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(54) ROCK CRACKER CARTRIDGE AND IGNITION CAPSULE

STEINBRECHKARTUSCHE UND ZÜNDKAPSEL

CARTOUCHE POUR ÉCLATER DE LA ROCHE ET CAPSULE D'ALLUMAGE

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Description

TECHNICAL FIELD

[0001] The invention concerns a rock cracker cartridge comprising a first, outer sleeve with an end wall in a first end and a central opening in a second end which in other respects is closed by a closure member; a substantially cylindrical, second sleeve which is coaxial with the first, outer sleeve and with said central opening and communicates with said central opening and is connected to and extends from said closure member in a main chamber in said first, outer sleeve; and a rock cracker cartridge which fills the space in the main chamber between said first and second sleeves and between the end wall in said first end and the closure member in the second end.

[0002] The invention also concerns an ignition capsule for igniting the rock cracker cartridge, which ignition capsule in combination with a surrounding ignition assembly sleeve defines an explosive ignition assembly in the rock cracker cartridge which is prepared for ignition, said ignition assembly sleeve being an integrated member of the rock cracker cartridge, when the rock cracker cartridge is not yet prepared for ignition, as well as of the rock cracker cartridge when the rock cracker cartridge is prepared for ignition.

BACKGROUND OF THE INVENTION

[0003] A rock cracker cartridge of the type mentioned in the preamble is disclosed in WO 2009/120139. This cartridge represents a significant contribution to the technical progress within its specific technical field; cracking major stones, usually called boulders, blocks of rock, minor bedrock sections and the like, in such a mode that it can be carried out even very close to buildings or in other environments which normally would require considerable measurements of precaution. It is also an objective of the invention to bring this technical progress a further step forwards. More specifically, it is ab purpose to provide ignition means for the rock cracker cartridge, which satisfy the requirements of lowest Swedish classification for transportation of explosives, transportation class 1,4. This means that the rock cracker cartridge shall be able to be fired without use of a detonator containing any detonating explosive, such as PENT or the like, which conventional ignition capsules do. These and other objectives of the invention can be achieved by means of a rock cracker cartridge and an ignition capsule which are characterized by what is stated in the appending patent claims.

[0004] Other characteristic features and advantages of the invention will be apparent from the following description of a preferred embodiment.

BRIEF DESCRIPTION OF DRAWINGS

[0005] In the following description of a preferred embodiment, reference will be made to the accompanying drawings, in which

Fig. 1 is perspective view of a sleeve, in this context termed ignition unit sleeve,
Fig. 2 shows an end view of the ignition unit sleeve according to Fig. 1,
Fig. 3 shows the ignition unit sleeve in a longitudinal cross-section along the line III-III in Fig. 2,
Fig. 4 shows the ignition unit sleeve in a transversal cross-section along the line IV-IV in Fig. 2,
Fig. 5 shows a complete ignition capsule including the ignition unit sleeve in longitudinal cross-section as in Fig. 3,
Fig. 6 shows an insert of mainly known design,
Fig. 7 shows the insert according to Fig. 6 in a longitidunal, axial cross-section,
Fig. 8 shows the rock cracker cartridge of the invention before priming as viewed obliquely from above,
Fig. 9 shows the rock cracker cartridge of the invention primed in a bore in a piece of rock that shall be cracked, and
Fig. 10 shows the primed rock cracker cartridge in cross-section along a line X-X in Fig. 9.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0006] The unprimed cracker cartridge 1, Fig. 8, comprises a first, outer plastic sleeve 2 and an insert unit 25, Fig.6 and Fig.7, which in turn consists of a plug 4 and a second, inner sleeve 7. The plug 4 and the inner sleeve 7 consist, according to the embodiment, of a hard plastic material, more specifically an acetal plastic material, and still more specifially of an acetal (POM)- copolymer and are mould jointly to form an integrated unit.

[0007] The outer sleeve 2 is, according to the embodiment, made of a so called ABS-plastic, which also is a hard plastic material, and has the shape of an elongated circular-cylindrical tube with a flat end wall. The interior of the outer sleeve 2 forms a main chamber 5 which is filled with a cracking powder charge 6, preferably a nitro powder charge (NC-powder), Fig. 9.

[0008] The plug 4 has a circular-cylindrical outer wall 19, a flat annular end wall 20, which faces the main chamber 5 and is pressed against the powder charge 6, and a tubular portion 31 which defines a through hole 8, which is coaxial with the outer sleeve 2. Radial beams 24 extend between the tubular portion 21 and the cylindrical wall. Wedge-shaped, material saving recesses between the beams 24 are designated 23, and an upper flange is designated. On said upper flange there are provided three spacer members 19a, which protrude in the axial direction.

[0009] The second, inner sleeve 7, which is coaxial with the first, outer sleeve 2, and defines an ignition assembly sleeve 7a in the primed cracker cartridge 1, extends from the flat end wall 20 of the plug 4 into the cracking powder charge 6 in the outer sleeve 2 to a significant

depth in the powder charge, as is shown in Fig. 9. The sleeve 7, 7a has a comparatively thin wall 13. According to the embodiment, it is about one millimetre thick. It may optionally, in order to make it stiffer, be provided with longitudinal, external stiffeners. According to the preferred embodiment, however, the outer surface as well as the main portion of the inner surface are quite smooth, which nevertheless affords the ignition assembly sleeve 7a an adequate stiffness but at the same time not a greater rupture resistance than what it maximally may have in order certainly to be broken up when that ignition capsule which shall be described in the following, is ignited, and which in the primed cracking cartridge 1 is accommodated in the space 9 of the ignition assembly sleeve 7a which is denominated priming chamber. The pointed nose portion or tip 12 is conical, forming an acute angle. Close to the nose portion 12, the sleeve 7a has an internal constriction 26, which is about 0.2 mm thick in the radial direction and about 5 mm long in the axial direction.

[0010] The plug 4 is pressed with some force into the mouth section of the outer sleeve 2 so far that the flange 22 abuts the upper edge of the outer sleeve 2 and the flat end wall 20 will be pressed against the cracking powder charge 6. In connection with the insert 25 being entered, the inner sleeve, 7, 7a, will be pressed into the cracking powder charge 6, which is facilitated by its pointed edge portion or tip 12. The quantity of powder in the cracking powder charge 6 is adapted so that the insert 25 can be pressed into the outer sleeve 2 such that the cracking powder charge is compacted to a certain degree, which is advantageous because that prevents the powder from moving to any significant degree during transportation, however, is not compacted so much that the thin wall 13 of the inner sleeve is damaged or is pressed together to any significant degree.

[0011] In the thus assembled cracker cartridge 1, the interior of the ignition assembly sleeve 7a forms a direct continuation of the through hole 8 in the plug 4 and it also has the same cross section as the hole 8. The hole 8 and the inner space in the ignition assembly sleeve 7a in other words are integrated and form said priming chamber 9.

[0012] With reference now also to Fig.1 - Fig. 5, the ignition capsule is generally designated 30. The ignition capsule 30 consists of an ignition unit sleeve 31, Fig. 1-Fig. 4, and, in said sleeve 31 an ignition unit 32 consisting of an igniter 33a which can be activated electrically, an ignition powder charge 29 consisting of the same type of NC-powder as the cracking powder charge 6, and an igniter socket 34, to which ignition cables 37 are connected. The igniter is of the type which has its normal use in the pyrotechnical field for firing pyrotechnical articles. Igniters of that type are manufactured e.g. by the Czech company META-PYRO, s.r.o., Brno.

