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(54) machine for pumping building materials

(57) A machine (1) for pumping building materials, in particular concrete, and presenting a number of cylinders (7), which in turn present respective pistons (9) activated by a cam (14), and communicate alternately with a material loading chamber (5) and a material outlet (33) by means of a continuously-rotating dispenser (34); the cam (14) and the dispenser (34) being activated by a single motor (16) via a common shaft (15).

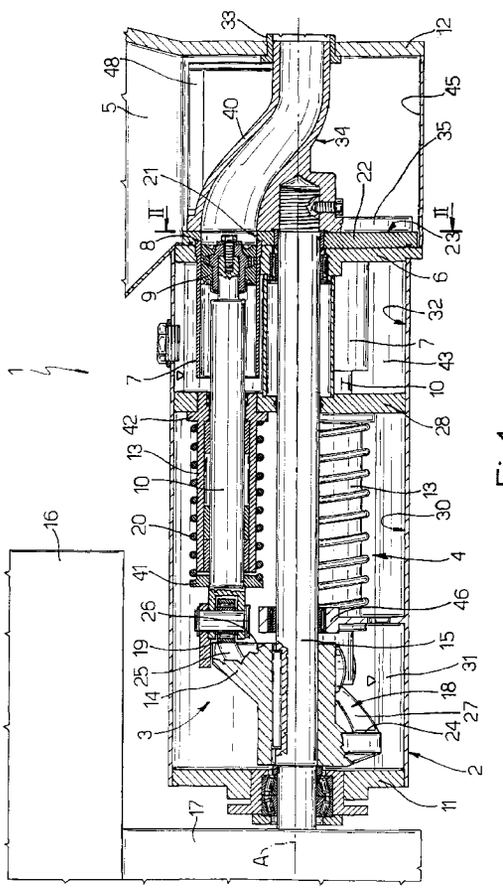

Fig.1

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Description

The present invention relates to a machine for pumping building materials, in particular course-grain materials such as concrete.

Pumping machines are known comprising a pair of cylinders with respective pistons operated by hydraulic actuators, and which communicate alternately with a chamber into which the material is loaded, and with a delivery conduit via a dispensing member.

The dispensing member is a reciprocating type, normally comprises a cone valve with the outlet connected to the delivery conduit of the machine and the inlet connected alternately to the two cylinders, and is switched cyclically by a further hydraulic actuator.

Known pumping machines of the above type present several drawbacks.

To begin with, using a reciprocating dispensing member inevitably involves a certain amount of downtime between the delivery strokes of the two cylinders, due to the time taken to switch the member from one operating position to the other. Since, for physical reasons, a limit exists to the extent to which the switching time can be reduced, the pumping rate of the machine cannot be increased over and above a given maximum value - normally around 15-18 cycles/min for each cylinder - beyond which, the downtime involved would represent too great a fraction of the cycle time, thus impairing operation of the machine.

The actuator controlling the dispensing member, and which in itself is a bulky, high-cost additional component, may either be operated by the same hydraulic circuit as the piston actuators, or present an independent circuit of its own. In the first case, the switching speed of the actuator is correlated to that of the pistons, and may therefore be unacceptably slow when only a small amount of material is required and, hence, oil supply to the piston actuators is reduced. In the second case, the latter drawback is eliminated, but, in addition to the aforementioned limit posed on the maximum pumping rate of the machine, the component cost of the independent hydraulic circuit results in an increase in the overall cost of the machine.

Finally, known machines normally feature a mixing device for preventing the material from settling inside the loading chamber, and which, by comprising a further actuator independent of those mentioned above, presents further drawbacks in terms of the overall cost and size of the machine.

It is an object of the present invention to provide a machine for pumping building materials, particularly concrete, designed to overcome the aforementioned drawbacks typically associated with known machines.

