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(54) Roller cutter with improved sealing

(57) A roller cutter (14) intended to be used at a drill head for rotary boring of the front of earth and rock formations, said roller cutter having a centre line (CL) and being provided with a hub (24) provided with rows of crushing members (29), at least one crushing member having its longitudinal axis at an angle relative to a normal to the centre line (CL), said hub being rotatable in relation

to a shaft (33) having shaft spigots (34, 35), the roller cutter being provided with at least one seal retainer (38) arranged at an axial end of the hub in order to hold sealing means (37) in position, wherein the hub comprises at least one circumferential recess (44) positioned axially inward relative to a radially inward projecting flange (43) in the hub.

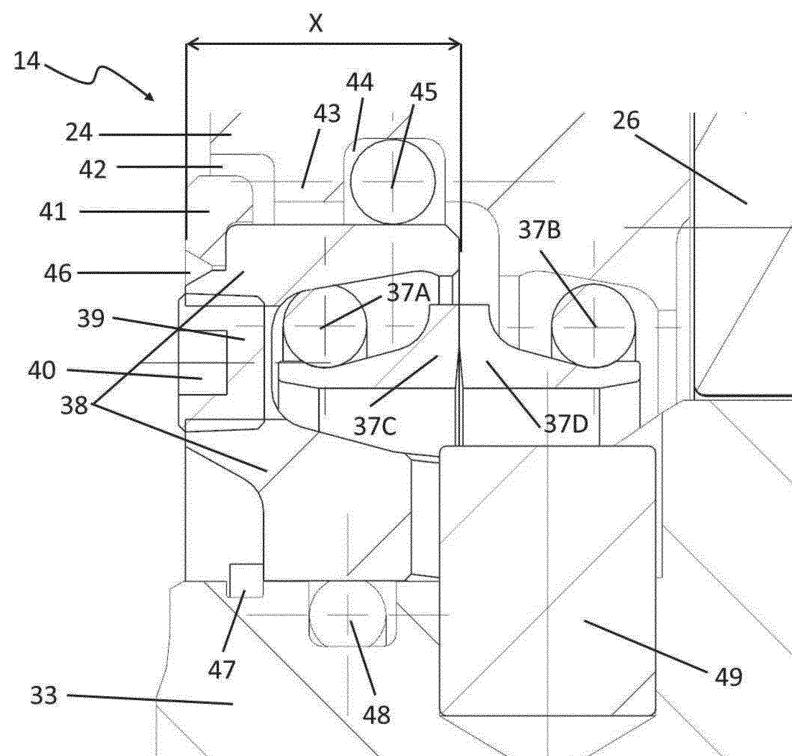


FIG 3B

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Description

Technical Field and Background

[0001] The present invention relates to a roller cutter for a drill head for rotary boring of a front of earth and rock formations according to the preamble of the independent claim.

[0002] A roller cutter comprising an improved sealing is addressed in U.S. Pat. No. 5,984,024. It shows sealing means held in position by a seal retainer. The roller cutter also comprises relief holes having conical plugs which are removed in order to refill the roller cutter with lubricant, such as grease or oil. However, with this solution dirt frequently reaches the sealing means and knocks the O-rings of the seal out of position, thus decreasing its sealing efficiency.

[0003] Another roller cutter with improved sealing is addressed in U.S. Pat. No. 7,278,500. It shows sealing means protected by a cover in order to prevent dirt from reaching the interior of the roller cutter. However, with this solution it is problematic to refill the roller cutter with lubricant.

Summary

[0004] One object of the present invention is to provide a roller cutter with improved sealing compared to existing roller cutters.

[0005] According to a one aspect, there is provided a roller cutter, having a centre line comprising: a hub provided with rows of crushing members, at least one crushing member having its longitudinal axis at an angle relative to a normal to the centre line, said hub being rotatable in relation to a shaft having shaft spigots, the roller cutter being provided with at least one seal retainer arranged at an axial end of the hub in order to hold sealing means in position, wherein the hub comprises at least one circumferential recess positioned axially inward relative to a radially inward projecting flange in the hub.

Brief Description of the Drawings

[0006] In the detailed description of the present invention reference will be made to the accompanying drawings, wherein,

Fig. 1 schematically shows an axial cross-section through a raise-boring head having roller cutters according to the invention.

