

**Australia**

Patents Act 1990

**NOTICE OF ENTITLEMENT**

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being authorised by the Applicant(s)/Nominated Person(s) in respect of an application entitled:

**LOAD INDICATING**

state the following:-

1. The Applicant(s)/Nominated Person(s) has/have, for the following reasons, gained entitlement from the actual inventor(s):-  
The Applicant/Nominated Person(s), by virtue of a Contract between the actual inventor(s) as employee(s) and the Applicant/Nominated Person(s) as employer(s), is/are a person(s) who would be entitled to have the patent assigned to it/them if a patent were granted on an application made by the actual inventor(s).

2a.\* The Applicant(s)/Nominated Person(s) is/are the applicant(s) of the of the basic application(s) listed \*on the Patent Request/ \*in the Declaration under Article 8 of the PCT.

2b.\* ~~The Applicant(s)/Nominated Person(s) is/are entitled to rely on the basic application(s) listed \*on the Patent Request/ \*in the Declaration under Article 8 of the PCT as follows:~~

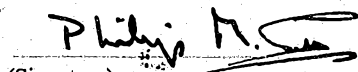
3.\* The basic application(s) listed \*on the Patent Request/ \*in the Declaration under Article 8 of the PCT is/are the application(s) first made in a Convention Country in respect of the invention.

4a.\* ~~The Applicant(s)/Nominated Person(s) is/are the depositor(s) of the deposit(s) listed in the Schedule hereto~~

4b.\* ~~The Applicant(s)/Nominated Person(s) has/have the consent of~~ x of x

~~the depositor(s) of the deposit(s) listed in the Schedule hereto, to rely on that/those deposit(s).~~

DATED this 15<sup>th</sup> day of June 1993

  
(Signature)  
Philip M Scott, Managing Director  
(Name & Title)

\* Delete if not applicable.



AU9211599

**(12) PATENT ABRIDGMENT (11) Document No. AU-B-11599/92**  
**(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 654841**

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**LOAD INDICATING**
- International Patent Classification(s)  
(51)<sup>5</sup> **F16B 031/02 G01L 005/24**
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- (87) PCT Publication Number : **WO92/13203**
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- (31) Number (32) Date (33) Country  
**9100890 16.01.91 GB UNITED KINGDOM**
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- (71) Applicant(s)  
**ROTABOLT LIMITED**
- (72) Inventor(s)  
**PHILIP MICHAEL SCOTT**
- (74) Attorney or Agent  
**SPRUSON & FERGUSON , GPO Box 3898, SYDNEY NSW 2001**
- (57) Claim

1. A device comprising a hollow member and first and second electrically conductive elements which are anchored to or fixed with respect to respective portions of the hollow member, which portions undergo relative movement when the hollow member is stressed, wherein:

when the hollow member is subjected to a first load, the elements are in mutual electrical contact at a position inside the hollow member and, when the hollow member is subjected to a second load, the elements are out of mutual electrically conductive contact; and

there is provided an inductor connected electrically between said elements so that a closed electrical circuit including the inductor exists when the elements are in mutual contact;

whereby a test apparatus capable of inductive coupling with the inductor can be used to provide an indication of whether the elements are in electrical contact.

OPI DATE 27/08/92 APPLN. ID 11599 / 92

AOJP DATE 01/10/92 PCT NUMBER PCT/GB92/00072



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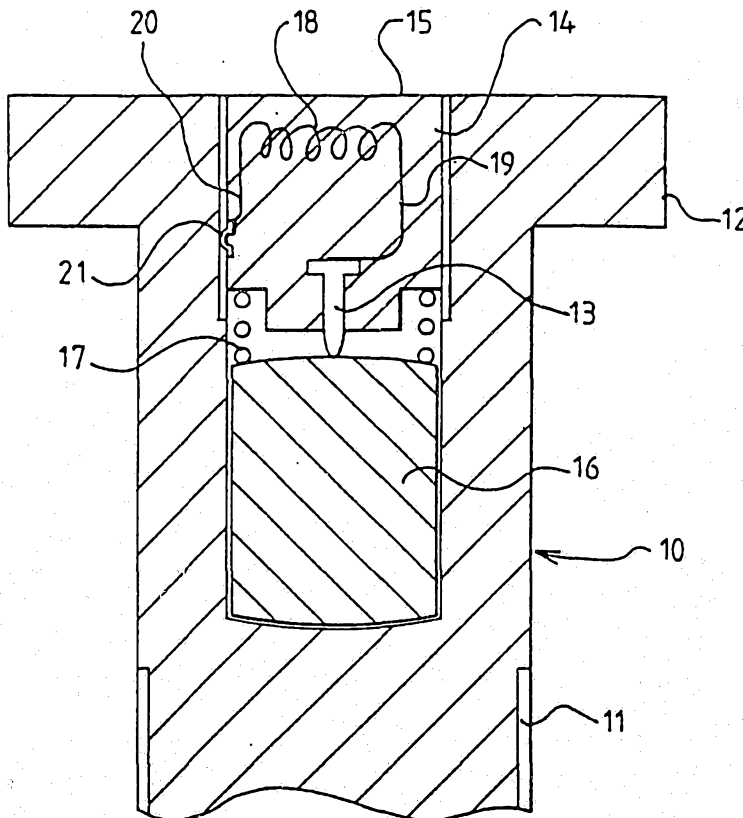
ON TREATY (PCT)

