



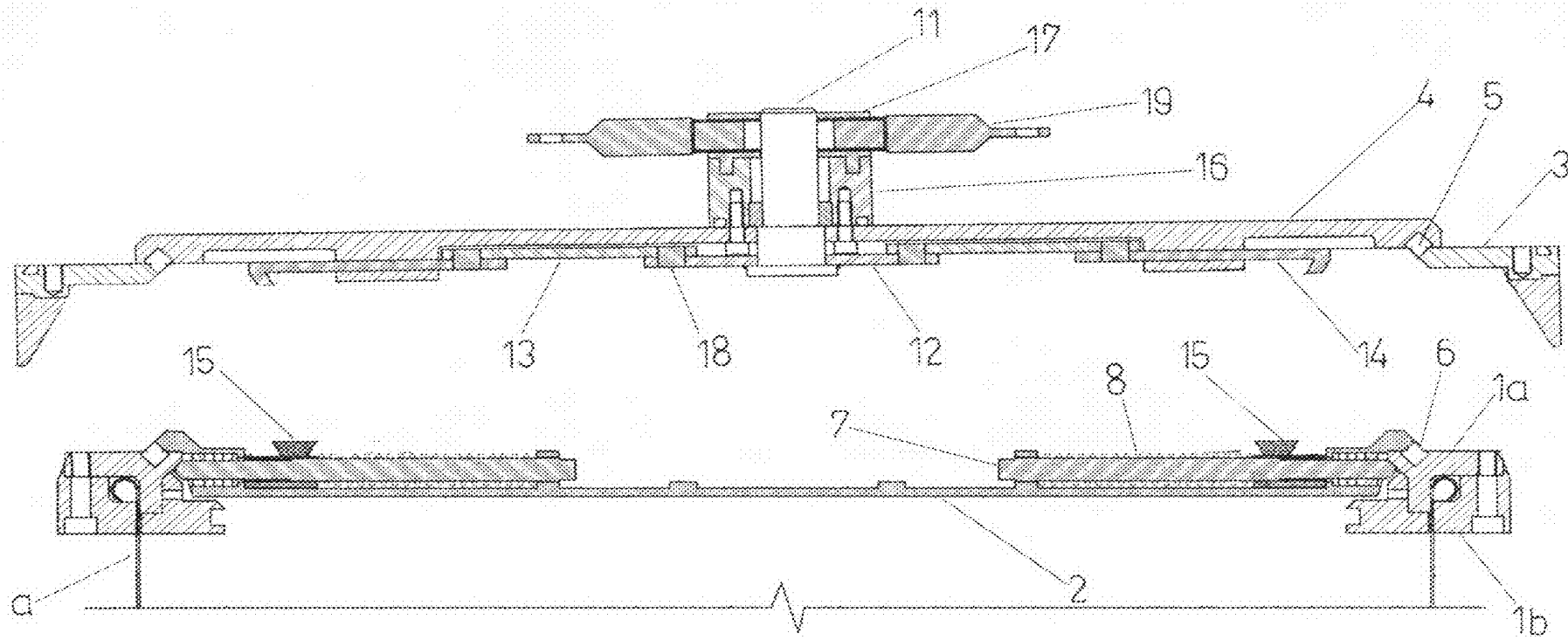
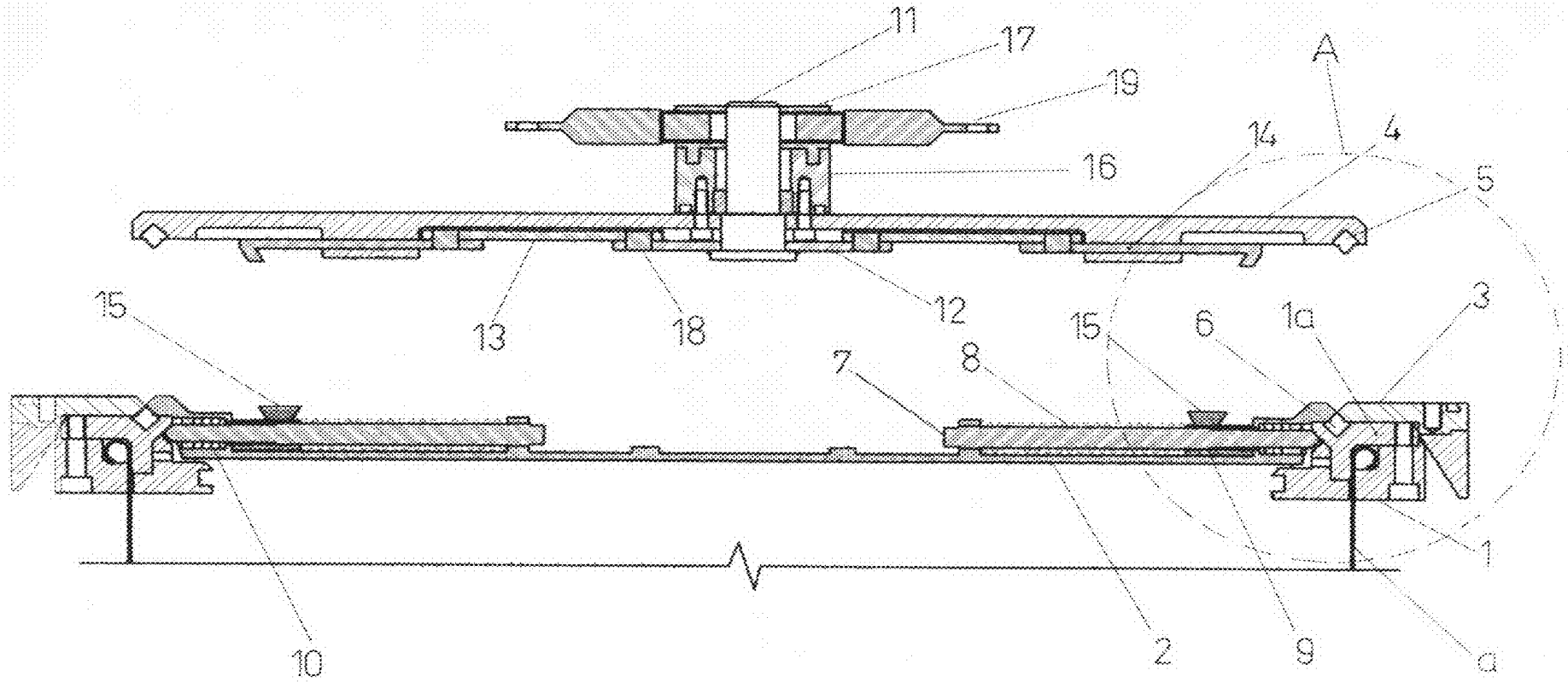


