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(54) **DRILL STEM FOR DEEP DRILLINGS**

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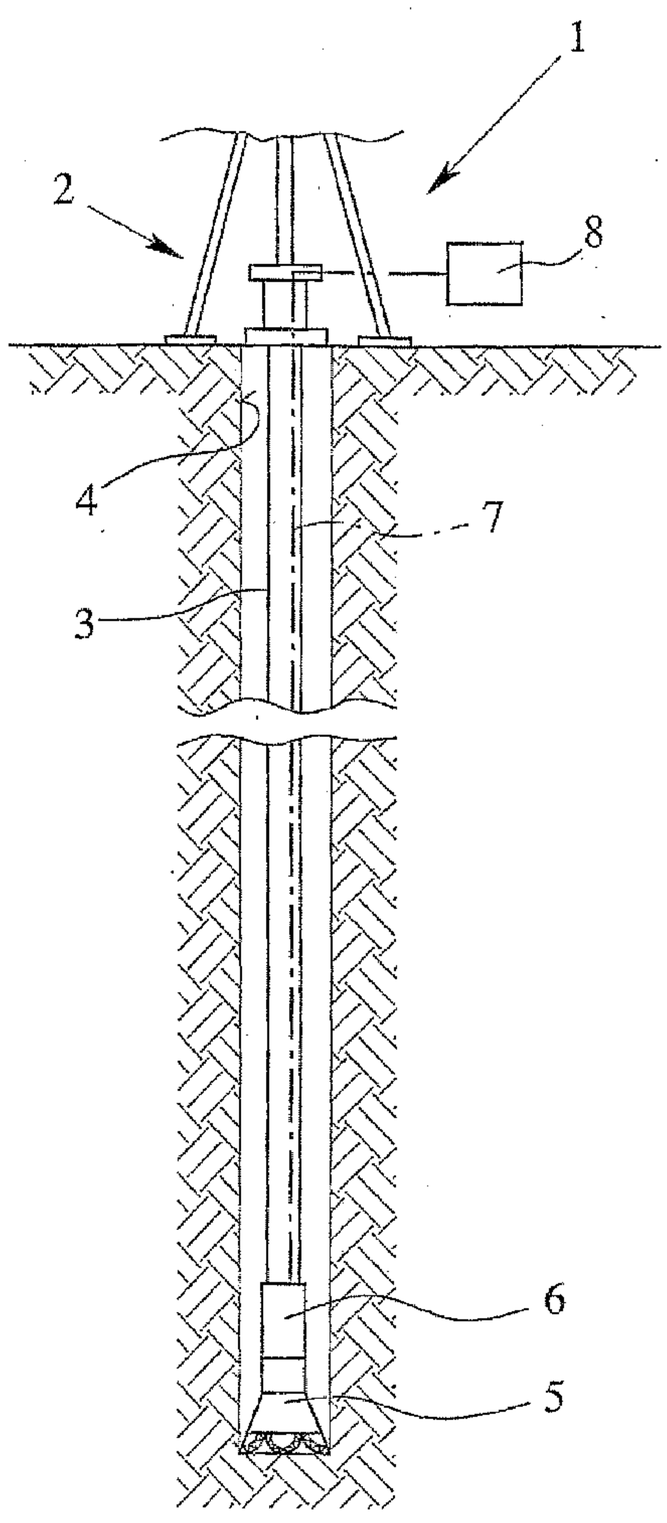
(57) **ABSTRACT**

The invention relates to a drill column (**3**) for deep wells, having a plurality of drilling pipes (**10**) having drilling pipe bodies (**12**) made from an electrically conductive material and a plurality of bushes (**11**) having bush bodies (**27**) made from an electrically conductive material. In order to obtain information from the drilling site quickly and precisely, provision is made for one electric pole to be formed by the drill column body comprising the drilling pipe bodies (**12**) and the bush bodies (**27**) and for the other electric pole to be formed by at least one conductor (**7**), which is electrically insulated from the drill column body and is arranged within the drill column body, with the result that transfer of both electrical energy and data is possible.



