

(57) Abrégé(suite)/Abstract(continued):

proximate the bottom thereof and a plurality of laterally directed outlet ports extending from the cartridge receiving chamber, each outlet port for directing water for selective alternative uses such as a spout, shower, body spray or the like, said stem cartridge having an inlet port proximate the bottom thereof in alignment with the inlet of said housing and having a plurality of laterally directed outlet ports for selective alignment with the outlet ports of said housing, said inlet ports and outlet ports of said stem cartridge having disposed there-between a stem waterway to allow water to flow from the inlet to said outlets, said cartridge having an interior defining said waterway and having contained therein adjacent said stem cartridge inlet port at least two checking mechanisms disposed prior to said waterway, said at least two check mechanisms preventing water the outlet ports from contaminating the water supply, wherein replacement of said stem cartridge permits simple replacement of faulty checking devices without the need for skilled tradesmen being involved.

ABSTRACT

A diverter valve comprising a housing and a diverting stem cartridge, said housing having a top and a bottom and a stem cartridge receiving chamber extending from proximate the top to proximate the bottom of said housing, said housing having an inlet port proximate the bottom thereof and a plurality of laterally directed outlet ports extending from the cartridge receiving chamber, each outlet port for directing water for selective alternative uses such as a spout, shower, body spray or the like, said stem cartridge having an inlet port proximate the bottom thereof in alignment with the inlet of said housing and having a plurality of laterally directed outlet ports for selective alignment with the outlet ports of said housing, said inlet ports and outlet ports of said stem cartridge having disposed there-between a stem waterway to allow water to flow from the inlet to said outlets, said cartridge having an interior defining said waterway and having contained therein adjacent said stem cartridge inlet port at least two checking mechanisms disposed prior to said waterway, said at least two check mechanisms preventing water the outlet ports from contaminating the water supply, wherein replacement of said stem cartridge permits simple replacement of faulty checking devices without the need for skilled tradesmen being involved.

TITLE OF THE INVENTION

SIMPLE DIVERTER VALVE FOR A ROMAN TUB WITH REPLACEABLE CARTRIDGE INCLUDING AT LEAST TWO CHECKS

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FIELD OF THE INVENTION

This invention relates to diverting valves and the simplification thereof.

10 **BACKGROUND OF THE INVENTION**

Checking devices can be strategically located in the supply line of the water system, preventing the flow of water from any one of a number of selected outlets back to the inlet water supply. In a bath tub the water may be diverted to the spout, showerhead or removable handheld shower, and so on. Such checking devices are used in commercial and household installations, for example Roman Tubs to prevent the contamination of the potable water supply. Alternatively checks have been provided in the wands of handheld devices which may not function if the wand is removed or replaced.

20 Applicant therefore provides herein a valve assembly comprising a dual check in a given circuit as required by code but disposed within a compact, easily manufactured, replaceable cartridge which much simplifies meeting the code requirement for two separate check installations in the feed-lines which is more costly to install.

25 It is therefore an object of this invention, to provide a simplified diverter valve with a dual check which is entirely reliable and easily serviced.

It is a further object of the invention to provide a 3 way diverting valve with back flow prevention.

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It is yet a further object of the invention to provide such a valve in easily replaceable cartridge format for the diverting valve and for the back flow prevention.

Further and other objects of the invention will become apparent to those skilled in the art from the following summary of the invention and more detailed description of preferred embodiments illustrated herein.

5 SUMMARY OF THE INVENTION

According to a primary aspect of the invention there is provided a valve assembly comprising a body containing an opening therein, said opening for receiving a valve cartridge, said body comprising an inlet and at least one outlet, said cartridge comprising an inlet and at least one
10 outlet having a waterway disposed there between, said cartridge being operable to selectively permit water flow to said outlet of said body from an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series (preferably also in a replaceable cartridge form) which allow for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to return from the waterway through each check
15 valve into the waterway to the inlet, wherein water from the outlets cannot re-enter the water supply to the valve to contaminate said water supply.

According to another aspect of the invention there is provided a diverter valve comprising a housing and a diverting stem cartridge, said housing having a top and a bottom and a stem
20 cartridge receiving chamber extending from proximate the top to proximate the bottom of said housing, said housing having an inlet port proximate the bottom thereof and a plurality of laterally directed outlet ports extending from the cartridge receiving chamber, each outlet port for directing water for selective alternative uses such as a spout, shower, body spray or the like, said stem cartridge having an inlet port proximate the bottom thereof in alignment with the inlet of
25 said housing and having a plurality of laterally directed outlet ports for selective alignment with the outlet ports of said housing, said inlet ports and outlet ports of said stem cartridge having disposed there-between a stem waterway to allow water to flow from the inlet to said outlets, said cartridge having an interior defining said waterway and having contained therein adjacent
30 said stem cartridge inlet port at least two checking mechanisms (preferably also in a replaceable cartridge form) disposed prior to said waterway, said at least two check mechanisms preventing water from the outlet ports from contaminating the water supply, wherein replacement of said stem cartridge (or alternatively replacement of check cartridge) permits simple replacement of faulty checking devices without the need for skilled tradesmen being involved.

According to yet another aspect of the invention there is provided a diverting valve assembly for a roman tub or the like comprising a body containing an opening therein, said opening for receiving a diverting cartridge, said body comprising an inlet and at least one outlet, said
5 cartridge comprising an inlet and at least one outlet having a waterway disposed there between, said cartridge being rotatable within a predetermined range to selectively align said outlet of said body with an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series (preferably disposed with a check cartridge) which allow for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to
10 return from the waterway through each check valve into the waterway to the inlet, wherein water from anyone of a selected number of outlets cannot re-enter the water supply to the valve to contaminate said water supply.

According to yet another aspect of the invention there is provided a valve assembly comprising
15 a body containing an opening therein, said opening for receiving a valve cartridge, said body comprising an inlet and at least one outlet, said cartridge comprising an inlet and at least one outlet having a waterway disposed there between, said cartridge being operable to selectively permit water flow to said outlet of said body from an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series in a replaceable check cartridge form
20 which allows for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to return from the waterway through each check valve into the waterway to the inlet, wherein water from the outlets cannot re-enter the water supply to the valve to contaminate said water supply, and wherein the check cartridge may be replaced without the necessity of replacing the entire cartridge.

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In one embodiment of the invention described in the previous paragraphs the diverter valve housing may include a cut out portion proximate the top thereof extending about a predetermined extent of the housing for co-operation with a stop portion provided with the cartridge to limit the
30 rotation of the cartridge between selected positions. In yet another embodiment of the invention described in the previous paragraphs said housing may include a threaded portion proximate the top thereof adjacent the opening thereof for receiving a corresponding threaded rotatable plug for retaining the cartridge in place within said housing. Preferably said threaded rotatable plug has

an opening to receive a spindle portion surrounded by a cylindrical sleeve threaded on the exterior thereof to allow attachment of appropriate trim portions adjacent a handle. Preferably said housing includes a detent and said cartridge includes a mating tab to ensure correct alignment of all functions of said valve.

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BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be illustrated with reference to drawings of embodiments of the invention.

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Figure 1 is a schematic view of the diverter valve installed on a deck for a roman tub and illustrated in a preferred embodiment of the invention.

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Figure 2 is a perspective view of the diverter valve assembled and illustrated in isolation from the schematic view of Figure 1.

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Figure 3 and 3A are cross-sectional views of the valve of Figure 2 illustrating the interrelationship of the components therefore, illustrated in alternative embodiments of the invention.

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Figure 4 and 4A are similar views to that which is illustrated in Figures 3 and 3A.

Figure 5 is a close-up view of the top section of the valve shown in Figure 4.

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Figures 5A, B, C, D, E, F, and G include various views in cross section and perspective illustrating the co-operation of the replaceable check cartridge and the diverting cartridge illustrated in one embodiment of the invention.

Figure 6 is a close-up view of the bottom section of the valve shown in Figure 4.

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Figure 7 is a cross-sectional schematic view of the cartridge of Figure 4 illustrating the components thereof and shown in one embodiment of the invention.

Figures 8A, 8B and 8C are a top view, side view in section and a perspective view respectively of the trim nut portion of the valve assembly.

Figures 9A, 9B and 9C are a top view , a side view in section, and a perspective view
5 respectively of the stem plug as best seen in Figure 3.

Figure 10 is a perspective view of the diverting stem illustrated in one embodiment of the invention.

10 Figures 11A, 11B and 11C are side, cross-sectional and perspective views respectively of the check mechanism (25A) and (25B) as best seen in Figure 4 and illustrated in one embodiment to the invention.

Figure 12, 12A, 12B, 12C, and 12D are top views of the diverter stem of Figure 7 and 5A
15 illustrating the stops or the detents that permit the selective alignment of the outlets of the diverter stem with the body of the valve and illustrated in preferred embodiments of the invention.

Figures 13 and 13A are views similar to that of Figure 10 provided for comparison purposes of
20 preferred embodiments.

Figure 13B illustrates the preferred cylindrical seal used in conjunction with the cartridge of Figure 13A.

25 Figures 14A, 14B and 14C are top, side and perspective views respectively and illustrated in an alternative embodiment of the body (10) of the diverting valve assembly (5).

Figures 15A, 15B and 15C are top, side and perspective views respectively of the valve body of
30 Figure 2.

Figures 16A and 16B refer to a side and perspective views of the flush plug and illustrated in preferred embodiment of the invention.

Figure 16C refers to the valve body (10) having the flush plug installed therein for the purpose which will hereinafter be described.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

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Referring to Figures 1 and 2 there is illustrated the diverter valve (5) installed on a deck (D) of a roman tub installation having a predetermined thickness and openings there through, through which the diverting valve body (10) is inserted to assume the position as shown in Figure 1. A mounting nut (13) is therefore provided with the valve assembly which is movable from a position shown in Figure 2 by rotating the nut with respect to the length of thread (12) provided with the body (10) so that the mounting nut (13) and the trim portion (13A) of the body (10) cooperate to fasten the valve (5) on the deck (D) of the roman tub assembly. Once the valve (5) is mounted on the deck (D) the other connections can be made to connect the water supply (S) to the inlet (11) of the valve body and the outlet of the valve body (10C) via the necessary fittings to allow water to move in a direction (1) to the telephone shower spray (T) also installed on the deck (D) in a conventional manner and which installation will not be described herein. Further conventional hot (H) and cold (C) water valves are installed to supply the diverting valve as shown. The outlet (10B) of the diverting valve (5) is also connected to a second use with water flowing in a direction (2) to the spout S. In this case the second use is the actual spout that fills the roman tub or whirlpool or alternatively may be a shower spray. Outlet (10A) may also extend to a third use which is not illustrated.

Referring now to Figures 3 and 3A there is illustrated the valve assembly (5) including the inlet (11) as best seen in Figure 1 to receive the water supply from a supply source such as a typical hot (H) and cold (C) water valves or the like. The body (10) of the valve is made from brass and is contained in an opening (10') to receive the diverter stem (20) therein. The body opening (10') is closed by a trim nut portion (9) which extends around the stem sleeve portion (21) and seals the diverter stem (20) into the opening (10') of the valve body (10). The valve body (10) includes openings (10A, 10B and 10C) as best seen in Figure 2 which may be coupled to various uses of the mixed water entering the valve through inlet (11). The diverter stem (20) may be selectively aligned to orient the water path of the diverter stem (20) as best seen in relation to Figure 10 with the outlet (10A, 10B and 10C) of the valve body (10). The diverter stem therefore may only be aligned with any one of said valve body outlets (10A, 10B and 10C). The

water outlets (24A and 24B) as best seen in Figure 10 will therefore be selectively aligned with said body outlets by rotating the stem to selectively align 24A and 24B with the desired outlet (10A, 10B and 10C).

5 Referring to Figures 4, 4A, 5, 5A, 5B, 5C, 5D, 5E, 5F, 5G, 6 and 7 the details of the valve assembly may be more readily observed. The diverter stem (20) therefore includes proximate the bottom therefore a stem plug (23) which is used to define the opening (23A) providing the inlet to the diverter stem. The stem plug also prevents water from passing from the waterway (27 and 20Y) back to the inlet (11) of the valve body. The diverter stem (20) also includes
10 proximate the stem plug a cylindrical wall (25') which defines a cylindrical opening within which check members (25 and 25B) are contained. Alternatively a check cartridge R may be provided as seen in Figure 5B, in which case plug 23 is not required as the entire check cartridge accomplishes the same purpose. The check valves (25A and 25B) allow water to pass through the opening (23A) into the waterway (27 and 20Y) which carry water through to the respective
15 outlet (10A, 10B and 10C) but does not allow water to pass from said waterway (27, 20Y) back through the check valves to potentially contaminate the water supply. The provision of two check valves (25A and 25B) is a matter of code requirements in a given circuit to ensure that the potable water supply is not contaminated by water returning from a outlet through to the inlet. The operation of the check mechanisms is best illustrated and described in relation to Figures
20 11A, 11B and 11C, the description of which will follow hereinafter.

Referring to Figures 4 and 4A, the diverter stem (20) has disposed proximate the top thereof a sleeve portion (21) and handle engaging portion (22). The sleeve portion (21) also has an opening (22B) provided therewith to enable a pinion like portion (20F) disposed proximate the top
25 of the diverter stem to access said sleeve (21). In this manner when the handle portion, not shown, is engaged with the handling engaging portion (22) and as the handle is rotated in a predetermined direction the stem cartridge (20) will rotate. The portion 20F includes a portion 20E which extends into the opening disposed on the top 20T of the diverter stem (20) as best seen in relation to Figure 13. This anchoring portion 20E therefore extends into that opening.
30 The nylon washer (15A) extends around that assembly to provide sealing thereof. The trim nut (9) will therefore be fastened over the sleeve (21) and the top 20T of the diverter stem (20) when said diverting stem (20) is inserted with an opening (10') of the body (10) for valve assembly (5). The stop mechanism 31 as best seen in Figure 3 and 5 is provided with the stem portion (20)

which engages dimples (10'') disposed above the perimeter of the interior of the opening (10') of the valve body (10) at the height illustrated in Figure 3. The ball bearing (31) therefore is resiliently biased by the spring portion (31) and the plug portion (33) to enter the dimples through opening (31') so that at predetermined selected positions, the openings of the diverter stem will be in alignment with the openings of the valve body and providing thereat some positive resistance of further rotation of the diverter stem, thereby providing engagement and positioning of the diverter assembly. The diverter stem (20) also includes and carries the necessary grommets (20C, 20A and 20B) to ensure the integrity of the waterway, so that as best seen in Figures 13 and 13A, water passing around the valve and out the waterway to the outlet (24A), will be properly sealed from permitting water to pass through outlet (24B). In one embodiment a cylindrical seal S1 made from engineered plastic, such as Delrin™, is provided as best seen in Figure 13B which is carried in cut out SC to ensure integrity of the water path.

Referring now to Figures 8A, 8B and 8C there is illustrated trim nut (9) having a top and having extending from the top to the bottom of the trim nut (9) an opening or port (9B) defined within a nut portion (9C) which provides for the sealing of the top of valve body. The threaded portion (9A) of the trim nut (9) allows the sleeve (21) to pass there-through so that the handle engaging portion (22) in communication with the handle will access and operate the diverter stem (20).

Referring to Figures 9A, 9B and 9C as previously described the stem plug (23) is illustrated in isolation from the diverter stem (20). The stem plug (23) therefore includes an opening (23A) to allow the passage of water into the diverter stem (20), and which provides a crescent shaped member (23B) as positioned in relation to Figure 4 to circumscribe a portion of the cylindrical wall (20X) which retains the check mechanisms and which further provides a ring portion (23C) to close the bottom of the diverter cartridge (20) as best seen in relation to Figure 4. The crescent shaped portion (23B) includes ends (23D and 23E) to partially surround the opening (23A) thereof. Alternatively as best seen in relation to Figure 5A to 5G, there is shown a check cartridge R which is replaceable separate from the diverting cartridge and including end 23' which serves the same purpose as stem plug 23 to separate the waterways. When check cartridge R is installed it operates in a similar manner to Figure 3 with exception of there being less turbulence. The cartridge R includes a wall 20' extending about the check cartridge containing elements 25A and 25B. The top of the check cartridge R includes a wall portion 21' cut back from 20a' as shown, and including at the other end thereof a base 23' including a key

23a' designed to fit in the opening 20Z and to ensure waterway integrity as best seen in Figures 5E, 5F and 5G.

Referring to Figure 10 the components thereof are clearly described and labelled in the prior drawings. However the opening (31') is clearly seen in this illustration through which the ball bearing (31) of the stop mechanism previously described will extend. The tang portions (20') extending from the top (20T) of the diverter stem (20) will be described hereinafter in relation to Figures 12 and 13.

Referring now to 11A, 11B and 11C there is illustrated the preferred check mechanism embodied with the preferred embodiments of this invention. This check mechanism is purchased from Neoperl, Inc of Waterbury Connecticut and provides for the operation of the checking function as is known and described at their website at www.neoperl.com for Check Valve product OV20. The reader is referred to that company's website for further information in relation to this construction of this check valve assembly. Generally speaking the check valve (25A) is illustrated which permits water to flow in a direction permitting water to pass through the valve assembly into the waterway but prevents water from passing back through the check valve to the valve body inlet. Rib portions R' are provided about the circumference of the check (25A) which includes a skirt portion (25A') and the sealing part (S') to allow water to move in the direction shown in the illustration G1, G2 and G3 respectively. Spring portions (S_p) are also provided for the operation of the valve to prevent water or permit water to move in and out of the check in relation to channels C1 and C2 and the faces C and C' of the check members.

Referring to Figures 12, 12A to D, and 13 there is illustrated the top portion (20T) of the diverter stem (20) which includes detents (20') and (28'') as best seen in Figure 12. The detent (28'') constitutes a pin which may be inserted with an opening (20H) as shown to provide for a stop portion to permit the valve to move and yet stop at predetermined positions as desired in relation to the body parts shown in Figures 14A, 14B, 14C and 15A, 15B and 15C, the operation of which is very similar with the exception of the inclusion of the pin portion (20') to permit the diverter stem (20) to stop at predetermined locations via the portions (S1 and S2) as best seen in relation to this set of Figures 14A, 14B, 14C and 15A, 15B and 15C to ensure the correct alignment of outlets (20A, 20B,) with the outlets 10A, 10B and 10C respectively. It is noted that with the installation of the body (10) of Figure 14A, 14B and 14C that outlet (10A) is removed

and a plug (10A') is inserted therein for obvious reasons. When a check cartridge is employed as seen in Figures 12A-12D the operation is quite similar to other embodiments to allow water to flow through the cartridge R into space 20Z and out the appropriate outlet.

5 Referring to Figure 16A and 16B there is illustrated a flush plug (40) having a top and including a handle portion (41) and a stop portion (42A and 42B) which will engage the stop portions (S1 and S2) of the valve body (10). The plug also includes sealing portions (40A) proximate the vertical wall thereof so that when the flush plug (40) is inserted within the opening (10') of the valve body, as best seen in Figure 16C, that the integrity of the water path may be checked for
10 leaks prior to installation of the diverter stem (20).

The deck mounted diverter valve (5) can therefore be used primarily for roman tubs and includes a double check valve to ensure that the code is met while still providing a simple easy to use valve assembly.

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A reliable simple diverting valve therefore is provided which meets the objectives of the invention as set out above and overcomes the limitations in the prior art.

As many changes can be made to the embodiments of the invention without departing from the
20 scope of the invention; it is intended that all matter contained herein be interpreted as illustrative of the invention and not in a limiting sense.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE AS FOLLOWS:

1. A diverter valve comprising a housing and a diverting stem cartridge, said housing having a top and a bottom and a stem cartridge receiving chamber extending from proximate the top to proximate the bottom of said housing, said housing having an inlet port proximate the bottom thereof and a plurality of laterally directed outlet ports extending from the cartridge receiving chamber, each outlet port for directing water for selective alternative uses such as a spout, shower, body spray or the like, said stem cartridge having an inlet port proximate the bottom thereof in alignment with the inlet of said housing and having a plurality of laterally directed outlet ports for selective alignment with the outlet ports of said housing, said inlet ports and outlet ports of said stem cartridge having disposed there-between a stem waterway to allow water to flow from the inlet to said outlets, said cartridge having an interior defining said waterway and having contained therein adjacent said stem cartridge inlet port at least two checking mechanisms (preferably also in a replaceable cartridge form) disposed prior to said waterway, said at least two check mechanisms preventing water from the outlet ports from contaminating the water supply, wherein replacement of said stem cartridge (or alternatively replacement of check cartridge) permits simple replacement of faulty checking devices without the need for skilled tradesmen being involved.

2. A diverting valve assembly for a roman tub or the like comprising a body containing an opening therein, said opening for receiving a diverting cartridge, said body comprising an inlet and at least one outlet, said cartridge comprising an inlet and at least one outlet having a waterway disposed there between, said cartridge being rotatable within a predetermined range to selectively align said outlet of said body with an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series (preferably disposed with a check cartridge) which allow for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to return from the waterway through each check valve into the waterway to the inlet, wherein water from anyone of a selected number of outlets cannot re-enter the water supply to the valve to contaminate said water supply.

3. A valve assembly comprising a body containing an opening therein, said opening for receiving a valve cartridge, said body comprising an inlet and at least one outlet, said cartridge comprising an inlet and at least one outlet having a waterway disposed there between, said cartridge being operable to selectively permit water flow to said outlet of said body from an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series (preferably also in a replaceable cartridge form) which allow for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to return from the waterway through each check valve into the waterway to the inlet, wherein water from the outlets cannot re-enter the water supply to the valve to contaminate said water supply.

4. A valve assembly comprising a body containing an opening therein, said opening for receiving a valve cartridge, said body comprising an inlet and at least one outlet, said cartridge comprising an inlet and at least one outlet having a waterway disposed there between, said cartridge being operable to selectively permit water flow to said outlet of said body from an outlet of said cartridge, the inlet of said cartridge including two check valve assemblies in series in a replaceable check cartridge form which allows for water to flow from the inlet toward at least one outlet of the cartridge but which does not permit the water to return from the waterway through each check valve into the waterway to the inlet, wherein water from the outlets cannot re-enter the water supply to the valve to contaminate said water supply, and wherein the check cartridge may be replaced without the necessity of replacing the entire cartridge.

5. The diverter valve of claim 1, 2, 3, or 4 wherein said housing includes a cut out portion proximate the top thereof extending about a predetermined extent of the housing for co-operation with a stop portion provided with the cartridge to limit the rotation of the cartridge between the selected positions.

6. The diverter valve of claim 1, 2, 3, or 4 wherein said housing includes a threaded portion proximate the top thereof adjacent the opening thereof for receiving a corresponding threaded rotatable plug for retaining the cartridge in place within said housing.

7. The valve of claim 1, 2, 3, or 4 wherein said threaded rotatable plug has an opening to receive a spindle portion surrounded by a cylindrical sleeve threaded on the exterior thereof to allow attachment of appropriate trim portions adjacent a handle.

8. The valve of claim 1, 2, 3, or 4 wherein said housing includes a detent and said cartridge includes a mating tab to ensure correct alignment of all functions of said valve.