Fig. 1



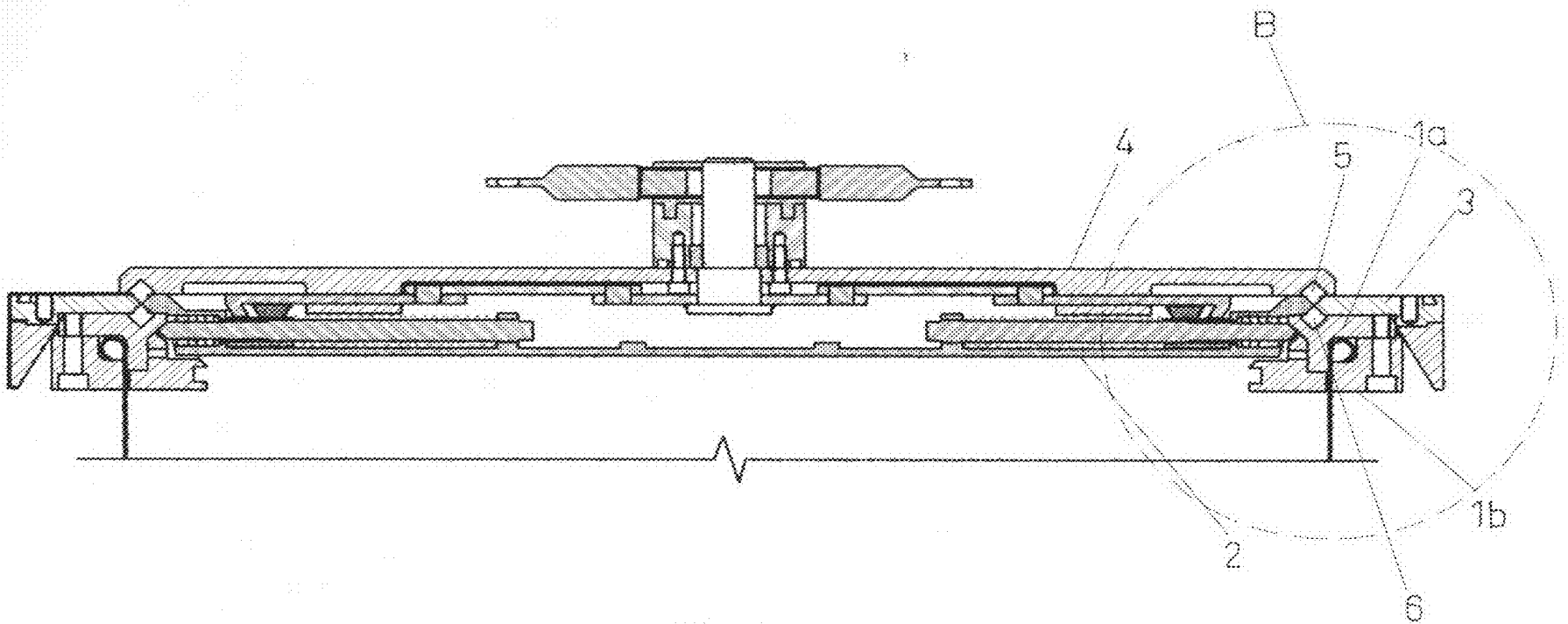


Fig. 3

