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• **Milroy, William John**
Cheltenham, Gloucestershire, GL51 5XJ (GB)

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(74) Representative: **Gibson, Stewart Harry**
URQUHART-DYKES & LORD,
Three Trinity Court,
21-27 Newport Road
Cardiff CF2 1AA (GB)

(71) Applicant: **LUCAS INDUSTRIES PUBLIC LIMITED**
COMPANY
Solihull, West Midlands B91 3TX (GB)

(72) Inventors:
• **Hall, Dean Andrew**
Wendover, Buckinghamshire, HO22 6JU, (GB)

(54) **Diesel engine fuel pump**

(57) A fuel pump for a diesel engine, the fuel pump comprising a tubular barrel (10) in which a plunger (12) is slidably disposed, and at least one group of ports (26)

positioned closely adjacent each other. By providing such a group of ports, rather than a single port, excessive stressing of the barrel (10) is avoided during the injection and "spill" phase of the fuel pump.

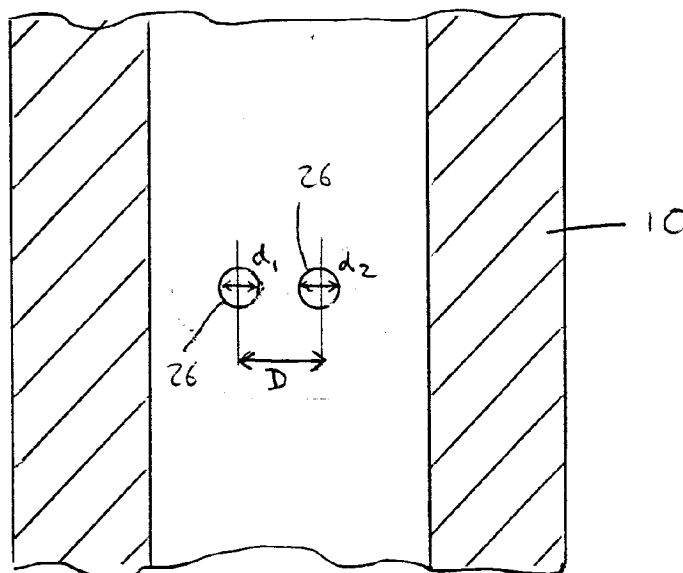


Figure 5

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Description

The present invention relates to a fuel pump for a diesel engine.

A typical fuel pump for diesel engines comprises a barrel in which a plunger reciprocates, the barrel having one or more inlet ports for supplying fuel into the inner pumping chamber of the barrel when the plunger is retracted. In performing its injection stroke, the plunger pumps the fuel out of the inner chamber and through an outlet passage, which may be formed in the opposite end of the barrel. The barrel often also includes a separate "spill" port, out of which the fuel within the inner pumping chamber flows when the plunger reaches a predetermined position during its injection stroke: the plunger may be formed with a helical groove through which the fuel passes to the spill port, and the rotary position of the plunger around its axis can be adjusted to determine the longitudinal position at which the helical groove communicates with the spill port, and hence the amount of fuel which is injected into the engine by the pump. The inlet port may however serve as both inlet and spill port: two diametrically opposite ports may be provided, each acting as both an inlet and spill port.

Because of the very high pressures which are developed within the inner pumping chamber of the above fuel pump during the injection stroke and particularly the very high pressure pulse which accordingly occurs at the spill phase, we have found that excessive stress can arise in the wall of the barrel, diametrically across the spill port or ports, causing the barrel to fatigue and eventually fracture.

We have now devised a diesel engine fuel pump, in which the above-described problem is alleviated.

In accordance with the present invention, there is provided a fuel pump for a diesel engine, said fuel pump comprising a tubular barrel in which a plunger is slidably disposed, and at least one group of ports formed through the side wall of said barrel, the ports of the or each said group being positioned closely adjacent each other.

The group of ports may comprise two or more ports positioned closely adjacent each other, the distance between the centres of each adjacent pair of ports being small compared with the internal diameter of the barrel. Preferably the or each adjacent pair of ports are positioned so that the distance between their respective centres, at the points at which they enter the inner pumping chamber, is less than or equal to twice the sum of their respective diameters.

More preferably, the or each adjacent pair of ports are positioned so that the distance between their respective centres, at the point at which they enter the barrel, is less than the sum of their respective diameters.

