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(54) Diaphragm pump with vent

(57) A diaphragm pump (10) comprises a housing (12), a diaphragm element (14) which is provided on the housing (12), and a drivetrain (16) in the housing (12) for reciprocating movement of the diaphragm element (14). The drivetrain (16) has an input drive element (42) and an output drive element (58) connected to the diaphragm element (14). The housing (12) includes a vent (62) at or adjacent to the input drive element (42) of the drivetrain (16), so that, by reciprocation of the diaphragm element (14), air is drawn through and discharged from the vent (62) and, due to the positioning of the vent (62), passed across at least a portion of the input drive element (42).

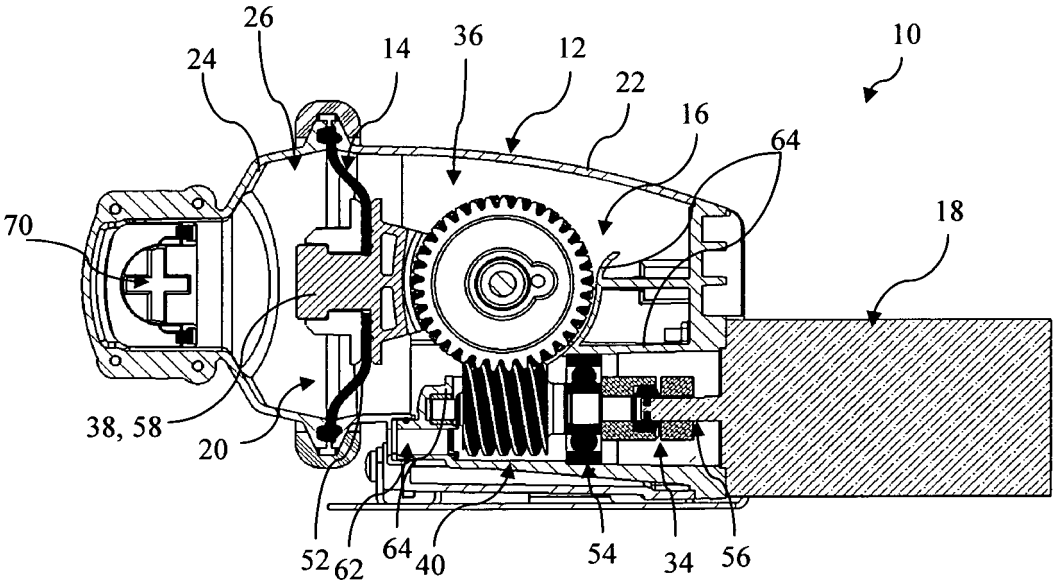

Fig. 2

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Description

[0001] The present invention relates to a diaphragm pump with a vent, particularly but not necessarily exclusively for use with a shower-tray waste-water outlet device.

[0002] It has been long established practice to utilise a diaphragm pump to aid drainage from a shower tray or wet-floor showering area. This is particularly so where a conventional gravity drainage unit cannot be used, for example, if the floor cannot be breached.

[0003] A diaphragm pump used in this environment has a specific duty cycle and operational time limitation to ensure, when operating at maximum power, for example, to move water to a maximum head, lift or distance, the pump and/or associated controller does not overheat. Thirty minutes continuous operation on a fifty percent duty cycle is not untypical.

[0004] A housing of the diaphragm pump behind the back-face of the diaphragm element is typically vented to atmosphere to ensure the cyclic variation in the air volume caused by the movement of the diaphragm element does not create resistance to the movement of the mechanism or stall the pump. This is exemplified by British patent application 9419768.8. However, the vent is solely for this purpose, and as such is located at the top or bottom of the housing, away from the electric motor and the geartrain.

[0005] It has been determined that the vent can be better positioned to serve an additional cooling function for the drivetrain, and the present invention seeks to provide this solution.

