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(54) MULTISTAGE PYROTECHNIC DEVICE WITH A CARBOARD STAGE SEPARATOR

(57) A multistage pyrotechnic device (100) comprising a launching tube (DD) and at least two pyrotechnic stages (ST) disposed inside the launching tube (DD); each pyrotechnic stage (ST) comprises a launching charge (C) and effect means (M); the pyrotechnic device (100) comprises a separator (1) disposed between the two pyrotechnic stages (ST) and provided with an axial conduit (10) suitable for housing a fuse (U); the peculiarity of the pyrotechnic device (100) consists in the fact that the separator (1) comprises a first thin end disk (11) made of cardboard, a second thin end disk (12) made of cardboard with a diameter (d1), and at least one spacing ring (2) made of cardboard with a diameter (d2) and disposed between the two thin end disks (11, 12); the internal diameter (d3) of the launching tube (DD) is higher than the diameter (d2) of the spacing ring (2) and is lower than the diameter (d1) of the thin end disks (11, 12).

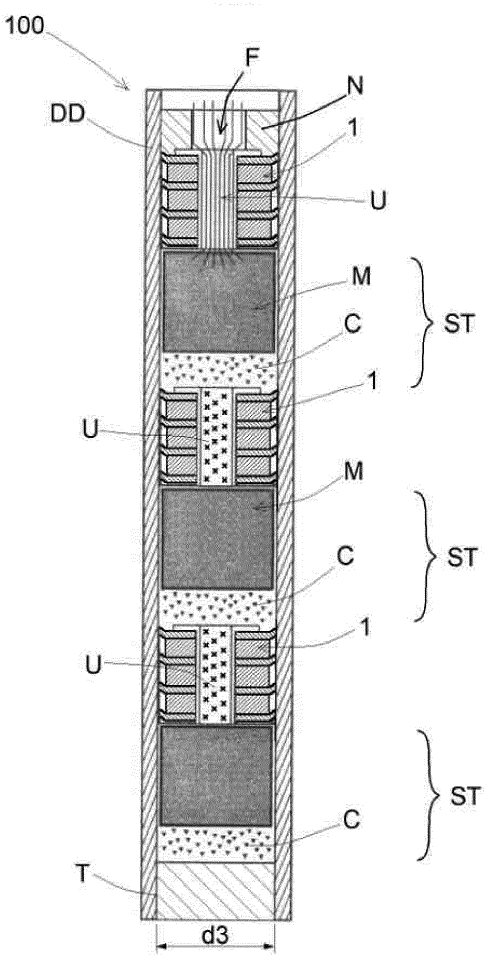

FIG. 7

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Description

[0001] The present patent application for industrial invention relates to a multistage pyrotechnic device with a cardboard stage separator.

[0002] The advantages of the present invention will become manifest after a description of the prior art and its drawbacks.

[0003] The prior art is herein described with reference to Figs. 1, 2 and 3, wherein:

Fig. 1 is a diagrammatic view of a multistage pyrotechnic device according to the prior art, sectioned with a plane passing through its longitudinal axis;
Fig. 2 is a view of a first type of separator of the multistage pyrotechnic device of Fig. 1;
Fig. 3 is a view of a second type of separator of the multistage pyrotechnic device according to the prior art.

[0004] The tubular pyrotechnic device (200) of Fig. 1 is commonly defined as "Roman candle".

[0005] Such a tubular multistage pyrotechnic device (200) comprises a launching tube (DD) provided with a bottom opening firmly closed by a cap (T) and an upper opening where a lid (N) is usually disposed.

[0006] Moreover, the pyrotechnic device (200) comprises a plurality of pyrotechnic stages (ST) sequentially disposed in the launching tube (DD) in such a way that an upper pyrotechnic stage (ST) is disposed in the vicinity of the upper opening of the launching tube (DD), and a plurality of lower pyrotechnic stages (ST) sequentially disposed towards the bottom opening.

[0007] Going from the bottom opening to the upper opening, each pyrotechnic stage (ST) comprises a launching charge (C) and effect means (M).

[0008] The pyrotechnic device (200) also comprises a separator (8) disposed between two consecutive pyrotechnic stages (ST). Preferably, in addition to comprising a separator (8) between each pair of consecutive pyrotechnic stages (ST), the pyrotechnic device (200) also comprises an upper separator (8) above the upper pyrotechnic stage (ST).

