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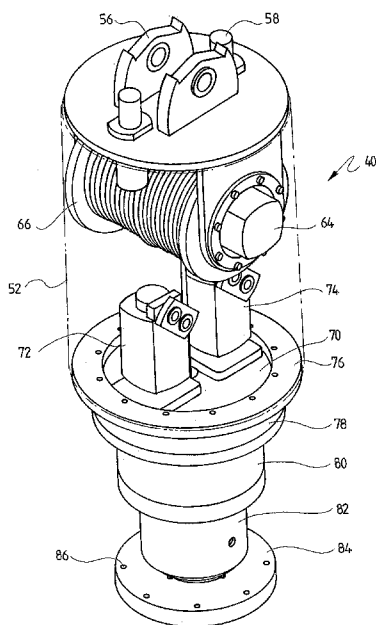
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(54) Title: IMPROVED DRILLING APPARATUS AND DRIVE UNIT



(57) Abstract: A drive unit (40) for driving a kelly bar drilling arrangement (10), the drive unit (40) comprising a chassis (52), the chassis carrying a kelly bar retriever (66, 68) for retrieving a kelly bar (10) from a hole or bore, the chassis (52) also carrying a kelly bar rotator (72, 74), the kelly bar rotator being effective to cause rotation of the kelly bar during drilling, wherein the drive unit (40) is positioned above the kelly bar (10) when the kelly bar (10) is connected to the drive unit (40).

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IMPROVING DRILLING APPARATUS AND DRIVE UNIT

FIELD OF THE INVENTION

The present invention relates to a drive unit for use in a drilling apparatus. The present invention also relates to an improved drilling apparatus.

5 BACKGROUND TO THE INVENTION

The drilling of holes or bores in the ground, for example, in construction, is widely practised. One method for drilling bores or holes in the ground involves attaching an auger or other drilling apparatus to a boom arm attached to a vehicle (such as a tractor, excavator, crane or front end loader). In such cases, the rotatable auger device or other
10 drilling apparatus is generally suspended from the boom and engineered such that the auger can be set up to drill vertical holes in required positions despite the fact that the surrounding terrain may mean that the vehicle to which the device is attached is not on a level surface. To accommodate various types of terrains and conditions, the auger is normally suspended from the boom arm so that it is able to freely swing on intersecting
15 planes.

When drilling is not taking place and the vehicle or boom arm is being moved, the auger can pendulate in a largely uncontrolled manner, thereby creating potentially dangerous impact situations for the operator and persons or property nearby. The present applicant has developed a dampening apparatus that is described in Australian Patent No.
20 2002240700 and sold by the present applicant under the trade name "SCS Swing Control System" to ameliorate such uncontrolled movement.

Drilling of holes using augers suspended from a boom arm or similar suffers from the disadvantage that the depth to which the hole can be conveniently made is limited to the length of the auger and the reach of the machine. In practice, this is typically limited
25 to a maximum depth of about 6 metres. If deeper holes are required, it is necessary to attach the auger to the boom arm, dig the hole, subsequently remove the auger from the swing arm, attach an extender bar to the auger, attach the other end of the extender bar to the boom arm and recommence the boring of the hole. This is cumbersome, time-consuming and represents a potential occupational health and safety risk.

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Another way in which holes may be drilled in the ground utilises a drilling rig. Drilling rigs typically utilise kelly bars to drill the holes or bores. Kelly bars typically include a series of telescoping bars that are able to be locked against rotation relative to each other by the use of either an interlock design or by friction. The person skilled in the art will understand how both interlock kelly bars and friction kelly bars are constructed and operate. An auger or drill bit is attached to the kelly bar, typically to the innermost bar of the kelly bar. The kelly bar is inserted through an opening in a kelly bar drive unit. The kelly bar drive unit engages with the outer surface of the kelly bar such that rotation of the kelly bar drive unit causes rotation of the kelly bar. As the hole in the ground is drilled and becomes deeper, the kelly bar is fed downwardly through the kelly bar drive unit. When the maximum extent of downward movement of the kelly bar has been achieved, the drill unit is stopped and the kelly bar is lifted by a winch. The winch is normally attached to the drive vehicle or to a drilling mast attached to the drive vehicle. Lifting the kelly bar causes all but the kelly bar driving the auger or drill bit to be raised. Effectively, the kelly bar is extended by virtue of the inner kelly bar remaining in the ground at drilling depth whilst the outer bars of the kelly bar are lifted back up through the kelly bar drive unit. When the outer bars of the kelly bar drive unit are in a desired raised position, the drive unit is again engaged to drive rotation of the kelly bar and drilling can continue. When the kelly bar again reaches a lower-most position, the drive unit is again disengaged and the outer bars of the kelly bar again lifted. At this time, the next of the inner kelly bars remains in its vertical position whilst the outer kelly bars are lifted relative to it.

In this fashion, kelly bars can be telescopically extended during the drilling operation to thereby enable drilling to greater depths.

The main disadvantage suffered by drilling rigs utilising kelly bar drilling apparatus arises from the large cost involved in purchasing such drilling rigs.

The applicant does not concede that the prior art discussed herein forms part of the common general knowledge in Australia or elsewhere.

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Throughout this specification, the term “comprising” or its grammatical equivalents shall be taken to have an inclusive meaning unless the context clearly indicates otherwise.

BRIEF DESCRIPTION OF THE INVENTION

5 It is an object of the present invention to provide an improved drive unit for use in drilling holes or bores.

 In a first aspect, the present invention provides a drive unit for driving a kelly bar drilling arrangement, the drive unit comprising a chassis, the chassis carrying a kelly bar retriever for retrieving a kelly bar from a hole or bore, the chassis also carrying a kelly bar
10 rotator, the kelly bar rotator being effective to cause rotation of the kelly bar during drilling, wherein the drive unit is positioned above the kelly bar when the kelly bar is connected to the drive unit.

