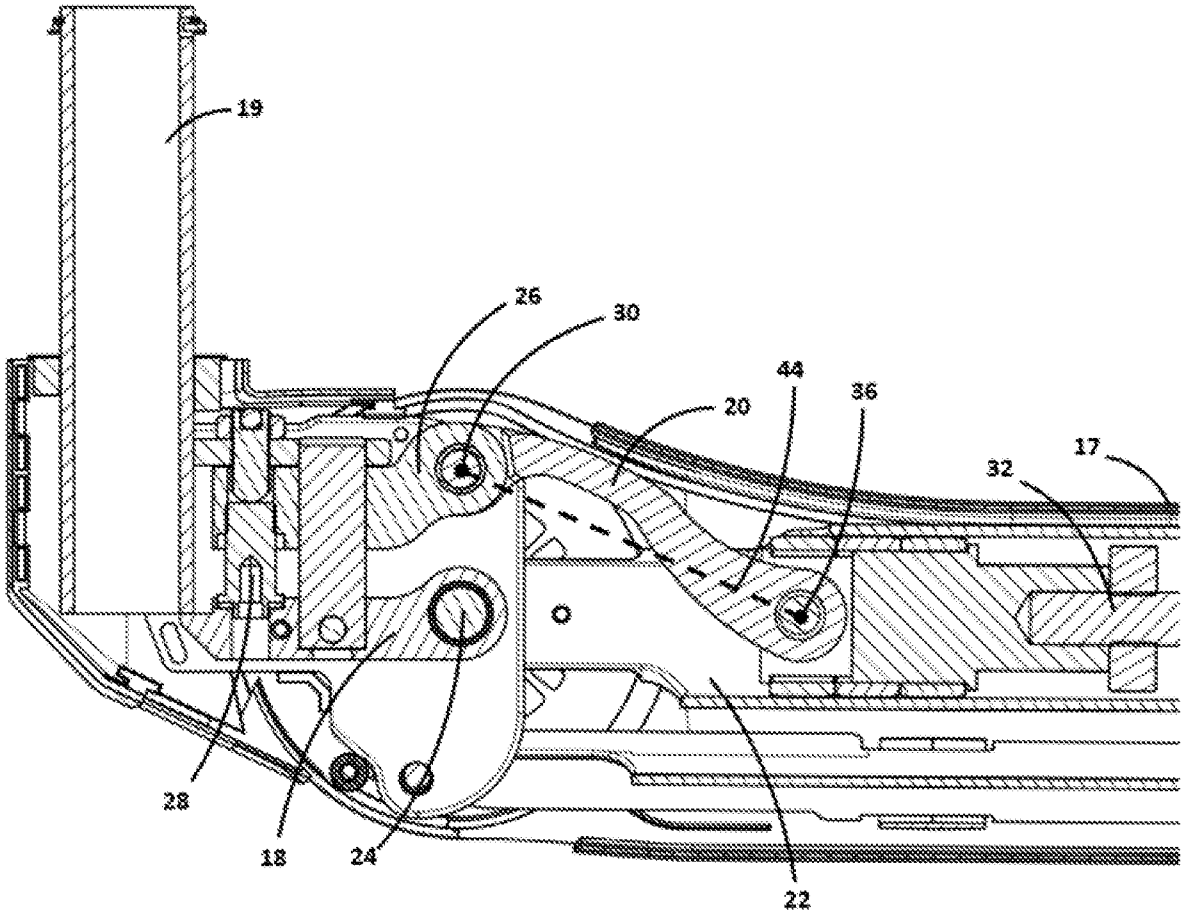


Fig. 8

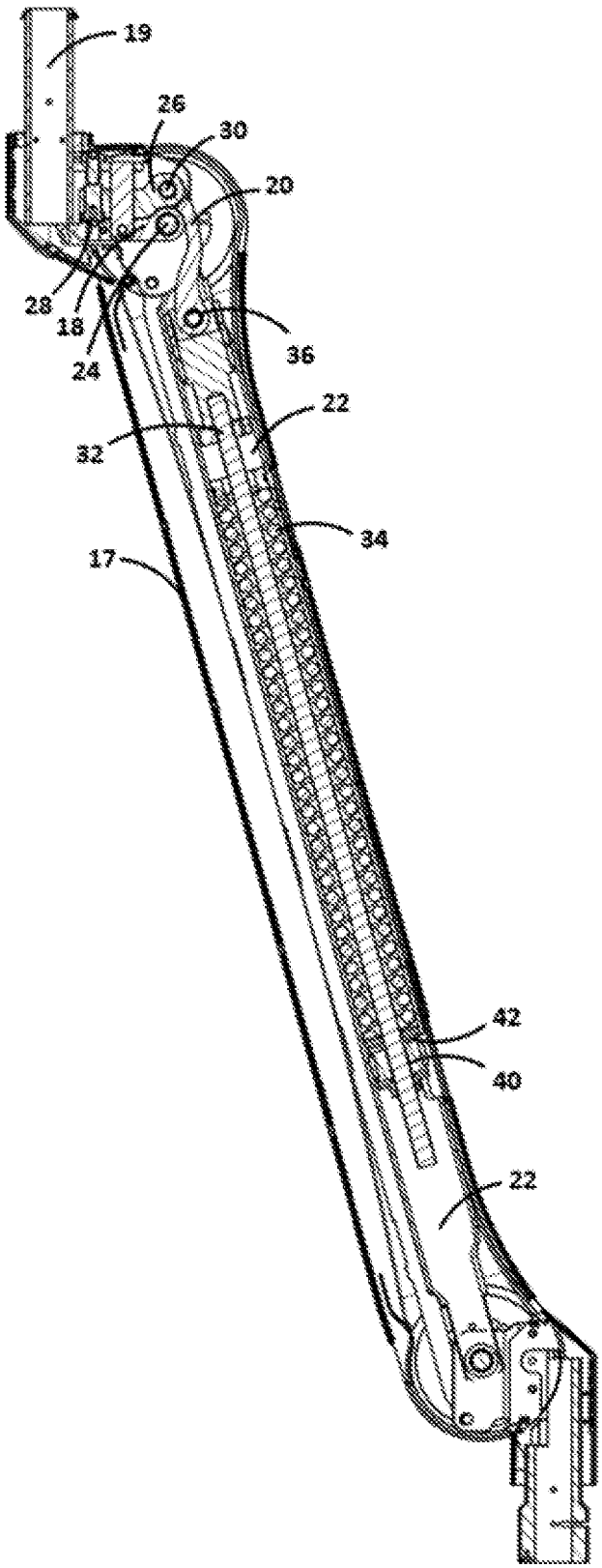


Fig. 9