<p>(51) International Patent Classification <sup>5</sup> : F16B 31/02, G01L 5/24</p>	<p>A1</p>	<p>(11) International Publication Number: <b>WO 92/13203</b> (43) International Publication Date: 6 August 1992 (06.08.92)</p>
<p>(21) International Application Number: PCT/GB92/00072 (22) International Filing Date: 14 January 1992 (14.01.92) (30) Priority data: 9100890.4 16 January 1991 (16.01.91) GB (71) Applicant (for all designated States except US): ROTABOLT LIMITED [GB/GB]; Peartree Business Park, Peartree Lane, Dudley, West Midlands DY2 0UW (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : SCOTT, Philip, Michael [GB/GB]; Peartree Business Park, Peartree Lane, Dudley, West Midlands DY2 0UW (GB). (74) Agent: BROWN, David, Alan; Mathys &amp; Squire, 10 Fleet Street, London EC4Y 1AY (GB).</p>	<p>(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), NO, SE (European patent), US.</p> <p>Published With international search report.</p> <p style="font-size: 2em; text-align: center;">654841</p>	

(54) Title: LOAD INDICATING

(57) Abstract

A hollow bolt (10) contains first and second electrical contact elements (13, 16) which are moved apart when the bolt is subjected to a predetermined tensile load. A carrier (14) for a first of the contact elements contains an inductor (18) connected electrically between the contact elements, the condition of the contact elements is ascertained by inductive coupling of test apparatus with the inductor.



LOAD INDICATING

The present invention relates to the indication of a load to which a member is subjected. The invention has been devised primarily for use in fasteners or other members which are to be subjected to a predetermined load and the invention is useful during initial loading of the member and subsequently for checking that the required load has been maintained.

In GB 2212284A, there is disclosed a hollow bolt containing first and second carriers, each carrying a respective electrically conductive element. When the bolt is subjected to a first load, these elements are in mutual contact. When the bolt is subjected to a second load, the conductive elements are out of mutual contact. This change in the condition of the device is detected electrically. To facilitate this, the first electrical contact extends through the first carrier to a face thereof exposed at an end of the bolt. The second carrier provides an electrically conductive path between the second element and the bolt. To ascertain whether the elements are in mutual contact, electrically conductive probes are applied to an end of the bolt and an exposed end of the first element, these probes being connected in an electrical circuit which includes a source of electrical power and a lamp or other signalling device.

It is an object of the invention to provide a more reliable indication of load than can be achieved by the known arrangement under certain conditions.

According to the present invention, there is provided a device comprising a hollow member, an inductor and first and second electrically conductive elements which are anchored to or fixed with respect to respective portions of the <sup>hollow</sup> member, which portions undergo relative movement when the member is stressed, wherein, when the member is

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subjected to a first load, the elements are in mutual electrical contact at a position inside the hollow member and, when the hollow member is subjected to a second load, the elements are out of mutual electrically conductive contact; and

there is provided an inductor connected electrically between said elements so that a  
5 closed electrical circuit including the inductor exists when the elements are in mutual contact;

whereby a test apparatus capable of inductive coupling with the inductor can be used to provide an indication of whether the elements are in electrical contact.

The presence or absence of the closed circuit can be checked, using inductive  
10 coupling between testing apparatus and the inductor of the device embodying the invention. It is therefore unnecessary to establish an electrically conductive relation between test apparatus and the device.

An example of a fastener embodying the present invention will now be described, with reference to the accompanying drawing, which shows the fastener partly in cross  
15 section.

The particular fastener illustrated in the accompanying drawing is a bolt 10 having a male screw thread 11 and a head 12. The bolt is hollow. In the particular example illustrated, a blind bore extends into the bolt from an end face thereof presented by the head 12. The bore is preferably coaxial with the thread 11 and extends substantially  
20 beyond the head 12.