[0013] The ignition unit sleeve 31 consists of a hard plastic material, preferably of the same type of ABS-plastic as the outer sleeve 2. The thickness, according to the embodiment is the same as of the ignition assembly sleeve 7a, about one millimetre. The ignition unit sleeve 31, however, is provided with a number, according to the embodiment of four external grooves 35 which extend from the cupped end portion 36 of the sleeve in the axial direction towards the mouth of the sleeve all the way to at level with the front end of the igniter 33a which is accommodated in the priming chamber 9. As to the rest the ignition unit sleeve 31 has a smooth circular-cylindrical outside surface 38. The depth of the grooves 35 exceeds half the wall thickness of the ignition unit sleeve 31, more specifically, the depth is 0.7 mm. The mean width of the grooves, which widen in the outwards direction, approximately equals the wall thickness of the ignition unit sleeve. The outer diameter of the ignition unit sleeve 31 is slightly - about 0.2 mm - smaller than the inner diameter of the ignition assembly sleeve 7a. Its cylindrical length equals the cylindrical length of the ignition assembly sleeve 7a, i.e. it extends all the way to the conical nose portion 12 of the ignition assembly sleeve 7a. This means that, when priming the cracker cartridge 1, the ignition capsule 30 can be entered into the ignition assembly sleeve 7a with close fit against the inside surface of the ignition assembly sleeve but without jamming. The gap 39 between the two sleeves 31 and 7a amounts to about 0.1 mm according to the embodiment but it may also be slightly smaller or larger. Preferably, however, the width of the gap should be within the range 0.05 - 0.2 mm. As has been mentioned in the foregoing, the ignition assembly sleeve 7a, however, has a constriction 26 quite close to the conical nose portion 12, which constriction has an extension in the radial direction which is greater than the width of the gap 39. In the preferred embodiment, the radial extension is about twice as large as the width of the gap or 0.2 mm. By, in the last phase of the entering operation of the ignition capsule 30 into the ignition assembly sleeve 7a, pressing the ignition unit sleeve 31 of the ignition capsule 30 into said constriction 26, the ignition capsule is fixed in the priming chamber 9, which prevents it from coming loose unintentionally and fall out when the rock cracker cartridge 1 is handled. The ignition unit sleeve 31 is provided with an outwardly directed flange 40 around its mouth 36, which sets a limit for its entering into the ignition assembly sleeve 7a.

[0014] The ignition unit sleeve 31 has a mouth section 41, Fig. 3, with an inner diameter which is slightly larger than the main portion of the sleeve 31 and a length adapted to the diameter and length of the socket 34 of the igniter 33a, so that the igniter 33a is secured in the charged ignition capsule 30 through press-fit between the socket 34 and the ignition unit sleeve 31 in the region of the mouth section 41. The igniter 33a extends in the ignition capsule 30 from its socket 34 into the ignition powder charge 29 all the way to where the grooves 35 have their rear ends on the outer side of the ignition capsule/ignition unit sleeve. The igniter 33a thus is surrounded by and is in intense contact with ignition powder, which, lightly compressed, occupies essentially all available space between the cupped bottom portion 36 of the ignition unit sleeve 31 and the igniter socket 34. There-

fore, the contact between the igniter 33a and the ignition powder charge 29 is very good, which promotes a safe ignition of the ignition powder charge when the ignition unit 32 is ignited electrically by means of the igniter 33a.

[0015] It is an important principle of the present invention that the ignition capsule 30 is not an explosive product "in free state", such as for example during transportation and storage, but that it shall be able to explode in a space which is closed by walls, such as in the ignition assembly sleeve 7a in the primed rock cracker cartridge 1. More specifically, the combustion of the ignition powder charge 29 and of the cracking powder charge 6 take place through that form of explosion which is called *deflagration ,* in which the reaction zone proceeds during the process of combustion of the powder at a velocity which is lower than the velocity of sound in the powder charge, in contrast to *detonation* in detonative explosives. In this mode the desired effect can be achieved, namely, according to the invention, to crack the boulder or rock portion in which the cracker cartridge has been primed in a boring, but not to fragment it into a lot of pieces which would run the risk to be thrown widely around.

[0016] In the above description, a number of terms have been used for the various components of the rock cracker cartridge of invention. These terms have been chosen in order that they as far as possible shall describe the function of the various components. How the various components are defined and how they work shall be summed up as follows:

- The rock cracker cartridge 1 is a cartridge which is filled with an explosive agent for the purpose of cracking large boulders, minor rock sections and the like through *deflagration* of the explosive agent which consists of (gun) powder.
- The ignition capsule 30 consists of an ignition unit sleeve 31 and an ignition unit 32
- The ignition unit 32 consists of an igniter 33a on a socket 34, electrical ignition cables 37 and ignition powder charge 29.
- The ignition capsule 30 can explode only if it is accommodated in a closed space which is limited by walls of adequate strength. The ignition unit sleeve 31 does not have such strength because its wall is thin and consists of a plastic material of limited rupture strength, and also because it is provided with said rupture strength reducing grooves 35. If the ignition unit 32 would be ignited in "the open air", the powder in the ignition powder charge would catch fire, the ignition unit sleeve 31 would be widened and possibly break as the powder successively is burnt but it would not explode. This means that the burning is not developed in a dramatic, explosion like mode, which, however does not mean that the ignition capsule may be handled carelessly. It shall be handled like a flammable product in the same class as various pyrotechnical articles.
- The sleeve 7 of insert unit 25 which is pressed into the cracking powder charge 6 is termed ignition assembly sleeve 7a in order to mark that it is an element of the integrated ignition assembly which comprises the ignition capsule 30 and the sleeve 7, 7a. In said assembly, in which the ignition capsule 30 is inserted in the ignition unit sleeve 31, the strength of the wall of the sleeve 7/the ignition assembly sleeve 7a is added to the wall strength of the ignition unit sleeve 31, so that said two sleeves in combination, and possibly also in cooperation with support from the surrounding cracking powder charge 6, get a sufficient resistance against rupture in order to afford explosive features to the assembly, so that the ignition powder charge 29 as well as the cracking powder charge 6 will explode and be combusted through *deflagration,* see above.

[0017] When priming the rock cracker cartridge 1, which is carried out on the blasting site where a large boulder or a section of the bedrock shall be cracked, the ignition capsule 30 is entered into the priming chamber 9 of the insert 25 in the rock cracker cartridge 6 so far as the flange 40 on the ignition unit sleeve 31 permits, and so that it is fixed in that position by means of the constriction 26, into which the front section of the cylindrical part of the ignition unit sleeve 31 is pressed in during the final phase of the entering procedure. Then the cartridge 1 is brought, upside down, all the way down into the bore 42 that has been made in the boulder or section of the bedrock to be cracked, such that the protruding spacer members 19a will rest against the bottom of the bore. If the rock cracker cartridge 1 is oriented in that way it can be hauled up again by means of the ignition cables 37, if one would wish to break off the cracking operation. If the rock cracker cartridge 1 instead were oriented with the protruding spacer members 19a directed upwards, and if one in that case would haul up the ignition cables 37, there would be a risk that the socket 34 with the igniter 33a or the entire ignition capsule 30 comes loose.

[0018] When the igniter 33a is electrically ignited, it ignites the ignition powder charge 29 causing the ignition powder charge to explode through *deflagration.* type of combustion. The ignition unit sleeve 31 is widened by the pressure developed by the explosion so far as is possible due to the narrow gap 39 and ruptures in the regions of the strength reducing grooves 35. Which will take place first; the widening or the rupture is difficult or impossible to say but has on the other hand no significant importance. Probably, the widening and the rupture occur as good as simultaneously. On the other hand, it is not unimportant that the ignition unit sleeve 31 ruptures in the region of the grooves 35, because that may contribute to a radially directed development of the pressure that almost simultaneously is transferred to the surrounding sleeve 7 - the ignition assembly sleeve 7a - so that also that one will rupture. The violent flame of fire which is developed in the ignition powder charge 29 now is trans-

ferred to the cracking powder charge 6 causing also that one to explode through *deflagration* type of combustion, which provides a desired radial development of pressure in the bore 42 and hence the intended cracking of the boulder or corresponding 43.

