



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| | | |
|---|-----------|---|
| (51) International Patent Classification ⁵ : F16B 31/02, G01L 5/24 | A1 | (11) International Publication Number: WO 91/08398 (43) International Publication Date: 13 June 1991 (13.06.91) |
| <p>(21) International Application Number: PCT/GB90/01746</p> <p>(22) International Filing Date: 13 November 1990 (13.11.90)</p> <p>(30) Priority data: 8926729.8 27 November 1989 (27.11.89) GB</p> <p>(71) Applicant (for all designated States except US): ROTABOLT LIMITED [GB/GB]; Peartree Business Park, Peartree Lane, Dudley, West Midlands DY2 0UW (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only) : WALTON, Brian [GB/GB]; The Warren, Cot Lane, Kingswinford, Dudley, West Midlands (GB).</p> <p>(74) Agent: MATHYS & SQUIRE; 10 Fleet Street, London EC4Y 1AY (GB).</p> | | <p>(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.</p> <p>Published <i>With international search report.</i></p> |
| <p>(54) Title: LOAD-INDICATING FASTENERS</p> <p>(57) Abstract</p> <p>A load indicating fastener such as a bolt (10) or stud, has a shank (12) which is subject to tensile loading in use. The shank (12) has an axially extending bore (22) which receives a first gauge pin (30) anchored at its inner end (32) to the shank (12) and protruding outwards beyond an end face (16) of the fastener. An indicating member (40) is rotatable on the protruding portion of the gauge pin (30) between the end face (16) of the fastener and the head (34) of the pin (30), so that the indicating member (40) is free to rotate when the shank (12) of the fastener is unstressed but when the shank (12) is subject to a predetermined tensile loading is held against rotation by contact with the end face (16) of the fastener. A second gauge pin (42) is received within an axially extending bore (36) in the first gauge pin (30) and is anchored at its inner end and protrudes outwards beyond the outer end of the first gauge pin (30). A second indicating member (50) is rotatable on the protruding part of the second gauge pin (42), between the head (46) of the pin (42) and the first indicating member (40). The second indicating member (50) is free to rotate when the shank (12) of the fastener is unstressed or subject to the first predetermined loading, but when the shank (12) is subject to a second predetermined tensile loading greater than the first predetermined loading, the second indicating member (50) is held against rotation by contact with the first indicating member (40). The first indicating member (40) provides an indication when the fastener has been tightened to a desired loading. The second indicating member (50) provides an indication when the fastener has been overloaded.</p> <div data-bbox="1117 1299 1436 2016"> </div> | | |

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | |
|----|------------------------------|----|--|----|--------------------------|
| AT | Austria | ES | Spain | MG | Madagascar |
| AU | Australia | FI | Finland | ML | Mali |
| BB | Barbados | FR | France | MR | Mauritania |
| BE | Belgium | GA | Gabon | MW | Malawi |
| BF | Burkina Faso | GB | United Kingdom | NL | Netherlands |
| BG | Bulgaria | HU | Hungary | NO | Norway |
| BJ | Benin | IT | Italy | RO | Romania |
| BR | Brazil | JP | Japan | SD | Sudan |
| CA | Canada | KP | Democratic People's Republic of Korea | SE | Sweden |
| CF | Central African Republic | KR | Republic of Korea | SN | Senegal |
| CG | Congo | LI | Liechtenstein | SU | Soviet Union |
| CH | Switzerland | LK | Sri Lanka | TD | Chad |
| CM | Cameroon | LU | Luxembourg | TG | Togo |
| DE | Germany, Federal Republic of | MC | Monaco | US | United States of America |
| DK | Denmark | | | | |

LOAD-INDICATING FASTENERS

This invention relates to load-indicating fasteners.

The invention relates in particular to fasteners, such as bolts or studs, which in use are subject to tensile loading. It is often important to ensure that the fastener is tightened to a predetermined loading. It is known to use the stretching of the fastener which occurs under tensile loading to give an indication when the appropriate loading has been reached.

