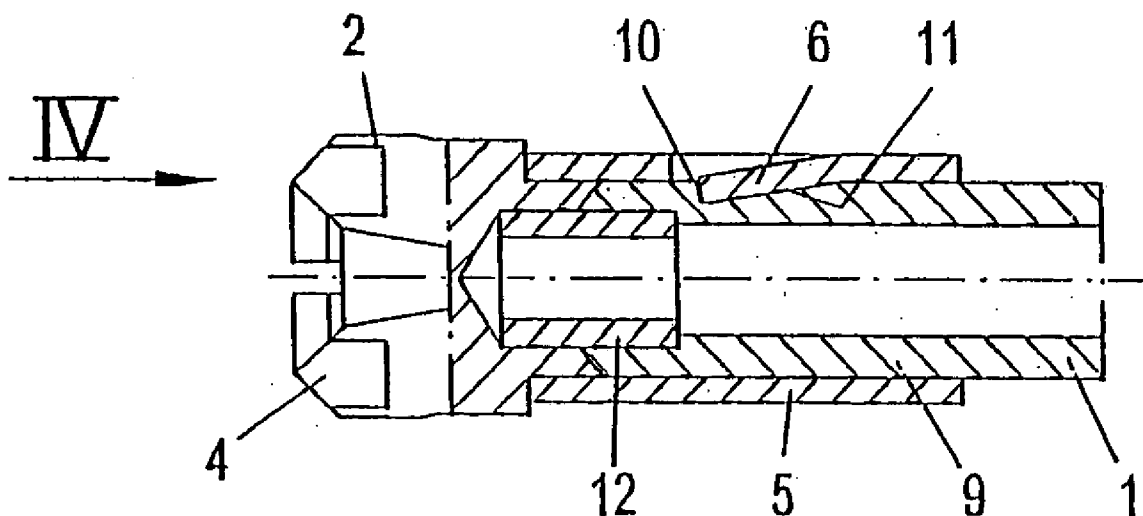


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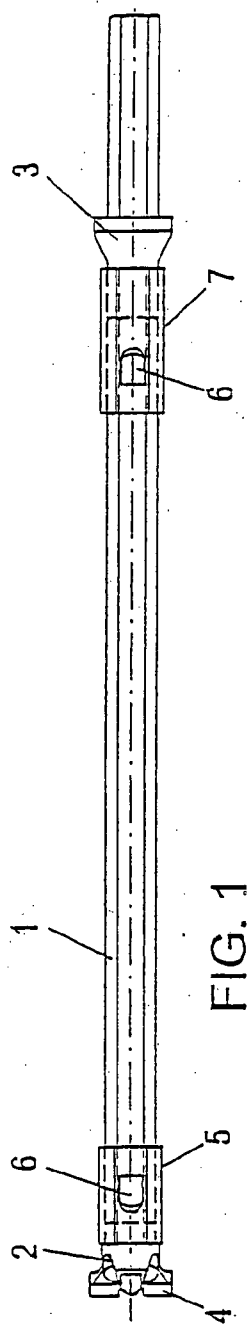


