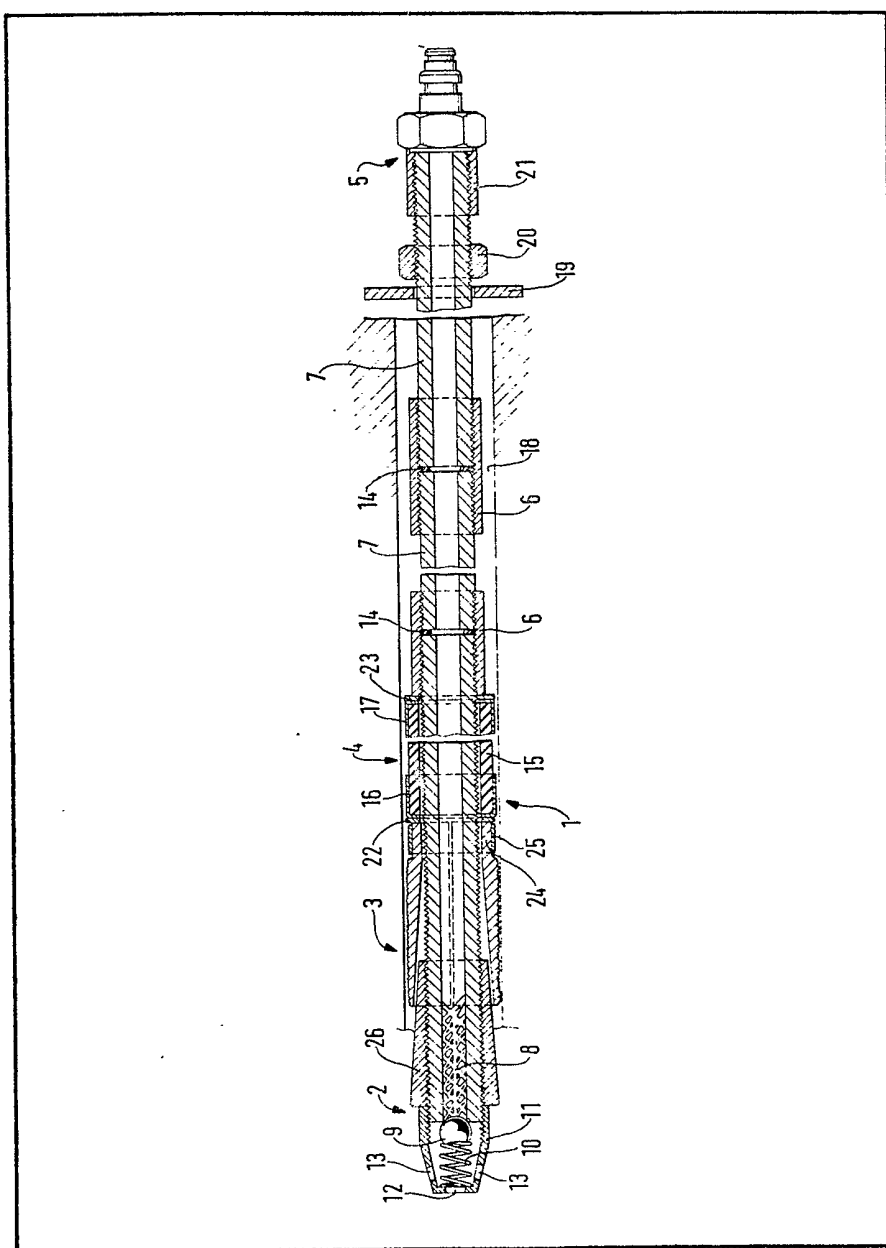


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(54) **Tubular Plug for a Blind Borehole**

