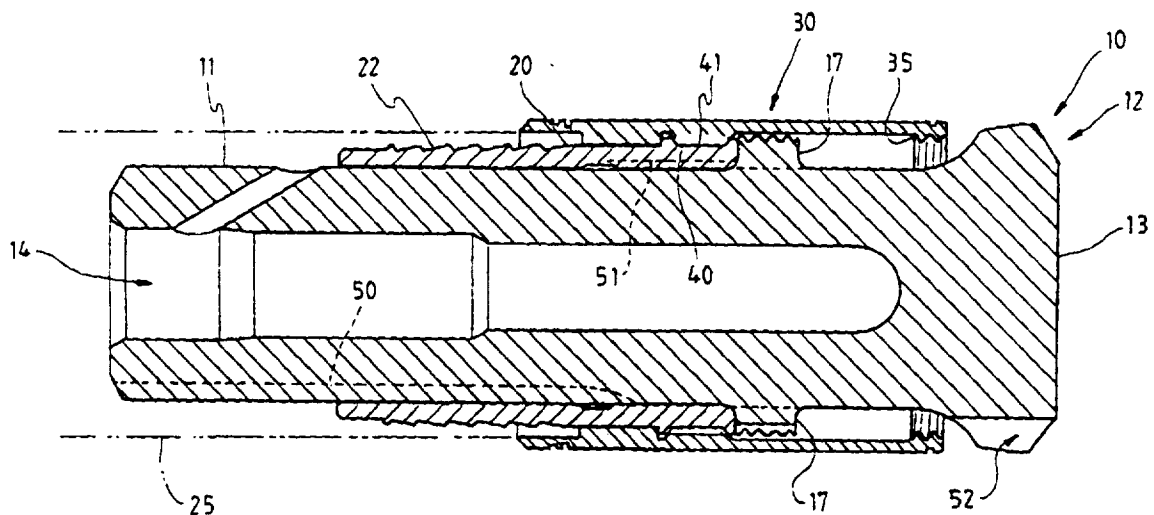




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/AU97/00482</p> <p>(22) International Filing Date: 31 July 1997 (31.07.97)</p> <p>(30) Priority Data:</p> <table border="0"> <tr> <td>PO 1351</td> <td>31 July 1996 (31.07.96)</td> <td>AU</td> </tr> <tr> <td>PO 7169</td> <td>5 June 1997 (05.06.97)</td> <td>AU</td> </tr> </table> <p>(71) Applicant (for all designated States except US): SDS DIGGER TOOLS PTY. LTD. [AU/AU]; 47-51 Vulcan Road, Canning Vale, W.A. 6155 (AU).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): MOIR, Frederick, Graham [AU/AU]; 47-51 Vulcan Road, Canning Vale, W.A. 6155 (AU). McINNES, Malcolm, Bicknell [AU/AU]; 5 Chardonay Court, Angle Vale, S.A. 5117 (AU).</p> <p>(74) Agent: MADDERN; 1st floor, 64 Hindmarsh Square, Adelaide, S.A. 5000 (AU).</p>		PO 1351	31 July 1996 (31.07.96)	AU	PO 7169	5 June 1997 (05.06.97)	AU	<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> With international search report.</p>
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(54) Title: FORWARDLY LOCATED BIT RETENTION MEANS



## (57) Abstract

A design for a drill bit retention means (30) for retaining a drill bit (10) to a percussive hammer. The drill bit is of the type that has a percussive cutting face (13) at one end of the drill bit body (10), and where the retaining means for holding the drill bit (10) to the percussive hammer comprises a circumferential shoulder (17) on the drill (10) spaced from the cutting face (13), and a drill bit retainer (30) comprising a generally tubular member which is secured to the percussive hammer and which has a flange means (33, 35) that engages the shoulder (17) so that the drill bit is able to move away from the percussive hammer whereupon the shoulder (17) engages against the flange means (33, 35) to thereby prevent further movement of the drill bit (10) and to hold it with respect to the percussive hammer. The invention has the advantage of being able to do away with the rear split ring retaining means used in conventional percussive hammer drill bits. This has the advantage of avoiding loss of components down the hole being drilled should there be a breakage, and producing stress raisers along the shank of the drill bit.

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## FORWARDLY LOCATED BIT RETENTION MEANS

This invention relates to a bit retention means for downhole drilling, and describes a bit retention means which can be used as the primary retaining means, or as an additional or secondary retaining means. It also relates to a drill bit for use with the retention means.

The retention means will retain broken bits to prevent a fractured drill bit from falling from a hammer into the bottom of the hole being drilled.

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The invention will find application on numerous styles of fluid powered drilling hammers. These include air hammers, and hammers driven by drilling muds or water. The invention will also be suitable for both direct circulation hammers or reverse circulation hammers.

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BACKGROUND OF THE INVENTION

Drill bits are normally retained within hammers by means of split rings which locate within recesses at the rear end of the bit shank. Drill bit bodies typically have a head and a rearwards protruding shank. The shank is commonly used to locate the bit in a hammer and to transmit torque to rotate the drill bit with the hammer and drill string. The drill bit shank is inserted through a drive subassembly, the split rings placed within the recesses, which prevent the drill bit from falling through the drive subassembly. The split rings are held in place once the drive subassembly and drill bit are located within the end of the hammer. This retention method is a commonly known rear bit retention means.

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25

One problem with drill bits in percussive hammers is the fracturing of the shank of a drill bit, particularly where it meets the bit head. When this occurs with a rear bit retention means the drill bit head is free to fall from the hammer into the hole being

30

drilled. This creates significant problems in retrieving the broken component or when having to grind it away before drilling can recommence.

5 The location of the conventional rear bit retention system at the rear of the shank results in a drill bit design that has some weaknesses. It requires the rotational drive section to be in the more highly stressed region of the shank which is close behind the bit head and in the same region as the thrust face which is the surface against which the end of the hammer applies down load to the drill bit. Bit breakage is very likely in this region.

10

Another problem with the conventional rear bit retention system is that it is located within the splined or drive region of the shank, thereby reducing the bearing surface area of the drive spline or surface.

15 Conventional rear bit retention systems also interfere with the placement and efficiency of passages for drilling fluids between the bit shank and drive subassembly.

Accordingly, it is the main object of this invention to provide an alternative drill bit retention means for a percussive hammer.

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It is also an object of this invention to provide a means of retaining a fractured bit component which would otherwise fall into the hole being drilled.

25 It is a further object of this invention to provide a means of locating the rotational drive means close to the rear of the bit shank and away from the fracture prone junction between the bit head and shank.

It is another object of this invention to allow the fluid passages between the shank and the drive subassembly to be more open thereby allowing less restrictive fluid flow.

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It is also an object of the invention to ensure that a bit retaining means is produced which minimises the number of components, and simplifies assembly or disassembly of the hammer.

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### SUMMARY OF THE INVENTION

In its broadest form, the invention is a bit retention means for retaining a drill bit to a percussive hammer where the drill bit has a percussive cutting face at one end of a drill bit body, said retention means comprising:

- 10 a circumferential shoulder surface on said drill bit body spaced from said cutting face, and
- a drill bit retainer comprising a generally tubular member which is secured to said percussive hammer that has a flange means for engaging said shoulder, said
- 15 drill bit being able to move away from said percussive hammer so that said shoulder engages against said flange means to thereby prevent further movement of said drill bit and to hold it with respect to said percussive hammer.

Preferably, the drill bit retainer is the primary means of holding the drill bit with respect to the hammer. In other words, the drill bit does not need to make use of a conventional split ring for retaining the drill bit in the hammer.

However, drill bits making use of a conventional split ring retention means may also be used in conjunction with the above described drill bit retention means. Obviously,

25 the bit retention means will act as a secondary or safety bit retaining means should some component of the drill bit fail above the retaining means.

By placing the placing the primary retention means forward of the end of the hammer, it enables the drive engagement used to rotate the bit with the hammer to

30 be moved to any desired position on the drill bit shank. This will include any desired

position along a conventional shank, or any other convenient portion of the drill bit head.

5 The design of air flow passages is greatly improved by being able to avoid the use of conventional split ring rear retaining means. The retaining means forward of the end of the hammer will enable the use of fluid flow passages that are less restrictive which will in turn reduce friction losses.

10 The bit retention means described above will prevent the loss of the drill bit head should there be a fracture somewhere above the retaining means. If this occurs, the fractured portion of the drill bit will be prevented from falling away from the hammer.

15 Preferably, the bit retention means allows the bit head to rotate freely if the fracture occurs. If the bit stops rotating with respect to the ground, it will stop drilling, and thus indicate to the driller that the bit is damaged.

20 Preferably, the flange means comprises some form of inwardly directed circumferential ledge but may also comprise a series of lugs. The circumferential shoulder on the drill bit may comprise a radially extending flange with the lower edge comprising the shoulder, or a radial recess with the upper edge comprising the shoulder. It may also comprise a number of radially extending lugs. The engagement of the shoulder with the flange means prevents further forward movement of the drill bit with respect to the bit retainer, while allowing the required amount of  
25 movement of the drill bit with respect to the hammer which enables the drill bit to be impacted by the piston of the percussive hammer and for the end of the hammer to bear against the thrust face of the drill bit.