[0009] Therefore, a launching charge (C), effect means (M) and a separator (8) are continuously and sequentially alternated along the entire launching tube (DD).

[0010] The effect means (M) can generate a "comet effect", namely an ascending trail of light, or a "fountain effect", namely a rain of pyrotechnic fire in the upper dead point of said ascending trail of light.

[0011] Each separator (8) acts as an insulating fireproof element between the pyrotechnic stages (ST) of the sequence, and as a retardant for the triggering of the launching charge (C) of the pyrotechnic stage (ST) disposed in immediately lower position, in such a way that the various stages are launched in the desired sequence.

[0012] As shown in Fig. 2 and in Fig. 3, two types of separators (8, 9) are currently known on the market.

[0013] According to a first type, which is shown in Fig. 1 and in detail in Fig. 2, said separators (8) comprise a felt cylindrical body (81) with a plastic bushing (80) in central position, and a fuse (U) in the axial conduit (80a) of the plastic bushing (80). It must be noted that the term "fuse (U)" means one or more inflammable cords or black retardant powder.

[0014] According to a second type of separators (9), which is shown in Fig. 3, the separators (9) consist in an annular cylindrical tub with a low conicity degree. Said annular cylindrical tub comprises an annular chamber defined by an external cylindrical wall (91), an internal cylindrical wall (90) and a bottom wall (92). The internal cylindrical wall (90) internally defines a conduit (90a) where the fuse (U) is suitable for being disposed. When said separator (9) is disposed in the launching tube (DD), attention must be paid to dispose the opening of said annular chamber towards the upper opening of the launching tube (DD). The annular chamber houses the launching charge (C) of the pyrotechnic stage (ST) disposed in immediately upper position, whereas said conduit (90a) houses the fuse (U) suitable for triggering the launching charge (C) of the pyrotechnic stage (ST) in immediately lower position with the desired delay.

[0015] It must be noted that the external diameter (D8, D9) of the two aforementioned types of separators (8, 9) is slightly higher than the internal diameter of the launching tube (DD), in such a way that the lateral wall of the felt body or of the annular chamber adheres to the internal surface of the launching tube (DD) and prevents the flame front produced in the launching chamber (C) of a pyrotechnic stage (ST) from escaping and propagating downwards and through the lateral wall, ultimately triggering the launching charge (C) of the pyrotechnic stage (ST) in lower position and eliminating the action of the fuse (U).

[0016] A central hole, which is technically defined as "quick match", is generally provided on the lid (N) for inserting the fuse (U) that descends in the conduit (80a, 90a) of the separator (8, 9) in upper position, in such a way to trigger the launching charge (C) and consequently launch the effect means (M) of the pyrotechnic stage (ST) in upper position.

[0017] When the fuse (U) is lit, a flame front is generated, is passed through the conduit (80a, 90a) of the separator (8, 9) in upper position and is propagated on the launching charge (C) of the upper stage, triggering the launching charge (C). So, the launching charge (C) explodes and launches the effect means (M) and the separator (8, 9) out of the launching tube (DD).

[0018] Simultaneously, the flame front propagates slowly from said launching charge (C) inside the conduit (80a, 90a) of the separator (8, 9) in immediately lower position until the flame front triggers the launching charge (C) of the successive pyrotechnic stage. Also in this case, the launching charge (C) explodes and launches the effect means (M) and the separator (8, 9) of the pyrotechnic stage (ST) in lower position out of the launching tube

(DD).

[0019] Such an effect is repeated until the flame front is propagated to the launching charge (C) of the last pyrotechnic stage (ST) of the pyrotechnic device (200), namely the stage that is disposed immediately above the cap (T) that closes the bottom opening.

[0020] The drawback of said pyrotechnic devices consists in the contaminating action caused by the fact that the separators are launched together with the effect means. However, whereas the effect means are burned in the air without leaving any residues, the separators fall onto the ground and are dispersed around the place where the pyrotechnic show was organized.

[0021] Considering that the first type of separators comprises a felt body with a plastic bushing, and the second type of separators comprises a plastic annular tub, the natural degradation and decomposition of said residues are very long processes and therefore the residues must be removed to eliminate the very high environmental impact.

[0022] The purpose of the present invention is to overcome the drawbacks of the prior art by disclosing a pyrotechnic device with a low environmental impact.

[0023] These purposes are achieved according to the invention with the characteristics of the appended independent claim 1.