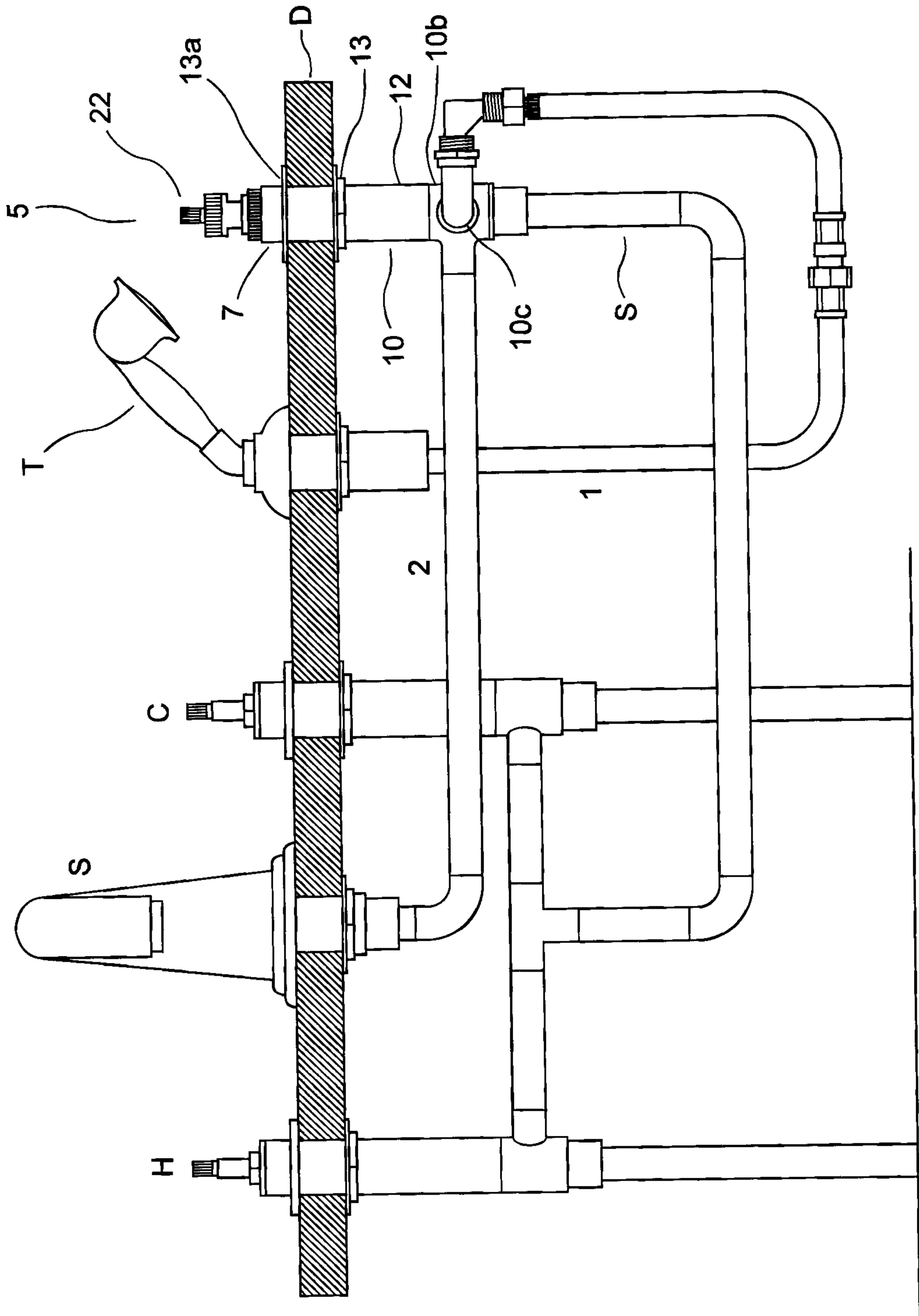


Figure 1

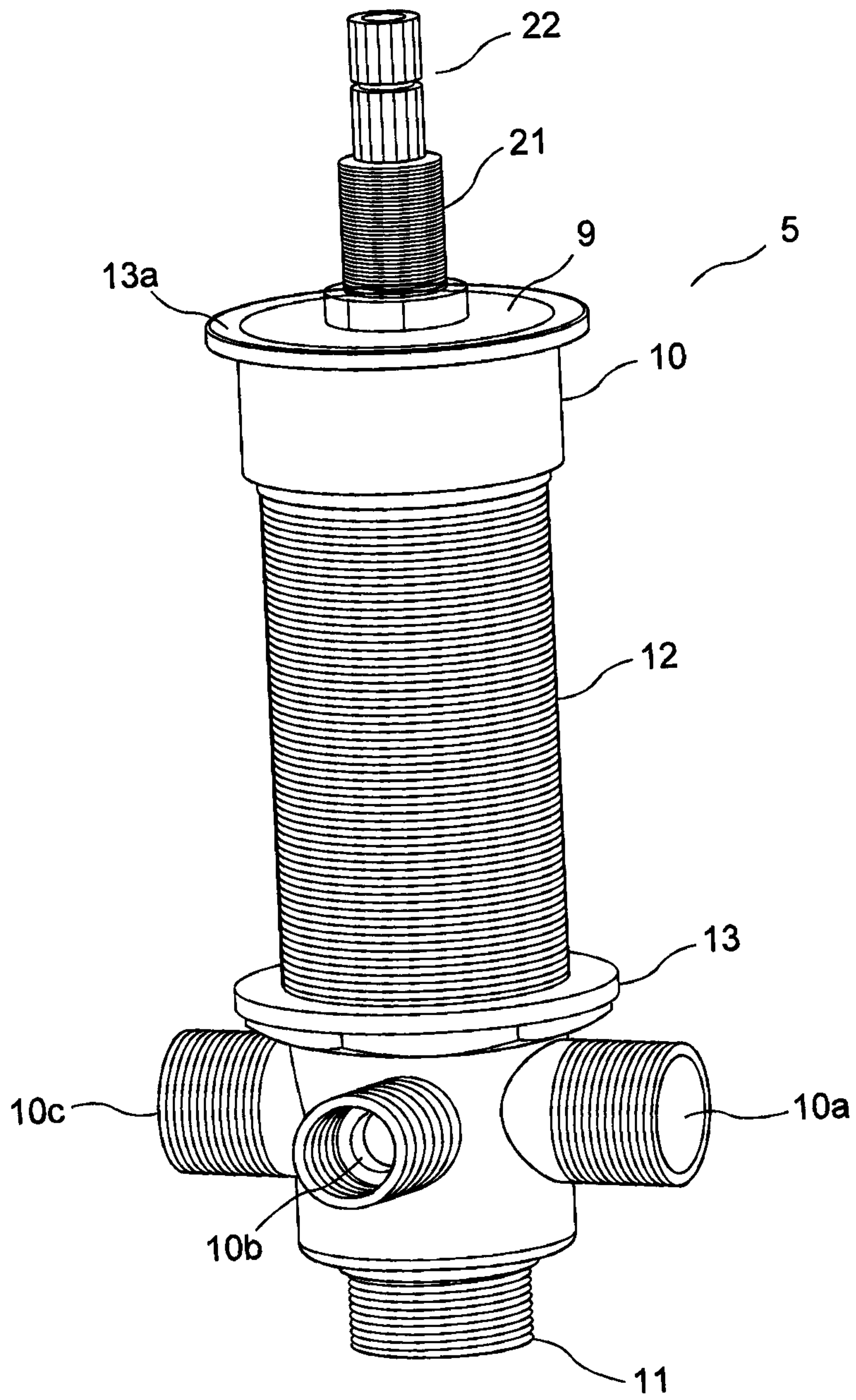


Figure 2

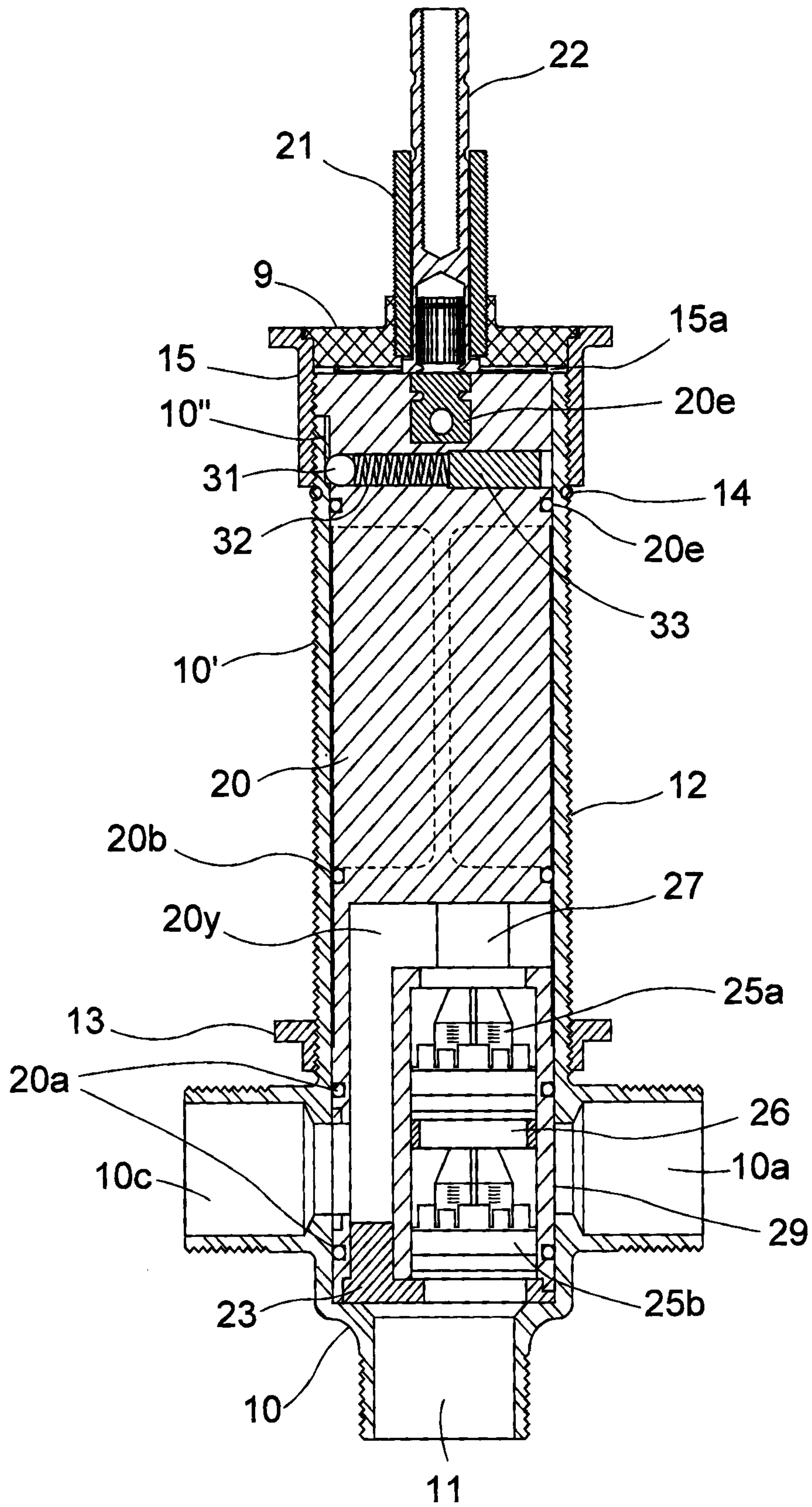


Figure 3

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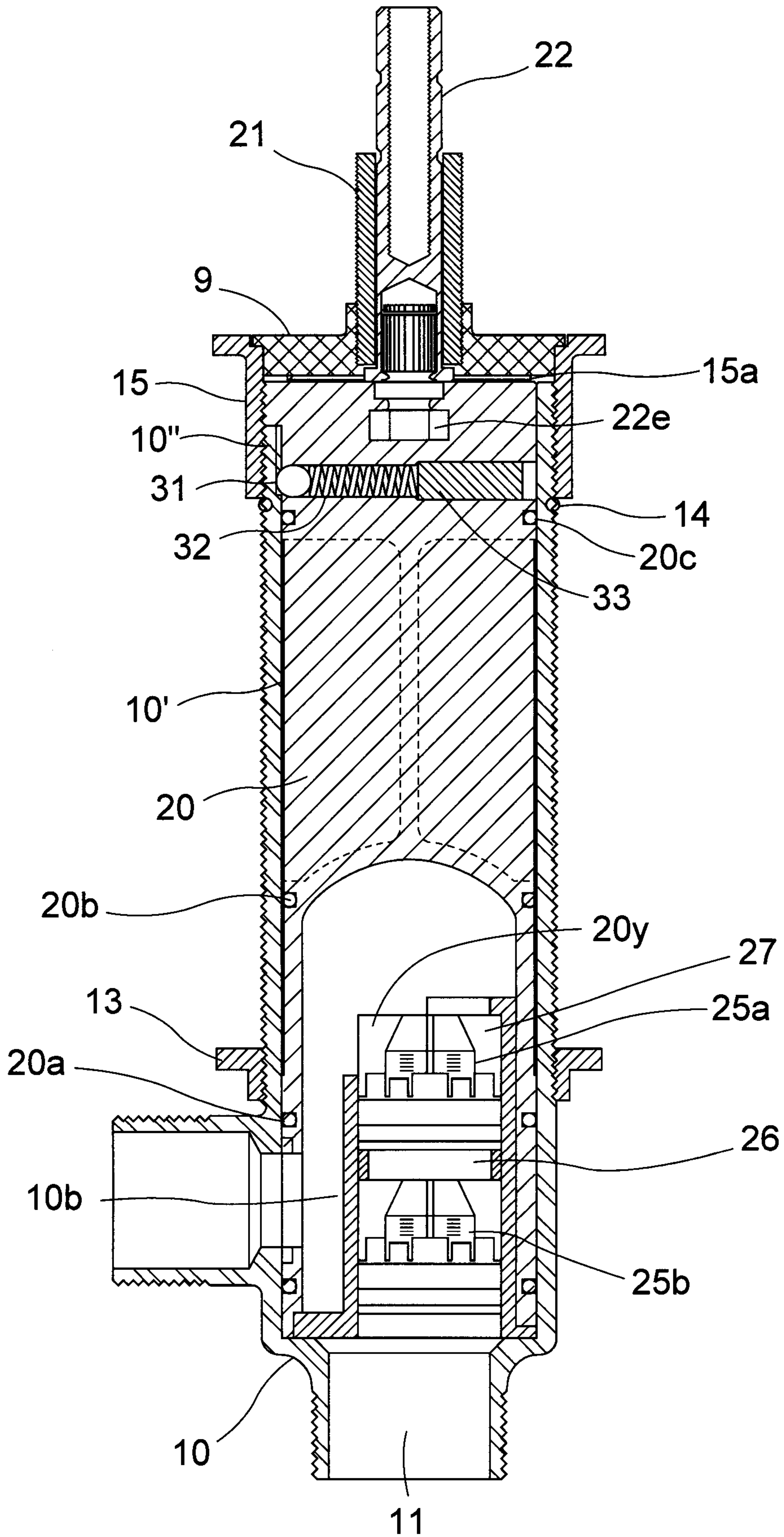


