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B3C C1B6J C1B6N

(56) Documents cited
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INT CL⁴ B23B 51/02, B25D 17/02 17/08 17/14

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(54) Drilling equipment

(57) A percussion drill bit 10 has a cutting face 22 with cutting elements which may be in the form of buttons 20 (e.g. carbide material) or blades. The bit has a cylindrical body with helical flutes 32, which extend into a reduced diameter neck 30 disposed between face 22 and the cylindrical body.

The bit 10 includes holes 28 extending therethrough to direct flushing medium (water) to the face 22 and a threaded socket for receiving threaded end of the drill rod.

The bit 10 can be combined in a drill string with an extension body 12 and a rod connector 16, all of which have similar helical fluted surfaces.

The body 12 has a threaded end received in the threaded socket of bit 10, and a threaded socket to receive therein a drill rod 14. The connector 16 has threaded sockets at its ends for receiving the rod 14 and a rod 18. The rods 14, 18, body 12 and bit 10 all have flushing passages therethrough.

The angle of the helix defined by flutes 32 is between 20° and 30°.

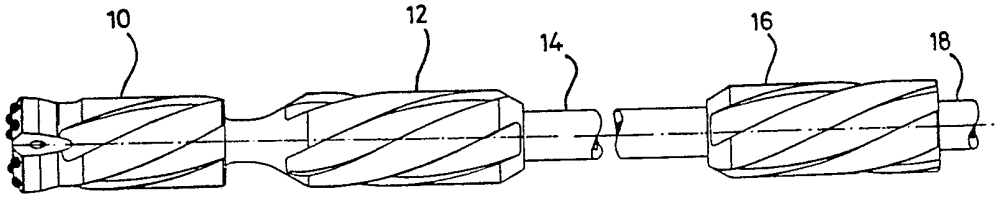


Figure 1

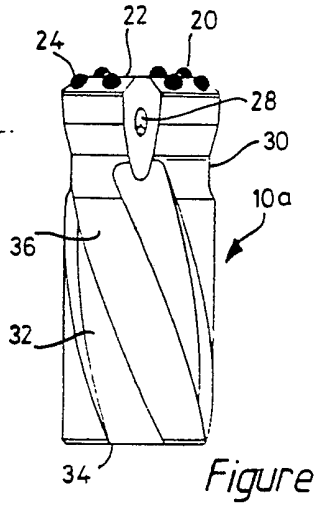


Figure 2

