



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 972 936 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
**19.07.2000 Bulletin 2000/29**

(51) Int Cl.7: **F04B 1/04**, F02M 59/10,  
F04B 9/04

(43) Date of publication A2:  
**19.01.2000 Bulletin 2000/03**

(21) Application number: **99305492.3**

(22) Date of filing: **12.07.1999**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

- **Cooke, Michael Peter**  
Gillingham, Kent ME7 1DR (GB)
- **Thornthwaite, Ian Roy**  
Gillingham, Kent ME7 3PJ (GB)
- **Collingborn, Peter Alban**  
Gillingham, Kent ME8 8RX (GB)

(30) Priority: **14.07.1998 GB 9815272**

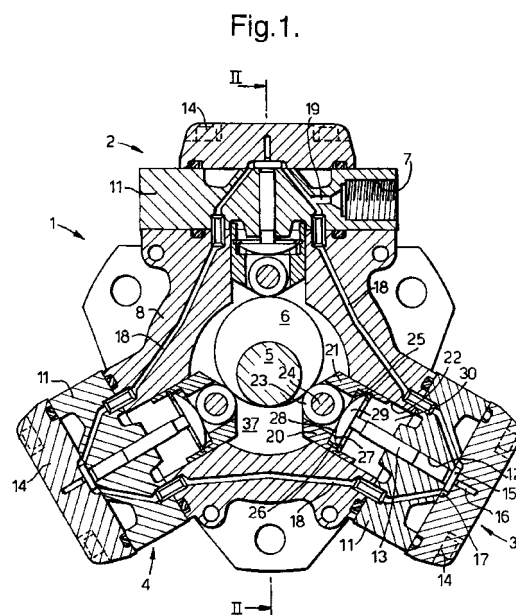
(71) Applicant: **Lucas Industries Limited**  
**London W1Y 4DJ (GB)**

(74) Representative: **Goodenough, Nigel et al**  
**A.A. Thornton & Co.**  
**235 High Holborn**  
**London WC1V 7LE (GB)**

(72) Inventors:  
• **Parker, Stephen Michael**  
**Redhill, Surrey RH1 5TW (GB)**

(54) **Positive displacement pumps**

(57) A high pressure positive displacement pump, for example suitable for delivering fuel to a fuel injection system comprises one or more pumping assemblies (2,3,4). Each pumping assembly comprises a cylinder block (11) which defines a pumping cylinder (12) in which a pumping plunger (13) is slidably mounted. Each pumping plunger is connected to a tappet assembly (20) which comprises a tappet shell (21) slidably mounted in a bore (22). In use, the tappet assemblies engage a cam (6) to drive the pumping plungers in the pumping direction. A working fluid chamber (30) is defined on the side of each tappet assembly (20) opposite to the cam (6). In use, pressurised working fluid is delivered to the working fluid chamber (30) to drive the tappet and pumping plunger in the return direction. The arrangement obviates the need to provide a return spring for the pumping plungers.



EP 0 972 936 A3



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 5492

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                           |                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Category                                                                                                                                                                                                                                                      | Citation of document with indication, where appropriate, of relevant passages                                                                 | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
| X                                                                                                                                                                                                                                                             | US 4 687 426 A (YOSHIMURA HIROICHI)<br>18 August 1987 (1987-08-18)                                                                            | 1-3,5,7,<br>10,11                                                                                                                                                                                                                                                            | F04B1/04<br>F02M59/10<br>F04B9/04            |
| Y                                                                                                                                                                                                                                                             | * abstract *<br>* column 6, line 29 - column 7, line 37 *<br>* column 8, line 14 - column 9, line 38 *<br>* figures 4,5 *                     | 4,6                                                                                                                                                                                                                                                                          |                                              |
| Y                                                                                                                                                                                                                                                             | GB 533 961 A (ROWLEDGE ARTHUR JOHN)<br>25 February 1941 (1941-02-25)                                                                          | 4,6                                                                                                                                                                                                                                                                          |                                              |
| A                                                                                                                                                                                                                                                             | * page 2, line 11 - page 3, line 60 *<br><br>* figure 1 *                                                                                     | 1-3,5,7,<br>10,11                                                                                                                                                                                                                                                            |                                              |
| A                                                                                                                                                                                                                                                             | US 2 702 008 A (STOCKARD JOHN M)<br>15 February 1955 (1955-02-15)<br>* column 1, line 39 - column 2, line 74 *<br>* figures 1-3 *             | 1,2,10                                                                                                                                                                                                                                                                       |                                              |
| A                                                                                                                                                                                                                                                             | DE 195 31 873 C (DAIMLER BENZ AG)<br>7 November 1996 (1996-11-07)<br>* abstract *<br>* column 1, line 48 - column 2, line 36 *<br>* figures * | 1-5                                                                                                                                                                                                                                                                          |                                              |
| P,A                                                                                                                                                                                                                                                           | EP 0 856 661 A (LUCAS IND PLC)<br>5 August 1998 (1998-08-05)<br>* abstract *<br>* column 4, line 43 - line 53 *<br>* figures 1,3 *            | 8                                                                                                                                                                                                                                                                            |                                              |
| The present search report has been drawn up for all claims                                                                                                                                                                                                    |                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                              |
| Place of search<br><b>THE HAGUE</b>                                                                                                                                                                                                                           |                                                                                                                                               | Date of completion of the search<br><b>29 May 2000</b>                                                                                                                                                                                                                       | Examiner<br><b>Kolby, L</b>                  |
| <b>CATEGORY OF CITED DOCUMENTS</b><br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                               | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                              |

EPO FORM 1503 03.82 [F04C01]

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

EP 99 30 5492

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  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-05-2000

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 4687426 A                              | 18-08-1987          | JP 61040467 A              | 26-02-1986          |
|                                           |                     | JP 61049177 A              | 11-03-1986          |
|                                           |                     | JP 61049181 A              | 11-03-1986          |
|                                           |                     | CA 1254443 A               | 23-05-1989          |
|                                           |                     | EP 0172421 A               | 26-02-1986          |
| GB 533961 A                               |                     | NONE                       |                     |
| US 2702008 A                              | 15-02-1955          | NONE                       |                     |
| DE 19531873 C                             | 07-11-1996          | FR 2738296 A               | 07-03-1997          |
|                                           |                     | GB 2304830 A,B             | 26-03-1997          |
|                                           |                     | IT RM960541 A              | 29-01-1998          |
| EP 0856661 A                              | 05-08-1998          | JP 10213049 A              | 11-08-1998          |
|                                           |                     | US 5884608 A               | 23-03-1999          |