 In most embodiments of the present invention, the drive unit is located wholly above the kelly bar when the kelly bar is connected to the drive unit. However, in some
15 embodiments, the kelly bar may extend into the drive unit. It is desirable that the kelly bar does not extend above an upper extent of the drive unit.

 The chassis of the drive unit may comprise any suitable arrangement. In one embodiment, the chassis comprises a housing. In another embodiment, the chassis comprises one or more chassis members. The chassis members may be chassis rods or
20 chassis beams.

 In preferred embodiments, the chassis comprises a generally cylindrical housing. The chassis may include an enclosed upper end.

 The chassis carries the kelly bar retriever. The kelly bar retriever may be mounted to the chassis. In embodiments where the chassis is a housing, the kelly bar retriever may
25 be mounted within the housing. In other embodiments, the kelly bar retriever may be mounted externally to the housing.

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The kelly bar retriever is used to retrieve a kelly bar from a bore or a hole. Typically, the kelly bar retriever will be operated when it is desired to retrieve an extended kelly bar from a completed bore or hole.

The kelly bar retriever may comprise any suitable arrangement for retrieving an
5 extended kelly bar. In one embodiment, the kelly bar retriever comprises a cable and
spool arrangement, in which one end of the cable is attached to the kelly bar. As the kelly
bar extends into the hole or bore during drilling, the cable and spool arrangement may be
allowed to operate such that the cable extends as the kelly bar extends. When it is desired
to retrieve the kelly bar, the cable and spool arrangement may be operated to wind the
10 cable back up onto the spool and thereby retrieve or lift the kelly bar out of the bore or
hole.

The cable and spool arrangement may be operated by providing an appropriate
motor or an appropriate motor and gear box arrangement to enable the cable to be wound
up or retracted back onto the spool. The motor may comprise a hydraulic motor (i.e. a
15 motor that is operated by hydraulic power). Other forms of motor may also be suitable
for use in this embodiment of the present invention, such as a mechanical motor,
electrical motor or pneumatic motor.

The kelly bar rotator may comprise any suitable arrangement that is effective to
cause rotation of the kelly bar when it is desired to rotate the kelly bar. In some
20 embodiments, the kelly bar rotator may comprise a motor. The motor may be a hydraulic
motor. In other embodiments, the kelly bar rotator comprises a gear box driven by a
motor.

The kelly bar is typically connected to the kelly bar rotator in order to enable the
kelly bar rotator to rotate the kelly bar. An appropriate connector or connection interface
25 may be provided to enable the kelly bar to be connected to the kelly bar rotator. In one
embodiment, the kelly bar rotator may have an output shaft that is connected to an upper
end of the kelly bar. For example, the output shaft may be provided with a flange having
bolt holes that enable bolts to be used to connect the kelly bar to the flange.

In other embodiments, the kelly bar rotator may be provided with a clamping
30 arrangement to enable the kelly bar rotator to clamp onto the kelly bar.

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In one embodiment of the present invention, the drive unit has a chassis in the form of a housing. The housing has a closed upper end and the kelly bar retriever is mounting to the closed upper end of the chassis. The kelly bar rotator is positioned below the kelly bar retriever. This enables the drive unit to be a compact unit.

5 In an embodiment of the present invention, the kelly bar retriever comprises a cable and spool arrangement and the kelly bar rotator is positioned below the cable and spool arrangement. The kelly bar rotator suitably includes a hollow portion through which the cable can pass to enable the cable to be attached to the kelly bar. Ideally, the cable is attached to an inner member of the kelly bar.

10 The kelly bar rotator may include one or more hydraulic motors mounted to the chassis. A drive train incorporating a gear box is driven by the one or more motors, with the drive train acting to cause rotation of the kelly bar when the kelly bar is attached to the drive unit. The drive train may include a splitter box arrangement having a hollow gear concentrically mounted about a longitudinal axis of an output shaft of the drive unit.

15 This gear may be driven by a driving gear that, in turn, is driven by a motor.

The concentrically mounted hollow gear may, in turn, provide drive to a reduction gearbox. Reduction gearboxes are typically used in drilling arrangements and need not be described further. The reduction gearbox may be a reduction planetary gearbox. The reduction gearbox may, in turn, drive an output shaft.

20 In another embodiment, the kelly bar rotator may comprise a motor having an aperture that receives an end of the kelly bar in a manner such that operation of the motor causes rotation of the kelly bar. A suitable motor may be purchased from Hagglunds AB.

The drive unit of the present invention may be used with pendulum drillers connected to excavator booms. If the drilling arrangement is connected to an excavator boom, it is desirable to also use a dampening apparatus to dampen uncontrolled oscillation or pendulation of the boom. For example, a dampening apparatus as described

25 in Australian Patent No. 2002240700 (the entire contents of which are herein incorporated by cross-reference), may be used. A suitable dampening apparatus is manufactured and sold by Digga Australia Pty Ltd under the trade mark "SCS Swing Control System".

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The kelly bar will typically be fitted with a drilling tool at the lower end. The drilling tool may comprise an auger or a drill bit. The person skilled in the art will readily appreciate and understand that a number of different drilling tools may be used in conjunction with kelly bars and use of all appropriate drilling tools fall within the scope of the present invention.