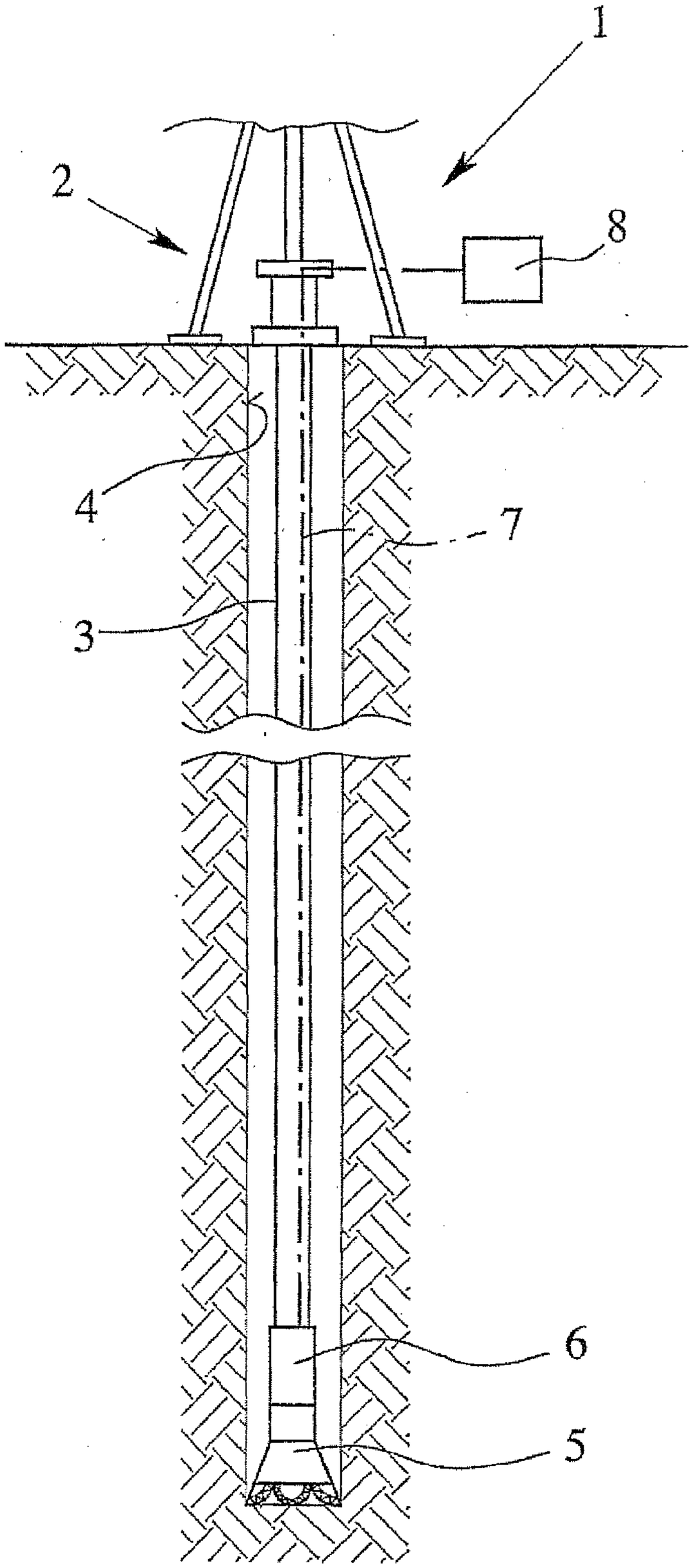


Fig. 1

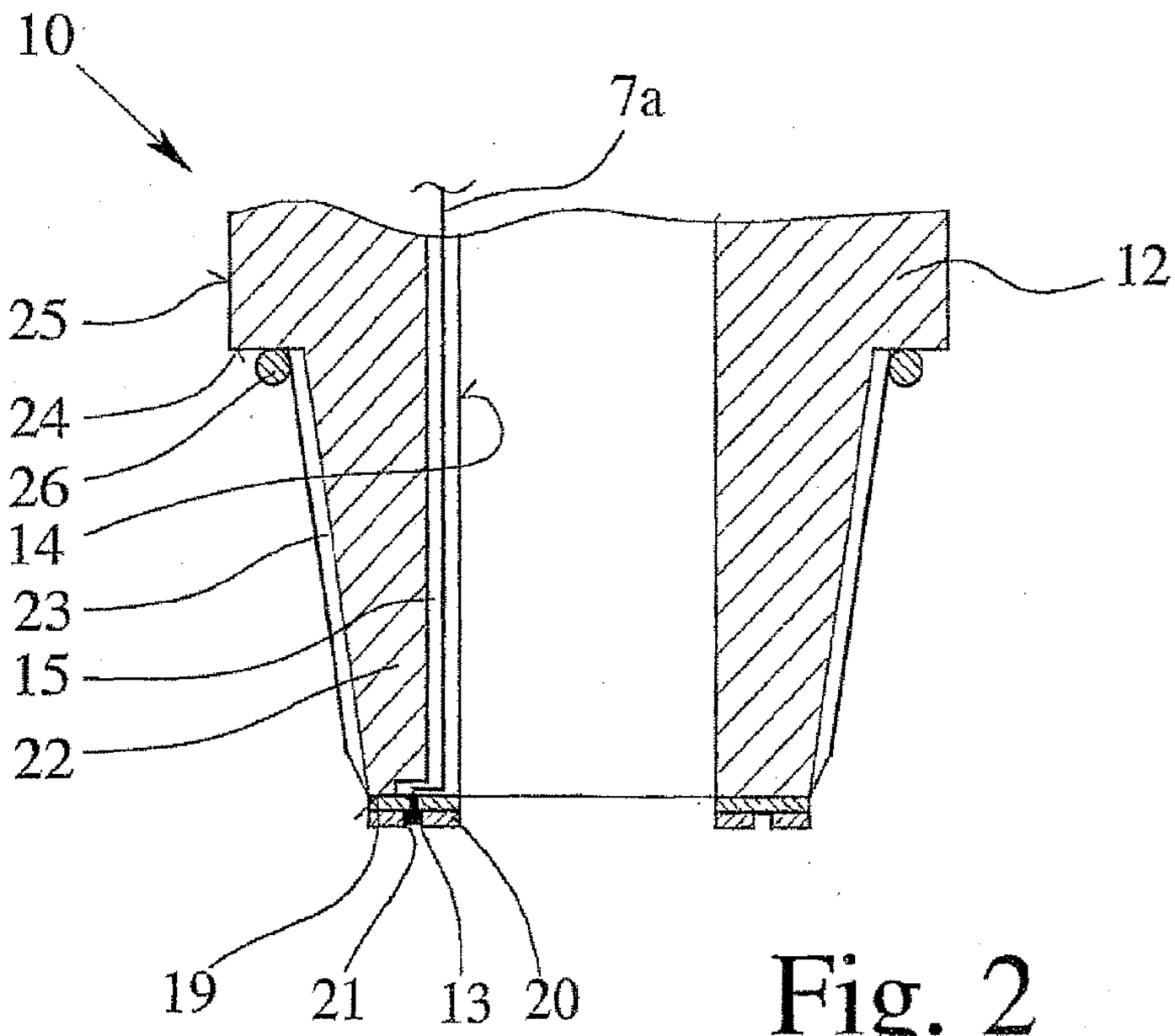

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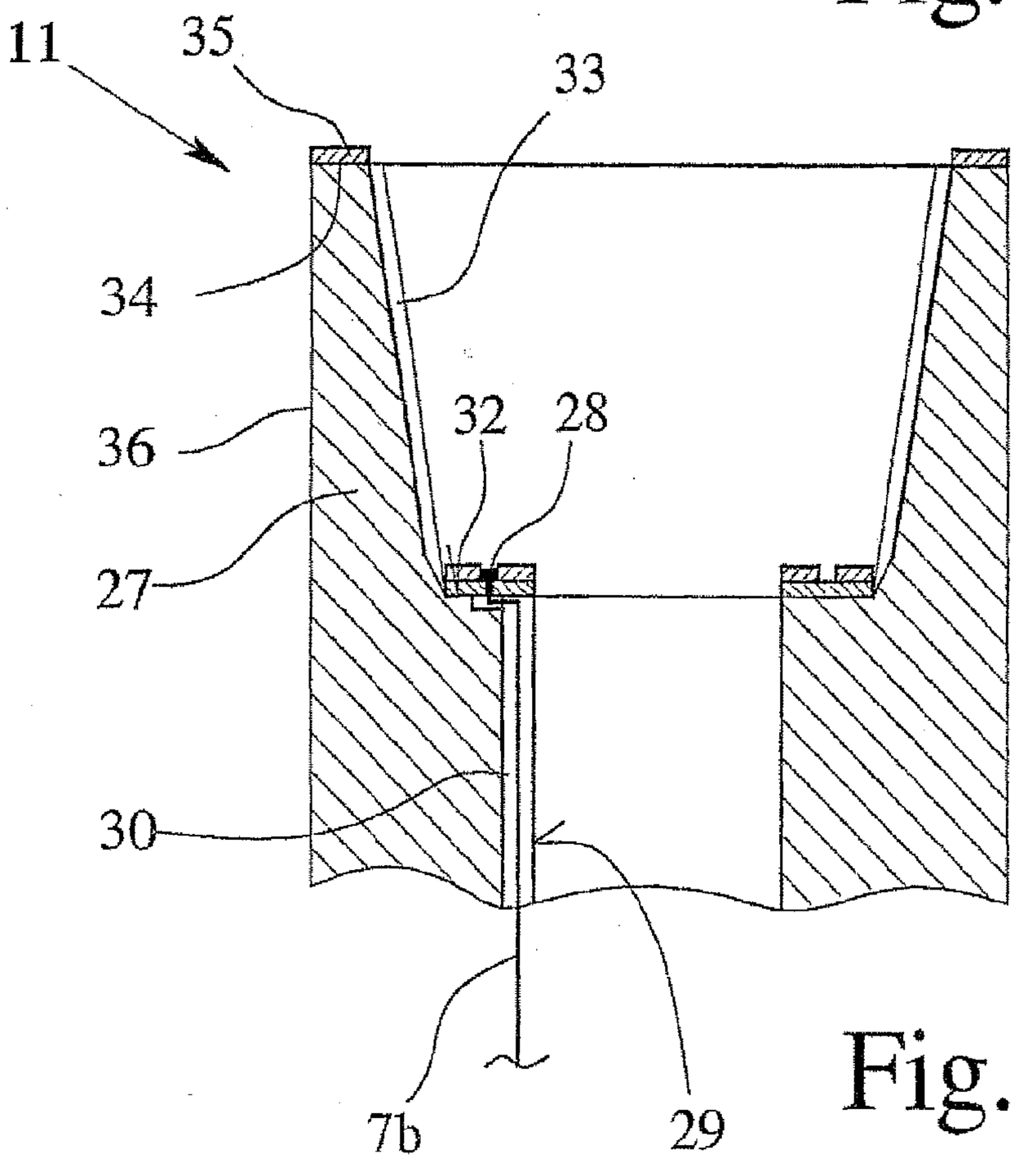
Fig. 2


11
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7b
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Fig. 3