[0024] Advantageous embodiments appear from the dependent claims.

[0025] The pyrotechnic device according to the invention is defined by claim 1.

[0026] For the sake of clarity, the description of the pyrotechnic device according to the invention continues with reference to the appended drawings, which have a merely illustrative, not limiting value, wherein:

Fig. 4 is an axonometric view of the separator of the pyrotechnic device according to the invention;
Fig. 5 is a side view of the separator of the pyrotechnic device according to the invention;
Fig. 6 is an axial view of the separator of Fig. 5;
Fig. 7 is a diagrammatic axial view of the pyrotechnic device according to the invention.

[0027] In the following description, elements that are identical or correspond to the aforementioned ones are indicated with the same numerals, omitting a detailed description.

[0028] With reference to Fig. 7, a pyrotechnic device according to the invention is disclosed, which is generally indicated with reference numeral (100).

[0029] The pyrotechnic device (100) comprises a plurality of pyrotechnic stages (ST), just like the ones of the type described in the prior art, namely an upper pyrotechnic stage (ST) and a plurality of lower pyrotechnic stages (ST) sequentially disposed one on top of the other.

[0030] The pyrotechnic device (100) comprises an innovative separator (1) disposed between two consecutive pyrotechnic stages (ST).

[0031] Preferably, the pyrotechnic device (100) also comprises a separator (1) in the vicinity of the upper opening and immediately above the upper pyrotechnic stage (ST).

[0032] The peculiarity of each separator (1) of the pyrotechnic device (100) according to the invention is that it comprises a multilayer structure composed of:

- a first thin end disk (11) made of cardboard,
- a second thin end disk (12) made of cardboard,
- a plurality of spacing rings (2) made of cardboard, disposed between the first thin end disk (11) and the second thin end disk (12), and
- a plurality of thin intermediate disks (13) made of cardboard, which are identical to the thin end disks (11, 12) and are disposed between each pair of spacing rings (2).

[0033] In particular, according to the embodiment shown in Figs. 5, 6 and 7, the separator (1) comprises two thin end disks (11, 12), three spacing rings (2) and two thin intermediate disks (13).

[0034] It must be noted that, although the separator (1) of the embodiment shown in Figs. 4, 5 and 6 comprises three spacing rings (2) and two thin intermediate disks (13), the purposes of the present invention are achieved also when the separator (1) is exclusively formed of one spacing ring (2) disposed between the two thin end disks (11, 12).

[0035] The diameter (d2) of the spacing rings (2) made of cardboard is lower than the diameter of the thin disks (11, 12, 13). In view of the above, when the thin disks (11, 12, 13) are assembled with the spacing rings (2) to form the separator (1) according to the invention, a perimeter portion (5) of the thin disks (11, 12, 13) shaped like an annular crown protrudes with respect to the spacing rings (2).

[0036] The internal diameter (d3) of the launching tube (DD) is higher than the diameter (d2) of the spacing ring (2) and is lower than the diameter (d1) of the thin end disks (11, 12).

[0037] The edge of said protruding perimeter portion (5) is suitable for adhering and sliding on the internal surface of the launching tube (DD) of the pyrotechnic device (100) wherein the separator (1) is inserted.

[0038] The spacing rings (2) and the thin disks (11, 12, 13) have a hole with the same diameter. In view of the above, an axial conduit (10) is formed in the center of the separator (1) according to the invention when the spacing rings (2) and the thin disks (11, 12, 13) are assembled.

[0039] A fuse (U), which may consist in an inflammable cord or black retardant powder, is disposed inside the axial conduit (10). In particular (as shown in Fig. 7), the inflammable cords are inserted in the axial conduit (10) of the separator (1) in upper position. Whereas the black retardant powder is contained in the axial conduit of the separators (1) in lower position.

[0040] Because of the provision of the perimeter por-

tion (5), the edge of which adheres and slides against the internal surface of the launching tube (DD), the separator (1) conveys the flame front of a launching charge (C) inside the axial conduit (10), where the fuse (U) propagates said flame front towards the pyrotechnic stage (ST) in lower position with the desired delay.

[0041] As mentioned above, the launching tube (DD) has a circular section, just like the spacing rings (2) and the thin disks (11, 12, 13).

