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(54) Title: RUDDER MOUNTING ASSEMBLY

(57) Abstract: A rudder mounting assembly (30, 30A, 30B, 30C) mounts a rudder to a hull of a marine vessel. Upper and lower conical bearings (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) mounted to a rudder post (18, 18A, 18B, 18C) carrying the rudder blade (20, 20A, 20B, 20C) for cooperative rotation therewith bear against conical upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) of a rudder tube (32, 32A, 32B, 32C) to prevent binding of the rudder post (18, 18A, 18B, 18C) against the rudder tube (32, 32A, 32B, 32C) due to loads applied to the rudder.

RUDDER MOUNTING ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application serial No. 60/950,173 filed July 17, 12007.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates to marine rudders and more particularly, to a mounting assembly for mounting a rudder to a marine vessel.

Description of the Related Art

[0003] A rudder is a planar device usually located near the stern of a boat for steering the boat. Rudders can be mounted to a boat in generally two ways. In a first way, rudders are attached to the exterior of the boat hull by a hinge, usually at or near the stern of the boat. Rudders mounted in the first way are often called "outboard rudders." In a second way, rudders are attached through or to the boat hull by means of a rudder post rotatably mounted in and extending through a rudder tube. The rudder tube is securely mounted to the hull. In some case rudders with a transom rudder bracket can also utilize a rudder tube and post structure. Rudders mounted in the second way are often called "inboard rudders."

[0004] Most of the load on an inboard rudder is carried by the rudder post. One key to a useful inboard rudder is, therefore, the available tolerances between the rudder post and the rudder tube for allowable movement of the post within the tube. Loads on the rudder tend to cause the rudder post to bind against the rudder tube, inhibiting motion and increasing wear. Phenomena such as rack and torque load and chatter often result. Lubrication and close tolerances tend to minimize such binding, but durability often suffers and frequent maintenance is necessary.

[0005] Known solutions include increasing the size of the rudder post and rudder tube and providing different materials for the rudder post and rudder tube. Present solutions have proven unsatisfactory, however. There remains a need to improve the durability of the

mounting between the rudder and the vessel. As well, there is a need to provide easier access to the rudder post and rudder tube for needed maintenance.

SUMMARY OF THE INVENTION

[0006] The invention lies in an improvement in a rudder mounting assembly, for a marine vessel, of the type comprising a rudder post and a rudder tube disposed on a longitudinal axis. According to the invention, upper and lower bearing surfaces are provided on the rudder tube and upper and lower bearing surfaces are provided on the rudder post. At least a portion of each bearing surface is disposed at an angle relative to the longitudinal axis. With this structure, binding and reduced wear between the rudder post and the rudder tube are minimized when the upper and lower bearing surfaces on the rudder post bear, respectively, against the upper and lower bearing surfaces on the rudder tube. Preferably, the bearing surfaces are conical.

[0007] In one aspect, the upper bearing surface can be on a bearing that is removably attached to the rudder post so that, upon disattachment, the rudder post can be withdrawn from the rudder tube for maintenance. Preferably, the bearing is attached to the rudder post by press fit. As well, the bearing can be secured against rotation relative to the rudder post by a key.

[0008] At least one of the bearing surfaces can be formed of a self-lubricating material. Further, a sleeve can be provided on the rudder post between the upper and lower bearing surfaces. As well, a seal can be disposed between the rudder tube and the rudder post.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the drawings:

[0010] Fig. 1 is a perspective view of a rudder assembly comprising a rudder mounting assembly according to one embodiment of the invention mounted to a hull, shown in section, of a marine vessel.

[0011] Fig. 2 is an exploded view of the rudder assembly of Fig. 1.

[0012] Fig. 3 is an exploded view of the rudder mounting assembly of Fig. 1.

[0013] Fig. 4 is a sectional view taken along line 4-4 of Fig. 2, unexploded.

[0014] Fig. 5 is an exploded view of a rudder assembly comprising a rudder mounting assembly according to another embodiment of the invention.

[0015] Fig. 5A is a perspective view of a lower bearing from the rudder mounting assembly of Fig. 5.

[0016] Fig. 6 is an exploded view of the rudder mounting assembly of Fig. 5.

[0017] Fig. 7 is a sectional view taken along line 7-7 of Fig. 5, unexploded.

[0018] Fig. 8 is an exploded view of a rudder assembly comprising a rudder mounting assembly according to another embodiment of the invention.

[0019] Fig. 9 is a sectional view taken along line 9-9 of Fig. 8, unexploded.

[0020] Fig. 10 is an exploded view of a rudder assembly comprising a rudder mounting assembly according to another embodiment of the invention.

[0021] Fig. 11 is a sectional view taken along line 11-11 of Fig. 10, unexploded.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0022] Fig. 1 illustrates a hull 10 of a marine vessel 12 and a rudder assembly 14 mounted to the hull 10 by a rudder mounting assembly 30 according to one embodiment of the invention. Here, the rudder assembly 14 is an inboard rudder assembly, and the rudder assembly 14 can be mounted to the hull 10 in any suitable location, as is well-known to one skilled in the marine vessel art.

[0023] Referring now to Fig. 2, which is an exploded view of the rudder assembly 14 of Fig. 1, the rudder assembly 14 comprises a rudder 16 having a rudder post 18 extending upwardly from a rudder blade 20. The illustrated rudder post 18 is generally cylindrical and defines a longitudinal axis X for the rudder assembly 14. While the rudder post 18 is shown and described as generally cylindrical, it is within the scope of the invention for the rudder post 18 to have any suitable configuration. Similarly, the rudder blade 20 can have any suitable configuration as numerous types of rudder blades are known for use with marine vessels. The rudder blade 20 of the current embodiment is provided for exemplary purposes

only. The rudder assembly 14 is coupled to a tiller 24 at an upper end of the rudder post 18. The rudder post 18 and the tiller 24 can be coupled to one another in any desired manner for cooperative rotation, and the rudder post 18 and the tiller 24 of the illustrated embodiment are coupled together via a clamp-type coupling mechanism having a screw that can be tightened to clamp the rudder post 18 within a slotted aperture 26 in the tiller 24. Other examples of coupling mechanisms include, but are not limited to, press-fit and keyed mechanisms. The tiller 24 can be coupled to a steering mechanism (not shown), as is well-known in the marine vessel art, to control rotation of the tiller 24 and, thereby, the rudder assembly 14.

[0024] The rudder post 18 extends through and is rotatable within the rudder mounting assembly 30 with the rudder blade 20 located below the rudder mounting assembly 30 and the tiller 24 located above the rudder mounting assembly 30. The rudder mounting assembly 30, which is shown in an enlarged exploded view in Fig. 3 and a sectional view in Fig. 4, comprises a rudder tube 32 having an upper end 34 and a lower end 36 and an integral flange 38 located near the lower end 34 for fixedly mounting the rudder tube 32 to an interior surface of the hull 10. As best seen in Fig. 4, which is a sectional view of a portion of the rudder assembly 14 and the rudder mounting assembly 30, the lower end 34 of the rudder tube 32 extends below the flange 38 for insertion into a port formed in the hull 10. The rudder tube 32, which rotatably receives the rudder post 18 coincident along the longitudinal axis X, is generally cylindrical and includes, on an interior surface, a generally conical upper bearing surface 40, a generally conical lower bearing surface 42, a generally cylindrical surface 44 between the upper and lower bearing surfaces 40, 42, and an enlarged seat 46 between the upper bearing surface 40 and the cylindrical surface 44. The generally conical upper and lower bearing surfaces 40, 42 are oriented such that a larger diameter portion is located at the upper and lower ends 34, 36, respectively, and extends to smaller diameter portion within the rudder tube 32. A generally cylindrical bearing sleeve 54 is press fit within the rudder tube 32 at the cylindrical surface 44 between the conical upper and lower bearing surfaces 40, 42. The bearing sleeve 54 has a central aperture sized and shaped to receive the rudder post 18.