According to the present invention, there is provided a machine for pumping building materials, in particular concrete, and of the type comprising a loading chamber for the material; a number of cylinders communicating with said loading chamber and presenting parallel axes; respective pistons sliding inside said cylinders; actuating means for actuating said pistons; a material outlet connectable to a feed conduit; and dispensing means for selectively and alternately connecting said cylinders to said loading chamber and to said outlet; characterized in that said actuating means comprise rotary cam means cooperating with said pistons; a motor for activating said cam means; and transmission means interposed between said motor and said dispensing means to rotate said dispensing means continuously and in time with said cam means.

A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a longitudinal section of a concrete pumping machine in accordance with the teachings of the present invention;

Figure 2 shows a section along line II-II in Figure 1 of a detail of the machine;

Figure 3 shows a graph illustrating operation of the pistons on the Figure 1 machine.

Number 1 in Figure 1 indicates a machine for pumping course-grain materials, in particular concrete.

Machine 1 presents a structure 2 (shown only partly) defining a chamber 3 for a pumping assembly 4, and a loading chamber 5 for the material to be pumped; the two chambers are separated by a vertical intermediate wall 6, and are defined axially by respective end walls 11, 12.

Pumping assembly 4 substantially comprises three cylinders 7 with respective axes parallel to and equally spaced 120° apart about the main horizontal axis A of the assembly. Cylinders 7 are fitted in projecting manner to wall 6 inside chamber 3, and communicate with loading chamber 5 at respective front ends 8 fitted through wall 6 and housed inside respective holes 21 formed through a plate 22 fitted to wall 6 on the chamber 5 side, and the opposite face of which to wall 6 defines a flat sealing surface 23.

Each cylinder 7 houses in sliding and sealed manner a respective piston 9, which presents a rod 10 movable axially inside a guide sleeve 13 fitted in projecting manner to an intermediate transverse wall 28 in chamber 3.

According to the present invention, pistons 9 are controlled by a cam 14 fitted to a shaft 15 of axis A in turn controlled by an electric motor 16 via a reducer 17. Shaft 15 extends along the whole of chamber 3, is fitted in sealed manner through walls 11, 6 and 28, and is supported radially at walls 11 and 6 and by an intermediate support 46.

Cam 14 is located adjacent to wall 11, and presents a front annular thrust surface 18 facing pistons 9. The respective free ends of rods 10 are fitted with respective tappet rollers 19 cooperating in rolling manner with surface 18 and maintained permanently contacting surface

18 by respective coil springs 20 coaxial with respective sleeves 13 and each compressed axially between a disk 41 integral with respective rod 10, and a shoulder 42 of respective sleeve 13.

The profile of surface 18 of cam 14 comprises a zero-lift portion 24 of an angle of 75°; a linearly-increasing-lift portion 25 (with reference to a given rotation direction) of an angle of 120°; a maximum-lift portion 26 of an angle of 75°; and a linearly-decreasing-lift portion 27 of an angle of 90°. The Figure 3 graph shows the motion of pistons 9 as a function of the rotation angle and the above profile of cam 14.

Wall 28 divides chamber 3 into a first compartment 30 housing cam 14, tappet rollers 19 of rods 10, and, at the bottom, a given volume of oil 31 for lubricating the cam/tappet connections; and a second compartment 32 adjacent to wall 6 and defining an annular tank 43 coaxial with shaft 15, and which houses cylinders 7 and is filled with water with which to lubricate the cylinders.

Machine 1 comprises an outlet 33 formed through end wall 12 of loading chamber 5 and connectable to a material feed conduit (not shown); and a dispenser 34 for selectively connecting cylinders 7 to chamber 5 and outlet 33.

According to the present invention, dispenser 34 is fitted to shaft 15, is therefore rotated with shaft 15 continuously and in time with cam 14 by motor 16, and comprises a disk 35 fitted to the end portion 36 of shaft 15 projecting inside chamber 5, and which rotates in sliding contact with surface 23 of plate 22 and presents an intake port 37 and a delivery port 38. Ports 37 and 38 comprise diametrically-opposite, circumferentially-elongated openings of a width (radially) equal to the inside diameter of cylinders 7, and extending circumferentially over an an angle of 90° and 120° respectively. Disk 35 is timed angularly in relation to cam 14, and more specifically, intake port 37 is located axially facing decreasing-lift portion 27, and delivery port 38 axially facing increasing-lift portion 25 of cam 14; and ports 37 and 38 are separated by respective 75° solid portions 39 of disk 35, which cooperate in sealed manner with front ends 8 of cylinders 7.