Fig. 2 schematically shows a roller cutter according to the present invention as well as a saddle in side view.

Fig. 3A schematically shows the roller cutter according to the present invention in a partial cross-section.

Fig. 3B schematically shows an enlarged section according to Fig. 3A.

Detailed Description

[0007] The features and advantages of the present invention are well understood by reading the following detailed description in conjunction with the drawings in which like numerals indicate similar elements and in which:

[0008] FIG. 1 illustrates how a pilot hole 11, which in a known way is pre-drilled between an upper and a lower, not shown, level in a mine is reamed by means of a drill head designated 10. The drill head 10 is connected to a drive stem 12 by means of which the drill head is rotated and is pressed against a ring-shaped surface 13 that surrounds the pilot hole 11. The surface 13, thus, defines the face of the earth formation.

[0009] The invention relates to earth boring in general, but is primarily intended for raise boring. At raise boring, a distance is drilled between the lower and the upper level in a mine, and then the pilot hole is reamed by means of a drill head having a large diameter.

[0010] The drill head 10 comprises a body 16 and a plurality of rollers or cutters 14, which are rotatably mounted on the body in fasteners or saddles 15. Each roller cutter comprises circumferential rows of buttons or crushing members of cemented carbide in a known way. The saddles 15 are mounted on the body 16. The drive stem 12 is connected to the body 16. The body 16 has a mounting surface 17 on which the saddles 15 are carried.

[0011] FIG. 2 illustrates how the saddle 15 comprises a bottom surface 18, which is intended to be connected, for instance by screwing or welding, to the mounting surface 17. Furthermore, the saddle 15 comprises two legs 19, 20, between which the roller cutter is mounted. The legs 19, 20 are, at the ends thereof facing away from the bottom surface 18 formed with arms 21. The arms 21 have different lengths from the bottom surface 18. Fastening devices in the form of threaded bolts 22 and nuts 23 are intended to hold the roller cutter 14 and the saddle 15 together.

[0012] FIG. 3A illustrates the roller cutter having a shaft 33 with a longitudinal centre line CL. Directions in the following description refer to this centre line. Axially outward refers to a direction towards the arms 21, and radially outward means a direction away from the centre line. The ends of the shaft 33 each has a shaft spigot 34, 35, which is intended to abut against a support surface (not shown) in the arms 21 of the saddle 15.

[0013] A hub 24 is rotatably mounted on the shaft 33 via bearing members 26. The bearing members 26 are received in circumferential grooves in the hub 24. The hub 24 is locked axially in relation to the shaft 33 by means of a lock member 28, preferably in the form of balls, which co-operate with circumferential grooves in both the shaft 33 and the hub 24.

[0014] The roller cutter 14 has inserts or crushing members 29 mounted in rows at an envelope surface of the hub 24. At least one of the crushing members 29 has

its longitudinal centre line CL1 at an angle relative to a normal to the centre line CL of the roller cutter 14.

[0015] FIG. 3B illustrates that between the axial ends of the hub 24 and the shaft 33 the cutter 14 is at at least one end, preferably both, provided with seal retainers 38. The seal retainer 38 has a maximum axial extension X. The seal retainer 38 supports sealing means 37 that prevents the lubricant, such as grease or oil, from leaking out from the interior of the cutter 14. In one embodiment the sealing means 37 is of the type mechanical face seal, also called duo-cone seal. It comprises two O-rings 37A and 37B, made of a resilient material, and two seal rings 37C and 37D, often made of cast iron. The most radially outward surfaces of the seal rings, 37C and 37D, have a concave shape in order to axially fix the O-rings, 37A and 37B, in position.

[0016] The seal retainers 38 are equipped with relief holes 39 having plugs 40 mounted in said holes to prevent lubricant from leaking out through said holes 39. The plugs 40 may be conical and are removed when the roller cutter 14 needs refilling of lubricant. With this method air escapes the interior of the roller cutter 14, thus making the refilling of lubricant easier.