We have found that by replacing one port by a group of smaller ports which are close together, the associated stresses occurring in the injection and spill phases become distributed, rather than concentrated in one plane,

and the risk of the barrel fracturing is substantially reduced.

The ports of the group may be of equal diameters, or may instead be of unequal diameters. The ports of the group may have their axes parallel to each other: instead, the ports of the group may have their axes inclined to each other, either radially and/or circumferentially.

The barrel of the fuel pump may be formed with two groups of ports, each group as described above, with one group positioned generally diametrically opposite the other and each group serving for the inlet and/or spill of fuel.

Any appropriate means may be provided to initiate the spill phase of the pump, i.e. such that at a predetermined point in the injection stroke of the plunger, the fuel becomes able to leave the inner chamber of the barrel through the group of ports, or through at least one of the groups of ports.

Embodiments of the present invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic longitudinal section through a prior art fuel pump for a diesel engine, the pump being shown with its plunger at the commencement of its injection stroke;

FIGURE 2 is a similar view of the fuel pump of Figure 1, shown during the injection stroke;

FIGURE 3 is a similar view of the fuel pump of Figure 1, shown during its "spill" phase;

FIGURE 4 is an end view of the inlet port of the fuel pump of Figure 1, shown from within the pumping chamber of the pump;

FIGURE 5 is a view similar to Figure 4, of a fuel pump in accordance with the present invention, provided with a pair of adjacent ports instead of the single port of the prior art pump;

FIGURE 6 is a cross-section through the fuel pump of Figure 5, showing one arrangement of the pair of ports;

FIGURE 7 is a similar cross-section through the pump of Figure 5, to show a second arrangement of the pair of ports;

FIGURE 8 is a similar cross-section to show a third arrangement of the pair of ports;

FIGURE 9 is a longitudinal section through a pump in accordance with the present invention to show a fourth arrangement of the pair of ports; and

FIGURE 10 is an end view of a pair of ports of a pump in accordance with the invention, to show a further arrangement of the ports.

Referring to Figures 1 to 3 of the drawings, there is shown a prior art fuel pump for a diesel engine, the fuel pump comprising a barrel 10 and a reciprocating plunger 12 formed with a helical groove 14 in its side. An inlet port 16 is formed through the wall of the barrel 10: Figure

1 shows the plunger 12 at the commencement of its injection stroke, fuel having filled the inner pumping chamber 20 of the barrel 10 via the inlet port 16, as indicated by the arrow A. As the injection stroke proceeds, the plunger 12 closes the inlet port 16 and pumps the fuel from within the chamber 20 and out through a passage 22 in the end of the chamber, as indicated by the arrow B in Figure 2. When the leading edge of the helical groove 14 passes the port 16, the fuel within the pumping chamber 20 is able to pass through a bore 24 in the centre of the plunger 12, to communicate with the helical groove 14 and port 16, acting now as a spill port: instead, the barrel may be formed with a separate spill port, diametrically opposite the inlet port 16, or it may be formed with a pair of diametrically opposite ports each acting as a combined inlet and spill port.

In use of the fuel pump shown in Figures 1 to 3, very high pressures (typically in excess of 2000 bar) are developed in the pumping chamber 20, such that very high stresses occur in regions diametrically across the or each port 16, these regions being indicated at S in Figure 4. These stresses can cause the barrel 10 to fracture longitudinally.

In accordance with the present invention, and as shown in Figure 5, the or each port 16 is replaced by a group of smaller-diameter ports 26, which are positioned closely adjacent each other. In the example shown in Figure 5, the group comprises two ports 26, but it may instead comprise more than two ports: the ports may be of equal diameters, as shown, or they may be of unequal diameters. Preferably the or each adjacent pair of ports 26 are positioned so that the distance D between their respective centres, at the point at which they enter the chamber 20, is less than or equal to twice the sum of their respective diameters d_1 and d_2 , i.e. $D \leq 2(d_1 + d_2)$. More preferably, the distance D between the respective centres of the or each pair of ports is less than the sum of the respective diameters, i.e. $D < (d_1 + d_2)$.

The or each adjacent pair or ports 26 may extend with their axes parallel to each other, as shown in Figure 6. Alternatively, the or each adjacent pair of ports 26 may have their axes converging towards each other, as shown in Figure 7. The group of ports 26 may extend generally radially, as shown in Figure 6, or may be offset to one side of a diametrical plane, as shown in Figure 8. The group of ports may lie in a transverse plane, to which the axis of the barrel 10 is normal, or they may be inclined to that plane, as shown in Figure 9. The points at which the ports enter the chamber 20 may lie in the same transverse plane, as shown in Figures 5 to 9, or in different transverse planes, as shown in Figure 10: the points at which the ports 26 enter the chamber 20 may be staggered both axially and circumferentially, as shown in Figure 10. It will be appreciated that other arrangements for the or each group of ports may instead be provided, and those shown in Figures 5 to 10 are given by way of examples only.