30 Preferably, the shoulder comprises a radial flange or ledge located on the drill bit head with longitudinal slots for air flow across the flange or ledge, and the flange means comprises an inwardly directed flange on the drill bit retainer. However,

other arrangements may work such as either a plurality of spaced lugs being used on the bit retainer or alternatively on the drill bit. The main requirement is that the drill bit should be prevented from freely falling through the bit retainer, or rotating to a position that allows the drill bit to fall through the bit retainer.

5

Preferably, the drill bit retainer is a tubular design. In one aspect of the invention, the drill bit may be provided with a shoulder that comprises an outwardly directed flange with a screw thread on the external surface of the flange. The bit retainer has an inwardly directed flange at its retaining end which likewise has a thread that  
10 corresponds to the bit shoulder located on the internal surface of the inwardly directed flange. This enables the drill bit to be inserted into the drill bit retainer and to allow the shoulder to locate past the flange means by rotating the drill bit with respect to the drill bit retainer.

15 The drill bit retainer may be held captive between the drive sub and the end of the hammer. The drive subassembly threadably engages into the end of the hammer barrel, and has a shoulder at one end. The drill bit retainer has a radial clamping flange that locates between the shoulder and the end of the hammer barrel. In this example, before the subassembly is screwed into place in the end of the hammer,  
20 shank of the drill bit can be inserted into the drive subassembly. As the drive subassembly and drill bit combination is able to rotate, with respect to the bit retainer, then the threaded portions on the inwardly directed flange bit retainer engage the threaded portion on the shoulder of the drill bit to enable the shoulder on the drill bit to pass through the forward end of the bit retainer.

25

Alternatively, the bit retainer may be threadably engaged to the end of the drive subassembly. In this case, the end of the drive subassembly may be provided with a thread which matches the thread on the outwardly directed flange so that both the inwardly directed flange on the end of the bit retainer passes over both the end of the  
30 drive subassembly and the outwardly directed flange of the drill bit with a second internal thread intermediate the two ends of the bit retainer which threadably engage

the bit retainer to the drive subassembly. The drive subassembly is then in turn threadably engaged into the end of the hammer.

5 The drill bit retainer may be split longitudinally into at least two segments to enable the segments to be brought together in the required position, either side of the drill bit and subassembly. A number of different styles of locking means may be used to hold the bit retainer components together. The segments of the bit retainer may be arranged to locate between the clamping flange of the drive subassembly and the hammer barrel. The drive subassembly threadably engages within the end of the  
10 hammer barrel, and clamps the bit retainer in place. The bit retainer may be provided with an additional means to hold or key the segments in place. For example, a cylindrical outer sleeve may locate over the outer surface of the bit retainer and also have a means whereby it can be clamped, along with the bit retainer, between the drive subassembly and the end of the hammer barrel.

15

An alternate means of securing the bit retainer may be to provide a projection on each segment of the drill bit retainer that engages in a locking recess on the drive subassembly. In one example, the clamping flange on the drill bit retainer, instead of having a square edge, may have a surface that angles from the outer edge of the  
20 clamping flange towards the inside surface of the drill bit retainer. In this way, a substantially V-shaped projection is formed. The shoulder of the drive subassembly may be provided with a corresponding V-shaped recess into which the projection locates. When the components are engaged, the interlocking projection and recess hold the drill bit retainer segments together.

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As an alternative, or in addition, the ends of the drill bit retainer segments and the hammer barrel may be provided with a step portion on the end of the drill bit retainer and a circumferential recess on the inside edge of the hammer barrel within which the step portion locates.

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In addition to all of the above, the end of the bit retainer may be provided with an outer sleeve portion which extends over a portion of the end of the hammer barrel. The use of this arrangement prevents ingress of dirt between the joint surfaces, and protects the end of the hammer barrel from significant wear.

5

In another aspect of the invention, there is a drill bit and bit retaining means comprising:

10 a drive subassembly that is threadably engaged into the end of a hammer barrel having a centre bore with a drive portion for receiving a drill bit, and having at least two radially spaced fingers extending from an end of said drive subassembly, the end of said fingers having inwardly directed lugs,

15 a drill bit having a shank, a drive portion for engaging the corresponding drive portion of a drive subassembly, a bit head on one end of said shank, a cutting face on said bit head and shoulder means on said bit head comprising radially spaced and outwardly extending shoulders, said shoulders being radially spaced so that said fingers fit between them and so that said drill bit may be inserted into said drive subassembly, and

20 a bit retainer for location at least over said fingers comprising a generally cylindrical sleeve having a plurality of radially spaced lugs at one end and a locking means at the other, said bit retainer lugs arranged so that they may either line up with said fingers to allow insertion of said drill bit into said drive subassembly and bit retainer when assembled, and by rotating said bit retainer said lugs of said bit retainer can be positioned across the openings between said adjacent fingers and locked in place by said locking means so that, if the drill bit fractures so that the drill  
25 bit head is able to rotate, said drill bit lugs will engage either the lugs of the said drive subassembly as a first means of retaining said drill bit, or will engage the lugs of said bit retainer as a second means for retaining said drill bit to thereby hold said drill bit within the assembly of said drive subassembly and bit retainer.

The bit retaining means described above may be used either as a primary bit retaining means within the end of a hammer, or may be used in conjunction with conventional split rings at the end of the drill bit shank.

- 5 In addition, the invention provides a means of holding a drill bit within the retaining means should there be a fracture between the drill bit head and the shank. It also allows the drive portion on the shank to be positioned in any desired position along the shank which is preferably towards the rear of the shank.
- 10 As will be seen from the above description of this further aspect of the invention, the fingers of the drive subassembly and the lugs on the bit retainer are designed so that the bit retainer can be rotated to bring its lugs into alignment with the fingers. The shoulders on the drill bit are radially spaced and of the required width to enable them to slidably locate between the fingers and the lugs on the bit retainer. The drill
- 15 bit can then be inserted within this assembly so that the shoulders on the drill bit move past the lugs on the fingers of the subassembly and the lugs on the end of the bit retainer. The bit retainer can then be rotated so that its lugs are then positioned between adjacent fingers thereby preventing the drill bit from freely falling from the assembly. In other words, if the shoulders on the drill bit align with the spaces
- 20 between the fingers, these shoulders will still abut against the lugs on the end of the bit retainer.

Preferably, the shoulders on the drill bit comprise a pair of steps, the first step that is closer to the cutting face of the drill bit having a smaller diameter by comparison to

25 the second step. The second step is designed to engage the lugs on the end of the drive subassembly if the bit breaks, with the second step having an overall diameter which is smaller than the opening between the end of the fingers so that the first step may then engage the lugs on the drill bit retainer. Obviously, if the drill bit head rotates such as when a fracture occurs, the second step on the drill bit will alternate

30 between engagement with the lugs on the end of the drive subassembly and alignment with the openings between the fingers. However, when they are aligned

with the openings, the first step will be engaged with the lugs on the end of the drill bit retainer. This will ensure that the drill bit is retained within the assembly of the drive subassembly and drill bit retainer.

- 5 Preferably, the drill bit retainer is held between a flange of the drive subassembly and the hammer barrel. This may be best achieved by an inwardly directed flange at the end of the drill bit retainer. In addition, indexing lugs may be provided at this end of the drill bit retainer which themselves are radially spaced and dimensioned so that they may be located between the adjacent fingers on the drive subassembly.
- 10 When the indexing lugs are positioned between the fingers, rotation of the drill bit retainer, is prevented. Clearly the indexing lugs at the other end are positioned so that when the indexing lugs are positioned between the fingers, the lugs at the other end are positioned across the openings between adjacent fingers. The bit retainer is then clamped between the flange of the drive subassembly and the hammer barrel
- 15 when the two components are screwed together. Accordingly, the bit retainer is locked in place and is unable to rotate with respect to the drive subassembly.

The bit retainer may be provided with either a stepped portion or an overlapping sleeve for engagement with the end of the hammer barrel.

20

- In addition, all aspects of the invention may be provided with wear indication means. These may comprise either one groove or indentation, or a number of grooves or indentations of different depths which provide a visual indication as to the state of wear to the outer surface and/or the point at which a component should
- 25 be discarded. In most cases, the outer surface of the bit retainer would be in contact with the outer surface of the hole being drilled, and will therefore be subject to the highest rate of wear. Grooves or indentations will provide a ready assessment as to the extent of that wear.

- 30 In addition to retaining the drill bit, the bit retainer may also function as a sealing arrangement and air director when it is being used as a reverse circulation hammer.

In the case of a reverse circulation hammer, the return airflow and drilling debris returns through the centre of the drill bit, hammer and drill string. Accordingly, the external surface of the bit retainer may be in contact with the wall of the hole being drilled to provide an effective seal to prevent air escaping to the surface between the drill rod and hole. One advantage of the bit retainer extending towards the cutting face of the drill bit is that the sealing effect likewise extends so that it is very close to the end of the hole being drilled.

In addition, the airflow, as it exits the end of the bit retainer, can be arranged so that it is directed towards the cutting face with sufficient velocity to entrain cuttings and debris and direct the air towards the exhaust ports in the centre of the drill bit face. In addition, the apertures through which the exhaust air flows between the bit retainer and the side walls of the drill bit can be sized to produce high velocity air streams for the given air flow rate.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

In order to fully understand the invention, preferred embodiments will now be described. However, it should be realised that the invention is not to be confined or restricted to the precise details of the embodiments described.