[0019] Also by means of the rock cracker cartridge 1 and of the ignition capsule 30 which have been improved according to the invention, delay ignition of ignition capsules and of rock cracker cartridges set at intervals may be applied according to the principles which have been disclosed in said WO 2009/120139. These principles therefore shall not be repeated in this text.

Claims

1. A rock cracker cartridge (1) comprising a first, outer sleeve (2) with an end wall (3) in a first end and a central opening (8) in a second end which in other respects is closed by a closure member (4); a substantially cylindrical, second, inner sleeve (7) which is coaxial with the first, outer sleeve and with said central opening and communicates with said central opening and is connected to and extends from said closure member in a main chamber (5) in said first, outer sleeve; and a rock cracking powder charge (6) filling the space in the main chamber between said first and second sleeves and between the end wall in said first end and the closure member in the second end, **characterized in**

   - **that** in the primed rock cracker cartridge there is provided an ignition assembly comprising a first and a second ignition assembly member,
   - **that** said first ignition assembly member includes an ignition capsule (30) with an ignition unit sleeve (31) containing an ignition unit comprising an ignition initiator (33) which can be activated electrically, and an ignition powder charge (29) which can be ignited by the ignition initiator, and
   - **that** the ignition unit sleeve (31) does not have the mechanical strength which would be required for an explosion of the ignition powder charge (29) upon ignition of said ignition powder charge when the ignition capsule is in the open air, in which case the ignition unit sleeve (31) only would be widened and possibly rupture and the ignition powder charge would burn without any explosive effect.

2. Rock cracker cartridge according to claim 1, **characterized in that** the mechanical strength of the ignition unit sleeve (31), when the ignition capsule is inserted into the ignition assembly sleeve (7a), which is surrounded by the cracking powder charge (6), in combination with the strength of the ignition assembly sleeve (7a) under support by the surrounding cracking powder charge, affords a sufficient mechanical strength to that assembly which comprises the ignition unit sleeve (31) and the ignition assembly sleeve (7a) in order that, upon ignition of the ignition powder charge, an adequate pressure shall develop in the assembly and the ignition powder charge explode and generate a flame of fire, and the ignition unit sleeve (31) and the ignition assembly sleeve (7a) be penetrated by the pressure and by the flame of fire which has a capacity to ignite the cracking powder charge.

3. Rock cracker cartridge according to claim 1 or 2, **characterized in that** the ignition unit sleeve (31) as well as the ignition assembly sleeve (7a) consist of a hard plastic material.

4. Rock cracker cartridge according to any claims 1-3, **characterized in that** the thickness of each of the ignition unit sleeve and of the ignition assembly sleeve amounts to at least 0.5 mm but not more than 2.0 mm, and that the combined thickness of the two sleeves amounts to at least 1.3 mm but not to more than 3 mm.

5. Rock cracker cartridge according to any of claims 1-4, **characterized in that** the ignition unit sleeve consists of a one piece tube of plastic material, that said tubular sleeve of hard plastic material has a front end portion (36) which is closed, and in the rear end a mouth portion (41) with a rear opening (27), that the ignition initiator comprises an electrically activatable igniter (33a) with a socket (34) to which ignition cables (37) are connected, that the socket is provided in said mouth portion of the ignition unit sleeve (31), and that the igniter is provided in the ignition unit sleeve (31) at a distance from the socket.

6. Rock cracker cartridge according to any of claims 1-5, **characterized in that** the ignition unit sleeve (31) is provided with external grooves (35) which reduce the strength of the ignition unit sleeve (31) in substantially the radial direction.

7. Rock cracker cartridge according to claim 6, **characterized in that** said grooves extend from a position at a distance from said mouth portion in a direction towards the closed end of the ignition unit sleeve (31), and that said grooves has an extension within which at least the main portion of the ignition powder charge extends.

8. Rock cracker cartridge according to claim 7, **characterized in that** the igniter is accommodated in the ignition powder charge, that the main portion of the ignition powder charge is provided between the igniter (33a) and the closed end portion (36) of the ignition unit sleeve, and that said external grooves

(35) extend from at level with the outer end of the igniter along the cylindrical wall of ignition unit sleeve to the closed end portion of the ignition unit sleeve.

9. Rock cracker cartridge according to any of claims 6-8, **characterized in that** the ignition unit sleeve (31) has an outwardly directed flange (40) in the region of the mouth (27), and that the outer surface of the ignition unit sleeve is cylindrical and smooth in the region between said flange and said grooves, and that said outer surface is cylindrical and smooth also between said grooves all along the length of said grooves.

10. Rock cracker cartridge according to any of the foregoing claims, **characterized in that** the end portion of the ignition unit sleeve is cupped and is located at least partly in or border the nose portion (12) of the ignition assembly sleeve (7a).

11. Rock cracker cartridge according to any of claims 6-10, **characterized in that** between the ignition assembly sleeve (7a) and the ignition unit sleeve (31) is a gap (39), the width of which has no significant importance for the strength of the ignition assembly but allows the ignition capsule (30), in connection with priming of the cracker cartridge, to be entered into the ignition assembly sleeve (7a) without jamming, and that a constriction (26) is provided on the inside of the ignition assembly sleeve (7a) in a zone adjacent to the tip (12) of the ignition assembly sleeve, said constriction having a radial extension which is larger than the width of said gap (39), in order to fix the ignition capsule in its primed position through friction between the ignition assembly sleeve (7a) and the ignition unit sleeve (31) in the region of the constriction.

12. Rock cracker cartridge according to any of claims 1-11, **characterized in that** one or more, in the axial direction protruding members (19a) are provided on said closure member (4), and that there is at least one free space between the protruding members, which form spacers when the rock cracker cartridge is placed upside-down in a bore with the protruding member/members resting on the bottom of the bore, such that the ignition cables (37) may run through said free space/spaces without being damaged.

13. Ignition capsule comprising an ignition unit sleeve (31) in the form of a tube, which has mouth (27) and a mouth portion (41) in one end, is closed in the opposite end, and contains an ignition unit (32), **characterized in that** the ignition unit sleeve consists of a hard plastic material, that the ignition unit comprises an ignition initiator (33) which can be activated electrically, and an ignition powder charge (29) which can be ignited by the ignition initiator, and that the ignition unit sleeve (31) does not have the mechanical strength which would be required for an explosion of the ignition powder charge (29) upon ignition of said ignition-powder charge when the ignition capsule is in the open air, in which case the ignition unit sleeve (31) only would be widened and possibly rupture and the ignition powder charge would burn without any explosive effect.

14. Ignition capsule according to claim 13, **characterized in that** the ignition intitiator comprises an electrically activatable igniter (33a) with a socket (34) to which ignition cables (37) are connected, and that the socket is provided in said mouth portion of the ignition unit sleeve (31).

15. Ignition capsule according to any of claims 13 and 14, **characterized in that** the ignition unit sleeve is provided with external grooves (35) which reduce the rupture strength of the ignition unit sleeve in substantially the radial direction thereof.

16. Ignition capsule according to claim 1.5, **characterized in that** said grooves extend from a position at a distance from said mouth portion towards the closed end of the ignition unit sleeve, that said grooves have an extension within which at least the main part of the ignition powder charge extends, that the grooves have a depth corresponding to at least half the wall thickness of the ignition unit sleeve, and **in that** the mean width of the grooves is of the same order as the wall thickness of the ignition unit sleeve.