[0025] It is to be noted that the bearing surfaces 40, 42 are disposed at an angle relative to the longitudinal axis X. It is within the scope of the invention for a portion of the bearing surfaces to be so disposed, which, of course, suggests that bearing surfaces 40, 42 need not

necessarily be conical. It is preferable that the angle be between 0° and 90°. It is believed that the more surface disposed at such angle, the better the performance.

[0026] The rudder mounting assembly 30 further includes an upper bearing 50, an optional seal 52 when used below the waterline, and a lower bearing 56 positioned along the rudder post 18 in that order. Each of the upper bearing 50, the seal 52, and the lower bearing 56 have a central aperture sized and shaped to receive the rudder post 18. The upper bearing 50 and the lower bearing 56 are securely positioned on the rudder post 18, such as by a press-fit, within the rudder tube 32 so that the upper bearing 50 and the lower bearing 56 rotate with the rudder post 18 relative to the rudder tube 32. The seal 52, which resides in the seat 46 of the rudder tube 32 includes a pair of interior sealing rings 58, such as O-rings, lip seals or mechanical seals, that abut the rudder post 18 to provide a fluid seal and prevent flow of water into the hull 10 through the port. Preferably, the seal 52 can also be arranged for cooperative rotation with the rudder post 18. Alternatively, the seal 52 can be arranged for free movement within the seat 46 or can be fixedly secured within the seat 46. Other seals can also be used to prevent fluid flow into the hull 10 through the rudder mounting assembly 30.

[0027] The upper bearing 50 has an annular flange 60 and a depending conical bearing surface 62. As best seen in Fig. 4, the upper bearing 50 is positioned such that the conical bearing surface 62 is disposed at the upper bearing surface 40 of the rudder tube 32 with the annular flange 60 sitting on the upper end 34 of the rudder tube 32. The lower bearing 56 has a conical bearing surface 64 positioned such that the conical bearing surface 62 is disposed at the lower bearing surface 42 of the rudder tube 32.

[0028] As with the bearing surfaces 40, 42, it will be understood that the bearing surfaces 60, 62 are disposed at an angle relative to the longitudinal axis X. It is within the scope of the invention for a portion of the bearing surfaces to be so disposed, which, of course, suggests that bearing surfaces 60, 62 need not necessarily be conical. It is preferable that the angle be between 0° and 90°. It is believed that the more surface disposed at such angle, the better the performance. As well, it will be understood that the bearing surfaces 60, 62 will preferably be complementary to the shape of the bearing surfaces 40, 42 with corresponding portions disposed at the same angles relative to the longitudinal axis X.

[0029] Certain parts of the rudder mounting assembly 30 can be self-lubricating to facilitate smooth rotation of the rudder post 18 within the rudder tube 32. For example, any of the upper bearing 50, the lower bearing 56, the sleeve 54, and the seal 56 can be self-lubricating, such as by being made of a self-lubricating material. Examples of self-lubricating materials include, but are not limited to, internally lubricated polymers, such as an acetal resin engineering plastic. A preferred polymer is Vesconite®. An example of another acceptable acetal resin engineering plastic is Delrin®. Any suitable type of self-lubricating material may be employed. Alternatively or additionally, the rudder tube 32 may be made of a self-lubricating material.

[0030] In operation, rotation of the tiller 24, such as via the steering mechanism, induces rotation of the rudder post 18 and the rudder blade 20 about the longitudinal axis X. Further, because the upper bearing 50 and the lower bearing 56 are coupled to the rudder post 18 for cooperative rotation, the rotation of the rudder post 18 induces rotation of the upper bearing 50 and the lower bearing 56 within the stationary bearing sleeve 54 of the rudder tube 32. If the seal 56 is also coupled to the rudder post 18 for cooperative rotation, the seal 56 will also rotate with the rudder post 18. During operation, the rudder mounting assembly 30 prevents binding of the rudder post 18 against the rudder tube 32 because any loads applied to the rudder blade 20 that would normally cause such binding are supported by the conical upper and lower bearing surfaces 40, 42. For example, a lateral load applied to the rudder blade 20 would cause the upper bearing 50 to bear against the upper bearing surface 40 and the lower bearing 56 to bear against the lower bearing surface 42. The sleeve 54, which is optional, provides additional support to the rudder post 18 to avoid binding. In other words, the invention minimizes binding and reduces wear on the components by distributing the load across a larger and wider surface area. Wear over time results in rack, slop or free play. The invention distributes the force load over a greater and wide surface area than any conventional system now known. The invention is adaptable to any rudder system utilizing a tube and post structure, including, for example, an external mounted rudder mounted to a rudder bracket. Rotation of the upper bearing 50 and the lower bearing 56 within the stationary rudder tube 32 is not hindered or at least not significantly hindered by the applied loads due to the self-lubricating materials for these components.

[0031] Figs. 5-7 illustrate another embodiment of the rudder mounting assembly 30A. The views in Figs. 5-7 are similar to the views in Figs. 2-4, and like components are identified with the same reference numeral bearing the letter "A." The embodiment of the rudder mounting assembly 30A in Figs. 5-7 is identical to the embodiment of the rudder mounting assembly 30 in Figs. 2-4, except that the rudder mounting assembly 30A includes a key coupling mechanism for coupling the tiller 24A and the upper bearing 50A with the rudder post 18A for cooperative rotation and for coupling the lower bearing 56A with the rudder post 18A for cooperative rotation.

[0032] In particular, as shown in Figs. 5 and 7, the tiller 24A, the upper bearing 50A, and the rudder post 18A each have key receiver 70A in the form of a generally vertical groove having a generally rectangular cross-section. For the tiller 24A and the upper bearing 50A, the key receiver 70A is formed on an inner surface, while the key receiver 70A on the rudder post 18A is formed on an outer surface so the key receivers 70A on the tiller 24A and the upper bearing 50A align with the key receiver 70A on the rudder post 18A to form a single key receiver 70A. A key 72A in the form of a generally rectangular shaft received within the key receiver 70A on the tiller 24A, the upper bearing 50A, and the rudder post 18A couple the tiller 24A, the upper bearing 50A, and the rudder post 18A for cooperative rotation.

[0033] As shown in Fig. 5, the rudder 16A further includes a key 74A located on an upper surface of the rudder blade 20A on opposite sides of the rudder post 18A at the juncture between the rudder post 18A and the rudder blade 20A. The key 74A of the illustrated embodiment has a generally rectangular configuration, although any suitable key geometry can be employed. Referring now to Fig. 5A, the lower bearing 56A includes at a lower end a key receiver 76A in the form of slots in an annular ring 78A. The key receiver 76A receives the key 74A on the rudder assembly 14A to couple the lower bearing 56A to the rudder 16A for cooperative rotation.