The drive unit of the present invention may also be used with drilling rigs. In this instance, the drive unit may be connected to the top of the kelly bar and positioned relative to the drilling mast of the drilling rig. As the drive unit in accordance with the present invention has its own kelly bar retriever, either no winch is required on the drilling rig or, where a winch is present on the drilling rig, the winch that is present on the drilling rig may be used for other duties.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view of a kelly bar that may be used with the present invention;

Figure 2 is a cross-sectional view of the kelly bar shown in figure 1;

Figure 3 is a perspective view of an embodiment of the present invention;

Figure 4 is another perspective view of the embodiment shown in figure 3;

Figure 5 is a detailed perspective view showing the various arrangements of the drive unit in accordance with the present invention, with the housing of the drive unit removed for clarity;

Figure 6 shows the drive unit shown in figure 5 with the housing shown in transparent outline;

Figure 7 is a front cross-sectional view of a drive unit in accordance with the present invention; and

Figure 8 is a side cross-sectional view of the drive unit shown in figure 7.

DETAILED DESCRIPTION OF THE DRAWINGS

It will be appreciated that the drawings accompanying the specification have been provided for the purpose of showing preferred embodiments of the present invention.

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Thus, it will be understood that the present invention should not be considered to be limited solely to the embodiments shown in the drawings.

Figure 1 shows a side view of a kelly bar 10 that may be used in conjunction with the drive unit of the present invention. The kelly bar 10 includes an outer bar 12. A number of telescoping inner bars (not shown in figure 1) are positioned within outer bar 12. The innermost bar, a lower part of which is shown at 14, has a drill tool connector 16 formed at a lower end thereof. Spring 18 is positioned between a collar 20 formed just above drill tool connector 16 and a lower portion of kelly bar 10. Spring 18 acts to cushion impact loads on the kelly bar from the drill tool during drilling.

The kelly bar 10 further includes a connection flange 22 at its upper end thereof. Connection flange 22 enables the kelly bar 10 to be connected to the drive unit in accordance with the present invention.

Figure 2 shows a cross-sectional view of the kelly bar 10. Figure 2 clearly shows that the kelly bar 10 includes the outermost bar 12, and inner bars 24, 26 and 28. Bar 28 is the innermost bar of the kelly bar. The bars 12, 24, 26 and 28 are arranged to be telescopically slidable within each other, as shown in figure 2.

Innermost bar 28 includes a cable connector 30 that allows a cable to be connected thereto. In this fashion, once a hole or bore has been drilled and it is desired to retract the kelly bar from its extended position to a retracted position, a cable that is connected to cable connector 30 is retracted to sequentially retrieve and lift the inner bars 28, 26 and 24.

The kelly bar 10 shown in figures 1 and 2 may be an interlocking kelly bar or a friction kelly bar. Both arrangements are well known to those skilled in the art and need not be described further.

Figures 3 and 4 show a drive unit in accordance with an embodiment of the present invention. In figures 3 and 4, the drive unit 40 is connected to kelly bar 10. Kelly bar 10 is suitably identical to kelly bar 10 shown in figures 1 and 2. An auger 42 having replaceable wear teeth 44 is attached to the drill tool connector 16 of kelly bar 10 in a manner that will be readily understood by a person skilled in the art.

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The auger 42 is suitably a full flight auger. Other drilling tools may also be used instead of auger 42.

The embodiment shown in figures 3 and 4 is intended to be used on a pendulum arm of an excavator boom. Accordingly, a dampening apparatus 46 is attached to the upper part of drive unit 40. Dampening apparatus 46 may be an apparatus such as that sold by Digga Australia Pty Ltd under the trade mark "SCS Swing Control System" and as described in Australian Patent No. 2002240700.

The dampening apparatus 46 has a backing plate 48 having appropriate bolt holes (some of which are shown at 50) to enable connection to the pendulum arm of the boom.

The drive unit 40 is shown in more detail in figures 5 and 6. The drive unit 40 shown in figures 5 and 6 includes a cylindrical housing 52 (shown in outline in figure 6, but removed for clarity purposes in figure 5).

Cylindrical housing 52 is also clearly shown in figures 3 and 4. Cylindrical housing 52 has a top closing plate 54 that is connected to the cylindrical housing 52 by any appropriate means. Suitably, the top closing plate 54 is connected to cylindrical housing 52 by bolts or other connectors (not shown).

Top closing plate 54 carries a yoke adaptor 56. Yoke adaptor 56 is designed to connect to the dampening apparatus 46, as will be known to a person skilled in the art. The top closing plate 54 also carries members 58 that form part of or are connected to the dampening apparatus 46.

The top closing plate 54 also includes two downwardly extending arms 60 (only one of which is shown in figures 5 and 6). The arms 60 are suitably diametrically opposed. Arm 60 carries a bearing 62 that receives an axle 64 of a spool 66 that carries a cable 68. The spool 66 has a spool drive (not shown in figures 5 and 6) that allows the spool to be selectively operated to wind up or retract the cable back onto the spool. A free end of the cable 68 is connected to the innermost bar 28 of the kelly bar 10 shown in figures 1 to 4. It will be understood that as the hole is drilled and the kelly bar 10 extends, the cable 68 extends or unwinds with the extension of the kelly bar. When it is

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desired to retrieve the kelly bar, the spool 66 is operated to wind up or retract the cable back onto the spool, which also lifts and retrieves the kelly bar.

The drive unit further includes a lower plate 70. Lower plate 70 provides a mounting surface for a first hydraulic motor 72 and a second hydraulic motor 74.
5 Hydraulic motor 72, 74 are mounted in a position that is offset from the longitudinal access of the drive unit 40.

Lower plate 70 is connected to collar 76. Collar 76 is, in turn, connected to cylindrical housing 52, as is best shown in figure 6.

The drive unit 40 further includes a hollow splitter box 78 and a reduction gearbox
10 80. Reduction box 80 is suitably a planetary reduction gearbox. The reduction gearbox 80 has an output shaft 82 that terminates in a connection flange 84. Connection flange 84 includes a number of bolt holes, some of which are shown at 86. Connection flange 84 is placed into abutment with connection flange 22 on kelly bar 10 and bolts are then used to bolt the connection flanges 84 and 22 together. This connects the kelly bar 10 to the drive
15 unit 40.