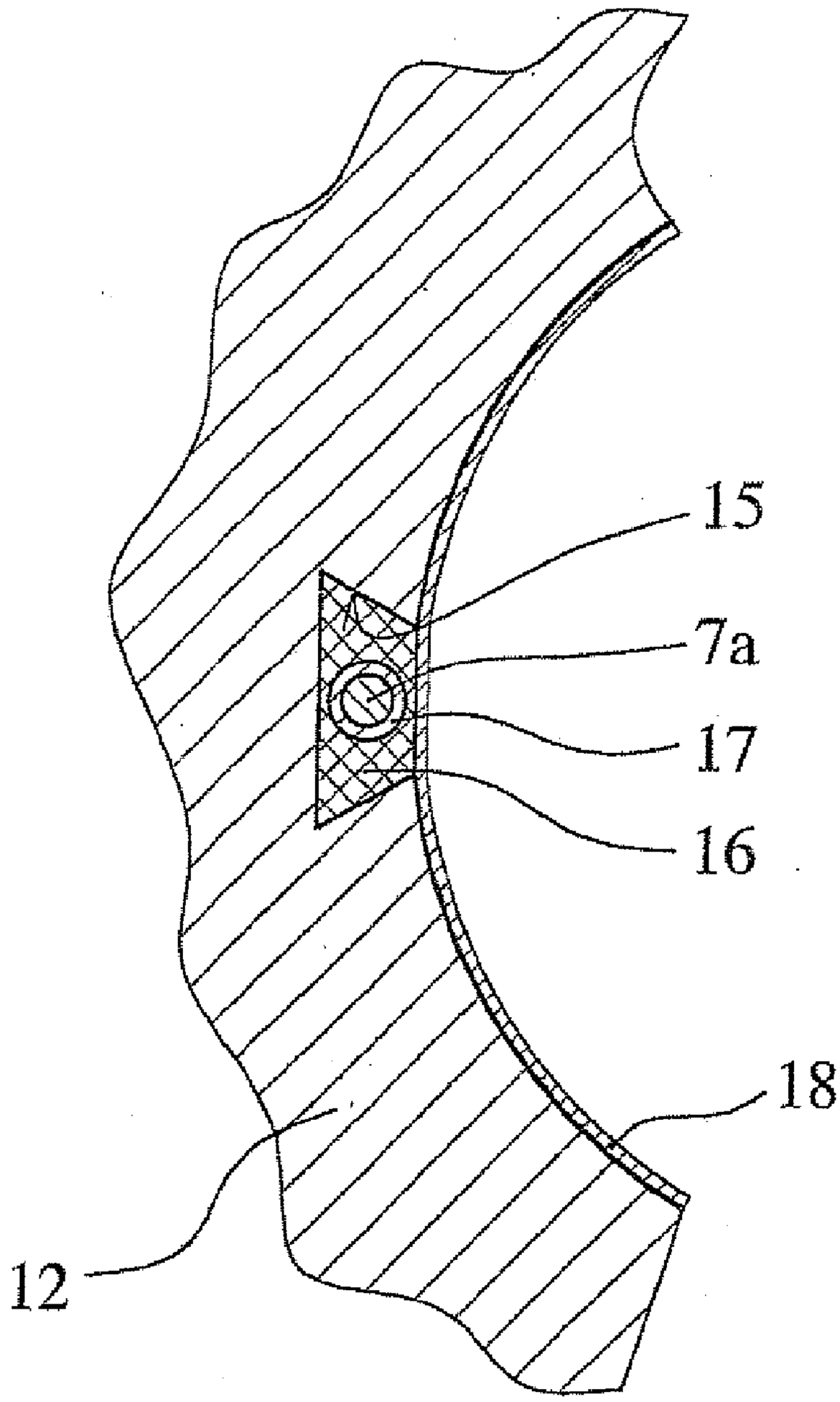

Fig. 4

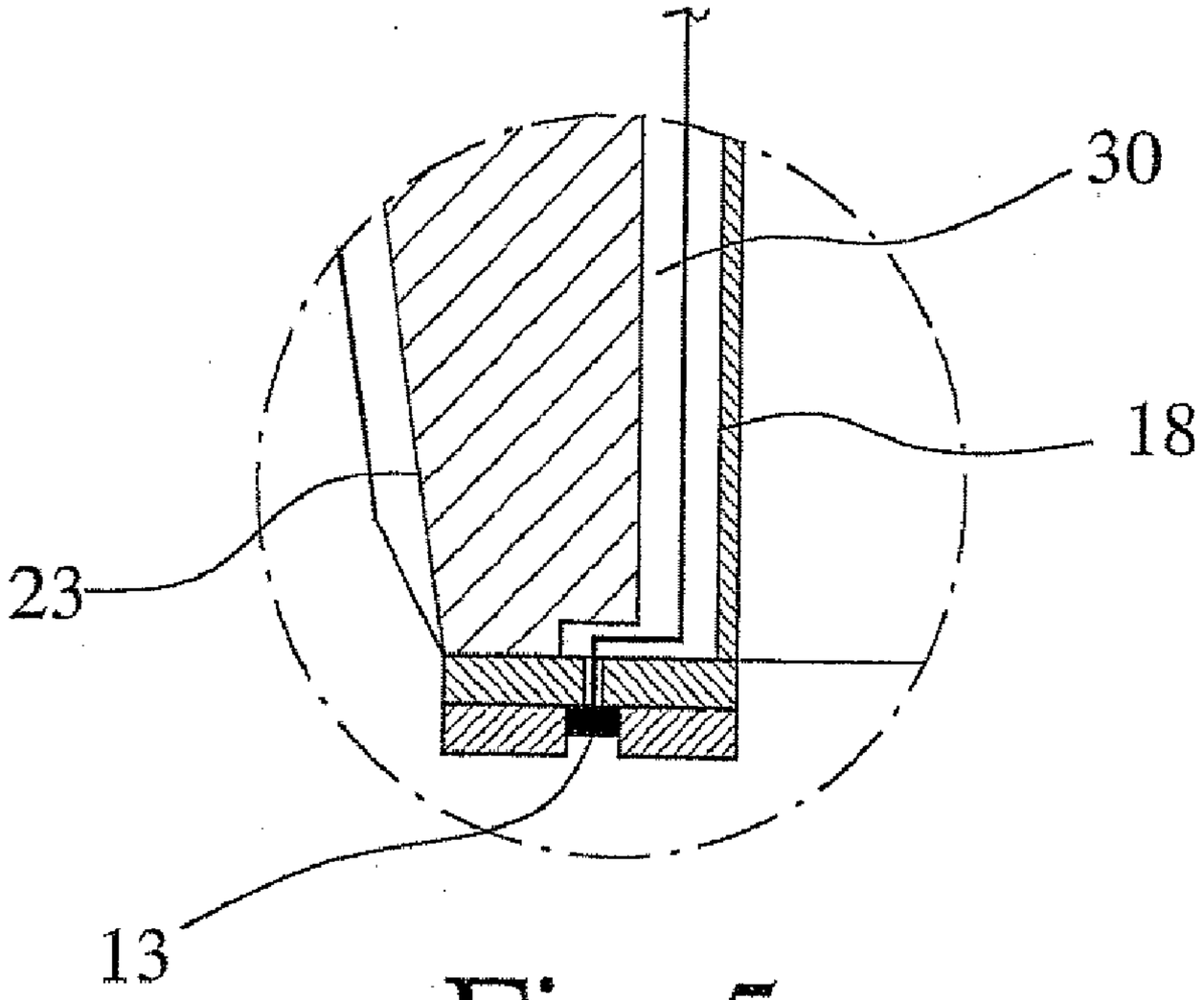

Fig. 5

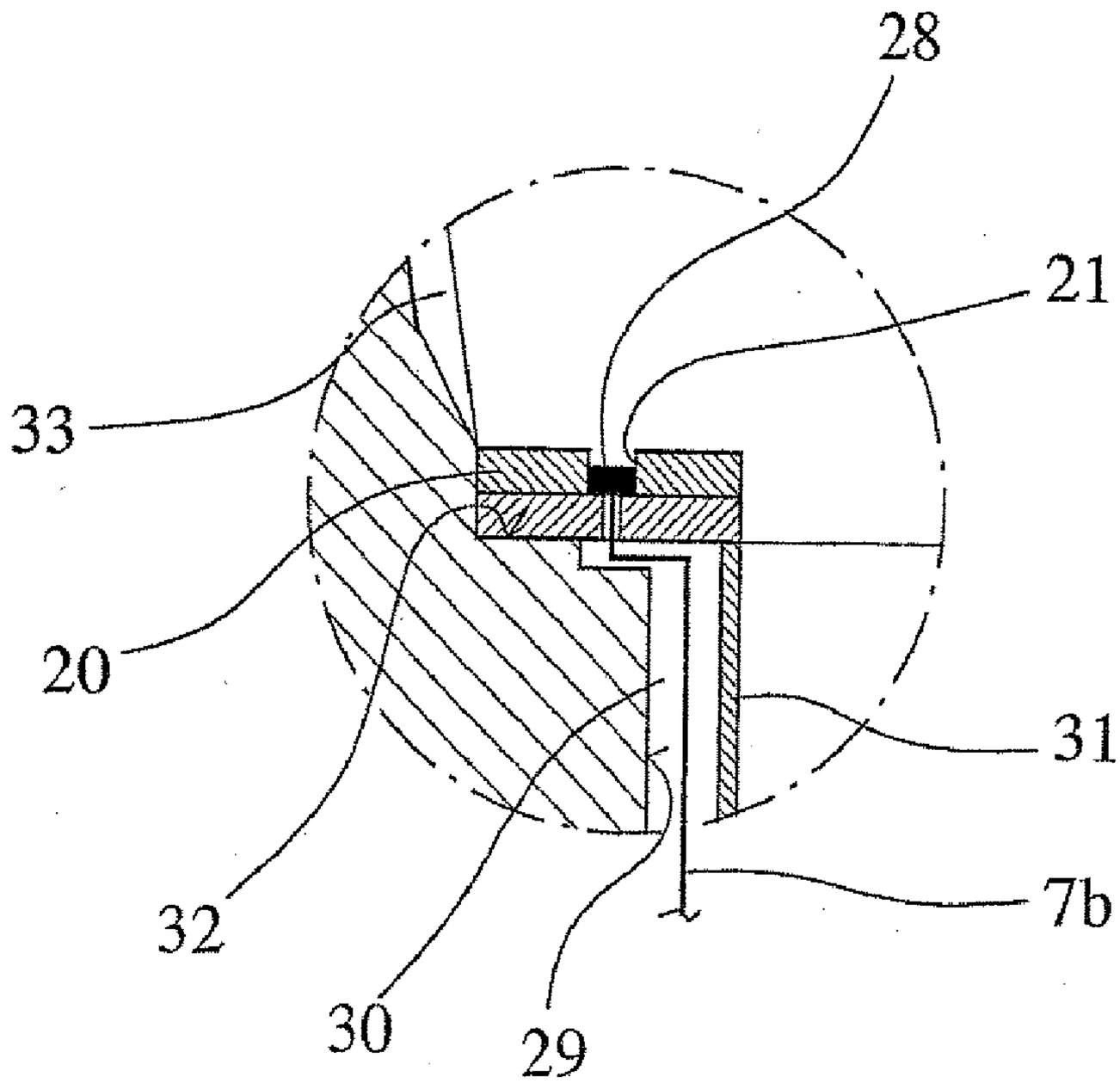

Fig. 6

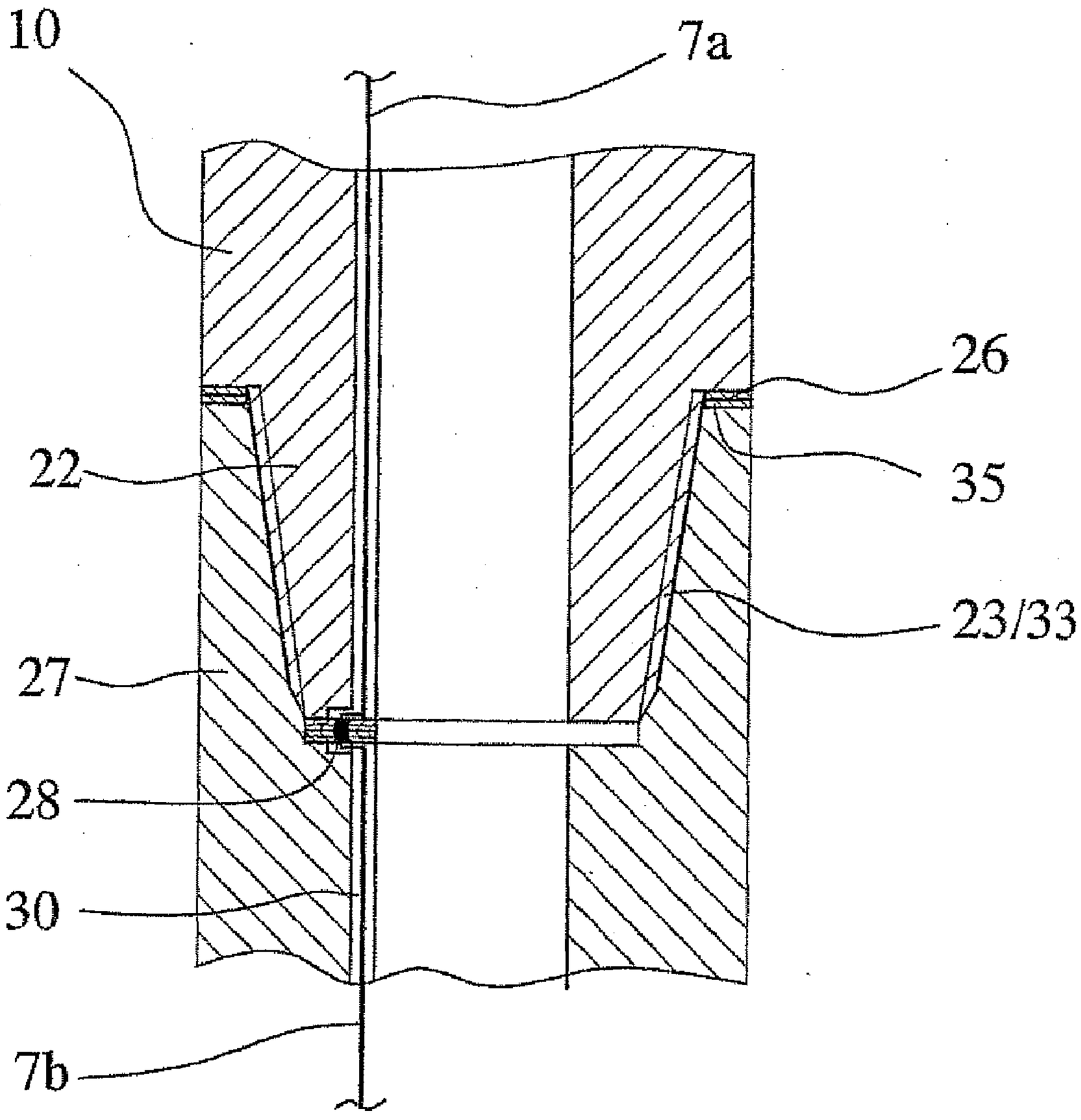

Fig. 7

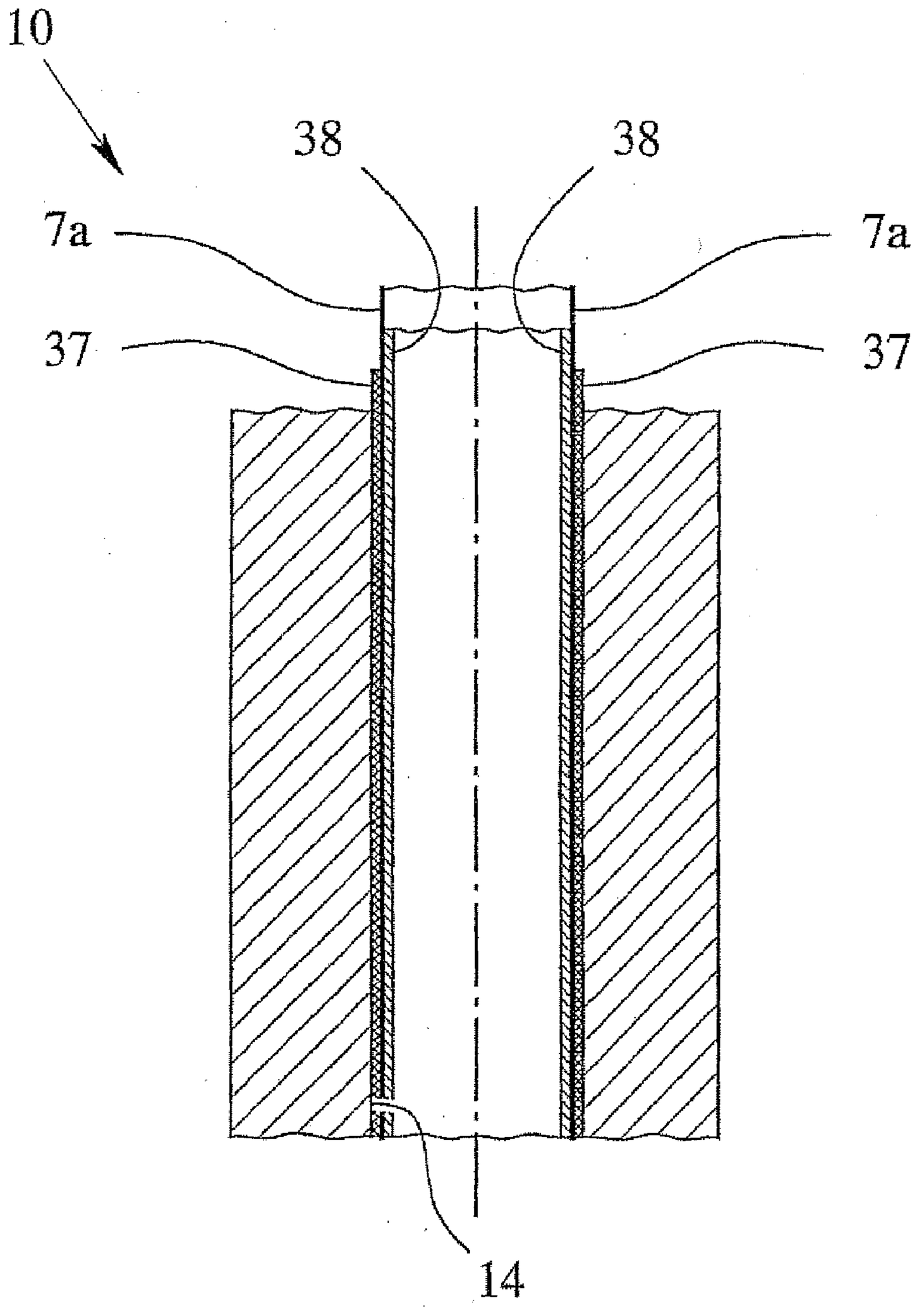

Fig. 8

DRILL STEM FOR DEEP DRILLINGS

[0001] The present invention relates firstly to a drilling pipe in accordance with the common precharacterizing clause of claims **1** and **5**. Furthermore, the invention relates to a bush in accordance with the common precharacterizing clause of claims **13** and **18**. Furthermore, the invention relates to a drill column for deep wells in accordance with claim **27**.

[0002] DE 27 44 829 C2 has disclosed a drilling pipe having a drilling pipe body made from an electrically conductive material, in which an electrical pipe conductor is passed through and is connected to a contact connection arranged at one end on the drilling pipe body, the pipe conductor and the contact connection being electrically insulated from the drilling pipe body. In the case of the known drilling pipe, the electrical conductor is guided in a protective pipe. The protective pipe with the conductor extends in the longitudinal direction along the inner wall of the drilling pipe body and is helical and is pressed, in this form, in a resilient manner against the inner wall of the axial borehole of the drilling pipe body. However, the protective pipe and the conductor arranged within the protective pipe cannot be prevented from being adversely affected when flushed with drilling mud, in which case the drilling fluid is pumped through the drill string at a very high rate. Furthermore, tools which are left by the drill string remain suspended at the turns of the protective pipe and damage the protective pipe or the conductor.

[0003] The object of the present invention is to provide a drilling pipe, a bush and a drill column in each case of the type mentioned initially, with which it is possible to transmit electrical energy and/or data from the surface to the bottom of the borehole and back with a high degree of reliability and a low degree of susceptibility to faults.