[0034] The key receivers 70A, 76A and the keys 72A, 74A can have any suitable size and shape and are not limited to the generally rectangular size shown and described herein. Further, the key coupling mechanisms can be used for coupling any of the components together, such as for coupling only the tiller 24A to the rudder post 18A rather than both the tiller 24A and the upper bearing 50A to the rudder post 18A. As another example, the sleeve

54A can be coupled to the rudder post 18A by a key coupling mechanism. It will be understood that instead of a key, alternate forms of coupling any of the components together can be accomplished within the scope of the invention. For example, the components can be pinned, splined, adhered, welded, compressed, or otherwise mechanically fastened. As well, in some cases, one or more components can be integrally molded with others, if formed of moldable material.

[0035] Figs. 8-9 illustrate another embodiment of the rudder mounting assembly 30B. The views in Figs. 8-9 are similar to the views in Figs. 2 and 4, and like components are identified with the same reference numeral bearing the letter "B." The embodiment of the rudder mounting assembly 30B in Figs. 8-9 is identical to the embodiment of the rudder mounting assembly 30 in Figs. 2 and 4, except that the rudder mounting assembly 30B includes an adjustable collar 80B secured to the rudder post 18B between the upper bearing 50B and the tiller 24B. In cases where the rudder mounting assembly 30B has a longer rudder post 18B so that the tiller is spaced from the upper bearing, there may be a need for a retaining collar to maintain tension on the upper bearing 50B. This will ensure that the upper bearing surfaces 60B, 62B stay abutted to the bearing surfaces 40B, 42B.

[0036] To facilitate tension on the upper bearing 50B, a spring 82B can be disposed between the adjustable collar 80B and the upper bearing 50B. The spring 82B can be as simple as a spring washer, or it can take any other configuration known in the art necessary to bias the upper bearing 50B against the upper end 34B of the rudder tube 32B. And where the rudder post 18B is not too long so that there is no need for an adjustable collar, a spring 82B can be disposed directly between the upper bearing 50B and the tiller 24B.

[0037] Figs. 10-11 illustrate another embodiment of the rudder mounting assembly 30C. The views in Figs. 10-11 are similar to the views in Figs. 5 and 7, and like components are identified with the same reference numeral bearing the letter "C." The embodiment of the rudder mounting assembly 30C in Figs. 10-11 is identical to the embodiment of the rudder mounting assembly 30A in Figs. 5 and 7, except that the rudder mounting assembly 30C includes an adjustable collar 80C secured to the rudder post 18C between the upper bearing 50C and the tiller 24C by a key 70C. In cases where the rudder mounting assembly 30C has a longer rudder post 18C so that the tiller is spaced from the upper bearing, there may be a

need for a retaining collar to maintain tension on the upper bearing 50C. This will ensure that the upper bearing surfaces 60C, 62C stay abutted to the bearing surfaces 40C, 42C.

[0038] To facilitate tension on the upper bearing 50C, a spring 82C can be disposed between the adjustable collar 80C and the upper bearing 50C, the spring having accommodation for the key 70C. The spring 82C can be as simple as a spring washer, or it can take any other configuration known in the art necessary to bias the upper bearing 50C against the upper end 34C of the rudder tube 32C. And where the rudder post 18C is not too long so that there is no need for an adjustable collar, a spring 82C can be disposed directly between the upper bearing 50C and the tiller 24C.

[0039] Optionally, the upper bearing 50 and the tiller 24 can be integrated into a single component to reduce the number of parts. Other variations may be made to the rudder mounting assembly 30 for ease of manufacture, reduction of parts, cost, etc. For example, the upper bearing can be made removable from the rudder post so as to enhance ease of maintenance. Removal of the upper bearing from the rudder post will enable the rudder to be dropped from the hull for servicing. The upper and/or lower bearings can be formed of two parts for ease of removal. In that way, the rudder assembly can be serviced on larger vessels without having to remove the rudder post completely from the rudder tube. As well, it will be understood that different types of steering mechanism can be employed without departing for the invention. Not all vessels use a tiller. Some steering mechanisms, for example, use a gear on the rudder post or a hydraulic steering mechanism. The principles of the invention remain applicable regardless of the steering mechanism employed.

[0040] While the invention has been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.

CLAIMS

What is claimed is:

1. In a rudder mounting assembly (30, 30A, 30B, 30C), for a marine vessel, comprising a rudder post (18, 18A, 18B, 18C) and a rudder tube (32, 32A, 32B, 32C) disposed on a longitudinal axis, the improvement comprising upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) on the rudder tube (32, 32A, 32B, 32C) and upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) on the rudder post (18, 18A, 18B, 18C), wherein at least a portion of each bearing surface (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) is disposed at an angle relative to the longitudinal axis, whereby to minimize binding and reduce wear between the rudder post (18, 18A, 18B, 18C) and the rudder tube (32, 32A, 32B, 32C) when the upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) on the rudder post (18, 18A, 18B, 18C) bear, respectively, against the upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) on the rudder tube (32, 32A, 32B, 32C).

2. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 1 wherein the bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) are conical.

3. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 2 wherein the upper bearing surface (40, 40A, 40B, 40C) is on a bearing that is removably attached to the rudder post (18, 18A, 18B, 18C) so that, upon disattachment, the rudder post (18, 18A, 18B, 18C) can be withdrawn from the rudder tube (32, 32A, 32B, 32C) for maintenance.

4. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 3 wherein the bearing is attached to the rudder post (18, 18A, 18B, 18C) by press fit.

5. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 3 wherein the bearing is secured against rotation relative to the rudder post (18, 18A, 18B, 18C) by a key (72, 72A, 72C).

6. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 1 wherein the upper bearing surface (40, 40A, 40B, 40C) is on a bearing that is removably attached to the rudder post (18, 18A, 18B, 18C) so that, upon disattachment, the rudder post (18, 18A, 18B, 18C) can be withdrawn from the rudder tube (32, 32A, 32B, 32C) for maintenance.

7. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 6 wherein the bearing is attached to the rudder post (18, 18A, 18B, 18C) by press fit.

8. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 6 wherein the bearing is secured against rotation relative to the rudder post (18, 18A, 18B, 18C) by a key (72, 72A, 72C).

9. The rudder mounting assembly (30, 30A, 30B, 30C) of claim 1 wherein at least one of the bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C) is formed of a self-lubricating material.

10. The mounting assembly of claim 1 further comprising a sleeve (54, 54A, 54B, 54C) on the rudder post (18, 18A, 18B, 18C) between the upper and lower bearing surfaces (40, 40A, 40B, 40C, 42, 42A, 42B, 42C).

11. The mounting assembly of claim 1 further comprising a seal (52, 52A, 52B, 52C) between the rudder tube (32, 32A, 32B, 32C) and the rudder post (18, 18A, 18B, 18C).