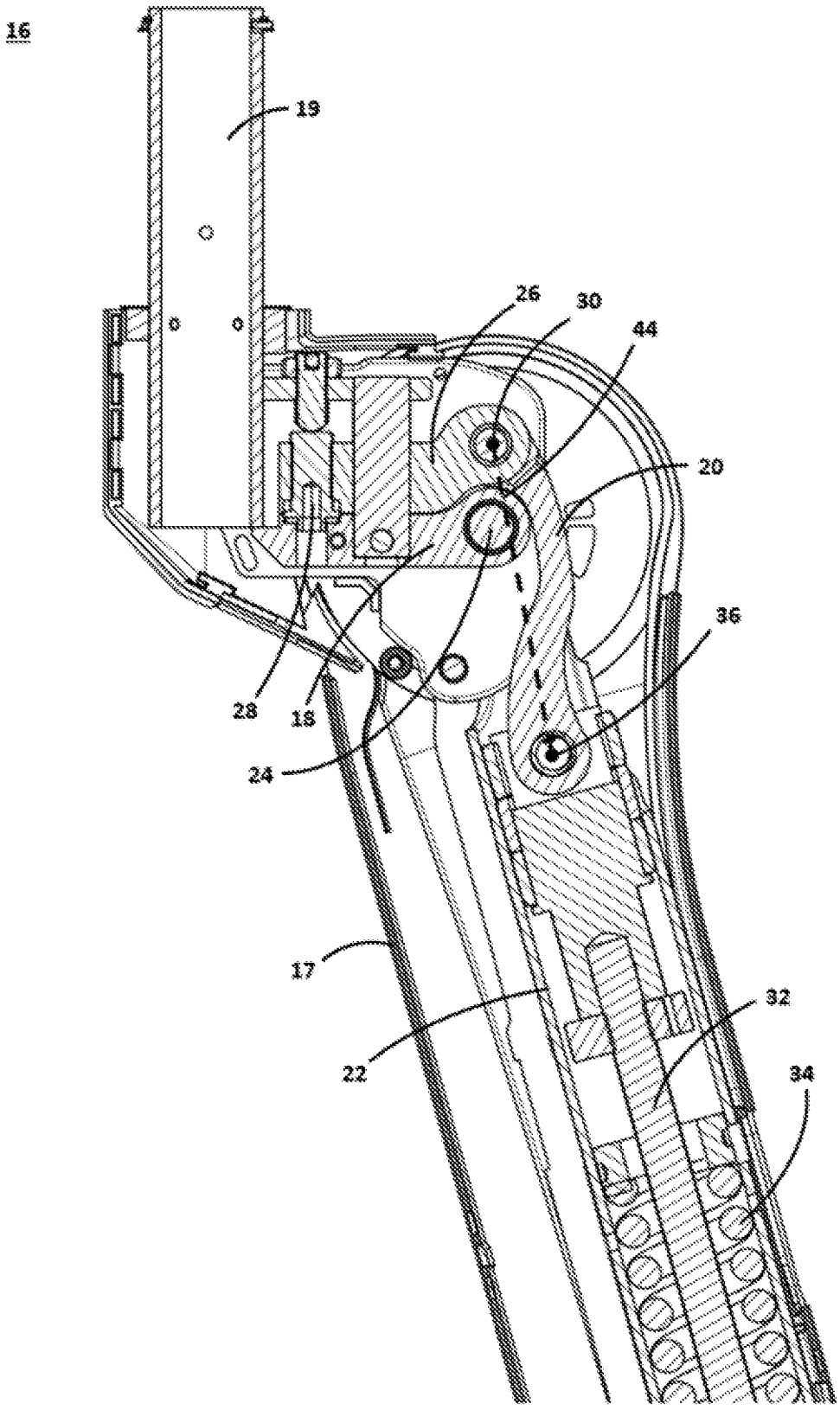


Fig. 10

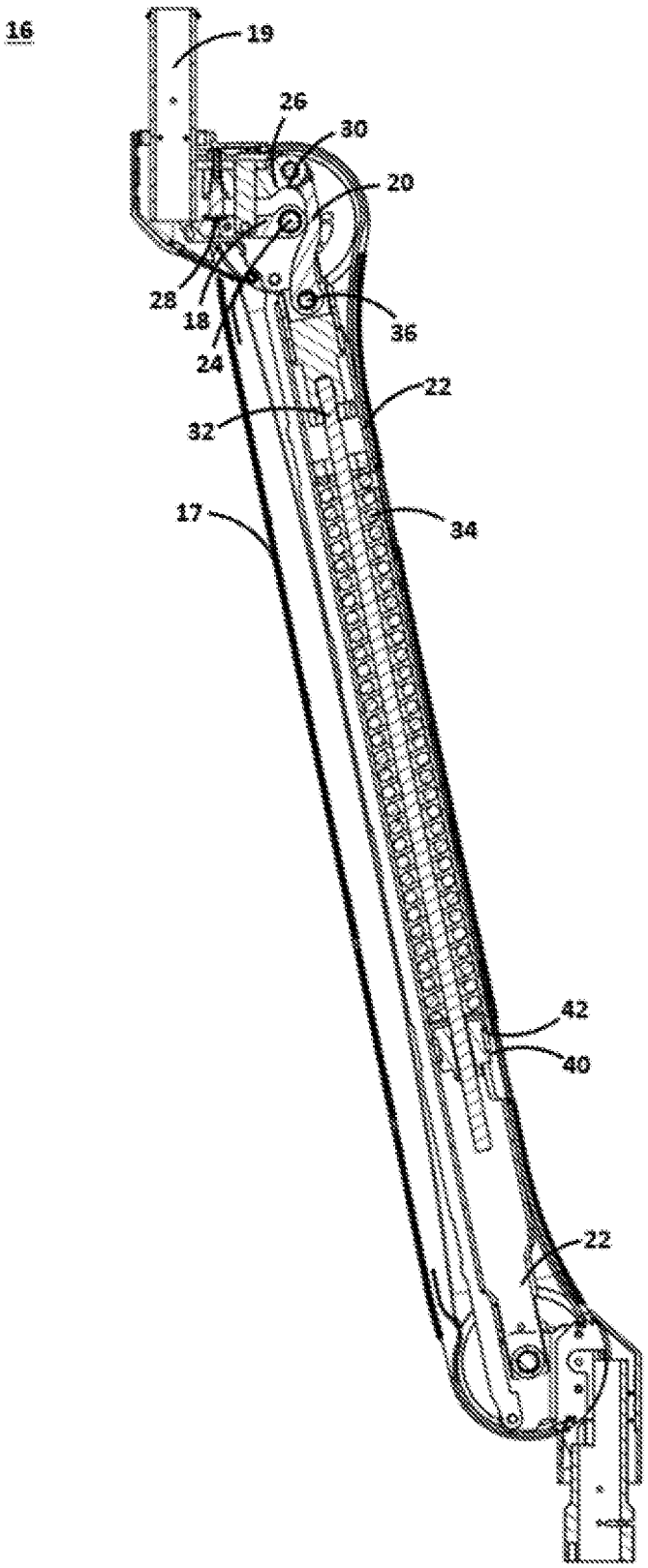


Fig. 11

