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(71) Applicant: **S.E.I. Societa Esplosivi Industriali S.p.A.**
25016 Ghedi (BS) (IT)

(72) Inventors:
• **Della Bella, Romeo**
25016 Ghedi
Brescia (IT)
• **Santi, Pietro Paolo**
25016 Ghedi
Brescia (IT)

(74) Representative: **Pulieri, Gianluca Antonio et al Jacobacci & Partners S.p.A.**
Piazza dela Vittoria, 11
25122 Brescia (IT)

(54) **Booster device for explosives and relative explosive device**

(57) A booster device (4) for explosives comprising a container (8), able to contain a booster charge (12) to facilitate the triggering of an explosive charge of the as-sociable explosive, a closing cover (16) associable to the container (8), trigger mechanisms (20,22,24,26) for the booster charge (12). Advantageously the booster charge (12) is a high potential, explosive substance in powder form and the closing cover (16) is sealed tight to the container (8) so as to prevent the infiltration of liquids inside the container (8).

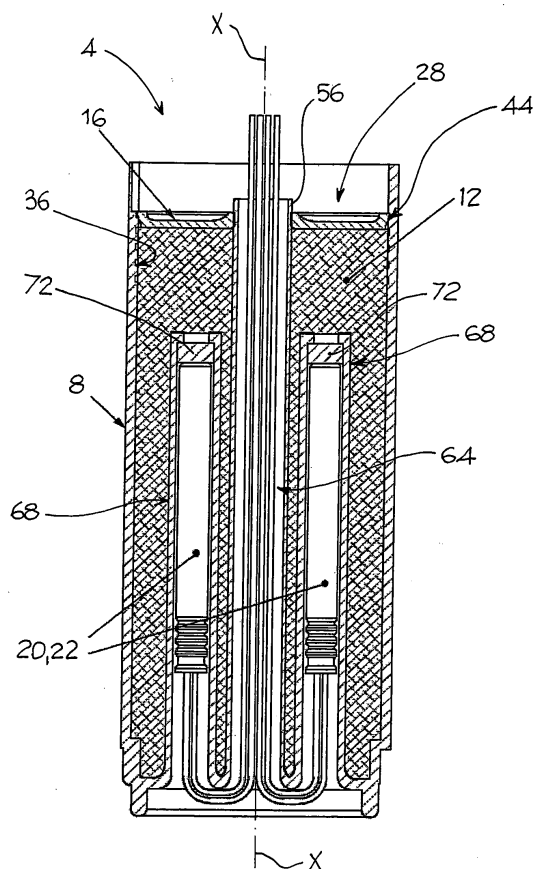


Fig. 4

Description

[0001] The present invention relates to a booster device for explosives for use in various sectors and applications, such as for example in the civil and mineral sphere, the performance of road works, the controlled demolition of buildings, underwater works, mineral blasting and quarrying. Such applications should not be considered exhaustive in that they indicate only some of the possible uses of the booster device which the present invention relates to.

[0002] In the explosive devices sector, the use of explosive charges which must be triggered by so-called fuse accessories, such as detonators of various types and/or detonating fuses, is known of.

[0003] With the development of the application techniques of explosives, mainly for safety reasons connected with their production, transport and use, the sensitivity of the same to external stimuli, and consequently also to the effect of triggering systems, such as detonators or detonating fuses has gradually been reduced.

[0004] Consequently, the use of booster devices, already used in the military sphere, in which the correct triggering of the explosive charge of the explosive device traverses an explosive chain composed of a trigger and a booster charge, has been extended to the civil sphere too.

[0005] In other words, given the reduced sensitivity of the explosive charge to being triggered, for safety reasons, a booster charge is added to provide greater activation energy and cause complete detonation of the explosive charge.

[0006] In the civil sector, some types of booster charges are used, normally produced from regenerated explosives re-utilisable following fusion, such as for example TNT, C/B, pentolite and so on.

[0007] Regenerated explosives have the advantage of enabling the re-use of explosives otherwise destined for costly destruction, and to the containment of the costs of products made with the same.

[0008] However, despite this, the known booster devices present several drawbacks and disadvantages.

[0009] In fact, in the devices known of in the art the time passing between the detonation of the booster charge and the rise in detonation pressure to its maximum level is considerable. As a result the triggering of the booster charge is not particularly incisive and does not always permit optimal control of the sequence of explosions programmed.

[0010] The problem which the present invention sets out to overcome is to create a booster device which resolves the drawbacks mentioned with reference to the known technique.

[0011] Such drawbacks are overcome by a booster device according to claim 1.

[0012] Other embodiments of the explosive device according to the invention are described in the subsequent claims.