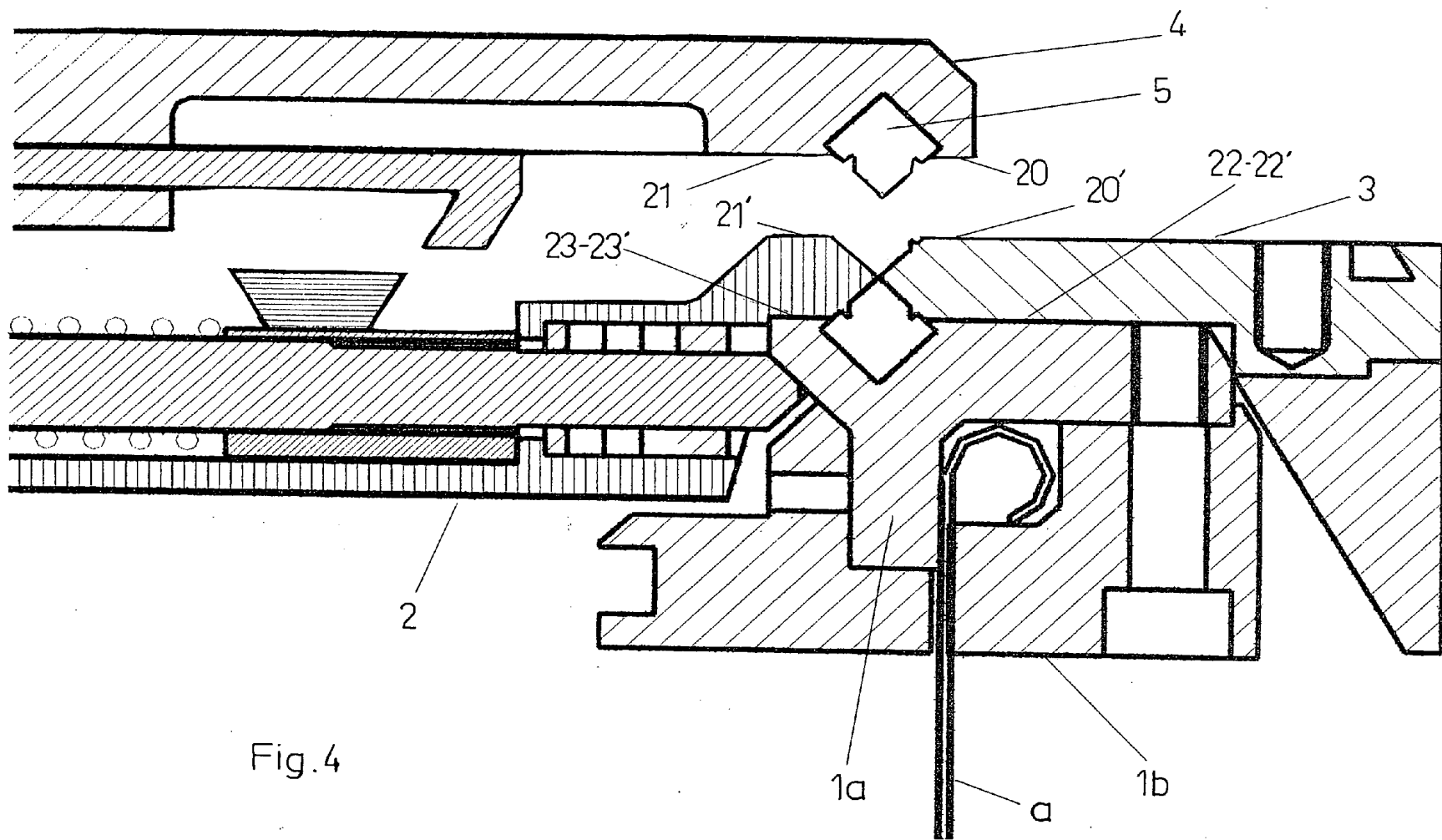


Fig.4