[0006] According to the present invention, there is provided a diaphragm pump comprising a housing, a diaphragm element which is provided on the housing, and a drivetrain in the housing for reciprocating movement of the diaphragm element, the drivetrain having an input drive element and an output drive element connected to the diaphragm element, the housing including a vent at or adjacent to the input drive element of the drivetrain, so that, by reciprocation of the diaphragm element, air is drawn through and discharged from the vent and, due to the positioning of the vent, passed across at least a portion of the input drive element.

[0007] Preferably, the housing defines an air flow path from the vent to the diaphragm element, the drivetrain being provided on the air flow path so that air must flow over the said portion of the input drive element.

[0008] Preferably, the drivetrain is provided on the air flow path such that the input drive element is closer to the vent than the output drive element.

[0009] The diaphragm pump may further comprise one or more baffle surfaces in the housing for directing air on the air flow path to pass over the said portion of the input drive element.

[0010] Advantageously, the said portion of the input drive element over which the air is passed may include at least one bearing. In this case, the bearing is a ball or roller bearing.

[0011] Preferably, the said portion of the input drive element over which the air is passed includes an input drive shaft. In this case, the input drive shaft may be journalled in the housing, and the vent is provided adjacent to the journal.

[0012] Preferably, an end of the input drive shaft is supported by the housing, and the vent is provided adjacent to the said end of the input drive shaft.

[0013] Optionally, the drivetrain includes a geartrain which may have an intermediate drive element between the input and output drive elements. In this case, the input drive element may be a worm, the intermediate drive element may be a worm wheel, and the output drive element may be a connecting rod.

[0014] Preferably, the vent is provided adjacent to the diaphragm element. The vent may be provided on a same side of the housing as the diaphragm element.

[0015] Preferably, the diaphragm pump further comprises an electric motor connected to the input drive element. In this case, the vent may face the electric motor. However, the vent may be adjacent to the electric motor.

[0016] According to a second aspect of the invention, there is provided a shower area having a waste water outlet device and a diaphragm pump in accordance with the first aspect of the invention connected to the waste water outlet device for pumping waste water therefrom.

[0017] The present invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which :

Figure 1 shows a perspective view of one embodiment of a diaphragm pump, in accordance with the present invention;

Figure 2 shows a cross-sectional view of the diaphragm pump, with the detail removed from the electric motor; and

Figure 3 shows an enlarged part of the diaphragm pump, with part of the housing, the diaphragm element and the motor removed.

[0018] Referring to the drawings, there is shown a diaphragm pump 10 which comprises a housing 12, a diaphragm element 14, a drivetrain 16, and an electric motor 18. The housing 12 is a multi-part moulded plastics and/or cast metal unit. The diaphragm element 14 is a flexible elastomeric moulded sheet which covers a front opening 20 to a rear part 22 of the housing 12. A front part 24 of the housing 12 forms a pumping chamber 26 and is engaged with the rear part 22 so as to fluid-tightly sandwich an entire perimeter edge of the diaphragm element 14 therebetween. One or more check valves 70 are typically provided in or adjacent to the inlet 28 and/or outlet 30 of the pumping chamber 26 to prevent reverse flow. The input 28 and/or outlet 30 of the pumping chamber 26 may optionally include push-fit pipe couplings 32

to aid installation.

[0019] The electric motor 18 is provided in a rear opening of the rear part 22 of the housing 12, and, in this embodiment, projects from the housing 12. However, the motor can be fully enclosed within the housing.

[0020] The drivetrain 16 transmits drive from the electric motor 18 to the diaphragm element 14, and includes a motor shaft coupler 34, a geartrain 36, and a diaphragm connecting rod 38. In this case, the geartrain 36 is or includes a worm 40, forming part of an input drive element 42, which meshes with a worm wheel 44, being an intermediate drive element 46.

[0021] The worm 40 includes an input drive shaft 48 with a helical thread 50. The shaft 48 is journalled at one end in the rear part 22 of the housing 12, adjacent to a rear face 52 of the diaphragm element 14 near, in this case, its bottom edge. A rotational axis of the shaft 48 extends in a direction of reciprocation of the diaphragm element 14, and the shaft 48 is further supported for rotation on the other side of the helical thread 50 by a ball or roller bearing 54, which also forms part of the input drive element 42. The other end of the shaft 48 thus projects from the ball or roller bearing 54 and is coupled with an output shaft 56 of the electric motor 18 via the coupler 34.