Dispenser 34 also comprises a substantially conical tubular fitting 40 rotating integral with disk 35, and which permanently connects delivery port 38 of the disk to outlet 33, and is itself connected to outlet 33 in sealed rotary manner.

Finally, for mixing the material in chamber 5, machine 1 comprises an impeller 48 rigidly connected to and extending substantially radially from dispenser 34, and presenting a profile such as to skim the bottom surface 45 of chamber 5.

Machine 1 operates as follows.

Shaft 15 synchronously rotates cam 14 and dispenser 34.

The three pistons 9 are operated by cam 14 so that each moves back and forth inside respective cylinder 7, and all perform the same movements, but at different times separated by an interval equal to a third of the rotation time of cam 14 (Figure 3). Each piston performs a pumping cycle comprising an intake stroke and a delivery stroke separated by standby phases in which the other pistons perform the active strokes.

More specifically, at the intake stroke, cylinder 7 communicates with loading chamber 5 via port 37 of disk 35, piston 9 withdraws along cylinder 7 by cooperating with decreasing-lift portion 27 of cam 14, and cylinder 7 is filled with material drawn from chamber 5; the intake stroke is followed by a first standby phase corresponding to the zero-lift portion 24 of cam 14 and in which cylinder 7 is cut off from chamber 5 by a solid portion 39 of disk 35; at the delivery stroke, cylinder 7 is connected to outlet 33 via delivery port 38 and tubular fitting 40, and the piston advances along cylinder 7 to pump the material in cylinder 7 along the delivery conduit (not shown) to the user location; and the delivery stroke is followed by a second standby phase in which cylinder 7 is cut off from chamber 5 by the other solid portion of disk 35.

By virtue of the 120° angle of increasing-lift portion 25 of cam 14 and delivery port 38 of dispenser 34, the end of the delivery stroke of one piston is followed by the start of the delivery stroke of the next piston (Figure 3), so that a substantially continuous flow of material is supplied to the outlet.

At each turn of dispenser 34, impeller 48 skims the bottom of chamber 5 to prevent the material from settling.

The advantages of machine 1 according to the teachings of the present invention will be clear from the foregoing description.

To begin with, by virtue of dispenser 34 rotating continuously and in time with cam 14, the delivery strokes of pistons 9 succeed one another continuously, thus eliminating the downtime and all the associated drawbacks due to the switching of known reciprocating dispensers. More specifically, the pumping rate may be increased considerably, e.g. up to 60 cycles/min per cylinder, thus enabling a drastic reduction in the size of the cylinders and, hence, in the size and cost of the machine for a given performance, and may be reduced with no difficulty when only a small amount of material is required.

Moreover, controlling pistons 9, dispenser 34 and impeller 48 by means of a single actuator (motor 16) provides for eliminating the various separate actuators currently used for performing these functions, thus reducing the overall cost and simplifying the systems design of the machine.

Clearly, changes may be made to machine 1 as described and illustrated herein without, however, departing from the scope of the present invention.

For example, changes may be made to the number of cylinders and, therefore, as will be obvious to an expert, to the profile of cam 14 and the angle of ports 37, 38 of dispenser 34. Though three cylinders, as de-

scribed, provides for a sufficiently continuous outflow of material, the number of cylinders may be reduced to two, thus further reducing cost, in the event continuous flow is not particularly essential.

Moreover, springs 13 may be eliminated and a double-acting connection used between tappet rollers 19 and cam 14; and, as opposed to disk 35, dispenser 34 may present two sealing portions extending circumferentially from fitting 40 and corresponding to portions 39, in which case, port 37 will be defined by the gap between the two portions.