[0042] The diameter (d2) of the spacing rings (2) is slightly lower than the diameter (d1) of the thin disks (11, 12, 13) that in turn have a higher diameter (d1) than the internal diameter (d3) of the launching tube (DD) in such a way that said separators (1) create some friction during the insertion in the launching tube (DD).

[0043] During the step of insertion, said perimeter portion (5) is slightly bent in such a way to allow for said insertion with friction. The same occurs during the step of launching, when the separator (1) is ejected together with the effect means (M).

[0044] Preferably, the ratio between the diameter (d2) of the spacing rings (2) and the diameter (d1) of the thin disks (11, 12, 13) ranges from 0.7 to 0.9, preferably 0.8.

[0045] Preferably, the width of the perimeter portion (5) of the thin disks (11, 12, 13) ranges from 1 mm to 5 mm, preferably 3 mm.

[0046] According to a preferred embodiment of the invention, the thickness of each thin disk (11, 12, 13) ranges from 1 mm to 2 mm, whereas the thickness of said spacing rings (2) ranges from 6 mm to 8 mm.

[0047] It must be noted that, although in Fig. 7 multiple pyrotechnic stages (ST) are disposed in lower position under the pyrotechnic stage (ST) in upper position, and consequently multiple separators (1) are disposed between said pyrotechnic stages (ST), the pyrotechnic device (100) may comprise only one lower pyrotechnic stage (ST) in lower position with only one separator (1) disposed between the lower pyrotechnic stage (ST) and the upper pyrotechnic stage (ST).

[0048] In view of the aforementioned description, the advantages of the separator (1) according to the invention are manifest.

[0049] In particular, being entirely made of cardboard, in case of disposal in the environment, the separator (1) does not have a negative environmental impact because the cardboard degrades and decomposes quickly because of weather agents, and therefore the cleaning operation of the area with the residues of said separators (1) may be omitted.

[0050] The separator (1) can play a central role in the field of pyrotechnics, replacing the separators (8, 9) of the prior art that are currently available on the market.

[0051] Numerous equivalent variations and modifications, which are within the reach of an expert of the field and fall in any case within the scope of the invention as disclosed by the appended claims, can be made to the present embodiment of the invention.

Claims

1. Multistage pyrotechnic device (100) comprising:

   - a launching tube (DD) provided with a bottom opening, an upper opening and an internal diameter (d3);
   - a cap (T) that closes said bottom opening of the launching tube (DD);
   - an upper pyrotechnic stage (ST) disposed inside the launching tube (DD) in the vicinity of the upper opening, and at least one lower pyrotechnic stage (ST) disposed inside the launching tube (DD) under the upper pyrotechnic stage (ST); going from the bottom opening towards the upper opening, each pyrotechnic stage (ST) comprises a launching charge (C) and effect means (M);
   - a separator (1) disposed between said upper pyrotechnic stage (ST) and said at least one lower pyrotechnic stage (ST); said separator (1) comprising an axial conduit (10) that is disposed in the center of the separator (1) in order to house a fuse (U);

   characterized in that said separator (1) comprises a first thin end disk (11) made of cardboard, a second thin end disk (12) made of cardboard with a diameter (d1), and at least one spacing ring (2) made of cardboard with a diameter (d2) disposed between said first thin end disk (11) and said second thin end disk (12); wherein the internal diameter (d3) of the launching tube (DD) is higher than the diameter (d2) of the spacing ring (2) and lower than the diameter (d1) of the thin end disks (11, 12); said thin disks (11, 12, 13) comprising a perimeter portion (5) shaped like an annular crown that protrudes with respect to the spacing rings (2); said perimeter portion (5) comprising an edge suitable for adhering on the internal surface of the launching tube (DD).

2. The pyrotechnic device (100) of claim 1, wherein said separator (1) comprises a plurality of spacing rings (2) made of cardboard disposed between said first thin end disk (11) and said second thin end disk (12); said separator (1) comprising a plurality of thin intermediate disks (13) made of cardboard, which are identical to the thin end disks (11, 12) and are disposed between each pair of spacing rings (2) made of cardboard.

3. The pyrotechnic device (100) of any one of the preceding claims, wherein the ratio between the diameter (d2) of said at least one spacing ring (2) and the diameter (d1) of the thin disks (11, 12, 13) ranges from 0.7 to 0.9.

4. The pyrotechnic device (100) of any one of the pre-

ceding claims, comprising a plurality of pyrotechnic stages (ST) disposed one on top of the other under the upper pyrotechnic stage (ST); said pyrotechnic device (100) comprising a plurality of separators (1), each of them being disposed between two consecutive pyrotechnic stages (ST).