20

These embodiments are shown in the accompanying drawings in which;

Fig 1 shows a part cut away perspective view of a first embodiment of a drill bit, drill bit retainer and drive subassembly,

25 Fig 2 shows a longitudinal cross-sectional view of the drill bit assembly shown in Fig 1,

Fig 3 shows a cross-sectional view of Fig 2 at line 3-3,

Fig 4 is a cross-sectional view of Fig 2 about line 4-4,

30 Fig 5 shows a longitudinal cross-section of a drill bit assembly which shows a variation to the first embodiment,

Fig 6 shows an exploded longitudinal cross-section of a drill bit assembly according to a second embodiment,

Fig 7 shows an assembled longitudinal cross-section of a drill bit assembly shown in Fig 6.

5 Fig 8 shows a longitudinal cross-sectional view of a drill bit assembly which shows a variation to the second embodiment, and

Figs 9-1 to 9-8 and Figs 10-1 to 10-8 show a third embodiment in which:

Fig 9-1 is a part sectioned side view of a drill bit,

Fig 9-2 is a cross-sectioned view of Fig 9-1,

10 Fig 9-3 is a cross-sectioned view of a drive sub-assembly,

Fig 9-4 is an end view of Fig 9-3,

Fig 9-6 is a cross-section of a drill bit retainer,

Fig 9-6 is an end view of Fig 9-5,

Fig 9-7 is a part cross-section view of a hammer barrel,

15 Fig 9-8 is an end view of a hammer barrel,

Fig 10-1 is a longitudinal cross-section of a drill bit assembly according to the third embodiment,

Fig 10-2 is a cross-section of Fig 10-1,

20 Fig 10-3 and 10-5 show longitudinal cross-section views of the third embodiment with the drive sub-assembly partly threaded into the hammer barrel with Fig 10-5 showing the drill bit removed from the end of the drive sub-assembly and drill bit retainer,

Fig 10-4 and 10-6 show cross-sectional views of Fig 10-3 and 10-5 respectively,

25 Fig 10-7 shows a longitudinal cross-sectional view of a drill bit assembly according to the third embodiment with a fractured drill bit, and

Fig 10-8 shows a cross-section view of Fig 10-7.

Fig 1 and Fig 2 shows a drill bit 10 which comprises a shank 11, a drill head bit 12 having a cutting face 13 (hard cutting inserts not drawn) and a centre conduit 14.

30 The drill bit shown in Fig 1 and Fig 2 is for use with a reverse circulation hammer

where conduit 14 is to enable the exhaust air and cuttings to return to the surface through the centre of the drill bit, hammer and drill string.

The drill bit head 12 is provided with a shoulder which in this embodiment is a series of spaced flange segments 17 positioned around the full diameter of the drill bit head 12 with spaces 17a between adjacent flange segments 17. The flange segments 17 are spaced from the cutting face 13, and there is a portion of the drill bit head 15 which has a constant diameter below the flange segments 17. The shank 11 has a number of flat surfaces 16 that are used to rotate the drill bit 10 .

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Fig 2 shows a side cross-sectional view of a drive subassembly 20. The drive subassembly 20 has a bore 21 with a number of flat surfaces 23. The shank 11 of the drill bit 10 locates within the bore 21 with the flat surfaces 16 and 23 engaging to provide a drive coupling between the two components. In this embodiment, the drive coupling is obtained by use of flat surfaces 16 and 17, but obviously other drive coupling arrangements, such as splines, may be used.

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The external surface of the drive subassembly 20 has a threaded portion 22 for engagement within the end of a hammer barrel 25. There is a radial shoulder 24 at the forward end of the drive subassembly 20. The forward end 26 of the drive subassembly 20 abuts against the flange segments 17 to provide downloaded to the drill bit 10 when assembled and operating.

20

The drill bit retainer 30 is of a generally tubular form, and is split longitudinally into two segments 31 and 32. At the forward end of the drill bit retainer 30, there are a number of inwardly directed lugs 35 that have a surface 36 that will abut against the flange segments 17 of the drill bit 10 when the drill bit moves forward in the drill bit retainer 30.

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The rear end of the drill bit retainer 30 has a radially clamping flange that comprises a shoulder 37 and a stepped portion having a surface 38 that has a smaller diameter

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by comparison to the remainder of the drill bit retainer 30. The shoulder 37 on the drill bit retainer 30 abuts against the shoulder 24 on the drive subassembly 20. The diameter of the internal surface 39 of the radially clamping flange is such that, when the drill bit retainer segments 31 and 32 are assembled over the drive subassembly  
5 20, the drive subassembly 20 is able to rotate with respect to the drill bit retainer 30.

The internal surface of the drill bit retainer segments 31 and 32 have a plurality of spaced radially projections 40 that are located forward of the shoulder 37. The surface of the drive subassembly 20 between the shoulder 24 and the forward end of  
10 the sub 26 have a series recesses 41 into which the radial projections 40 of the drill bit retainer 30 locate. When in place, the radial projections and recesses 40 and 41 prevent rotation of the drill bit retainer 30 with respect to the drive subassembly 20.

A location ring 45 is used to hold the segments 31 and 32 of the drill bit retainer 30  
15 together. The location ring 45 has a forward sleeve 46 that locates over surface 38 of the step portion on the drill bit retainer 30. The sleeve 46 is sufficiently long to ensure that the segments 31 and 32 are held together tightly. The location ring 45 has an internal radial flange 47 that locates between the end of the drill bit retainer 30 and the hammer barrel 25. The location ring 45 has an upper sleeve 48 that extends over  
20 and around the end of the hammer barrel 25. The hammer barrel 25 may be provided with a stepped portion over which the upper sleeve 48 locates.

The assembly of the various components is reasonably straightforward. The drive subassembly 20 is first located over the shank 11 of the drill bit 10. The forward end  
25 26 of the drive sub assembly 20 abuts against the flange segments 17. The two segments 31 and 32 are then located either side of the drive subassembly 20 and the drill bit 10, with the radial projections and recesses 40 and 41 engaging. The location ring 45 is then placed over the end of the drill bit retainer 30. This assembly is then located into the end of a hammer barrel 25 by threadably engaging the drive  
30 subassembly 20. This is achieved by applying rotational force to the drill bit head 12. Due to the engagement of the flat surfaces 16 and 23, the drill bit 10 rotates the drive

subassembly 20, thereby enabling engagement of the drive subassembly into the end of the hammer barrel 25.

The drill bit 10 is free to slide back and forth with respect to the drive subassembly  
5 20. However, when the drill bit 10 is hanging from the end of the hammer barrel 25, the flange segments 17 will abut against lugs 35 therefore holding the drill bit 10 within the end of the hammer barrel 25. In the use position, the forward end 26 of the drive subassembly 20 will bear against and provide a download via the flange segment 17.

10

The embodiment illustrated in Figs 1 to 4 is a reverse circulation hammer. Exhaust air from the hammer flows between the shank 11 and the internal surface of the drive subassembly 20 and exhausts between surfaces 15 on the drill bit head and the internal surface of the drill bit retainer 30. This embodiment is designed to have air  
15 channels which remain in alignment. This is the reason why the drive subassembly 20 and the drill bit retainer 30 have radial projections and recesses 40 and 41 to prevent relative rotation between these components. This enables air passages to remain in alignment. In addition, the drill bit shank 11 is unable to rotate with respect to the drive subassembly 20, and accordingly air channels between the drive  
20 subassembly 20 and shank 11 can be maintained in alignment.

Firstly, the shank 11 is provided with air channels 50 which connect with air channels 51 in the drive subassembly 20. The air channels 50 and 51 align with the spaces 17a between the flange segments 17. Further, the spaces between the lugs 35 on the drill  
25 bit retainer 30 align with the spaces 17a between the flange segments 17 and there are channels 52 in the drill bit head 12 which align with the spaces between the lugs 35. Accordingly, the air channels in the various components are arranged so that they can be kept in alignment, thereby providing an open and unobstructed air flow passage.

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Fig 5 shows a minor variation to the first embodiment. In this embodiment, the drill bit retainer 30 is cylindrical and not split into segments. Accordingly, the location ring 45 is not required. The internal surface of the lugs 35 have a screw thread, and each of the flange segments 17 have a screw thread on their external surface. The screw threads on the lugs 35 and flange segments 17 engage and enable the flanged segments 17 to move past the lugs 35 by rotation of the drill bit 10. In order to rotate the combination of the drill bit 10 and drive subassembly 20, the drill bit retainer 30 is moved rearwardly along the drive subassembly 20 to prevent engagement of the radial projections and recesses 40 and 41. This allows the drill bit 10 and drive subassembly to rotate with respect to the drill bit retainer 30. Once the flange segments 17 have passed the lugs 35, then the radial projections and recesses 41 are engaged, and the whole assembly is placed into the end of a hammer barrel 25.