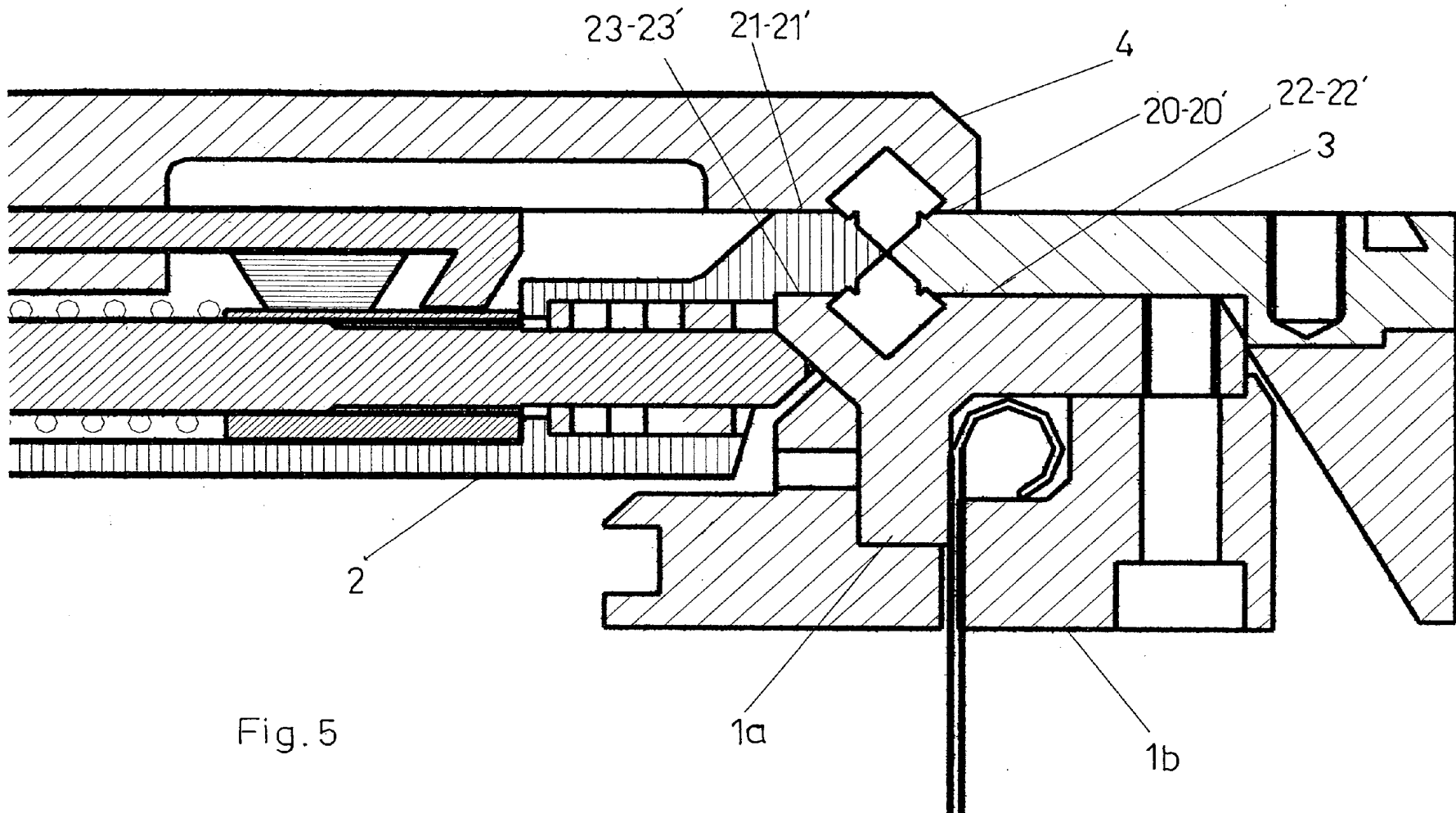
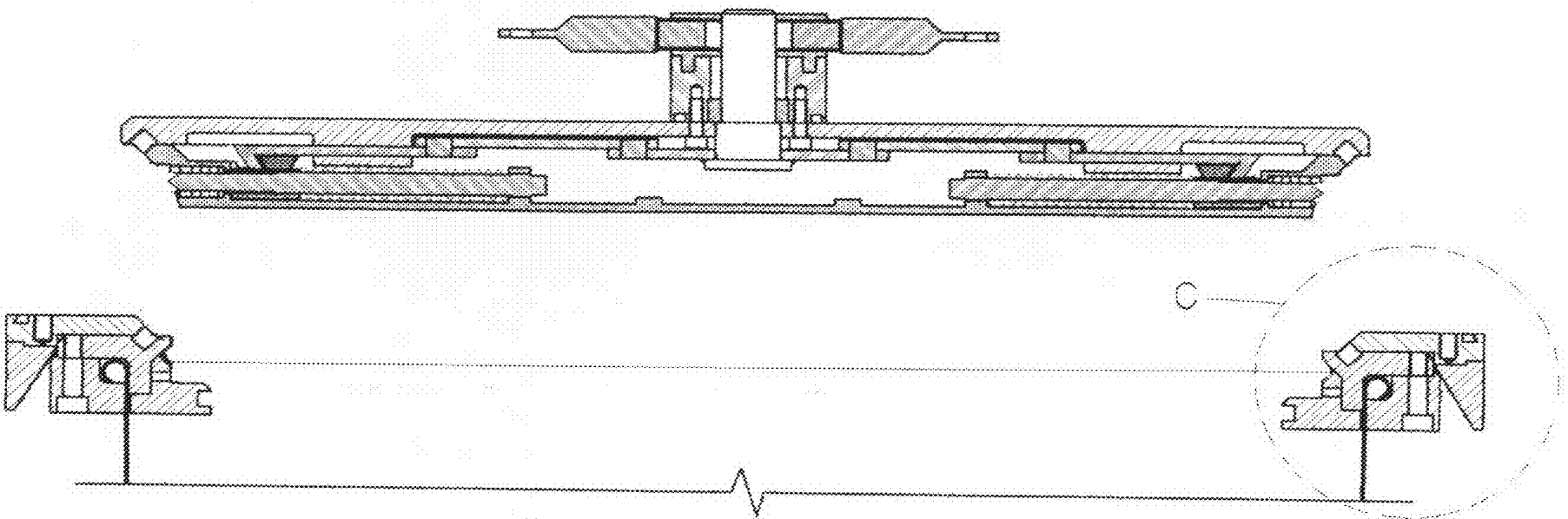