FIG. 1

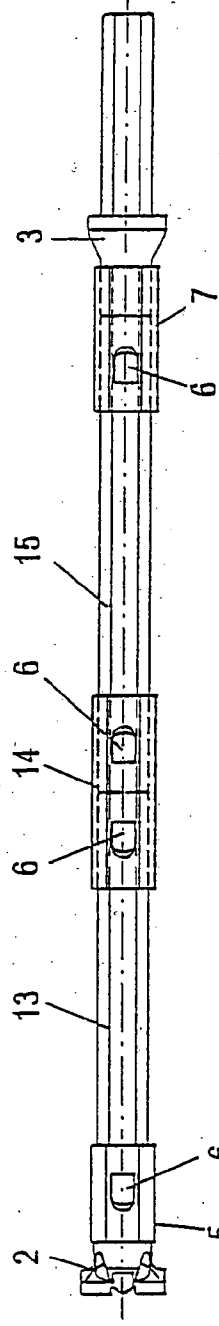


FIG. 2

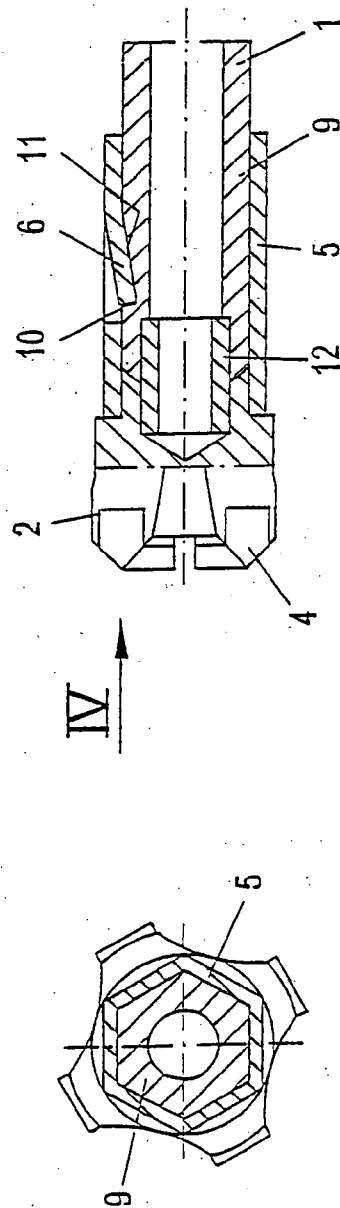


FIG. 3

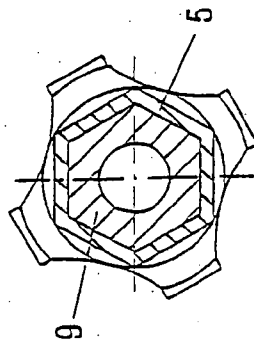


FIG. 4

DEVICE FOR CONNECTING TWO ELEMENTS HAVING A SUBSTANTIALLY CYLINDRICAL OR TUBULAR SHAPE

FIELD OF THE INVENTION

[0001] The present invention relates to a device for connecting two substantially rod- or tube-shaped elements, for instance parts of a rod assembly of a drilling device and/or a rod assembly element with a drill bit or a drill head, wherein the elements to be connected are each designed to comprise a male end and a complementary female end or contiguous ends are each overlapped by a bushing or sleeve wherein on the female end or sleeve, respectively, at least one partial region capable of being shifted towards the female end substantially in the radial direction of the connection, and/or pressed in, is engagingly fixed in a complementary recess or depression provided on the male end.

DESCRIPTION OF THE PRIOR ART

[0002] Devices of such type can be taken for example from U.S. Pat. No. 5,304,012, WO 97/41377, U.S. Pat. No. 4,513,488 or FR 21 104 E.

[0003] In the context of connecting substantially rod- or tube-shaped or cylindrical elements, various ways of connection are known, wherein, for instance, screw connections or latch connections or couplings, e.g., in the manner of a bayonet catch, may be cited as examples. Those known connections, in particular, involve the disadvantage that ends partially worked to fit snugly, of elements to be connected must each be inserted one into the other and rotated relative to each other, or generally moved, in order to enable a desired connection to be established. It is immediately apparent that, for instance, such screw connections not only involve much time for manufacture, but also call for a high positioning accuracy, or the alignment of elements to be connected, in order to secure said connections, such an accurate positioning being difficult in some cases such as, for instance, the extension of drill rod assemblies or the like usually having great lengths. Besides, a proper extension is sometimes not readily feasible in the rough environment to which such connections are exposed. Moreover, it is to be anticipated that the connection sites are subjected to accordingly high stresses, particularly after an extended period of use or use under rough environmental conditions, so that connections of this type will partially not be detachable again or only at high time and energy inputs. Furthermore, it is to be anticipated that, in order to ensure a proper connection by the aid of a thread, an accordingly large material thickness will have to be provided in the region of the thread connection, both in the region of a male end and in the region of a female end, in order to take up, and transmit, the optionally high strains involved in the realization of a drilling operation, so that defined minimum dimensions of, for instance, a drill bit or rod assembly parts must not be fallen short of. Thus, it is, for instance, not feasible to provide drill bits for the production of bores or holes having small diameters, since it must inter alia be taken into consideration that the drill rod assembly must, as a rule, be designed to be hollow in order to enable the supply of flushing liquid into the region of the drill bit and/or the haulage of worked material and afford an accordingly large clear width. In order to obtain smaller bore diameters, it has, for instance, been proposed in this respect not to realize an