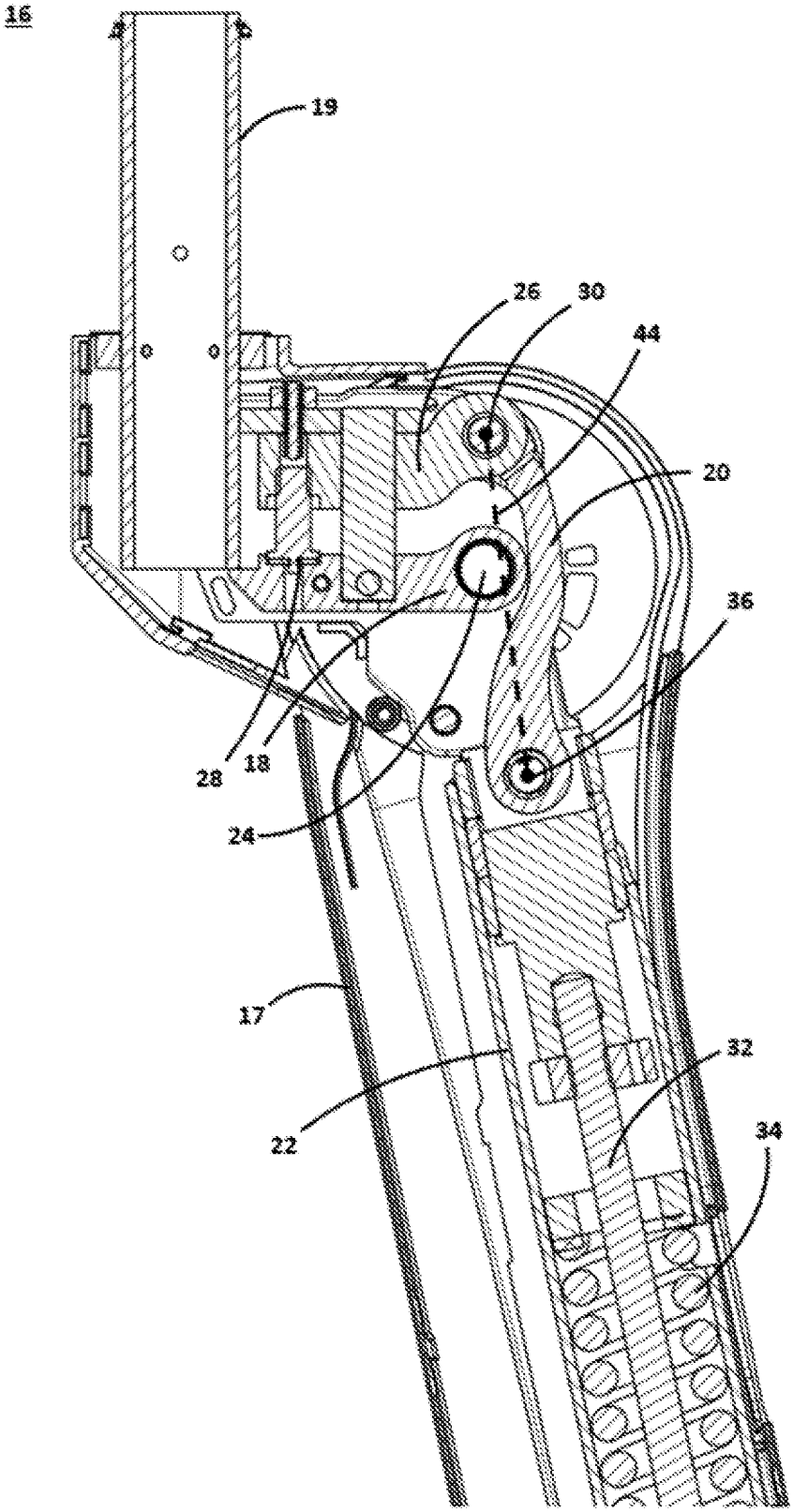


Fig. 12

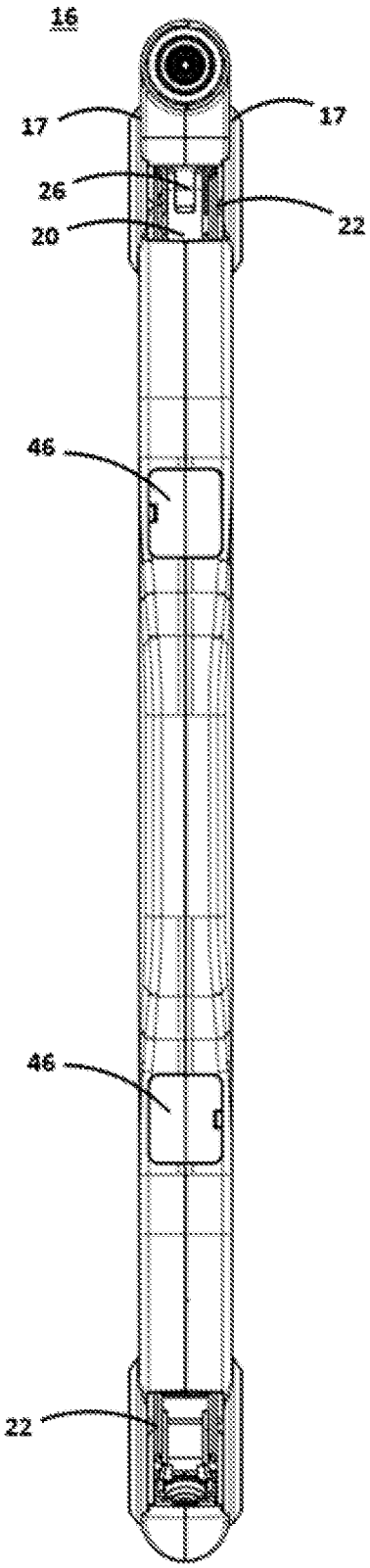


Fig. 13