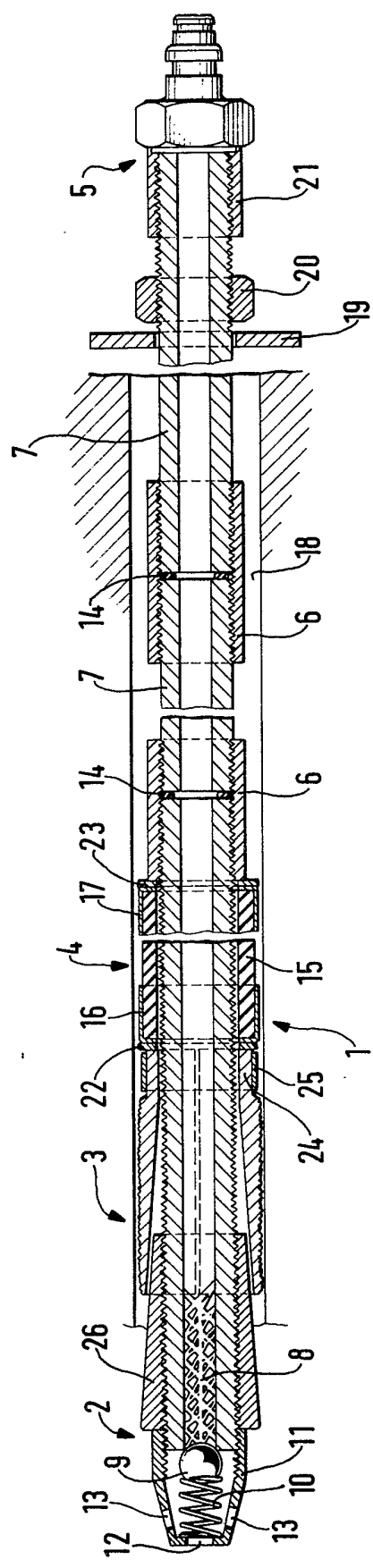
(57) A borehole plug has at its leading end a non-return valve 9, 10 inside a housing 11 with axial 12 and lateral 13 openings through which a fluid medium can be injected into the borehole. An expander unit 3 retains

the plug in the borehole. A sealing element 4 prevents injected medium seeping out of the borehole. Any number of additional pipe sections 7 can be inserted with connectors 6 to produce a plug of the desired length. A threaded nipple 5 can be turned to operate the expander unit 3 and the sealing element 4.



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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SPECIFICATION

Tubular Plug for a Blind Borehole

The invention relates to a tubular plug for a blind borehole, especially for synthetic resin injection.

From the German Patent Specification 25 50 555, a tubular borehole plug for synthetic resin injection is already known, having a throttle section as well as an expansible elastic hose segment fastened onto a pipe section, in which the hose segment acting merely as a sealing means is made of an elastic material with slider collars on its end for guidance on the pipe section. Furthermore, on a threaded portion of the pipe section, a retaining element formed of an expanding cone with internal thread and expanding shells as well as a flange plate serving as an abutment, are screwed. For joining the sealing element and retaining element, there is provided a tightening means in the form of a threaded nipple, which is screwed on the other portion of the pipe section carrying a thread.

The disadvantage of this tubular borehole plug is to be seen primarily in that it can be fitted only within the region of the borehole mouth, that no adequate backflow safety means is provided and that in addition the mixing function has to be carried out outside the borehole plug.

In a further development of the borehole plug known from German Patent Specification 25 50 555, the plug is provided at its apex with a backflow safety means which consists of a spring-operated ball valve arranged in a housing and of an opening provided centrally in the valve housing in an extension of the pipe section.

In spite of the provision of a backflow safety means, even this improved borehole plug has the disadvantage that it cannot be fitted at any desired location of the borehole. Moreover, the backflow safety means is not free of problems, in particular because the free flow of the injection media is not assured, owing to the back pressure of the spring caused by the injected medium.

According to the invention, there is provided a tubular plug for a blind borehole through which a medium suitable for strata consolidation can be injected into the borehole, the plug comprising a leading pipe section, and mounted on said leading pipe section a backflow safety means having a spring-loaded non-return valve contained within a housing which has outlet openings at the leading end of the plug and in lateral surfaces of the housing, an expandable retainer element for retaining the leading pipe section in the borehole, and a sealing element for preventing material injected through the valve from leaking out of the borehole around the pipe section, the plug also including a threaded nipple for tightening the retainer element and bringing the sealing element into operation, and means between the leading pipe section and the threaded nipple for receiving one or more extension pipe sections.

It is found to be particularly advantageous if the sealing element is a hose segment

surrounding the pipe section, is made of a rubber having a shore hardness of 40—80 and is mounted at its ends in metal sleeves.

Provision may be made for the use of the borehole plug as an expanding anchor when a collar nut is screwed on a pipe section to secure an anchor plate.

The invention will now be further described, by way of example, with reference to the accompanying drawing which shows a borehole plug according to the invention, in partial section.