[0017] The seal retainer 38 has a radially outward projecting part 41 at its axially and radially most outward part. Adjacent to, and radially outward from the projecting part 41 is a circumferential indent 42 in the hub 24. The indent 42 and the projecting part 41 form a labyrinth which further decreases the risk of dirt reaching the interior of the roller cutter 14. There may be a radial space, of about 1.4 to 2 mm, between the hub 24 and the seal retainer 38 in order to separate the hub 24 from the seal retainer 38 even at loads of up to 30 metric tonnes. For the same reason, there may be a radial and axial space, of about 1.4 to 2 mm, between the hub 24 and the projecting part 41.

[0018] In one embodiment, the projecting part 41 is in the form of a ring attached to the seal retainer 38. This ring 41 can be metallurgically bonded to the seal retainer 38, preferably by welding.

[0019] Axially inward from the indent 42, there is a radially inward projecting flange 43 in the hub 24. The flange 43 has substantially parallel side surfaces and an end surface substantially parallel to the centre line CL. Further axially inward from the flange 43, there is a circumferential recess 44 in the hub 24 in order to hold an O-ring 45 in position. One side surface of the flange 43 constitutes a boundary of the recess 44. The flange 43 and the recess 44 are positioned radially outward from the seal retainer 38 and are axially entirely contained within the seal retainer's 38 axial extension X.

[0020] There is a groove 46 at the axially outermost end of the seal retainer 38, in order to facilitate attachment of the ring 41.

[0021] A snap ring 47 is used in conjunction with a lock ring (not shown) to lock the seal retainer 38 in position on the shaft 33.

[0022] Another O-ring 48, made of a resilient material,

prevents leakage between seal retainer 38 and shaft 33.

[0023] If dirt enters the area between hub 24 and seal retainer 38 then a force will be transmitted through the dirt to the seal retainer 38 which may lead to the seal retainer 38 starting to rotate. A dowel pin 49 fixes the seal retainer 38 statically in position thus hindering it from rotational movement.

[0024] The O-rings, 37A, 37B, 45 and 48, are all made of a resilient material. Examples of such materials are silicone, Viton and nitrile rubber. The material chosen depends on the load and temperature the O-ring is supposed to be exposed to.

[0025] The present invention is not limited to the above described embodiments. Different alternatives, modifications and equivalents might be used. The above mentioned embodiments should therefore, not be considered limiting to the scope of the invention, which is defined by the patent claims.

Claims

1. A roller cutter (14) intended to be used at a drill head for rotary boring of the front of earth and rock formations, said roller cutter having a centre line (CL) and being provided with a hub (24) provided with rows of crushing members (29), at least one crushing member having its longitudinal axis at an angle relative to a normal to the centre line (CL), said hub being rotatable in relation to a shaft (33) having shaft spigots (34, 35), the roller cutter being provided with at least one seal retainer (38) arranged at an axial end of the hub in order to hold sealing means (37) in position, **characterized in that** the hub comprises at least one circumferential recess (44) positioned axially inward relative to a radially inward projecting flange (43) in the hub.
2. The roller cutter according to claim 1, **characterized in that** one side surface of the flange constitutes a boundary of the recess.
3. The roller cutter according to claim 1 or 2, **characterized in that** the seal retainer has a maximum axial extension (X) and the flange and the recess are positioned radially outward from said seal retainer and are axially entirely contained within said axial extension.
4. The roller cutter according to claim 1, 2 or 3, **characterized in that** the recess holds an O-ring (45) in position.
5. The roller cutter according to any of the preceding claims, **characterized in that** at least one seal retainer comprises a radially outward directed projecting part (41) at a position forming a seal retainer's axial and radial outermost end.

6. The roller cutter according to claim 5, **characterized in that** the projecting part is a ring.
7. The roller cutter according to claim 6, **characterized in that** the ring is metallurgically bonded to the seal retainer. 5
8. The roller cutter according to any of the preceding claims, **characterized in that** the hub comprises at least one circumferential indent (42) radially outward from and adjacent to the projecting part on the seal retainer. 10
9. The roller cutter according to any of the preceding claims, **characterized in that** at least one seal retainer has a groove (46) at its axially outermost end. 15