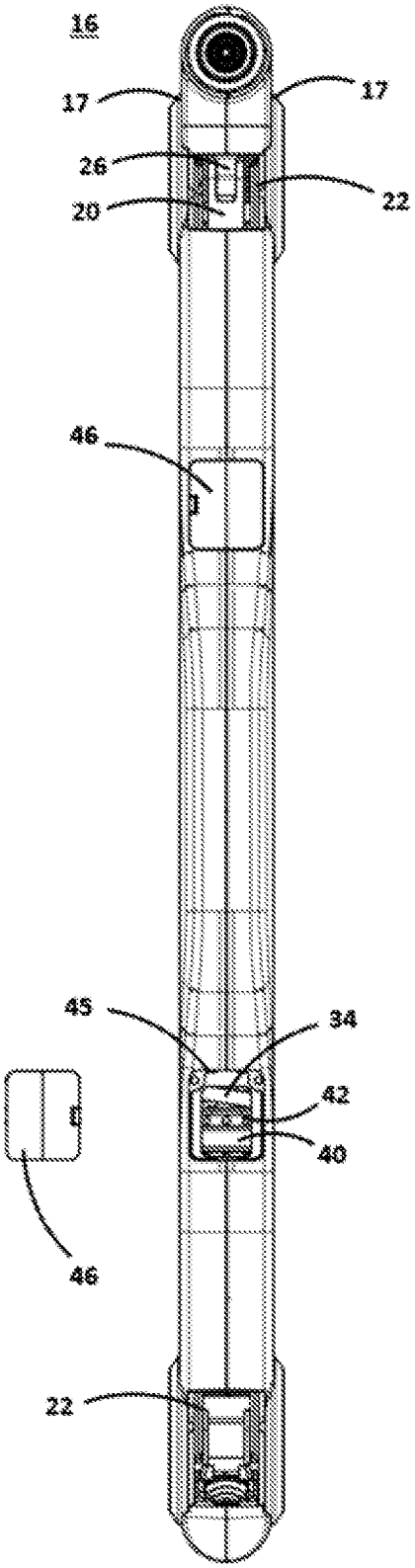


Fig. 14

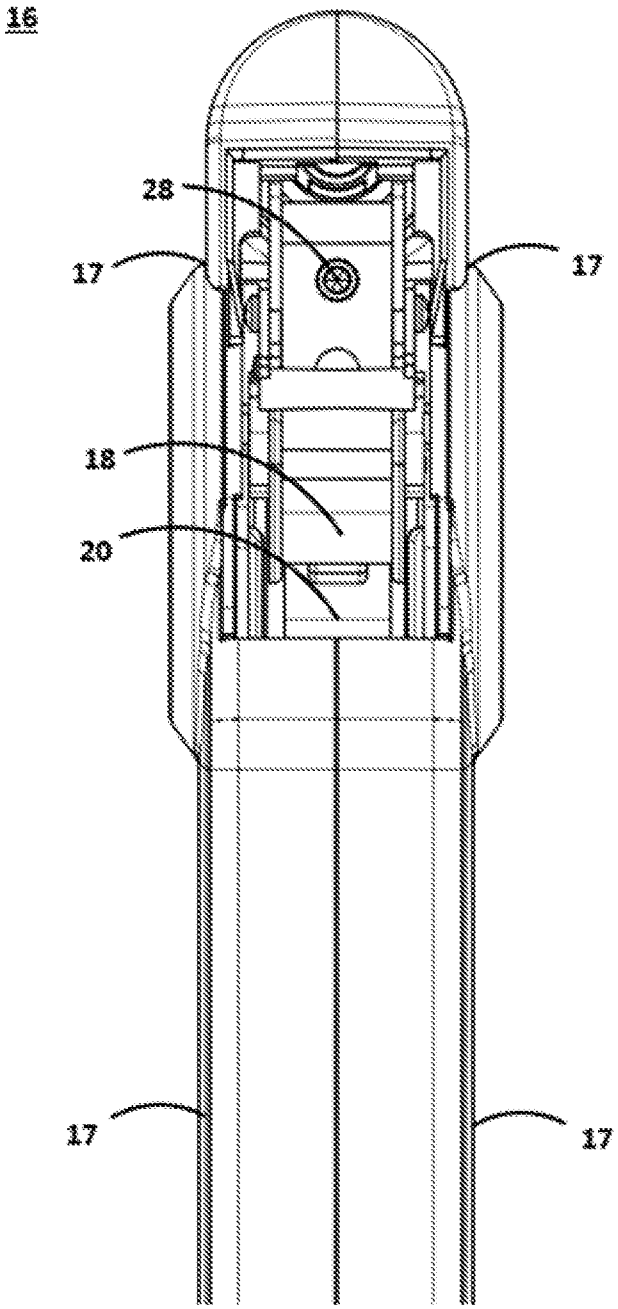


Fig. 15

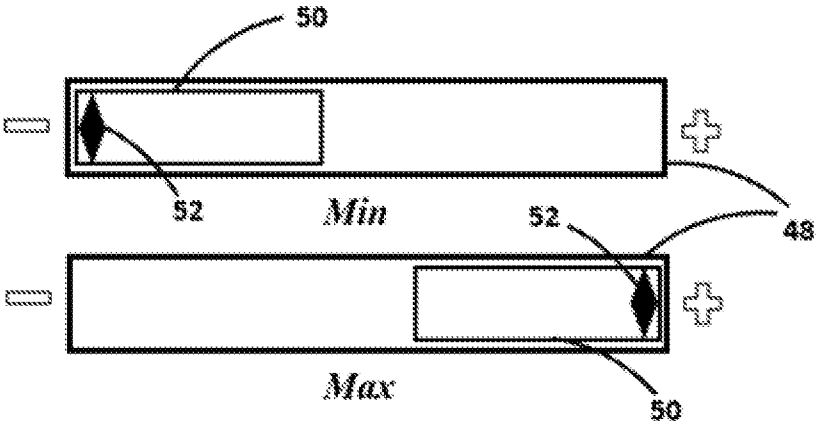