Figures 7 and 8 show cross-sectional views of the drive unit 40 shown in figures 3 to 6. Figures 7 and 8 show a number of the internal details of the drive unit 40.

As can best be seen from figure 8, motor 72 is connected via an output shaft 86 to a driven gear 88 such that motor 72 causes rotation of gear 88. Similarly, motor 74 is
20 connected via output shaft 90 to a driven gear 92. Gears 88, 92 engage with a further gear 94 such that rotation of the gears 88, 92 causes rotation of the gear 94. Gear 94 has an aperture or hole through it so that the cable 68A that has been unwound from the spool 66 can extend through gear 94.

Gear 94 engagingly drives with gear 96, which represents the input drive gear of
25 the planetary reduction gearbox 80. Again, gear 96 and planetary reduction gearbox 80 have apertures therethrough to enable the cable 68A to pass therethrough.

Planetary reduction gearbox 80 is of generally conventional construction and need not be described further.

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Output shaft 82 is driven by the output of planetary reduction gearbox 80 in a manner that will be known to a person skilled in the art. Connection flange 84 is connected to output shaft 82 such that when the output shaft 82 rotates, the connection flange rotates with it.

5 The spool 66 is mounted within the housing 52. For reasons of space, the drive motor for driving the spool to wind up the cable 68 is positioned inside the drum of the spool. Appropriate gearing arrangements between the drum of the spool and the drive motor are provided to enable the motor to selectively drive the spool, when required. The drive motor inside the drum of the spool is suitably a hydraulic drive motor.

10 As also shown in figures 7 and 8, the free end 98 of cable 68A extends through the connection flange 84. It will be appreciated that connection flange 84 is also provided with an aperture such that the cable can pass through the connection flange 84.

 The drive unit of the present invention provides for a compact, relatively inexpensive drive unit that allows for drilling of holes that may go down to 20 - 40 metres
15 in depth. The drive unit of the present invention can be used with pendulum arms or excavator booms and allows for convenient drilling of holes that may be much deeper than those that are conveniently dug using convention boom-mounted drilling apparatus. The drive unit may also be used on drilling rigs, in which case the winch on the drilling rig is freed up for other uses. The drive unit does not extend very far beyond the lateral
20 extent of the kelly bar, thereby allowing holes to be dug close to walls or other structures.

 Those skilled in the art will appreciate that the present invention may be subject to variations and modifications other than those specifically described. It will be understood that the present invention extends to all such variations and modifications that fall within its spirit and scope.

CLAIMS.

1. A drive unit for driving a kelly bar drilling arrangement, the drive unit comprising a chassis, the chassis carrying a kelly bar retriever for retrieving a kelly bar from a hole or bore, the chassis also carrying a kelly bar rotator, the kelly bar rotator
5 being effective to cause rotation of the kelly bar during drilling, wherein the drive unit is positioned above the kelly bar when the kelly bar is connected to the drive unit.
2. A drive unit as claimed in claim 1 wherein the drive unit is located wholly above the kelly bar when the kelly bar is connected to the drive unit.
- 10 3. A drive unit as claimed in claim 1 wherein the kelly bar extends into the drive unit.
4. A drive unit as claimed in claim 3 wherein the kelly bar does not extend above an upper extent of the drive unit.
5. A drive unit as claimed in claim 1 wherein the chassis comprises a housing or one
15 or more chassis members.
6. A drive unit as claimed in claim 5 wherein the chassis comprises a generally cylindrical housing.
7. A drive unit as claimed in claim 1 wherein the chassis includes an enclosed upper end.
- 20 8. A drive unit as claimed in claim 1 wherein the kelly bar retriever is mounted within the housing or the kelly bar retriever is mounted externally to the housing.
9. A drive unit as claimed in claim 1 wherein the kelly bar retriever comprises a cable and spool arrangement, in which one end of the cable is attached to the kelly bar and as the kelly bar extends into the hole or bore during drilling, the cable and
25 spool arrangement is allowed to operate such that the cable extends as the kelly bar extends and when it is desired to retrieve the kelly bar, the cable and spool arrangement is operated to wind the cable back up onto the spool and thereby retrieve or lift the kelly bar out of the bore or hole.

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10. A drive unit as claimed in claim 9 wherein the cable and spool arrangement is operated by providing a motor or a motor and gear box arrangement to enable the cable to be wound up or retracted back onto the spool.
11. A drive unit as claimed in claim 10 wherein the motor comprises a hydraulic motor (i.e. a motor that is operated by hydraulic power).
12. A drive unit as claimed in claim 1 wherein the kelly bar rotator comprises a motor or a gear box driven by a motor.
13. A drive unit as claimed in claim 1 wherein a connector or connection interface is provided to connect the kelly bar to the kelly bar rotator.
- 10 14. A drive unit as claimed in claim 13 wherein the kelly bar rotator has an output shaft that is connected to an upper end of the kelly bar
15. A drive unit as claimed in claim 13 wherein the kelly bar rotator is provided with a clamping arrangement to enable the kelly bar rotator to clamp onto the kelly bar.
- 15 16. A drive unit as claimed in claim 1 wherein the drive unit has a chassis in the form of a housing, the housing having a closed upper end, the kelly bar retriever being mounting to the closed upper end of the chassis, and the kelly bar rotator being positioned below the kelly bar retriever.
- 20 17. A drive unit as claimed in claim 1 wherein the kelly bar retriever comprises a cable and spool arrangement and the kelly bar rotator is positioned below the cable and spool arrangement, the kelly bar rotator including a hollow portion through which the cable can pass to enable the cable to be attached to the kelly bar.
18. A drive unit as claimed in claim 17 wherein the cable is attached to an inner member of the kelly bar.
- 25 19. A drive unit as claimed in claim 1 wherein the kelly bar rotator includes one or more hydraulic motors mounted to the chassis and a drive train incorporating a gear box is driven by the one or more motors, with the drive train acting to cause rotation of the kelly bar when the kelly bar is attached to the drive unit.