Fig. 5



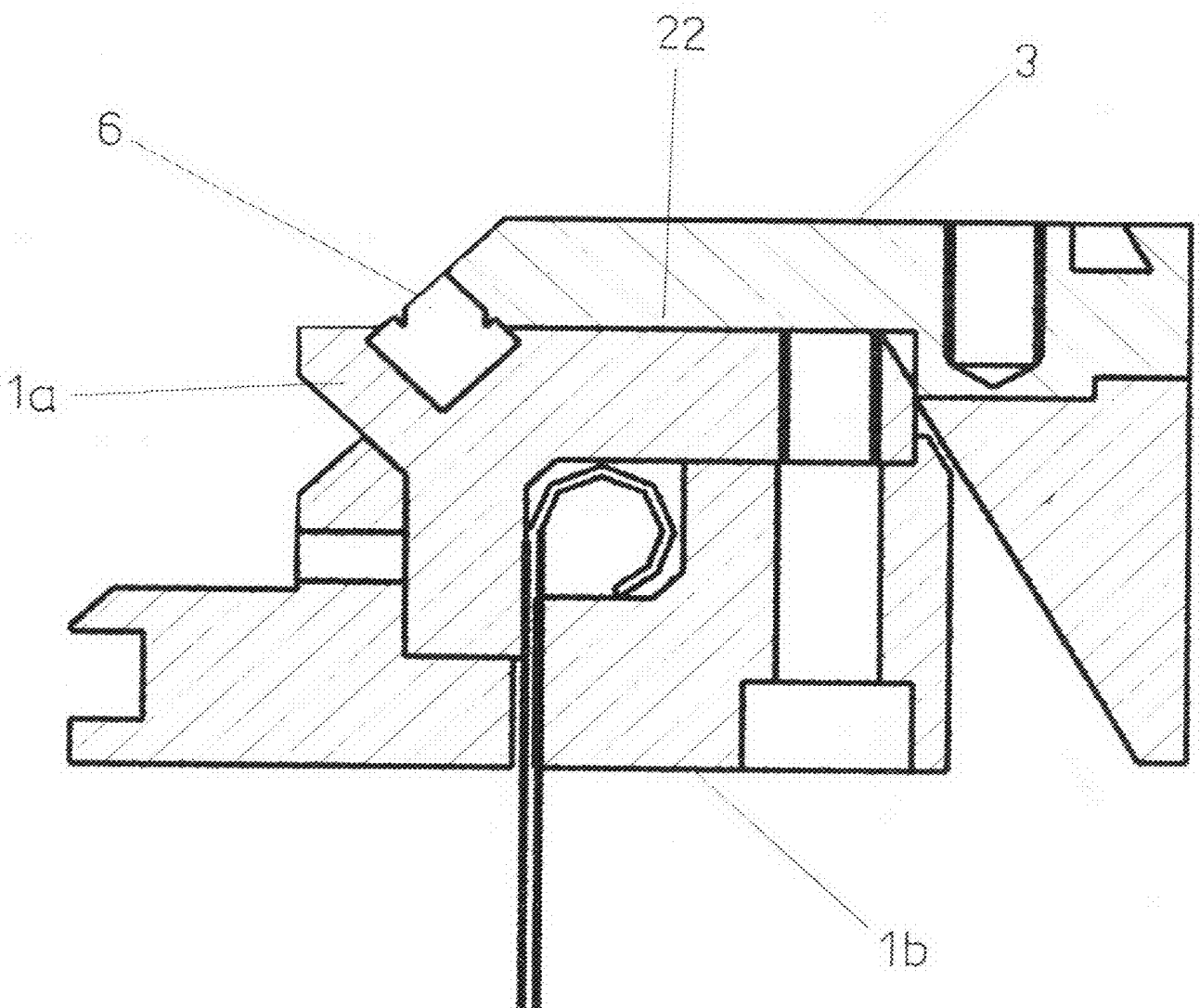
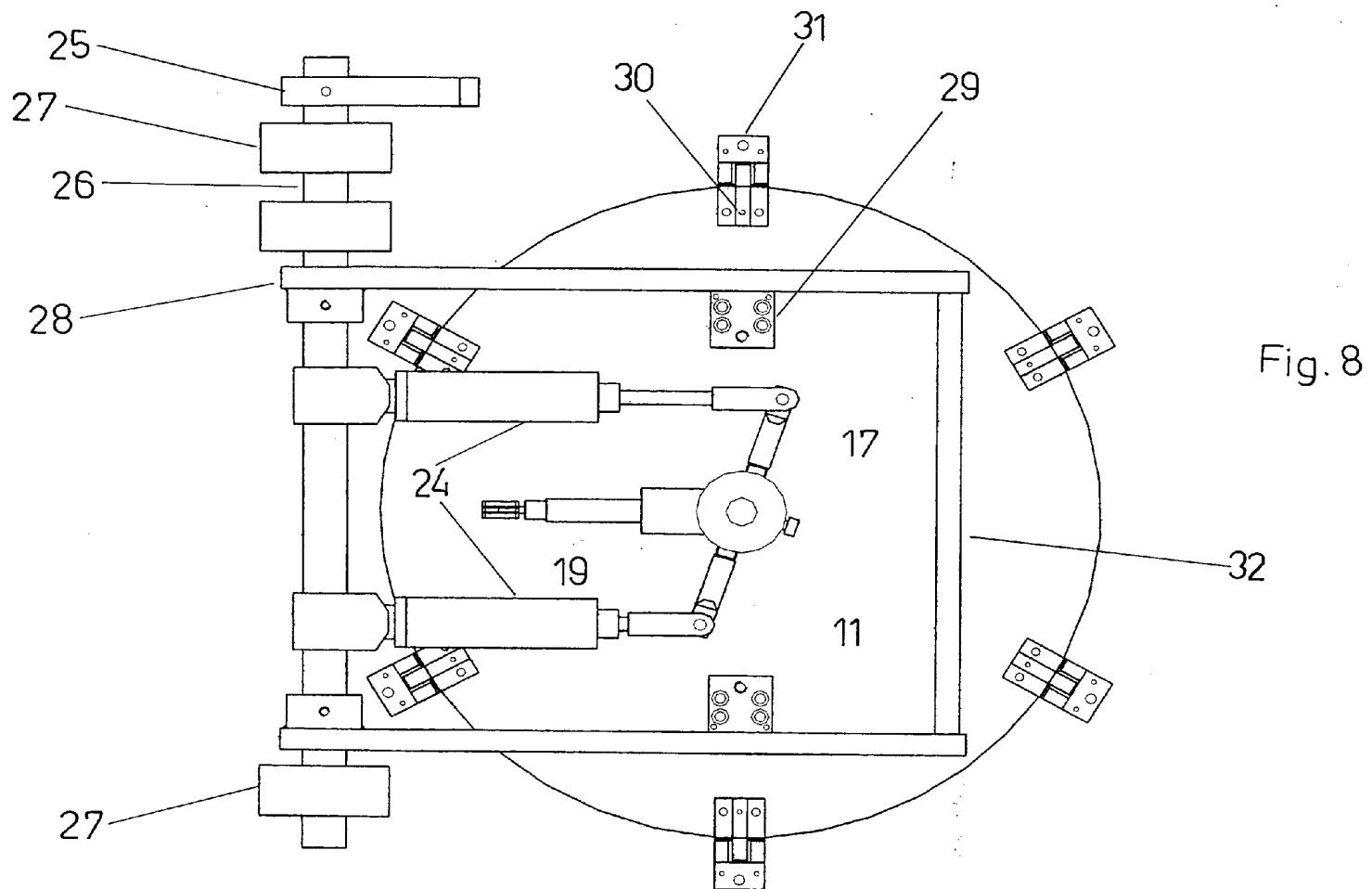