17. Ignition capsule according to any of claims 13-16, **characterized in that** the igniter is accommodated in the ignition powder charge, that the main portion of the ignition powder charge is provided between the igniter (33a) and the closed end portion (36) of the ignition unit sleeve, that said external grooves (35) extend from at level with the outer end of the igniter along the cylindrical wall of ignition unit sleeve to the closed end portion of the ignition unit sleeve, **in that** the ignition unit sleeve (31) has an outwardly directed flange (40) in the region of the mouth (27), and that the outer surface of the ignition unit sleeve is cylindrical and smooth in the region between said flange and said grooves, and that said outer surface is cylindrical and smooth also between said grooves all along the length of said grooves.

18. Ignition capsule according to any of claims 13-17, **characterized in that** the ignition powder charge consists of nitro powder.

Patentansprüche

1. Steinbrecherkartusche (1) umfassend eine erste äu-

ßere Hülse (2) mit einer Endwand (3) an einem ersten Ende und einer zentralen Öffnung (8) an einem zweiten Ende, das ansonsten durch ein Verschlusselement (4) verschlossen ist; eine im Wesentlichen zylindrische zweite innere Hülse (7), die koaxial mit der ersten äußeren Hülse und mit der zentralen Öffnung ist, und mit der zentralen Öffnung in Verbindung steht, und verbunden ist mit und sich erstreckt von dem Verschlusselement in einer Hauptkammer (5) in der ersten äußeren Hülse; und eine Steinbrecherpulverladung (6), die den Raum in der Hauptkammer zwischen den ersten und zweiten Hülsen und zwischen der Endwand an dem ersten Ende und dem Verschlusselement an dem zweiten Ende füllt; **dadurch gekennzeichnet,**

- **dass** in der scharf gemachten Steinbrecherkartusche ein Zündaufbau bereitgestellt ist, der ein erstes und ein zweites Zündaufbauelement umfasst,
- **dass** das erste Zündaufbauelement eine Zündkapsel (30) enthält, mit einer Zündeinheits-Hülse (31), die eine Zündeinheit enthält, welche einen Zündauslöser (33), der elektrisch aktiviert werden kann, und eine Zündpulverladung (29), die durch den Zündauslöser gezündet werden kann, umfasst, und
- **dass** die Zündeinheits-Hülse (31) nicht die mechanische Festigkeit aufweist, die benötigt würde für eine Explosion der Zündpulverladung (29) nach Zündung der Zündpulverladung, wenn sich die Zündkapsel im Freien befindet, in welchem Fall die Zündeinheits-Hülse (31) nur geweitet und möglicherweise reißen würde und die Zündpulverladung ohne irgendeinen explosiven Effekt abbrennen würde.

2. Steinbrecherkartusche gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die mechanische Festigkeit der Zündeinheits-Hülse (31), wenn die Zündkapsel in die Zündaufbau-Hülse (7a), welche von der Brecherpulverladung (6) umgeben ist, eingesetzt ist, zusammen mit der Festigkeit der Zündaufbau-Hülse (7a), unter Unterstützung durch die umgebende Brecherpulverladung, dem Aufbau, welcher die Zündeinheits-Hülse (31) und die Zündaufbau-Hülse (7a) umfasst, eine ausreichende mechanische Festigkeit bietet um, beim Zünden der Zündpulverladung, einen hinreichenden Druck in dem Aufbau zu entwickeln und die Zündpulverladung zur Explosion zu bringen und eine Feuerflamme zu erzeugen, und wobei die Zündeinheits-Hülse (31) und die Zündaufbau-Hülse (7a) durch den Druck und durch die Feuerflamme durchbrochen werden, welche die Fähigkeit hat die Brecherpulverladung zu entzünden.

3. Steinbrecherkartusche gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Zündeinheits-Hülse (31) sowie die Zündaufbau-Hülse (7a) aus einem Hartplastikmaterial bestehen.

4. Steinbrecherkartusche gemäß einem der Ansprüche 1-3, dadurch **gekennzeich net**, dass die Dicke der Zündeinheits-Hülse und der Zündaufbau-Hülse jeweils mindestens 0,5 mm aber nicht mehr als 2,0 mm beträgt, und dass die kombinierte Dicke der zwei Hülsen mindestens 1,3 mm aber nicht mehr als 3 mm beträgt.

5. Steinbrecherkartusche gemäß einem der Ansprüche 1-4, dadurch **gekennzeich net**, dass die Zündeinheits-Hülse aus einer einstückigen Röhre aus Plastikmaterial besteht, dass die röhrenförmige Hülse aus Hartplastikmaterial einen vorderen Endabschnitt (36), der geschlossen ist, und an dem hinteren Ende einen Eingangsabschnitt (41), mit einer hinteren Öffnung (27), aufweist, dass der Zündauslöser einen elektrisch aktivierbaren Zünder (33a) mit einer Buchse (34), mit der die Zündkabel (37) verbunden sind umfasst, dass die Buchse in dem Eingangsabschnitt der Zündeinheits-Hülse (31) bereitgestellt ist, und dass der Auslöser in der Zündeinheits-Hülse (31) in einem Abstand von der Buchse bereitgestellt ist.

6. Steinbrecherkartusche gemäß einem der Ansprüche 1-5, dadurch **gekennzeich net**, dass die Zündeinheits-Hülse (31) mit außenliegenden Rillen (35) versehen ist, die die Festigkeit der Zündeinheits-Hülse (31) im Wesentlichen in der radialen Richtung reduzieren.

7. Steinbrecherkartusche gemäß Anspruch 6, **dadurch gekennzeichnet, dass** sich die Rillen von einer Stelle in einem Abstand von dem Eingangsabschnitt in eine Richtung zu dem geschlossenen Ende der Zündeinheits-Hülse (31) erstrecken, und dass die Rillen sich über einen Bereich erstrecken, innerhalb dem sich mindestens der Hauptabschnitt der Zündpulverladung erstreckt.

8. Steinbrecherkartusche gemäß Anspruch 7, **dadurch gekennzeichnet, dass** der Zünder in der Zündpulverladung untergebracht ist, dass der Hauptabschnitt der Zündpulverladung zwischen dem Zünder (33a) und dem geschlossenen Endabschnitt (36) der Zündeinheits-Hülse bereitgestellt ist, und dass die außenliegenden Rillen (35) sich von einer Ebene mit dem äußeren Ende des Zünders entlang der zylindrischen Wand der Zündeinheits-Hülse zu dem geschlossenen Endabschnitt der Zündeinheits-Hülse erstrecken.

9. Steinbrecherkartusche gemäß einem der Ansprüche 6-8, dadurch **gekennzeich net**, dass die

Zündeinheits-Hülse (31) einen auswärts gerichteten Flansch (40) in dem Bereich des Eingangs (27) aufweist, und dass die äußere Oberfläche der Zündeinheits-Hülse in dem Bereich zwischen dem Flansch und den Rillen zylindrisch und glatt ist, und dass die äußere Oberfläche ebenfalls zwischen den Rillen entlang der ganzen Länge der Rillen zylindrisch und glatt ist.

10. Steinbrecherkartusche gemäß einem der vorgehenden Ansprüche, dadurch **geken nzeichnet**, dass der Endabschnitt der Zündeinheits-Hülse gewölbt ist und zumindest teilweise in dem oder angrenzend an den Nasenabschnitt (12) der Zündaufbau-Hülse (7a) angebracht ist.