[0022] The worm wheel 44 is supported for rotation by the rear part 22 of the housing 12, adjacent to the rear face 52 of the diaphragm element 14. A rotational axis of the worm wheel 44 extends at right angles to the rotational axis of the worm 40. In this embodiment, the worm 40 is provided below the worm wheel 44, but it may be above. The worm may even be positioned such that its rotational axis extends perpendicularly or non-parallel to the reciprocating direction of the diaphragm element.

[0023] The connecting rod 38, being an output drive element 58, is connected at one end to the worm wheel 44, at a position which is offset from the axis of rotation, and at the other end to the diaphragm element 14, preferably at its centre. The connecting rod 38 may preferably include a bayonet fitting 60 for releasable connection with the diaphragm element 14.

[0024] To prevent possible stalling, but also importantly to aid cooling, a vent 62 is provided in the rear part 22 of the housing 12. The vent 62 is an opening to atmosphere, but its positioning is critical. The vent 62 is positioned so that an air flow path is defined in the rear part 22 of the housing 12 from the vent 62 to the rear face 52 of the diaphragm element 14. The drivetrain 16 is positioned at least in part on the air flow path so that the worm 40 is closer to the vent 62 than the worm wheel 44. One or more baffles 64, or elements which beneficially act as baffles, may also be provided in the rear part 22 of the housing 12 to aid in the direction of the flow of air, so that increased cooling across the worm 40 is realised.

[0025] In this embodiment, the vent 62 is positioned directly adjacent to, and in this case preferably below, the journaling of the end of the worm 40. Due to the helical thread 50 of the worm 40 being spaced slightly from an interior surface of the rear part 22 of the housing 12, a passage 66 is defined to the ball or roller bearing 54. As such, as the diaphragm element 14 reciprocates, air is drawn in through the vent 62, over the helical thread 50 and through the ball or roller bearing 54, before then passing up and around the worm wheel 44 and into the remaining portion of the rear part 22 of the housing 12. Once the diaphragm element 14 moves to its opposite position, the air is pushed back to and discharged from the vent 62 after passing over the worm 40 and the ball or roller bearing 54. Heat being generated by the rotation of the worm 40, the ball or roller bearing 54, and the electric motor 18 is thus effectively dissipated through convection and radiation to the passing air flow.

[0026] The vent 62 is conveniently positioned adjacent to and below the diaphragm element 14, facing the electric motor 18. However, the vent 62 could just as easily be positioned in a side of the rear part 22 of the housing 12, as long as the vent 62 is adjacent to sources of heat within the drive mechanism such as rubbing gears or bearings. Preferably, in the present embodiment, the vent 62 is closer to the worm 40 than to the worm wheel 44.

[0027] More than one vent can be provided. In this case, vents on opposite sides may be advantageous.

[0028] Although a worm gear mechanism is described above, as long as the drivetrain includes an input drive element for transmitting drive from the motive source, and an output drive element which is connected to the diaphragm element and receives the transmitted drive from the input drive element, then the drivetrain can take any suitable form. For example, the motive source may directly drive a crank wheel, being therefore the input drive element, to which a connecting rod, being the output drive element, is connected. In this case, the vent is positioned to cool one or both bearings of the crank wheel. As such, there may be no geartrain, and this element is thus optional.

[0029] Instead of the geartrain being a worm gear mechanism, a spiroid or bevel reduction gear mechanism or any other suitable gear arrangement may be utilised.

[0030] The diaphragm pump may be supplied without the electric motor, thereby allowing a customer to select their own suitable power source, for example, pneumatic, hydraulic or electric, for the intended purpose.

[0031] The entire drivetrain need not be provided on the air flow path, and only a portion of the drivetrain which requires heat dissipation need be provided on the air flow path. Typically therefore, the portion of the drivetrain which does require cooling is therefore interposed between the diaphragm element and the vent so that cooling air must pass thereover or thereacross. Baffle elements or surfaces may be conveniently used, either integrally formed as part of the housing or provided separately, to direct cooling air from the vent to the part requiring heat dissipation and back to the vent.