European patent EP 0 049 537B describes a load indicating fastener having a shank with an axially extending bore which receives a gauge pin anchored at its inner end to the shank and protruding outwards beyond an end face of the fastener, with an indicating member rotatable on the protruding part of the gauge pin and arranged so that the indicating member is free to rotate when the fastener is unstressed but when the fastener is subject to a predetermined tensile loading is held against rotation by contact with the end face of the fastener.

The gauge pin and indicator member are usually set with an initial gap between the indicator member and the end face of the fastener such that the gap is closed when the fastener is subjected to the predetermined loading and the end face bears against the indicator member sufficiently to prevent its being rotated by hand.

A difficulty which can arise in use of the fastener described in EP 0 049 537B is that to ensure that the fastener is not over-tightened, the operator has to check the indicator member at frequent intervals during tightening. This problem is particularly acute when the fastener is tightened using a power tool. Moreover, after the fastener has been

- 2 -

tightened, there is nothing to indicate whether the fastener has been over-stressed.

It is an object of this invention to provide a load indicating fastener which avoids this problem.

The present invention consists in a load indicating fastener having a shank which is subject to tensile loading in use, the shank having an axially extending bore which receives a gauge pin anchored at its inner end to the shank and protruding outwards beyond an end face of the fastener, an indicating member rotatable on the protruding portion of the gauge pin and arranged so that the indicating member is free to rotate when the shank of the fastener is unstressed but when the shank is subject to a predetermined tensile loading is held against rotation by contact with the end face of the fastener, characterised in that the gauge pin has an axially extending bore, a second gauge pin is received within the bore in the first gauge pin and is anchored at its inner end and protrudes outwards beyond the outer end of the first gauge pin, and a second indicating member is rotatable on the protruding part of the second gauge pin, the second indicating member being free to rotate when the shank of the fastener is unstressed or subject to the first predetermined loading, but when the shank is subject to a second predetermined tensile loading greater than the first predetermined loading, the second indicating member is held against rotation by contact with part of the fastener.

The second gauge pin and indicator member can be set so that the second indicator member is held against movement when the tensile

- 3 -

loading reaches a maximum desired value. Thus, in use, if the second indicator member cannot be rotated, the operator will know the fastener has been overtightened. Moreover, the state of the fastener can subsequently be easily checked, by simply checking both indicator members. If the fastener is at the correct tension, the first indicating member will be held against rotation whilst the second will rotate freely. If neither member can rotate, this will indicate that the fastener has been overtightened. If both indicator members rotate freely this will indicate that the fastener requires retightening.

In one form of the invention, the second gauge pin is anchored at its inner end to the first gauge pin.

In another form of the invention, the second gauge pin is anchored at its inner end to the shank of the fastener.

In one embodiment of the invention, the first indicator is a disk trapped between the outer end of the fastener and a head on the outer end of the first gauge pin, and the second indicator member has an inner face arranged to abut the outer face of the disk, with a recess formed in the face of the second indicator member to accommodate the head of the first gauge pin. The second indicator member may be trapped between the first indicator member and an enlarged head at the outer end of the second gauge pin.

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

Figure 1 is a side elevation, partly in cross-section, of a bolt in accordance with the invention, and

- 4 -

Figure 2 is a side elevation, partly in cross-section, of a bolt in accordance with a second embodiment of the invention.

Referring to Figures 1 and 2, a bolt 10 has a shank 12 and head 14. A bore 22 of uniform diameter extends from the end face 16 of the head, partway through the shank 12. The bore 22 is internally screw threaded over a short length 24 extending from its inner end.

A first gauge pin 30, having an outside diameter slightly less than the inside diameter of the bore 22, extends through the bore 22 and is anchored at its inner end to the shank 12 by means of a threaded portion 32 at the end of the pin which engages the threaded portion 24 of the bore 22. The outer end of the gauge pin 30 projects outwards from the outer face 16 of the bolt and terminates in an enlarged head 34.