11. Steinbrecherkartusche gemäß einem der Ansprüche 6-10, dadurch **gekennzeic hnet**, dass zwischen der Zündaufbau-Hülse (7a) und der Zündeinheits-Hülse (31) eine Lücke (39) besteht, deren Breite keine maßgebliche Bedeutung für die Festigkeit des Zündaufbaus besitzt, jedoch der Zündkapsel (30) ermöglicht, in Verbindung mit dem scharf machen der Brecherkartusche, in die Zündaufbau-Hülse (7a) ohne Blockierung eingesetzt zu werden, und dass eine Verengung (26) an der Innenseite der Zündaufbau-Hülse (7a), in einer Zone benachbart der Spitze (12) der Zündaufbau-Hülse, bereitgestellt ist, wobei sich die Verengung über einen radialen Bereich erstreckt, der grösser als die Breite der Lücke (39) ist, um die Zündkapsel in ihrer scharf gemachten Stellung durch Reibung zwischen der Zündaufbau-Hülse (7a) und der Zündeinheits-Hülse (31) in dem Bereich der Verengung zu fixieren.

12. Steinbrecherkartusche gemäß einem der Ansprüche 1-11, dadurch **gekennzeic hnet**, dass eines oder mehrere, in der axialen Richtung hervorstehende, Elemente (19a) auf dem Verschlusselement (4) bereitgestellt sind, und dass sich dort mindestens ein freier Raum zwischen den vorstehenden Elementen befindet, welche Abstandshalter bilden wenn die Steinbrecherkartusche auf dem Kopf stehend in einer Bohrung platziert wird, wobei das vorstehende Element / die vorstehenden Elemente auf dem Boden der Bohrung ruhen, so dass die Zündkabel (37) durch den freien Raum / die freien Räume verlaufen können ohne beschädigt zu werden.

13. Zündkapsel umfassend eine Zündeinheits-Hülse (31) in der Form einer Röhre, welche einen Eingang (27) und einen Eingangsabschnitt (41) an einem Ende aufweist, an dem gegenüberliegenden Ende geschlossen ist, und eine Zündeinheit (32) enthält, **dadurch gekennzeichnet, dass** die Zündeinheits-Hülse aus einem Hartplastikmaterial besteht, dass die Zündeinheit einen Zündauslöser (33), der elektrisch aktiviert werden kann, und eine Zündpulverladung (29), die durch den Zündauslöser gezündet werden kann, aufweist, und dass die Zündeinheits-Hülse (31) nicht die mechanische Festigkeit besitzt, welche benötigt würde für eine Explosion der Zündpulverladung (29) nach Zündung der Zündpulverladung, wenn sich die Zündkapsel im Freien befindet, in welchem Fall die Zündeinheits-Hülse (31) nur geweitet und möglicherweise reißen würde und die Zündpulverladung ohne irgendeinen explosiven Effekt abbrennen würde.

14. Zündkapsel gemäß Anspruch 13, **dadurch gekennzeichnet, dass** der Zündauslöser einen elektrisch aktivierbaren Zünder (33a) mit einer Buchse (34), mit welcher Zündkabel (37) verbunden sind, aufweist, und dass die Buchse in dem Eingangsabschnitt der Zündeinheits-Hülse (31) bereitgestellt ist.

15. Zündkapsel gemäß einem der Ansprüche 13 und 14, dadurch **gekennzeichne t**, dass die Zündeinheits-Hülse mit außenliegenden Rillen (35) versehen ist, die die Reißfestigkeit der Zündeinheits-Hülse im Wesentlichen in der radialen Richtung hiervon reduzieren.

16. Zündkapsel gemäß Anspruch 15, **dadurch gekennzeichnet, dass** sich die Rillen von einer Stelle in einem Abstand von dem Eingangsabschnitt in eine Richtung zu dem geschlossenen Ende der Zündeinheits-Hülse erstrecken, dass sich die Rillen über einen Bereich erstrecken, innerhalb dem sich mindestens der Hauptabschnitt der Zündpulverladung erstreckt, dass die Rillen eine Tiefe aufweisen, die mindestens der Hälfte der Wanddicke der Zündeinheits-Hülse entspricht, und dass die mittlere Breite der Rillen von der gleichen Größenordnung wie die Wanddicke der Zündeinheits-Hülse ist.

17. Zündkapsel gemäß einem der Ansprüche 13-16, **dadurch gekennzeichnet, dass** der Zünder in der Zündpulverladung untergebracht ist, dass der Hauptabschnitt der Zündpulverladung zwischen dem Zünder (33a) und dem geschlossenen Endabschnitt (36) der Zündeinheits-Hülse bereitgestellt ist, dass die außenliegenden Rillen (35) sich von einer Ebene mit dem äußeren Ende des Zünders entlang der zylindrischen Wand der Zündeinheits-Hülse zu dem geschlossenen Endabschnitt der Zündeinheits-Hülse erstrecken, dass die Zündeinheits-Hülse (31) einen auswärts gerichteten Flansch (40) in dem Bereich des Eingangs (27) aufweist, und dass die äußere Oberfläche der Zündeinheits-Hülse in dem Bereich zwischen dem Flansch und den Rillen zylindrisch und glatt ist, und dass die äußere Oberfläche ebenfalls zwischen den Rillen entlang der ganzen Länge der Rillen zylindrisch und glatt ist.

18. Zündkapsel gemäß einem der Ansprüche 13-17, **da-**

durch gekennzeichnet, dass die Zündeinheitsladung aus Nitropulver besteht.

Revendications

1. Cartouche de craqueur de roche (1) comprenant un premier manchon extérieur (2) avec une paroi d'extrémité (3) dans une première extrémité et une ouverture centrale (8) dans une seconde extrémité qui, sous d'autres aspects, est fermée par un organe de fermeture (4) ; un second manchon intérieur sensiblement cylindrique (7) qui est coaxial avec le premier manchon extérieur et avec ladite ouverture centrale et communique avec ladite ouverture centrale et est raccordé à et s'étend depuis ledit organe de fermeture dans une chambre principale (5) dans ledit premier manchon extérieur ; et une charge de poudre de craqueur de roche (6) remplissant l'espace dans la chambre principale entre lesdits premier et second manchons et entre la paroi d'extrémité dans ladite première extrémité et l'organe de fermeture dans la seconde extrémité, **caractérisée en ce que**

   - dans la cartouche de craqueur de roche amorcée, est prévu un ensemble d'allumage comprenant un premier et un second organe d'ensemble d'allumage,
   - ledit premier organe d'ensemble d'allumage comporte une capsule d'allumage (30) avec un manchon d'unité d'allumage (31) contenant une unité d'allumage comprenant un initiateur d'allumage (33) qui peut être activé électriquement, et une charge de poudre d'allumage (29) qui peut être allumée par l'initiateur d'allumage, et
   - le manchon d'unité d'allumage (31) ne possède pas la résistance mécanique qui serait nécessaire pour faire exploser la charge de poudre d'allumage (29) lors de l'allumage de ladite charge de poudre d'allumage lorsque la capsule d'allumage est en plein air, auquel cas le manchon d'unité d'allumage (31) serait uniquement élargi et se romprait éventuellement et la charge de poudre d'allumage brûlerait sans effet explosif.

2. Cartouche de craqueur de roche selon la revendication 1, **caractérisée en ce que** la résistance mécanique du manchon d'unité d'allumage (31), lorsque la capsule d'allumage est insérée dans le manchon d'ensemble d'allumage (7a), qui est entouré par la charge de poudre de craqueur de roche (6), en combinaison avec la résistance du manchon d'ensemble d'allumage (7a) avec l'aide de la charge de poudre de craqueur de roche environnante, confère une résistance mécanique suffisante à cet ensemble qui comprend le manchon d'unité d'allumage (31) et le manchon d'ensemble d'allumage (7a) afin que, lors de l'allumage de la charge de poudre d'allumage, une pression adéquate se développe dans l'ensemble et que la charge de poudre d'allumage explose et génère une flamme de feu, et que le manchon d'unité d'allumage (31) et le manchon d'ensemble d'allumage (7a) soient pénétrés par la pression et par la flamme de feu qui a la capacité d'allumer la charge de poudre de craqueur de roche.