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20. A drive unit as claimed in claim 19 wherein the drive train includes a splitter box arrangement having a hollow gear concentrically mounted about a longitudinal axis of an output shaft of the drive unit, said hollow gear being driven by a driving gear that, in turn, is driven by a motor.
- 5 21. A drive unit as claimed in claim 20 wherein the concentrically mounted hollow gear provides drive to a reduction gearbox.
22. A drive unit as claimed in claim 1 wherein the kelly bar rotator comprises a motor having an aperture that receives an end of the kelly bar in a manner such that operation of the motor causes rotation of the kelly bar.

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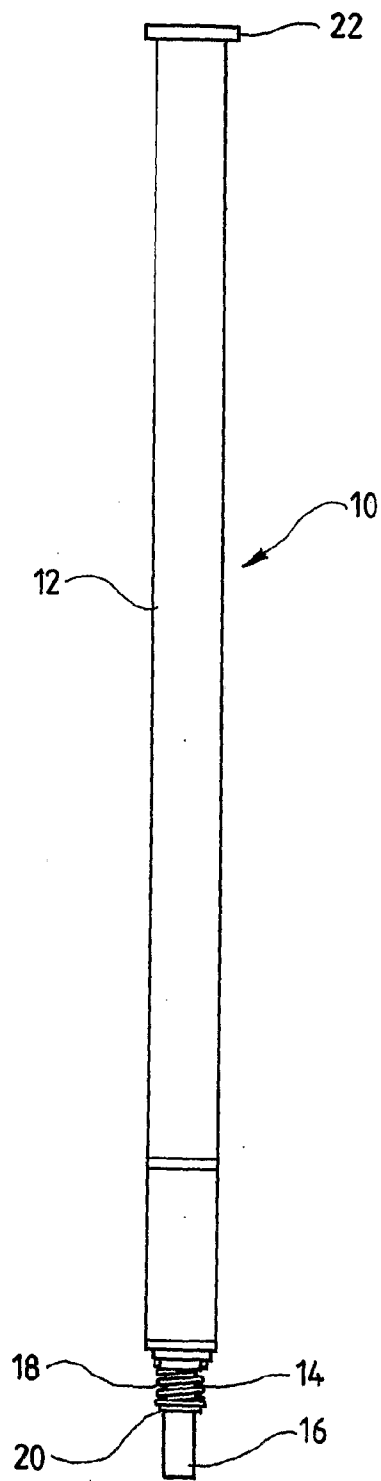