[0032] Of course, the entire drivetrain may be provided on the air flow path and thus between the diaphragm

element and the vent, as necessity dictates.

[0033] The air flow on the air flow path is preferably through or immediately adjacent to one or more bearings, since these are the elements that generally generate excessive heat. The bearing may preferably be a plain bearing, ball or roller bearing, or any other type of bearing.

[0034] There is thus provided a diaphragm pump with a vent which not only acts to equalize pressure in the rear of the housing, but also dissipates heat in or at the input drive element of the drivetrain. This particular diaphragm pump is particularly beneficial for connection to a waste water outlet unit of a shower area. However, it is not exclusively for use in this application, and can be utilised as necessity dictates.

[0035] The embodiments described above are provided by way of examples only, and various other modifications will be apparent to persons skilled in the art without departing from the scope of the invention as defined by the appended claims.

Claims

1. A diaphragm pump (10) comprising a housing (12), a diaphragm element (14) which is provided on the housing (12), and a drivetrain (16) in the housing (12) for reciprocating movement of the diaphragm element (14), the drivetrain (16) having an input drive element (42) and an output drive element (58) connected to the diaphragm element (14), the housing (12) including a vent (62) at or adjacent to the input drive element (42) of the drivetrain (16), so that, by reciprocation of the diaphragm element (14), air is drawn through and discharged from the vent (62) and, due to the positioning of the vent (62), passed across at least a portion of the input drive element (42).

2. A diaphragm pump as claimed in claim 1, wherein the housing (12) defines an air flow path from the vent (62) to the diaphragm element (14), the drivetrain (16) being provided on the air flow path so that air must flow over the said portion of the input drive element (42).

3. A diaphragm pump as claimed in claim 2, wherein the drivetrain is provided on the air flow path such that the input drive element (42) is closer to the vent (62) than the output drive element (58).

4. A diaphragm pump as claimed in claim 2 or claim 3, further comprising one or more baffle surfaces (64) in the housing for directing air on the air flow path to pass over the said portion of the input drive element (42).

5. A diaphragm pump as claimed in any one of the preceding claims, wherein the said portion of the input drive element (42) over which the air is passed includes at least one bearing (54).

6. A diaphragm pump as claimed in claim 5, wherein the bearing is a ball or roller bearing (54).

7. A diaphragm pump as claimed in any one of the preceding claims, wherein the said portion of the input drive element (42) over which the air is passed includes an input drive shaft (48).

8. A diaphragm pump as claimed in claim 7, wherein the input drive shaft (48) is journalled in the housing (12), and the vent (62) is provided adjacent to the journal.

9. A diaphragm pump as claimed in claim 7 or claim 8, wherein an end of the input drive shaft (48) is supported by the housing (12), and the vent (62) is provided adjacent to the said end of the input drive shaft (48).

10. A diaphragm pump as claimed in any one of the preceding claims, wherein the drivetrain (16) includes a geartrain (36) which has an intermediate drive element (46) between the input and output drive elements (42, 58).

11. A diaphragm pump as claimed in claim 10, wherein the input drive element (42) includes a worm (40), the intermediate drive element (46) includes a worm wheel (44), and the output drive element (58) includes a connecting rod (38).

12. A diaphragm pump as claimed in any one of the preceding claims, wherein the vent (62) is provided adjacent to the diaphragm element (14).

13. A diaphragm pump as claimed in any one of the preceding claims, further comprising an electric motor (18) connected to the input drive element (42).

14. A diaphragm pump as claimed in claim 13, wherein the vent (62) faces the electric motor (18).

15. A shower area having a waste water outlet device and a diaphragm pump as claimed in any one of the preceding claims connected to the waste water outlet device for pumping waste water therefrom.