[0013] Further characteristics and advantages of the present invention will be more clearly comprehensible from the description below, made by way of an illustrative and non-limiting example of embodiment, wherein:

[0014] figure 1 shows a view from above, partially in cross-section, of a booster device according to an embodiment of the present invention;

[0015] figure 2 shows a cross-section view of the booster device in figure 1;

[0016] figure 3 shows a perspective view of a detail of the booster device in figure 1;

[0017] figure 4 shows a cross-section view of the booster device in figure 1, along the cross-section plane IV-IV of figure 1, said booster device being equipped with an electric detonator, according to a possible embodiment of the present invention;

[0018] figure 5 shows a cross-section view of the booster device in figure 1, along the cross-section plane IV-IV of figure 1, said booster device being equipped with a detonating fuse, according to a possible embodiment of the present invention;

[0019] figure 6 shows a cross-section view of the booster device in figure 1, along the cross-section plane IV-IV of figure 1, said booster device being equipped with a "none!" detonator, according to a possible embodiment of the present invention;

[0020] figures 7-9 shows cross-section views of a multiple booster device respectively equipped with an electric detonator, a detonating fuse and a "none!" detonator according to possible embodiments of the present invention.

[0021] With reference to the aforesaid figures, reference numeral 4 globally denotes an explosive booster device.

[0022] According to one embodiment, the booster device 4 comprises a container 8 able to contain a booster charge 12. The booster charge 12 is able to facilitate the triggering of an explosive charge of an associable explosive so as to produce a clean, complete detonation. In other words, the booster charge 12 has the function of providing greater activation energy to provoke a complete detonation of the explosive charge.

[0023] Advantageously, the booster charge 12 is a high potential, explosive substance in powder form.

[0024] According to one embodiment of the present invention, the booster charge 12 comprises cyclotrimethylenetrinitramine in powder form.

[0025] According to one embodiment, the booster charge 12 comprises an agent reducing sensitivity to external stimuli, to permit safe use.

[0026] According to a preferred embodiment, the booster charge 12 comprises 98.5% in weight of cyclotrimethylenetrinitramine and 1.5% in weight of a sensitivity-reducing agent.

[0027] The booster device 4 also comprises a closing cover 16 which can be fitted to the container 8 and a triggering device 20 to trigger the booster charge 12.

[0028] For example the triggering device 20 may com-

prise an electric detonator 22, a 'Nonel' type detonator 24 and/or a detonating fuse 26, depending on the specific application and type of explosive used.

[0029] The container 8, on the part opposite the closing cover 16, comprises a bottom 27.

[0030] According to one embodiment, the container 8 comprises an insertion aperture 28 able to permit filling of the same container with the booster charge 12; according to one embodiment the container is a cylindrical body having an X-X extension axis.

[0031] According to one embodiment, on an inner lateral wall 32 of the insertion aperture 28, the container 8 comprises for example a knurl or number of steps 36 able to facilitate mechanical coupling with the associable closing cover 16.

[0032] Preferably, the closing cover 16 interlocks with the insertion aperture 28 of the container 8. For example, between a lateral rim 40 of the cover 16 and the inner lateral wall 32 of the insertion aperture 28 of the container 8, there is a male-female type coupling. For example the lateral rim 40 sits firm against the inner lateral wall 32, preferably fitted with steps 36, so as to ensure firm closure of the said cover.

[0033] Advantageously, the closing cover 16 is sealed tight to the container 8 so as to prevent the infiltration of liquids inside the container 8.

[0034] According to one embodiment, between the closing cover 16 and the inner lateral wall 32 of the insertion aperture 28 of the container 8 is a sealing mechanism able to ensure watertightness.

[0035] For example, said sealing mechanism comprises a sealing paste and/or O-ring; for example the sealing mechanism is housed in the area defined by two consecutive steps 36 of the container 8. According to one embodiment, the sealing mechanism 44 comprises a twin-component polyurethane resin.

[0036] According to a further embodiment, the closing cover 16, previously interlocked to the insertion aperture 28, is joined to a cover plate 48, also insertable in the insertion aperture 28. Preferably, the sealing mechanism 44 is positioned between the closing cover 16 and the cover plate 48.

[0037] For example, a polymer ring of the O-ring type axially compressed between the cover 16 and the cover plate 48 may be used as a sealing mechanism, so as to dilate radially against the inner lateral wall 32 and form a seal.

[0038] Axial direction is taken to mean a direction parallel to the extension axis X-X of the container 8; radial direction is taken to mean a direction perpendicular to the axial direction and incident with it.

[0039] According to a further embodiment, between the closing cover 16 and the cover plate 48 sealing mechanisms 44 in a liquid, paste or semisolid form are inserted so that, following axial compression between the cover 16 and the plate 48, said sealing mechanism 44 distends radially against the inner lateral wall 32 to then solidify and/or polymerise.

[0040] The container 8 defines a chamber 52 housing the booster charge 12, and an inner tube 56 which crosses said chamber 52 and which houses at least partially the trigger mechanisms 20, 22, 24, 26.

[0041] The inner tube preferably passes through the cover 16 through a hole 60 in said cover 16.

[0042] For example, the chamber 52 assumes a toroidal conformation, co-axial with the extension axis X-X and with the inner tube 56. Said inner tube 56 goes through the hole 60 of the closing cover 16 and comprises an aperture 64 passing through an extension of the inner tube 56. Such aperture permits insertion of the trigger mechanisms inside the container 8.

[0043] According to one embodiment, the container 8 comprises at least one seat 68 communicating with the inner tube 56, said seat 68 co-operating with the inner tube 56 to house the trigger mechanisms 20, 22, 24, 26.