[0004] The abovementioned object is achieved in each case by a drilling pipe of the type mentioned initially having the characterizing features of Patent claims **1** and **5** and by a bush of the type mentioned initially having the characterizing features of Patent claims **13** and **18**. Furthermore, the object according to the invention is achieved by the drill column claimed in Patent claim **27**.

[0005] Owing to the design according to the invention of the drilling pipes on the one hand and bushes on the other hand in conjunction with the respective conductors and contact connections, a system results in which, when the drilling pipes are connected to the bushes in order to extend the drill column, in each case an electrically conductive connection results via two poles. In this case, one pole is formed by the drill column body and the other pole is formed by the conductor arranged therein. This then makes it possible to transmit electrical energy from the surface to any desired point in the borehole and to transmit data via the conductor to the surface without any delay. The conductor can be made from such a material that both energy and data transfer is possible.

[0006] The drilling pipes and the bushes, as far as the arrangement of the conductor is concerned, have essentially the same design. In a first embodiment of the invention, in accordance with Patent claims **1** and **13** provision is made for the pipe conductor to be fixed to the pipe inner side or for the bush conductor to be fixed to the bush inner side. It is therefore necessary for them to be fixed in the column interior since some of the drilling mud is pumped through the drill column string at a very high speed and this could result in the conductor being adversely affected if there is insufficient fixing. In order to reliably protect the conductor within the column, a longitudinal groove is provided on the pipe inner side of the drilling pipe body or on the bush inner side of the bush body. The groove can be realized, both