Figure 3A

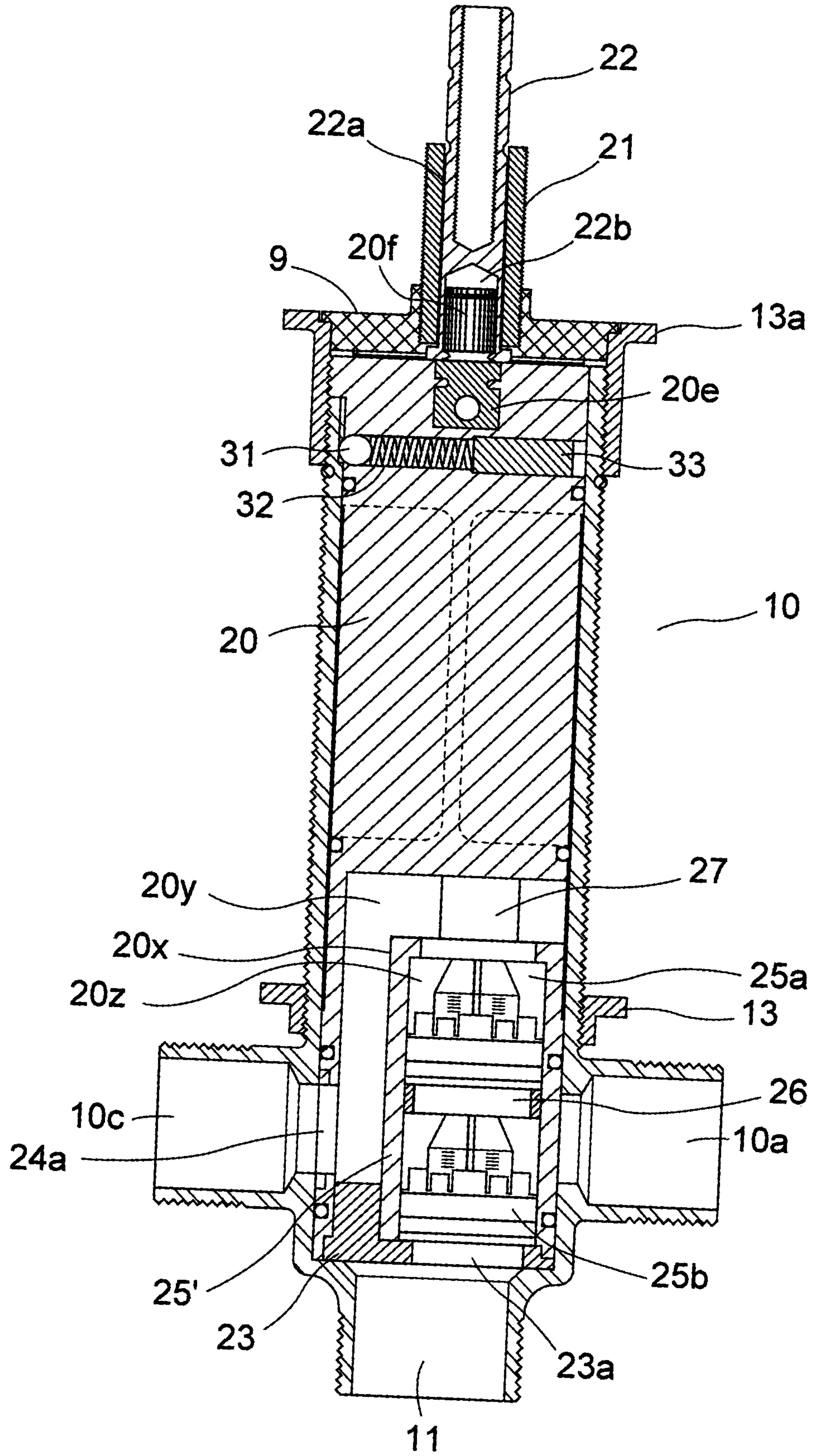


Figure 4

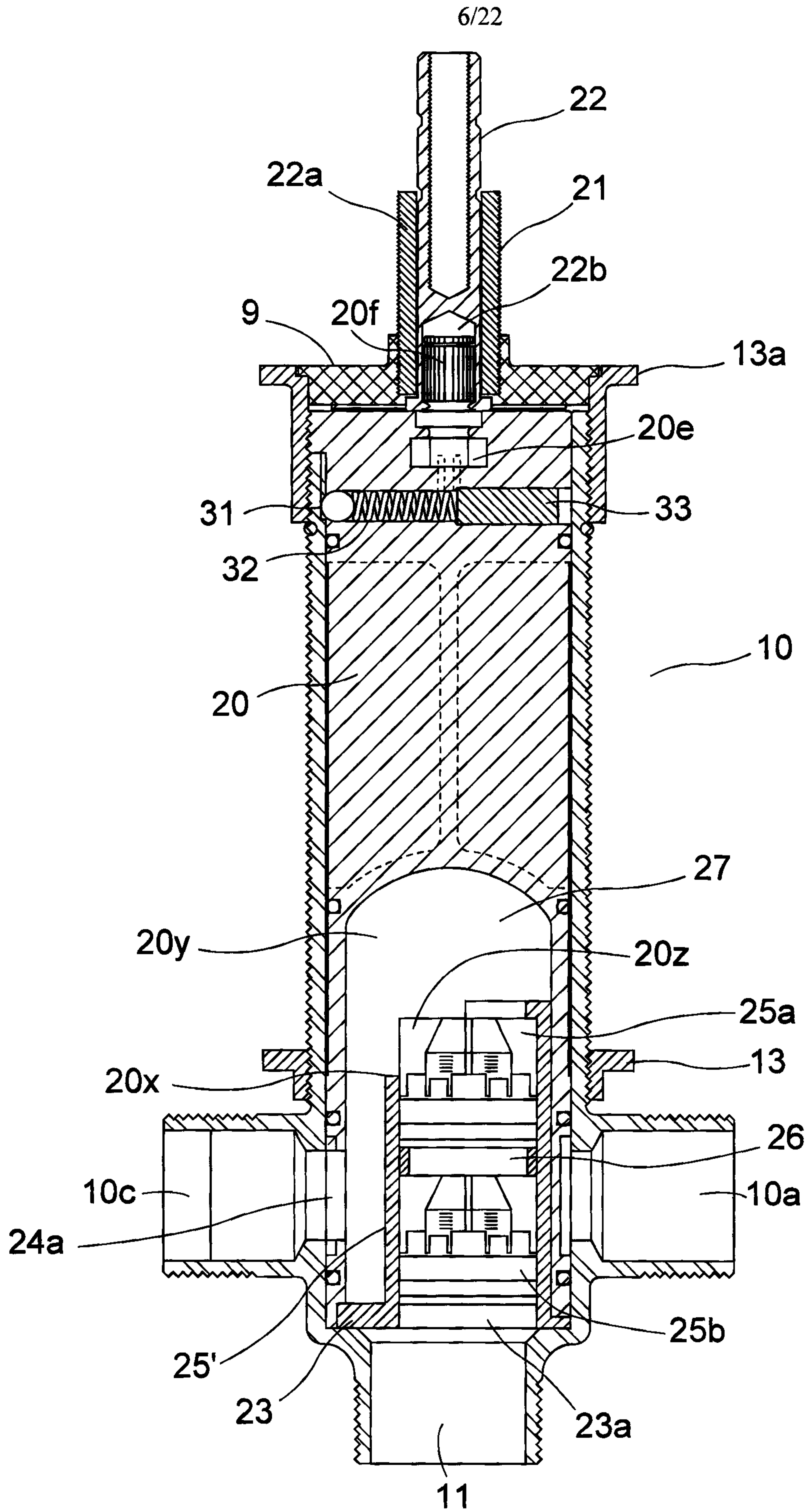


Figure 4A

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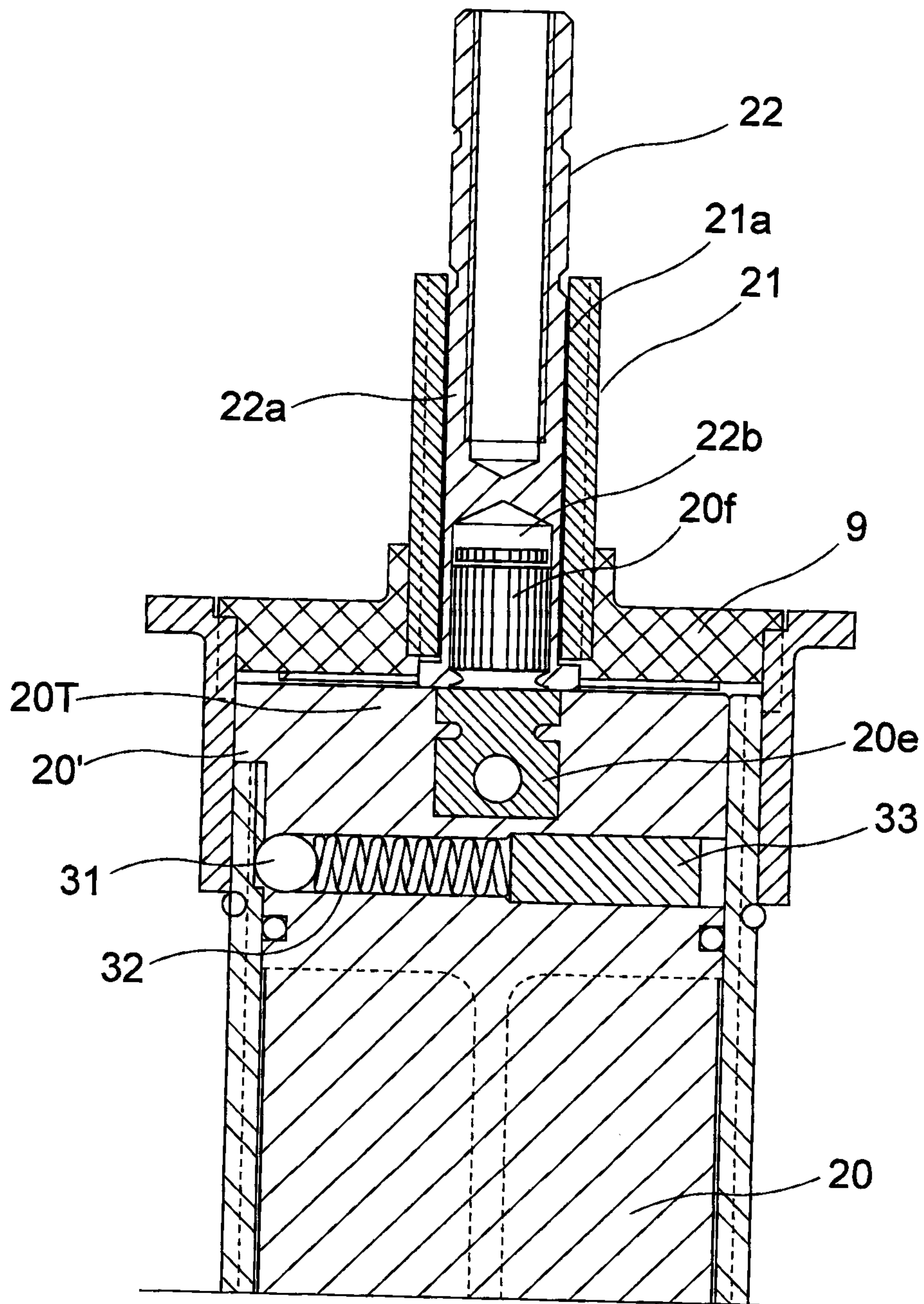


Figure 5

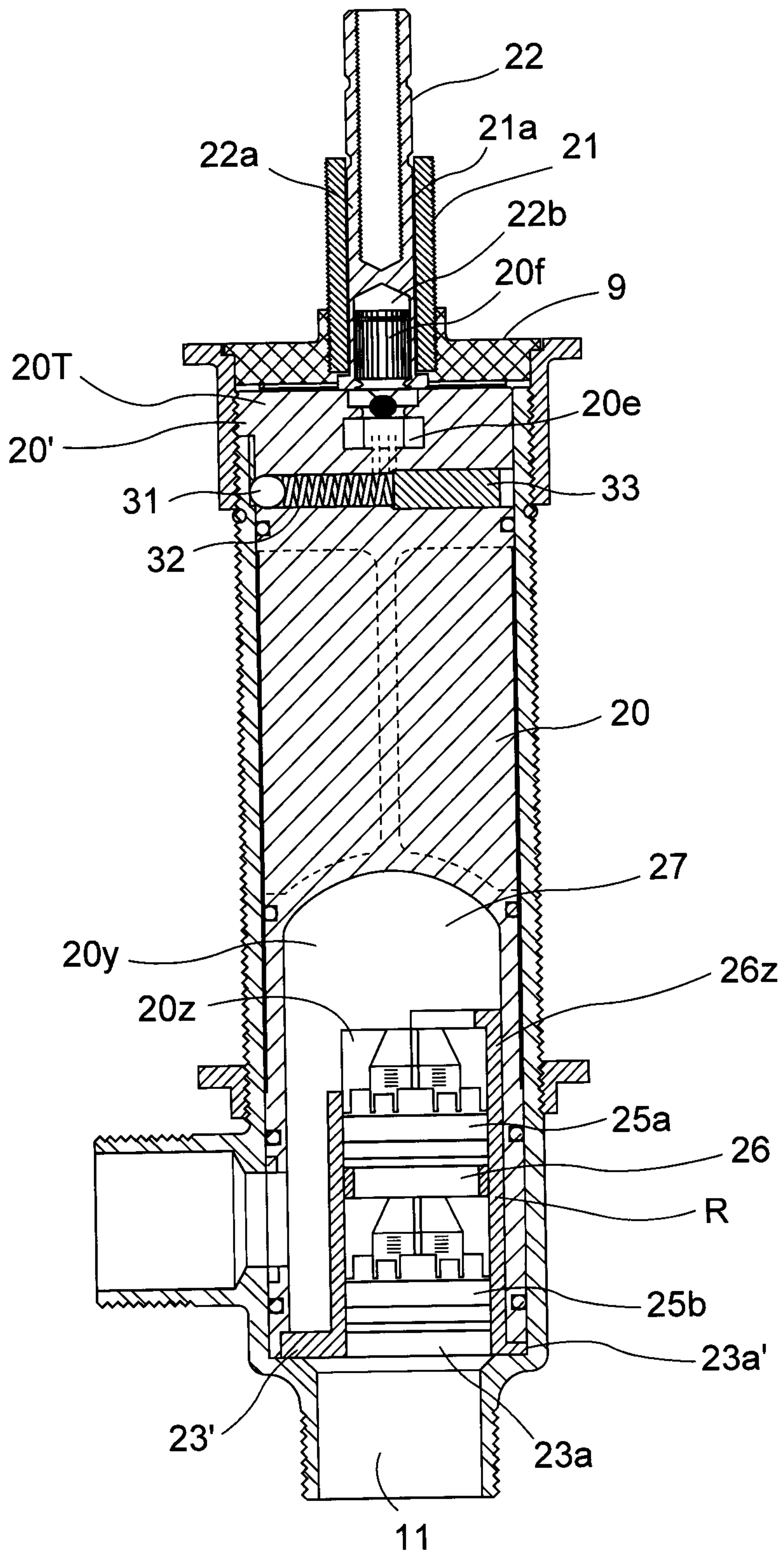


Figure 5A

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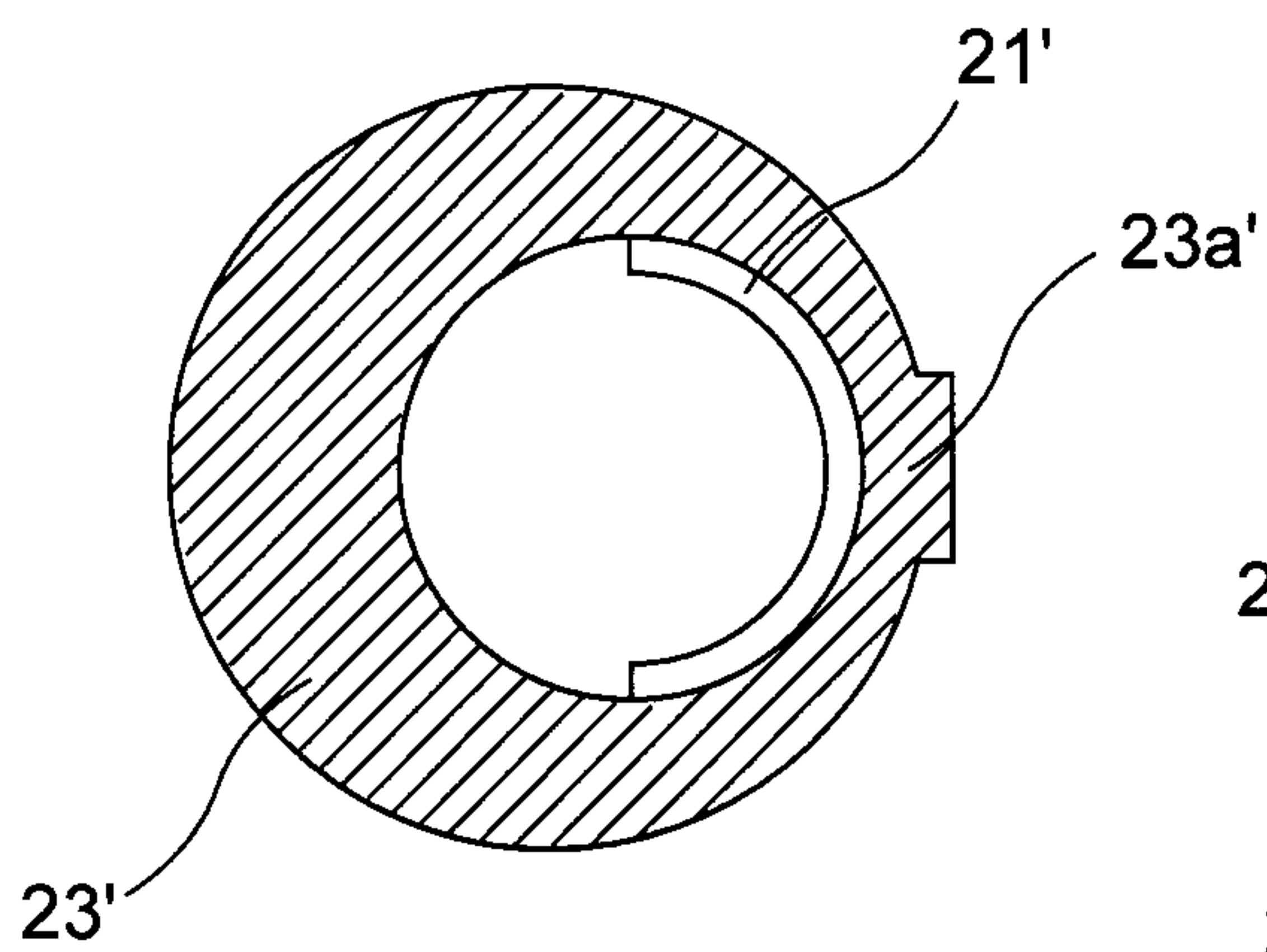


Figure 5C

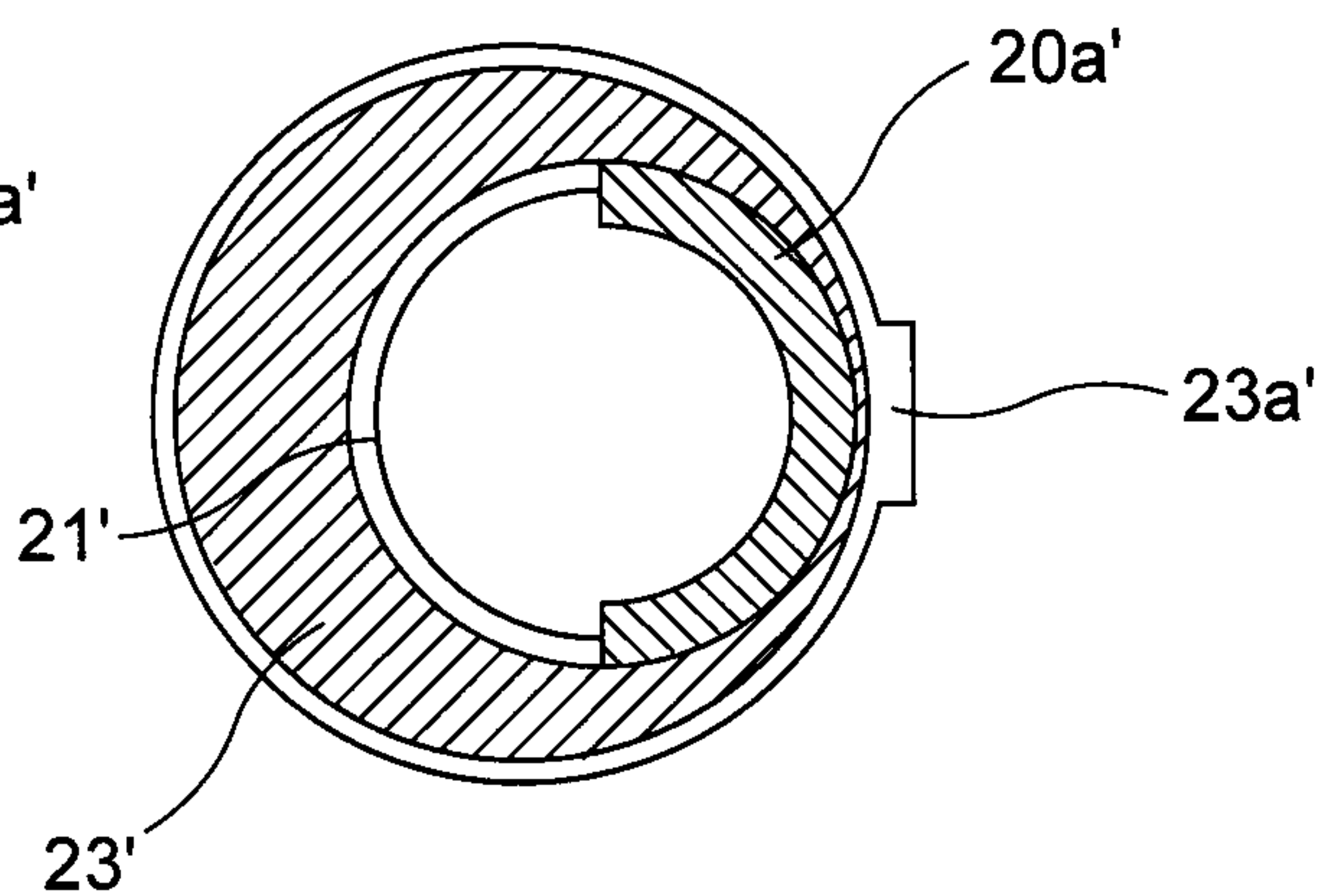


Figure 5D

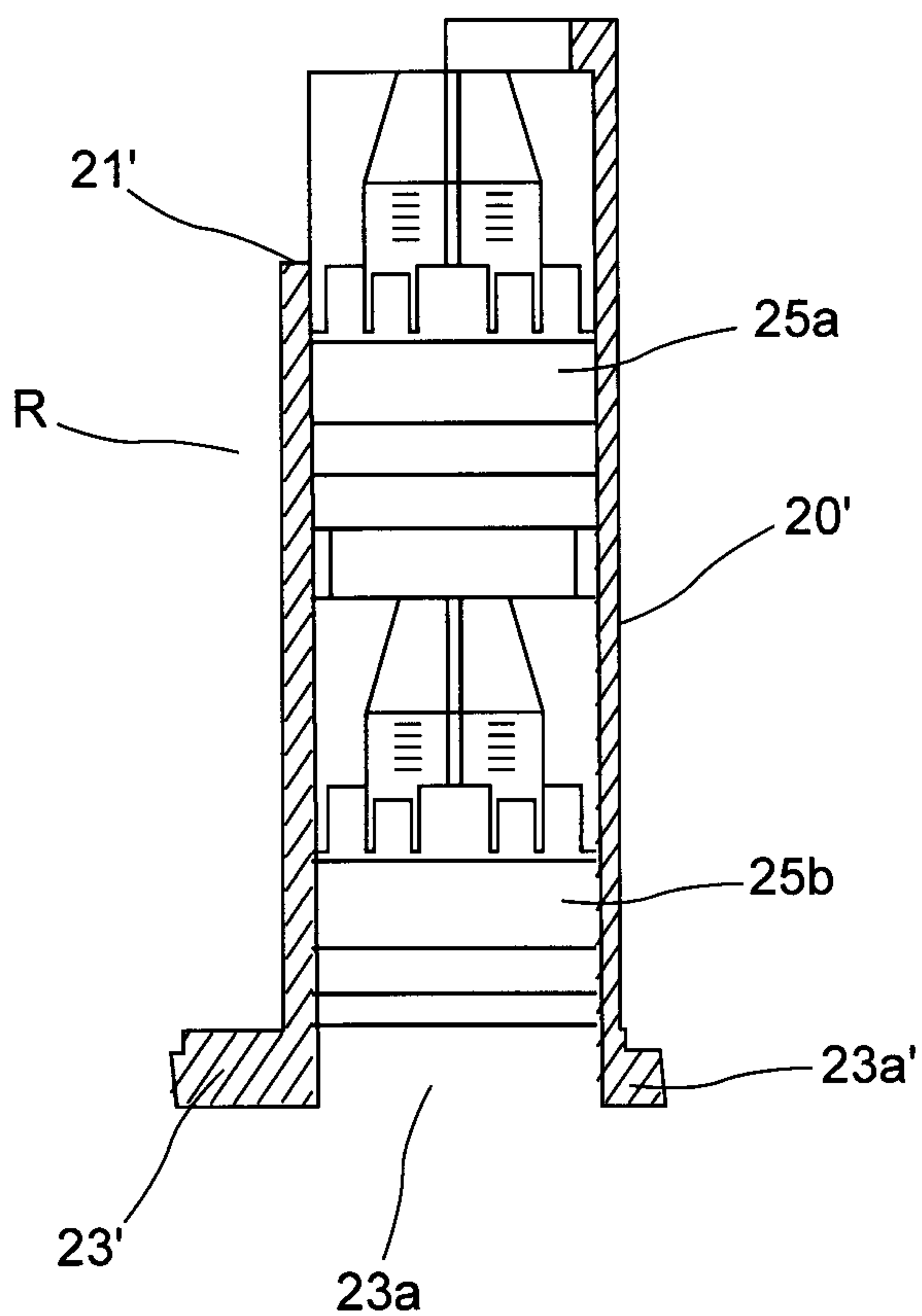


Figure 5B

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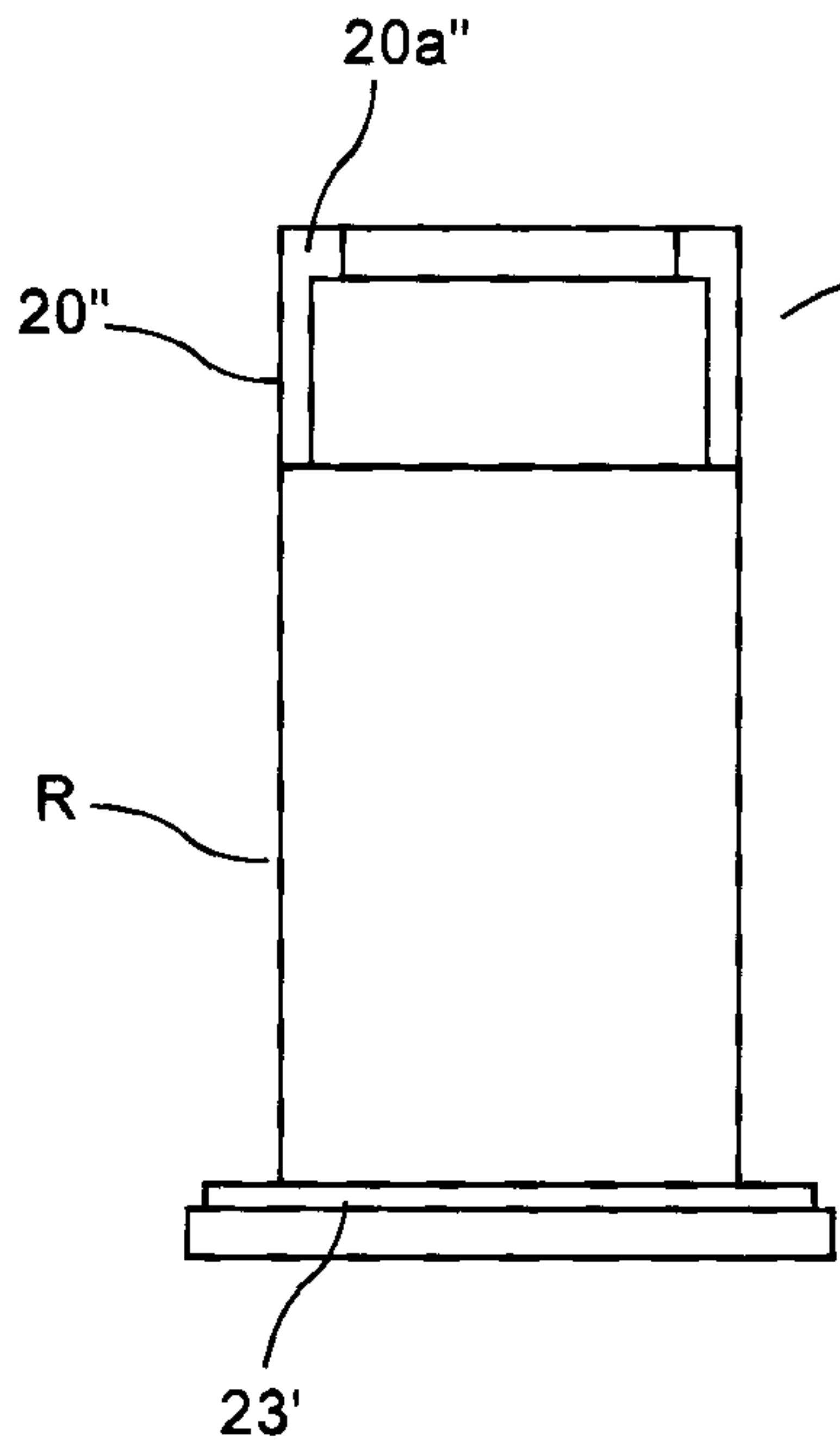