A first indicator member in the form of a disk 40 is positioned between an abutment 20 formed in a machined recess 18 in the end face of the bolt and the head 34 of the first gauge pin 30, the gauge pin fitting through a central hole in the disk 40 so that the disk is normally free to rotate on the pin.

The first gauge pin 30 is in itself formed with a uniform diameter bore 36, extending axially through the head 34 and partway along the length of the pin 30. The bore 36 has an internally threaded portion 38 near its inner end. A second gauge pin 42, having an outside diameter slightly less than the inside diameter of the bore 36 in the first gauge pin 30, extends through the bore 36 in the first gauge pin 30 and is anchored to the first gauge pin 30 by means of a threaded portion 42 at its inner end which engages the internal thread 38 of the bore 36. At

- 5 -

its outer end, the second gauge pin 42 projects beyond the head 34 of the first gauge pin 30, and itself terminates in an enlarged head 46.

A second indicator member 50 is positioned between the enlarged head 46 of the second gauge pin 42 and the first indicator member 40. The second gauge pin 42 passes through a hole in the second indicator member 50 so that it is free to rotate on the pin 42. The inner face of the indicator member 50 is formed with a recess 52 to accommodate the head 34 of the first indicator pin 30 so that the second indicator member 50 can rotate without interference from the first gauge pin 30. The outer face of the indicator member 50 is also formed with a recess 54, which receives the head 46 of the pin 42, so that the head 46 does not project outwards beyond the indicator member 50.

The first and second gauge pins 30 and 42 are set so that when the bolt is unstressed there are predetermined clearances between the first indicator member 40 and the abutment 20 at the end face 16 of the bolt, and between the second indicator member 50 and the outer face of the first indicator member 40. In use, when the bolt is tightened, the shank 12 is stretched elastically. Since the first gauge pin 30 is anchored only at its inner end to the shank 12 of the bolt, it is not stretched, and the elongation of the shank of the bolt causes the gap between the first indicator member 40 and the abutment 20 to close and pressure to be exerted on the indicator member 40 which holds it against rotation. The initial gap between the first indicator member 40 and the abutment 20 is set so that as the tensile loading on the bolt reaches a first predetermined level, the pressure on the first indicator member 40

- 6 -

prevents it being turned by hand. If the bolt is tightened further, further elongation of the shank 12 of the bolt, and consequently of the first gauge pin 30, closes the gap between the first indicator member 40 and the second indicator member 50, until pressure between the two prevents the second indicator member 50 from rotating. This is set to occur at a second predetermined tensile loading, so that when the second indicator member 50 is not free to rotate this gives an indication that the bolt has been overtightened.

The first and second gauge pins 30 and 42 are preferably of a material compatible with that of the bolt, so that the operation is unaffected by changes in temperature. The indicator members may be of any suitable material, for example stainless steel.

A protective cap 60 may be provided, fitting tightly over the second indicator member 50, so that the indicator member 50 can be rotated by rotating the cap 60. Similarly, a sleeve 62 may be provided, fitting tightly over the first indicator member 40, through which the indicator member 40 may be rotated. The interiors of the sleeve 62 and cap 60 may be packed with a suitable grease to give protection against corrosion without affecting the free rotation of the indicator members.

Modifications may be made in the described embodiment. For example, the second indicator member 50 could be arranged to engage the outer end 16 of the bolt rather than the first indicator member 40, the second indicator member being made of a suitably large diameter, so that the recess 52 can accommodate the first indicator member 40. Alternatively, the second indicator member 50 could be arranged to engage the head 34 of the first gauge pin 30.