A further embodiment is shown in Figs 6 to 7. A drill bit 10 comprises a shank 11, a drill head bit 12 having a cutting face 13 and a centre conduit 14. The drill bit shown in Figs 6 and 7 is for use with a reverse circulation hammer where conduit 14 is to enable the exhaust air and cuttings to return to the surface through the centre of the drill bit, hammer and drill string.

The drill bit head 12 is provided with a shoulder 18 which in this embodiment is a peripheral flange extending around the full diameter of the drill bit head 12. The shoulder 18 is spaced from the cutting face 13, and there is a portion of the drill bit which has a constant diameter below the shoulder 18. The drill bit is provided with a drive spline 19.

25

Figs 6 and 7 show a side cross-sectional view of a drive subassembly 20. The drive subassembly 20 has a bore 21 with a spline 19a. The drill bit 10 locates within the bore 21 with the splines 19 and 19a engaging to provide a drive coupling between the two components. In this embodiment, the drive coupling is obtained by use of splines, but obviously other drive coupling arrangements, such as the flat surfaces used in the first embodiment, may be used.

30

The external surface of the subassembly 20 has a threaded portion 22 for engagement within the end of a hammer barrel 25 and also has a locking flange 27. The locking flange has a forward surface 26 that abuts against shoulder 18 to apply download to  
5 the drill bit 10. A shoulder on the locking flange 27 has a locking recess 27a formed by an angled surface 28 that slopes towards the forward surface 26 from the outer edge of the locking flange 27. In addition to the use of an angled surface 28, a step or square cross-section recess may also be used. It is clear that a number of cross-sectional shapes may be used.

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Figs 6 and 7 show a bit retainer 30. In this embodiment, the bit retainer 30 is formed from two segments 31 and 32, which when put together, form a generally tubular member. The bit retainer 30 has a flange means that comprises ledge member 33 and a radial clamping flange 29. The internal diameter of the clamping flange 29, when  
15 the segments 31 and 32 are brought together, enables the drill bit retainer to locate over the outer surface of the drive subassembly 20. The internal diameter of the ledge member 33 enables it to locate around the peripheral wall 15 between the shoulder 18 and cutting face 13. Obviously, when the bit retainer segments 31 and 32 are located together over the drill bit 10, the shoulder 18 abuts against the ledge member 33  
20 thereby holding the drill bit 10 within the drill bit retainer 30.

The bit retainer 30 has a locking projection 34 formed by an angled surface 28a. The projection 34 is shaped so that it locates snugly within the locking recess 27a on the drive subassembly 20. The end of the radial clamping flange 29 opposite to the  
25 locking projection 35 is provided with a stepped portion 42 which is designed to locate within a recess 43 of the hammer barrel 25.

Assembly of this embodiment is simple and straightforward. The drill bit 10 locates within the bore 21 of the drive subassembly 20 and the splines 19 and 19a engage.

30 The drive subassembly 20 may be first partly threaded into the hammer barrel 25.

The thread 22 on the drive subassembly 20 engages recess 43 on the hammer barrel 25.

5 In this partly assembled position, the drill bit retaining segments 31 and 32 may be placed over both the drive subassembly 20 and the drill bit 10 so that the radial clamping flange 29 of the bit retainer 30 locates between the end of the hammer barrel 25 and the locking flange 27 of the drive subassembly 20. In addition, the ledge member 33 locate between the shoulder 18 and cutting face 13 of the drill bit 10.

10

The locking projection 34 of the drill bit retainer segments 31 and 32 can be pushed into engagement with the corresponding locking recess 27a of the drive subassembly 20.

15 With the drill bit retainer segments 31 and 32 held in place, the drive subassembly 20 can be screwed fully into the hammer barrel 25 by gripping and turning the drill bit head 12. The drive subassembly 20 is screwed tightly into the hammer barrel 25 so that the step portion 42 on the bit retainer 30 engages within the recess 43 in the hammer barrel 25, whereupon the radial clamping flange 29 is held tightly between  
20 the locking flange 27 of the drive subassembly 20 and the end of the hammer barrel 25. In this position, the two segments of the drill bit retainer 31 and 32 are unable to separate.

If the shank 11 were to break away from the drill bit head 12, the drill bit head 12  
25 would be retained within the assembly rather than dropping out of the hammer by the shoulder 18 abutting against the ledge member 33.

In one variation of the above embodiment, spline 19 on the drill bit 10 may be located more towards the strike end of the shank 11. This moves the stress raiser affect away  
30 from the transition between the shank 11 and the drill bit head 12 which should reduce the likelihood of fracture in this region.

A further embodiment is illustrated in Fig 8. In this embodiment, the drill bit 10 is the same as described above. The drill bit retainer 30 segments 31 and 32 are also substantially the same. In this embodiment, the two drill bit retainer segments 31 and 32 are held together by an outer sleeve 53. The outer sleeve 53 has a flange 54 which locates between the end of the drill bit retainer segments 31 and 32 and the end of the hammer barrel 25.

In order to assemble the arrangement shown in Fig 8, the drill bit 10 is first located within the drive subassembly 20. The two segments 31 and 32 of the drill bit retainer 30 are brought together either side of these two components so that the ledge members 33 locate between the shoulder 17 and the bit head 12.

The outer sleeve 53 is then slid into position over the drill bit retainer segments 31 and 32. The inner diameter of the outer sleeve 53 allows a sliding fit but holds the two segments 31 and 32 together. The flange 54 of the outer sleeve 53 fits behind the end of the drill bit retainer segments 31 and 32.

The drive subassembly 20 is then screwed into the end of the hammer barrel 25. The end of the drill bit retainer 30 and the flange 54 locate between the locking flange 27 of the drive subassembly 20 and the end of the hammer barrel 25 and are thereby held firmly in place. The shoulder 18 then works in conjunction with the ledge members 33 as described above.

Various external components such as the drill bit retainer 30, or location ring 45, that are in contact with the hole being drilled, may be provided with wear indication grooves 49 as seen in Fig 2. A number of grooves 49 may be provided of progressively different depths which thereby provide a means of monitoring progressive wear of the outer surface of these various components. The wear indication grooves 49 will provide a means of determining when a particular component has worn to extent where it needs replacing.

A third embodiment is shown in Figs 9-1 to 10-8. As shown in Figs 9-1 and 9-2, the drill bit 10 comprises a shank 11, a drill bit head 12, a cutting face 13, and a conduit 14. The drill bit shown in Fig 9-1 is identical to that shown in Fig 6. However, the  
5 drill bit has four discrete shoulders 55 which are radially spaced around the peripheral wall 15 as shown in Fig 9-2. Each shoulder 55 comprises a first step 56 and a second step 57.

The drive subassembly 20 is similar to that shown in Fig 6, in that it has a bore 21,  
10 thread 22 and a spline 19a for engaging the spline 19a on the drill bit 10. However, the drive subassembly 20 shown in Fig 9-3 has four fingers 60 radially spaced around the drive subassembly 20 as shown in Fig 9-4. Each finger 60 comprises a shoulder 61 at one end and a lug 62 at the other end.

15 The width of the shoulders 55 on the drill bit 10, and their spacing, are such that the four shoulders 55 will fit between the fingers 60. This enables the drill bit 10 to be inserted into the drive subassembly 20 by aligning the shoulders 55 of the openings between the fingers 60, and then pushing the drill bit 10 into the drive subassembly  
20 20. The diameter between two opposite first steps 56 is similar to the internal diameter between two adjacent lugs 62. Therefore, the first steps 56 of the shoulder 55 would be able to rotate within the circumference defined by the inner surface of the lugs 62 if the drill bit 10 were free to rotate.

Figs 9-5 and 9-6 show the bit retainer 30. In this embodiment, the bit retainer 30  
25 comprises a cylindrical sleeve 65 and has four equally spaced lugs 66 as shown in Fig 9-6. The locking means 67 comprises a surface 68 and a shoulder 69. Four indexing lugs 70 are located on the surface 68.

The width and radial spacing of the lugs 66 are such that they are able to slide  
30 through the openings formed between adjacent fingers 60. Therefore, the bit retainer 30 can be located onto the drive subassembly 20 by aligning the lugs 66 with the

openings between the fingers 60 and sliding the lugs 66 past the shoulders 61 and between each of the adjacent fingers 60.

When the lugs 66 are aligned with the openings between the fingers 60, the indexing lugs 70 abut against the shoulder 61 formed by each of the fingers 60. Once the bit retainer 30 is pushed fully onto the drive subassembly 20 so that the indexing lugs 70 abut against the shoulders 61 the lugs 66 are forward and clear of the lugs 62 at the end of the fingers 60. In this position, the bit retainer 30 is able to be rotated so that the indexing lugs 70 line up with and engage into the opening formed between adjacent fingers 60. Once the indexing lugs 70 are located within these openings, the bit retainer 30 is prevented from rotating. In this position, the surface 68 abuts against the shoulder 61.

By rotating the bit retainer 30, the lugs 66 can be brought into alignment with the lugs 62 on the drive subassembly 20. With the bit retainer 30 in this position, the drill bit 10 can then be inserted into the drive subassembly 20. The shoulders 55 will pass both sets of lugs 62 and 66.

The above assembly of the drill bit 10, drive subassembly 20 and bit retainer 30 can then be located into the end of the hammer barrel 40. This is illustrated in Fig 10-1.