Fig. 7



## DOUBLE CAP SYSTEM FOR THE HANDLING AND TRANSFER OF HAZARDOUS MATERIALS

### FIELD OF THE INVENTION

[0001] The present invention pertains to a "Double cap system for the handling and transfer of hazardous materials" between two vessels, for radioactive or toxic materials, or for materials containing pathogenic microorganisms. This system comprises a particular metal-metal contact sealing between a cap and a flange of a first vessel or a water-tight compartment, and a cap and flanges of a second vessel, the latter being a 200-litre standardized vessel or barrel.

### DESCRIPTION OF THE PRIOR ART

[0002] The aim of the double cap systems is to prevent, during the transfer of some hazardous materials between two vessels, any leakage to the atmosphere or the environment surrounding such vessels. For that reason, the caps of both vessels are coupled, leaving external surfaces facing each other and making up the "double cap" as used herein. Subsequently, said double cap or coupled caps are opened by means of an opening/closing electropneumatic mechanism, located within one of the vessels, which places the double cap apart from the hazardous materials transfer opening.

[0003] Once the double cap is removed, the vessels remain connected through their openings and the transfer between vessels can be carried out in the direction needed. Once said hazardous material is transferred between vessels, the opening/closing electropneumatic mechanism places the double cap back to where it was removed from, and the two caps thereof are then uncoupled so that each cap is placed in its respective vessel.

[0004] As shown herein, when this procedure is carried out, the external surfaces of the caps, or surfaces in contact with the environment, do not get polluted thanks to their mutual hermetic coupling, in spite of having remained in one of the vessels.

[0005] In addition, there will not be any leakage in the coupling of the vessels either, that is to say, in the loading and unloading opening of the material to be transferred.

[0006] These double cap systems are preferably applied to the transfer of material from a waste container or barrel to a water-tight compartment, such as a glove box or a waste treatment cell, or vice versa.

[0007] To ensure total security in the procedure, certain operations must be performed in the correct order, for example, the door to the water-tight compartment or cell must not be opened until the second vessel has been coupled, or until both caps have been coupled to each other.

[0008] With reference to the prior art of the present invention, double cap systems are known, as disclosed in patents U.S. Pat. No. 5,857,308 (AEA TECHNOLOGY PLC) dated Jan. 12, 1999, GB 2,330,549 (KARLSRUHE FORSCHZENT) dated Apr. 28, 1999, DE 1954811.8 (KARLSRUHE FORSCHZENT-DE) Jun. 26, 1997, and U.S. Pat. No. 4,580,694 (KERNFORSCHUNGSZ KARLSRUHE-DE) dated Apr. 8, 1986. The disadvantage of these systems over the present invention lies in the use of a sealing method consisting solely of a rubber joint with no metal-metal contact, which means that, in case the joint gets

damaged by aging, chemical reaction with a material or fire, stagnation is lost and the material contained is released to the atmosphere or environment.

[0009] Another disadvantage of the previous art systems is that a special vessel or barrel must be used, as well as complex, specifically designed rubber gaskets, so no other container can be used. Moreover, the simple manufacture square-section gasket used herein results in lower system production costs.

[0010] Furthermore, in the systems of the prior art, the rubber gasket is stressed by weight, unlike the system of the present invention wherein the gasket is only stressed by weight when the caps are coupled.