Fig. 16

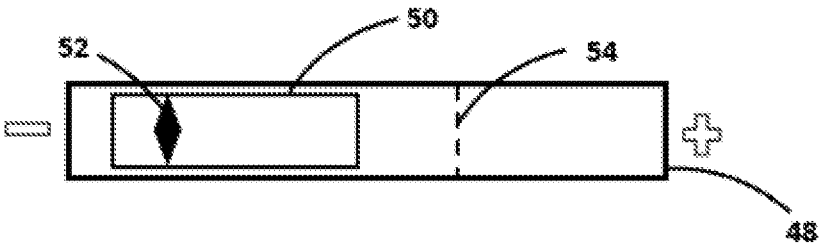


Fig. 17

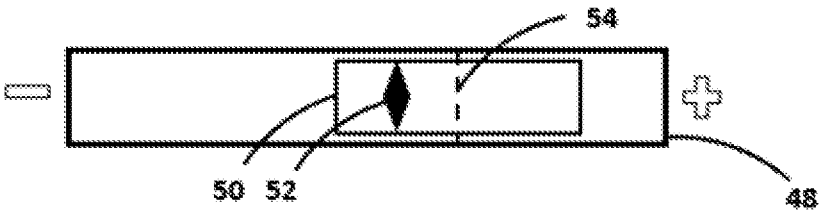