There is disposed inside the bolt a first electrically conductive element 13 carried by a carrier 14. The carrier also is disposed at least partly inside the bolt. However, at least one face 15 of the carrier is exposed at the outside of the bolt. The carrier 14 is fixed with respect to the bolt 10. In the example illustrated, the carrier and the bolt have  
25 respective cooperating screw threads and the carrier is restrained against turning relative to the bolt, for example by means of an adhesive on the threads. Also in the example illustrated, the electrically conductive element 13 is fixed with respect to the carrier 14.

A second electrically conductive element 16 is also disposed inside the bolt. This element occupies an inner portion of the bore formed in the bolt and is urged by a spring  
30 17 onto a seat at the blind end of the bore. The spring 17 acts between the element 16 and the



carrier 14. The element 16 is resiliently compressible and may comprise a plastics composition loaded with an electrically conductive material. The bolt 10 is formed of an electrically conductive material and the element 16 is in electrically conductive relation with the bolt.

The carrier 14 is formed of an electrically insulating material, conveniently a plastics material. There is encapsulated in the carrier an inductor 18. The inductor is connected electrically between the element 13 and the element 16. In the example illustrated, the inductor is a coil having one end connected by a lead 19 with the element 13 and an opposite end of the coil is connected by a lead 20 with a metal sleeve 21 on the outside of the carrier 14. A part of the screw thread of the carrier may be formed on this sleeve. The sleeve is in electrical contact with the bolt 10, which provides an electrically conductive path to the element 16.

The device is prepared for use by placing the element 16 in the bore of the bolt, then placing the spring 17 in the bore and then screwing the carrier 14 into the bore until the element 13 just contacts the element 16. This condition may be detected electrically. The carrier is then screwed a further, predetermined distance into the bore. This further movement of the carrier and element 13 is accommodated by compression of the element 16. The carrier is then fixed in the position to which it has been set. This may be achieved by curing of an adhesive on the internal thread of the bolt. Other ways of fixing the carrier 14 with respect to the bolt may be employed. For example, the carrier may be a force-fit inside the bolt.

When the bolt is in use and is subjected to tension, the shank of the bolt stretches and the carrier 14 moves away from the seat at the blind end of the bore. When the bolt has been subjected to the required load, the element 14 moves out of electrical contact with the element 16. This is detected electrically.

For detecting whether the elements 13 and 16 are in electrical contact with each other, there is used a test apparatus (not shown) which

is capable of inductive coupling with the inductor 18 of the circuit in the bolt. The test apparatus may be arranged to provide an indication of whether there is a closed circuit containing the inductor 18 in the bolt. Additionally, the test apparatus may be arranged to provide an indication which varies in a manner dependent upon the capacitance between  
5 the elements 13 and 16. It will be appreciated that this capacitance will change as the separation between these elements changes.

The bolt 10 may be used in place of bolts disclosed in GB2212284A. Furthermore, the device illustrated in the accompanying drawing may be modified by the incorporation of features disclosed in the aforesaid specification. For example, there may be substituted  
10 for the element 16 a second carrier carrying an electrically conductive element and containing a spring which acts between the second carrier and the second conductive element. The device may be modified so that the electrically conductive elements are out of electrical contact when the bolt is unstressed and are moved into electrical contact when the bolt is subject to the required load.

15 The inductor 18 lies close to the face 15 of the carrier 14 so that an inductor of test apparatus can be brought into close proximity with the inductor 18.

The carrier 14 preferably closes the bore of the bolt to prevent ingress of moisture and of air.



**The claims defining the invention are as follows:-**

1. A device comprising a hollow member and first and second electrically conductive elements which are anchored to or fixed with respect to respective portions of the hollow member, which portions undergo relative movement when the hollow member  
5 is stressed, wherein:

when the hollow member is subjected to a first load, the elements are in mutual electrical contact at a position inside the hollow member and, when the hollow member is subjected to a second load, the elements are out of mutual electrically conductive contact;  
and

10 there is provided an inductor connected electrically between said elements so that a closed electrical circuit including the inductor exists when the elements are in mutual contact;

whereby a test apparatus capable of inductive coupling with the inductor can be used to provide an indication of whether the elements are in electrical contact.

15 2. A device according to claim 1 further comprising a carrier for the inductor, which carrier lies at least partly inside the hollow member.

3. A device according to claim 2 wherein the carrier also carries the first electrically conductive element.

4. A device according to claim 2 or claim 3 wherein the inductor is inside the  
20 carrier and is adjacent to an exterior surface thereof which is exposed outside the hollow member.