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

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

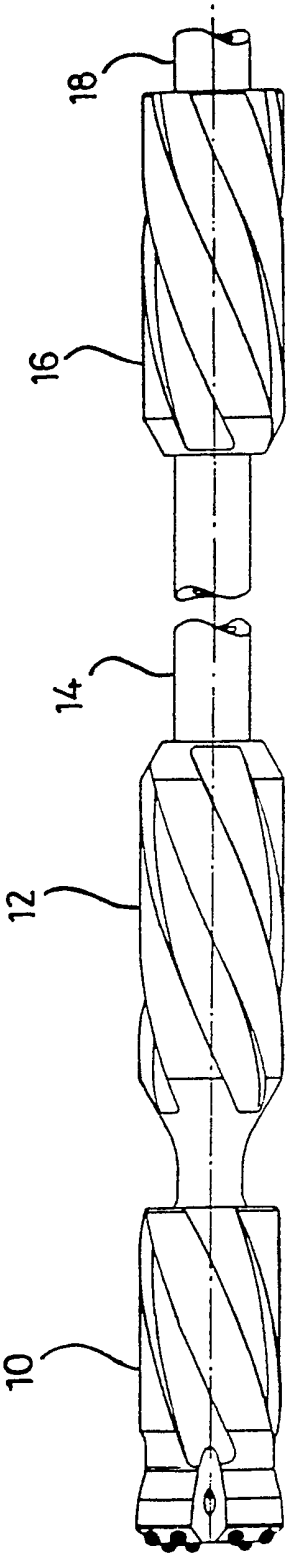


Figure 1

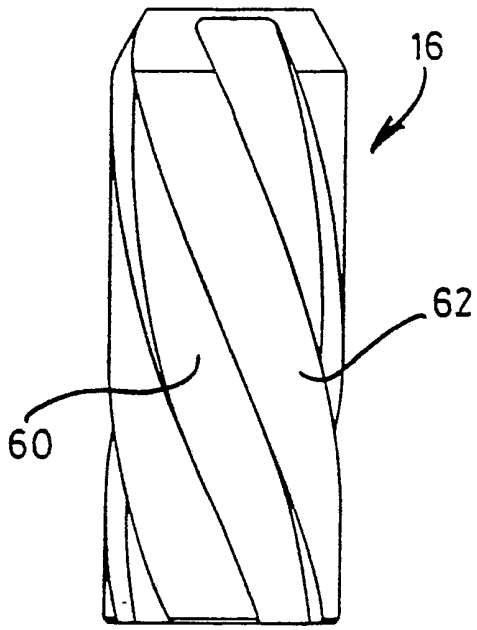


Figure 9

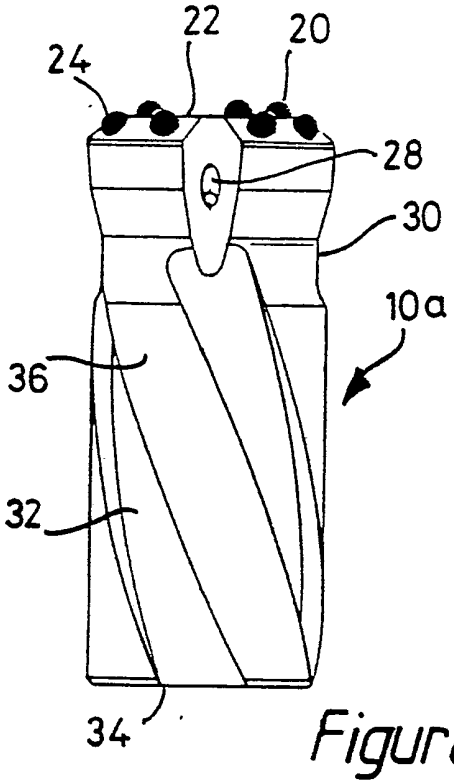


Figure 2

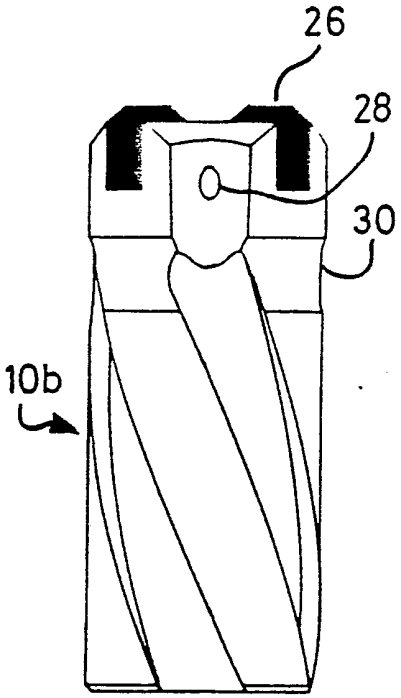


Figure 3

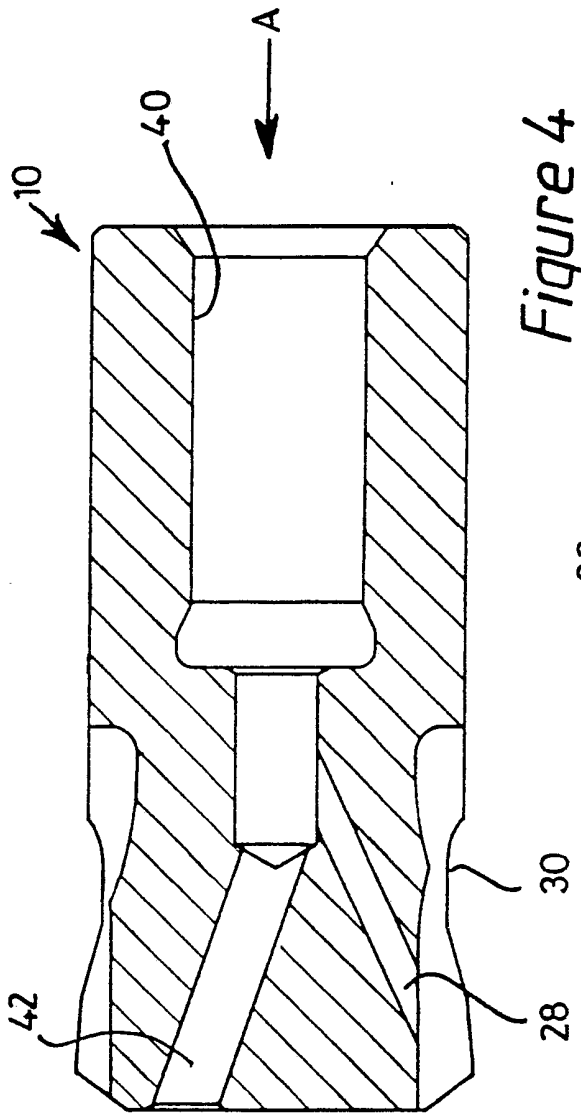


Figure 4

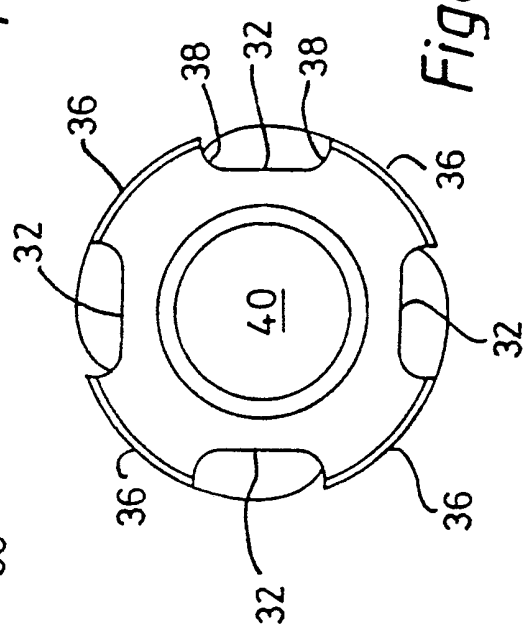


Figure 5

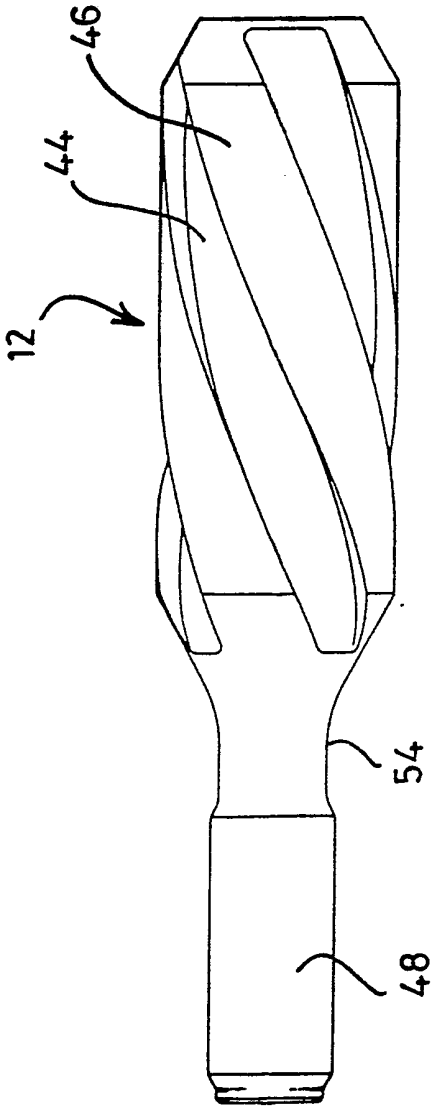


Figure 6

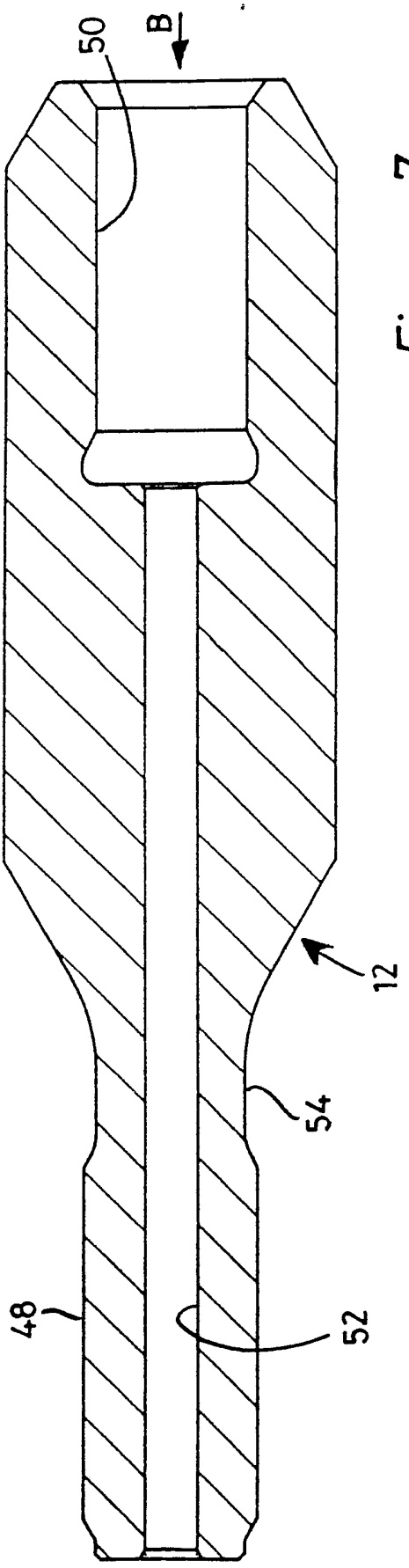


Figure 7

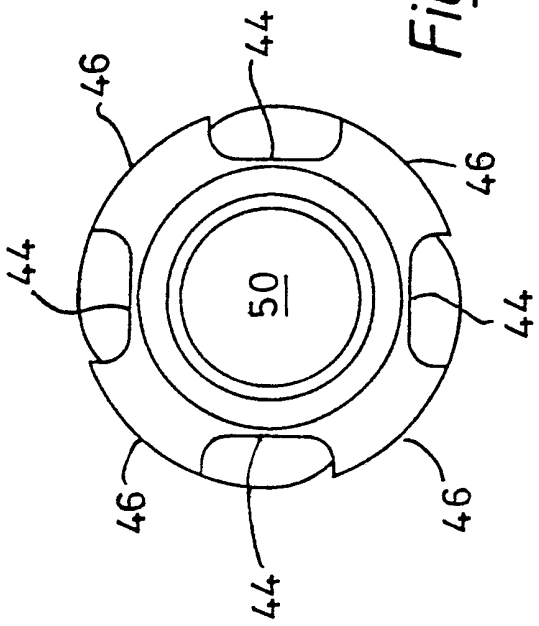


Figure 8

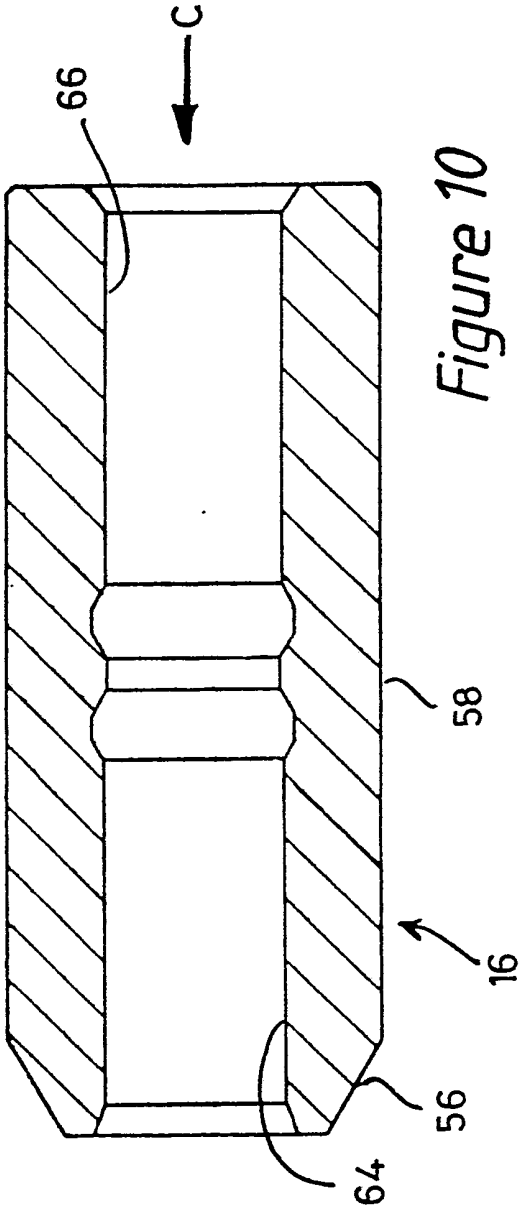


Figure 10

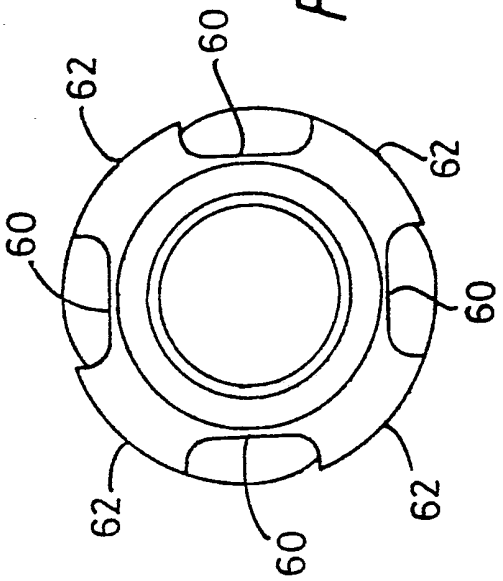


Figure 11

TITLE: DRILLING EQUIPMENT

This invention relates to drilling equipment for the drilling of holes in rock by percussive techniques, where the drill bit is subjected to repeated axial impacts, whilst being rotated in the hole.

There is a requirement in modern mining and drilling practice for the production of long, straight holes. This invention is intended to facilitate the drilling of such holes.

According to a first aspect of the invention, there is provided a percussion drill bit having a cutting face carrying drilling inserts, a neck behind the cutting face, and a body portion extending back from the neck, the body portion having an outer cylindrical surface with helical