Figure 5G

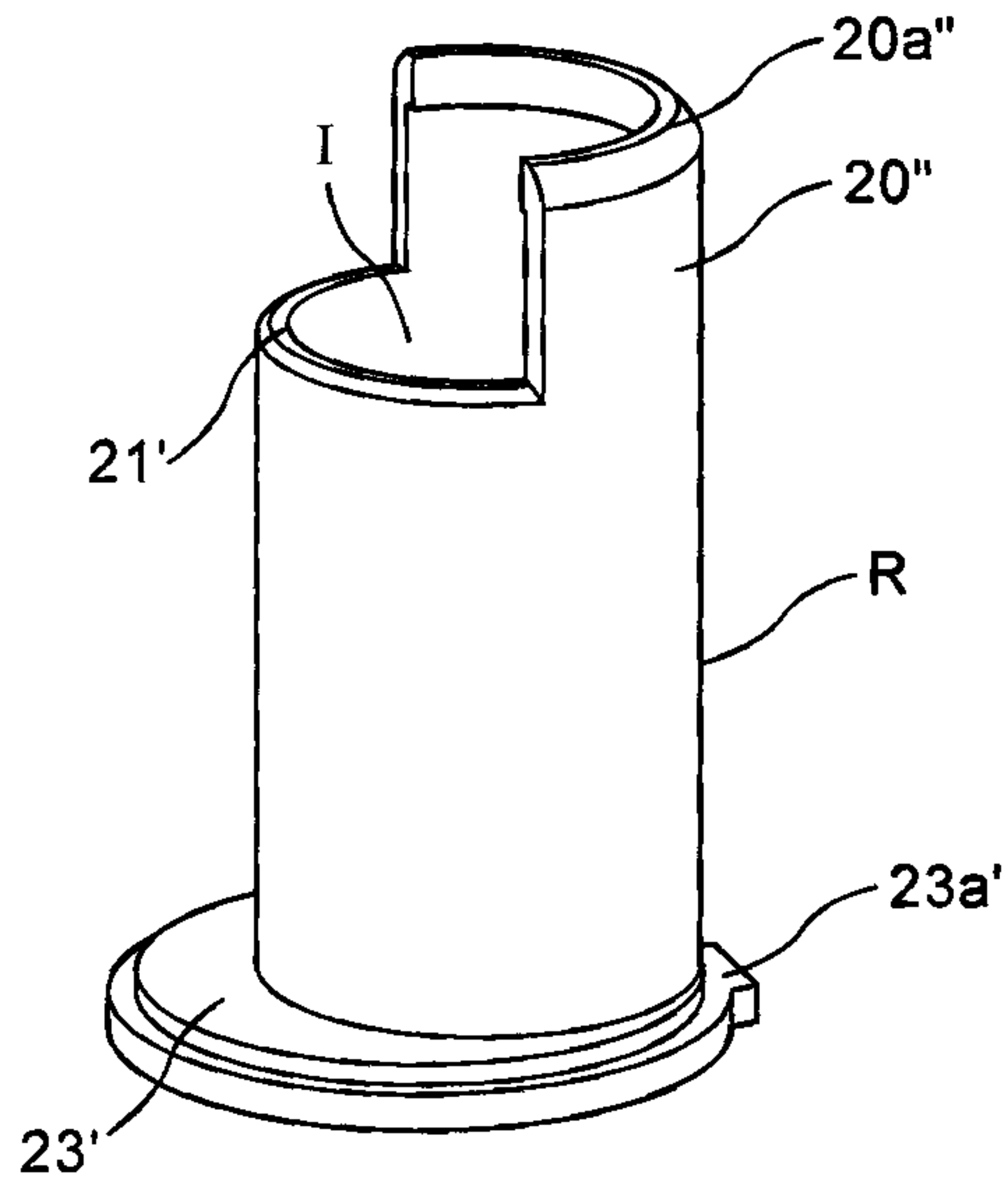


Figure 5F

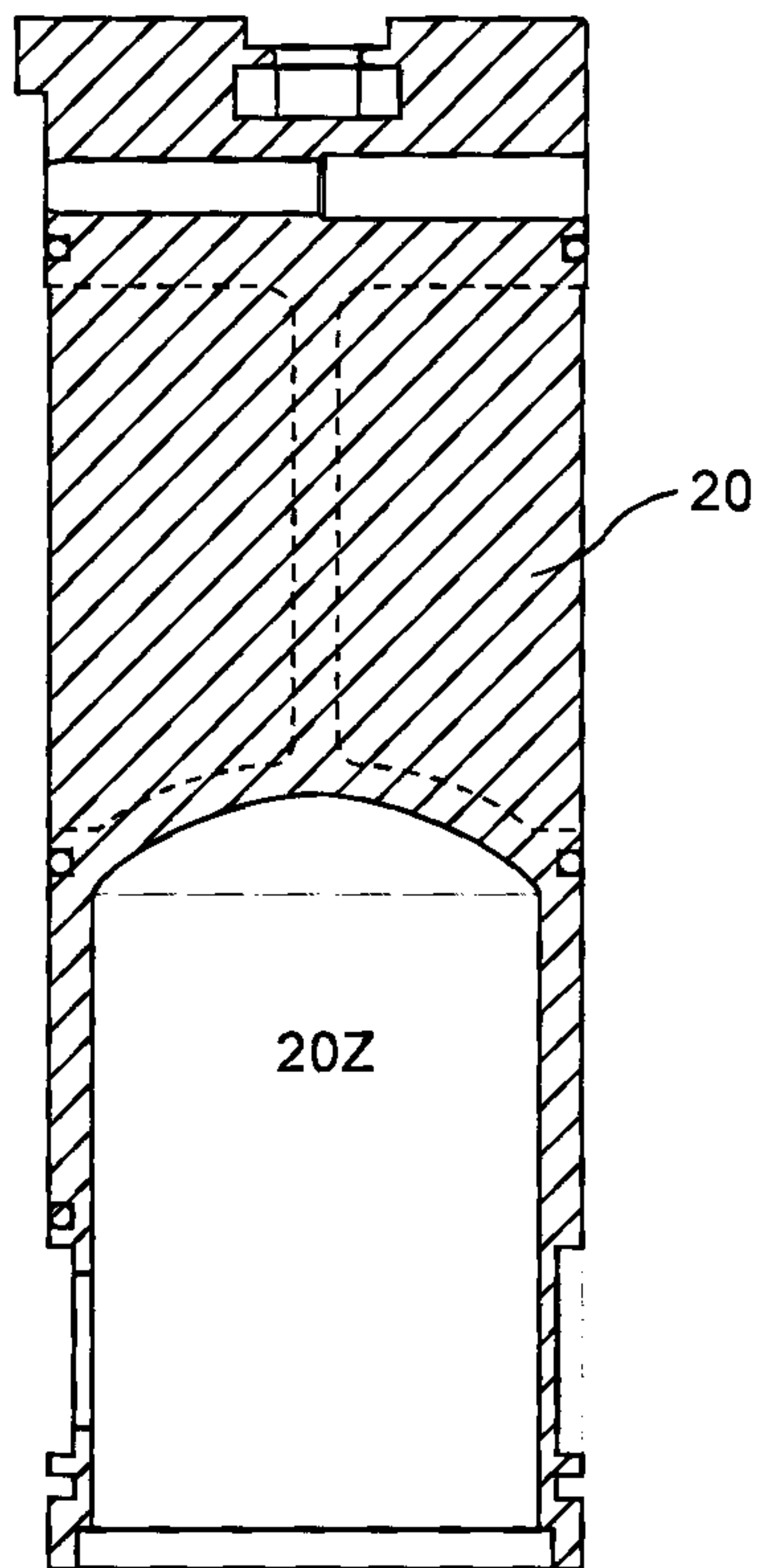


Figure 5E

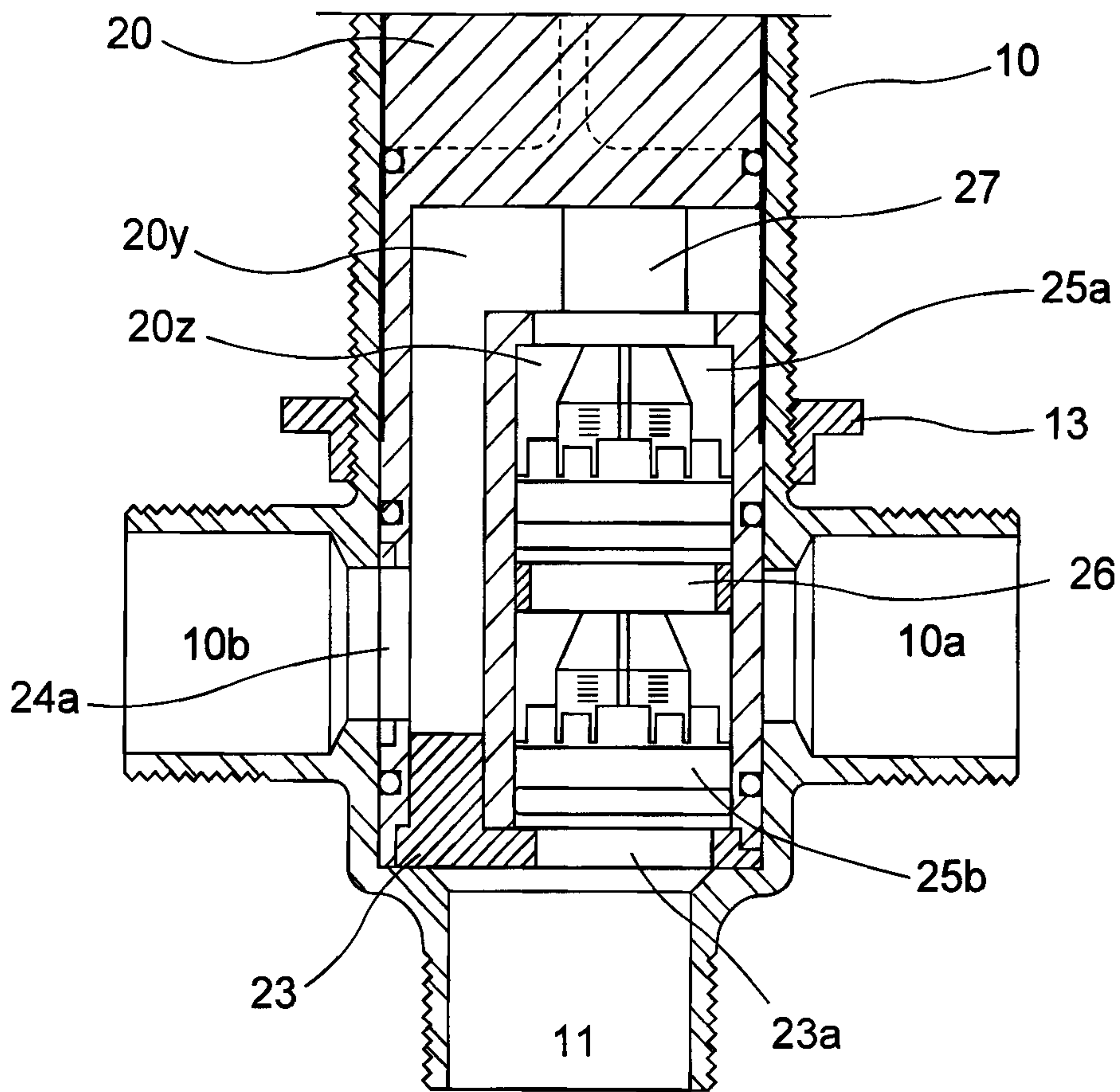


Figure 6

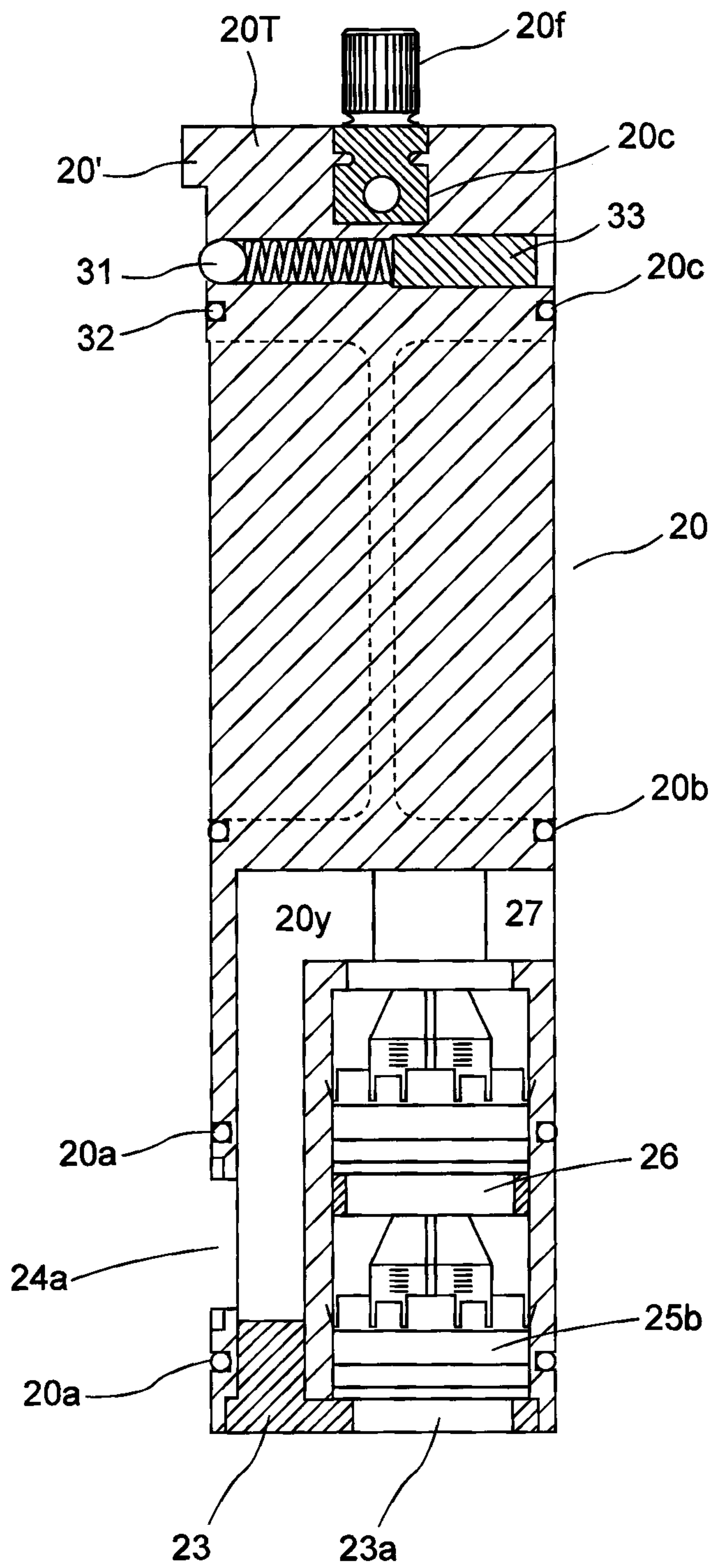


Figure 7

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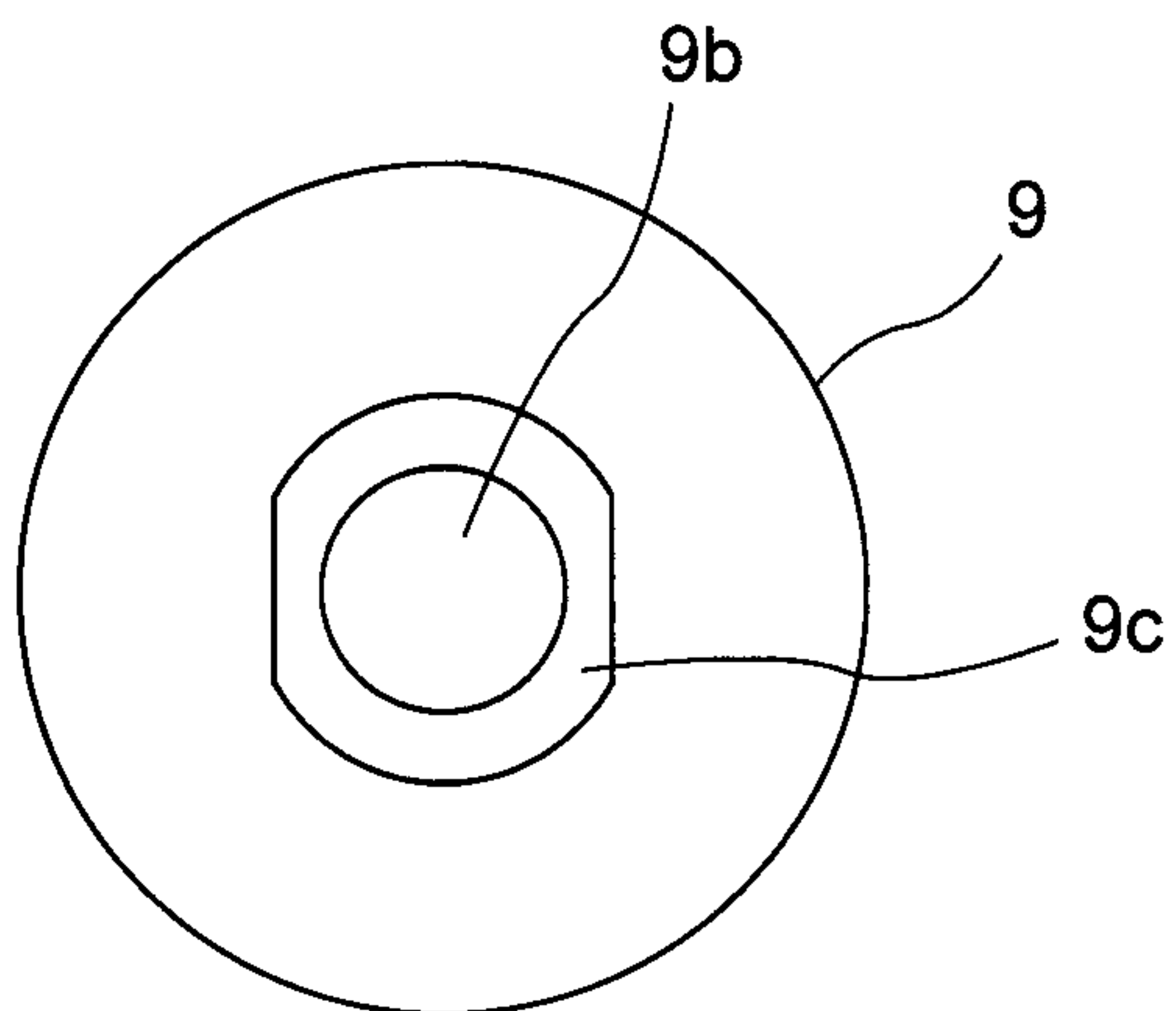


