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(54) **Device for preventing permeation of rainwater or the like at a separator portion in a concrete structure**

(57) A plug for sealing an opening in a concrete structure, in particular an opening of a separation portion of the concrete structure, said plug comprising a stem with a base at the distal end and a seal element provided on the stem frontal of said base, wherein the seal element is manufactured in a material having a lower hardness than the stem, characterized in that a free space is defined between the distal end of the seal element and the frontal end of the base.

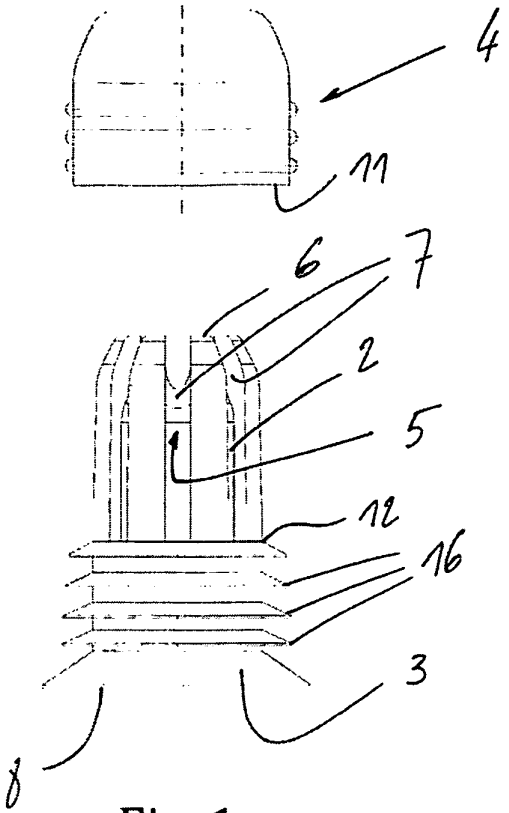


Fig. 1

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Description

Field of the Invention

[0001] The present invention concerns a plug for sealing an opening in a concrete structure, in particular an opening of a separation portion of the concrete structure, said plug comprising a stem with a base at the distal end and a seal element provided on the stem frontal of said base, wherein the seal element is manufactured in a material having a lower hardness than the stem.

Background of the Invention

[0002] It is well known to seal an opening of a separation portion in a concrete structure with a plug or the like. The French patent application FR 2.742.784 and the European patent document EP 0.288.583 disclose a plug made in a rigid material that is provided with a ring(s) of moisture swellable elastic material surrounding a section of the plug. When the plug is introduced in an opening of a separation portion, the ring(s) of moisture swellable elastic material will allow a sealing contact between the rigid material of the plug and the inner wall of the opening, thereby preventing water from entering the opening in the concrete structure. The plugs described in both above mentioned prior art documents can be introduced in an opening by use a hammer alone, without the need for any special equipment.

[0003] An inconvenience of the known plugs is that the ring of moisture swellable elastic material deforms due to friction with the inner walls of the opening when hammering the plug in that opening of the concrete structure. The friction results in a creep of the elastic material over the rigid core of the plug, thereby increasing the outer diameter of the plug and increasing the force needed to introduce the plug in the opening. As this type of plugs has an outer diameter that is slightly larger than the inner diameter of the opening of the separation portion in the concrete structure to ensure a tight fit and to prevent accidental removal of the plug, a further increase of the plug diameter will make it impossible to introduce the plug in the opening or will result in damaging the ring of elastic material at introduction of the plug in the opening, thereby potentially disrupting the seal between the plug and the inner wall of the opening.

[0004] It is clear from the above that there remains a demand for a technical solution which not only ensures tight sealing of the opening of separation portions in concrete structures but which is also easy to apply without the need for any equipment but a hammer.

[0005] The present invention meets this demand by providing a specifically designed plug for sealing an opening of a separation portion in a concrete structure.

Summary of the Invention

[0006] The present invention concerns a plug for sealing an opening in a concrete structure, in particular an opening of a separation portion of the concrete structure, said plug comprising a stem with a base at the distal end and a seal element provided on the stem frontal of said base, wherein the seal element is manufactured in a material having a lower hardness than the stem, characterized in that a free space is defined between the distal end of the seal element and the frontal end of the base.