flutes formed in the surface, a flushing hole extending through the bit to direct flushing medium to the cutting face, and a threaded socket for receiving the threaded end of the drill rod, the cylindrical outer surface extending up to that end of the bit remote from the cutting face.

The bit is preferably a button bit having buttons of a hard material such as a carbide material mounted in the cutting face. The invention is however also useful in connection with blade bits.

The use of an elongated cylindrical bit surface (with helicalflutes to carry away the debris) helps to stabilise the bit in the hole and to ensure that a straight hole is produced.

The diameter of the cylindrical surface is preferably 4 to 8 mm less than the gauge diameter of the cutting face, when the bit is new.

The invention also provides the combination of a drill bit as set forth above together with an extension body, the extension body having a male threaded end, a female threaded socket coaxial with the male end, an outer cylindrical surface with helical flutes formed in the surface and a flushing hole extending through the body, the male threaded end being adapted to screw into the socket in the drill bit, and the thread of the female socket being adapted to receive the threaded end of a drill rod.

The use of such an extension body in combination with the drill bit can substantially extend the length of the cylindrical, helically fluted surface and thus provide even better centralisation of the bit in the hole leading to increased straightness.

Still further, the invention provides the combination of the drill bit and extension body set forth above with at least one drill rod connector, the drill rod connector being adapted to receive the threaded ends of two drill rods, and having a cylindrical outer surface with helical flutes therein.

According to a second aspect of the invention the invention provides a drilling string for drilling long straight holes in rock using a percussive drilling technique, the string comprising a drill bit, an extension body, at least two drill rods with threaded ends and at least one drill rod connector, the extension body being threadedly connected to the drill bit, one drill rod being threadedly connected to the extension body and the connector connecting the one drill rod to another drill rod, wherein all of the drill bit the extension body and the connector have outer cylindrical surfaces with helical flutes formed in the surface.

The use of a drill string having all these features still further enhances the straightness of a hole as it is drilled.

In all three components, there are preferably four flutes around the circumference of the cylindrical surface, and the flutes and lands which separate the flutes preferably have approximately equal circumferential extents.

The angle of the helix is preferably between 20° and 30°, and an angle of 26° has been found to be particularly suitable. Such a helix will turn through less than half a revolution over the length of a typical component which is likely to have an overall length of about 150 - 200 mm.

The bit is preferably arranged to be rotated anti-clockwise as it rotates, and the helix will be handed to conform to this direction of rotation.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a completed drill string in accordance with the invention;

Figures 2 and 3 are external views of two alternative drill bits in accordance with the invention;

Figure 4 is a section through the drill bit of Figure 2;

Figure 5 is a view in the direction of arrow A from Figure 4;

Figure 6 is an external view of an extension body in accordance with the invention;

Figure 7 is a cross sectional view of the extension body from Figure 6;

Figure 8 is a view of the extension body taken in the direction of the arrow B from Figure 7;

Figure 9 is an external view of a drill rod connector;

Figure 10 is a cross section view through the connector of Figure 9; and

Figure 11 is an end view of the connector of Figure 10 taken in the direction of the arrow C from Figure 10.