Figure 8A

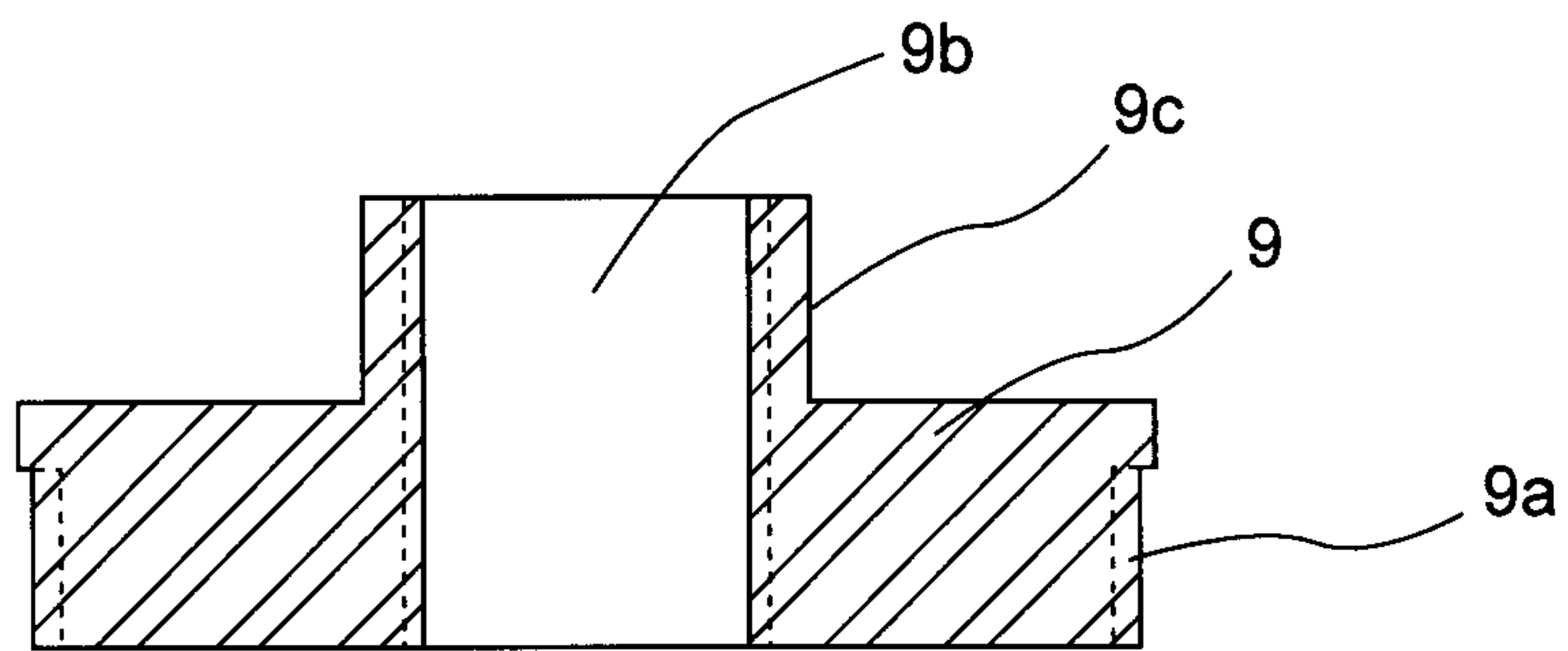


Figure 8B

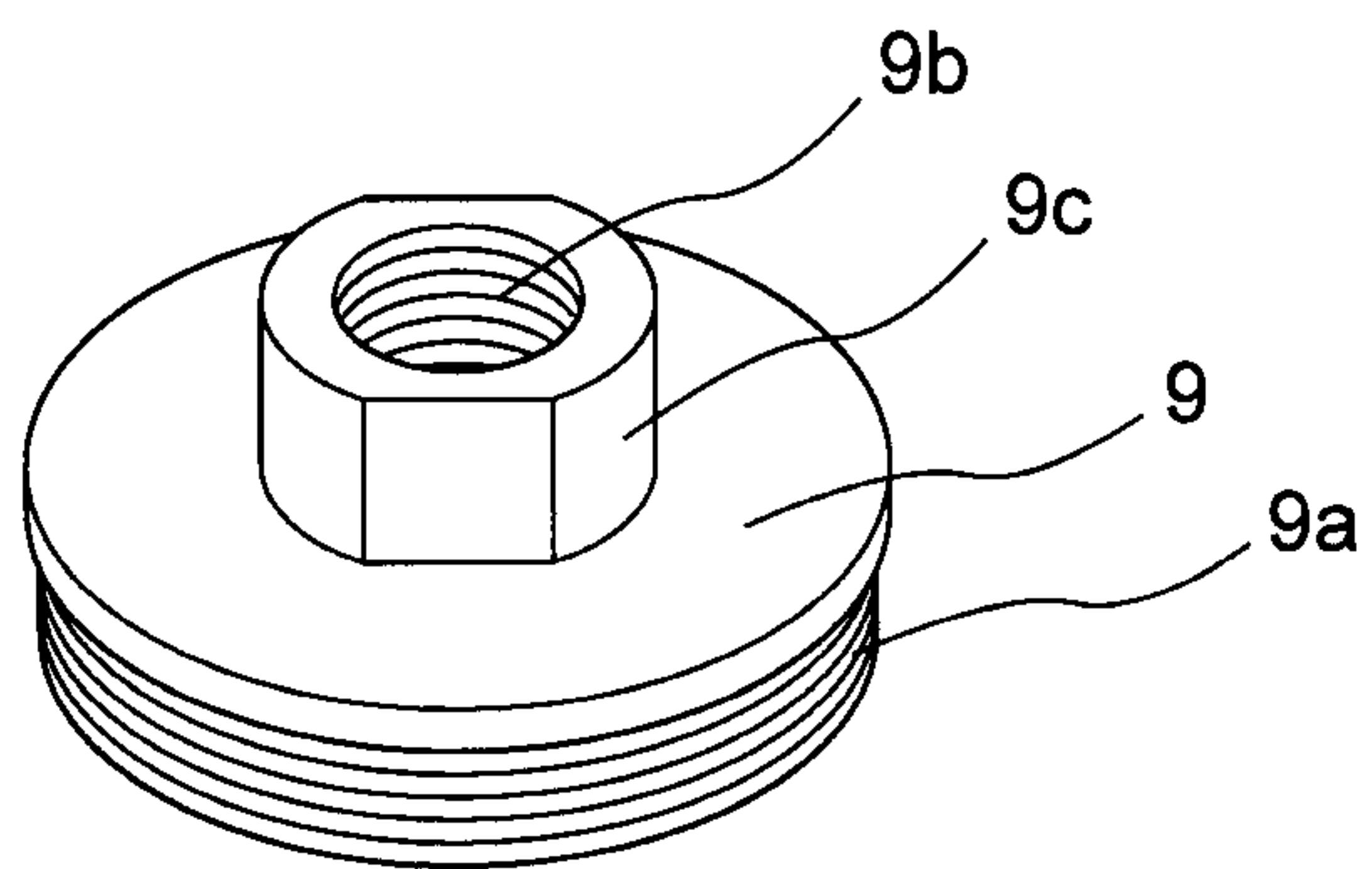


Figure 8C

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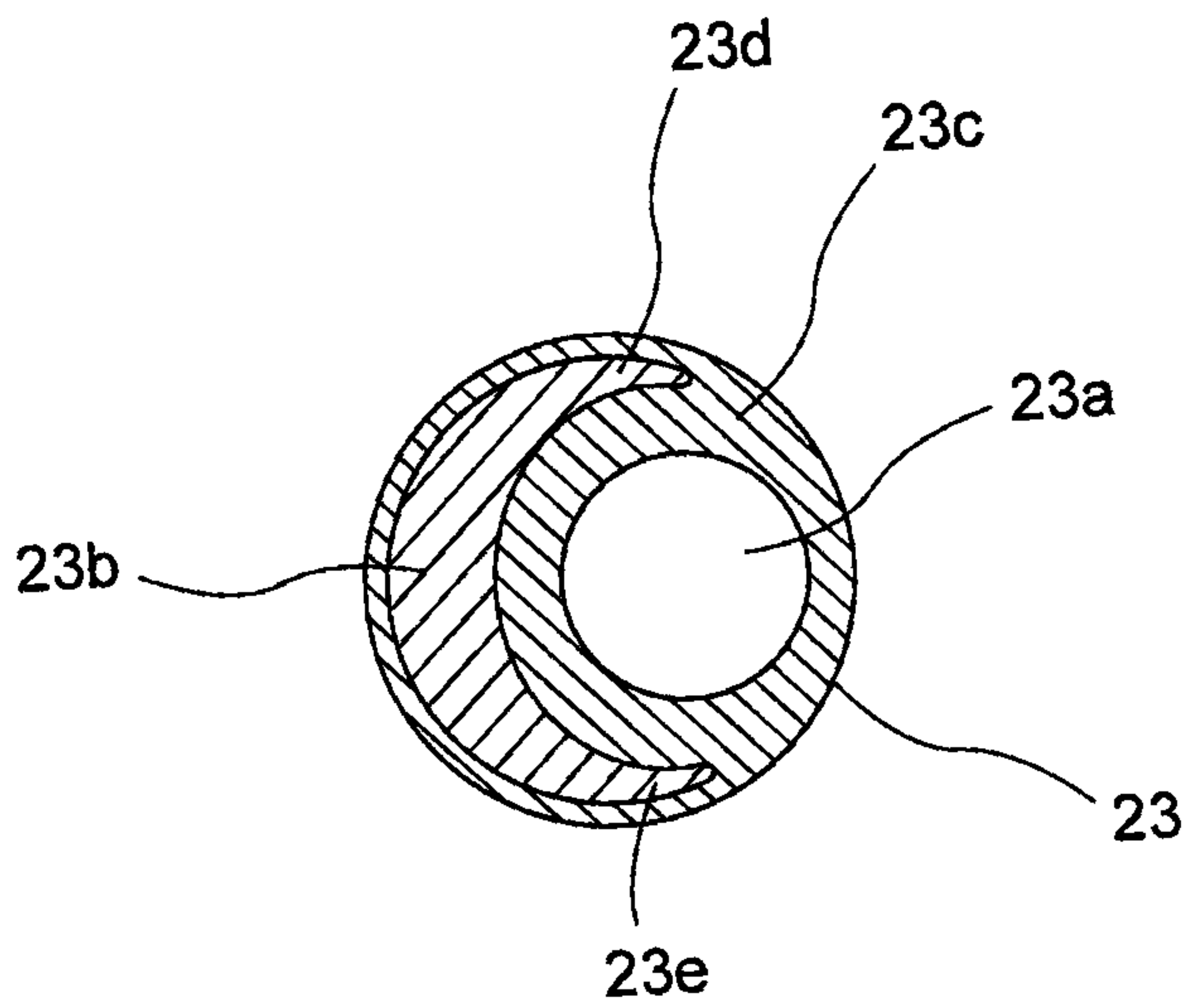