[0044] For example, the booster device comprises two cylindrical seats 68, positioned symmetrically and in diametrically opposed positions in relation to the inner tube 56. The seats 68 and the inner tube 56 are in direct communication with each other at the bottom 27 of the container 8.

[0045] The seats 68 are fluidly separate from the chamber 52 so as to prevent any contamination of the booster charge 12. According to one embodiment, the seats comprise means of closure 72, such as for example stoppers, to ensure water tightness and prevent the penetration of fluid into the chamber 52.

[0046] According to one embodiment, the bottom 27 of the container 8 is open so as to facilitate the passage of the trigger mechanisms 20, 22, 24, 26 through the inner tube 56 so as to be housed in their respective seats 68.

[0047] Preferably, the bottom 27 is counter-shaped in relation to the insertion aperture 28 of the container 8 so that it can be inserted in the insertion aperture 28 of a further, associable booster device 4, enabling piling up in a column of several booster devices 4 (figures 7-9).

[0048] Depending on the use and power required, it is in fact possible to pile up at least two booster devices 4 having a communal inner tube 56 housing the trigger mechanisms 20, 22, 24, 26 shared by the booster devices 4.

[0049] As a result, it is possible to create a multiple or column booster device 80; such column device 80 can be made directly on site by rapidly assembling a number of booster devices.

[0050] As may be seen from the description, the booster device according to the present invention makes it possible to overcome the drawbacks presented by the known devices in the art.

[0051] In fact, the detonation pressure is released practically immediately, while with the known booster charges the time passing between detonation of the charge and the maximum rise in detonation pressure, occurs after about 2-4 μ s.

[0052] By achieving the maximum detonation pressure practically immediately, the effect of the booster charge

is particularly effective in the triggering phase of the explosive charge.

[0053] This way it is possible to produce multiple controlled explosions in total safety. Improved safety derives both from being able to precisely control the trigger times of the explosive charges and from the fact that increasingly less sensitive explosive charges can be used which are therefore safer during the transport and/or storage phases.

[0054] Advantageously, the booster device of the present invention can be used in water in that it is possible to prevent infiltration of the same inside the container. Such infiltration of water could lead to the explosive becoming inert or to failure of proper triggering by the detonator.

[0055] In addition, the use in water could cause further safety problems in the event of dispersion of explosive powder and leakage of the same from the container.

[0056] Advantageously such dangers are prevented by the relative container with safety cover which is able to ensure hermetic sealing by affixing of a sealant.

[0057] The type of closure of the cover and the affixing of the sealant result in a product able to withstand the hydrostatic pressure of a column of water 30 metres high. This feature is extremely important in the use of explosive charges not just in holes full of water but also for underwater purposes up to a depth of 30 metres.

[0058] Advantageously, multiple explosive devices can be used which in a simple, modular and economic manner enable the power of the booster charge to be increased in relation to the type and quantity of the explosive charge of the explosive used.

[0059] The high reactivity and rapidity of the booster charge makes it possible to achieve safe and perfectly controlled explosions even with elevated quantities of explosive charge.

[0060] A person skilled in the art may make numerous modifications and variations to the booster devices described above so as to satisfy contingent and specific requirements all while remaining within the sphere of protection of the invention as defined by the following claims.

Claims

1. Booster device (4) for explosives comprising

- a container (8) able to contain a booster charge (12), said booster charge (12) being able to facilitate the triggering of an explosive charge of an associable explosive, so as to achieve a clean and complete detonation,
- a closing cover (16) associable to the container (8),
- trigger mechanisms (20,22,24,26) for the booster charge, such as a detonator (22,24) and/or detonating fuse (26),

characterised by the fact that

- the booster charge (12) is a high potential, explosive substance in powder form,
 - the closing cover (16) is sealed tight to the container (8) so as to prevent the infiltration of liquid inside the container (8).
2. Booster device (4) according to claim 1, wherein the booster charge (12) comprises cyclotrimethylene-trinitramine in powder form.
 3. Booster device (4) according to claim 1 or 2, wherein the booster charge (12) comprises an agent which reduces sensitivity to external stimuli and permits safe use.
 4. Booster device (4) according to claims 1, 2 or 3, wherein the booster charge (12) comprises 98.5% in weight of cyclotrimethylenetrinitramine and 1.5% in weight of a sensitivity-reducing agent.
 5. Booster device (4) according to any of the previous claims, wherein the closing cover (16) is interlocked to an insertion aperture (28) of the container (8).
 6. Booster device (4) according to any of the previous claims, wherein between the lateral rim (40) of the closing cover (16) and an inner lateral wall (32) of the insertion aperture (28) of the container (8), there is a shaped coupling of the male-female type.
 7. Booster device (4) according to any of the previous claims, wherein between the closing cover (16) and an inner lateral wall (32) of the insertion aperture (28) of the container (8) is a sealing mechanism (44) able to ensure water-tightness.
 8. Booster device (4) according to any of the previous claims, wherein a cover plate (48) is joined to the closing cover (16) and a sealing mechanism (44) is placed between the closing cover (16) and the cover plate (48).
 9. Booster device (4) according to any of the previous claims, wherein the container (8) defines a chamber (52) housing the booster charge (12) and comprises an inner tube (56) which crosses said chamber (52) and which houses the trigger mechanisms (20,22,24,26) at least partially.
 10. Booster device (4) according to claim 9, comprising at least one seat (68) communicating with the inner tube (56), said seat (68) co-operating with the inner tube (56) to house the trigger mechanisms (20,22,24,26).
 11. Booster device (4) according to claim 10, wherein

said seat (68) comprises means of closure (72) to ensure water-tightness and prevent the penetration of fluid into the chamber (52) of the container (8).