in the case of new drilling pipes and bushes and in the case of those which have already been used, by means of a corresponding special device such that the invention can also easily be implemented retrospectively. The conductor in the string interior is protected by the groove, which preferably runs parallel to the centre axis of the column, to be precise in particular if the depth of the groove is greater than the diameter of the conductor, with the result that the conductor is completely accommodated in the groove. Furthermore, in order to fix the conductor in the groove, said conductor should be cast in via an insulation. In addition, it is moreover possible to completely sheath the conductor by means of a corresponding conductor insulation in order to ensure the required electrical insulation. Moreover, in order to electrically insulate the string interior from the string exterior, an electrical insulating layer is applied, in particular vapour-deposited, over the entire surface of the pipe inner side, in which case the insulating layer should preferably cover the conductor.

[0007] In another embodiment of the invention, in accordance with Patent claims **5** and **18** provision is made for the pipe conductor or the bush conductor to be tubular, for the pipe conductor or the bush conductor to be passed through the drilling pipe body or the bush body and/or to sheath the drilling pipe body or the bush body, and for, preferably, the pipe conductor or the bush conductor and the drilling pipe body or the bush body to have essentially the same linear thermal expansion behaviour, the design of the drilling pipe according to the invention being described below. The described features are correspondingly transferable to the bush according to the invention. The bush has a corresponding design to that for the drilling pipe. It is essential that an inner pipe and/or outer pipe is provided as the pipe conductor or bush conductor, energy and data being transmitted from the surface to the bottom of the borehole and back via said inner pipe and/or outer pipe.