Claims

1. A machine (1) for pumping building materials, in particular concrete, and of the type comprising a loading chamber (5) for the material; a number of cylinders (7) communicating with said loading chamber (5) and presenting parallel axes; respective pistons (9) sliding inside said cylinders (7); actuating means (14, 16, 17) for actuating said pistons (9); a material outlet (33) connectable to a feed conduit; and dispensing means (34) for selectively and alternately connecting said cylinders (7) to said loading chamber (5) and to said outlet (33); characterized in that said actuating means comprise rotary cam means (14) cooperating with said pistons (9); a motor (16) for activating said cam means (14); and transmission means (15) interposed between said motor (16) and said dispensing means (34) to rotate said dispensing means (34) continuously and in time with said cam means (14).

2. A machine as claimed in Claim 1, characterized in that said dispensing means comprise a dispenser (34) housed in said loading chamber (5), facing said cylinders (7), and rotating about an axis (A) parallel to the axes of the cylinders (7); said dispenser (34) defining an intake port (37) and a delivery port (38) separated circumferentially from each other by a pair of sealing portions (39), and comprising a connecting element (40) connecting said delivery port (38) to said outlet (33).

3. A machine as claimed in Claim 2, characterized in that said cam means and said dispenser are coaxial; said transmission means comprising a common shaft for activating said cam means and said dispenser.

4. A machine as claimed in Claim 2 or 3, characterized in that said pistons (9) present respective tappet means (19); said cam means (14) comprising a front surface (18) cooperating with said tappet means (19).

5. A machine as claimed in Claim 4, characterized in that said front surface (18) of said cam means (14) comprises a zero-lift portion (24), an increasing-lift portion (25), a maximum-lift portion (26), and a decreasing-lift portion (27); said zero-lift and maximum-lift portions (24, 26) facing said sealing portions (39) of said dispenser (34); said increasing-lift portion (25) facing said delivery port (38); and said decreasing-lift portion (27) facing said intake port (37).

6. A machine as claimed in one of the foregoing Claims from 3 to 5, characterized by comprising mixing means (48) for mixing the material to be pumped, and which are housed inside said loading chamber (5) and connected rigidly to said dispenser (34).

7. A machine as claimed in one of the foregoing Claims, characterized by comprising a tank (43) for a lubricating fluid; said cylinders (7) extending inside said tank (43).