Once the drill bit 10 is located within the assembly formed between the drive subassembly 20 and the bit retainer 30, the drive subassembly 20 can be screwed into the end of the hammer barrel 25. Provided that the indexing lugs 70 are located within the openings formed between the adjacent fingers 60, then the bit retainer 30 will be held in place between the shoulder 61 and the end of the hammer barrel 25.

The process of removing the drill bit 10 is illustrated in Fig 10-5. All that is required is to loosen the drive subassembly 20 sufficiently to enable the indexing lugs 70 to be disengaged to allow rotation of the bit retainer 30. The bit retainer 30 is rotated until the lugs 66 align with the lugs 62 which will then enable the drill bit 10 to be rotated

so that the shoulders 55 align with the openings formed between the lugs 62 and 66. In this position, the drill bit can be withdrawn from the end of the hammer.

Fig 10-7 illustrates a common fracture which may occur between the drill bit head 12 and the shank 11. When the indexing lugs 70 are located in the openings between the fingers 60, the lugs 66 are positioned so that they are between the openings formed by the fingers 60. In this position, if drill bit 10 breaks, the drill bit head 12, which will be free to rotate, will be retained either by the first step 56 abutting against lugs 66, or when the shoulders 55 align with the openings between the fingers 60, then the second step 57 will abut against the lugs 62 which are positioned across the openings between the adjacent fingers 60. In this way, the drill bit head 12 will be prevented from falling out of the end of the hammer.

Again, the above embodiment may vary in accordance with those variations described for the other embodiments. These variations include changing the position of the spline 19 on the shank 11, a variation in the abutment between the end of the bit retainer 30 and the hammer barrel 25, and the provision of wear indication grooves or recesses.

The claims defining the invention are as follows:

1. A drill bit retention means for retaining a drill bit to a percussive hammer where the drill bit has a percussive cutting face at one end of a drill bit body, said  
5 retention means comprising:
  - a circumferential shoulder surface on said drill bit body spaced from said cutting face, and
  - a drill bit retainer comprising a generally tubular member which is secured to said percussive hammer that has a flange means for engaging said shoulder, said  
10 drill bit being able to move away from said percussive hammer so that said shoulder engages against said flange means to thereby prevent further movement of said drill bit and to hold it with respect to said percussive hammer.
2. A drill bit retention means according to claim 1 wherein said shoulder  
15 comprises a circumferential step within said drill bit body.
3. A drill bit retention means according to claim 1 wherein said shoulder comprises a circumferential radial flange.
- 20 4. A drill bit retention means according to claim 1 wherein said shoulder comprises a plurality of spaced radial flange segments where the spaces between said radial segments provide air flow passages.
5. A drill bit retention means according to either claim 3 or claim 4 wherein the  
25 upper surface of said radial flange or radial flange segments comprise the hammer thrust face of said drill bit.
6. A drill bit retention means according to any one of the preceding claims wherein said flange means of said drill bit retainer comprises an inwardly directed  
30 circumferential ledge.



7. A drill bit retention means according to any one of claims 1 to 5 wherein said flange means of said drill bit retainer comprises a plurality of spaced and inwardly directed lugs.

5 8. A drill bit retention means according to claim 7 wherein said spaces between said lugs provide air flow passages.

9. A drill bit retention means according to claim 4 wherein said flange means of said drill bit retainer comprises a plurality of spaced lugs where the spaces between  
10 said lugs provide air flow passages where said spaces between said lugs align with said spaces between said radial segments.

10. A drill bit retention means according to any one of the preceding claims wherein the means of securing said drill bit retainer to said hammer comprises a  
15 drive subassembly which has an externally threaded portion along a majority of its length with a radially projecting shoulder at one end, the drill bit retainer further comprising a radial clamping flange projecting inwardly at one end that is clamped between the end of said hammer and said shoulder of the drive subassembly, said  
drill bit retainer extending over and beyond the end of said drive subassembly.

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11. A drill bit retention means according to claim 10 based on claims 6 to 9 wherein the inner radial surface of said drill bit retainer flange means comprises a screw thread, and the external radial surface of said drill bit body beyond said shoulder towards the rear of said drill bit comprises a screw thread that engages with  
25 the screw thread of said retainer flange thereby enabling assembly of said drill bit and drill bit retainer by locating the rear end of said drill bit into the forward end of said bit retainer, engaging said screw threads and rotating said drill bit with respect to said drill bit retainer until said retainer flange is located forwardly of said shoulder.

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12. A drill bit retainer means according to claim 10 wherein said drill bit retainer is split longitudinally into at least two segments, said clamping flange further comprising a locking projection on each segment of said drill bit retainer wherein said locking projection extends in a direction that is parallel to the longitudinal axis of said drill bit retainer and a locking recess in at least said shoulder of the drive subassembly into which said locking projections locate to lock said segments in place.
13. A drill bit retainer means according to claim 12 wherein said locking projection comprises an angled surface that extends from the outside edge of said clamping flange to the inside wall of said drill bit retainer to create a generally v-shaped projection with said locking recess comprising a V-shaped recess into which said locking projection locates.
14. A drill bit retention means according to claim 12 wherein said locking projections comprise a cylindrical projection spaced from the inside wall of said drill bit retainer.
15. A drill bit retainer means according to claim 12 wherein locking recesses are provided in both said shoulder of the drive subassembly and the end of said hammer.
16. A drill bit retention means according to claim 10 wherein said drill bit retainer is split longitudinally into at least two segments, and further comprising an outer locking ring that locates between the end of said drill bit retainer and the end of said hammer and that extends over at least a portion of the outer surface of said drill bit retainer to thereby hold said segments together.
17. A drill bit retention means according to claim 16 wherein the outside diameter of said locking ring is substantially the same as the outside diameter of said drill bit retainer with the end of said drill bit retainer comprising a portion of reduced

diameter over which said locking ring locates and a radial flange projecting inwardly from the inside surface of said locking ring that locates between the end of said hammer and the end of said drill bit retainer.

5 18. A drill bit retention means according to claim 17 wherein the end of said hammer comprises a portion of reduced diameter over which said locking ring locates.

10 19. A drill bit retention means according to claim 16 wherein said locking ring extends over the full length of said drill bit retainer.

15 20. A drill bit retention means according to any one of claims 12 to 19 wherein each segment of said drill bit retainer has at least one radially directed projection on an inside surface that engages within a recess on said drive subassembly which prevents rotation of said drill bit retainer with respect to said drive subassembly and enables said drill bit retainer to be specifically positioned with respect to said drive subassembly.

21. A drill bit and drill bit retaining means comprising:

20 a drive subassembly that is threadably engaged into the end of a hammer barrel having a centre bore with a drive portion for receiving a drill bit, and having at least two radially spaced fingers extending from an end of said drive subassembly, the end of said fingers having inwardly directed lugs,

25 a drill bit having a shank, a drive portion for engaging the corresponding drive portion of a drive subassembly, a bit head on one end of said shank, a cutting face on said bit head and shoulder means on said bit head comprising radially spaced and outwardly extending shoulders, said shoulders being radially spaced so that said fingers fit between them and so that said drill bit may be inserted into said drive subassembly, and

30 a drill bit retainer for location at least over said fingers comprising a generally cylindrical sleeve having a plurality of radially spaced lugs at one end and a locking

means at the other, said drill bit retainer lugs arranged so that they may either line up with said fingers to allow insertion of said drill bit into said drive subassembly and drill bit retainer when assembled, and by rotating said drill bit retainer said lugs of said drill bit retainer can be positioned across the openings between said adjacent  
5 fingers and locked in place by said locking means so that, if the drill bit fractures so that the drill bit head is able to rotate, said drill bit lugs will engage either the lugs of the said drive subassembly as a first means of retaining said drill bit, or will engage the lugs of said drill bit retainer as a second means for retaining said drill bit to thereby hold said drill bit within the assembly of said drive subassembly and drill bit  
10 retainer.