The drill string shown in figure 1 consists of a bit 10, an extension body 12, a first drill rod 14, a drill rod connector 16 and a second drill rod 18. The threads which connect the various components will be one of the known threads which are specifically designed for connecting drill string components in percussive, rotary drilling. It should also be noted that the drill rods 14, 18, the extension body 12 and the bit 10 all have central flushing passages through which flushing medium passes from the drill itself to the cutting face of the bit.

The substantial cylindrical surface area presented by the components 10, 12 and 16 ensures that when a hole is drilled in rock, the forward progress of the bit is controlled for centricity by the contact made between the cylindrical surfaces and the walls of the hole as it is drilled. In this way it is possible to drill a long straight hole.

Figures 2 and 3 show respectively a button bit 10a and a blade bit 10b. The button bit has inserted carbide buttons 20 on its cutting face 22. An outer row of buttons 24 forms a gauge row or heel row and defines the diameter of the hole

which will be drilled. Although it cannot be seen in the drawing, the outermost regions of these buttons extend radially beyond the cutting face itself to cut the edges of the hole, as is known in the art.

In the blade bit 10b, blades 26 of carbide material are inserted in the head. There will normally be four such blades equally spaced around the head, and they extend to the outer circumference of the head.

Both bits have outlet holes 28 for a flushing medium which is usually water, and which is passed down the centre of the drill string, exits through the holes 28 and 42 and then carries the drilling debris along the spiral flutes and out of the drilled hole.

Immediately behind the cutting face 22, the bit narrow to a neck 30, and from this neck helical flutes 32 extend towards the opposite end of the bit 34. The flutes 32 are spaced from one another by lands 36. As can be seen from figure 5, there are four flutes 32 equally spaced around the circumference. Figures 2 and 3 show that the flutes 32 extend all the way from the neck 30 to the end 34 of the bit.

Figure 5 shows how the bases of the flutes do not have sharp corners but in fact have large radii 38. These radii may amount to about 5mm.

The bit itself is of generally massive constructions as can be seen from figure 4, so that it can withstand repeated percussive blows which are used to make the bit drill the necessary hole. The bit has a socket 40 which carries an internal thread form (not shown, but which will be of a standard type known in this type of installation). From the

front of the socket 40, flushing passages 28 and 42 extend towards the cutting face 22.

Figures 6, 7 and 8 show the extension body 12. On the outside of the body, helical flutes 44 and separating lands 46 are formed in much the same way as the flutes 32 and lands 36 in Figures 2 and 3. The lands 46 form an outer cylindrical surface which guides the drill string in the hole. One end of the extension body has a male threaded end 48, the thread corresponding to those on drill rods. This threaded end 48 can then be screwed into the socket 40 on the drill bit. At its other end the extension body has a socket 50 which corresponds to the socket 40 in the drill bit. A flushing passage 52 leads from the socket 50 to the opposite end of the body. The body also has a neck 54 between the threaded portion 48 and the cylindrical fluted region.

Figures 9, 10 and 11 show more details of the coupling 16 which has a tapered leading end 56 and a cylindrical body region 58 which is provided with helical flutes 60 and lands 62 similar to those already described for the bit and the extension body. The coupling has two female sockets 64 and 66 again with standard thread forms on them to receive standard threads on the ends of two drill rods to be connected.

Figure 1 shows the drill string with a length of the drill rod 14 broken away.

When drilling a long hole there will be a considerable number of drill rods 14, 18, etc, with the drill rods joined end to end by connectors 16. There will be a continuous flushing passage extending through the string.

The helix angle should be chosen so that it presents minimum hindrance to the flow of flushing medium and debris back up the hole. Typically the helix angle is between 20° and 30°, preferably 26°, with the angle being measured between a plane which includes the cylinder axis and one flank of one of the flutes, where the flute cuts the plane.

The drill string is to be rotated anti-clockwise to carry out drilling, and the fluting will be arranged so that, as seen looking into the hole, the ends of the fluting nearest the top of the hole trail the bottom ends wich are closest to the cutting face of the bit.