12. Booster device (4) according to any of the claims from 9 to 11, comprising a bottom (27) of the container (8) open so as to facilitate the passage of the trigger mechanisms (20,22,24,26) through an inner tube (56) so as to be housed in their respective seats (68). 5 10
13. Booster device (4) according to claim 12, wherein the bottom (27) is counter-shaped to the insertion aperture (28) of the container (8) so as to be insertable in the insertion aperture (28) of a further associable booster device (4), permitting the piling in a column of a number of booster devices (4). 15
14. Multiple booster device (80) comprising at least two booster devices (4) according to any of the claims from 1 to 13, said devices (4) being piled up together and having a communal inner tube (56) housing shared trigger mechanisms for the said devices. 20
15. Explosive device comprising a booster device (4) according to any of the claims from 1 to 14. 25

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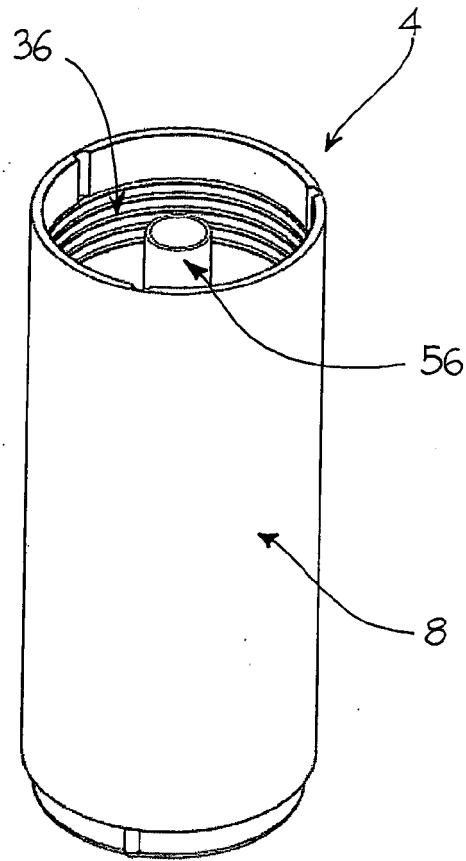