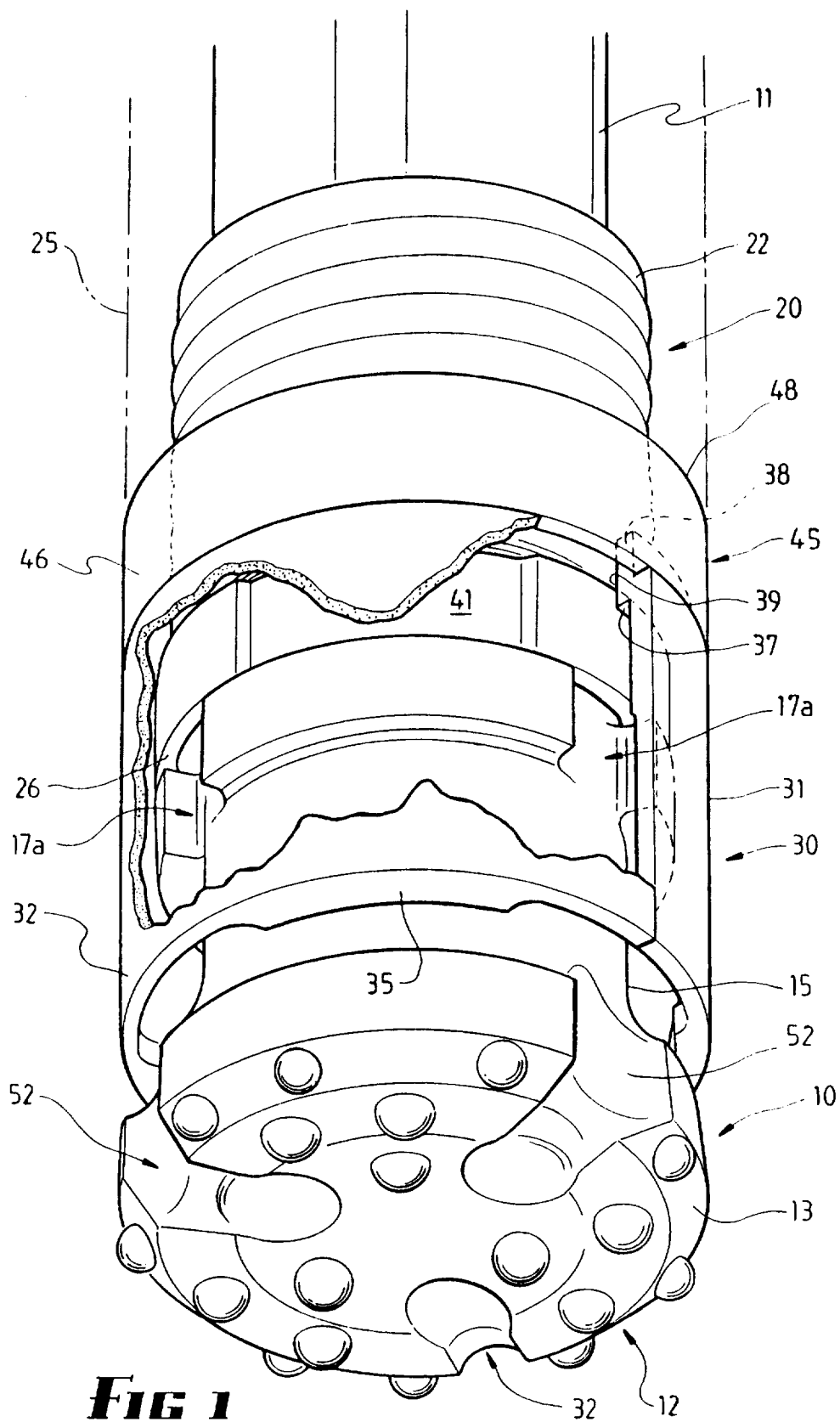
22. A drill bit and drill bit retaining means according to claim 21 wherein said locking means comprises a plurality of indexing lugs which are radially spaced so that they are able to locate between adjacent fingers on said drive subassembly to thereby  
15 prevent rotation of said drill bit retainer.

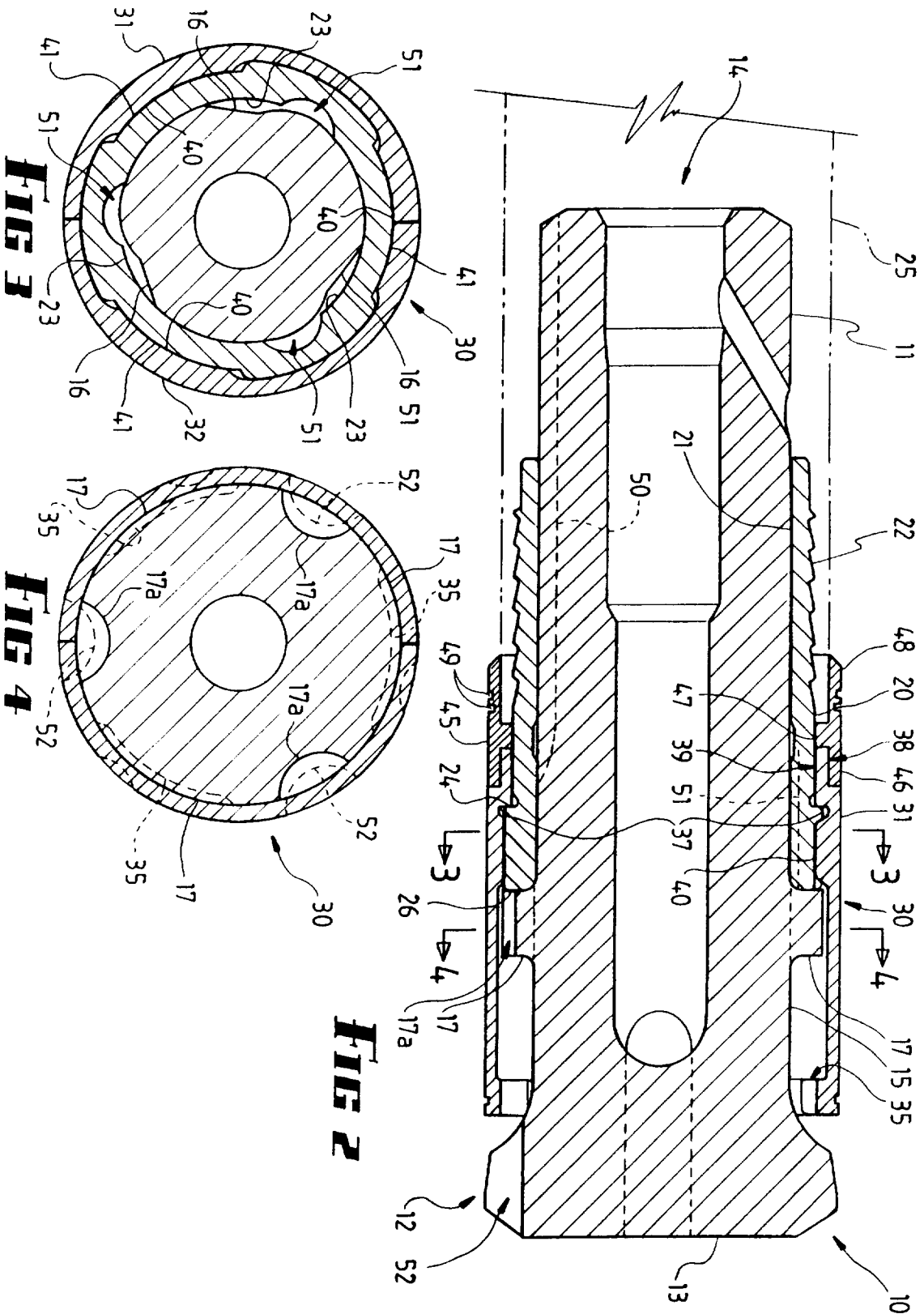
23. A drill bit and drill bit retaining means according to claim 22 wherein said drill bit retaining means has a radial flange that locates between a shoulder on said drive subassembly and the end of said hammer barrel.  
20

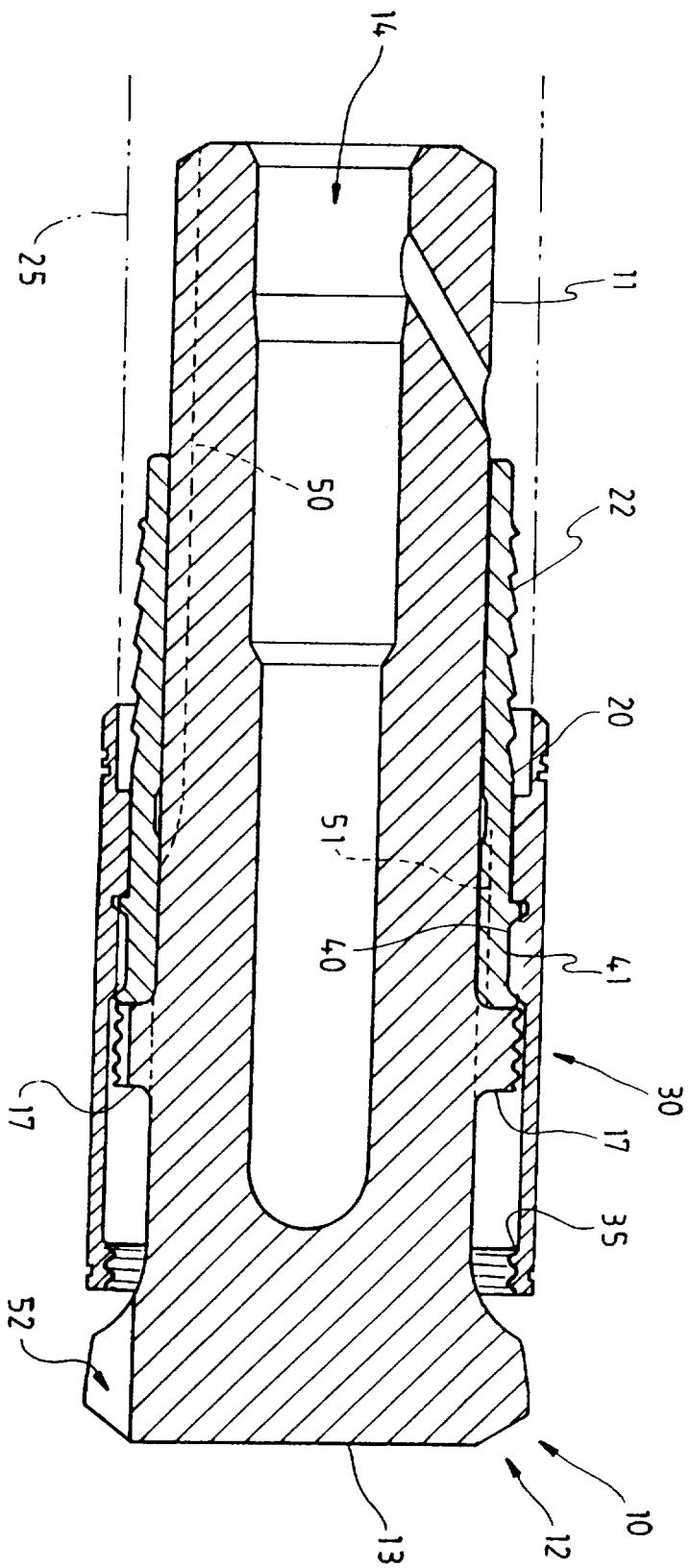
24. A drill bit and drill bit retaining means according to any one of claims 21 to 23 wherein each said radially spaced shoulder comprises a pair of steps, where the first step, that is closest to the cutting face of said drill bit, has a lower height by comparison to the second step, wherein said first step will abut against the lugs of  
25 said drill bit retainer, and said second step will abut against the lugs of said drive subassembly.