[0008] In order to ensure the transmission of energy and data even at considerable drilling depths, provision is preferably made for the pipe conductor or the bush conductor and for the drilling pipe body or the bush body to have essentially the same linear thermal expansion behaviour. The linear thermal expansion behaviour, defined by the coefficient of linear expansion α, indicates by how much the length of an object increases if the temperature of the object is increased by 1° C. If the pipe conductor has a comparable or even identical linear expansion behaviour to the drilling pipe body, there is no axial displacement of the pipe conductor in relation to the drilling pipe body even at considerable drilling depths. There is therefore no danger of the energy and data transmission being disrupted or interrupted owing to the pipe conductor and the drilling pipe body having different degrees of linear expansion. In this context, the pipe conductor and the drilling pipe body may be produced from the same material, preferably from steel, for reasons of simplicity. In principle, however, it is also pos-

sible for an alloy which has an appropriate linear expansion behaviour to be used as the material for the pipe conductor.

[0009] In order to provide a fixed connection between the pipe conductor and the drilling pipe body, the pipe conductor can be connected to the drilling pipe body in a cohesive and/or force-fitting manner. For example, it is possible to adhesively bond the pipe conductor to the drilling pipe body. It is just as easily possible for a slotted sleeve to be inserted, as the pipe conductor, into the drilling pipe body, in which case it is necessary to correspondingly compress the outer surface of the sleeve in order to make it possible to insert the sleeve in the drilling pipe body. The resetting forces in the outer surface of the sleeve result in a force-fitting connection between the sleeve and the drilling pipe body in said drilling pipe body. It is naturally also possible just as easily for the drilling pipe body to be shrunk onto the sleeve.

[0010] A gap of 0.5 cm to 2.5 cm, in particular a gap of 1.5 cm, is preferably provided between the pipe conductor and the drilling pipe. The gap can be filled with a casting compound, in particular a plastic, preferably with epoxy resin. The casting compound firstly produces a cohesive bond between the pipe conductor and the drilling pipe and also acts as an insulating layer. The inside outer surface of the pipe conductor is preferably coated with a further insulating layer. If, on the other hand, provision is made for the pipe conductor to sheath the drilling pipe body, the outer side of the pipe conductor can be coated with an electrically nonconductive material.

[0011] Since the line resistance of the pipe conductor increases as the length of the pipe increases, the wall thickness of the pipe conductor is preferably fixed as a function of the maximum drilling depth. In this case, a wall thickness for the pipe conductor of 0.5 mm to 1.5 mm, in particular of 0.7 mm to 1.2 mm, may preferably be provided up to a drilling depth of 2000 m. If, on the other hand, it is intended to drill up to depths of 5000 m, a pipe conductor having a wall thickness of 4 mm to 8 mm, preferably 5 mm to, 6 mm, can be used. The above-described features of the pipe conductor or bush conductor according to the invention allow for energy to be transmitted at a low voltage or a very low voltage of preferably 42 volts.

[0012] If the conductor is provided in the interior of the drill string, it is possible for the pipe contact connection to be provided on the end-side front face of the drilling pipe body. The end-side front face in this case represents a shoulder towards the pipe inner side. In order to be able to interact with the pipe contact connection, the bush contact connection is provided on a front-side shoulder towards the bush inner side. When the mechanical connection is made, i.e. when the drilling pipe and the bush are screwed together, an electrical connection is then produced between the pipe conductor on the one hand and the bush conductor on the other hand via the contact connections on both sides.

[0013] Since the drilling pipes are generally screwed to the bushes, it is particularly advantageous for both the pipe contact connection and the bush contact connection to be of circumferential design, i.e. to be in the form of contact connection rings. In order to ensure electrical insulation between the respective contact connection and the drilling string body, in this case the pipe contact connection should be arranged on an insulating ring resting on the front face, while the bush contact connection should be arranged on an insulating ring resting on the shoulder. In order in this case to ensure sufficient insulation not only from the drill column body but also from the interior of the drill string and the mud located therein during the drilling operation, the insulating ring, which should be made from an elastic material, should have an annular groove for the purpose of accommodating the respective contact connection, in which case the annular groove should be deeper than the height of the contact connection. This ensures that, when the drilling pipes are screwed to the bushes, there is a sufficient seal at the mutually facing surfaces of the insulating rings owing to these rings being pressed together when simultaneous contact is made with the contact connections.

[0014] Since, in the case of very long drill columns, which may have a length of several thousand metres, it is possible for longitudinal movements between the bushes and the drilling pipes to result, a possible solution is for the contact connections to be spring-loaded in particular in the direction away from the front face or the shoulder. Owing to the spring-loading, the contact connections are pushed towards one another such that any movements of the drilling pipes and adjacent bushes cannot result in an interruption of the electrical contact between the contact connections.

[0015] Moreover, in order to prevent the drilling mud from passing from the annular space into the intermediate space between the contact connections, at least one circumferential seal should be provided in the region of the pin of the drilling pipe body. The seal is preferably located at the step from the pipe outer side to the pin and/or at the transition from the step to the pin. One or more seals can also be provided in the region of the pin itself. On the bush, a possible solution is to provide at least one circumferential seal on the outer front face of the bush body.

[0016] It goes without saying that it is possible with the invention for not just one conductor but a plurality of conductors to be provided in the drill column. Since the conductors cannot be selected to have any desired size in terms of their diameter in order not to take into account any weakening of the drill column which is too severe by means of grooves on the inner side of the drill column which are too deep, the number of conductors which generally in any case have a small diameter is determined as a function of the electrical energy requirement for operating the respective measuring and analysis instrument located in the borehole.

[0017] Exemplary embodiments of the invention will be described below with reference to the drawing, in which:

[0018] FIG. **1** shows a schematic view of a drill column introduced into a borehole,

[0019] FIG. **2** shows a schematic view of the pipe end of a drilling pipe,

[0020] FIG. **3** shows a schematic view of part of a bush,

[0021] FIG. **4** shows a cross-sectional view of part of a drilling pipe,

[0022] FIG. **5** shows a detailed view of part of a drilling pipe,

[0023] FIG. **6** shows a detailed view of a bush,

[0024] FIG. **7** shows a schematic partial view of a drilling pipe, which has been screwed into a bush, having a pipe conductor or bush conductor fixed in a groove, and

[0025] FIG. **8** shows a schematic partial view of a drilling pipe having a tubular pipe conductor.

[0026] FIG. **1** is a schematic illustration of a drilling apparatus **1**. The drilling apparatus **1** has a drilling head **2** arranged at the surface and a drill column **3**, which is located in a borehole **4** in the drilling state. A bit unit **5** is located at the other end of the drill column **3**. In the exemplary embodiment illustrated, a measuring device **6**, which is connected to an evaluation device **8** located at the surface via a conductor **7**, is located directly above the bit unit **5**. The measuring device **6** makes it possible to record measured values during drilling which can then be evaluated directly via the evaluation device **8**.

[0027] The drill column **3** itself in this case comprises a large number of alternately arranged drilling pipes **10** and bushes **11**. Drilling pipes **10** of the type in question may have a length of up to 10 m or longer, while drill columns **3** for deep wells may have a length of several thousand metres.