Fig.1

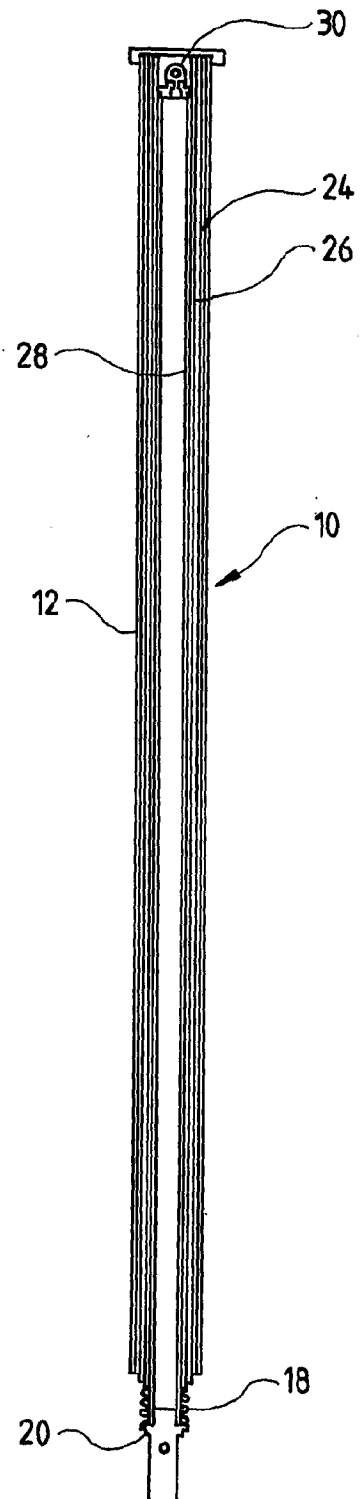
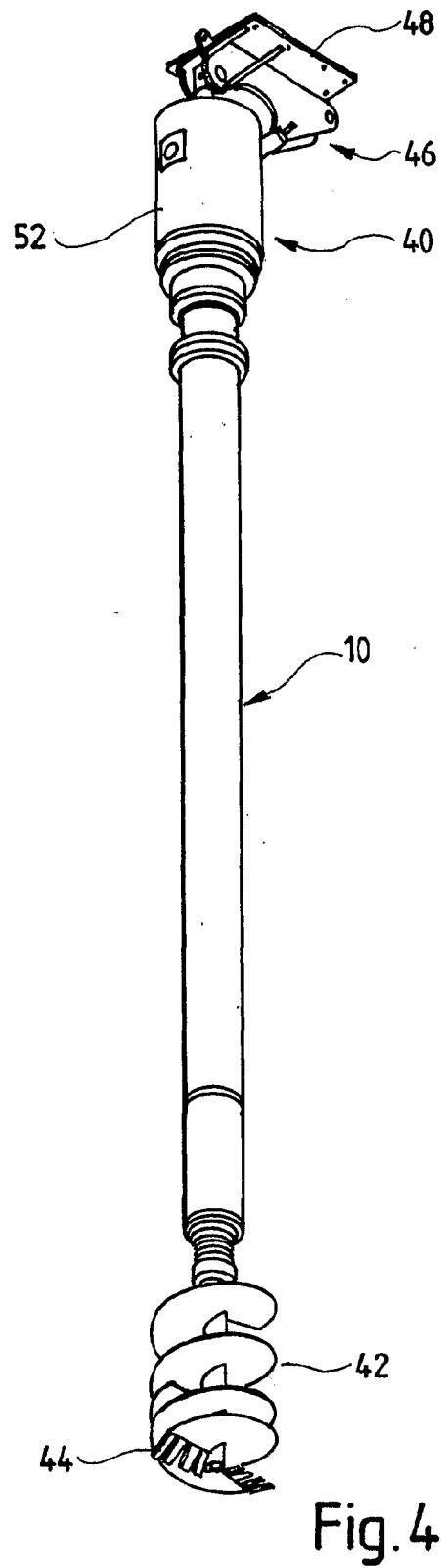
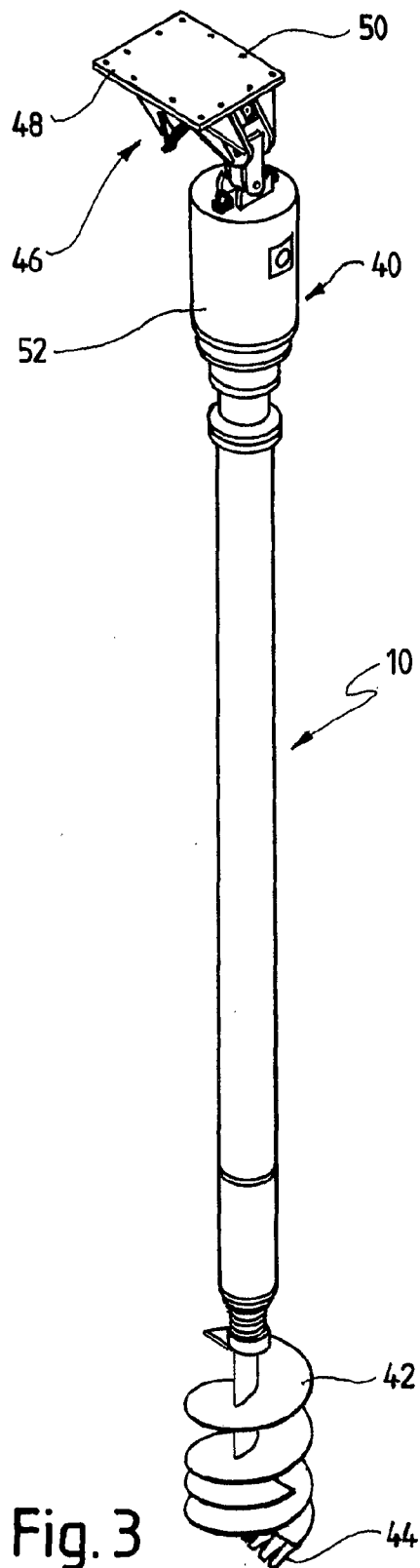