Although the above description relates to a fuel pump having a mechanically-operated control making use of a helical groove in the plunger, the invention is equally applicable to a fuel pump having electronic control, i.e. in which a valve is opened under electronic control to initiate the spill phase, instead of using a helical groove in the plunger.

10 Claims

1. A fuel pump for a diesel engine, said fuel pump comprising a tubular barrel (10) in which a plunger (12) is slidably disposed, and at least one group of ports (26) formed through the side wall of said barrel, the ports of the or each said group being positioned closely adjacent each other.
2. A fuel pump as claimed in claim 1, in which the or each adjacent pair of ports (26) are positioned so that the distance (D) between their centres, at the points at which they enter the inner chamber of the barrel, is less than or equal to twice the sum of their respective diameters (d_1 , d_2).
3. A fuel pump as claimed in claim 2, in which the or each adjacent pair of ports (26) are positioned so that the distance (D) between the centres, at the points at which they enter the inner chamber of the barrel, is less than the sum of their respective diameters (d_1 , d_2).
4. A fuel pump as claimed in any preceding claim, in which the ports of the or each said group are of equal diameters.
5. A fuel pump as claimed in any one of claims 1 to 4, in which the ports of the or each said group are of unequal diameters.
6. A fuel pump as claimed in any preceding claim, in which the ports of the or each group have their axes parallel to each other.
7. A fuel pump as claimed in any one of claims 1 to 5, in which the ports of the or each group have their axes inclined to each other, either radially and/or circumferentially.
8. A fuel pump as claimed in any preceding claim, in which said barrel (10) is formed with two said groups of ports, with one group positioned generally diametrically opposite the other and each group of ports serving for the inlet and spill of fuel.