3. Cartouche de craqueur de roche selon la revendication 1 ou 2, **caractérisée en ce que** le manchon d'unité d'allumage (31) ainsi que le manchon d'ensemble d'allumage (7a) sont constitués d'un matériau plastique dur.

4. Cartouche de craqueur de roche selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** l'épaisseur de chacun du manchon d'unité d'allumage et du manchon d'ensemble d'allumage s'élève à au moins 0,5 mm mais pas plus de 2,0 mm, et que l'épaisseur combinée des deux manchons s'élève à au moins 1,3 mm mais pas plus de 3 mm.

5. Cartouche de craqueur de roche selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** le manchon d'unité d'allumage est constitué d'un tube monobloc de matériau plastique, **en ce que** ledit manchon tubulaire de matériau plastique dur comporte une portion d'extrémité avant (36) qui est fermée, et dans l'extrémité arrière, une portion d'embouchure (41) avec une ouverture arrière (27), **en ce que** l'initiateur d'allumage comprend un allumeur activable électriquement (33a) avec une prise (34) à laquelle sont raccordés des câbles d'allumage (37), **en ce que** la prise est prévue dans ladite portion d'embouchure du manchon d'unité d'allumage (31), **en ce que** l'allumeur est prévu dans le manchon d'unité d'allumage (31) à une distance de la prise.

6. Cartouche de craqueur de roche selon l'une quelconque des revendications 1 à 5, **caractérisée en ce que** le manchon d'unité d'allumage (31) est pourvu de gorges externes (35) qui réduisent la résistance du manchon d'unité d'allumage (31) sensiblement dans la direction radiale.

7. Cartouche de craqueur de roche selon la revendication 6, **caractérisée en ce que** lesdites gorges s'étendent depuis une position à une distance de ladite portion d'embouchure dans une direction vers l'extrémité fermée du manchon d'unité d'allumage (31), **en ce que** lesdites gorges comportent une extension au sein de laquelle s'étend au moins la portion principale de la charge de poudre d'allumage.

8. Cartouche de craqueur de roche selon la revendication 7, **caractérisée en ce que** l'allumeur est logé dans la charge de poudre d'allumage, **en ce que** la portion principale de la charge de poudre d'allumage

est prévue entre l'allumeur (33a) et la portion d'extrémité fermée (36) du manchon d'unité d'allumage, et **en ce que** lesdites gorges externes (35) s'étendent depuis le niveau de l'extrémité extérieure de l'allumeur le long de la paroi cylindrique du manchon d'unité d'allumage jusqu'à la portion d'extrémité fermée du manchon d'unité d'allumage.

9. Cartouche de craqueur de roche selon l'une quelconque des revendications 6 à 8, **caractérisée en ce que** le manchon d'unité d'allumage (31) comporte une bride dirigée vers l'extérieur (40) dans la région de l'embouchure (27), **en ce que** la surface extérieure du manchon d'unité d'allumage est cylindrique et lisse dans la région entre ladite bride et lesdites gorges, et **en ce que** ladite surface extérieure est également cylindrique et lisse entre lesdites gorges sur toute la longueur desdites gorges.

10. Cartouche de craqueur de roche selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la portion d'extrémité du manchon d'unité d'allumage est en forme de coupelle et est située au moins en partie dans ou en bordure de la portion de nez (12) du manchon d'ensemble d'allumage (7a).

11. Cartouche de craqueur de roche selon l'une quelconque des revendications 6 à 10, **caractérisée en ce que**, entre le manchon d'ensemble d'allumage (7a) et le manchon d'unité d'allumage (31) se trouve un écartement (39), dont la largeur n'a aucune importance significative pour la résistance de l'ensemble d'allumage mais permet d'entrer la capsule d'allumage (30), dans le cadre de l'amorçage de la cartouche de craqueur de roche, dans le manchon d'ensemble d'allumage (7a) sans coincement, et **en ce qu'**un étranglement (26) est prévu sur l'intérieur du manchon d'ensemble d'allumage (7a) dans une zone adjacente à la pointe (12) du manchon d'ensemble d'allumage, ledit étranglement ayant une extension radiale qui est plus grande que la largeur dudit écartement (39), afin de fixer la capsule d'allumage dans sa position amorcée par frottement entre le manchon d'ensemble d'allumage (7a) et le manchon d'unité d'allumage (31) dans la région de l'étranglement.

12. Cartouche de craqueur de roche selon l'une quelconque des revendications 1 à 11, **caractérisée en ce que**, dans la direction axiale, un ou plusieurs organes protubérants (19a) sont prévus sur ledit organe de fermeture (4), **en ce qu'**il existe au moins un espace libre entre les organes protubérants, qui forment des entretoises lorsque la cartouche de craqueur de roche est placée à l'envers dans un alésage avec le (les) organe(s) protubérant(s) appuyant sur le fond de l'alésage, de sorte que les câbles d'allumage (37) puissent courir à travers ledit (lesdits) espace(s) libre(s) sans être endommagés.

13. Capsule d'allumage comprenant un manchon d'unité d'allumage (31) sous forme de tube, qui comporte une embouchure (27) et une portion d'embouchure (41) dans une extrémité, est fermé dans l'extrémité opposée, et contient une unité d'allumage (32), **caractérisée en ce que** le manchon d'unité d'allumage est constitué d'un matériau plastique dur, **en ce que** l'unité d'allumage comprend un initiateur d'allumage (33) qui peut être activé électriquement, et une charge de poudre d'allumage (29) qui peut être allumée par l'initiateur d'allumage, et **en ce que** le manchon d'unité d'allumage (31) ne possède pas la résistance mécanique qui serait nécessaire pour faire exploser la charge de poudre d'allumage (29) lors de l'allumage de ladite charge de poudre d'allumage lorsque la capsule d'allumage est en plein air, auquel cas le manchon d'unité d'allumage (31) serait uniquement élargi et se romprait éventuellement et la charge de poudre d'allumage brûlerait sans effet explosif.

14. Capsule d'allumage selon la revendication 13, **caractérisée en ce que** l'initiateur d'allumage comprend un allumeur activable électriquement (33a) avec une prise (34) à laquelle sont raccordés des câbles d'allumage (37), et **en ce que** la prise est prévue dans ladite portion d'embouchure du manchon d'unité d'allumage (31).

15. Capsule d'allumage selon l'une quelconque des revendications 13 et 14, **caractérisée en ce que** le manchon d'unité d'allumage est pourvu de gorges externes (35) qui réduisent la résistance à la rupture du manchon d'unité d'allumage sensiblement dans sa direction radiale.

16. Capsule d'allumage selon la revendication 15, **caractérisée en ce que** lesdites gorges s'étendent depuis une position à une distance de ladite portion d'embouchure vers l'extrémité fermée du manchon d'unité d'allumage, **en ce que** lesdites gorges ont une extension au sein de laquelle s'étend au moins la partie principale de la charge de poudre d'allumage, **en ce que** les gorges ont une profondeur correspondant à au moins la moitié de l'épaisseur de paroi du manchon d'unité d'allumage, et **en ce que** la largeur moyenne des gorges est du même ordre que l'épaisseur de paroi du manchon d'unité d'allumage.

17. Capsule d'allumage selon l'une quelconque des revendications 13 à 16, **caractérisée en ce que** l'allumeur est logé dans la charge de poudre d'allumage, **en ce que** la portion principale de la charge de poudre d'allumage est prévue entre l'allumeur (33a) et la portion d'extrémité fermée (36) du manchon

d'unité d'allumage, **en ce que** lesdites gorges externes (35) s'étendent depuis le niveau de l'extrémité extérieure de l'allumeur le long de la paroi cylindrique du manchon d'unité d'allumage jusqu'à la portion d'extrémité fermée du manchon d'unité d'allumage, **en ce que** le manchon d'unité d'allumage (31) comporte une bride dirigée vers l'extérieur (40) dans la région de l'embouchure (27), et **en ce que** la surface extérieure du manchon d'unité d'allumage est cylindrique et lisse dans la région entre ladite bride et lesdites gorges, et **en ce que** ladite surface extérieure est également cylindrique et lisse entre lesdites gorges sur toute la longueur desdites gorges.