[0028] FIG. **2** and the detailed illustration shown in FIG. **4** illustrate part of a drilling pipe **10**. The drilling pipe **10** has a drilling pipe body **12** made from an electrically conductive material. Provision is now made for at least one electrical pipe conductor **7***a* to be passed through the drilling pipe body **12**, said electrical pipe conductor **7***a* being connected at the end, to be precise at both ends, to a pipe contact connection **13** provided on the drilling pipe body **12**, the pipe conductor **7***a* and the pipe contact connection **13** being electrically insulated from the drilling pipe body **12**. As can be seen in particular in FIG. **4**, the pipe conductor **7***a* is fixed to the pipe inner side **14**. For this purpose, a longitudinal groove **15** for the pipe conductor **7***a* is provided on the pipe inner side **14**. In this case, the groove **15** is dovetailed. In principle, however, any other groove shape is also possible. The groove **15** runs parallel to the centre axis of the drilling pipe **10**. The depth of the groove **15** is in this case greater than the outer diameter of the pipe conductor **7***a*. The pipe conductor **7***a* is held in the groove **15** via an insulation **16**. In addition to its fixing function, the insulation **16** also has an electrically insulating function. In addition to the insulation **16**, the pipe conductor **7***a* has a conductor insulation **17** which extends over the entire length of the pipe conductor **7***a*. As can further be seen in FIG. **4**, an electrical insulating layer **18** is vapour-deposited over the entire surface of the pipe inner side **14** and also covers the groove **15** and thus the pipe conductor **7***a*. The insulating layer **18** is applied over the entire surface of the pipe inner side **14**.

[0029] The pipe contact connection **13** is provided on the end-side front face **19** of the pipe end of the drilling pipe **10**. In this case, it goes without saying that in each case one corresponding pipe contact connection **13** is provided at both ends of the drilling pipe body **12**, even if this is not specifically described below. The pipe contact connection **13** is of circumferential design and has the form of a contact ring. Moreover, the pipe contact connection **13** is arranged on an insulating ring **20** resting on the front face **19**. The insulating ring **20**, which is made from an elastic material, has an annular groove **21** for the purpose of accommodating the pipe contact connection **13**. In this case, the annular groove **21** is deeper than the height of the pipe contact connection **13**.

[0030] Moreover, the pipe contact connection **13** is in this case spring-loaded in the direction away from the front face **19**, namely in the direction towards the bush **11** to be connected to the drilling pipe **10**.

[0031] A pin **22**, on which an external thread **23** is provided, is located at both pipe ends of the drilling pipe **10**. A step **24**, which merges at its end with the pipe outer side **25**, is located between the pins **22** having the external thread **23**. A circumferential seal **26**, which in this case is an O ring, is located at the transition between the step **24** and the external thread **23**. In place of the seal **26** or in addition to said seal, an annular seal can also be arranged on the step **24**.

[0032] FIG. **3** and the detailed illustration shown in FIG. **6** illustrate part of a bush **11**. The bush **11** has a bush body **27** made from an electrically conductive material. An electrical bush conductor **7***b* is passed through the bush body **27** and is connected at the end, to be precise at both ends of the bush body **27**, to bush contact connections **28**, even if this is not specifically illustrated. The bush conductor **7***b* and the bush contact connections **28** are electrically insulated from the bush body **27**.

[0033] The bush conductor **7***b* is fixed to the bush inner side **29**. For this purpose, a longitudinal groove **30** is provided on the bush inner side **29** of the bush body **27**. The groove **30** has the same design as the groove **15**. Moreover, the groove **30** runs parallel to the centre axis of the bush **11**. The illustration does not show the fact that the bush conductor **7***b* is cast into the groove **30** via an insulation and moreover is sheathed by a conductor insulation. Furthermore, an electrical insulating layer **31** is vapour-deposited on the bush inner side **29** and on the pipe inner side **14**, said electrical insulating layer **31** also covering the bush conductor **7***b*.

[0034] As can be seen in particular in FIG. **6**, the bush contact connection **28** is provided on a front-side shoulder **32**. The shoulder **32** is located between the internal thread **33** and the bush inner side **29**. The bush contact connection **28** is of circumferential design and is arranged on an insulating ring **20** resting on the shoulder **32**. The insulating ring **20** corresponds in terms of type and design to the insulating ring **20** provided on the drilling pipe **10**, i.e. has an annular groove **21** for the purpose of accommodating the bush contact connection **28**, in which case the annular groove **21** is deeper than the height of the bush contact connection **28**. Moreover, the bush contact connection **28** is spring-loaded in the direction away from the shoulder **32**. The spring-loading can be designed with respect to the contact connections **13**, **28** such that one or a plurality of springs, for example small helical compression springs, act on the respective underside of the contact connection. Furthermore, spring tongues can be provided on the respective contact connection. The spring tongues may in principle point inwards and/or outwards, it then being possible for outwardly pointing spring tongues to protrude beyond the actual contact connection and cause the electrical contact to be made.

[0035] In this case, a circumferential seal **35** is located on the outer front face **34** of the bush body **27**. The outer front face **34** is located between the internal thread **33** and the bush outer side **36**.

[0036] The drilling pipes **10** and bushes **11** as described above in conjunction with the pipe conductors **7***a* and bush conductors **7***b* result in a two-pole energy and data trans-

mission system via the drill column **3**. In this case, one pole is formed by the drill column body, which comprises the drilling pipe bodies **12** and the bush bodies **27**, while the other pole is formed by the conductor **7**, which comprises the pipe conductors **7***a* and the bush conductors **7***b* as well as the contact connections **13** and **28**. The system according to the invention moreover has the advantage that the drill column **3** and thus the two poles can be extended as desired since screwing a drilling pipe **10** to a bush **11** provides the electrical connection via the contact connections **13**, **28** on the one hand and via the material of the drilling pipe body **12** and of the bush body **27** on the other hand.

[0037] Energy is supplied to and data tapped off from the conductor **7** via a slipring collector (not illustrated), which is provided on the first drilling pipe **10**. The slipring collector is connected to the pipe conductor **7***a* and insulated from the drilling pipe body **12**. The slipring collector in turn is connected to the evaluation device **8**, while the drill column body forms the connection to earth.

[0038] FIG. **8** illustrates a schematic partial view of a drilling pipe **10** having a tubular pipe conductor **7***a*. The pipe conductor **7***a* is adhesively bonded to the pipe inner side **14** over the entire surface via an insulating layer **37**. The insulating layer **37** may be, for example, epoxy resin, which ensures electrical insulation of the pipe conductor **7***a* from the drilling pipe **10** and with which the gap between the pipe inner side **14** and the pipe conductor **7***a* is cast. Furthermore, a further insulating layer **38** is provided on the inside outer surface of the pipe conductor **7***a* and is preferably coated with an electrically nonconductive material having a low surface roughness. A low-friction coating of the pipe conductor **7***a* in the interior contributes to a low flow resistance when there is a flow passing through the drilling pipe **10** during the production operation or during the flushing operation. The embodiment illustrated in FIG. **8** of a drilling pipe **10** having a tubular pipe conductor **7***a* can correspond to the design of the bush **11** having the tubular bush conductor **7***b*. The contact connections of the drilling pipe **10** and the bush **11** essentially correspond to the above-described embodiments when the pipe conductor **7***a* or the bush conductor **7***b* is in each case guided in a longitudinal groove **15**, **30**, in which case it is necessary to ensure that the respective contact connection is electrically insulated from the drilling pipe **10** or the bush **11**. In the case of a tubular design, the pipe conductor **7***a* and the bush conductor **7***b* can have a collar at the end in order to produce a line contact in a simple manner.

1. Drilling pipe (**10**) for a drill column (**3**) for deep wells, having a drilling pipe body (**12**) made from an electrically conductive material, at least one electrical pipe conductor (**7***a*) being passed through the drilling pipe body (**12**), the pipe conductor (**7***a*) being connected to a pipe contact connection (**13**) provided at one end on the drilling pipe body (**12**), and the pipe conductor (**7***a*) and the pipe contact connection (**13**) being electrically insulated from the drilling pipe body (**12**), characterized in that the pipe conductor (**7***a*) is fixed to the pipe inner side (**14**), and in that a longitudinal groove (**15**) for at least one pipe conductor (**7***a*) is provided on the pipe inner side (**14**) of the drilling pipe body (**12**).