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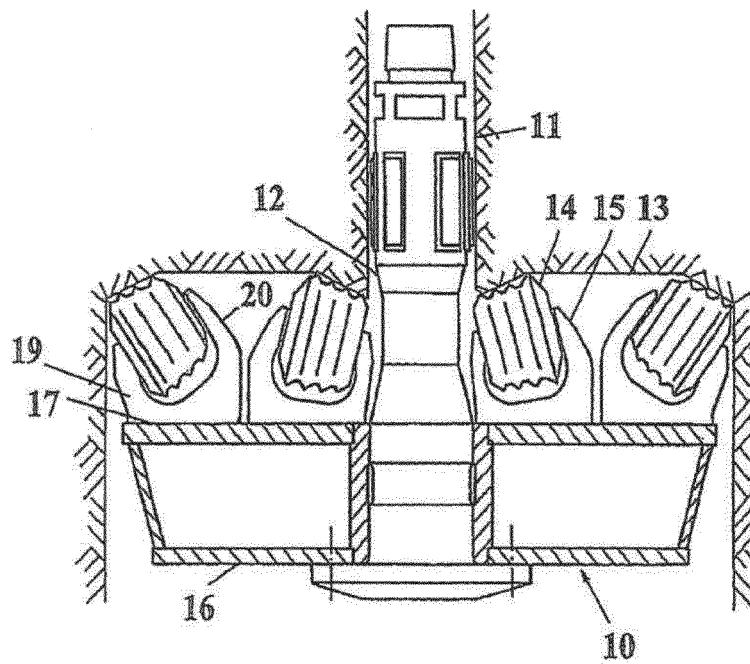