extension of a drill rod assembly by screw connections, but to remove the entire drill rod assembly including the drill bit from the bore hole after having carried out a bore over a defined length and use a longer drill rod assembly after this, wherein it is immediately apparent that such a mode of procedure involves an accordingly increased time and work input.

SUMMARY OF THE INVENTION

[0004] The present invention aims to provide a device for connecting two substantially rod- or tube-shaped elements of the initially defined kind, which enables the simple and reliable connection of two elements to be connected. Such a simple and reliable connection is to be feasible particularly under rough environmental conditions and aimed to reliably prevent any undesired detachment or separation of the elements to be connected, both in the axial direction and in the longitudinal direction of the elements to be connected as well as being readily or simply produced.

[0005] To solve these objects, a device of the initially defined kind is essentially characterized in that the partial region capable of being pressed in and/or shifted is delimited by a slot provided in the female end or sleeve, respectively, and delimiting in top view a particularly substantially U-shaped partial region capable of being pressed in. Such a, for instance, substantially U-shaped slot can be produced in the region of the female end, or a sleeve or bushing, respectively, by simple means and accordingly quickly, whereupon, after insertion or introduction of the male end, a connection of the elements to be connected is feasible by simply pressing or displacing or driving the partial region delimited by the slot into the complementary or corresponding depression or recess provided on the male end.

[0006] Due to the fact that according to the invention a partial region provided on the female end and capable of being shifted and/or pressed in engages in a complementary depression or recess provided on the male end of the second element of the connection to be assembled, and is received in said depression or recess in a substantially positive manner, a simple coupling or connection of the elements to be connected is ensured either directly via the female end into which the male end is immersed, or by the aid of an appropriate bushing or sleeve. The partial region capable of being pressed in or driven in engages in the respective recess provided on the female end, and any detachment or separation of the elements to be connected is reliably prevented in the axial direction and/or longitudinal direction by the arrangement of the insertable partial region or projection, respectively. Moreover, it is immediately apparent that the connection proposed according to the invention by the simple insertion, or fitting into each other, of the elements to be connected, or by the insertion of a male element into a bushing or sleeve, will be sufficient, whereupon, after the desired positioning in a relative axial position, a partial region capable of being pressed in or driven in is driven into the depression or recess of the female part, thus rapidly and safely providing the desired connection. In addition, the partial region provided according to the invention and capable of being shifted and/or pressed in not only ensures a reliable plug-type connection on mutually cooperating ends, but also enables the provision of an accordingly thin material thickness for maintaining the plug-type connection such that even small bore or borehole diameters may be

envisaged. Compared with a thread connection, such a plug-type connection also ensures an enhanced force transmission, because accordingly large stop surfaces or reception surfaces can be provided between the individual elements of a plug-type connection, while only small abutment surfaces, for instance by line contacts, will be available with threads, particularly in the case of wear due to high stresses or strains.

[0007] For an optionally desired detachment of such a connection it will do in the event of an appropriate orientation of the depression or recess as well as the partial region capable of being driven in, to act on the same in the axial direction so as to overcome the connection force provided by the partial region capable of being driven in or pressed in, in order to separate the elements connected with each other. It is apparent that any excessively accurate adjustment or orientation of the elements to be connected, which may optionally have large lengths, can be obviated in the connection proposed by the invention and that, furthermore, no mutual rotational movements are required to produce or complete the connection, as is, for instance, necessary with screw connections or bayonet couplings or similar connection means belonging to the prior art. A connection proposed according to the invention can, thus, be employed in a time- and cost-saving manner even under rough environmental conditions such as, for instance, during the production of a borehole in soil or rock material or when used along with a taphole drilling machine, both for the production of a connection and for an optionally required separation of the connection after use under high stresses and strains exerted on the connection sites.