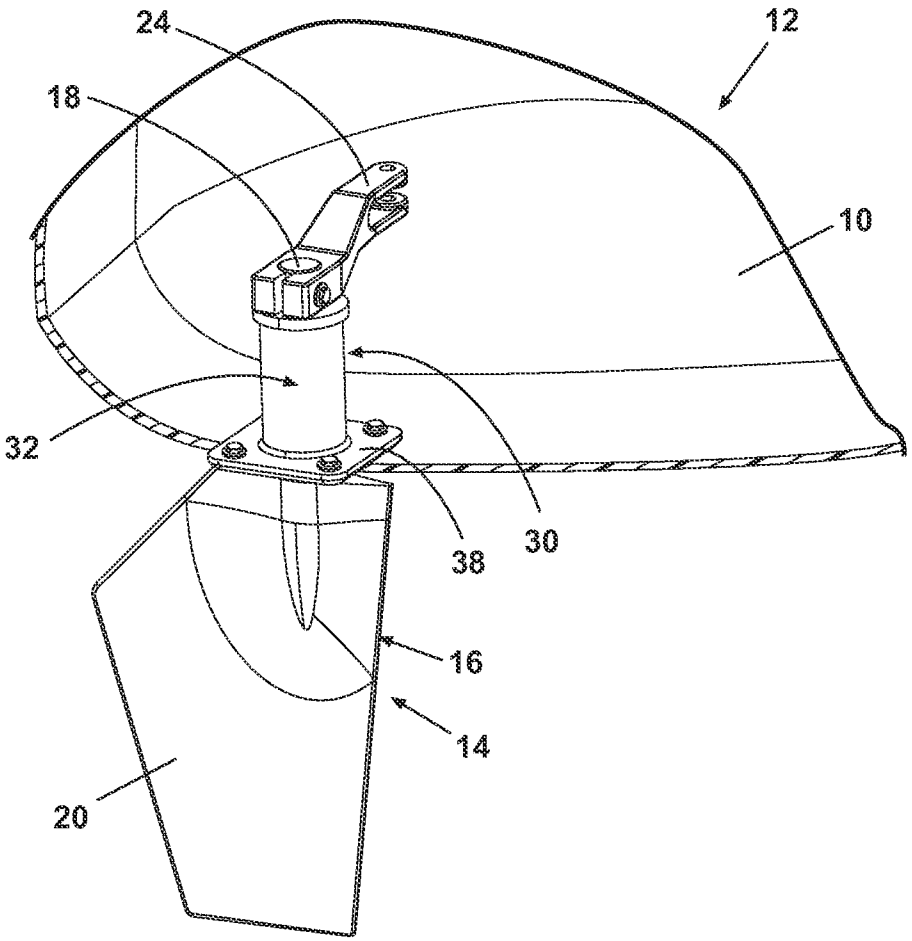

Fig. 1

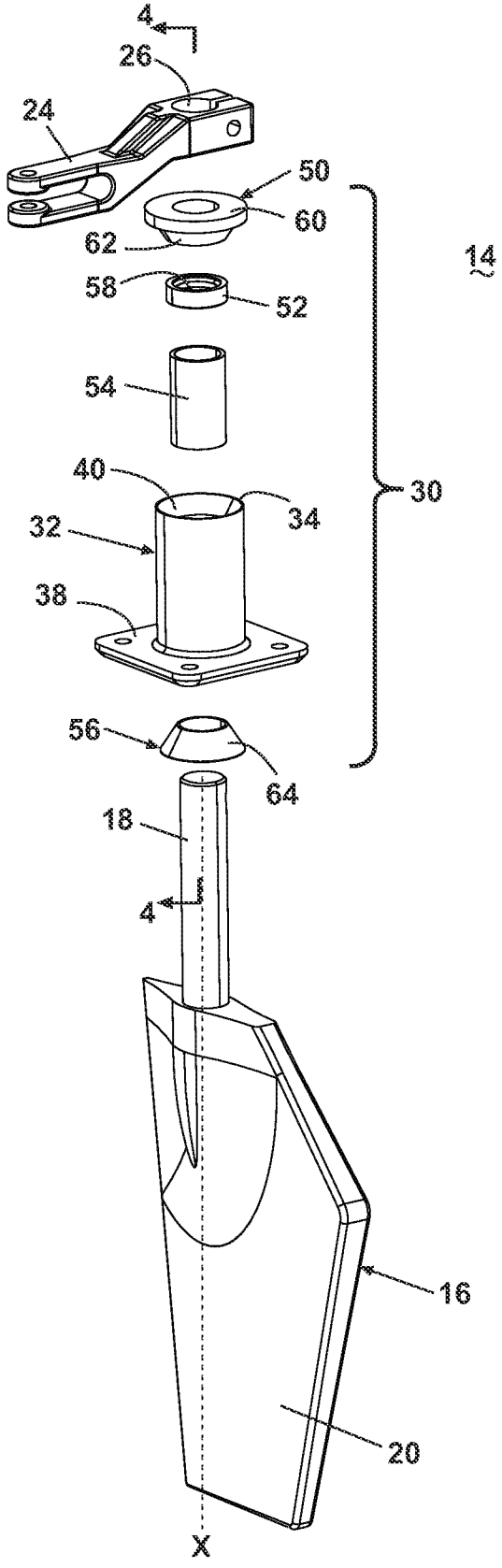

Fig. 2

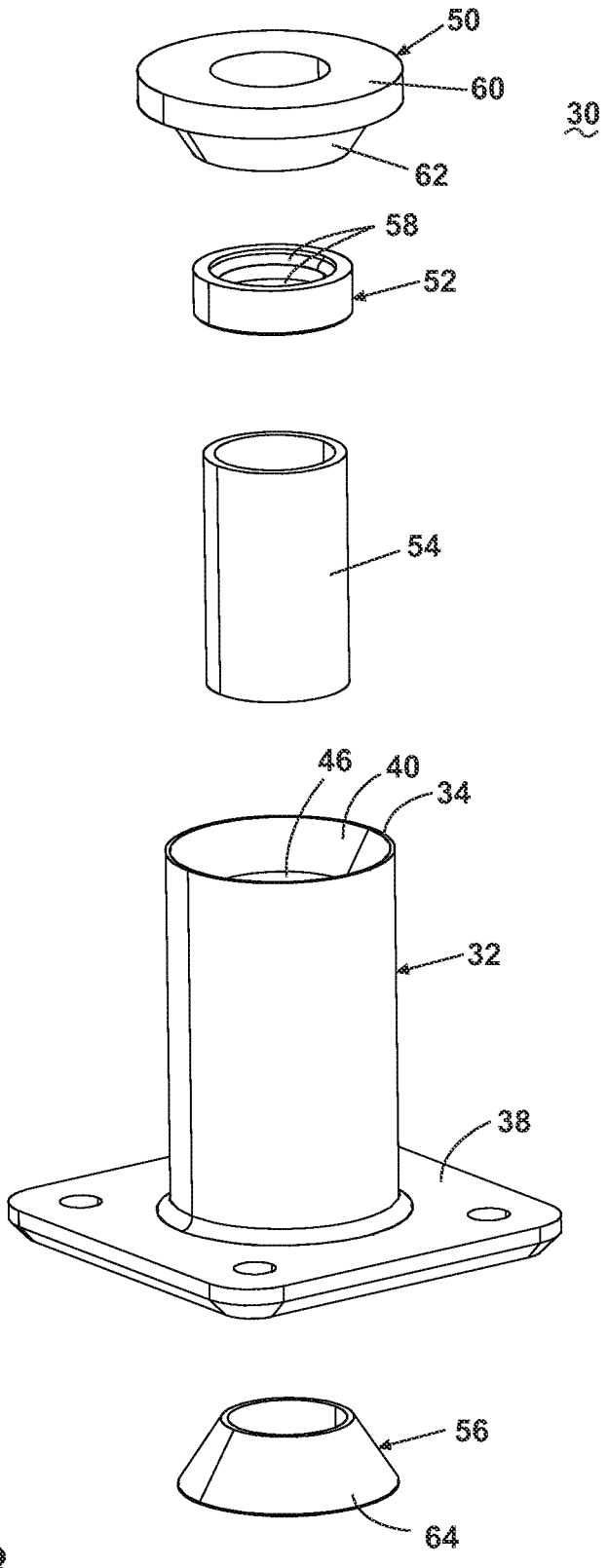

Fig. 3