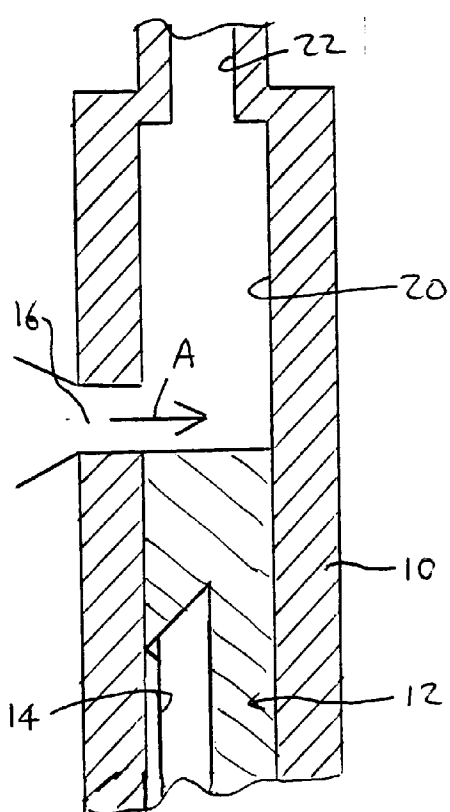


Figure 1

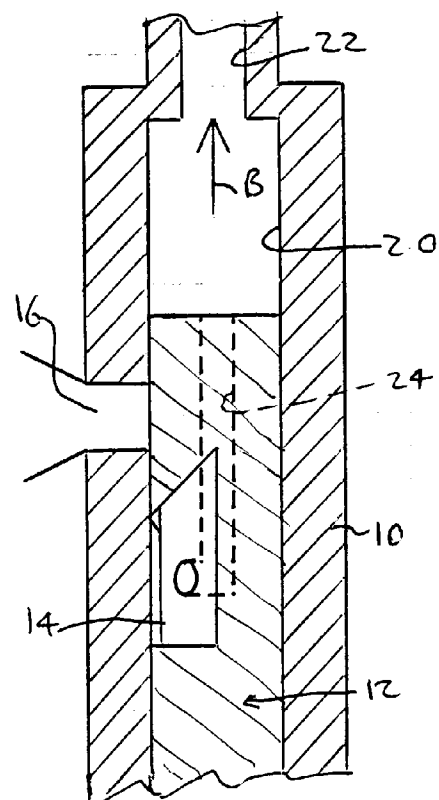


Figure 2

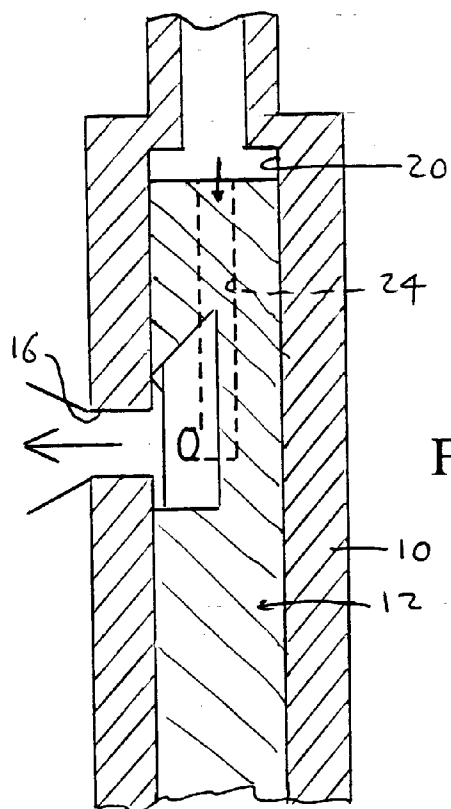


Figure 3

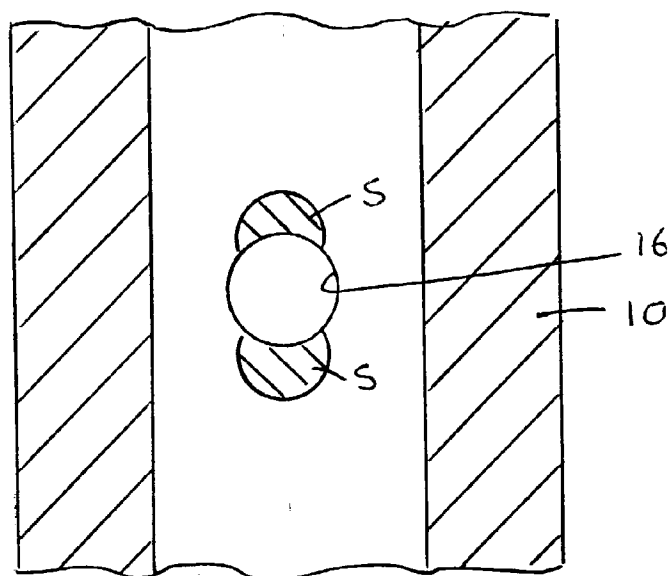


Figure 4

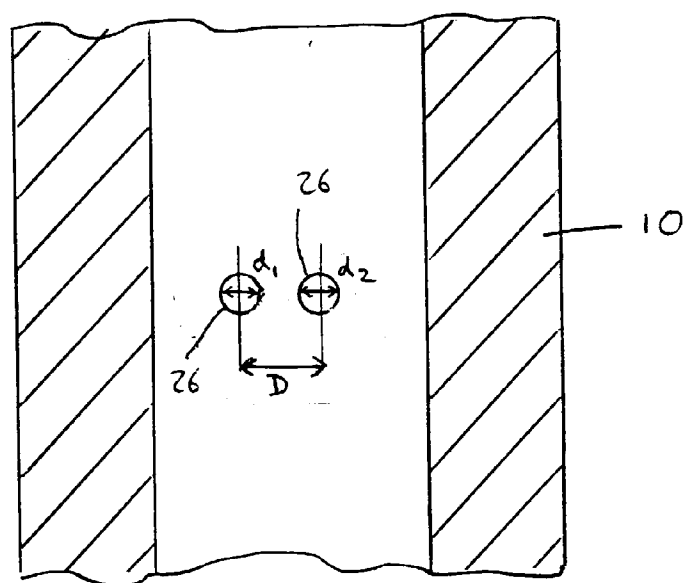


Figure 5

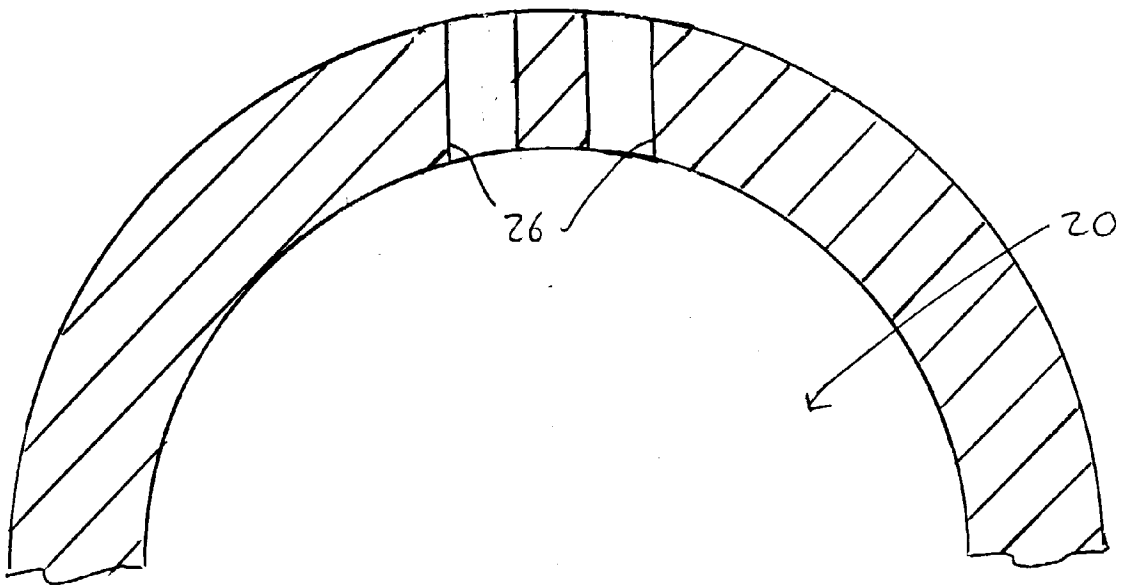


Figure 6

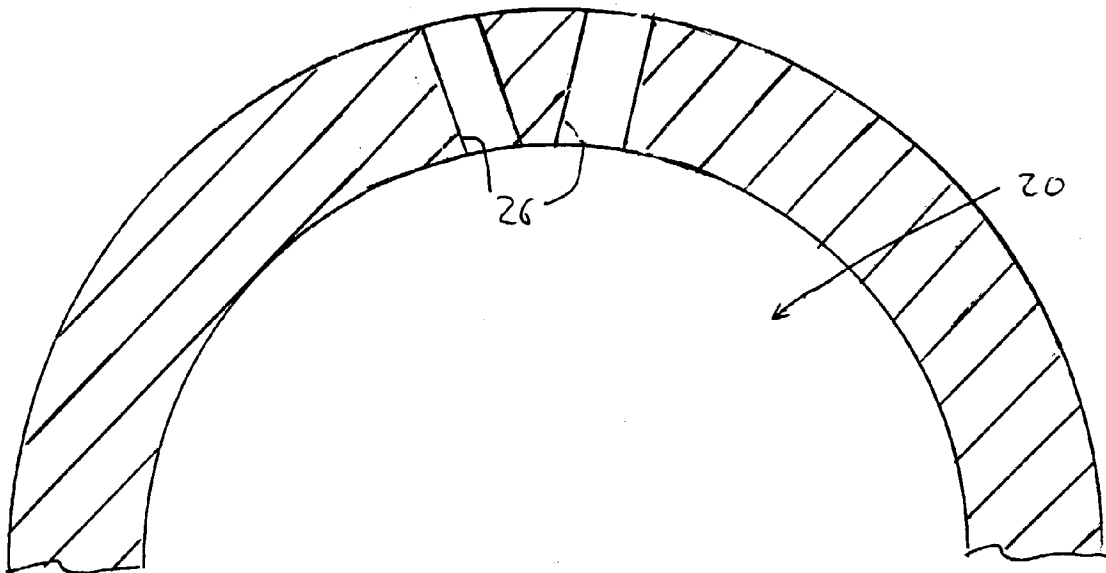


Figure 7

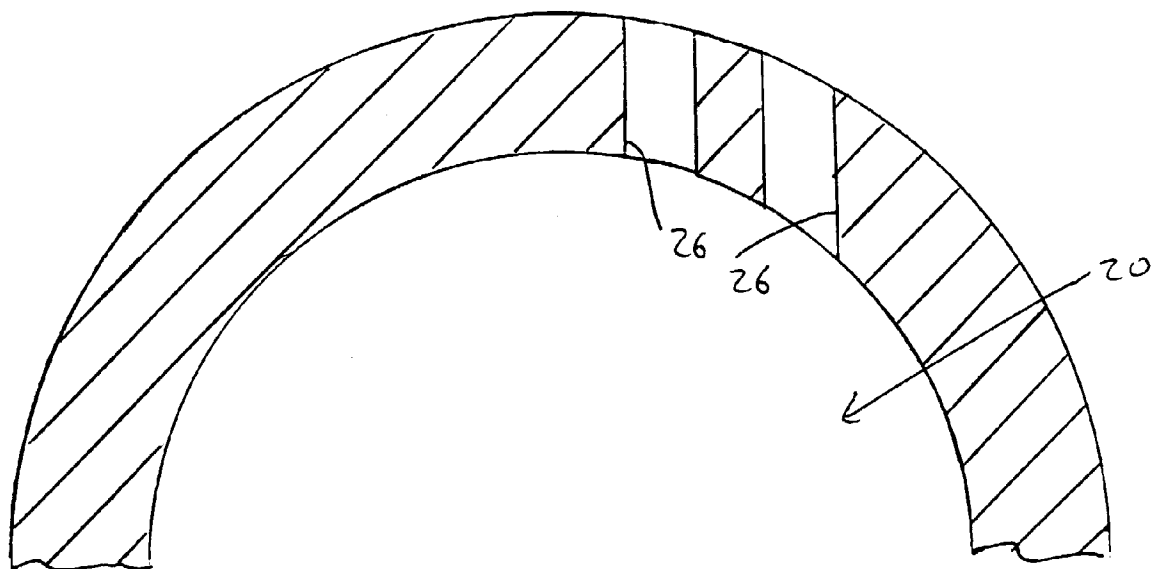


Figure 8

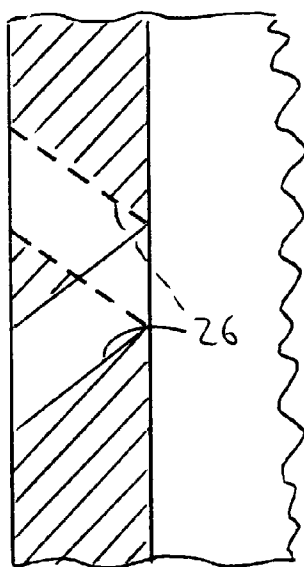