[0008] When using a sleeve or bushing for the connection of tube- or rod-shaped elements, it is proposed according to a further preferred embodiment that a sleeve or bushing for the connection of the contiguous ends of tube-shaped elements is designed to include two partial regions capable of being shifted and/or pressed in, which are oriented in a relatively opposite relationship. Optionally required different actions of force aimed to generate the desired connection force in the region of the sleeve can be taken into account by appropriately positioning or arranging the respective partial regions capable of being pressed in or shifted, on different partial regions of the sleeve, which cooperate with the two distinct ends of the elements to be connected.

[0009] For another particularly simple and hence cost-effective and time-saving configuration of the respective depression or recess provided on the male end, it is, moreover, proposed that the recess or depression provided on the male end is formed by a channel or groove extending substantially in the longitudinal direction of the elements to be connected, as in correspondence with a further preferred embodiment of the device according to the invention. As already indicated above, it is feasible by the device proposed according to the invention to provide a reliable securement substantially simple to produce, of rod- or tube-shaped elements to be connected, in the axial direction or longitudinal direction of these elements. If the elements are to be secured against a relative rotational movement too, or if a rotational movement is exerted on these elements, for instance when carrying out a drilling procedure, or if a rotational movement is to be transmitted from a driving means to a drilling tool via those elements such as, for instance, rod assembly elements, it is provided according to

a further preferred embodiment, in order to obtain an appropriate rotational entrainment, that the male end and the female end or sleeve, respectively, are each designed to have a peripheral shape deviating from a circular shape, for instance a peripheral shape hexagonal in cross section. Such peripheral shapes deviating from a circular shape can also be produced in an accordingly simple and cost-effective manner with a snug fit so as to again ensure a simple connection by the simple introduction or insertion of a male end into a female end, or a sleeve or bushing forming an intermediate element, by subsequently pressing or displacing the respective partial regions into the respective recesses provided on the outer peripheries of the ends to be received. Since rod- or tube-shaped elements to be connected may optionally have comparatively high material cross sections, thus optionally rendering difficult the pressing in or driving in of the partial regions provided for the connection, or optionally requiring a high impact strain to do so, it is proposed according to another preferred embodiment that the partial region capable of being shifted and/or pressed in is designed to have a cross section reduced relative to the adjacent end regions. Such a reduced cross section allows for the reliable driving in or pressing in of the partial regions provided for the connection, while still affording a sufficiently high connection force or retention force against any unintentional detachment, particularly in the axial direction.

[0010] In order to ensure a substantially positive abutment of the partial region capable of being shifted and/or pressed in, it is proposed according to another preferred embodiment that the depression or recess provided in the male end and receiving the displaceable partial region is designed to be bevelled, or increase in depth, in the longitudinal direction of the tubular elements to be connected.

[0011] In order to provide a defined stop position or end position of the connection to be produced according to the invention, it is proposed according to a further preferred embodiment that the depression or recess in the longitudinal direction of the tubular elements to be connected forms a stop for the partial region capable of being pressed in or shifted.

[0012] In addition to using the device according to the invention to connect, for instance, rod assembly elements of a rod assembly or the like, the connection capable of being rapidly and readily produced by the device according to the invention can also be employed to fix, for instance, a drill bit or a drill head to a drill rod assembly. In this context, it is proposed that the female end is formed by a sleeve or bush-shaped projection provided on the end facing away from the drilling surface of a drill bit, into which projection the male end of a rod assembly element is introducible, as in correspondence with a further preferred embodiment of the device according to the invention.

[0013] In order to avoid an optionally non-uniform load about the periphery of the elements to be connected, or to provide a necessary connection or retention force in a manner distributed about the periphery, it is proposed according to a further preferred embodiment that a plurality of partial regions capable of being shifted and/or pressed in and complementary recesses and depressions are provided about the periphery of the elements to be connected. By providing an optionally different number of connection regions, or partial regions capable of being shifted or pressed

in, on the outer peripheries of elements to be connected, it is also feasible to provide different retention or connection forces in different partial regions, so that, by providing an optionally different number of connection regions in different partial regions of a longer connection, preferred sites for the detachment of a connection of tubes or rod assemblies comprised of several elements can be defined for a desired detachment.