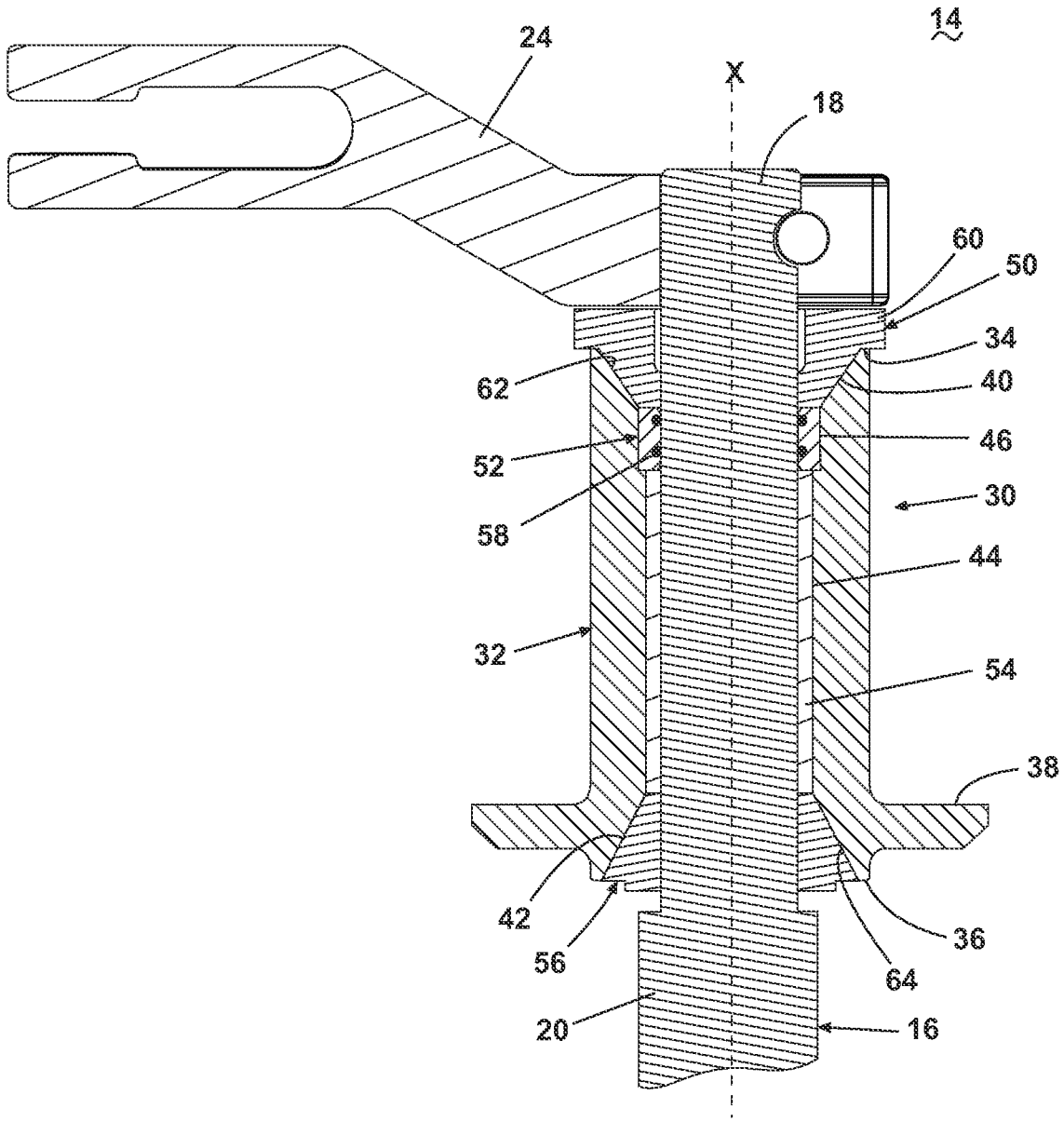

Fig. 4

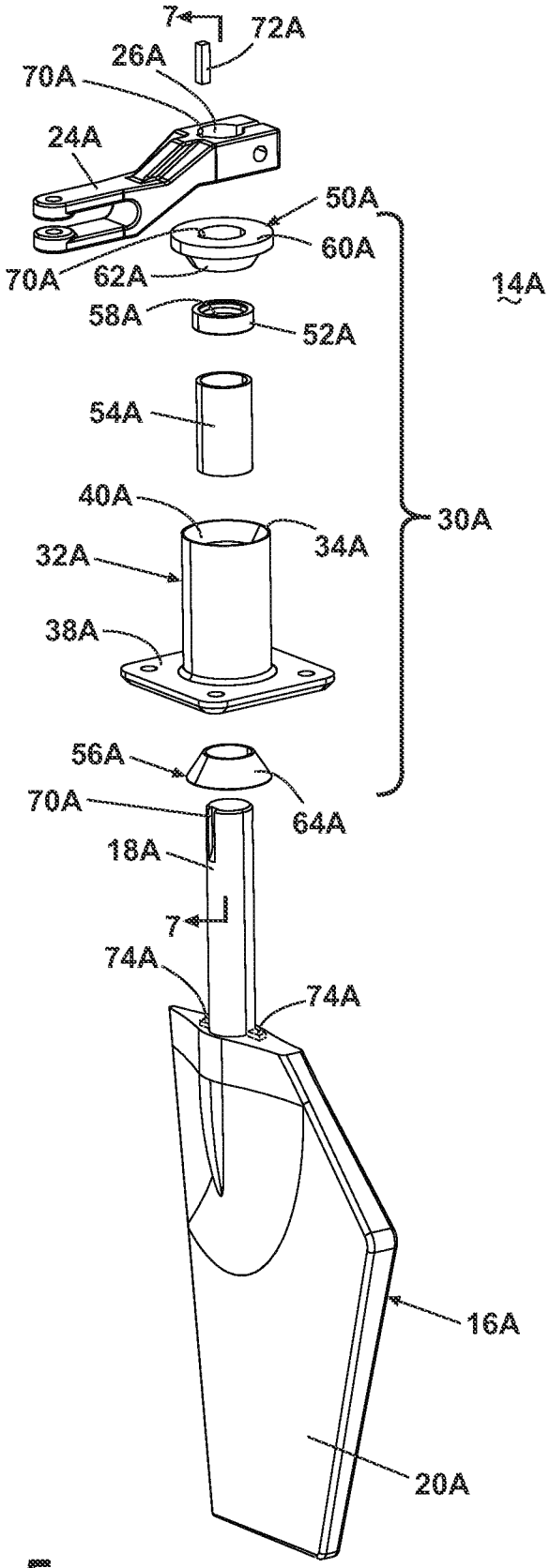
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Fig. 5