Figure 9

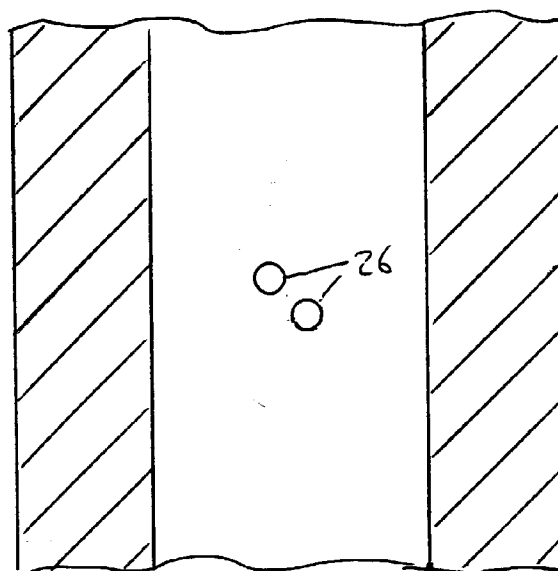


Figure 10



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 8097

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.6)
X	GB 1 413 400 A (MITSUI SHIPBUILDING ENG) 12 November 1975	1-4,6	F02M59/26
Y	* page 1, line 86 - page 2, line 33; figures 5-9 *	8	

X	GB 1 571 137 A (SEMT) 9 July 1980	1-4,6	
Y	* page 2, line 11 - page 3, line 72; figures 1,3 *	8	

X	FR 1 094 136 A (DAIMLER-BENZ AG) 13 May 1955	1-3,5	
	* page 1, paragraph 10 - page 2, paragraph 4; figure 2 *		

X	FR 1 432 975 A (SULZER) 25 March 1966	1,4,7	
	* page 2, last paragraph; figures 5,6 *		

X	EP 0 294 822 A (KLOECKNER HUMBOLDT DEUTZ AG) 14 December 1988	1-3,5,7	
	* column 6, line 16 - column 7, line 18; figures 6-9A *		

The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		17 February 1997	Hakhverdi, M
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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