- 7 -

In Figure 2, which shows a second embodiment of the invention, parts which correspond to those of the embodiment of Figure 1 have been given the same reference numeral with the addition of the prefix "1". The bolt shown in Figure 2 is generally the same as that shown in Figure 1, except that the second gauge pin 142 is anchored at its inner end to the shank 112 of the bolt rather than to the first gauge pin 130. To this end, the bore 122 in the shank 112 of the bolt has a smaller diameter counterbore 126 extending beyond the threaded portion 124 of the bore. The second gauge pin 142 extends beyond the inner end of the first gauge pin 130, and its threaded end portion 144 engages an internal thread in the counterbore 126.

Operation of the embodiment of Figure 2 is similar to that of the embodiment of Figure 1.

In the embodiment of Figure 2, the inner end of the first gauge pin 130 is secured to the shank, by engagement with the threaded portion 124 of the bore 122. In a further embodiment of the invention, the inner end of the first gauge pin 130 could be secured to the second gauge pin 142 at a location spaced from the inner end of the second gauge pin, both gauge pins being anchored to the shank 112 by the connection of the inner end of the second gauge pin 142 to the shank.

The invention could be applied to other fasteners which are subject to tensile loading, in particular to other screw-threaded fasteners, such as studs.

- 8 -

CLAIMS

1. A load indicating fastener having a shank (12) which is subject to tensile loading in use, the shank (12) having an axially extending bore (22) which receives a gauge pin (30) anchored at its inner end (32) to the shank (12) and protruding outwards beyond an end face (16) of the fastener, an indicating member (40) rotatable on the protruding portion of the gauge pin (30) and arranged so that the indicating member (40) is free to rotate when the shank (12) of the fastener is unstressed but when the shank (12) is subject to a predetermined tensile loading is held against rotation by contact with the end face (16) of the fastener, characterised in that the gauge pin (30) has an axially extending bore (36), a second gauge pin (42) is received within the bore (36) in the first gauge pin (30) and is anchored at its inner end and protrudes outwards beyond the outer end of the first gauge pin (30), and a second indicating member (50) is rotatable on the protruding part of the second gauge pin (42), the second indicating member (50) being free to rotate when the shank (12) of the fastener is unstressed or subject to the first predetermined loading, but when the shank (12) is subject to a second predetermined tensile loading greater than the first predetermined loading, the second indicating member (50) is held against rotation by contact with part of the fastener.

2. A fastener as claimed in Claim 1, in which the second gauge pin (42) is anchored at its inner end to the first gauge pin (30).

- 9 -

3. A fastener as claimed in Claim 1, in which the second gauge pin (42) is anchored at its inner end to the shank (12).

4. A fastener as claimed in any one of Claims 1 to 3, in which, when the shank (12) is subject to the second predetermined loading, the second indicating member (50) is held against rotation by contact with the first indicating member (40).