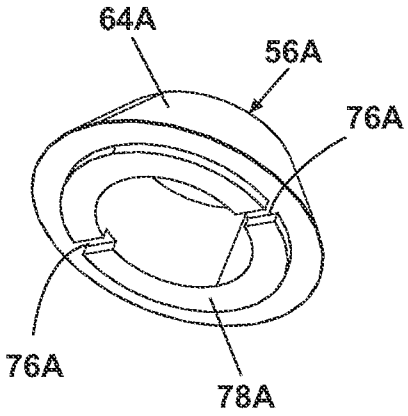
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Fig. 5A

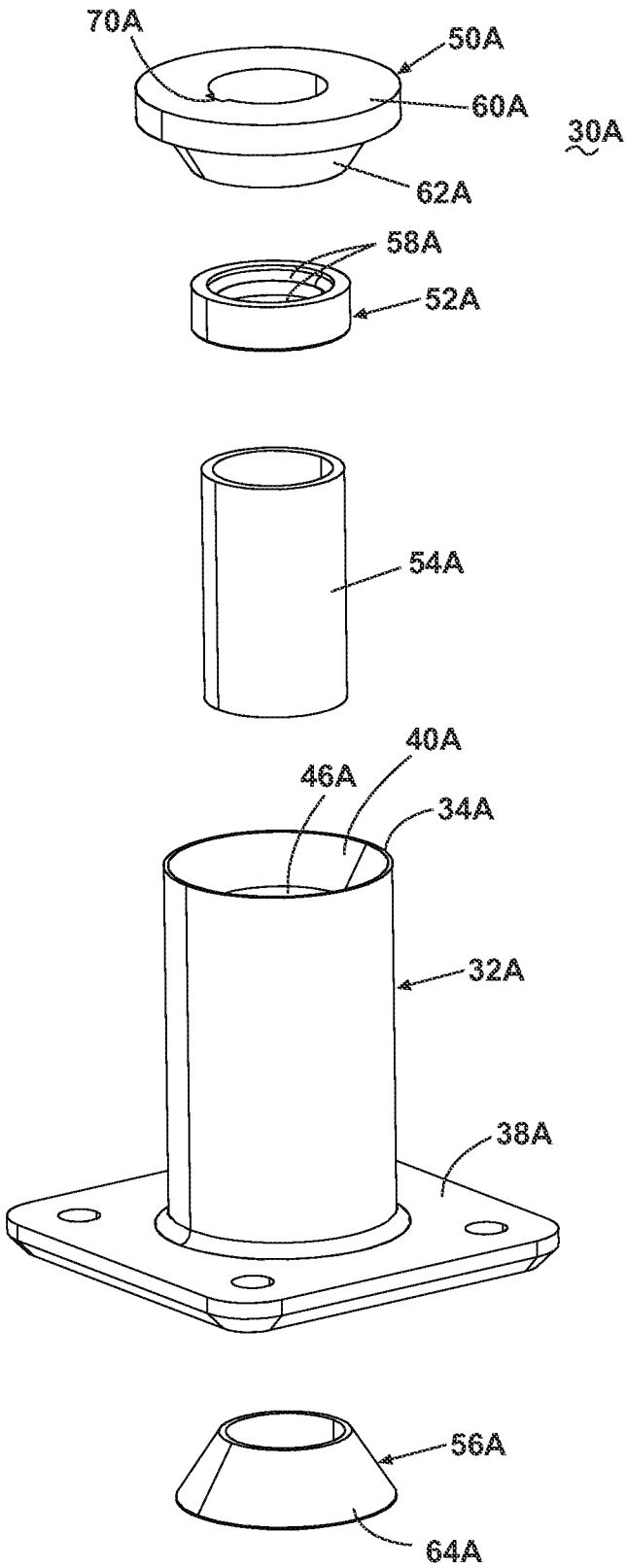
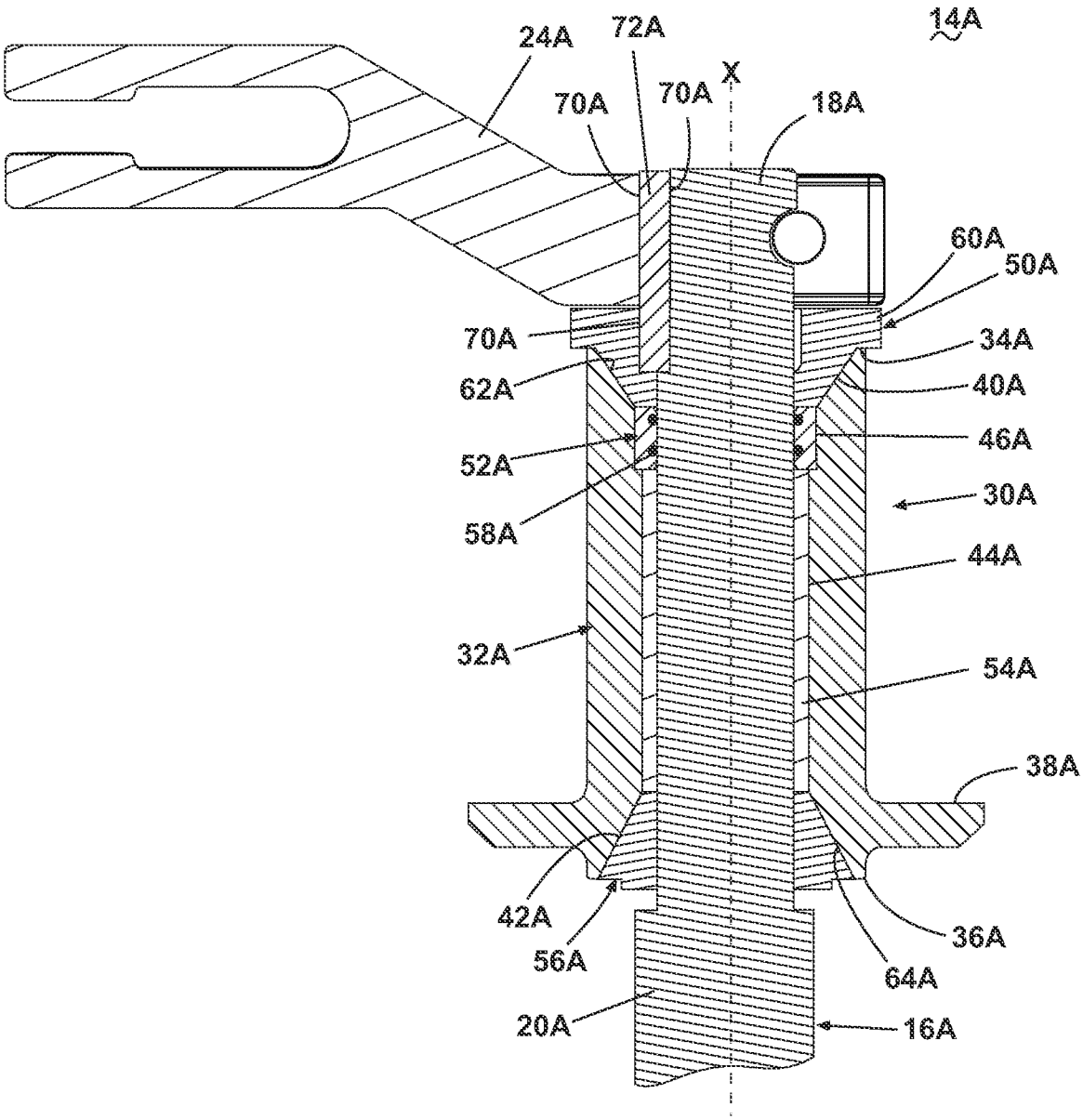