8. A machine as claimed in Claim 7, characterized in that said tank (43) is annular and coaxial with said shaft (15).

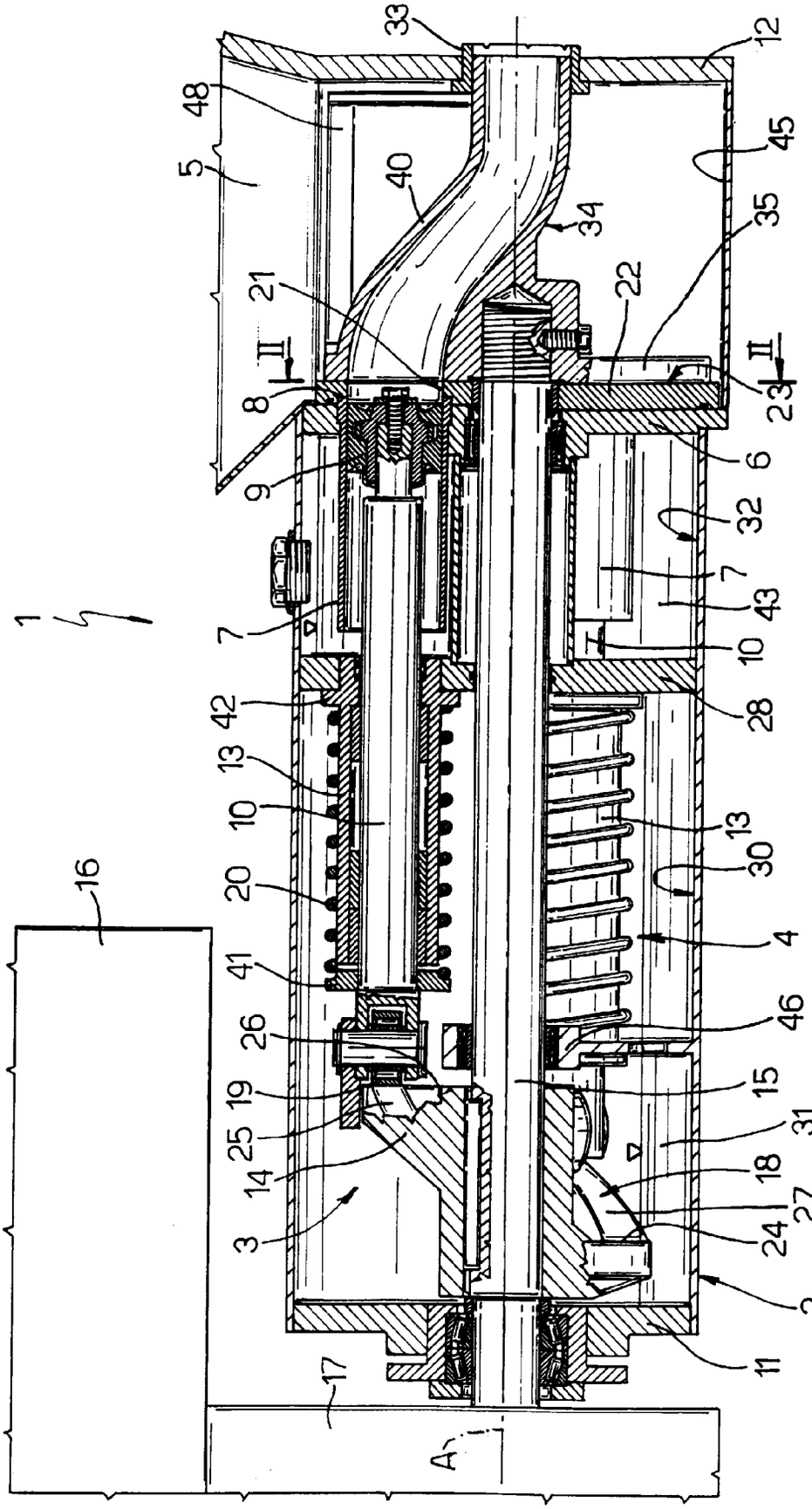
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Fig.1