[0007] The present invention also concerns a kit of parts comprising a separation portion protection tube and one or more plugs as identified here above.

Description of the Invention

[0008] The seal element is preferably manufactured in an elastomeric material, having a hardness of 90 Shore A or lower. More preferably, the elastomeric material is a moisture swellable material. By this particular plug composition with a rigid stem and a softer seal element and with a free space is defined between the distal end of the seal element and the frontal end of the base, a plug can be obtained allowing to seal an opening at high pressure.

[0009] Said free space preferably has a width (D) corresponding to or larger than the displacement of the material of the seal element when inserting the plug with its frontal side in an opening.

[0010] According to a preferred embodiment, the seal element comprises a cap like body enveloping the frontal end of the stem of the plug. The plug is inserted and left in the opening to be sealed.

Brief Description of the Drawings

[0011]

Figure 1 represents a exploded side view of a plug according to the present invention;

Figure 2 represents an perspective view of a plug according to the present invention;
Figure 3 represents a view according to arrow P3 in figure 1;
Figure 4 schematically represents a plug according to the present invention when inserted in an opening of a separation portion in a concrete structure.

Description of a preferred Embodiment

[0012] Figure 1 represents a plug according to the present invention, the plug 1 comprising a stem 2 with a base 3 at the distal end and a seal element 4 provided on the stem 2, frontal of said base 3.

[0013] According to the present invention, the seal element 4 is manufactured in a material having a lower hardness than the stem 2.

[0014] The stem 2 and base 3 are preferably manufactured as a single piece in a rigid synthetic and impact resistant material such as polyethylene; polypropylene or polyamide.

[0015] As represented in figure 2, the stem 2 is provided with a seat 5 for accommodating the seal element. This seat can be defined by an annular groove in the stem or as is the case in the represented embodiment by the frontal end 6 of the stem 2 and allows preventing sliding of the seal element 4 over the stem when introducing the plug in an appropriate opening to be sealed.

[0016] The seat 5 is preferably further defined by one or more axial grooves 7 or rims provided in or on the stem.

[0017] The base 3 is preferably a flat disc extending in a plane perpendicular to the stem. The distal surface 8 of the base can either be flat or slightly bulged outwardly and serves as a surface for hammering the plug in an opening. Optionally, the base comprises one or more radially extending rings 16 that are slightly inclined from the base to their outer perimeter towards the distal end of the plug 1. These rings have cross sectional dimensions substantially equal to cross sectional dimensions (A) of the opening (typically a diameter (A) of 21,5 to 22 mm) to be sealed and are an integral part of the stem 2 and base 3 and allow fixation of the plug into an opening. The advantage of these rings 16 is that the plug can be fixed in an opening with a resistance up to 5 bar of water pressure or ambient pressure, without being forced out of the opening. Hence, the seal element 4 can have a pure sealing function without being affected by the pressure in the opening the plug is sealing.

[0018] The seal element 4 can be either a separate piece to be assembled on the stem or can be molded on the stem 2.

[0019] According to the invention, a free space 10 is defined between the distal end 11 of the seal element 4 and the frontal end 12 of the base. This free space 10 has a width (D) corresponding to or larger than the displacement of the material of the seal element 4 when inserting the plug with its frontal side in an opening. The free space 10 is defined in that the diameter of the plug at the distal end 11 of the seal element is larger than the diameter of the plug along a portion of the plug immediately distal of the seal element 4.

[0020] In the present embodiment, the seal element 4 is designed as a cap like body enveloping the frontal end 6 of the stem 2, whereby rims 9 or grooves are provided at the inner surface of the cap which cooperate with the above mentioned rims or grooves 7 on the stem to prevent rotation of the seal element in view of the stem 2 and to support the seal element 4.

[0021] The seal element 4 is preferably manufactured in an elastomeric material having a hardness of 90 Shore A or lower, for example a thermoset rubber such as styrene-ethylene/butylene-styrene (SEBS) or styrene-ethylene/propylene-styrene (SEPS) rubbers.