Fig. 6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16A

Fig. 7

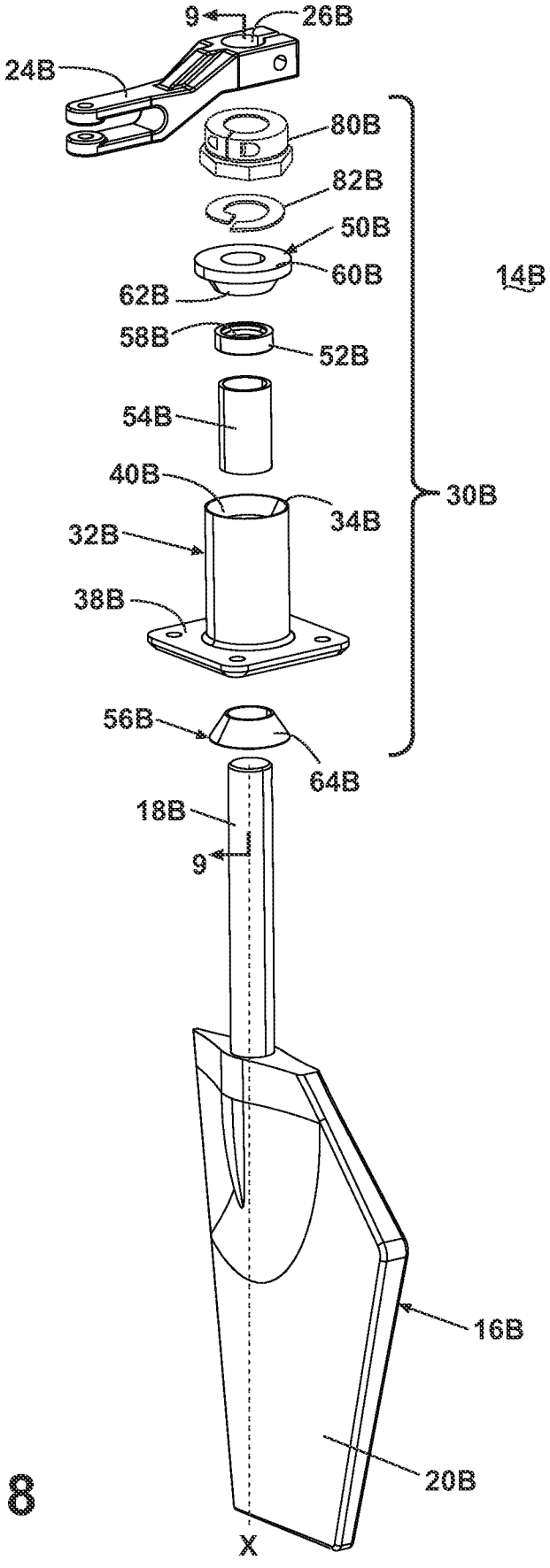
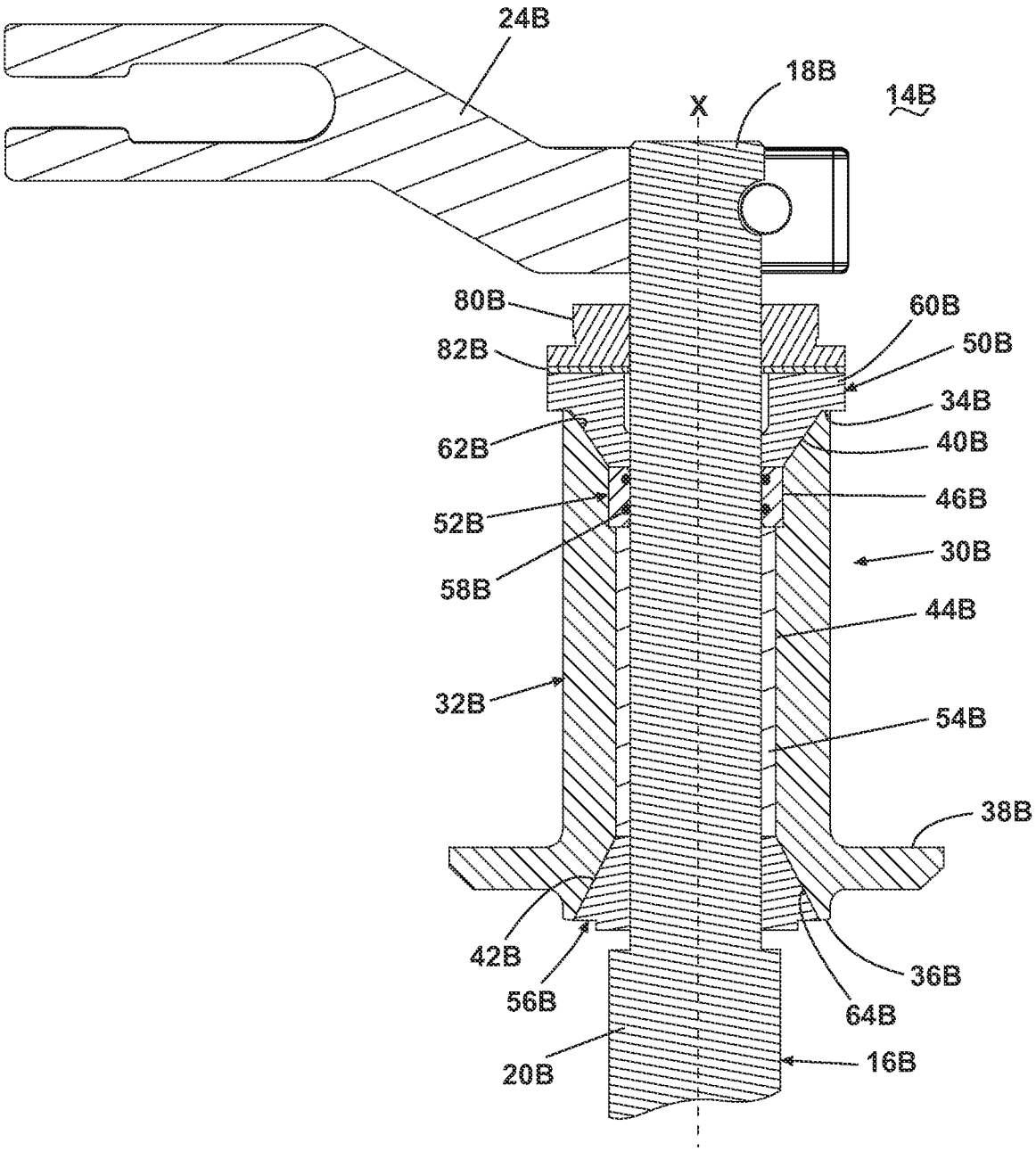