5. The pyrotechnic device (100) of any one of the preceding claims, comprising an upper separator (1) disposed above the upper pyrotechnic stage (ST).

6. The pyrotechnic device (100) of any one of the preceding claims, wherein the width of said perimeter portion (5) of each thin disk (11, 12, 13) is comprised between 1 mm and 5 mm.

7. The pyrotechnic device (100) of any one of the preceding claims, wherein each thin disk (11, 12, 13) of the separator (1) has a thickness of approximately 1 mm - 2 mm.

8. The pyrotechnic device (100) of any one of the preceding claims, wherein the thickness of each spacing ring (2) is comprised between 6 mm and 8 mm.

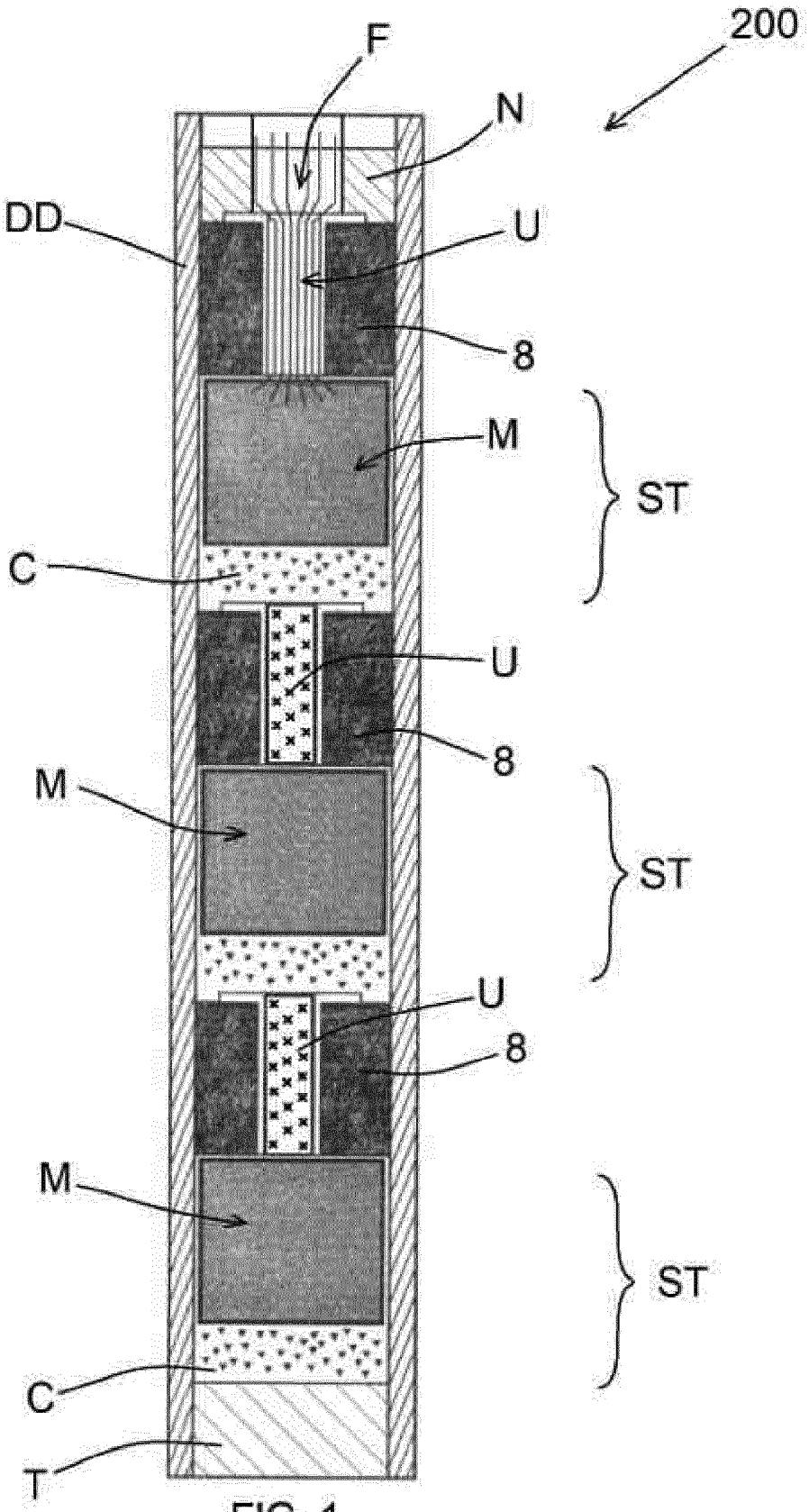

FIG. 1
PRIOR ART

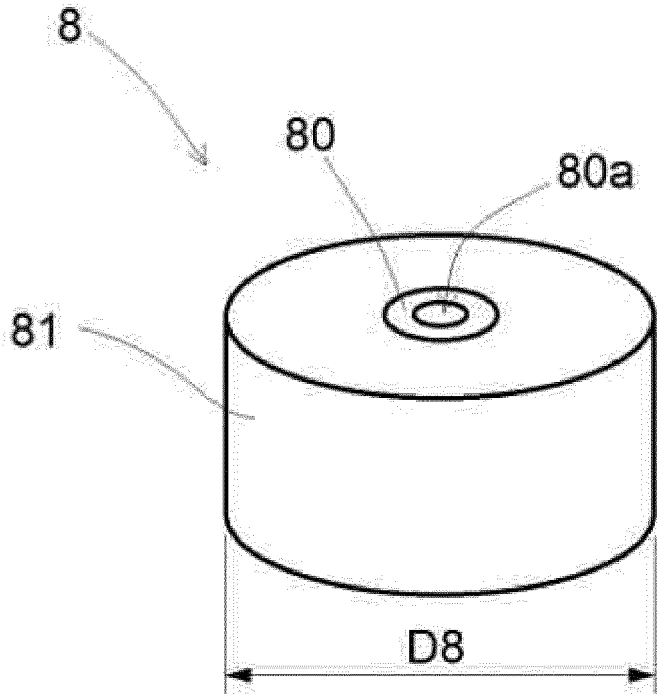

FIG. 2
PRIOR ART

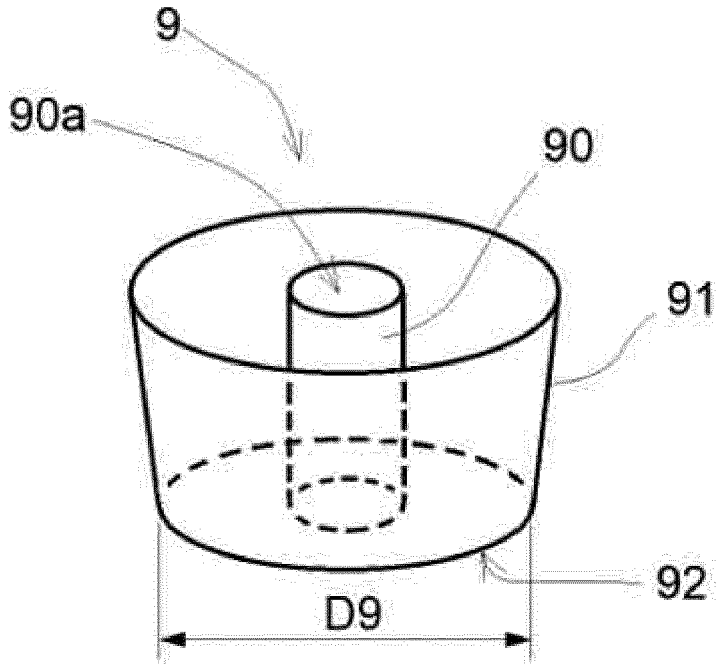