FIG 1

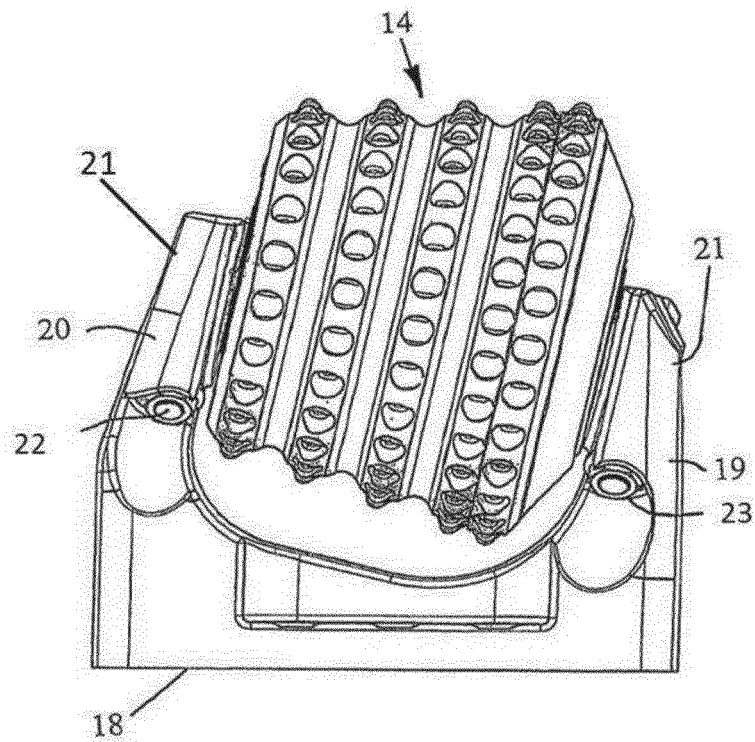


FIG 2

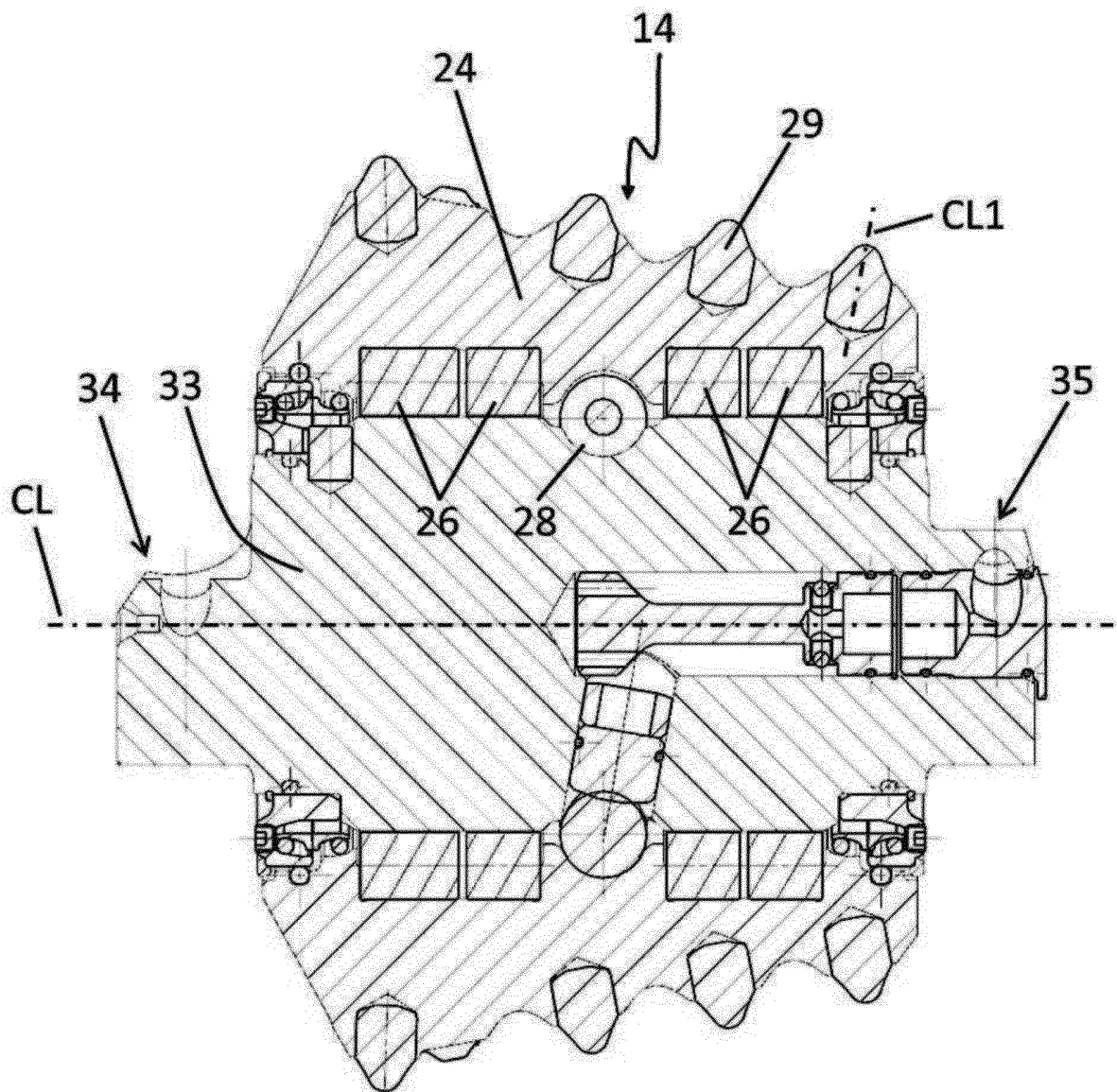


FIG 3A

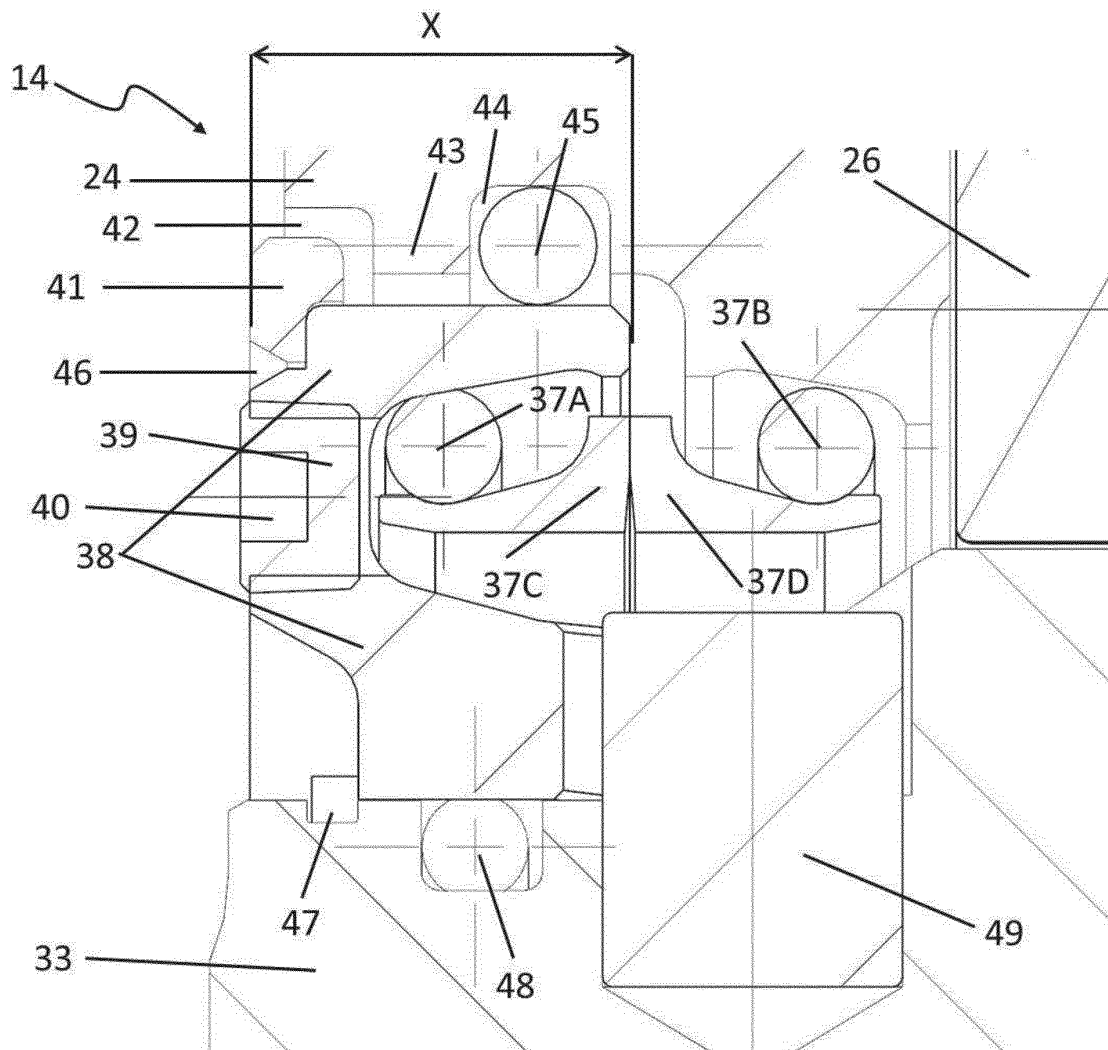


FIG 3B



EUROPEAN SEARCH REPORT

 Application Number
EP 13 16 0149

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 449 024 A (LICHTE CARL L) 10 June 1969 (1969-06-10) * figures 1,3 * * the whole document * -----	1,2,4,5	INV. E21B10/25
X	US 3 572 452 A (WINBERG DOUGLES F) 30 March 1971 (1971-03-30) * column 5, line 58 - column 7, line 9; figures 1, 2 *	1,2,5,6	
A	----- US 5 984 024 A (STRAND GOERAN [SE]) 16 November 1999 (1999-11-16) * figure 1 *	7	
A,D	----- US 5 984 024 A (STRAND GOERAN [SE]) 16 November 1999 (1999-11-16) * figure 1 *	3,8,9	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 July 2013	Examiner Maukonen, Kalle
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 16 0149

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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19-07-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3449024 A	10-06-1969	DE 1525065 A1	03-07-1969
		US 3449024 A	10-06-1969
US 3572452 A	30-03-1971	NONE	
US 5984024 A	16-11-1999	AU 712317 B2	04-11-1999
		CA 2224372 A1	09-01-1997
		DE 69627655 D1	28-05-2003
		DE 69627655 T2	29-04-2004
		EP 0833999 A1	08-04-1998
		JP 3545419 B2	21-07-2004
		JP H11508335 A	21-07-1999
		SE 509184 C2	14-12-1998
		SE 9502277 A	23-12-1996
		US 5984024 A	16-11-1999
		WO 9701016 A1	09-01-1997
		ZA 9605301 A	23-01-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5984024 A [0002]
- US 7278500 B [0003]