9
26B
24B
80B
82B
50B
60B
14B
62B
58B
52B
54B
40B
34B
30B
32B
38B
56B
64B
18B
9
16B
20B
X

Fig. 8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18B
14B
X
80B
60B
82B
50B
34B
62B
40B
46B
52B
30B
58B
44B
32B
54B
38B
42B
36B
56B
64B
20B
16B

Fig. 9

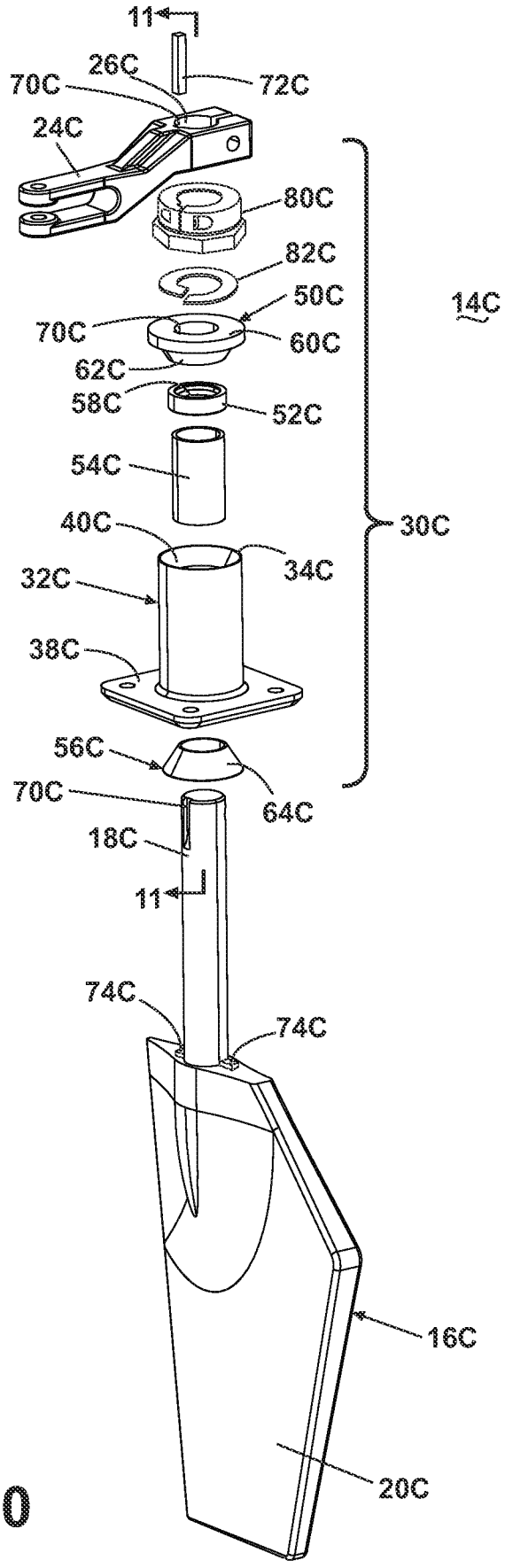
11
26C
70C
72C
24C
80C
82C
50C
14C
70C
60C
62C
58C
52C
54C
40C
30C
34C
32C
38C
56C
70C
64C
18C
11
74C
74C
16C
20C

Fig. 10

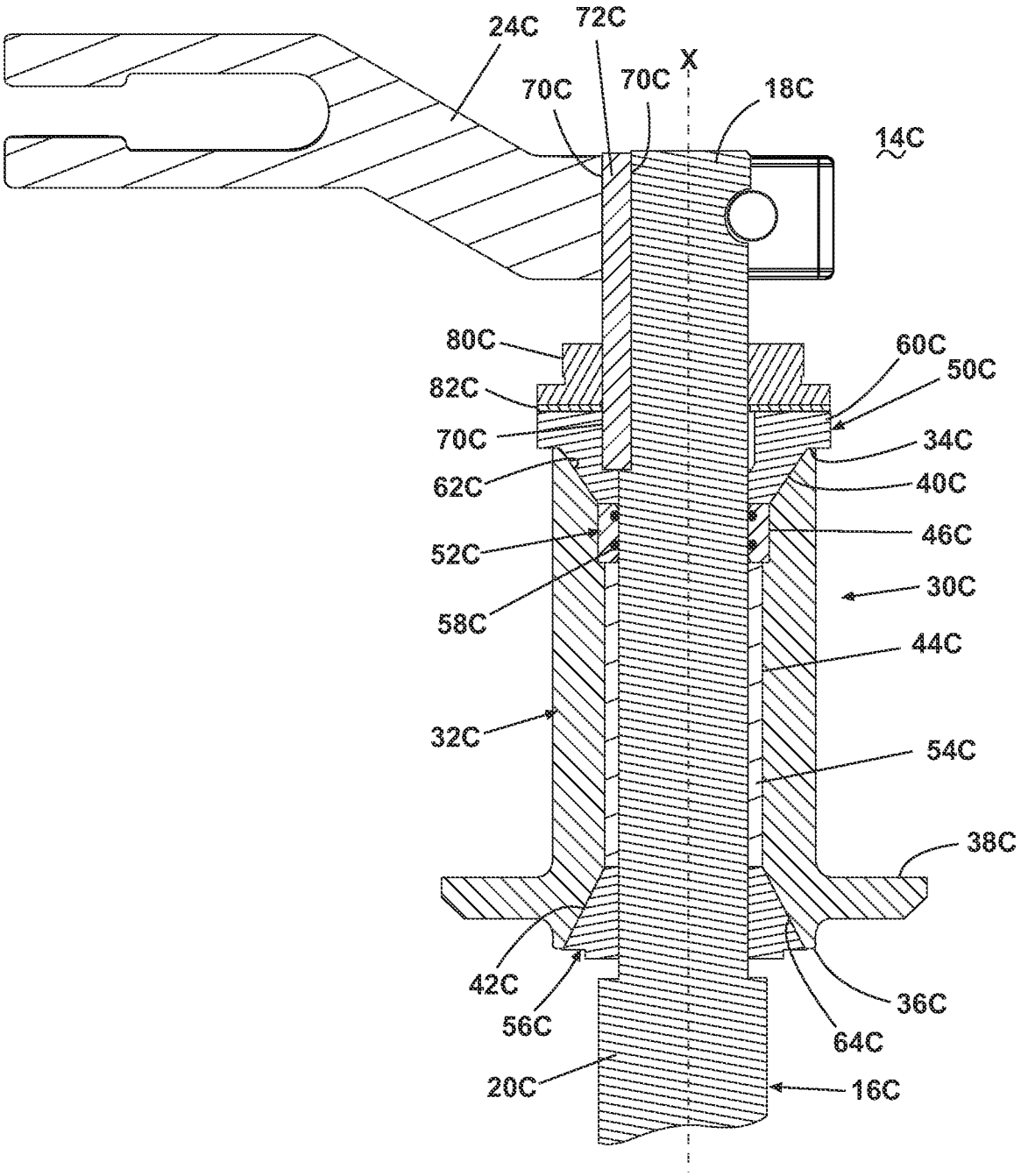
24C
72C
X
70C
70C
18C
14C
80C
60C
50C
82C
70C
34C
62C
40C
52C
46C
58C
30C
44C
32C
54C
38C
42C
56C
36C
64C
20C
16C

Fig. 11