2. Drilling pipe according to claim 1, characterized in that the depth of the groove (**15**) is greater than the diameter of the pipe conductor (**7***a*), and in that, preferably, the pipe conductor (**7***a*) is cast into the groove (**15**) via an insulation (**16**).

3. Drilling pipe according to claim 1, characterized in that the pipe conductor (**7***a*) is sheathed by a conductor insulation.

4. Drilling pipe according to claim 1, characterized in that an electrical insulating layer (**18**) is applied, in particular vapour-deposited, over the entire surface of the pipe inner side (**14**), and in that, preferably, the insulating layer (**18**) covers the pipe conductor (**7***a*).

5. Drilling pipe (**10**) for a drill column (**3**) for deep wells, having a drilling pipe body (**12**) made from an electrically conductive material, at least one electrical pipe conductor (**7***a*) being provided, the pipe conductor (**7***a*) being connected to a pipe contact connection (**13**) provided at one end on the drilling pipe body (**12**), and the pipe conductor (**7***a*) and the pipe contact connection (**13**) being electrically insulated from the drilling pipe body (**12**), characterized in that the pipe conductor (**7***a*) is tubular, in that the pipe conductor (**7***a*) is passed through the drilling pipe body (**12**) and/or sheaths the drilling pipe body (**12**), and in that, preferably, the pipe conductor (**7***a*) and the drilling pipe body (**12**) have essentially the same linear thermal expansion behaviour.

6. Drilling pipe according to claim 5, characterized in that the pipe conductor (**7***a*) and the drilling pipe body (**12**) are produced from the same material, preferably from steel.

7. Drilling pipe according to claim 5, characterized in that the pipe conductor (**7***a*) is connected to the drilling pipe body (**12**) in a cohesive and/or force-fitting manner.

8. Drilling pipe according to claim 5, characterized in that a gap of 0.5 cm to 2.5 cm, preferably of 1.5 cm, is provided between the pipe conductor (**7***a*) and the drilling pipe body (**12**), and in that, preferably, the gap is filled with a casting compound, in particular with epoxy resin.

9. Drilling pipe according to claim 1, characterized in that the pipe contact connection (**13**) is provided on the end-side front face (**19**) of the drilling pipe body (**12**).

10. Drilling pipe according to claim 1, characterized in that the pipe contact connection (**13**) is of circumferential design, and in that, preferably, the pipe contact connection (**13**) is arranged on an insulating ring (**20**) resting on the front face (**19**), and in that, further preferably, an annular groove (**21**) is provided in the insulating ring (**20**), which is made from an elastic material, for the purpose of accommodating the pipe contact connection (**13**), and in that the annular groove (**21**) is deeper than the height of the pipe contact connection (**13**).

11. Drilling pipe according to claim 1, characterized in that the pipe contact connection (**13**) is spring-loaded in particular in the direction away from the front face (**19**) and/or in that outwardly protruding contact tongues are provided on the pipe contact connection (**13**).

12. Drilling pipe according to claim 1, characterized in that at least one circumferential seal is provided in the region of the pin (**22**) of the drilling pipe body (**12**), and in that a seal (**26**) is provided on the step (**24**) from the pipe outer side (**25**) to the pin (**22**) and/or at the transition between the step (**24**) and the pin (**22**).

13. Bush (**11**) for a drill column (**3**) for deep wells, having a bush body (**27**) made from an electrically conductive material, at least one electrical bush conductor (**7***b*) being passed through the bush body (**27**), the bush conductor (**7***b*)

being connected to a bush contact connection (**28**) provided at one end on the bush body (**27**), and the bush conductor (**7***b*) and the bush contact connection (**28**) being electrically insulated from the bush body (**27**), characterized in that the bush conductor (**7***b*) is fixed to the bush inner side (**29**), and in that a longitudinal groove (**30**) for at least one bush conductor (**7***b*) is provided on the bush inner side (**29**) of the bush body (**27**).

14. Bush according to claim 13, characterized in that the depth of the groove (**30**) is greater than the diameter of the bush conductor.

15. Bush according to claim 13, characterized in that the bush conductor (**7***b*) is cast into the groove (**30**) via an insulation.

16. Bush according to claim 13, characterized in that the bush conductor (**7***b*) is sheathed by a conductor insulation.

17. Bush according to claim 13, characterized in that an electrical insulating layer (**31**) is applied, in particular vapour-deposited, over the entire surface of the bush inner side, and in that, preferably, the insulating layer (**31**) covers the bush conductor (**7***b*).

18. Bush (**11**) for a drill column (**3**) for deep wells, having a bush body (**27**) made from an electrically conductive material, at least one electrical bush conductor (**7***b*) being passed through the bush body (**27**), the bush conductor (**7***b*) being connected to a bush contact connection (**28**) provided at one end on the bush body (**27**), and the bush conductor (**7***b*) and the bush contact connection (**28**) being electrically insulated from the bush body (**27**), characterized in that the bush conductor (**7***b*) is tubular, in that the bush conductor (**7***b*) is passed through the bush body (**27**) and/or sheaths the bush body (**27**), and in that, preferably, the bush conductor (**7***b*) and the bush body (**27**) have essentially the same linear thermal expansion behaviour.

19. Bush according to claim 18, characterized in that the bush conductor (**7***b*) and the bush body (**27**) are produced from the same material, preferably from steel.

20. Bush according to claim 18, characterized in that the bush conductor (**7***b*) is connected to the bush body (**27**) in a cohesive and/or force-fitting manner.

21. Bush according to claim 18, characterized in that a gap of 0.5 cm to 2.5 cm, preferably of 1.5 cm, is provided between the bush conductor (**7***b*) and the bush body (**27**), and in that, preferably, the gap is filled with a casting compound, in particular with epoxy resin.

22. Bush according to claim 13, characterized in that the bush contact connection (**28**) is provided on a front-side shoulder (**32**) to the bush inner side (**29**).

23. Bush according to claim 13, characterized in that the bush contact connection (**28**) is of circumferential design, and in that the bush contact connection (**28**) is arranged on an insulating ring (**20**) resting on the shoulder (**32**).

24. Bush according to claim 13, characterized in that an annular groove is provided in the insulating ring (**20**), which is made from an elastic material, for the purpose of accommodating the bush contact connection (**28**), and in that the annular groove (**21**) is deeper than the height of the bush contact connection (**28**).

25. Bush according to claim 13, characterized in that the bush contact connection (**28**) is spring-loaded in particular in the direction away from the shoulder (**32**) and/or in that outwardly protruding contact tongues are provided on the bush contact connection (**28**).

26. Bush according to claim 13, characterized in that at least one circumferential seal (**35**) is provided on the outer front face (**34**) of the bush body (**27**).

27. Drill column (**3**) for deep wells, having a plurality of drilling pipes (**10**) having drilling pipe bodies (**12**) made from an electrically conductive material and a plurality of bushes (**11**) having bush bodies (**27**) made from an electrically conductive material, having at least one drilling pipe (**10**) according to one of the preceding claims and at least one bush (**11**) according to one of the preceding claims, one electric pole being formed by the drill column body comprising the drilling pipe bodies (**12**) and the bush bodies (**27**), and the other electric pole being formed by at least one conductor (**7**), which is electrically insulated from the drill column body and is arranged within the drill column body, and, preferably, the pipe contact connection (**13**) and the bush contact connection (**28**) being designed and arranged such that, when the drilling pipe (**10**) and the bush (**11**) are screwed together, an electrical connection results.

28. Drill column according to claim 27, characterized in that a slipring collector, which is insulated from the drilling pipe body (**12**) and is connected to the pipe conductor (**7**), is provided on the first drilling pipe (**10**).

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