Fig. 1 a

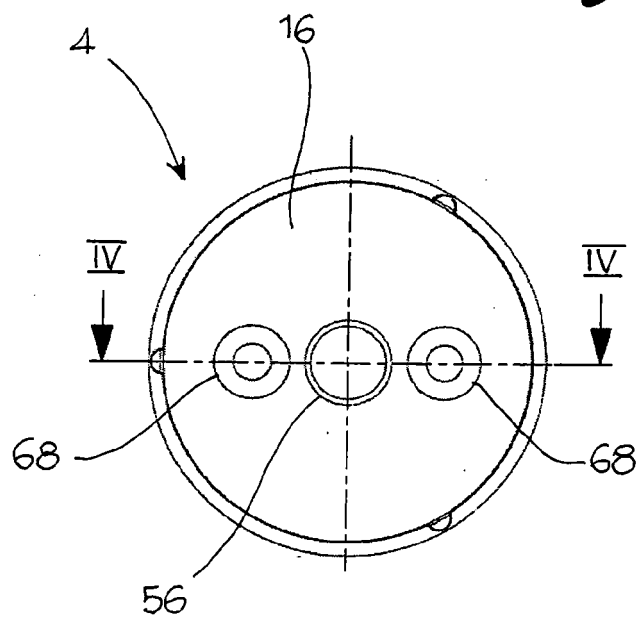


Fig. 1 b

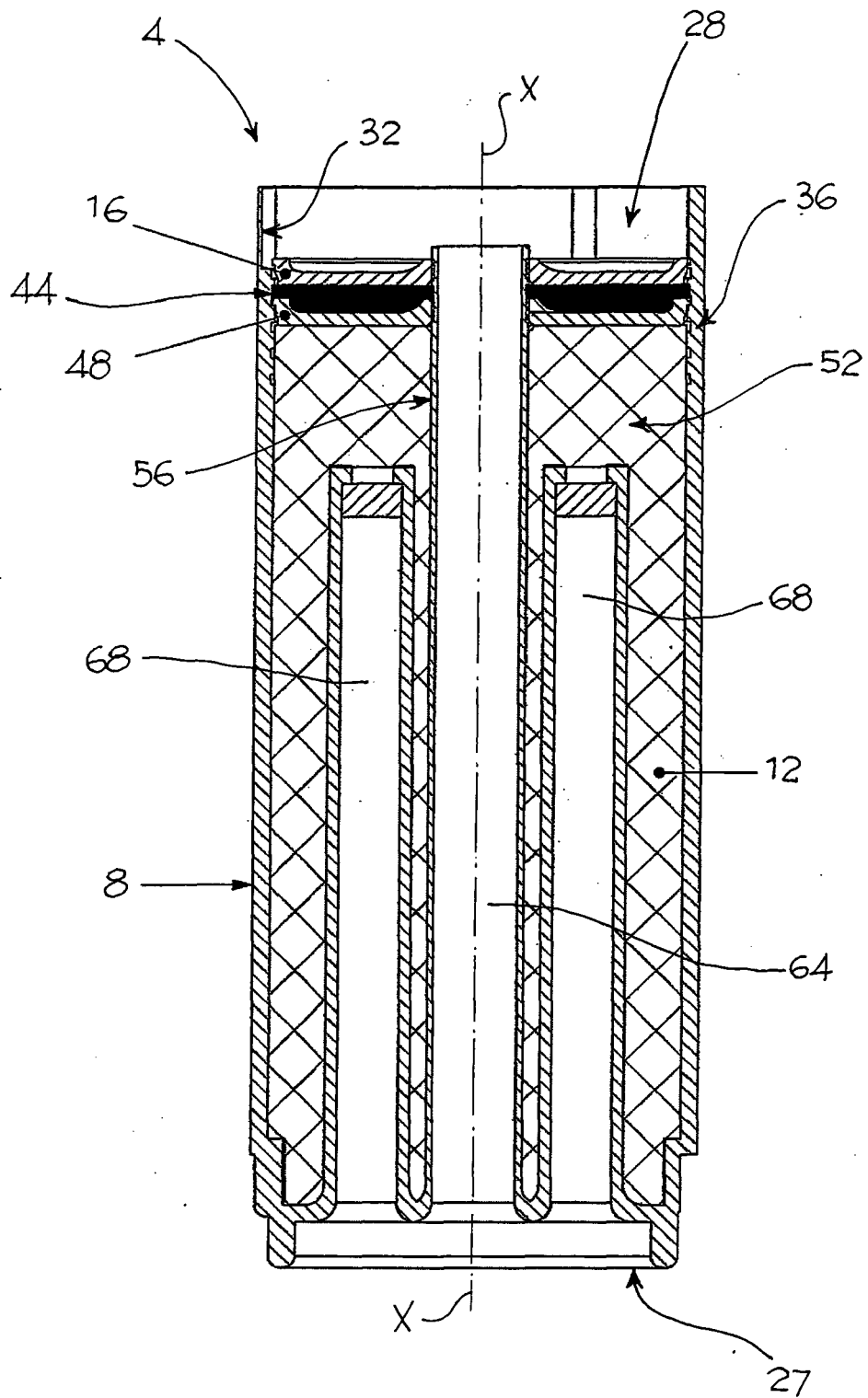


Fig. 2

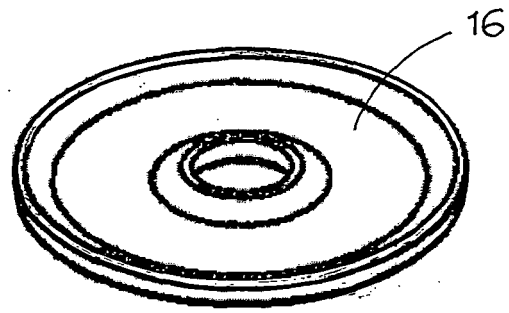


Fig. 3a

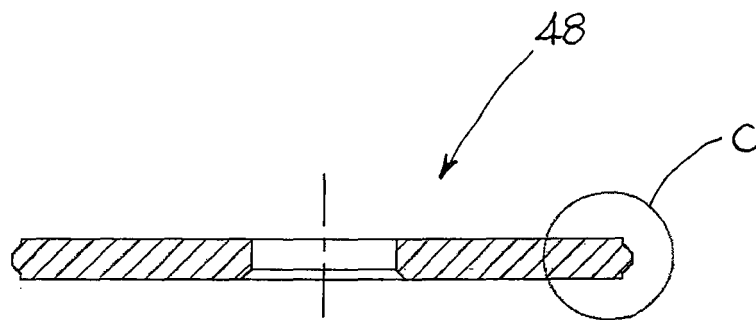


Fig. 3b

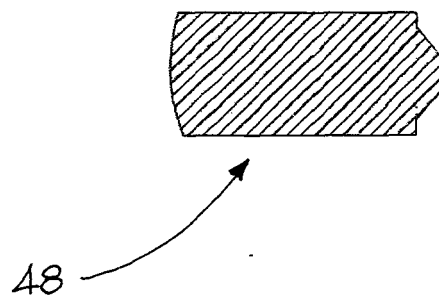


Fig. 3c

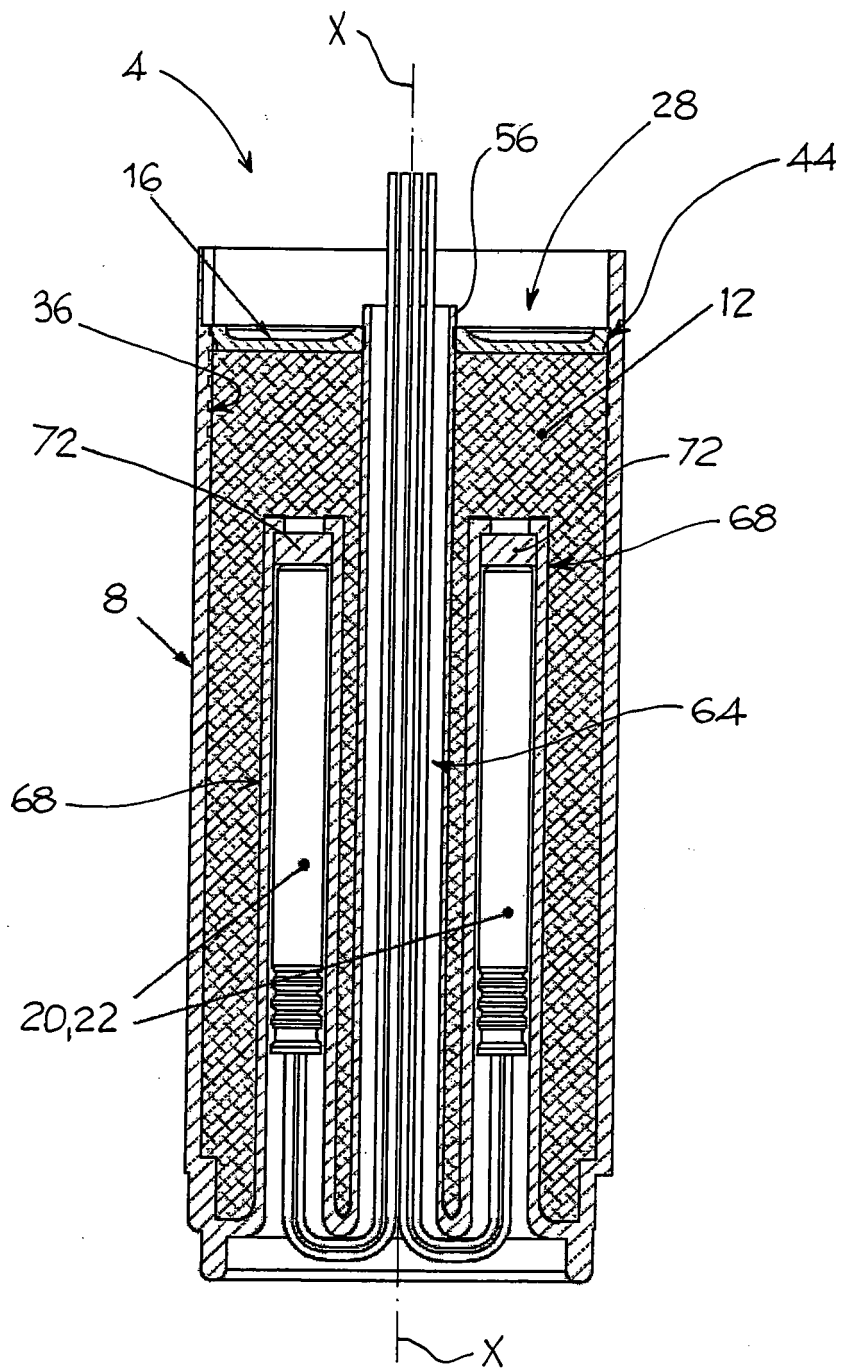


Fig. 4

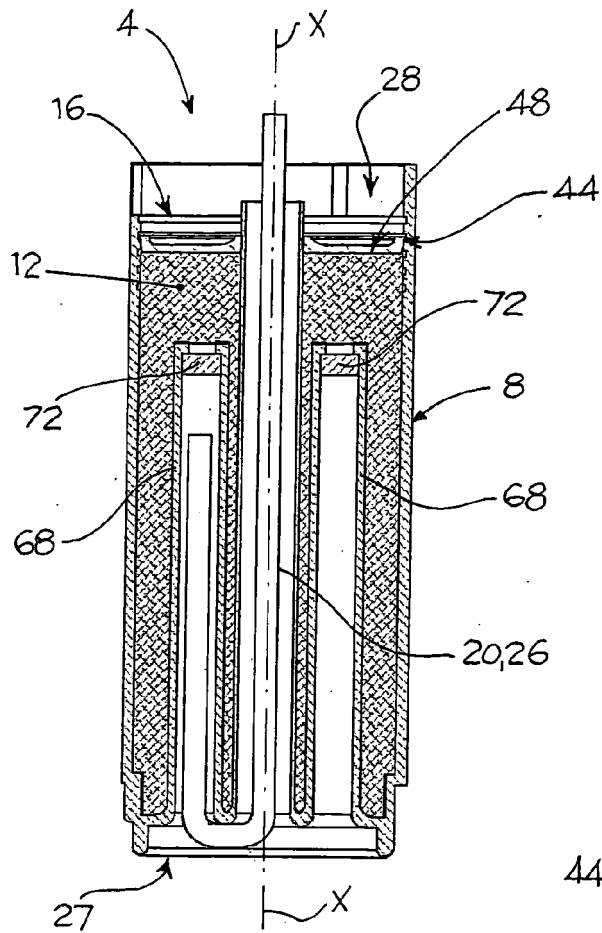


Fig. 5

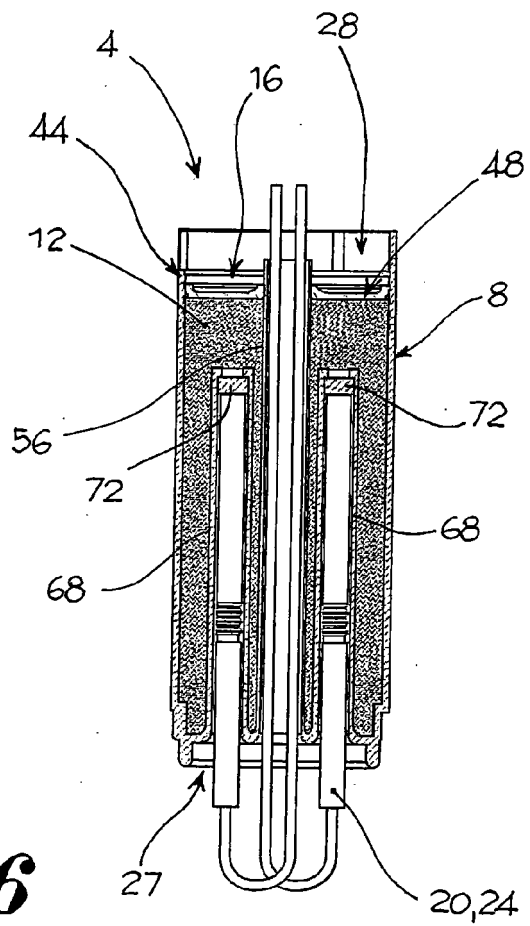


Fig. 6