SHORT DESCRIPTION OF THE DRAWINGS

[0014] In the following, the invention will be explained in more detail by way of exemplary embodiments schematically illustrated in the accompanying drawing. Therein:

[0015] **FIG. 1** is a schematic side view of a first embodiment of a device according to the invention;

[0016] **FIG. 2** shows a modified embodiment in an illustration similar to **FIG. 1**;

[0017] **FIG. 3** is a partial section through a device according to the invention for the production of a connection between a drill bit and a contiguous rod assembly element on an enlarged scale as compared to **FIGS. 1 and 2**; and

[0018] **FIG. 4** is a partially sectioned view in the sense of arrow IV of **FIG. 3**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] **FIG. 1** depicts a tubular rod assembly element 1 which, on the one hand, is to be fixable to, or connectable with, a drill bit or drilling tool 2 and, on the other hand, on its end facing away from the drill bit 2, is connected via a percussion element 3 with a driving means not illustrated in detail and acting on the percussion element 3 such as, for instance, a drive for rotary percussion drilling.

[0020] The connection of the drill rod assembly 1 both with the drill bit 2 and with the percussion element 3 is realized in the region of the drill bit 2 by immersing the rod assembly element 1 into a projection 5 projecting from the end facing away from the working surface of the drill bit 2, wherein the projection 5 comprises on its outer periphery a partial region 6 capable of being shifted and/or pressed in and entering a respective recess or groove provided on the outer periphery of the male end of the drill rod assembly 1, as is illustrated in more detail in **FIG. 3**.

[0021] In a similar manner, the end of the drill rod assembly 1 facing the percussion element 3 is connected with the percussion element 3 via a sleeve 7, wherein also the sleeve 7 comprises a partial region 6 capable of being shifted and/or pressed in, which reaches again into a respective recess or depression provided on the outer periphery of the male end of the rod assembly or tube 1.

[0022] From the illustration according to **FIG. 3**, it is apparent that the drill bit or drill head 2, on its end facing away from the working surface 4, comprises a bush-shaped projection 5 into which the male end 9 of the drill rod assembly or tubular element 1 is immersed. In the connected state represented in **FIG. 3**, the partial region 6 capable of being shifted and/or pressed in or driven in is received in a respective recess or depression 10 provided on the outer periphery of the male end 9. The depression or recess 10 is provided with a bevelled or inclined surface 11, on which the

partial region 6 capable of being driven in or pressed in gets into abutment as it is brought into engagement in the depression or recess 10, departing from a position in alignment with the contiguous partial regions. In **FIG. 3**, a bush-shaped centering projection 12 is further indicated in the region of the drill bit 2.

[0023] From the partially sectioned illustration according to **FIG. 4**, it is, furthermore, apparent that both the bush-shaped projection 5 of the drill bit 2 and the male end 9 of the rod assembly 1 have each a cross section deviating from a circular shape so as to enable the rotational entrainment of the drill bit 2 via the, for instance, hexagonal cross sectional or peripheral shape represented in **FIG. 4**, as the rod assembly 1 is being set in rotation, while providing a reliable securement relative to any displacement or detachment in the axial direction by the partial region 6 of the bush-shaped projection 5 engaging in the recess 10. If the rod assembly 1 is to be separated, for instance, from the drill bit 2 after completion of a drilling operation, a force exceeding the connection force must be exerted on the tubular element 1 in the direction of removal of the tubular element 1 from the drill bit 2 so as to effect a separation of the tubular element 1 from the drill bit 2 under the deformation of the partial region 6 received in the recess 10.

[0024] The connection between the sleeve 7 of the percussion element 3 and the rod assembly end located opposite, or facing away from, the drill bit 2, is realized in a manner similar to that of the connection between the drill bit 2, or its sleeve-shaped projection 5, and the male end 9 of the rod assembly 1.