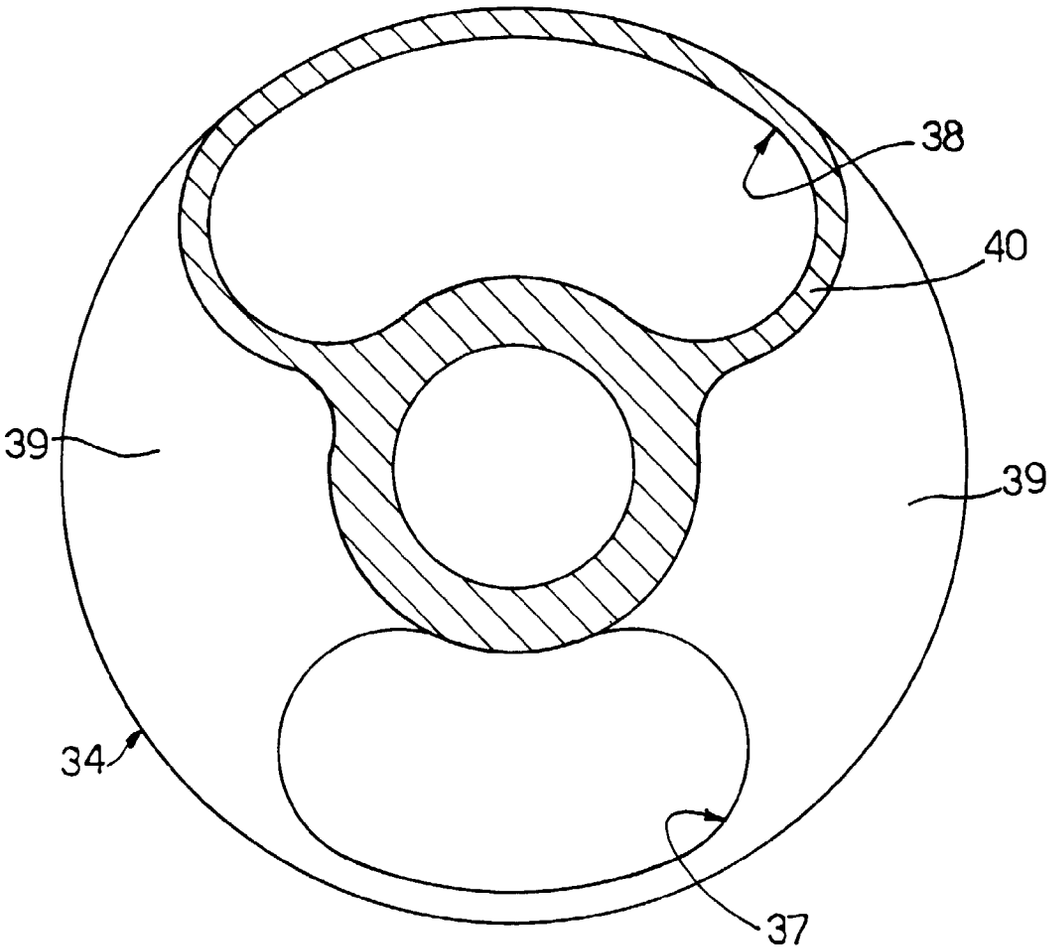

Fig. 2

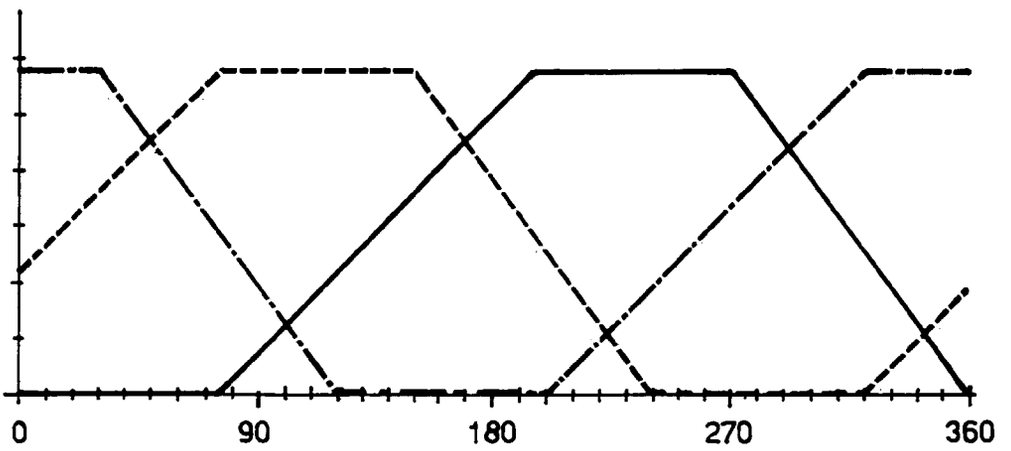

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 5974

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)
A,P	EP 0 690 229 A (SEDEPRO) 3 January 1996 * the whole document *	1-5	F04B15/02
A	DE 844 535 C (SCHLOSSHAUER) * the whole document *	1-5	
A	BE 799 752 A (EECKHAUTE LEOPOLD VAN) 17 September 1973 * the whole document *	1	
A	DE 34 09 917 A (SCHLECHT KARL) 26 September 1985 * the whole document *	1,6	
A	FR 820 189 A (LONDAIS) * page 6, line 2 - line 54 *	1,7,8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 January 1997	Von Arx, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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