Figure 9A

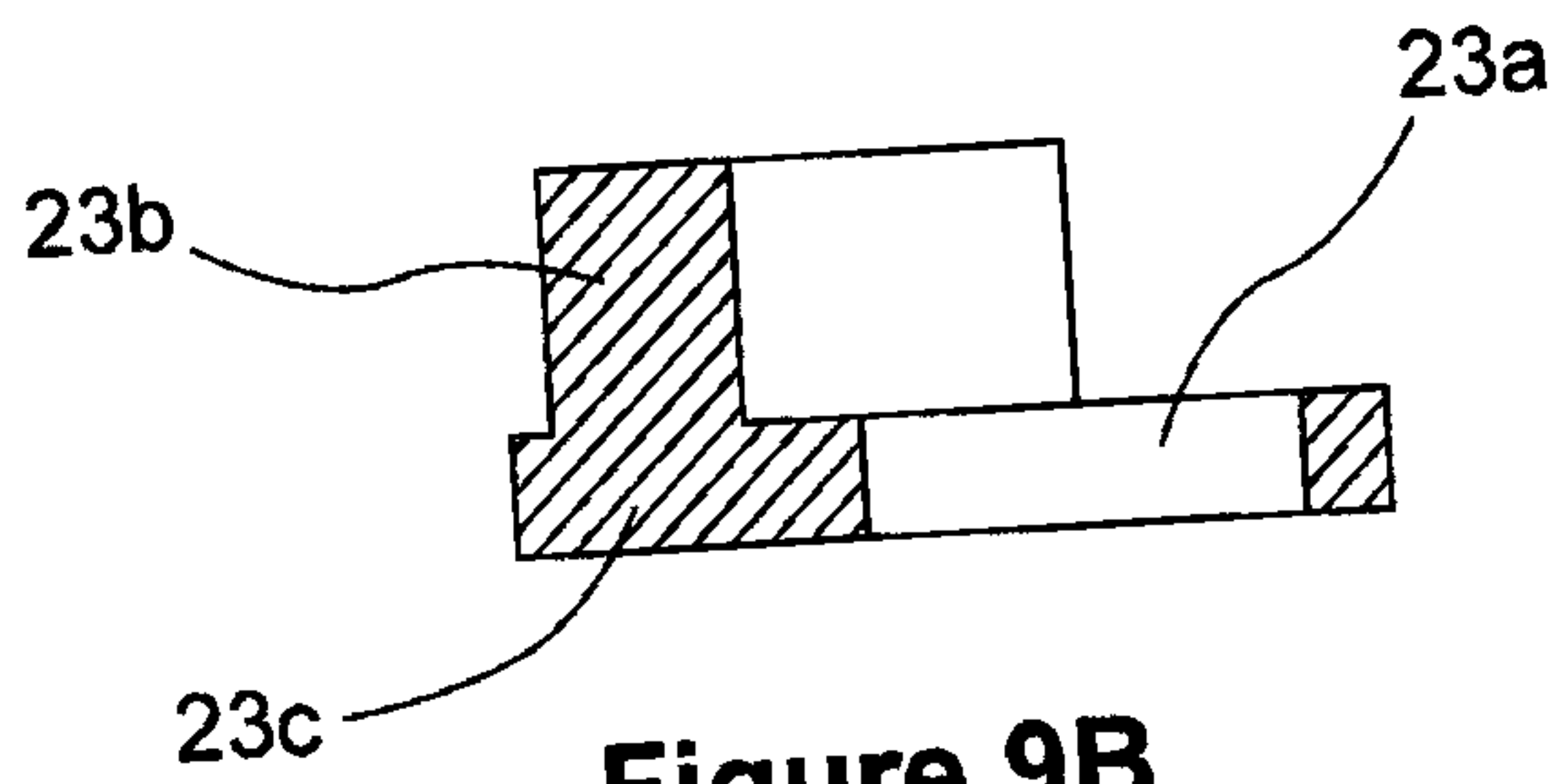


Figure 9B

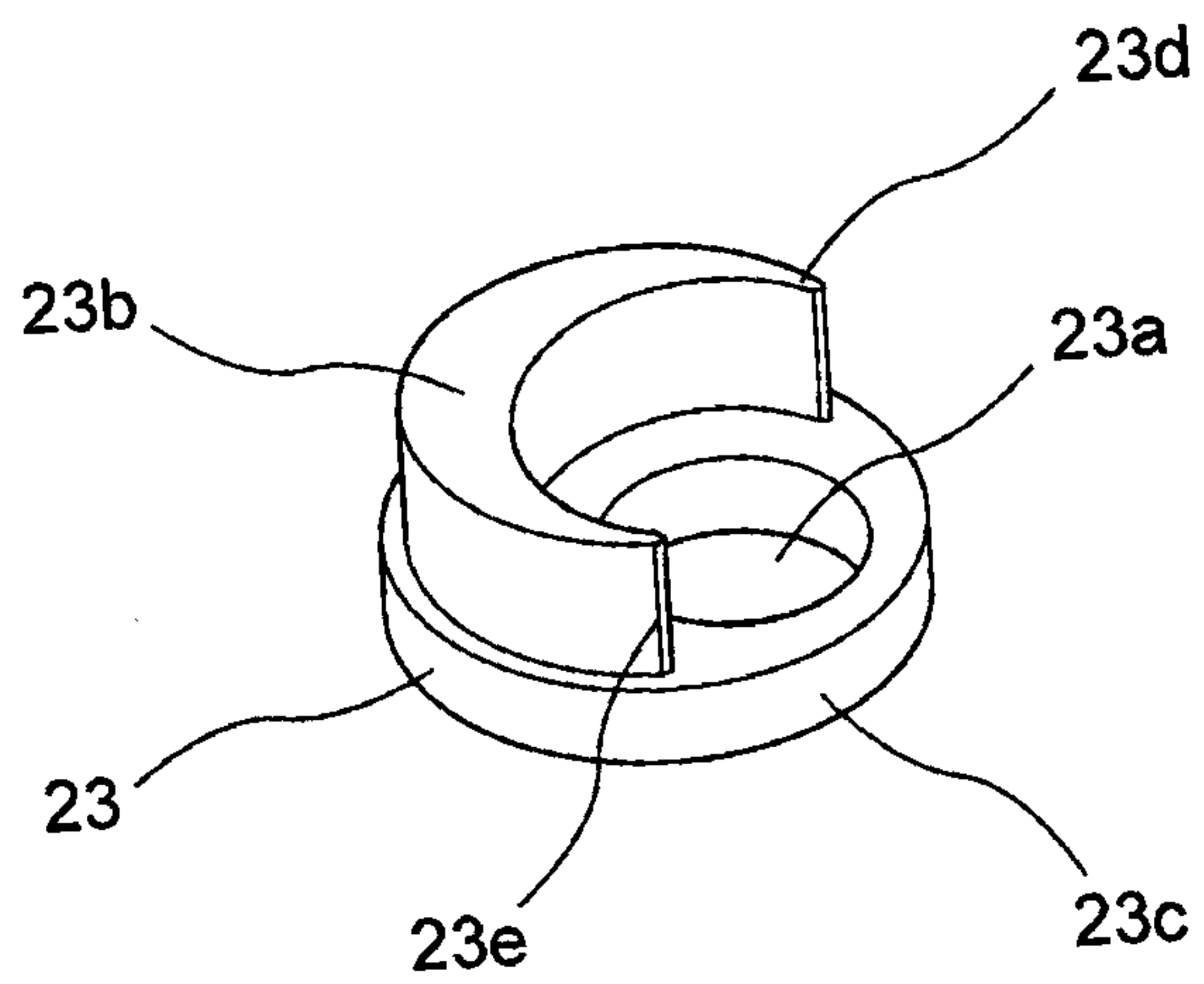


Figure 9C

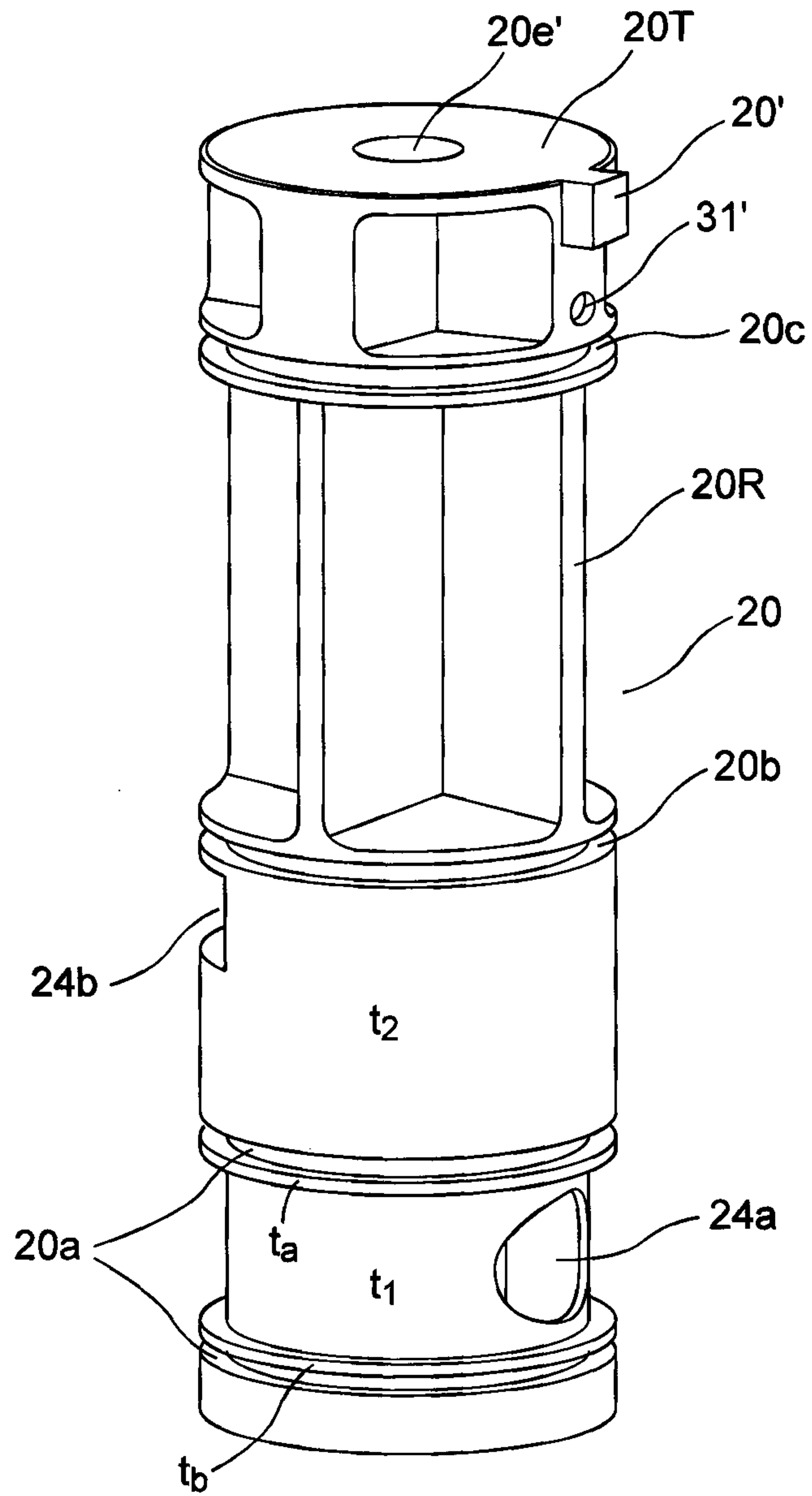


Figure 10

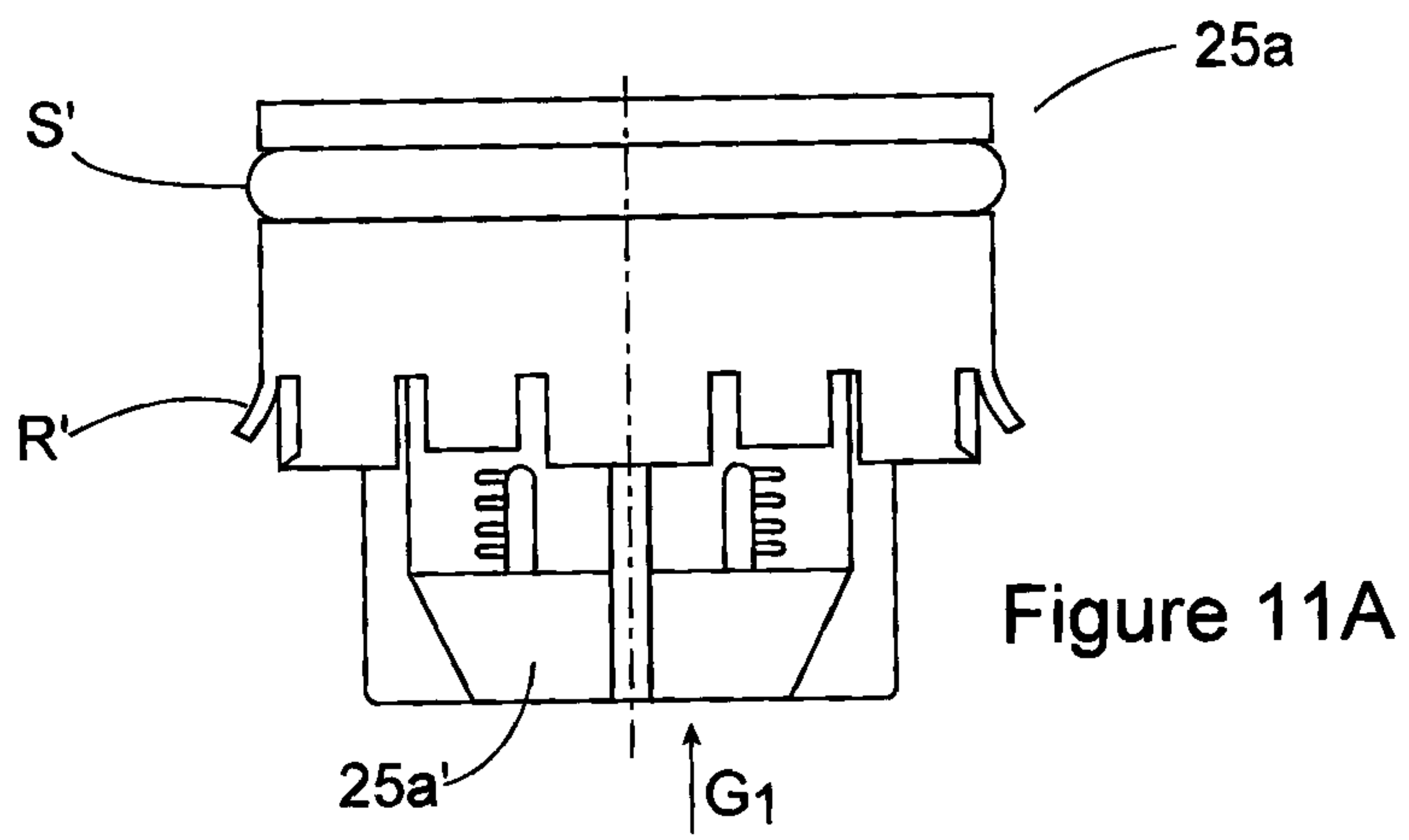


Figure 11A

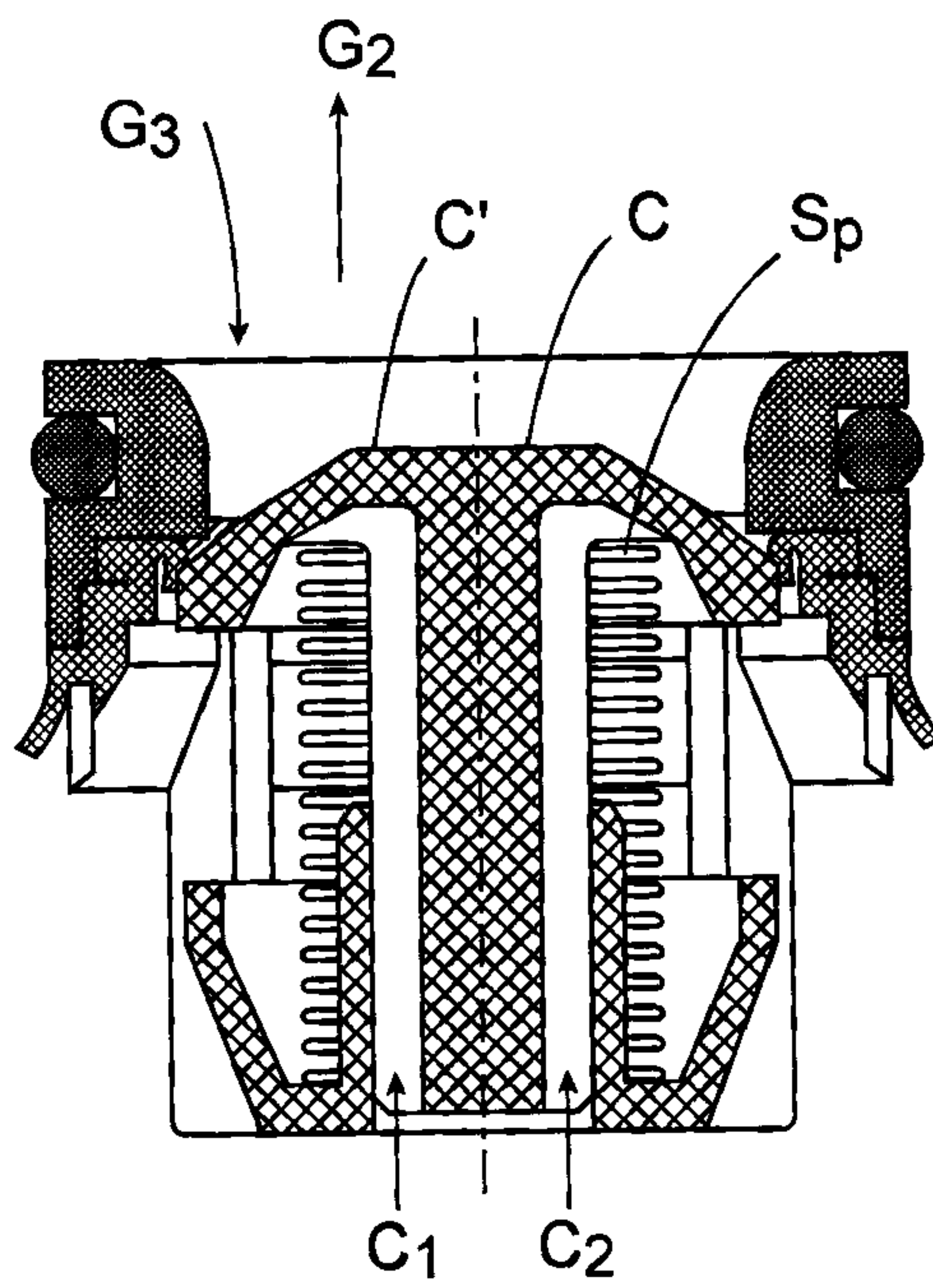


Figure 11B

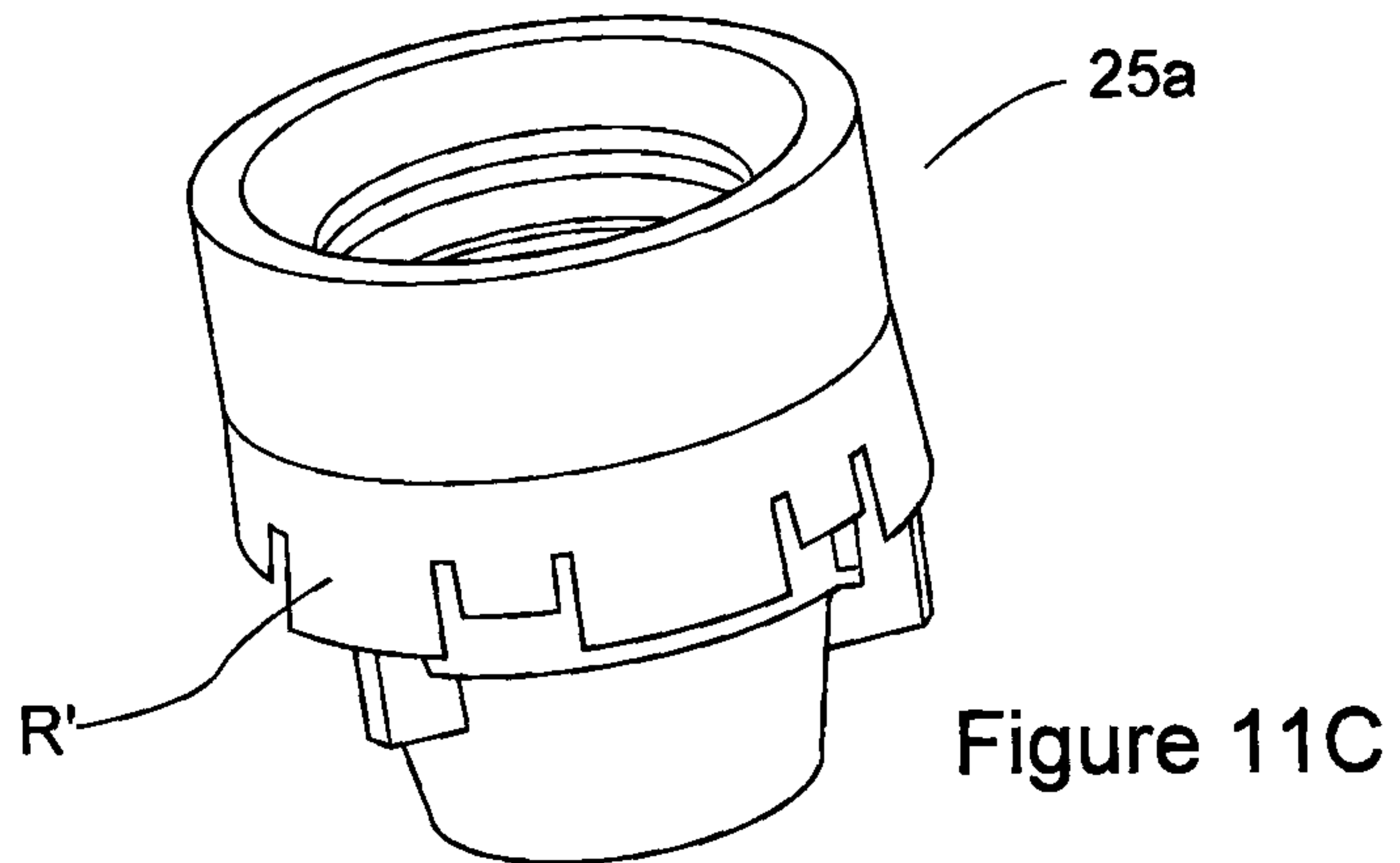


Figure 11C

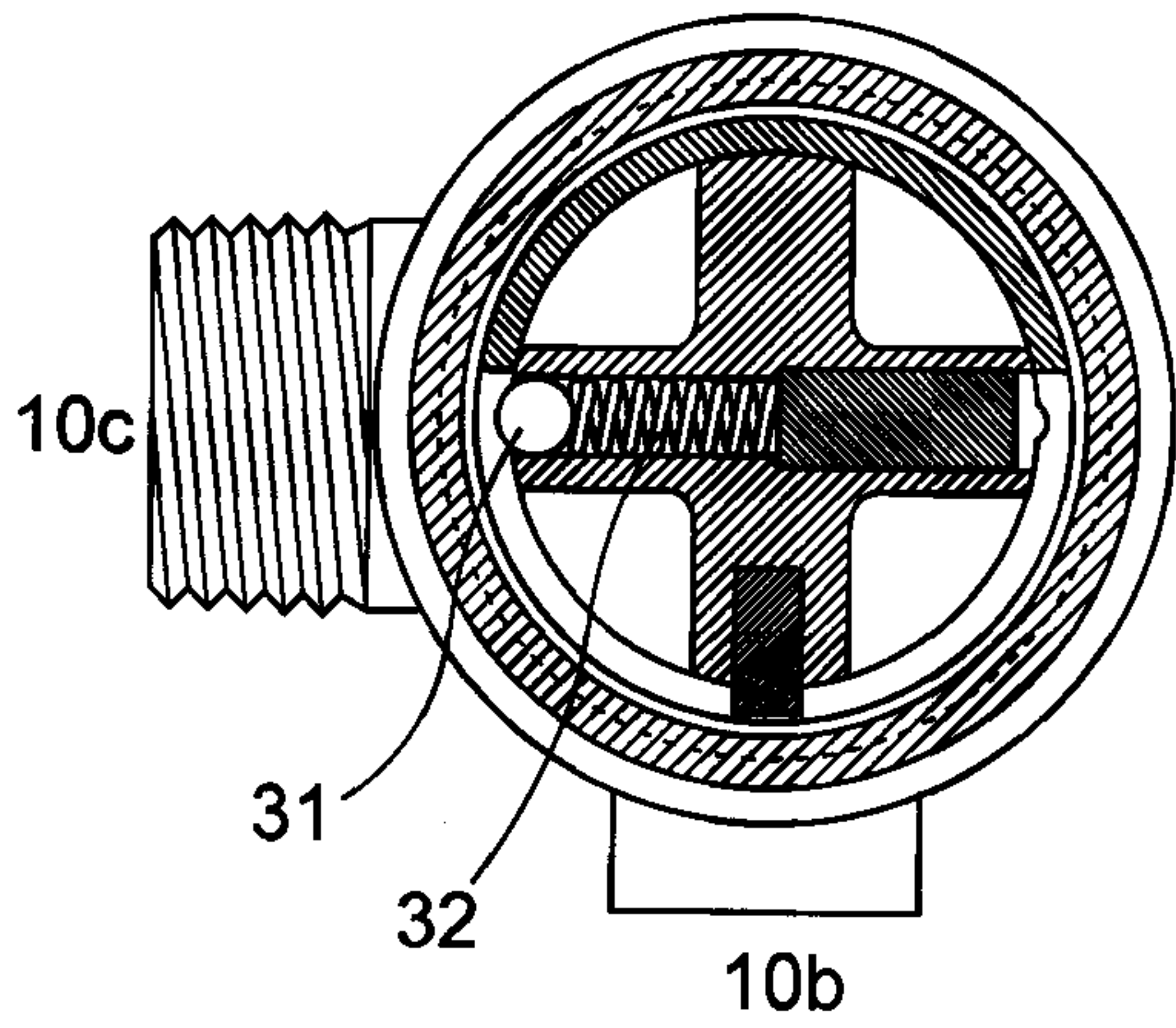


Figure 12A

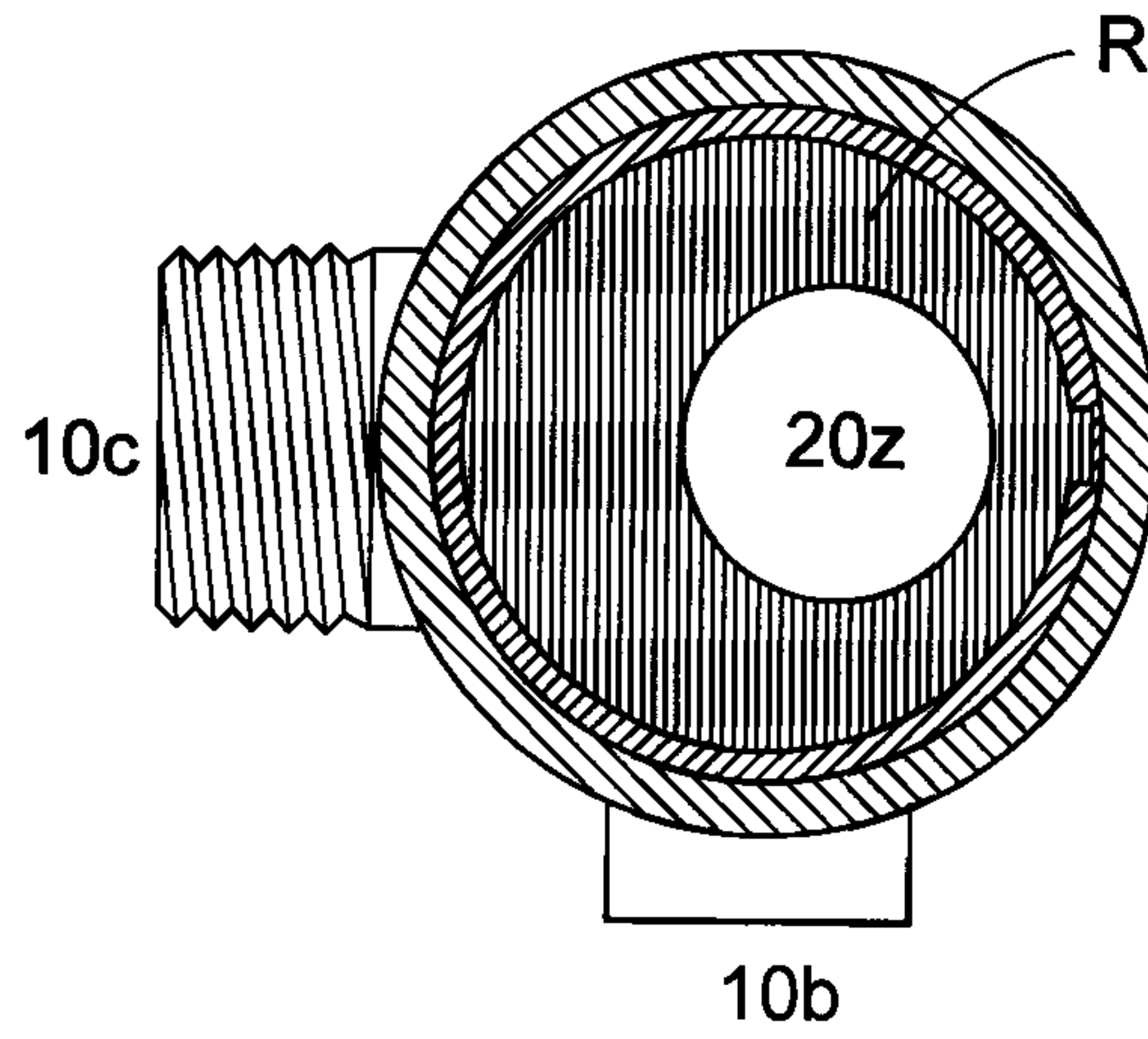