Fig. 18

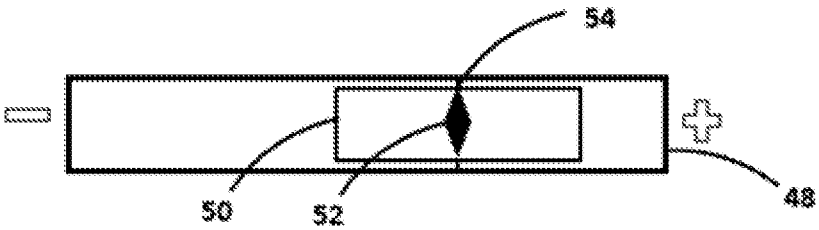


Fig. 19

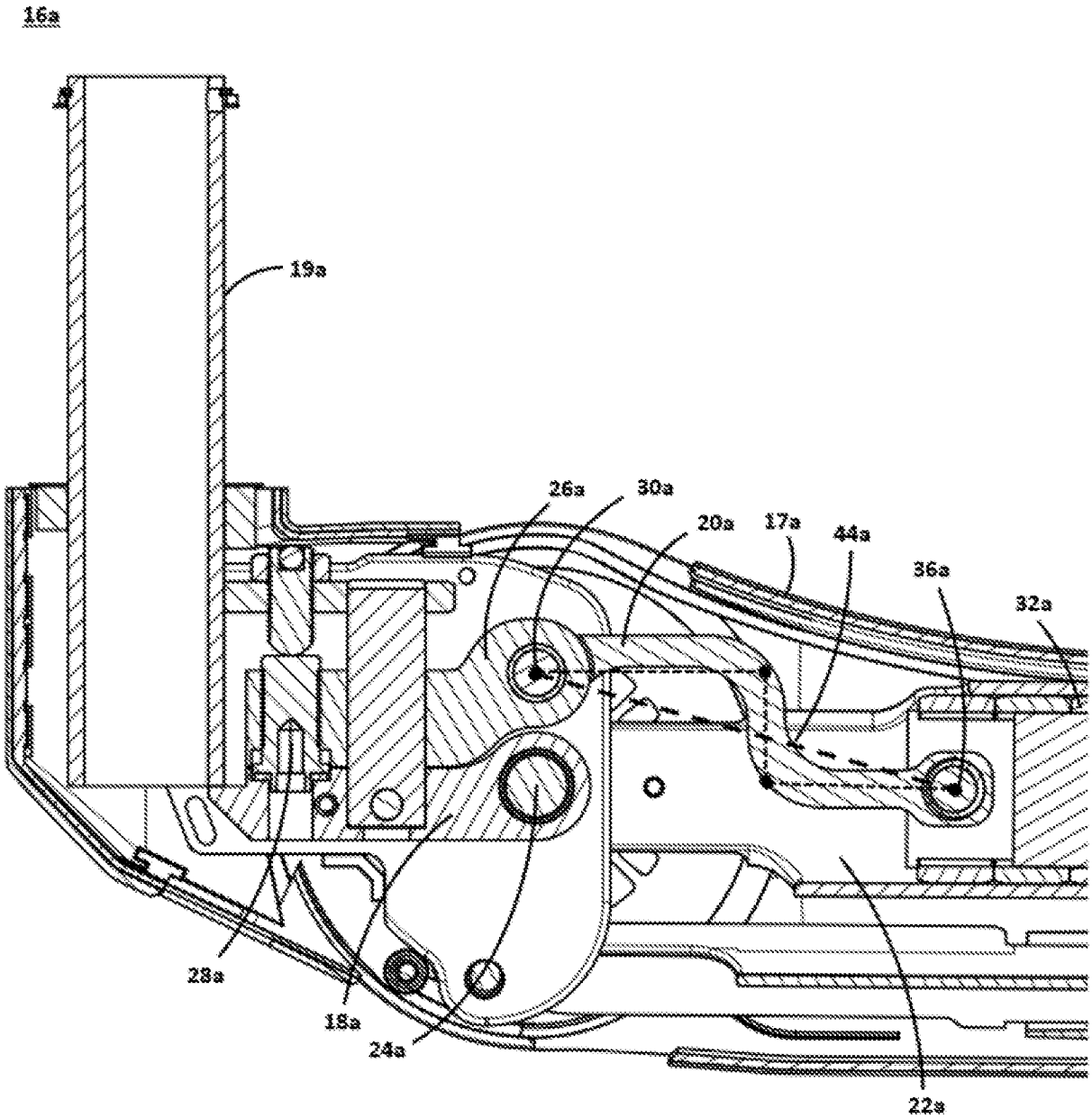