[0022] The seal element preferably comprises moisture swellable materials to increase the sealing function of the plug. The combination of a rigid stem with a softer seal element and a free space is defined between the distal end of the seal element and the frontal end of the base allows providing a plug with a guaranteed air pressure resistance and a water pressure resistance of 5 bar or more.

[0023] Examples of moisture swellable materials that can be used for the seal element 4 include acryl, vinyl and inorganic moisture swelling resins. It is particularly preferable to use a flexible material containing moisture swelling polyurethane which comprises a mixture of a moisture swelling polyurethane resin, and for example, natural, synthetic or reclaimed rubber, therefor.

[0024] Such a flexible material as described above may be obtained by kneading one or more polyether polyols of the following general formula:

$$R[(OR)n]p$$

wherein R represents a polyhydric alcohol residue; (OR) represents a polyoxyalkylene chain comprising oxyalkylene groups each having an oxyethylene group and an alkylene group carrying three or four carbon atoms, provided that the content of the oxyethylene groups amounts to 20 to 100% of the total molecular weight;
n is a number corresponding to the degree of polymerization of the oxyalkylene groups and giving a hydroxyl group equivalent of 200 to 2500; and p is a number of 2 to 8, preferably 2 to 4; together with urethane polymer(s) having

polyisocyanate groups, a crosslinking agent and the rubber as defined above followed by curing.

[0025] Examples of said polyhydric alcohol include dihydric alcohols such as ethylene glycol and propylene glycol; trihydric alcohols such as glycerol and trimethylolpropane; tetrahydric alcohols such as erythritol and pentaerythritol; pentahydric alcohols such as arabitol and xylitol; and hexahydric alcohols such as sorbitol and mannitol.

[0026] Said polyether polyols may be obtained by adding alkylene oxide(s) to these polyhydric alcohols in such a manner as to give the desired molecular weight. Either random or block addition may be employed therefor. When the content of the oxyethylene groups is less than 20%, the resulting material is unsatisfactory as a moisturestop material. Any polyisocyanates may be employed. The content of the terminal isocyanate groups may be 1 to 12%, preferably 2 to 7%.

[0027] Example of said crosslinking agent include polyols and polyamines each carrying two to six active hydrogen atoms per molecule and has an average molecular weight per active hydrogen atom of 30 to 15000, for example, low-molecular weight polyols, addition polymers of low-molecular weight polyols and alkylene oxides and addition polymers of low-molecular weight polyamines and alkylene oxides, as well as mixtures thereof.

[0028] It is preferable that the flexible material as described above contains 20 to 800 parts of moisture swelling polyurethane resin per 100 parts of the rubber.

[0029] Other examples of preferable flexible materials are those obtained by further adding hydraulic material(s) to a composition comprising said moisture swelling polyurethane resin and rubber. Examples of available hydraulic materials include Portland cement, blast furnace cement, colloidal cement and gypsum. It is preferable to employ a curing accelerator for cement comprising calcium aluminate simultaneously therewith. A flexible material comprising such a hydraulic material has an advantage that it shows little shrinkage when dried. It is preferable that the hydraulic material is blended in an amount of 20 to 30 parts per 100 parts of the mixture of the moisture swelling polyurethane and rubber.

[0030] The above flexible material may further contain appropriate moisture absorbing material(s). Examples of the moisture absorbing materials include those mainly comprising an alpha, beta-unsaturated compound, which carries one or more carboxyl groups or those capable of being derived thereto such as carboxyl, carboxylate, carboxylic imide, carboxylic amide or carboxylic anhydride groups per molecule, and optionally polymerized with other alpha, beta.-unsaturated compound(s) and/or modified with isocyanate(s).

[0031] Examples of such a moisture absorbing resin include conventional moisture absorbing polymers such as starch-acrylic acid graft copolymer, a salt of styrene/maleic anhydride copolymer, crosslinked poly(sodium acrylate), vinyl ester/ethylenically unsaturated carboxylic acids, and saponified products or derivatives thereof.