Fig. 2

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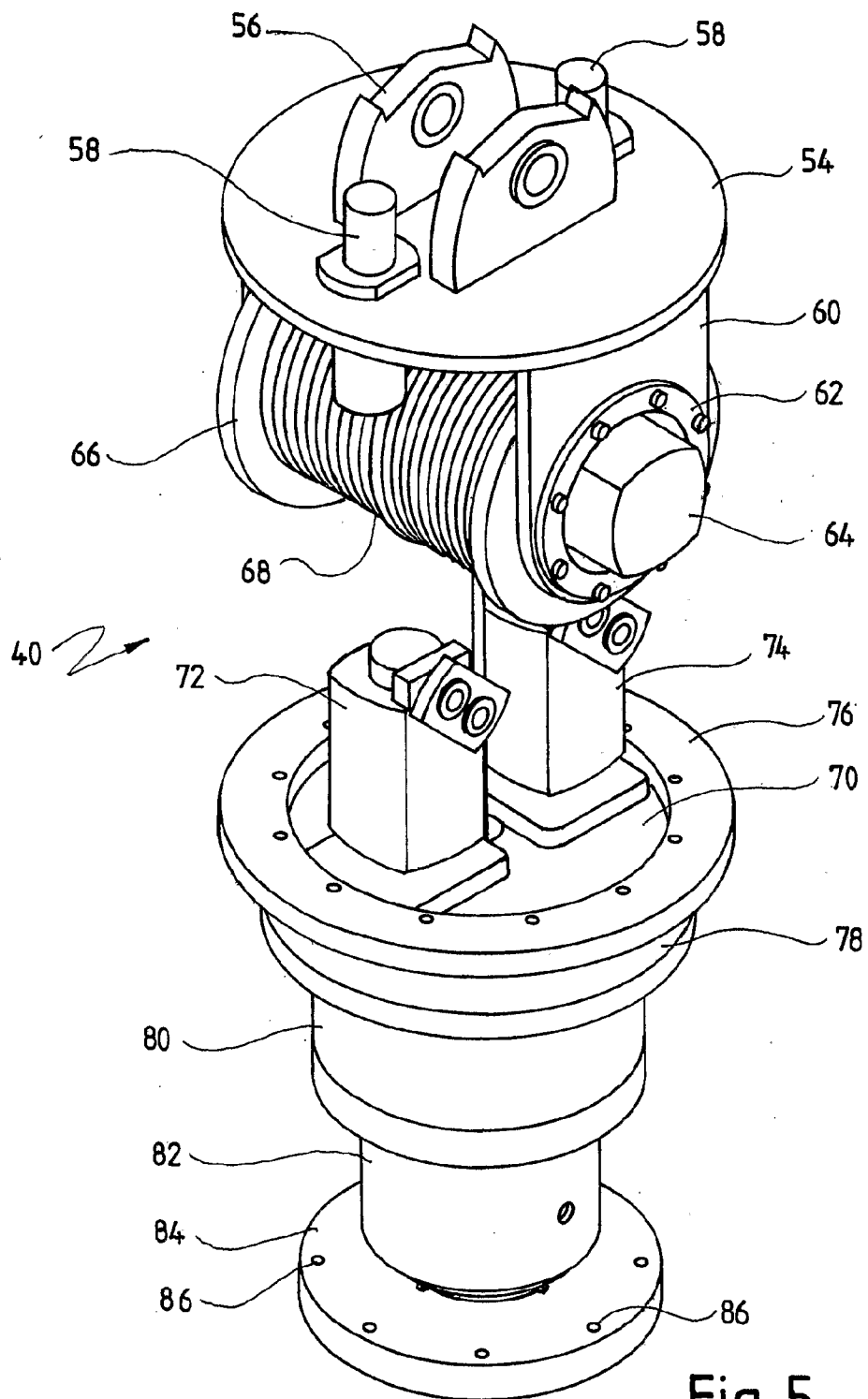
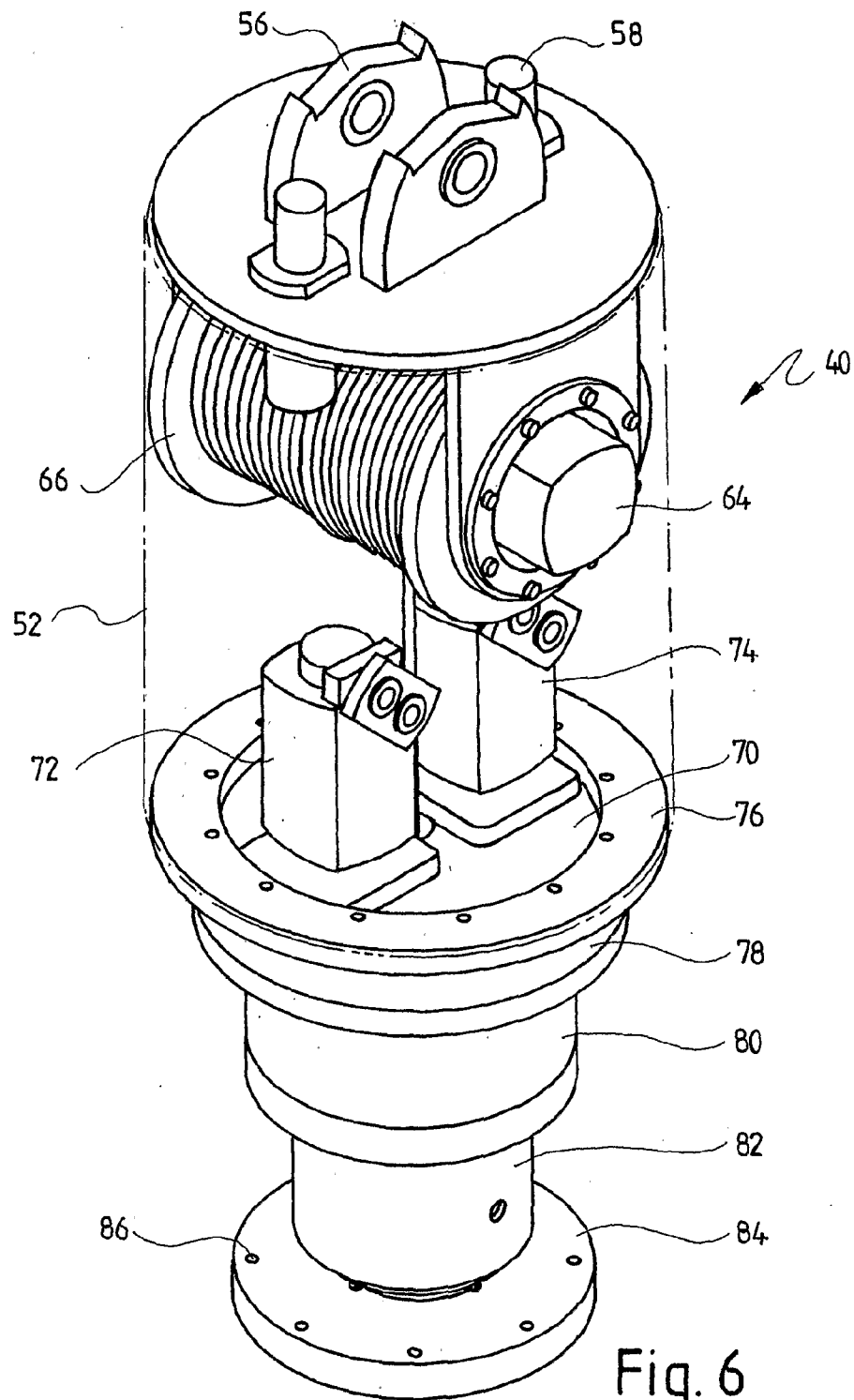