### SUMMARY OF THE INVENTION

[0011] The double cap of the present invention overcomes the problems and/or drawbacks of the systems of the prior art by means of a particular structure of the water-tight compartment, vessel or barrel caps and flanges thereof, which enables the formation of metal-metal seals preventing leakages to the outside, even when the rubber gaskets are subject to poor use conditions.

[0012] The use of flanges applied to the vessel or barrel enables the use of other types of barrels and only the flange that adapts to each type needs to be changed.

[0013] There is also electro pneumatic activation with a pneumatic piston for the opening and closing of the double cap which is monitored by sensors associated to electronic logic, so as to ensure the correct operation sequence of the pneumatic actuators, preventing the compartment cap from opening when the container is uncoupled and thus from polluting the environment.

[0014] One of the main objectives of the present invention is to ensure water-tight sealing during the handling and transfer of hazardous materials and to ensure long-lasting elements, preventing its watertight nature from being damaged by aging.

[0015] The second objective of the present invention is to achieve the water-tight sealing of each one of the caps once they are placed in the corresponding containers.

[0016] The third objective of the double cap system is to facilitate the use of any container suitable for the handling and transfer of hazardous materials by means of the coupling of flanges, which shall be compatible with the water-tight compartment cap the material transfer is performed with.

[0017] A particular application of the present invention is the handling and transfer of hazardous materials such as radioactive or toxic materials or pathogenic microorganisms.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] To achieve a better understanding of the present invention and its advantages, below is a detailed description of a preferred example of the formulation of the double cap presented herein, based on the attached drawings, wherein:

[0019] FIG. 1 shows a sectional view of the set of water-tight compartment cap (upper part) placed in the compartment itself over the corresponding flange.

[0020] FIG. 2 shows a sectional view of the set of barrel cap and water-tight compartment or closed cell cap.

[0021] FIG. 3 shows a sectional view of the set of barrel cap and compartment cap in contact position, prior to the coupling of the caps.

[0022] FIG. 4 shows detail view of section A of FIG. 2.

[0023] FIG. 5 represents detail view of section B of FIG. 3.

[0024] FIG. 6 shows the double cap system of the present invention.

[0025] FIG. 7 shows detail view of section C of FIG. 6.

[0026] FIG. 8 shows the activation mechanism for the coupling of the barrel and cell or water-tight caps.

#### DETAILED DESCRIPTION OF THE INVENTION

[0027] FIG. 1 shows a sectional view of the set of water-tight compartment cap (upper part) placed in the compartment itself over the corresponding flange, and the vessel or barrel cap with the flanges fastening it to the corresponding barrel (lower part), prior to the contact of the barrel with the water-tight compartment, in accordance with a method of production of the present invention.

[0028] FIG. 2 shows a sectional view of the set of barrel cap and water-tight compartment or closed cell cap, where the water-tight compartment cap is represented apart from its flange and the cap of the vessel, in accordance with the method of production of FIG. 1.

[0029] FIG. 3 shows a sectional view of the set of barrel cap and compartment cap in contact position, prior to the coupling of such caps, in accordance with a method of production of the present invention.

[0030] FIG. 4 shows detail A of FIG. 2.

[0031] FIG. 5 represents detail B of FIG. 3.

[0032] FIG. 6 shows the double cap system, uncoupled from the opening of the water-tight compartment or cell, which compartment has already the container or barrel coupled to it.

[0033] FIG. 7 shows detail C of FIG. 6;

[0034] FIG. 8 shows the activation mechanism for the coupling of the barrel and cell or water-tight caps, and for the elevation of the double cap.

[0035] In the figures listed above, equal or equivalent components of the example of the invention execution correspond to equal reference numbers.

[0036] As shown in FIG. 4, the present invention comprises a double cap system wherein the coupling constitutes a metal-metal sealing by means of contact of 20, 20' and 21, 21' circular areas belonging to the water-tight compartment 4 cap, to the container or barrel 2 cap and flange 3 of the water-tight compartment cap. In addition, there shall be a metal-metal sealing between the lower surface (22) of flange 3, and the upper outer surface (22') of flange 1a of the container or barrel "a"; and between the container or barrel cap (23') and the upper inner surface (23) of flange 1a.

[0037] Also, FIGS. 1 to 7 show the use of flanges 1a and 1b placed in container or barrel "a"; flanges adaptable to any container "a", including a standardized 200-litre barrel and flange 3 placed over the wedge surface of the water-tight compartment cap 4.

[0038] The barrel flange 1a and the cell or water-tight compartment cap 4 have microalveolar rubber gaskets housing 5 and 6, preferably square section, in order to achieve a hermetic seal among cap 4, water-tight compartment flange 3 and cap 2, and among barrel flange 1a, water-tight compartment flange 3 and container or barrel cap 2.

[0039] As shown in FIGS. 4 and 5, metal-metal seals can be found between water-tight compartment cap 4 and flange 3 (contact area 20, 20'); between barrel flange 1a and

water-tight compartment flange 3 (contact area 22, 22'), between barrel flange 1a and cap 2 (contact area 23, 23') and between barrel cap 2 and water-tight compartment cap 4 (contact area 21, 21').

[0040] The designs known in the prior art use rubber gaskets placed directly over the specially designed barrel, which consequently has the same diameter, and cannot be used with other containers. The container or barrel flange structures presented herein enable a safe transfer of hazardous materials without the need of special containers, so that standardized 200-litre barrels can be used for storing radio-active or dangerous waste.