Fig. 20

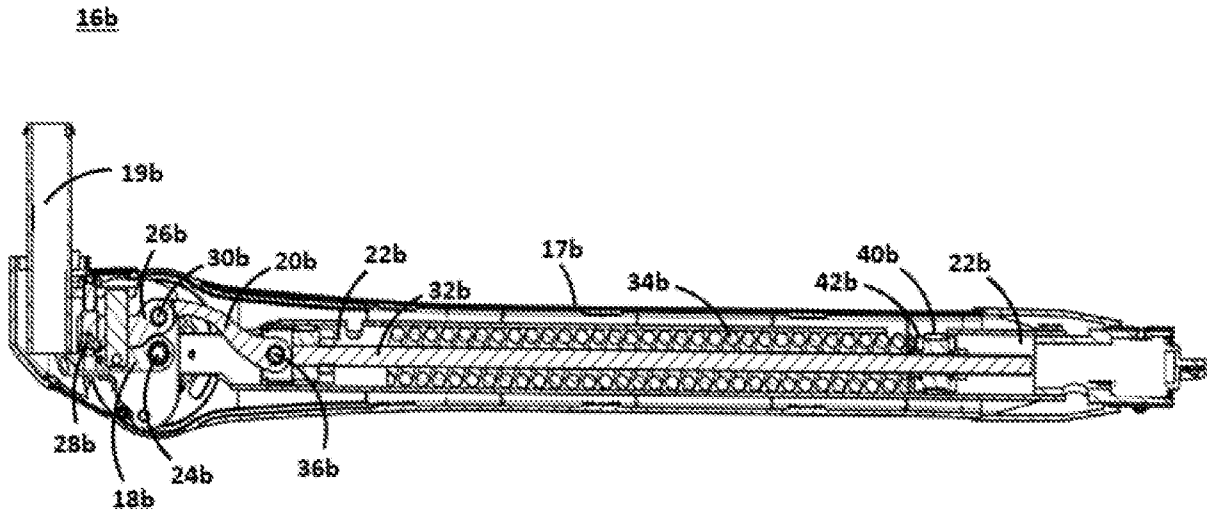


Fig. 21

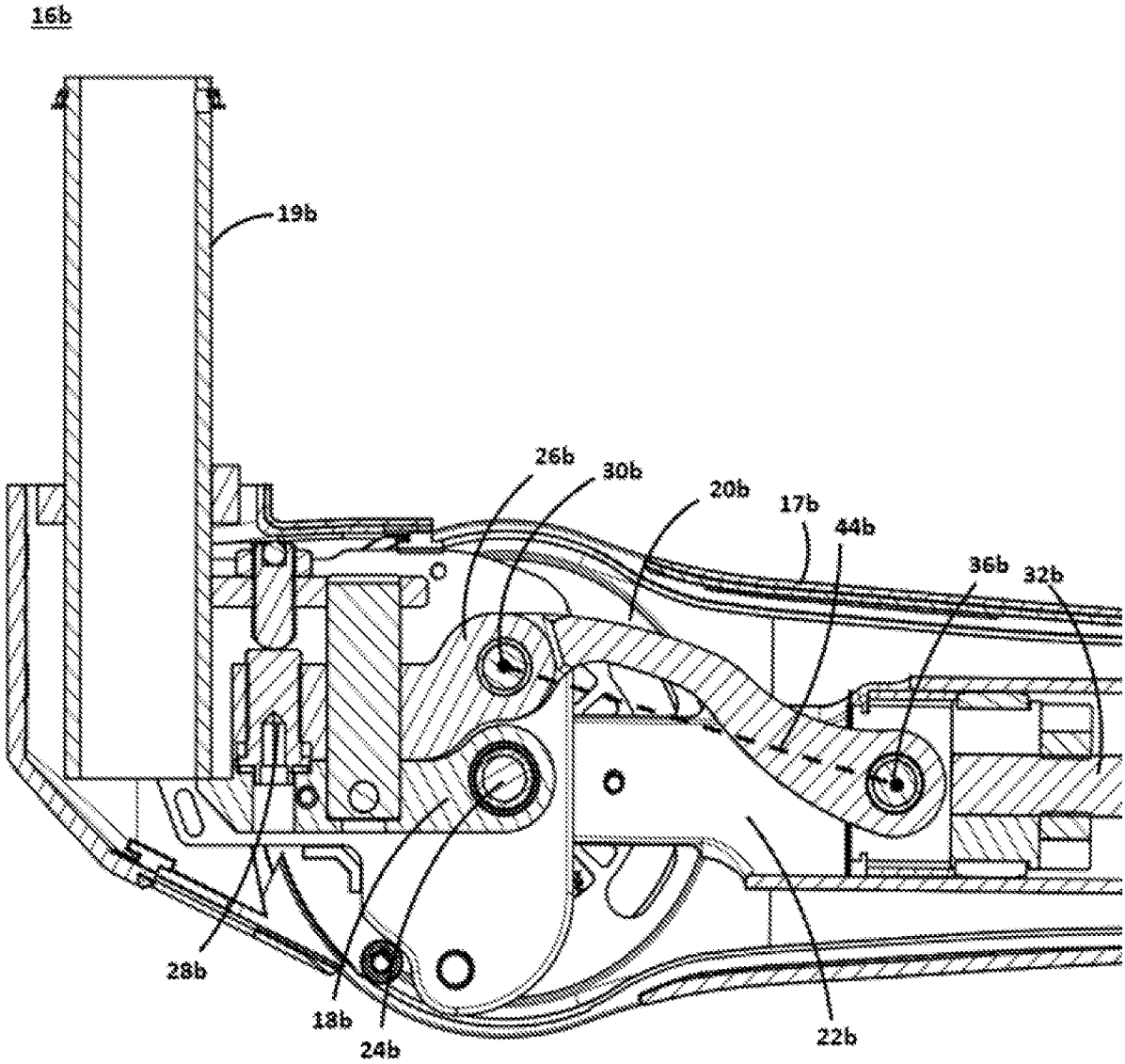