Figure 12B

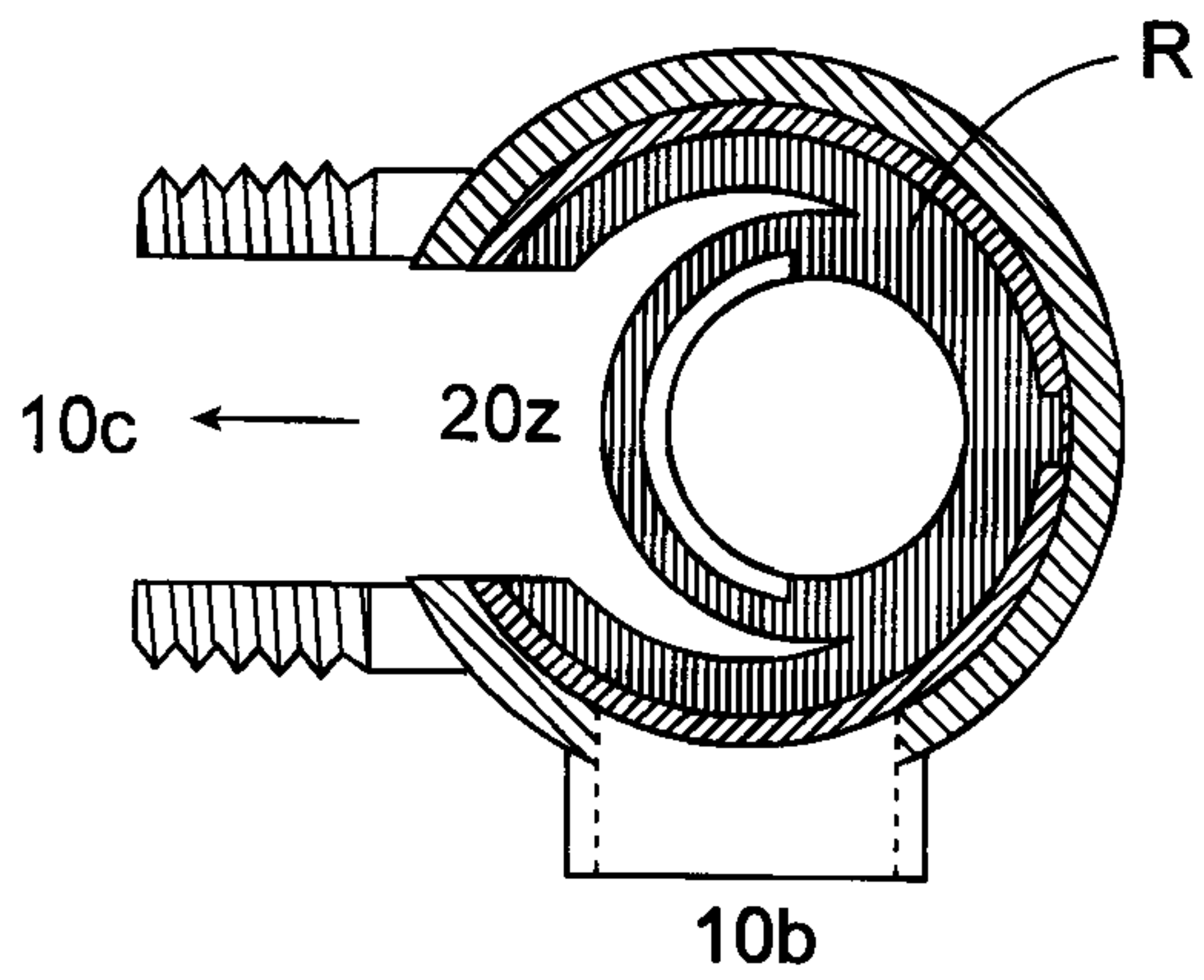


Figure 12C

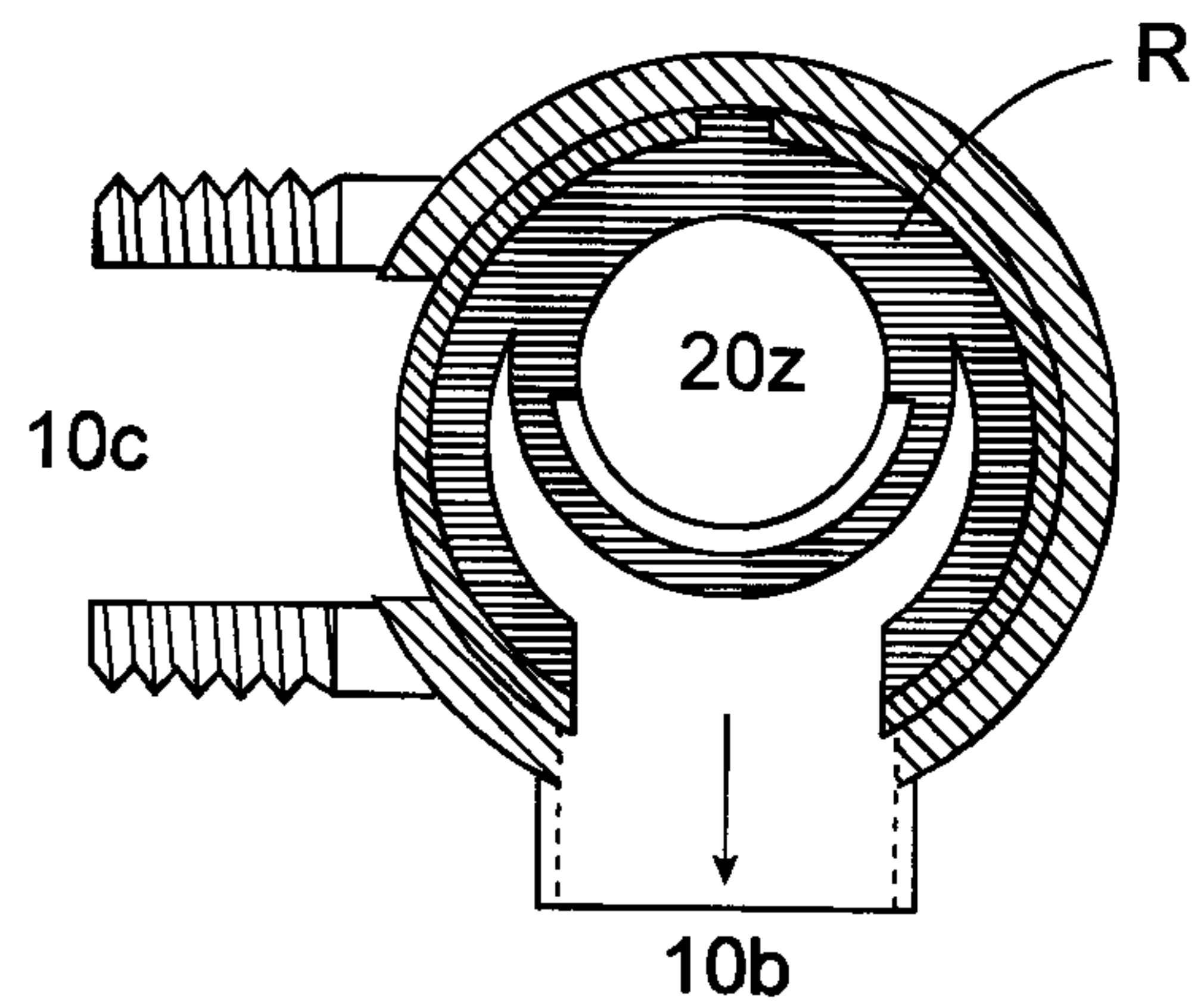


Figure 12D

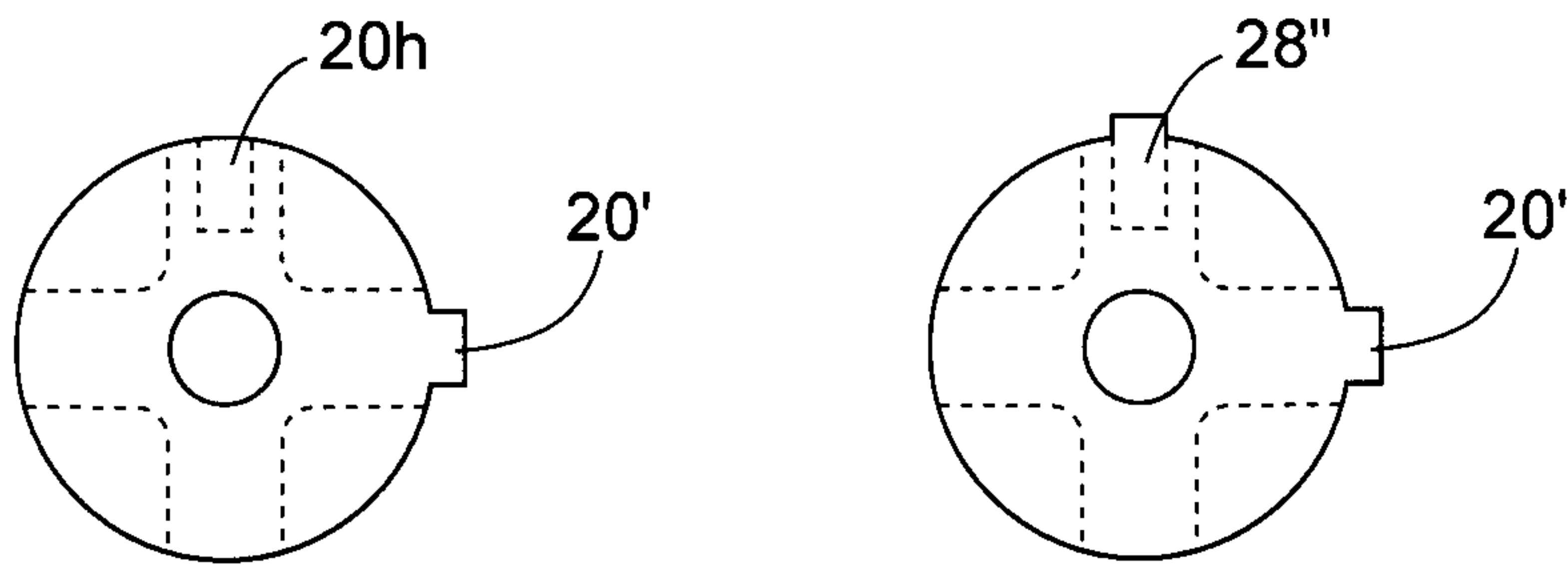


Figure 12

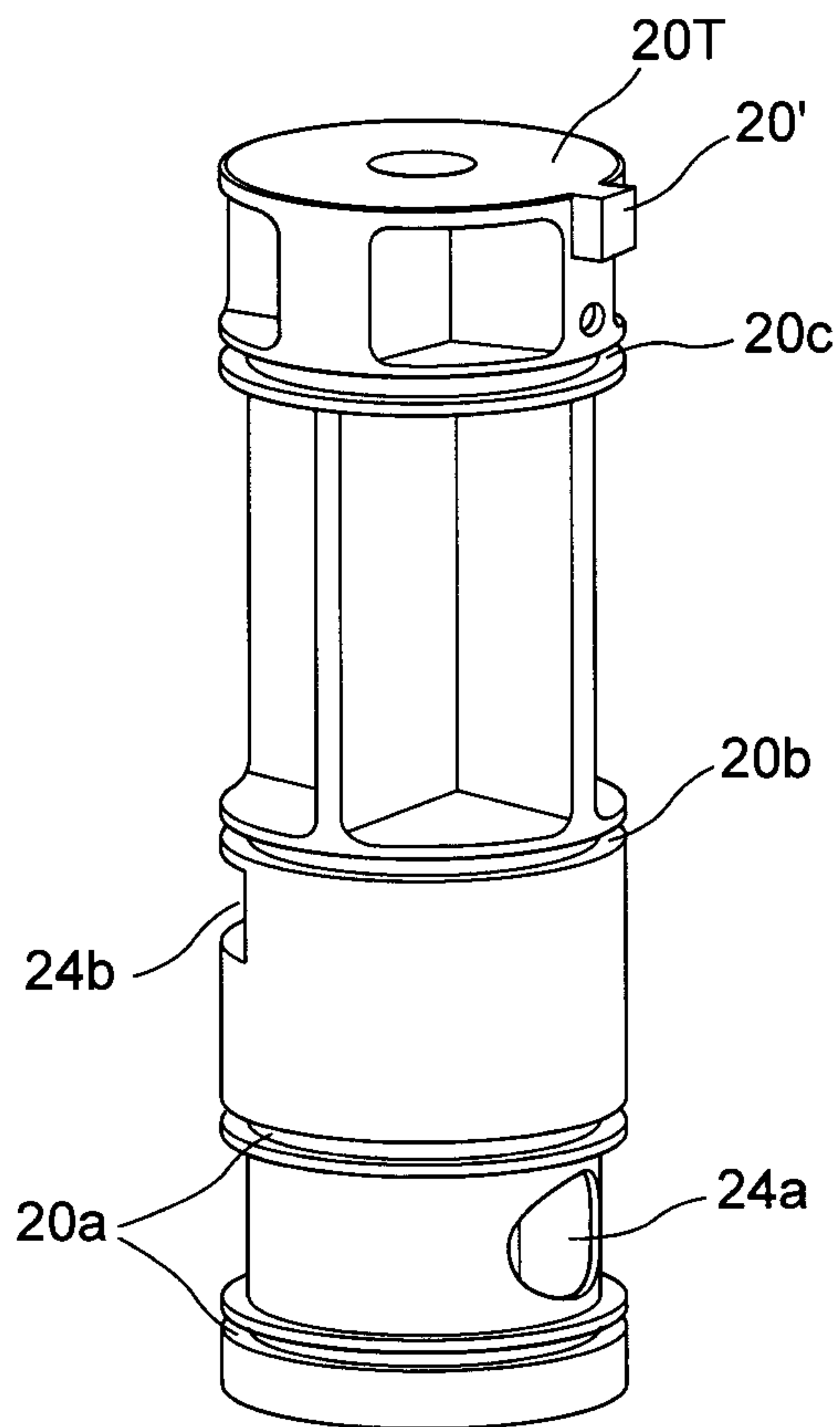


Figure 13

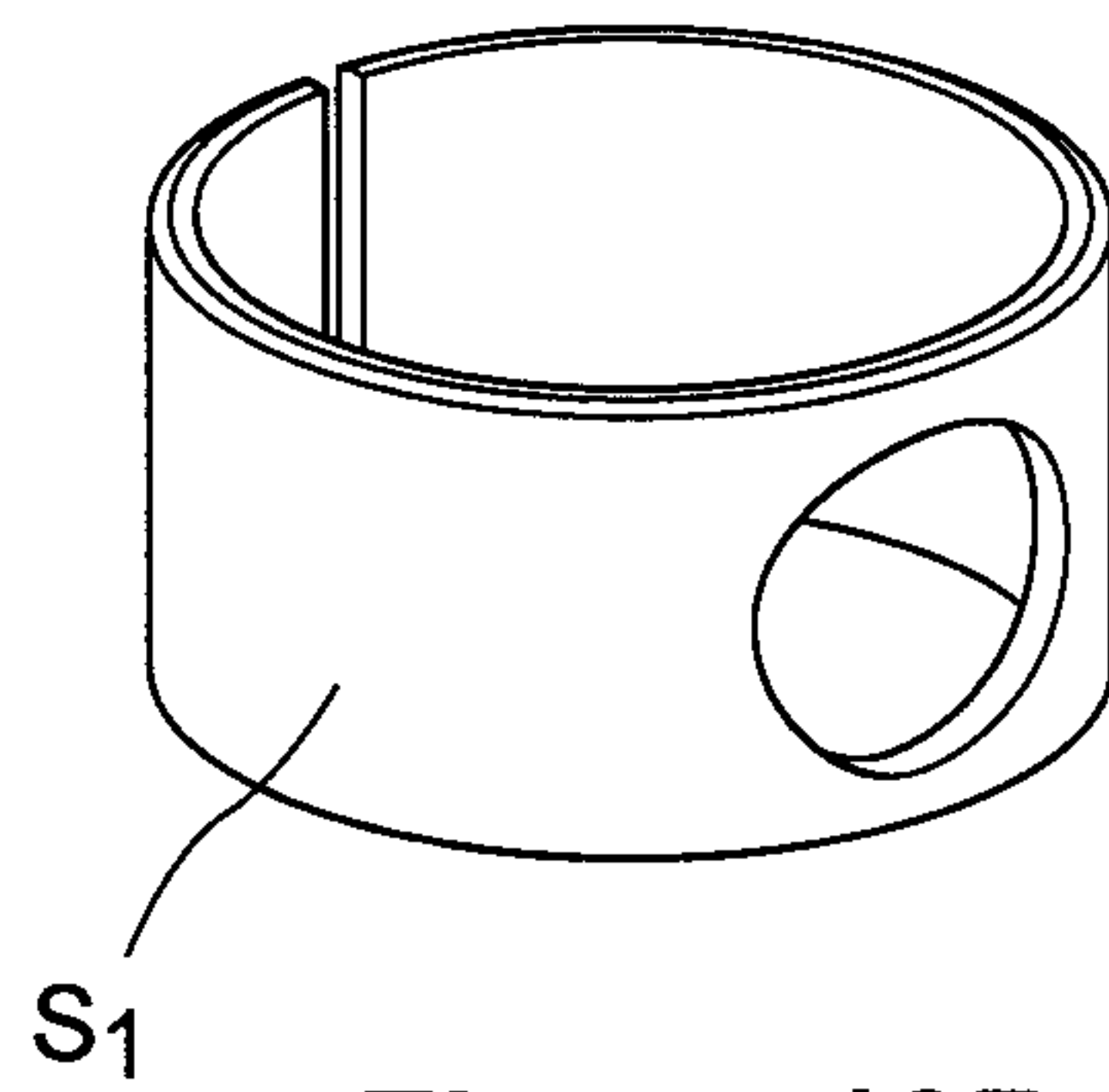


Figure 13B

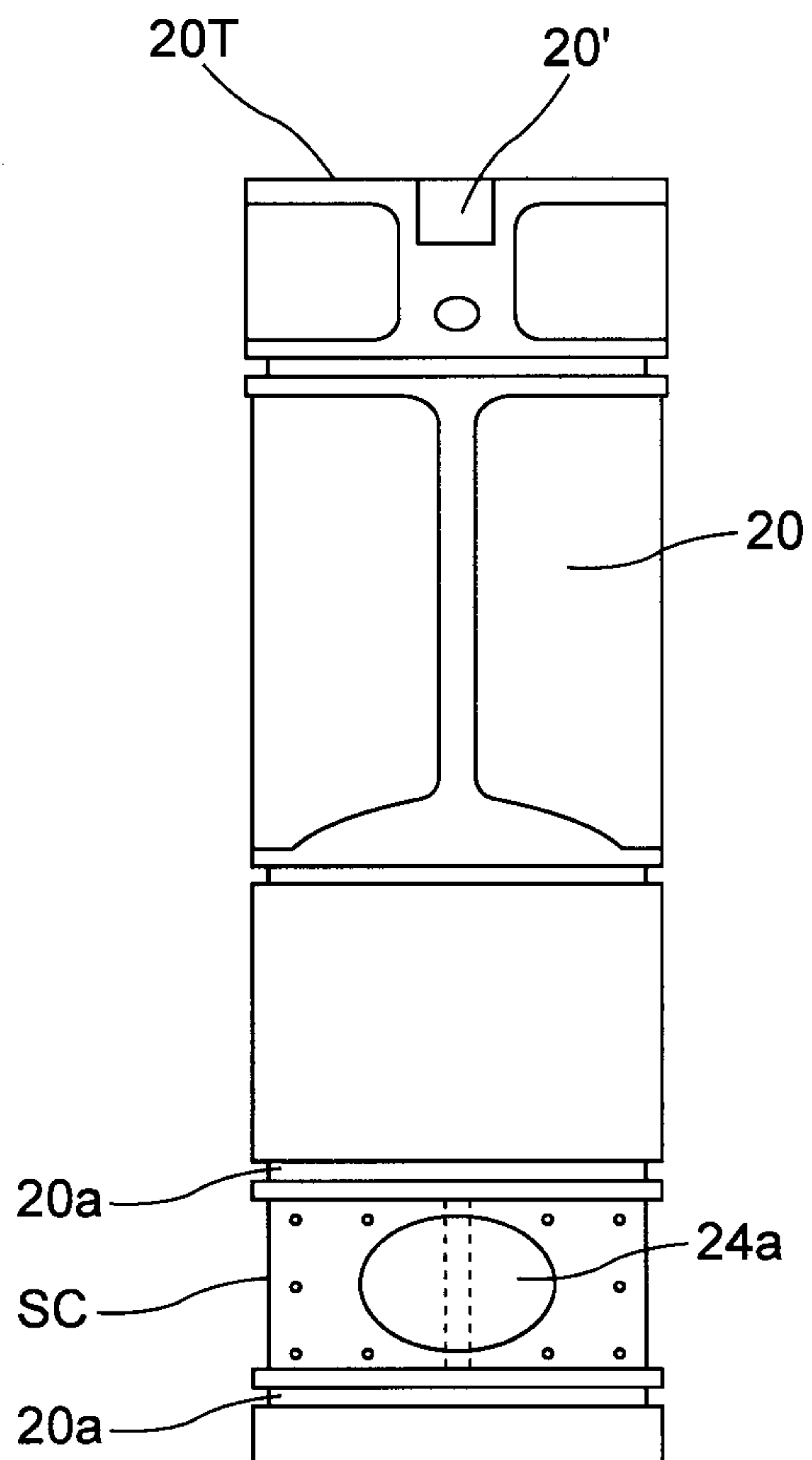


Figure 13A

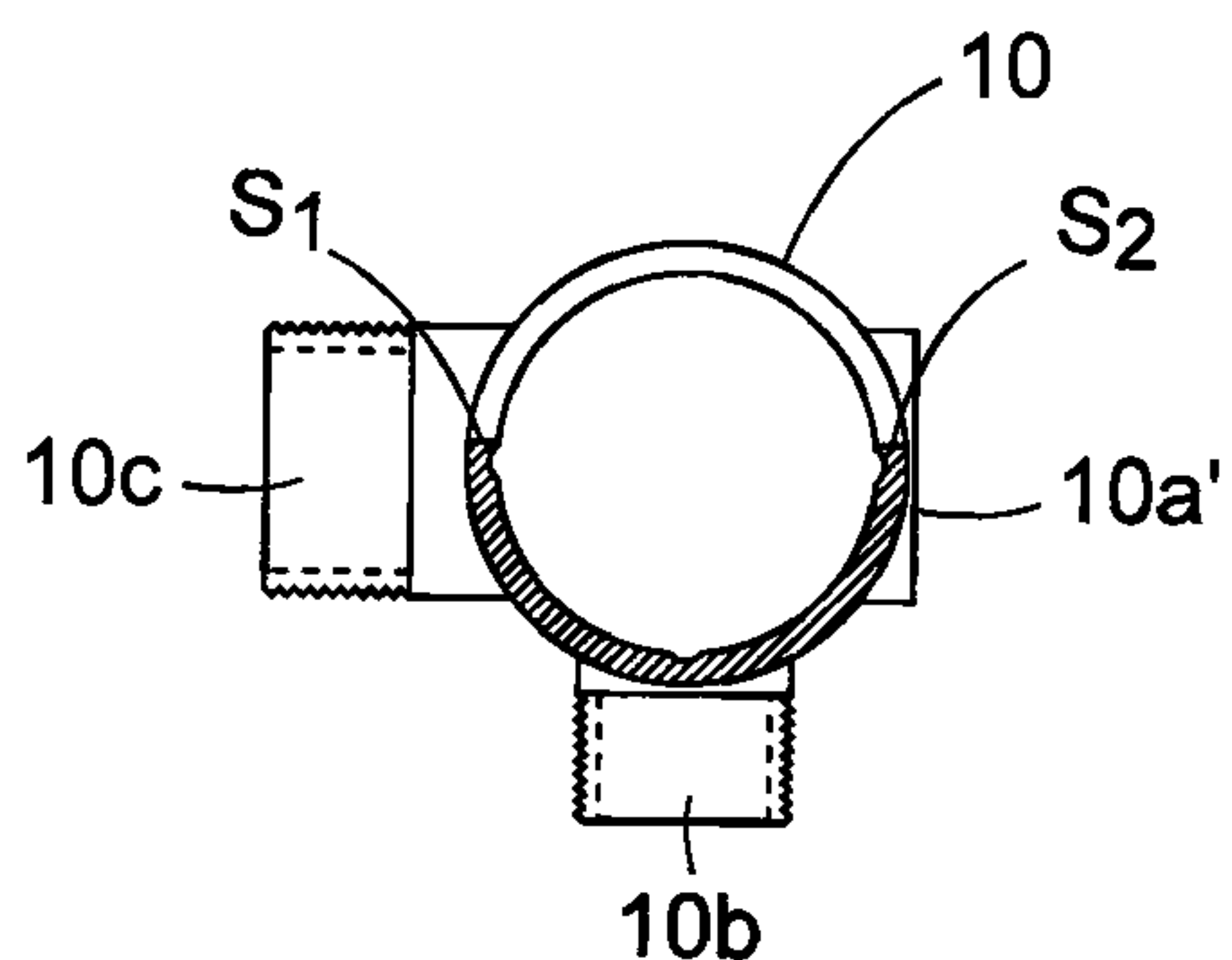


Figure 14A