FIG. 3
PRIOR ART

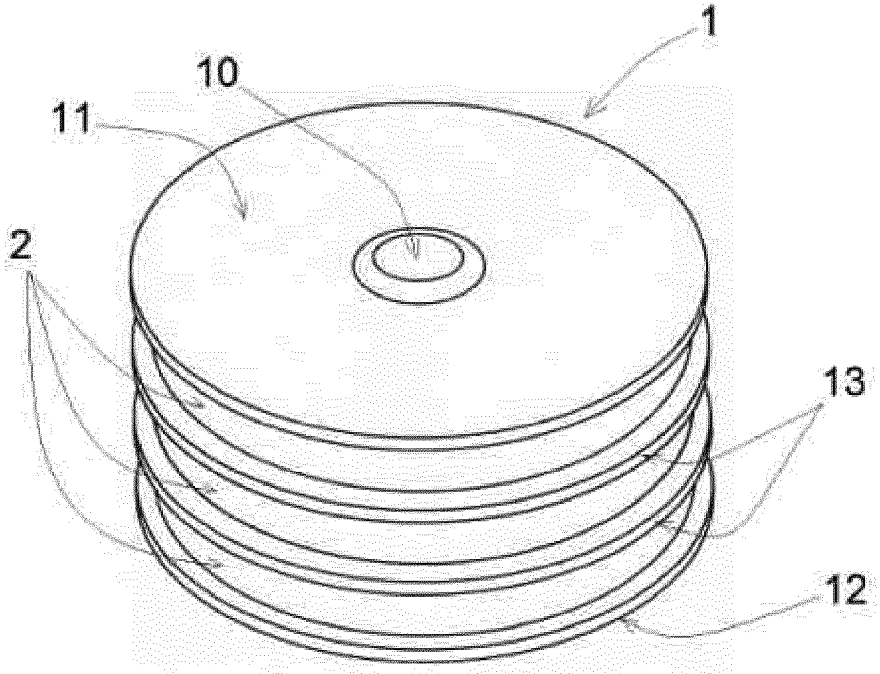

FIG. 4

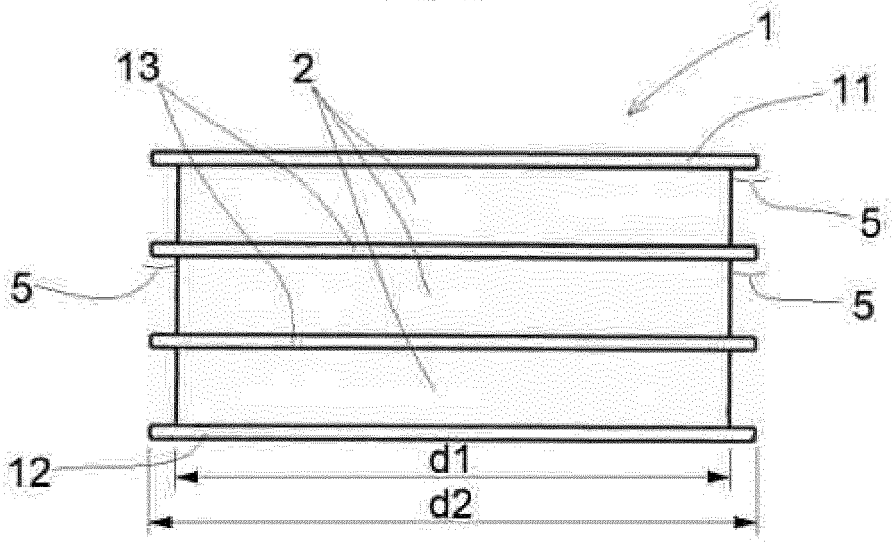

FIG. 5

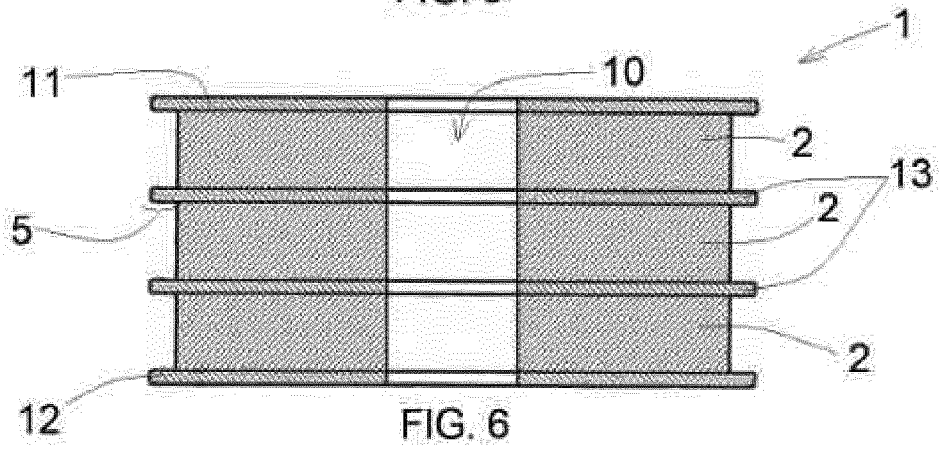

FIG. 6

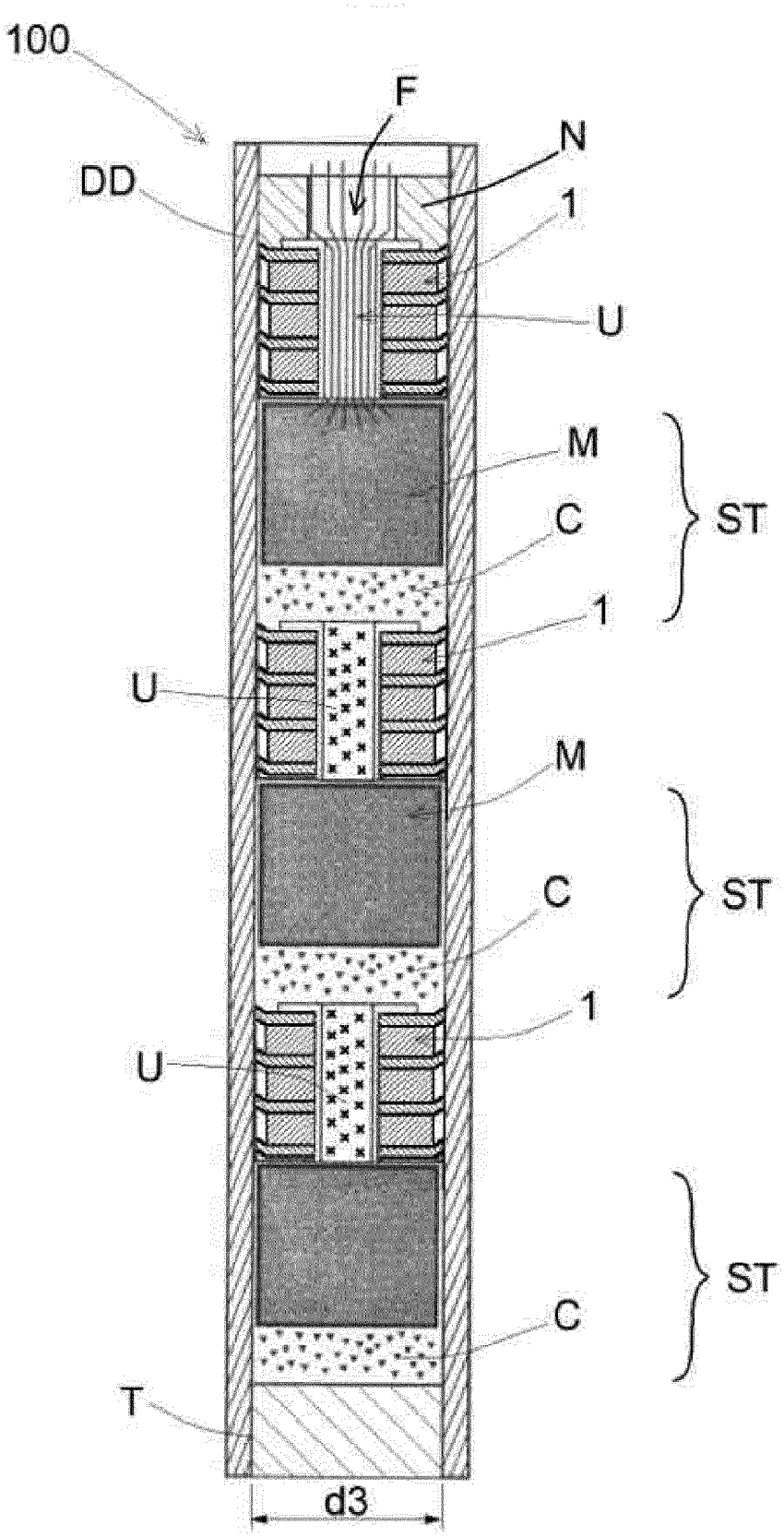

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 6850

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 1 696 598 A (HUANG MINGFA [CN]) 16 November 2005 (2005-11-16) * the whole document *	1-8	INV. F42B4/02 F42B4/24
A	JP 2004 003782 A (ISHIKAWA ENKA KK) 8 January 2004 (2004-01-08) * paragraph [0006]; figure 1 *	1-8	
A	JP S52 123574 U (UNKNOWN) 20 September 1977 (1977-09-20) * the whole document *	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

F42B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 March 2021	Seide, Stephan

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