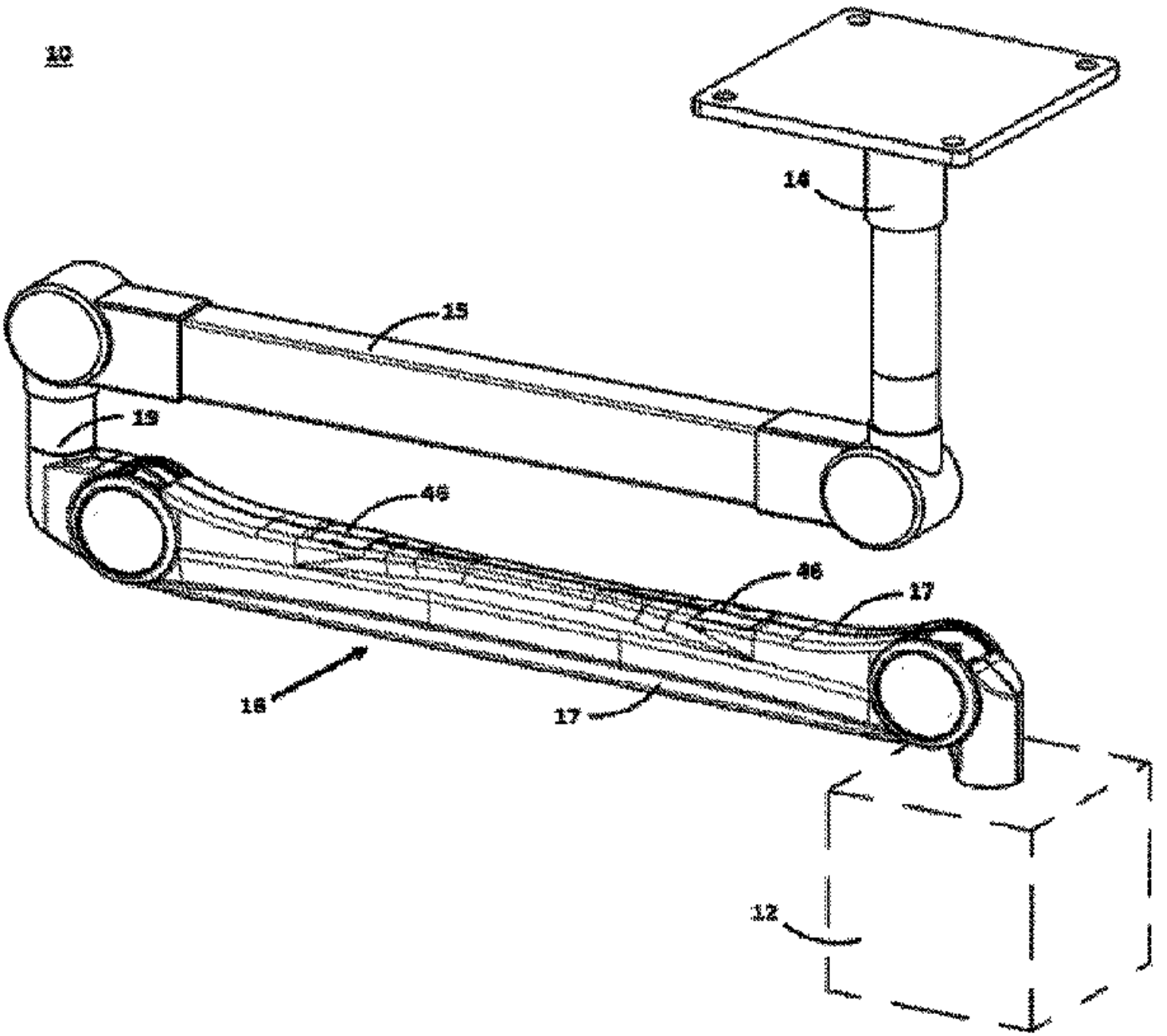


Fig. 22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