[0032] The flexible material may be further vulcanized with the use of a crosslinking agent such as sulfur.

[0033] It is preferable that the composition of the flexible material may be controlled in such a manner as to give a moisture swelling ratio of the resulting molded article of 10 to 350%, still preferably 40 to 250%.

[0034] Figure 4 represents the plug 1 when inserted with its frontal end first in an opening 13 of a separation portion protection tube 14 of a concrete structure 15, the base 3 abutting the outer surface of the concrete structure around the opening 13.

[0035] The present invention is by no means limited to the embodiments described above and represented in the accompanying figures; on the contrary, such a plug for sealing an opening in a concrete structure can be made in various executions while remaining within the scope of the invention.

Claims

1. A plug for sealing an opening in a concrete structure, in particular an opening of a separation portion of the concrete structure, said plug comprising a stem with a base at the distal end and a seal element provided on the stem frontal of said base, wherein the seal element is manufactured in a material having a lower hardness than the stem, **characterized in that** a free space is defined between the distal end of the seal element and the frontal end of the base.

2. The plug according to claim 1, wherein the sealing element is manufactured in an elastomeric material.

3. The plug according to claim 2, wherein the sealing element is manufactured in a thermoset rubber.

4. The plug according to claim 1, wherein the sealing element is manufactured in a moisture swellable material.

5. The plug according to claim 1, wherein the seal element is manufactured in a material having a hardness of 90 Shore A or lower.

6. The plug according to claim 1, wherein the base comprises one or more radially extending rings (16) having cross

sectional dimensions (A) substantially equal to cross sectional dimensions of the opening to be sealed.

7. The plug according to claim 6, wherein the rings (16) are inclined from the base to their outer perimeter towards the distal end of the plug (1).

8. The plug according to claim 1, wherein said free space has a width (D) corresponding to or larger than the displacement of the material of the seal element when inserting the plug with its frontal side in an opening.

9. The plug according to claim 1, wherein the seal element comprises a cap like body enveloping the frontal end of the stem of the plug.

10. A kit of parts comprising a separation portion protection tube (14) and one or more plugs (1) as identified in claims 1 to 9.