18. Capsule d'allumage selon l'une quelconque des revendications 13 à 17, **caractérisée en ce que** la charge de poudre d'allumage est constituée de poudre nitro.

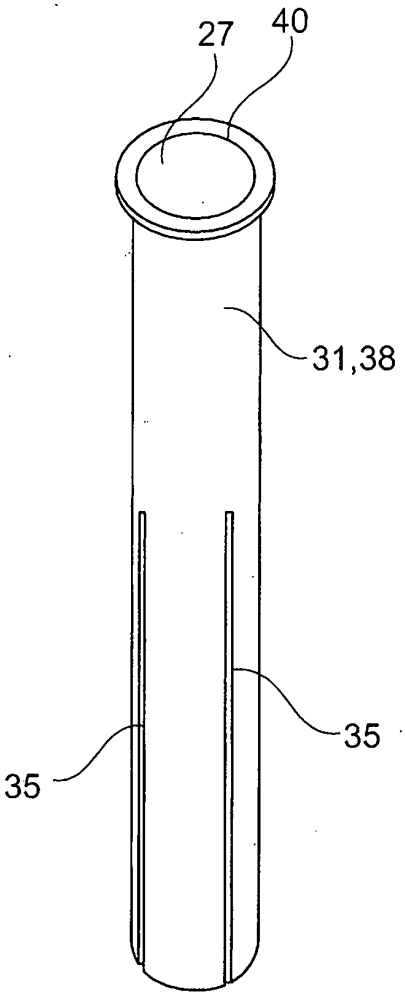


Fig. 1

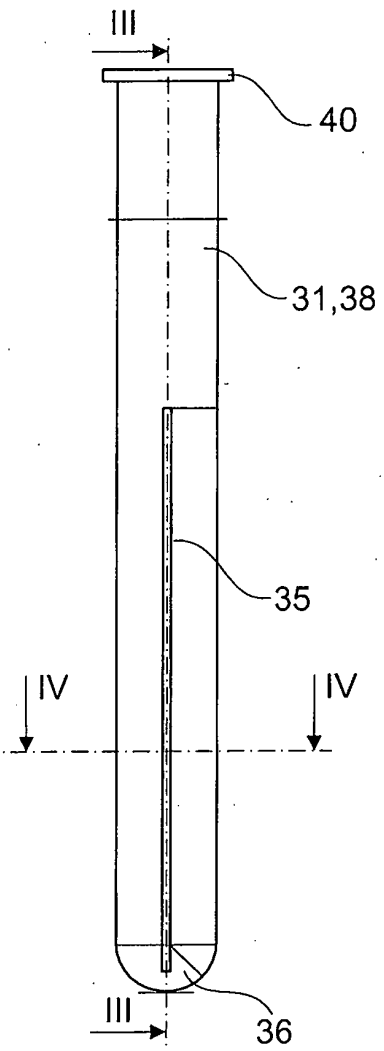


Fig. 2

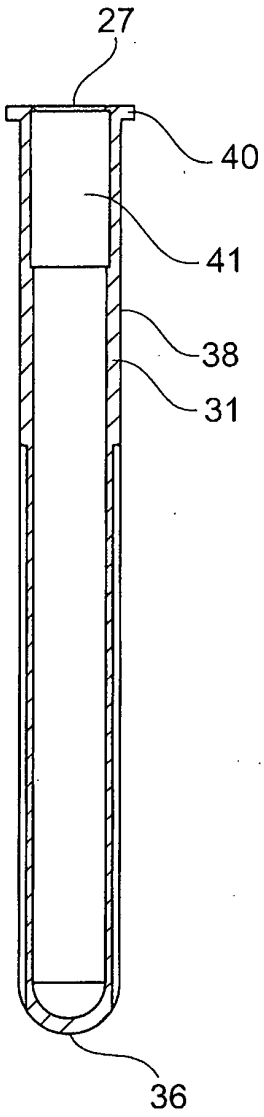


Fig. 3

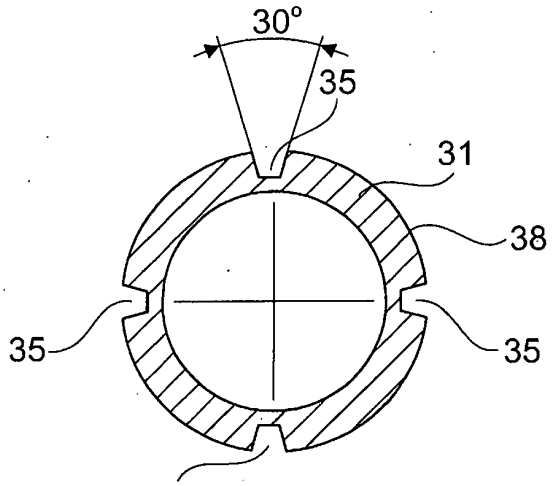


Fig. 4

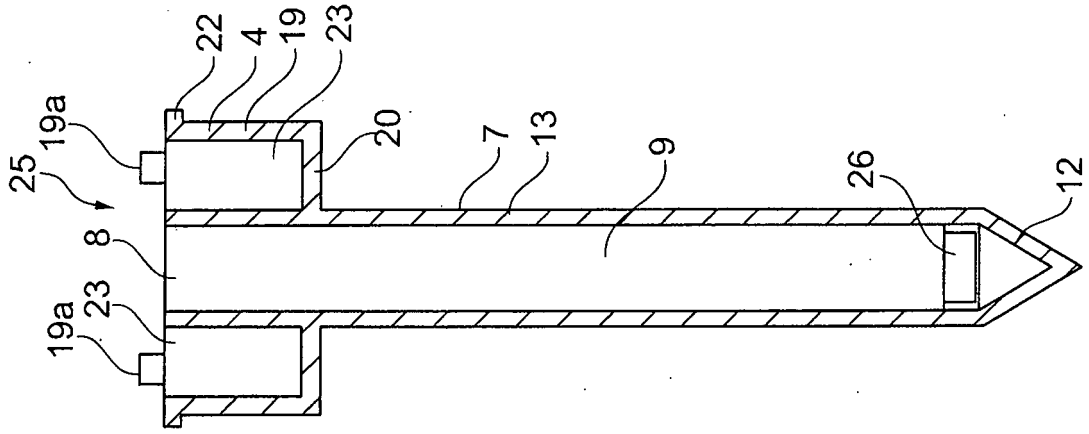


Fig. 7

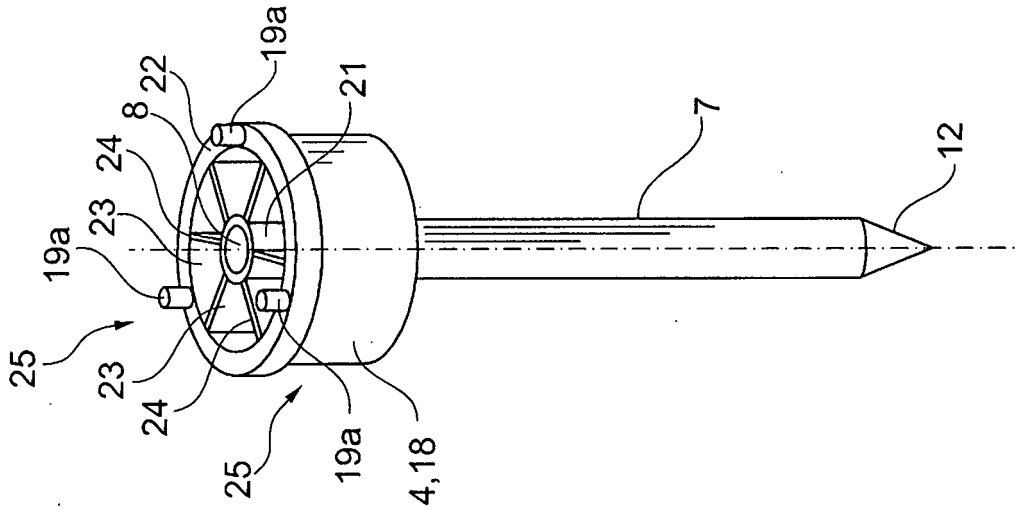


Fig. 6