[0041] The operation sequence of the double cap system is as follows:

[0042] 1. Elevation of barrel "a" comprising flanges 1a and 1b, under the set of gate or cap 4 of the water-tight compartment or waste cell "b" comprising flange "3";

[0043] 2. Positioning of barrel "a" in flange 3 of the water-tight compartment or waste cell so that the lower part of rubber seal 5 placed on cap 4 of the compartment lies properly on the corresponding wedge of cap 2 of container or barrel "a".

[0044] 3. Coupling, by means of internal mechanisms of the water-tight compartment, of cap 4 to cap 2 of container or barrel "a" (segments 14 of cap mechanism 4 lock to wheels 15. When such segments are moved towards the center, cap 2 is opened and coupled to cap 4).

[0045] 4. Elevation, with the subsequent opening of the double cap and free access to the inside of the barrel, for loading or unloading.

[0046] In the preferred embodiment, cap 2 of barrel "a" locks onto the barrel by means of six bolts (7) with springs (8) which, at the time of closing cap 2, are inserted in a notch existing on flange 1a of barrel "a".

[0047] Bolts 7 are tightened onto cap 2 by means of a thread in the locking die (9). Three retainers (10) are used to seal the bolt outlet hole.

[0048] Once cap 2 of the barrel and barrel "a" itself have been coupled to flange 3 of the water-tight compartment, cap 2 of the barrel must be unlocked to be coupled to cap 4 of the water-tight compartment, and thus enable the caps to be elevated and removed from the opening of the compartment to freely communicate the container or barrel and the water-tight compartment.

[0049] This mechanism is made up of a central axis (11) with a disk (12) united to the latter. Twelve piston rods (13) are attached to the disk (12) by means of bolts (18) and each to a segment (14). Two pneumatic pistons (24), see FIG. 8, activate the sleeves (19), which are threaded to the central piece and which rotates jointly with the central axis (11). The piece (16) by means of which cap 4 is fastened is placed under the central axis (11) and makes both the disk (12) and the piston rods (13) rotate as well. When piston rods (13) rotate, the segments (14) move towards the center of the cap in a radial fashion. As the latter move, the segments are fitted to the tapered wheels (15) and move the locking die (9) and the bolt (7) towards the center of the cap compressing the spring (8) and releasing the bolt (7) from the notch in the barrel flange.

[0050] Thus, cap 2 is unlocked from container or barrel "a" and coupled to cap 4 of the water-tight compartment between the segments (14) and the tapered wheels (15).

[0051] Once caps 2 and 4 are coupled, they are raised by means of a pneumatic piston. As shown in FIG. 8, this piston activates the main piston rod (25) which makes the axis (26) placed over three bearings (27) rotate. The main hinges (28) are fixed to the water-tight compartment cap through the pieces (29) and connected to each other by means of the bar (32). The hinges rotate together with the axis (26) to elevate the double cap.

[0052] Cap 4 of the water-tight compartment comprises six bolts (30) placed equidistantly, as shown in FIG. 8, which, when closed, enable the correct positioning of the cap by means of the guides (31).

[0053] To ensure the correct order of operations, the air cylinders have sensors to indicate the position of the embolus. In addition, the system has sensors to indicate if the barrel is coupled to the flange of the water-tight compartment and if both caps are coupled to each other. All sensors are associated to an electronic logic, for example a PLC, to ensure that no step of the operation sequence is performed until the previous step is completed. Electronic logic prevents the cap from opening if the barrel is not coupled to the water-tight compartment, the water-tight compartment cap from opening if it is not coupled to the barrel cap, the barrel cap from uncoupling while the water-tight compartment cap is open, and the barrel from being removed while the double cap is open or when the barrel cap has not been locked to the flange thereof.

[0054] Any system operation can also be performed manually, for which purpose they have special pieces that enable this operation by means of telemanipulators.

1-9. (canceled)

10. A double cap system for handling and transferring hazardous materials comprising:

a first cap of a first container which is subject to being coupled to a second cap of a second container made of metallic materials that couple to form a double cap; wherein said caps comprise flanges for mutual coupling thereof, and wherein at least one metal-metal sealing contact is defined between the caps and the flanges.

11. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein said cap of the first container comprises at least one seal and the flange of the second container comprises at least one seal.

12. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein said cap of the first container comprises two perimeter annular surfaces between which at least one first seal is located, and wherein the cap of the second container comprises an annular upper surface on the peripheral brim thereof that can get in contact with the perimeter annular internal surface of the cap of the first container when coupled with the cap of the latter;

wherein the first container comprises two bearing flanges over the opening thereof;

wherein the upper flange defines an internal and external circular surface between which at least one seal is located; and

wherein the cap comprises a flange which defines an annular surface in contact with the perimeter external surface of the cap of the second container.

13. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein the first container is a water-tight compartment or waste cell.

14. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein the seals are made of elastomeric material.

15. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein the seals comprise a square cross section.

16. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein the second container is a standardized barrel.

17. The double cap system for the handling and transfer of hazardous materials according to claim 16 wherein the second container is a 200-litre standardized container.

18. The double cap system for the handling and transfer of hazardous materials according to claim 10 wherein the flange defines a lock for cap seal bolt.

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