5. A device according to any one of claims 1 to 4, wherein said first load is greater than said second load.

6. A device according to any one of claims 1 to 4, wherein said second load is  
25 greater than said first load.

7. A device substantially as hereinbefore described with reference to the accompanying drawings.

**Dated 12 September, 1994**

**Rotabolt Limited**

**Patent Attorneys for the Applicant/Nominated Person**

**SPRUSON & FERGUSON**



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11599/92

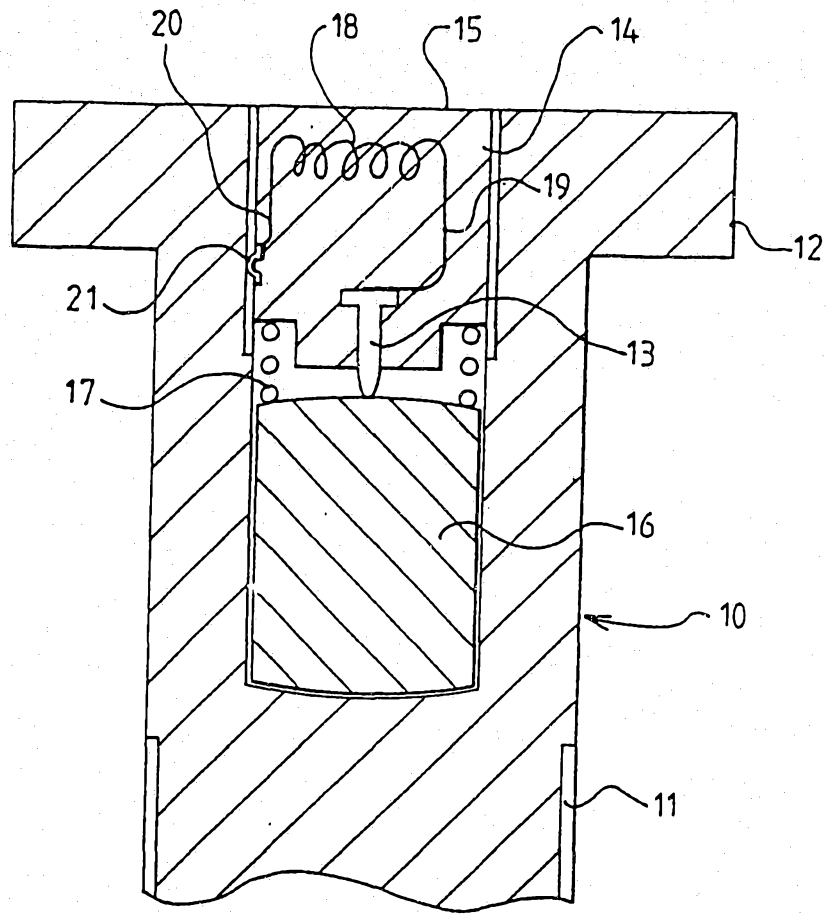


FIG 1

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 92/00072

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC <sup>S</sup> : F 16 B 31/02, G 01 L 5/24		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched †		
Classification System	Classification Symbols	
IPC <sup>S</sup>	F 16 B 31/00, G 01 B 7/00, G 01 L 3/00, G 01 L 5/00	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched *		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT ‡</b>		
Category *	Citation of Document, †† with indication, where appropriate, of the relevant passages ‡‡	Relevant to Claim, No. ‡‡
A	US, A, 4 295 377 (COUCHMAN) 20 October 1981 (20.10.81), see totality. ---	1, 2
A	GB, A, 2 212 284 (BRIAN WALTON) 19 July 1989 (19.07.89), see abstract (cited in the application). ---	1, 2, 3
A	GB, A, 2 000 843 (THE SOLON MANUFACTURING COMPANY) 17 January 1979 (17.01.79), see fig. 15. ----	1
<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</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>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
12 March 1992	- 3. 04. 92	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	Maria Peis <i>Maria Peis</i>	

**ANHANG**

zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentedokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

**ANNEX**

to the International Search Report to the International Patent Application No.

PCT/GB 92/00072 SAE 55377

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

**ANNEXE**

au rapport de recherche international relatif à la demande de brevet international n°

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visé ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office.

Im Recherchenbericht angeführtes Patentedokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
US A 4295377	20-10-81	keine - none - rien	
GB A 2212284		GB A0 8726339 GB A0 8801889 GB A1 2212284 GB B2 2212284	16-12-87 24-02-88 19-07-89 15-01-92
GB A 2000843		CA A1 1093904 DE A1 2829533 FR A1 2396966 GB A1 2000843 GB B2 2000843 JP A2 54019782 US A 4131050	20-01-81 25-01-79 02-02-79 17-01-79 24-03-82 14-02-79 26-12-78