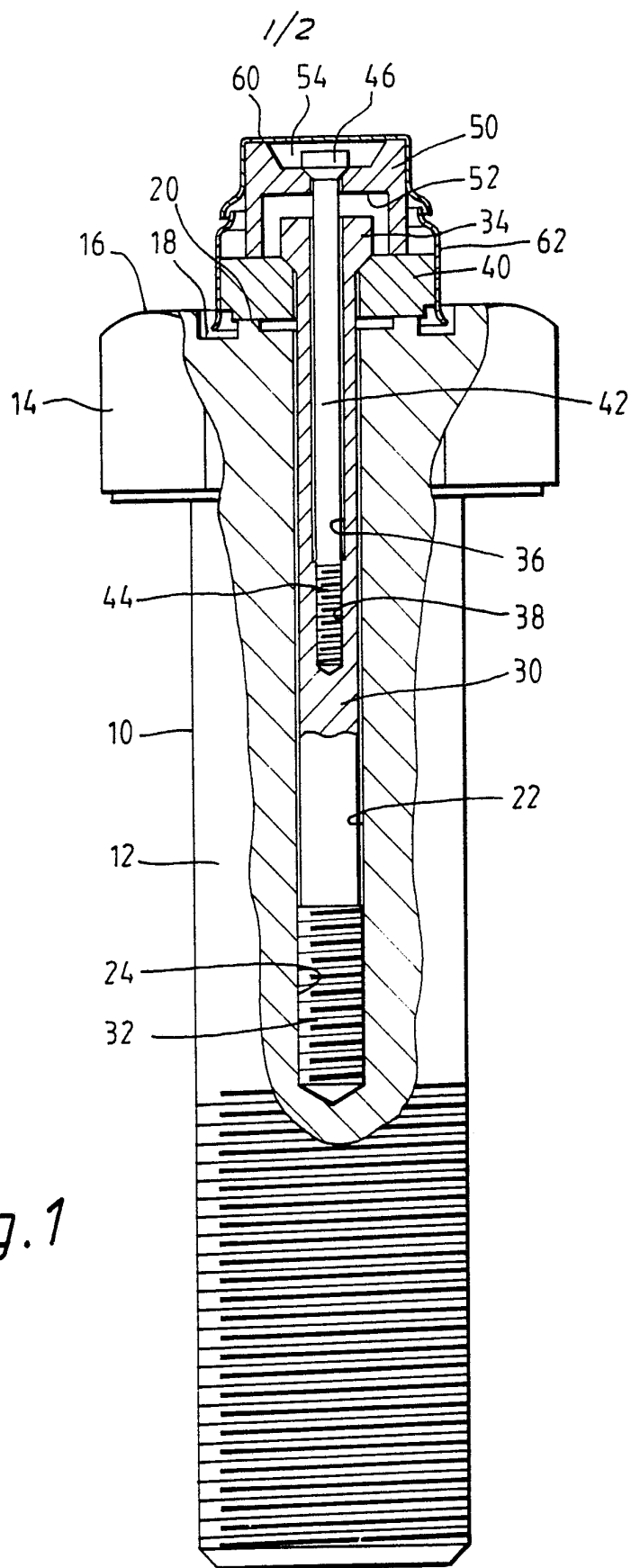
5. A fastener as claimed in any of Claims 1 to 3, in which, when the shank (12) is subject to the second predetermined loading, the second indicating member is held against rotation by contact with the first gauge pin (30).

6. A fastener as claimed in any one of Claims 1 to 3, in which, when the shank (12) is subject to the second predetermined loading, the second indicating member is held against rotation by contact with the end face (16) of the fastener.