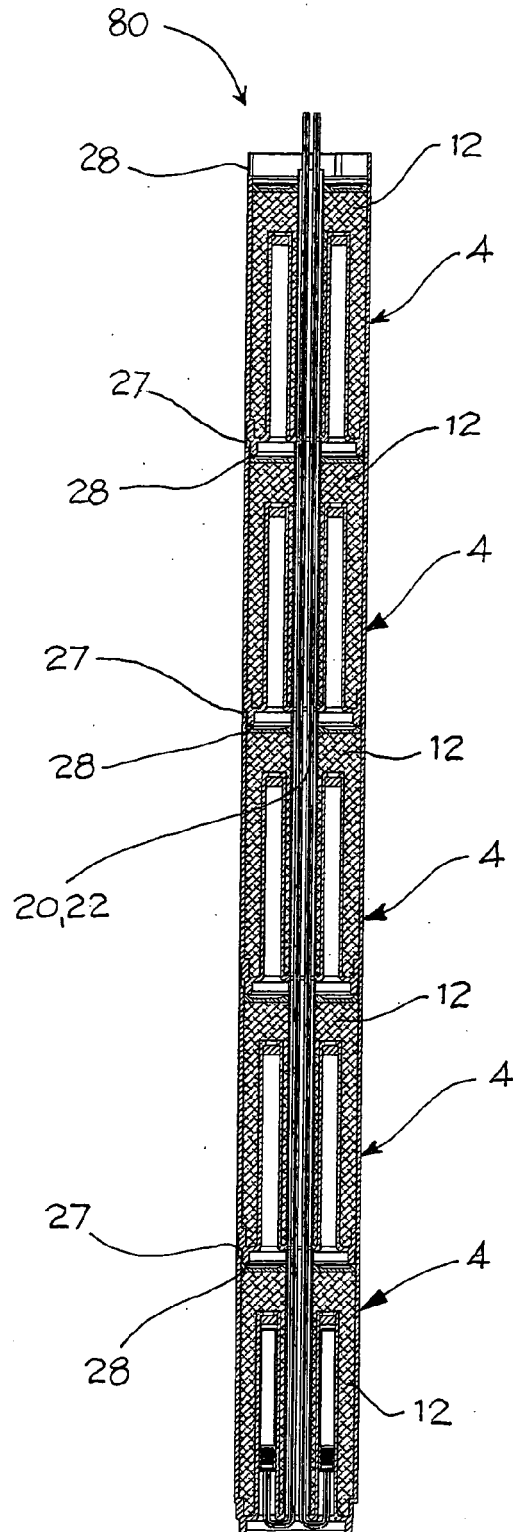


Fig. 7

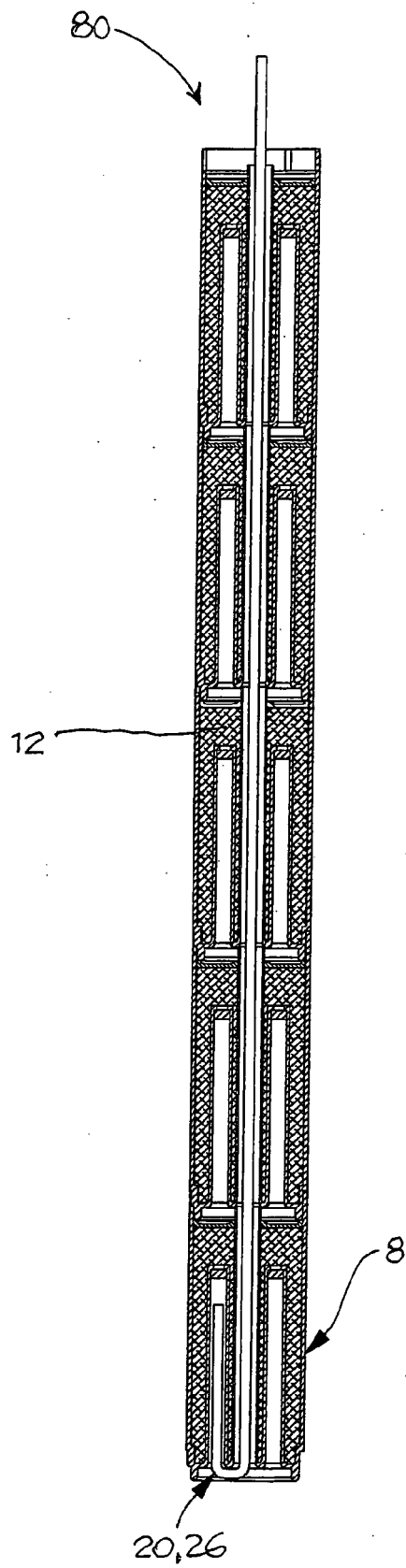
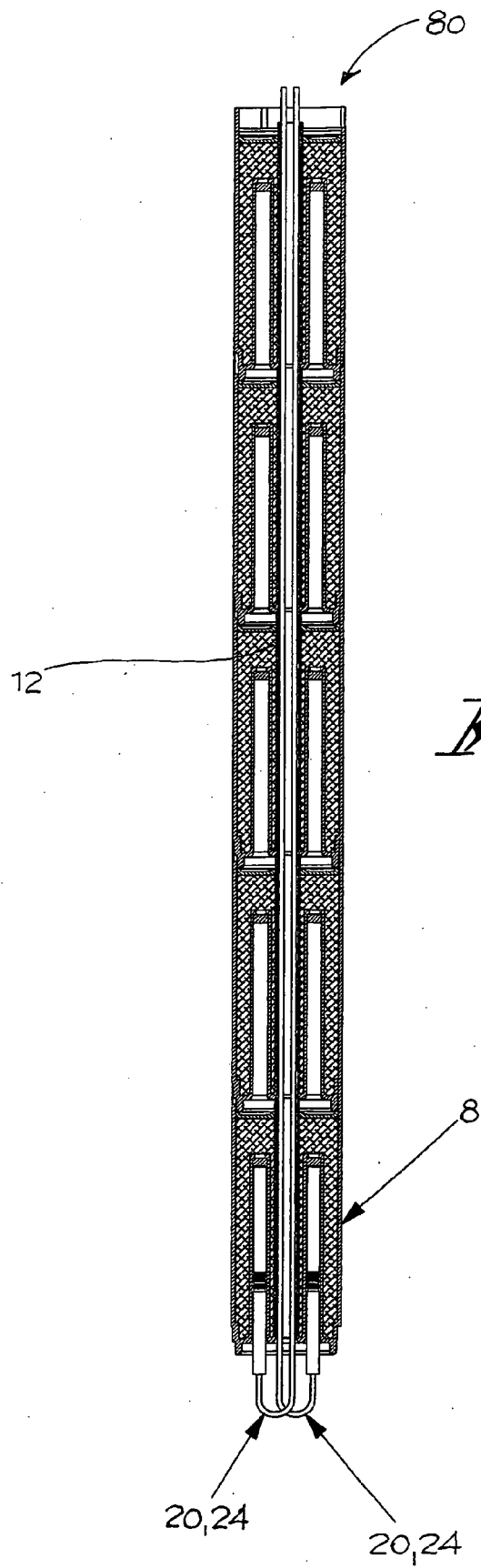


Fig. 8





EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5674

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 334 476 A (DAY JOHN T ET AL) 15 June 1982 (1982-06-15)	1-12,15	INV. F42B3/26
Y	* abstract * * column 3, lines 2-4 * * column 4, line 22 - column 6, line 32 * * figures 1,2,4,7,8 *	13	
X	US 3 747 527 A (GRIFFITH G) 24 July 1973 (1973-07-24)	1-4,9, 14,15	
Y	* abstract * * column 2, line 38 - column 5, line 24 * * figures 1,11,13 *	13	
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X	US 4 485 741 A (MOORE JACK M [US] ET AL) 4 December 1984 (1984-12-04)	1-12,14, 15	TECHNICAL FIELDS SEARCHED (IPC)
	* abstract * * column 2, line 5 - column 3, line 48 * * figures 1-3 *		F42B F42D E21B
X	US 2 993 441 A (GRIFFITH GEORGE L ET AL) 25 July 1961 (1961-07-25)	1-7,15	
	* column 1, line 65 - column 2, line 2 * * column 3, lines 20,21 * * figures 1,2 *		
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 April 2009	Examiner Menier, Renan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 42 5674

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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