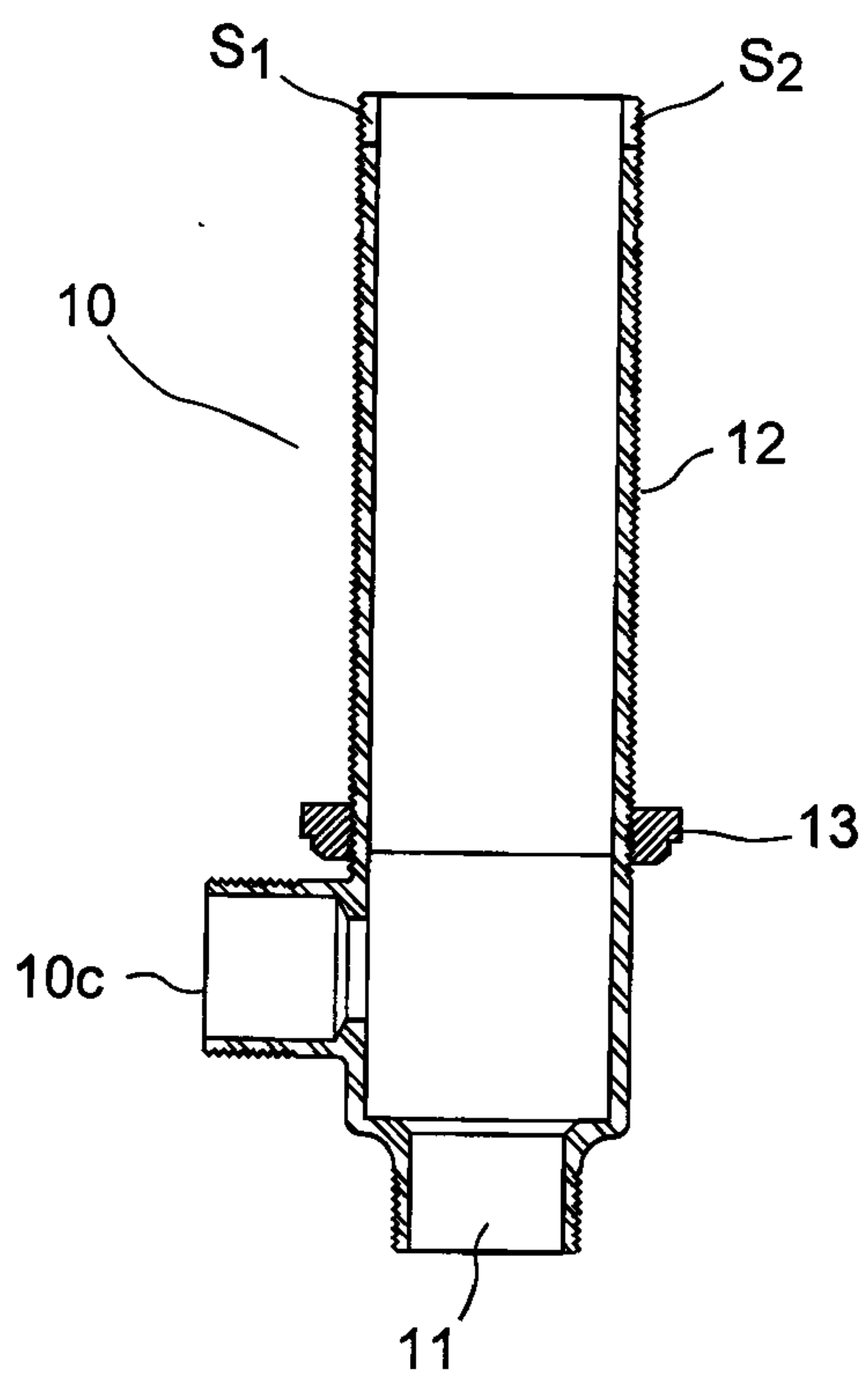


Figure 14B

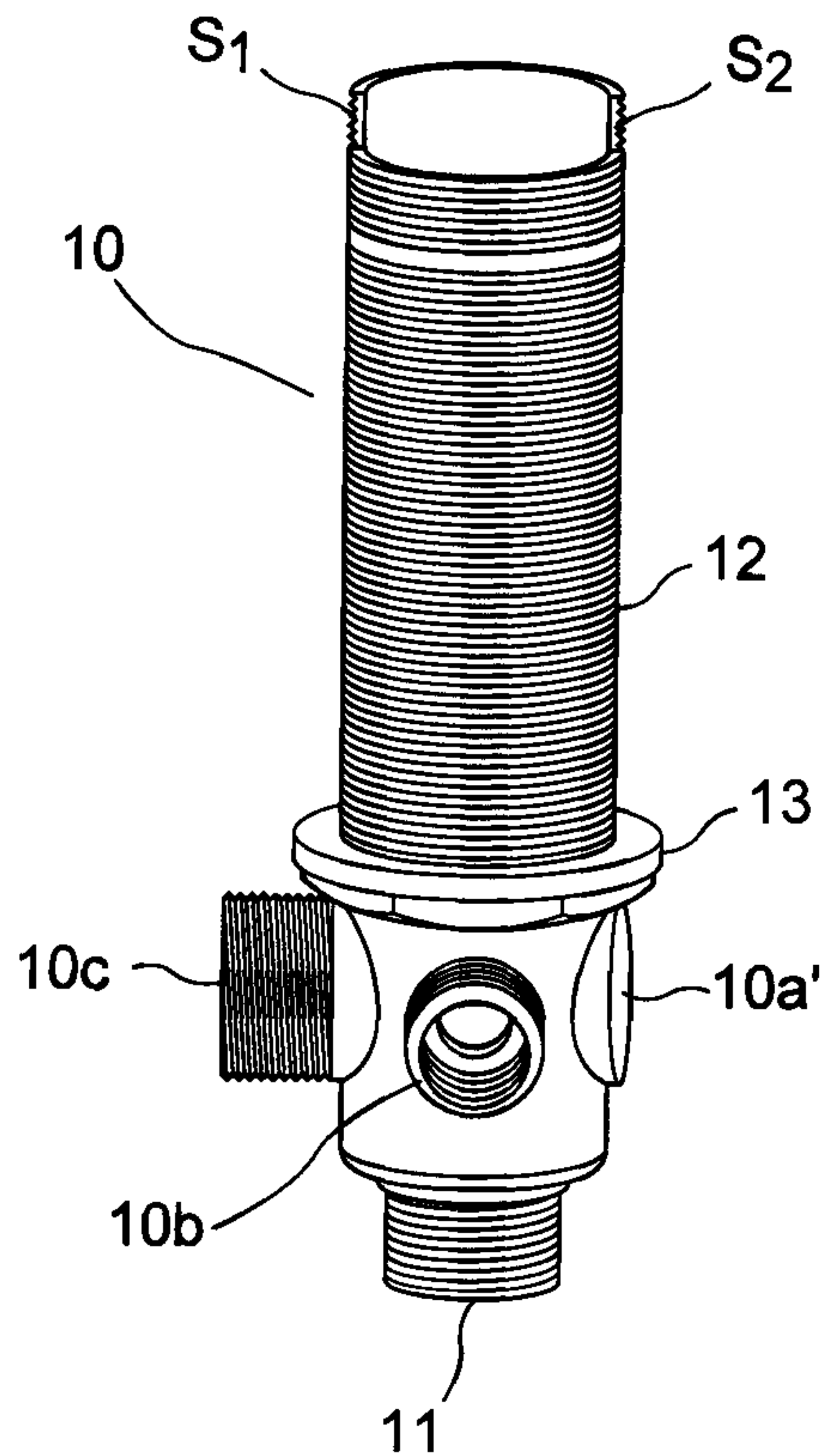


Figure 14C

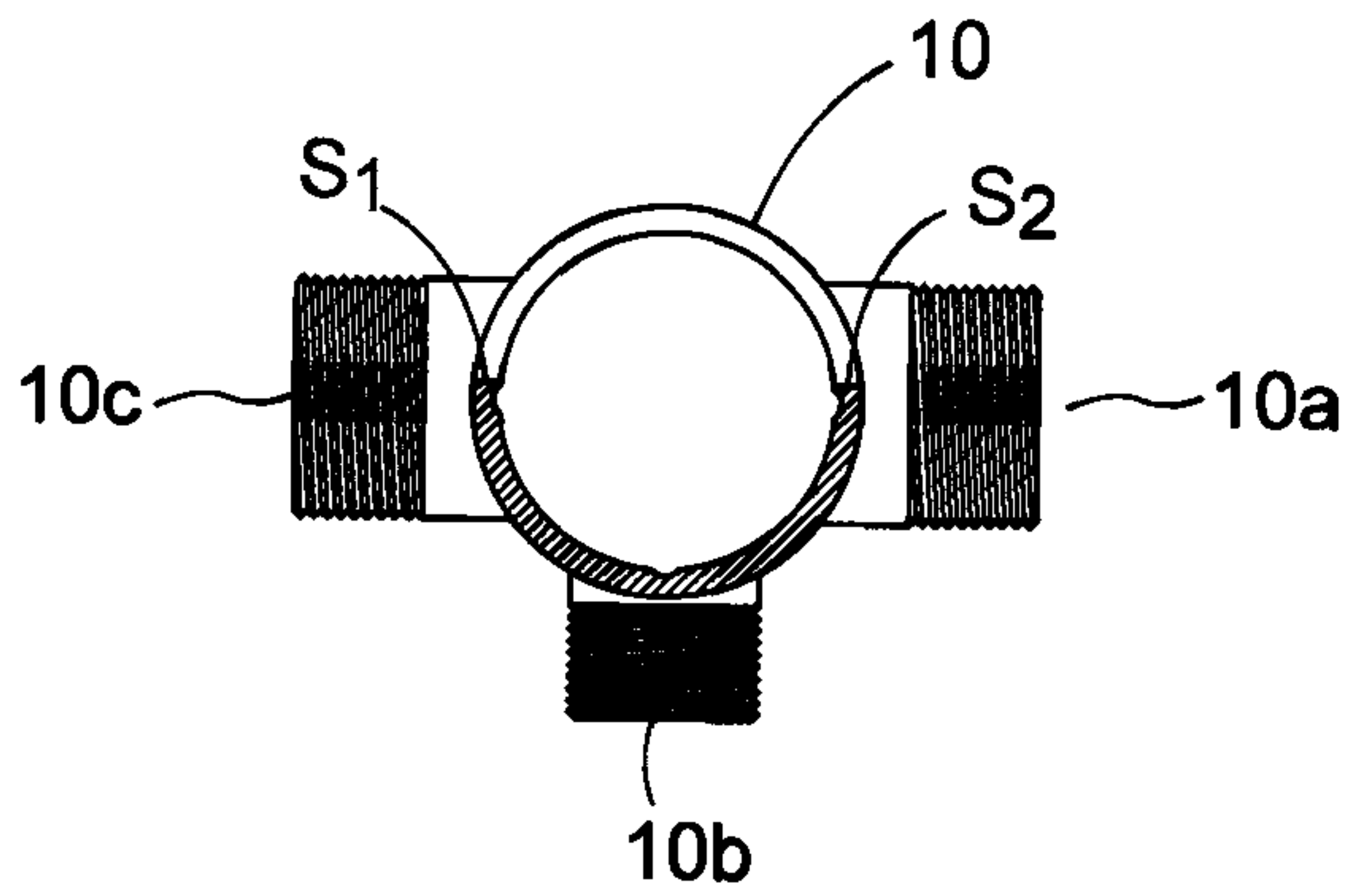


Figure 15A

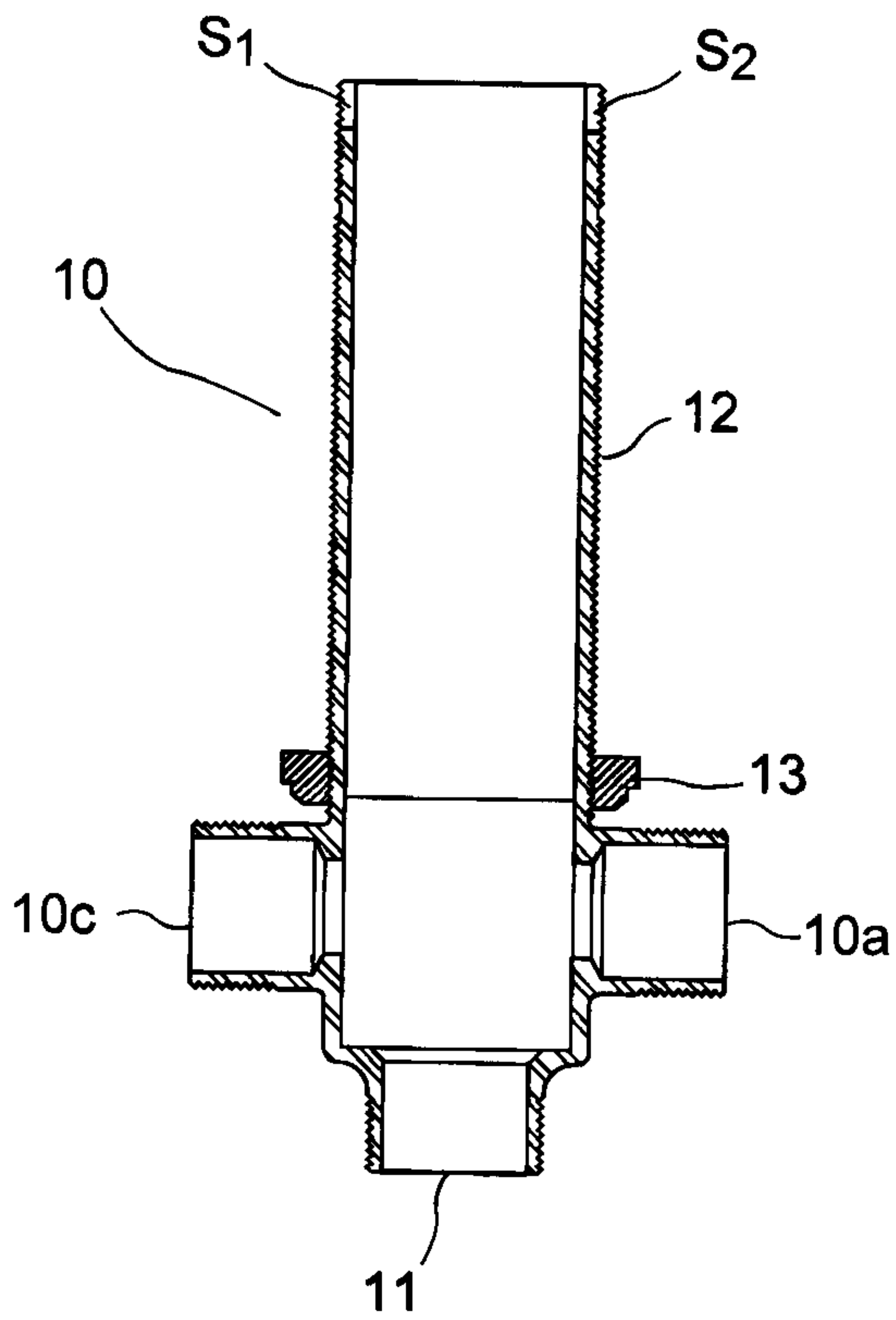


Figure 15B

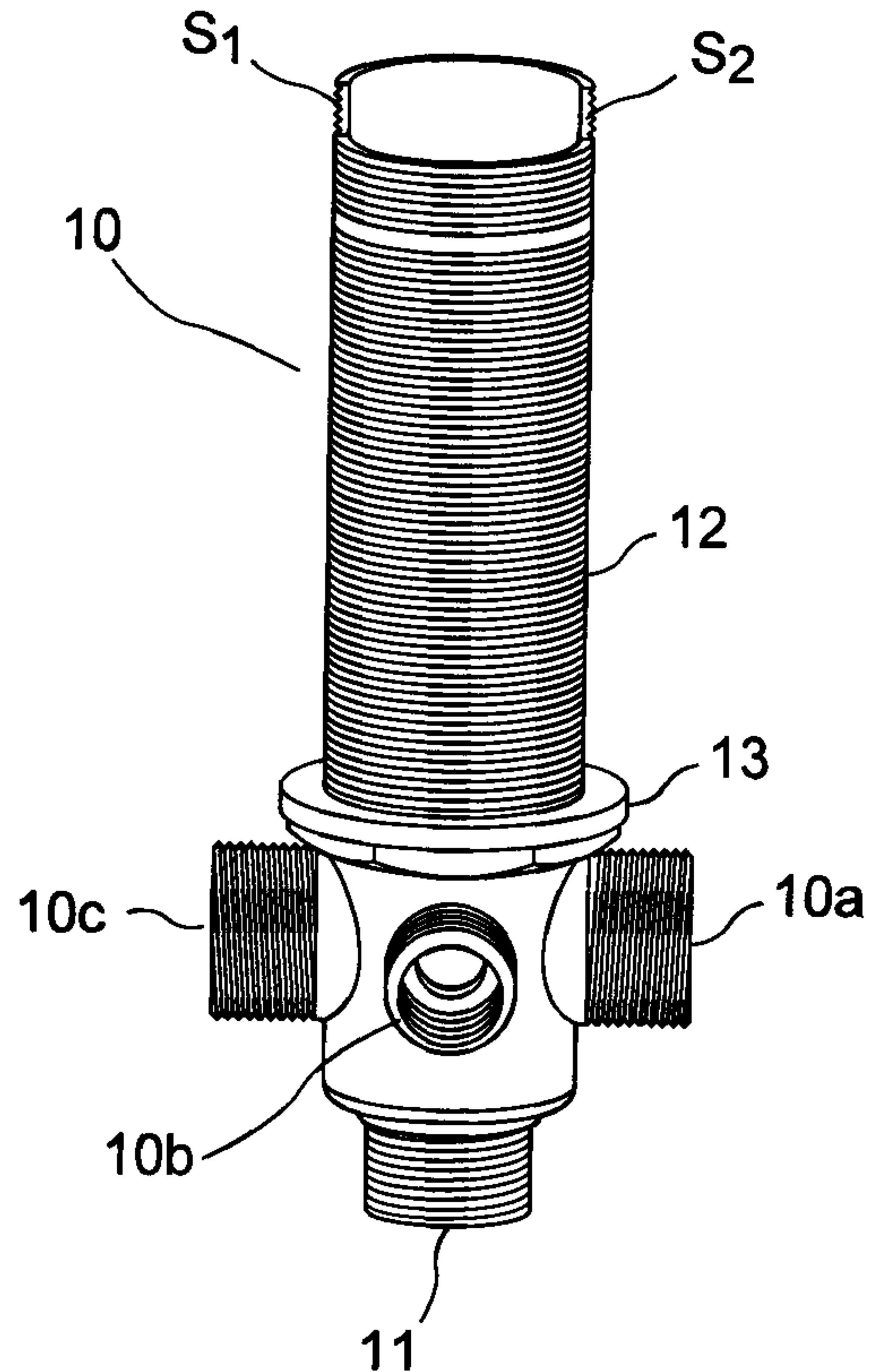


Figure 15C

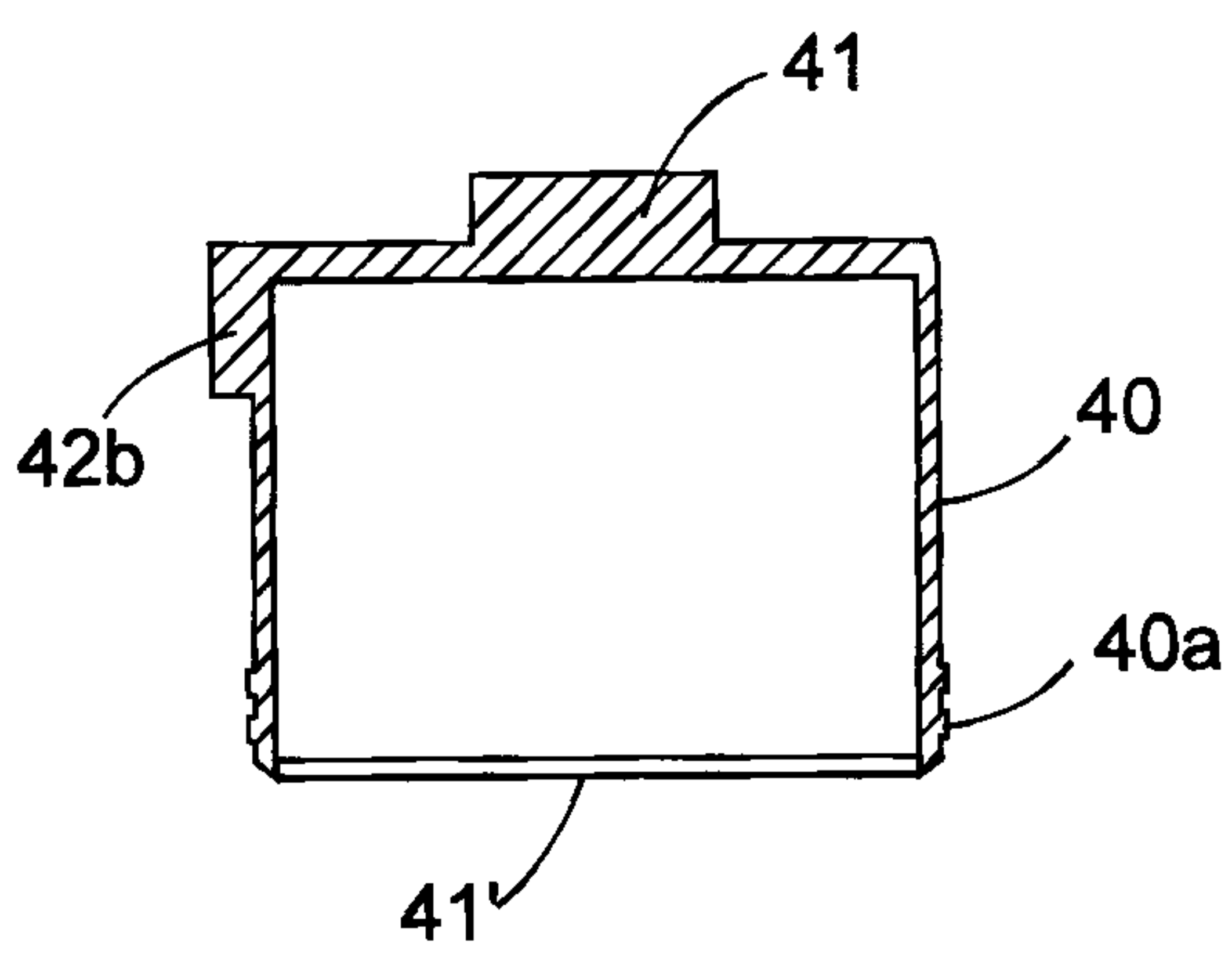


Figure 16A

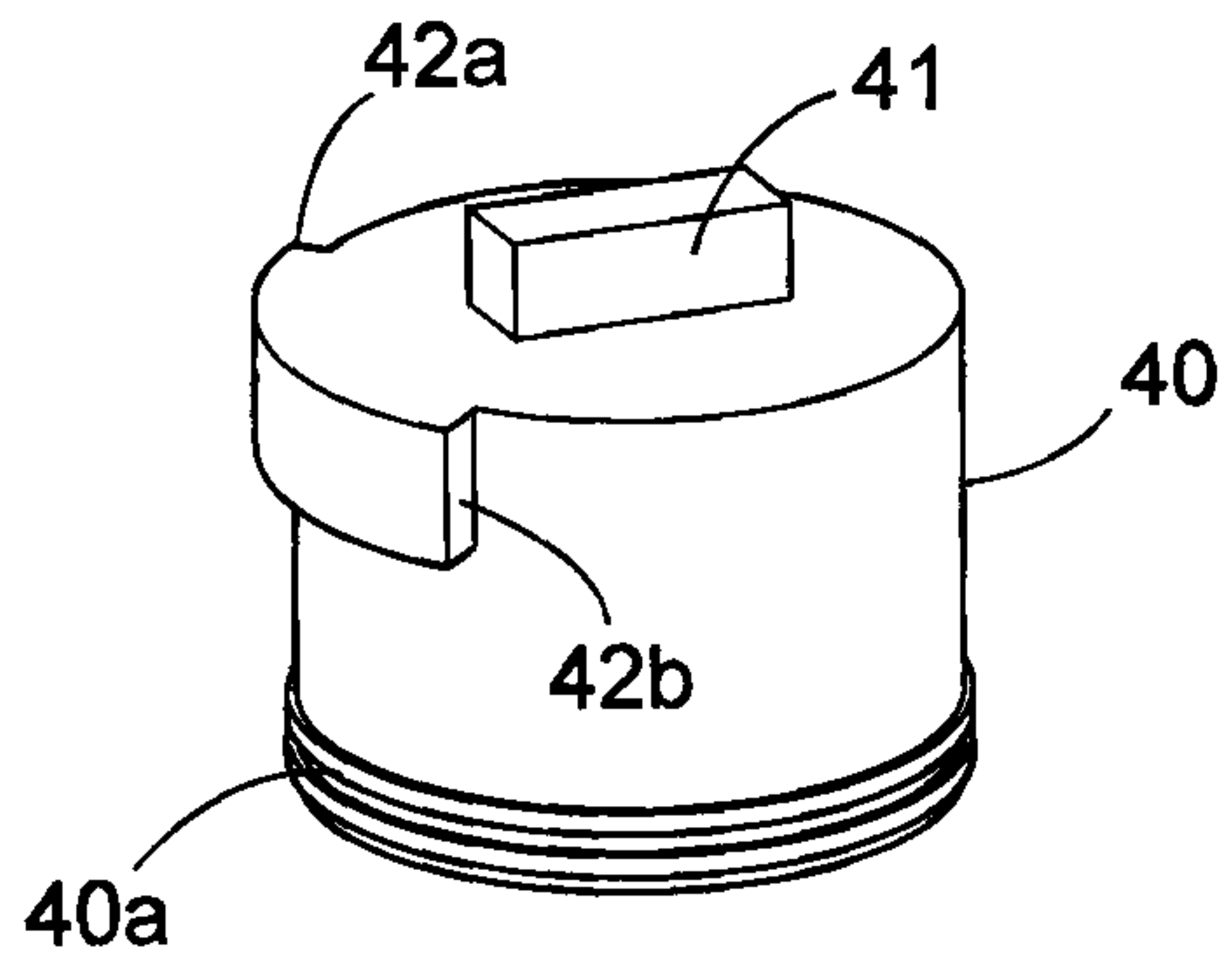


Figure 16B

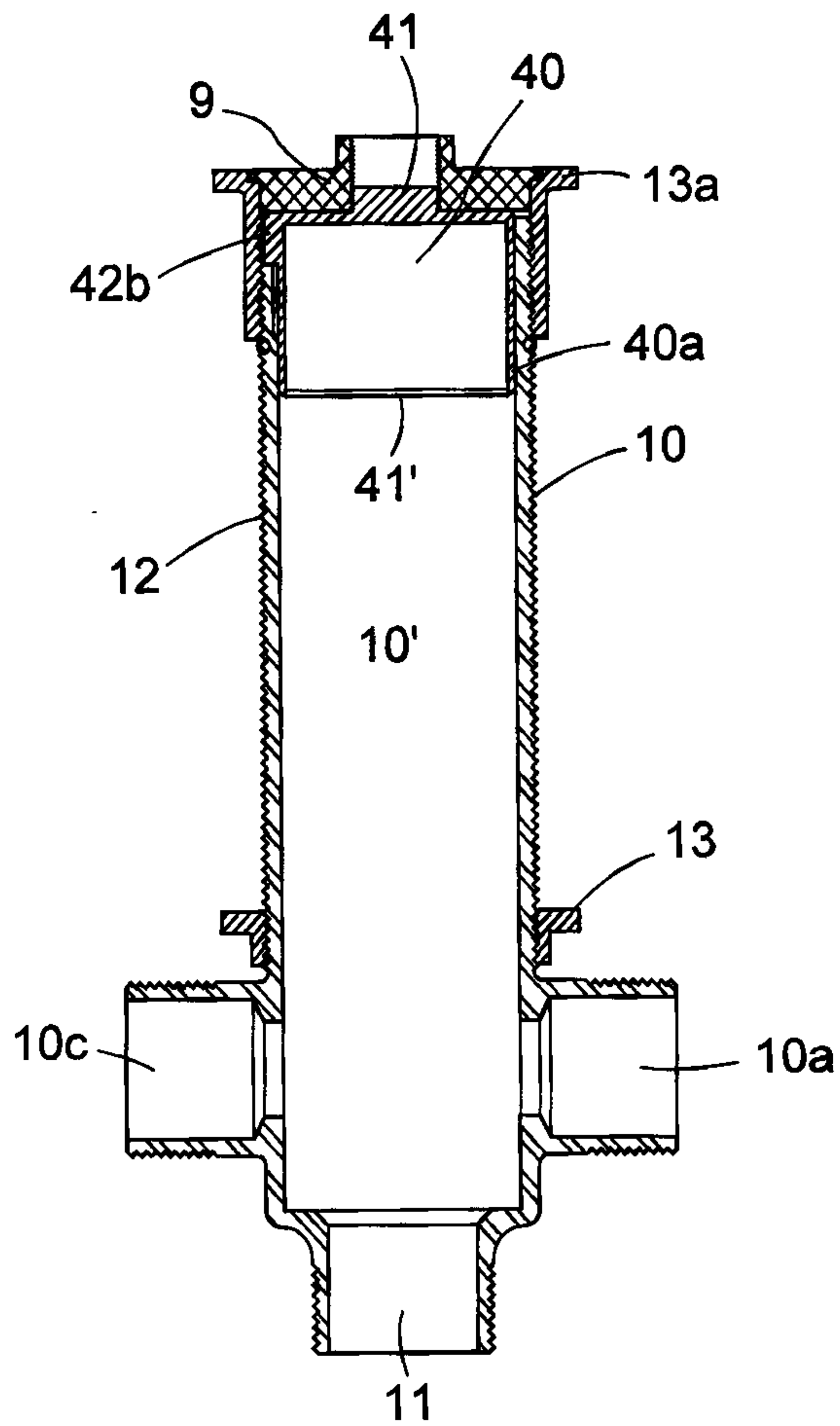


Figure 16C