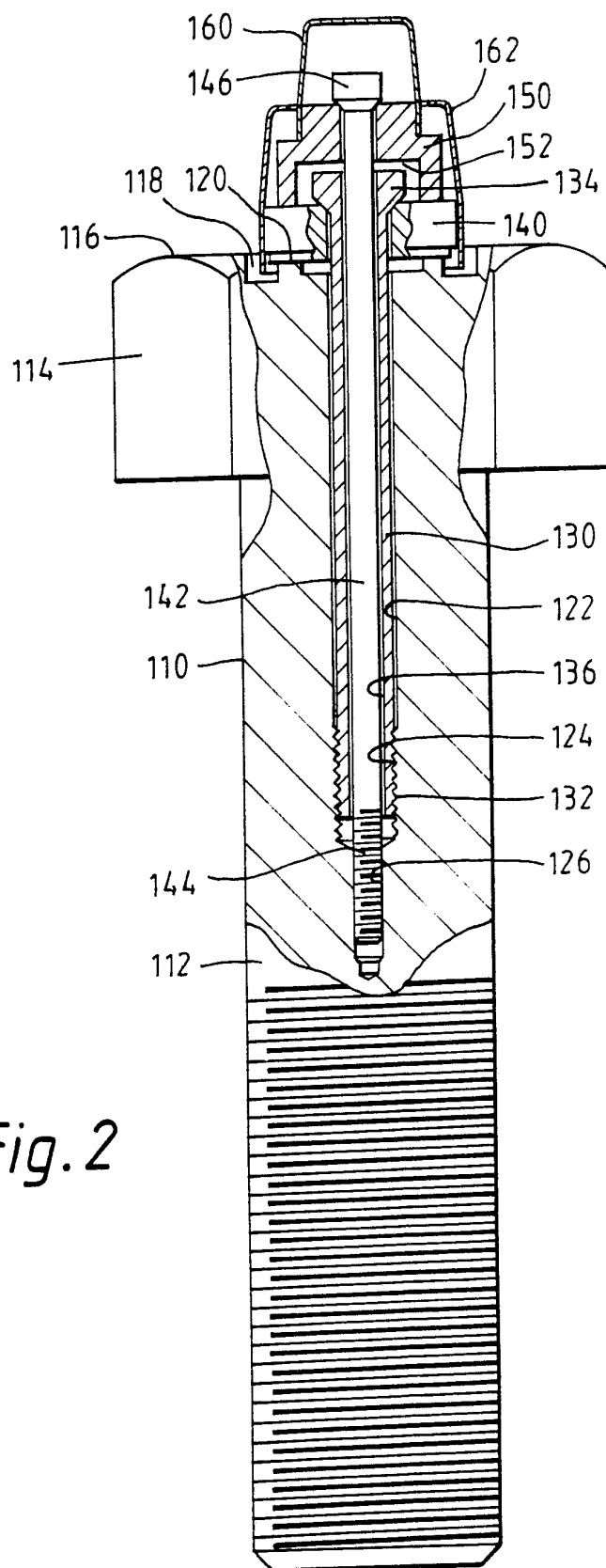
7. A fastener as claimed in Claim 4, in which the first indicating member is a disk (40) trapped between the outer end face (16) of the fastener and a head (34) on the outer end of the first gauge pin (30), and the second indicating member (50) has an inner face arranged to abut the outer face of the disk (40), with a recess (52) formed in the face of the second indicating member (50) to accommodate the head (34) of the first gauge pin.

- 10 -

8. A fastener as claimed in Claim 7, in which the second indicating member is trapped between the first indicating member (40) and an enlarged head (46) at the outer end of the second gauge pin (42)



2/2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 90/01746

| | | |
|--|--|-------------------------------------|
| I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ | | |
| According to International Patent Classification (IPC) or to both National Classification and IPC | | |
| IPC ⁵ : F 16 B 31/02, G 01 L 5/24 | | |
| II. FIELDS SEARCHED | | |
| Minimum Documentation Searched ⁷ | | |
| Classification System | Classification Symbols | |
| IPC ⁵ | F 16 B, G 01 L, B 25 B | |
| Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ | | |
| III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ | | |
| Category ¹⁰ | Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹² | Relevant to Claim No. ¹³ |
| A | US, A, 4636120 (BRANDSBERG et al.) 13 January 1987 see column 3, line 4 - column 4, line 29; figures 1,2 --- | 1,4 |
| A | US, A, 3943819 (CHARRON) 16 March 1976 see column 1, line 67 - column 2, line 34; claims 1; figure 1 --- | 1 |
| A | EP, A, 0049537 (ROTABOLT LIMITED) 14 April 1982 cited in the application ----- | |
| <p>* Special categories of cited documents: ¹⁰</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</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>"Z" document member of the same patent family</p> | | |
| IV. CERTIFICATION | | |
| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report | |
| 5th February 1991 | - 1. 02. 91 | |
| International Searching Authority | Signature of Authorized Officer | |
| EUROPEAN PATENT OFFICE | M. Perz | |

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

GB 9001746

SA 41743

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 15/02/91
The European 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 | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| US-A- 4636120 | 13-01-87 | None | |
| US-A- 3943819 | 16-03-76 | None | |
| EP-A- 0049537 | 14-04-82 | AU-B- 556066 | 23-10-86 |
| | | AU-A- 9080882 | 31-05-84 |
| | | JP-A,B,C57090414 | 05-06-82 |
| | | NL-A- 8204506 | 18-06-84 |
| | | US-A- 4525114 | 25-06-85 |