[0025] **FIG. 2** depicts a modified embodiment, wherein, in addition to the connection of a rod assembly element denoted by 13 with a drill bit again denoted by 2 via a partial region 6 capable of being pressed in or driven in, an extension of the rod assembly by a sleeve 14 is effected, via which the tube-shaped element 13 is connected with a further tube-shaped element 15, which, in turn, is again connected with a percussion element 3. In order to provide a safe and reliable connection, particularly in the axial direction or longitudinal direction, partial regions 6 capable of being shifted and/or pressed in or driven in are again provided on the bush-shaped projection 5 of the drill bit 2, on sleeve 14 and on the sleeve 7 of the percussion element 3 so as to enable an accordingly simply and quickly realizable connection between individual tube-shaped elements 13 and 15 in a manner similar to the embodiment according to **FIGS. 1 and 3**.

[0026] Instead of the connection illustrated in the Figures, which uses substantially sleeve-shaped intermediate elements 5, 7 and 14, a connection can also be created in that a sleeve end or female end of a tube- or rod-shaped element directly overlaps a male end of a second tube- or rod-shaped element or tip end, the connection being again realized by the at least one partial region 6 capable of being shifted in the direction towards the female end and/or driven in.

[0027] In order to avoid nonuniform straining or connection forces at optionally larger cross sections, it may be provided that a plurality of partial regions 6 each capable of being pressed in or driven in are provided so as to be substantially uniformly distributed over the periphery of a connection site.

[0028] As is apparent from the drawings, slight material thicknesses or wall thicknesses of the mutually overlapping

partial regions such as, for instance, both the bush-shaped projection **5** and the drill rod assembly **1** will suffice in the illustration according to **FIG. 3**, so that even small bore diameters can be produced despite the provision of an accordingly large clear width in the interior of the drill rod assembly. It is, furthermore, apparent that substantially full-surface contiguous stop surfaces may be provided between interconnected elements in order to ensure a proper force transmission.

1. A device for connecting two substantially rod- or tube-shaped elements, for instance parts of a rod assembly of a drilling device and/or a rod assembly element with a drill bit or a drill head, wherein the elements to be connected are each designed to comprise a male end and a complementary female end or contiguous ends are each overlapped by a bushing or sleeve, wherein on the female end or sleeve, respectively, at least one partial region capable of being shifted towards the female end substantially in the radial direction of the connection, and/or pressed in, is engagingly fixed in a complementary recess or depression provided on the male end, wherein the partial region capable of being pressed in and/or shifted is delimited by a slot provided in the female end or sleeve, respectively, and delimiting in top view a particularly substantially U-shaped partial region capable of being pressed in.

2. A device according to claim 1, wherein a sleeve or bushing for the connection of the contiguous ends of tube-shaped elements is designed to include two partial regions capable of being shifted and/or pressed in, which are oriented in a relatively opposite relationship.

3. A device according to claim 1, wherein the recess or depression provided on the male end is formed by a channel

or groove extending substantially in the longitudinal direction of the elements to be connected.

4. A device according to claim 1, wherein the male end and the female end or sleeve are each designed to have a peripheral shape deviating from a circular shape, for instance a peripheral shape hexagonal in cross section.

5. A device according to claim 1, wherein the partial region capable of being shifted and/or pressed in is designed to have a cross section reduced relative to the adjacent end regions.

6. A device according to claim 1, wherein the depression or recess provided in the male end and receiving the displaceable partial region is designed to be bevelled, or increase in depth, in the longitudinal direction of the tubular elements to be connected.

7. A device according to claim 6, wherein the depression or recess in the longitudinal direction of the tubular elements to be connected forms a stop for the partial region capable of being pressed in and/or shifted.

8. A device according to claim 1, wherein the female end is formed by a sleeve or bush-shaped projection provided on the end facing away from the drilling surface of a drill bit, into which projection a male end of a rod assembly element is introducible.

9. A device according to claim 1, wherein a plurality of partial regions capable of being shifted and/or pressed in and complementary recesses and depressions are provided about the periphery of the elements to be connected.

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