It is important that the diameters of the cylindrical surfaces on the various components be large enough to perform a worthwhile guiding function in conjunction with the walls of the drilled hole whilst avoiding the production of excess friction which would retard drilling. It is therefore necessary to reach a compromise which will permit an efficient action to take place. It has been found that a satisfactory action takes place if the diameter of the cylindrical surface is between 3 and 10 mm, preferably 6 mm less than the diameter of the heel row of button inserts on the drill bit.

This invention can be applied to drill strings which drill a hole having a diameter between 50 and 100 mm, and satisfactory operation has been proved at about 75mm diameter.

Claims

1. A percussion drill bit having a cutting face carrying drilling inserts, a neck behind the cutting face, and a body portion extending back from the neck, the body portion having an outer cylindrical surface with helical flutes formed in the surface, a flushing hole extending through the bit to direct flushing medium to the cutting face, and a threaded socket for receiving the threaded end of the drill rod, the cylindrical outer surface extending up to that end of the bit remote from the cutting face.

2. A drill bit as claimed in Claim 1, which is a button bit.

3. A drill bit as claimed in Claim 1, which is a blade bit.

4. A drill bit as claimed in any preceding claim, wherein the diameter of the cylindrical surface is 4 to 8 millimetres less than the gauge diameter of the cutting face, when the bit is new.

5. In combination, a drill bit as claimed in any one of Claims 1 to 4, together with an extension body, the extension body having a male threaded end, a female threaded socket coaxial with the male end, an outer cylindrical surface with helical flutes formed in the surface and a flushing hole extending through the body, the male threaded end being adapted to screw into the socket in the drill bit, and the thread of the female socket being adapted to receive the threaded end of a drill rod.

6. The combination as claimed in Claim 5, together with at least one drill rod connector, the drill rod connector being adapted to receive the threaded ends of two drill rods, and having a cylindrical outer surface with helical flutes therein.

7. A drilling string for drilling long straight holes in rock using a percussive drilling technique, the string comprising a drill bit, an extension body, at least two drill rods with threaded ends and at least one drill rod connector, the extension body being threadedly connected to the drill bit, one drill rod being threadedly connected to the extension body and the connector connecting the one drill rod to another drill rod, wherein all of the drill bit, the extension body and the connector have outer cylindrical surfaces with helical flutes formed in the surfaces.

8. A drill bit as claimed in any one of Claims 1 to 4, wherein the cylindrical surface has four flutes around the circumference, and the flutes and the lands which separate the flutes, have approximately equal circumferential extents.

9. A drill bit as claimed in any one of Claims 1 to 4 and 8, wherein the helix angle of the helical flutes is between 20° and 30°.

10. A drill bit as claimed in Claim 9, wherein the angle of the helix is approximately 26°.

11. A drill bit as claimed in any one of Claims 1 to 4 or 8 to 10, wherein the helix is handed to conform to an anti-clockwise direction of rotation.

12. The combination as claimed in Claim 5 or Claim 6, wherein each cylindrical surface has four flutes around the circumference, and the flutes and the lands, which separate the flutes have approximately equal circumferential extents.

13. The combination as claimed in Claim 5, Claim 6 or Claim 12 wherein the helix angle of the helical flutes is between 20° and 30°.

14. The combination as claimed in Claim 13, wherein the helix angle is approximately 26°.

15. The combination as claimed in Claim 5 or Claim 6 or any one of Claims 12 to 14, wherein the helix formed by the helical flutes is handed to conform to an anti-clockwise direction of rotation.

16. A drilling string as claimed in Claim 7, wherein each cylindrical surface has four helical flutes around the circumference, and the flutes and the lands, which separate the flutes, have approximately equal circumferential extents.

17. A drilling string as claimed in Claim 7 or Claim 16, wherein the helix angle of the helical flutes is between 20° and 30°.

18. A drilling string as claimed in Claim 17, wherein the helix angle is approximately 26°.

19. A drilling string as claimed in any one of Claims 7 or 16 to 18, and arranged to be rotated anti-clockwise with the helix formed by the helical flutes being handed to conform to this direction of rotation.

20. A drilling string substantially as herein described with reference to and as shown in Figure 1 of the accompanying drawings.

21. A percussion drill bit substantially as herein described with reference to and as shown in any one of Figures 1 to 5 of the accompanying drawings.

22. The combination of a drill bit, an extension body and a drill rod connector, substantially as herein described with reference to the accompanying drawings.

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