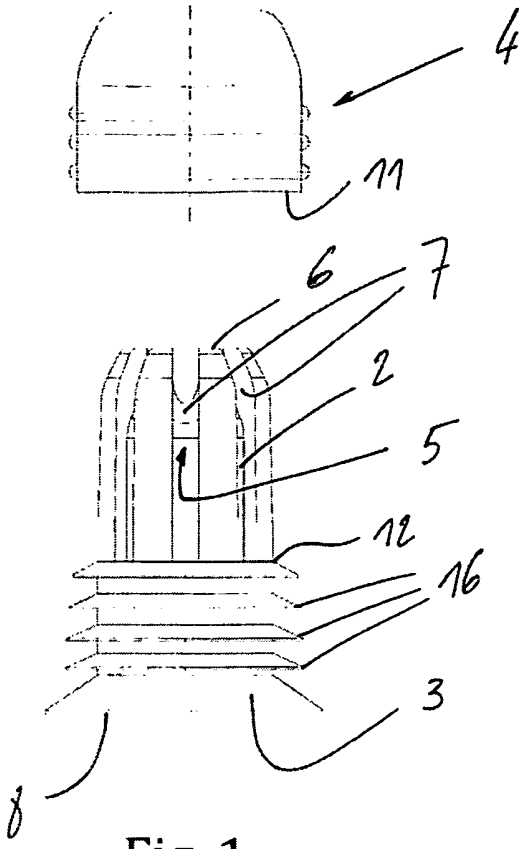


Fig. 1

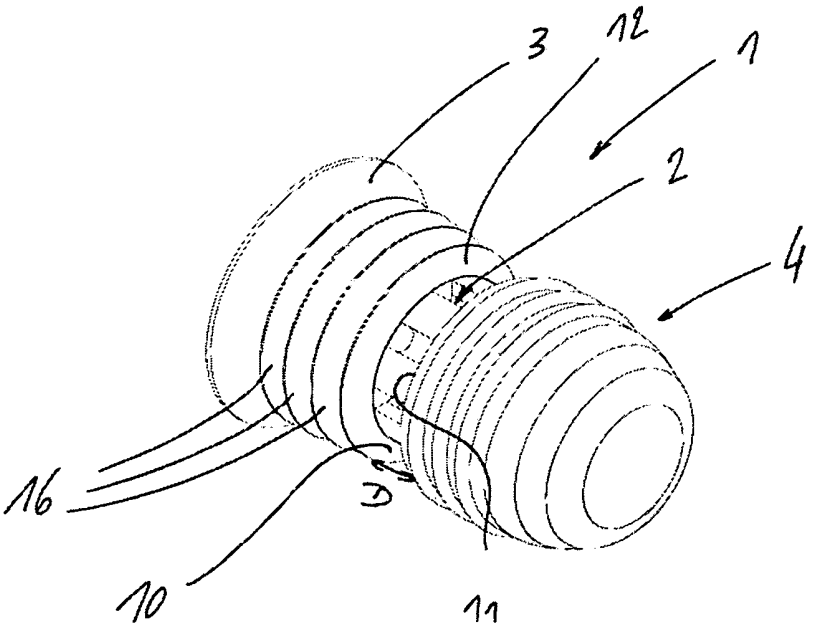


Fig. 2

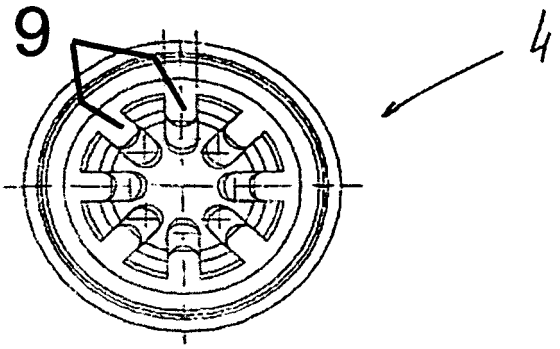


Fig. 3

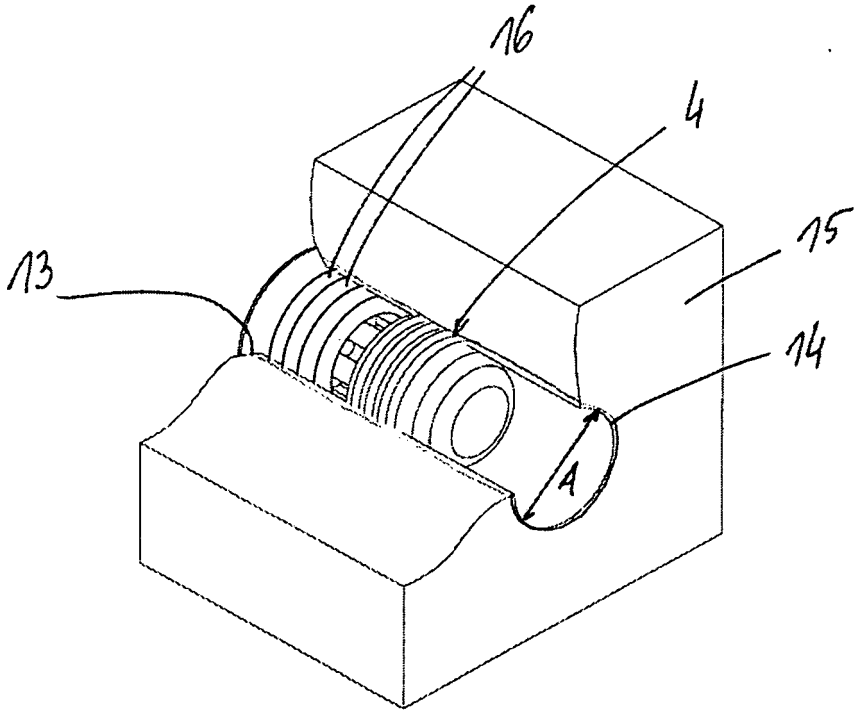


Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 7146

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 November 2010	Andlauer, Dominique

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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