25. A drill bit retention means according to any one of the preceding claims wherein said hammer is a reverse circulation hammer, and wherein said drill bit  
30 retainer has a diameter that is larger than said hammer barrel such that said drill bit retainer acts as an air seal against a hole being drilled.

26. A drill bit retention means substantially as described hereinbefore and in accordance to and as illustrated in the accompanying drawings.

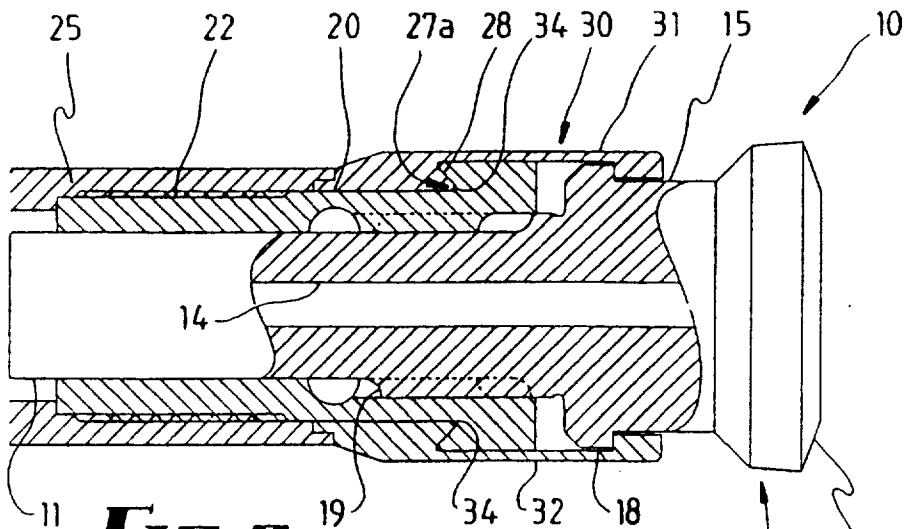




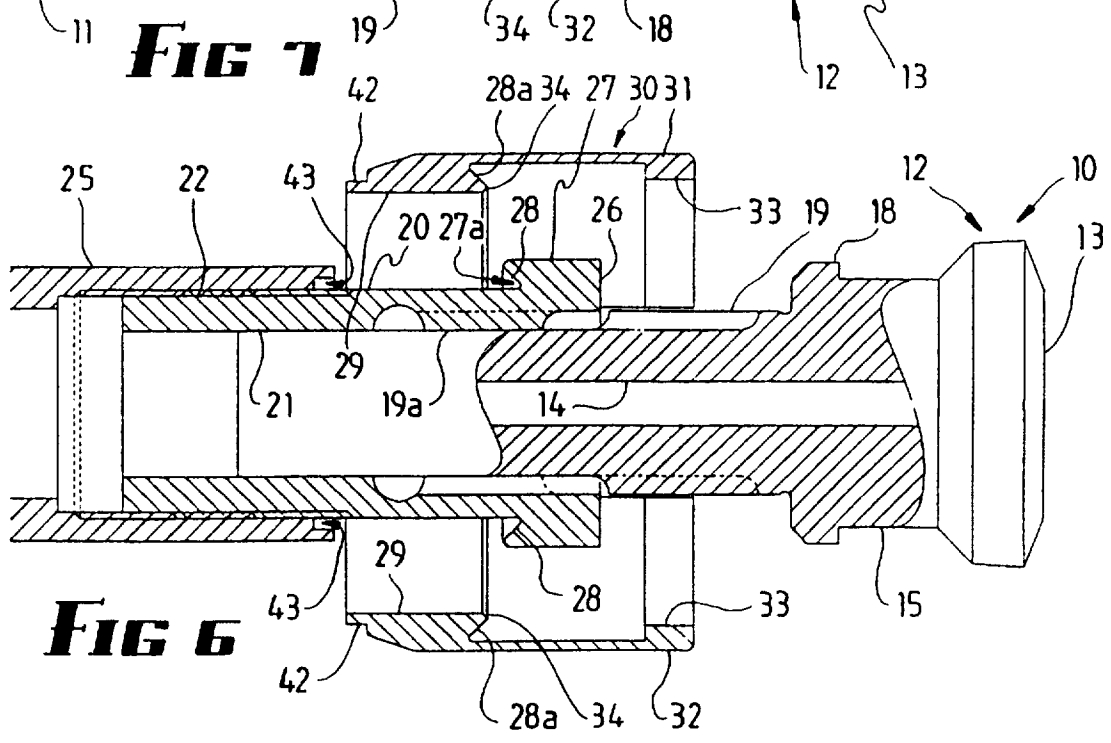


**FIG 5**

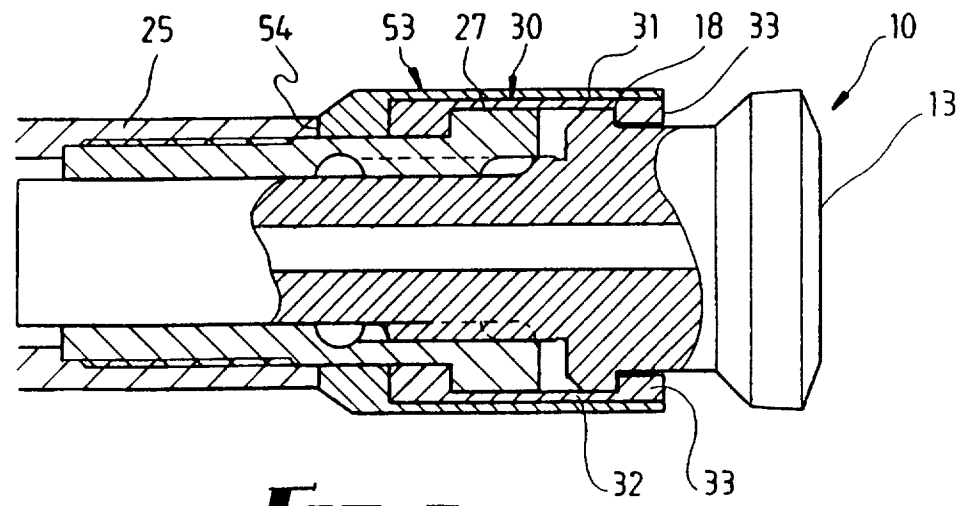




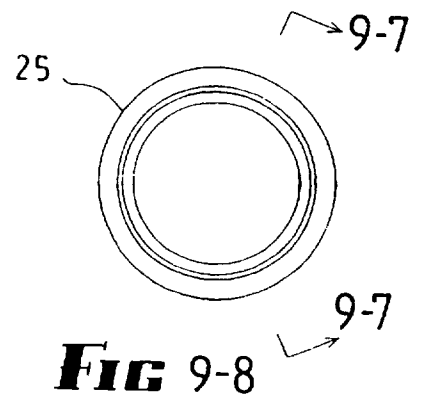
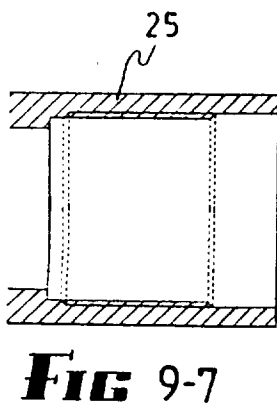
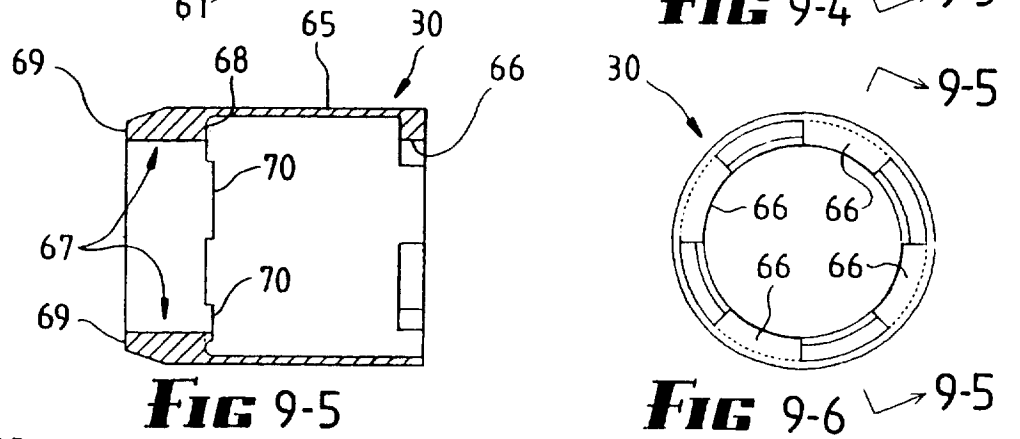
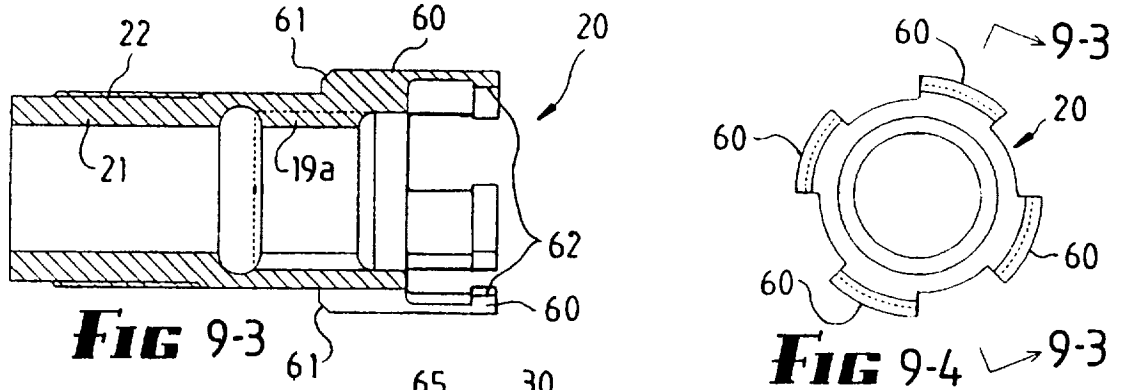
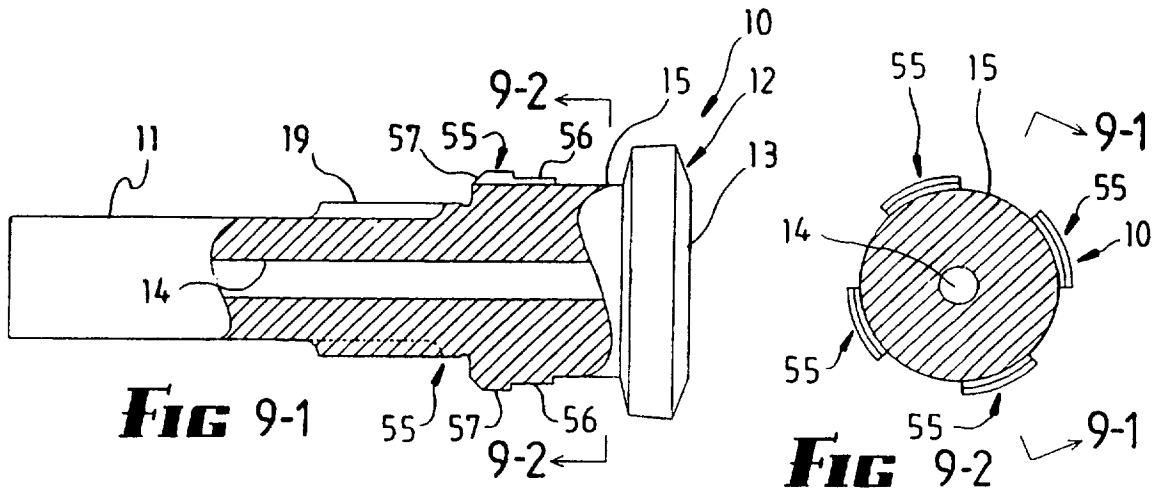
**FIG 7**

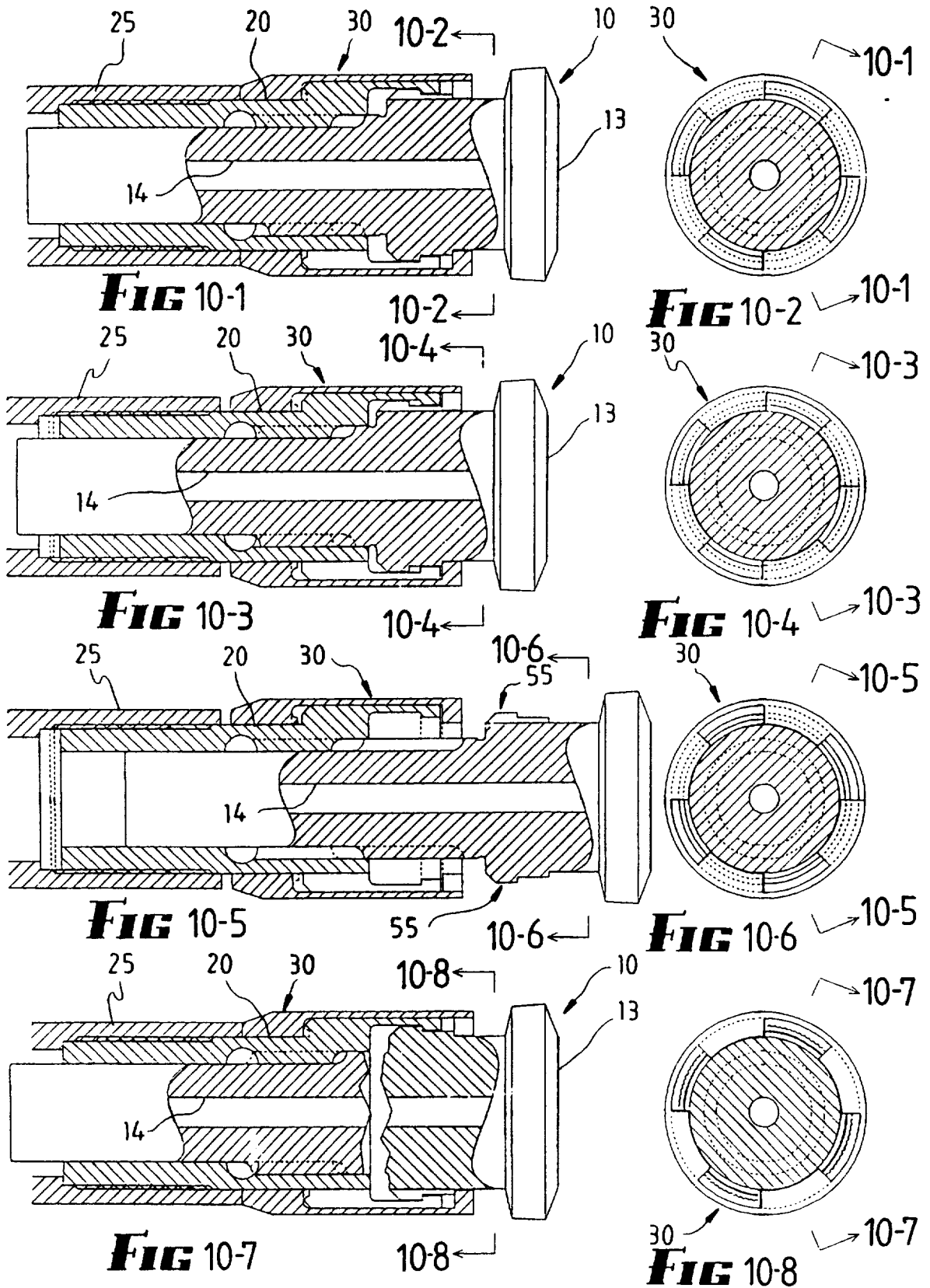


**FIG 6**



**FIG 8**





# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 97/00482

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
Int Cl <sup>6</sup> : B25D 17/08, E21B 10/36		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC B25D 17/08, E21B 10/36		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5065827 A (MEYERS et al.) 19 November 1991 Whole document	1-3, 5-6 10, 11
X	GB 2228703 A (ECOAIR DRUCKLUFTTECHNIK GMBH) 5 September 1990 Page 4 line 10 - page 5 line 7	1-3, 5-6
X	EP 505726 A (KRUPP MASCHINENTECHNIK GMBH) 30 September 1992 Figure 1	1-3, 5-6
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C		<input checked="" type="checkbox"/> See patent family annex
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
Date of the actual completion of the international search 27 August 1997		Date of mailing of the international search report <b>08 SEP 1997</b>
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer <b>D.G. FRY</b> Telephone No.: (02) 6283 2130

# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 97/00482

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 657105 A (HENSCHEL & SOHN GMBH) 24 February 1938 Figure 1	1-3, 5-6

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.  
PCT/AU 97/00482

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	2228703	AT	396/90	CH	680915	DE	3905248
		FR	2643301	NL	9000415		
EP	505726	DE	4110261				

END OF ANNEX