Fig. 5

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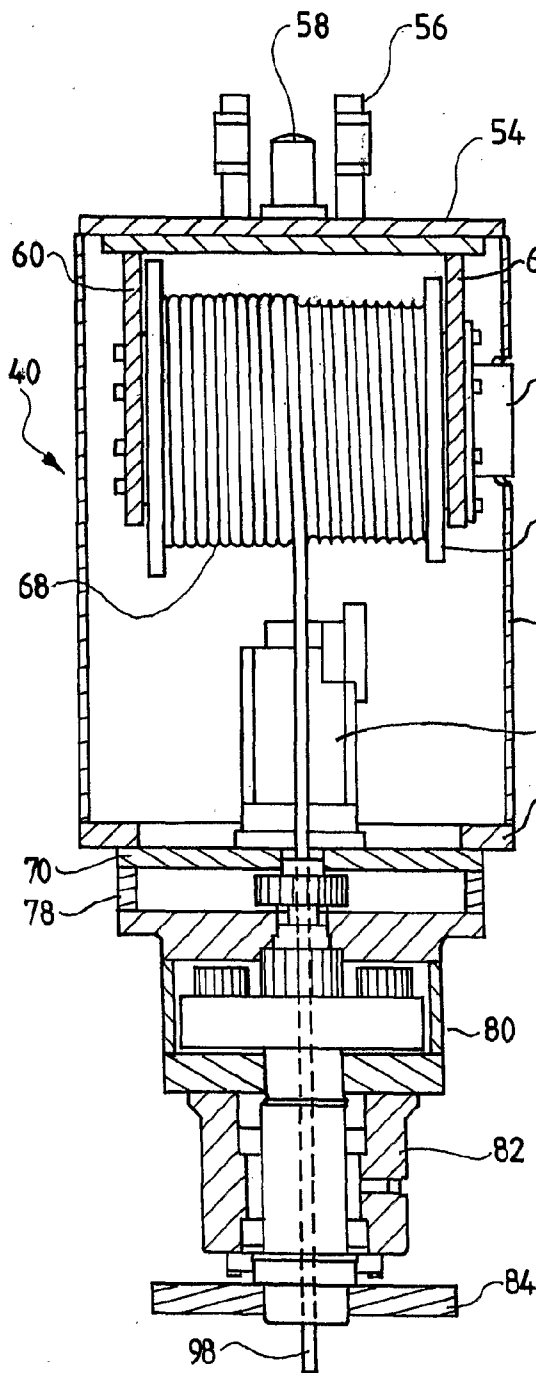


Fig.7

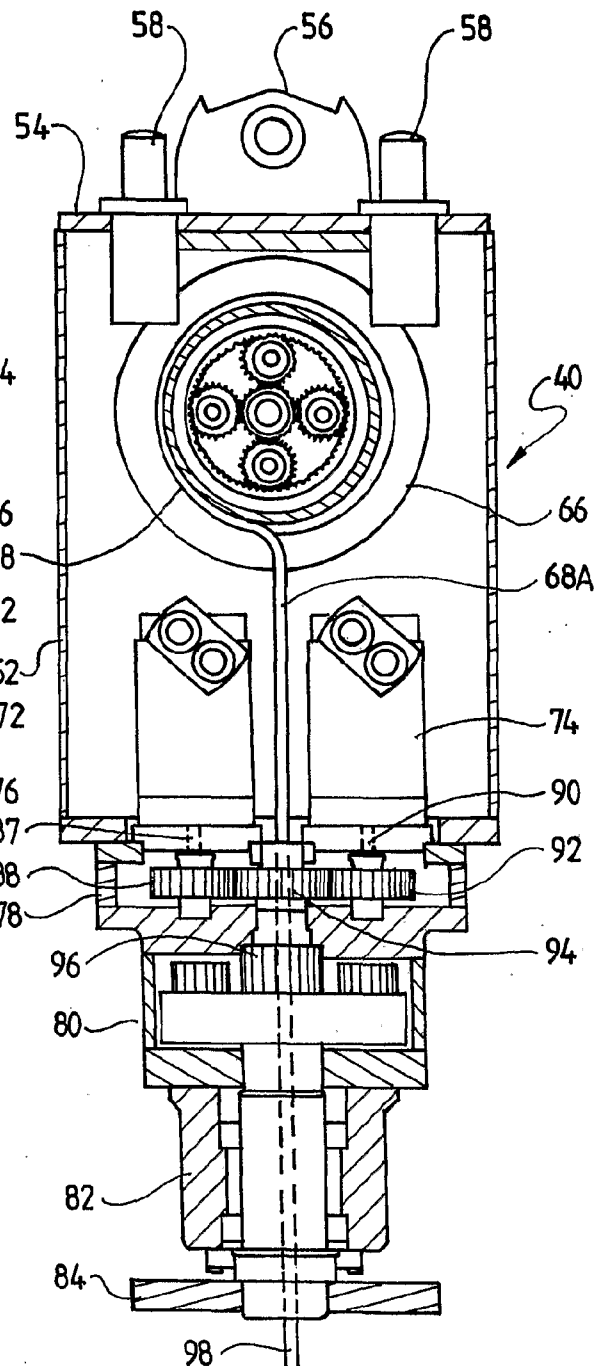


Fig.8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2007/000507

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl.		
E21B 11/00 (2006.01) E21B 4/00 (2006.01) E21B 7/00 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) E21B/ic, E02F/ic, E02D/ic with keywords		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 86-297279/45, Class Q49, SU 1218055 A (GLAVMOSTOSTROI BUR) 15 March 1986	1-22
X	Derwent Abstract Accession No. 97-084494/08, Class X22 X25, JP 08326456 A (KOKEN KOGYO KK) 10 December 1996	1-22
X	US 2003/0037940 A1 (HOWELL) 27 February 2003 The whole document	1-22
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* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
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"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 30 May 2007		Date of mailing of the international search report 6 JUN 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer LEOPOLD FILIPOVIC AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2105

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2007/000507

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5746277 A (HOWELL) 5 May 1998 The whole document	1-22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2007/000507

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	
SU	1218055		
JP	8326456	US	5630477
US	2003037940	US	6725946
US	6009941	CA	2326268
		US	6209633
US	5746277		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
END OF ANNEX			