The borehole plug consists of a leading pipe section 1 having an external thread, which at its apex has a backflow safety means 2 which can be screwed thereon. The backflow safety means 2 is accommodated in a housing 11 which conically tapers in the direction of the depth of the borehole and is flattened out at its extremity, said housing being provided with a central opening 12 and additionally with lateral openings 13. Within the housing 11 a spring-operated non-return ball valve is arranged, which consists of a ball 9 and a spring 10. Under the pressure of the spring 10, the ball 9 seals the duct passing through the pipe section 1, through which a medium can be injected into the borehole. During the injection, the pressure of the injected medium opens the valve and the medium flows through the openings 12, 13 into the borehole 18. When injection is interrupted, the ball 9 is pressed back onto its seat by the back pressure of the injected medium acting within the borehole 18. Excessive tensioning of the spring 10 reduces or blocks the flow. When this occurs, the medium is pressed through the additional openings 13.

Behind the backflow safety means 2 there is provided a retaining element 3 with an expanding cone 26 which can be screwed on the thread of the pipe section 1, which cone is surrounded by several expansion shells which are of known construction and do not need detailed description. The expansion shells have an abutment portion 24, which is surrounded by a retaining collar 25.

Behind the retaining element 3 there is arranged at least one sealing element 4 on the pipe section 1. The sealing element or elements 4 are supported on the abutment portion 24. A sealing element 4 consists of a hose segment made of an elastic material, preferably a rubber with a Shore hardness of 40—80. The sealing element 4 is furthermore mounted at its ends in metal sleeves 16, 17. The metal sleeves 16, 17 abut sliding washers 22, 23. Depending on the hardness of the rock, it can be advantageous to vary the Shore hardness of the rubber used in the sealing elements 4.

Behind the retaining element 3 a connector sleeve 6 is screwed on the pipe section 1 and is made fast therewith. By rotating a pipe section 7 screwed into the connector sleeve 6 the retaining element 3 and the sealing element 4 are brought into operation. The expansion shells of the element 3 are pressed outwards, and the rubber element 4 bulges outwards to seal against the wall of the borehole.

A further pipe section 7 can be connected to the sleeve 6 fast with the pipe section 1 *via* a seal 14 having the form of a washer or of an O-ring. By means of an arbitrary number of connector sleeves 6 and a corresponding number of pipe section 7 it is possible to locate the borehole plug at any desired point of a borehole 18. In addition, it is also possible, by different embodiments of the seals 14, to release the drill pipe composed of pipe sections 7 from the mouth of the borehole. A predetermined release of the pipe sections 7 is made possible by an O-ring seal, whereas the other, more difficultly releasable sleeve connections have washer seals.

The use of an arbitrary number of pipe sections 7 and connector sleeves 6 provides not only the possibility of arranging the borehole plug at any desired point within a borehole 18, but also enables the borehole plug to be used as an expansion anchor in connection with an anchor plate 19 and a collar nut 20 mounted on a pipe section 7 outside the borehole 18.

The threaded nipple 5 acting as tightening means is located outside the borehole 18.

Through the threaded nipple 5 and the pipe sections 7 with the respective sleeve connectors 6, and the connector sleeve 6 fast with pipe section 1, the function of the retaining element 3 and sealing element 4 is initiated during rotation of the threaded nipple 5.

Within the pipe section 1 below the backflow safety means 2 one or several mixing elements 8 of known construction are to be mounted. The mixing elements 8 are adapted with respect to their diameter to the pipe section 1 and effect mixing of the injected medium in dependence on the flow velocity. The use of a given mixing element 8 or of several mixing elements 8 arranged one behind the other is to be coordinated with the injection media employed.

Claims

1. A tubular plug for a blind borehole through which a medium suitable for strata consolidation can be injected into the borehole, the plug comprising a leading pipe section, and mounted on said leading pipe section a backflow safety means having a spring-loaded non-return valve contained within a housing which has outlet openings at the leading end of the plug and in lateral surfaces of the housing, an expandable retainer element for retaining the leading pipe section in the borehole, and a sealing element for preventing material injected through the valve from leaking out of the borehole around the pipe section, the plug also including a threaded nipple for tightening the retainer element and bringing the sealing element into operation, and means between the leading pipe section and the threaded nipple for receiving one or more extension pipe sections.

2. A borehole plug as claimed in claim 1, wherein O-ring seals are provided between adjacent pipe sections.

3. A borehole plug as claimed in claim 1 or claim 2, wherein the sealing element is tubular, surrounds the leading pipe section, is made of a rubber having a Shore hardness of 40—80, and has its ends mounted in metal sleeves.

4. A borehole plug as claimed in any preceding claim, wherein a collar nut is threaded onto a pipe section adjacent to the threaded nipple, and an anchor plate surrounds the pipe section, so that the nut can be tightened against the anchor plate, and the plug can be used as an expanding anchor.

5. A tubular plug for a blind borehole, substantially as herein described with reference to the accompanying drawing.