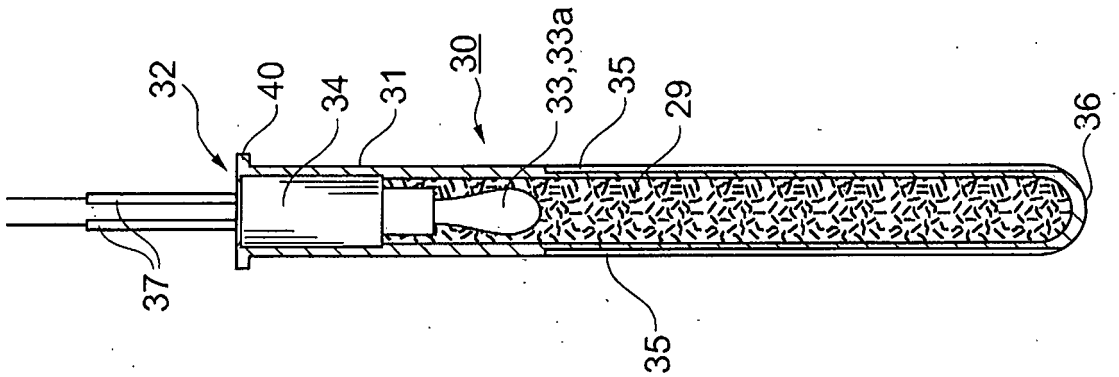


Fig. 5

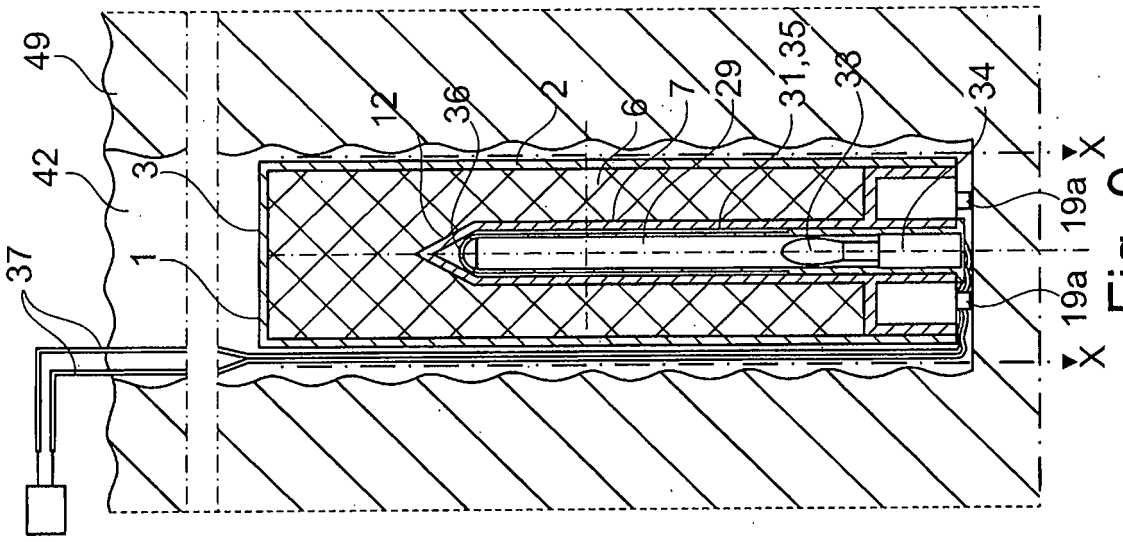

49
42
3
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37
12
36
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6
7
29
31,35
38
34
19a
19a
X
X

Fig. 9

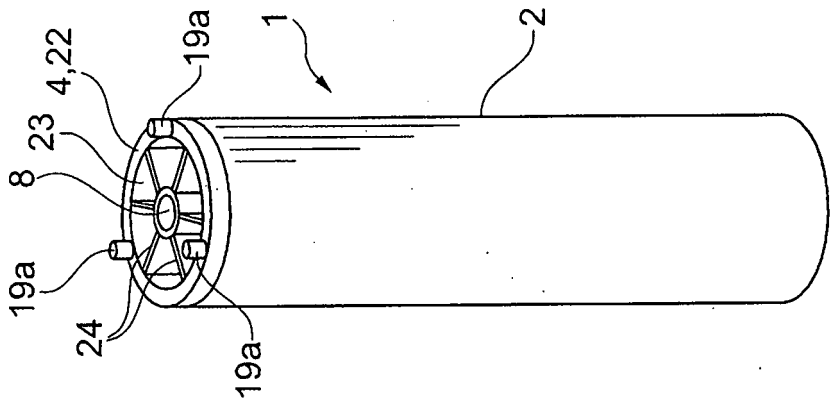

1
2
19a
4,22
23
8
19a
24
19a

Fig. 8

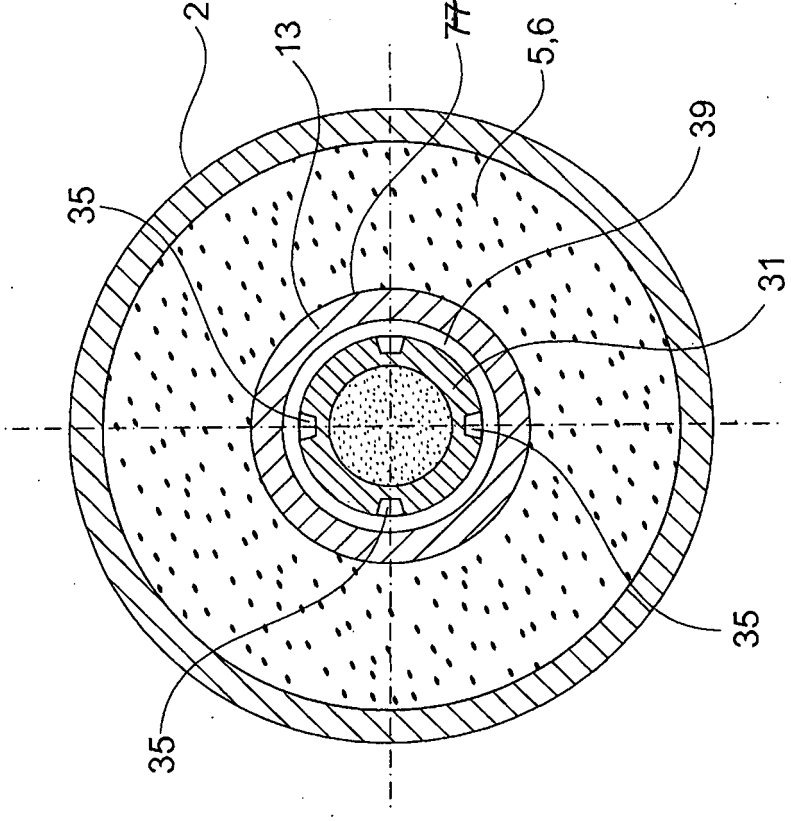


Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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