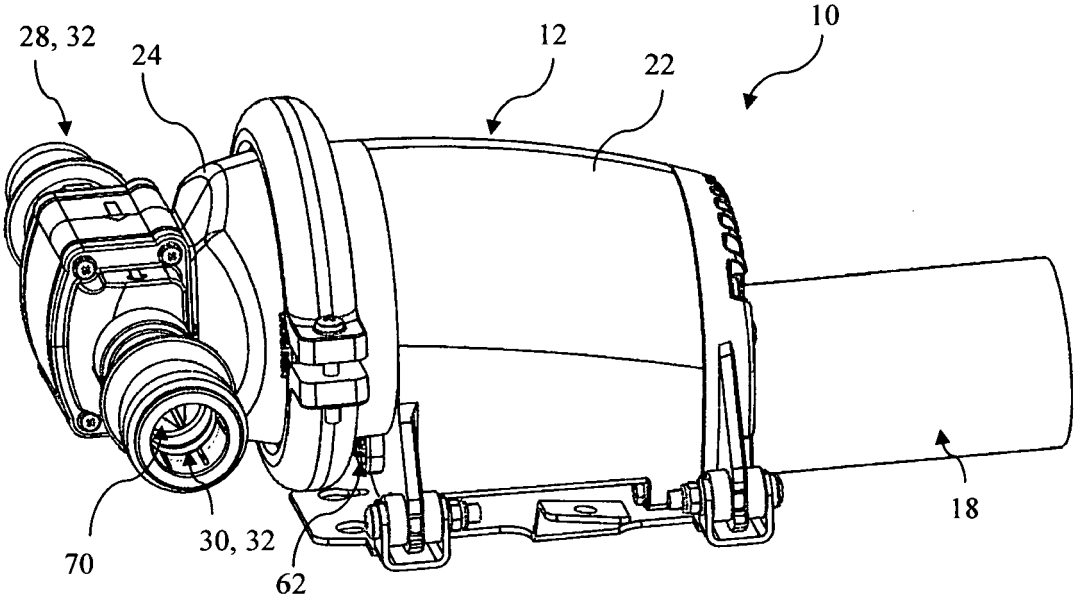
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Fig. 1

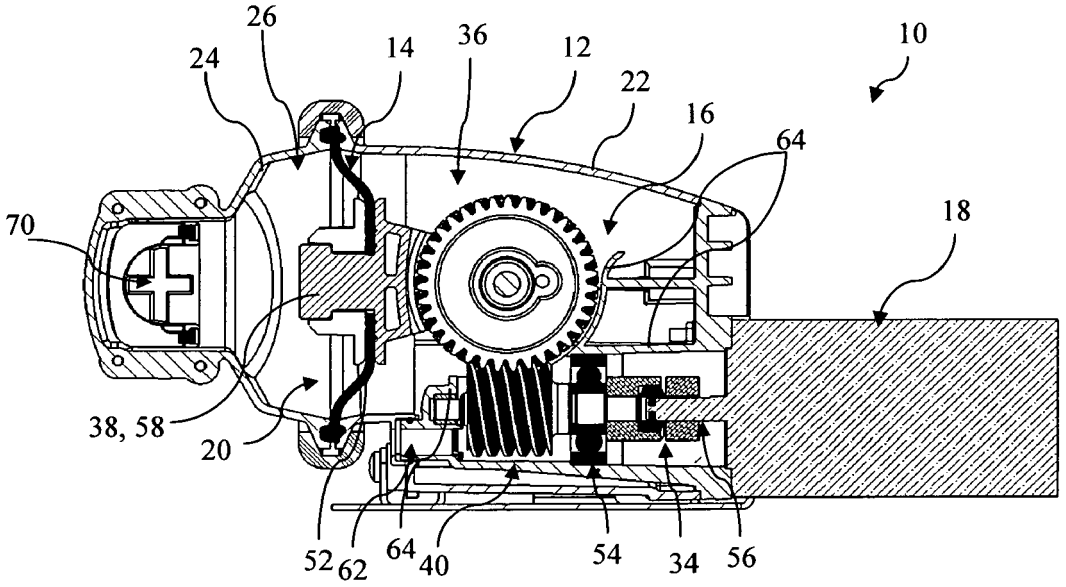
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Fig. 2

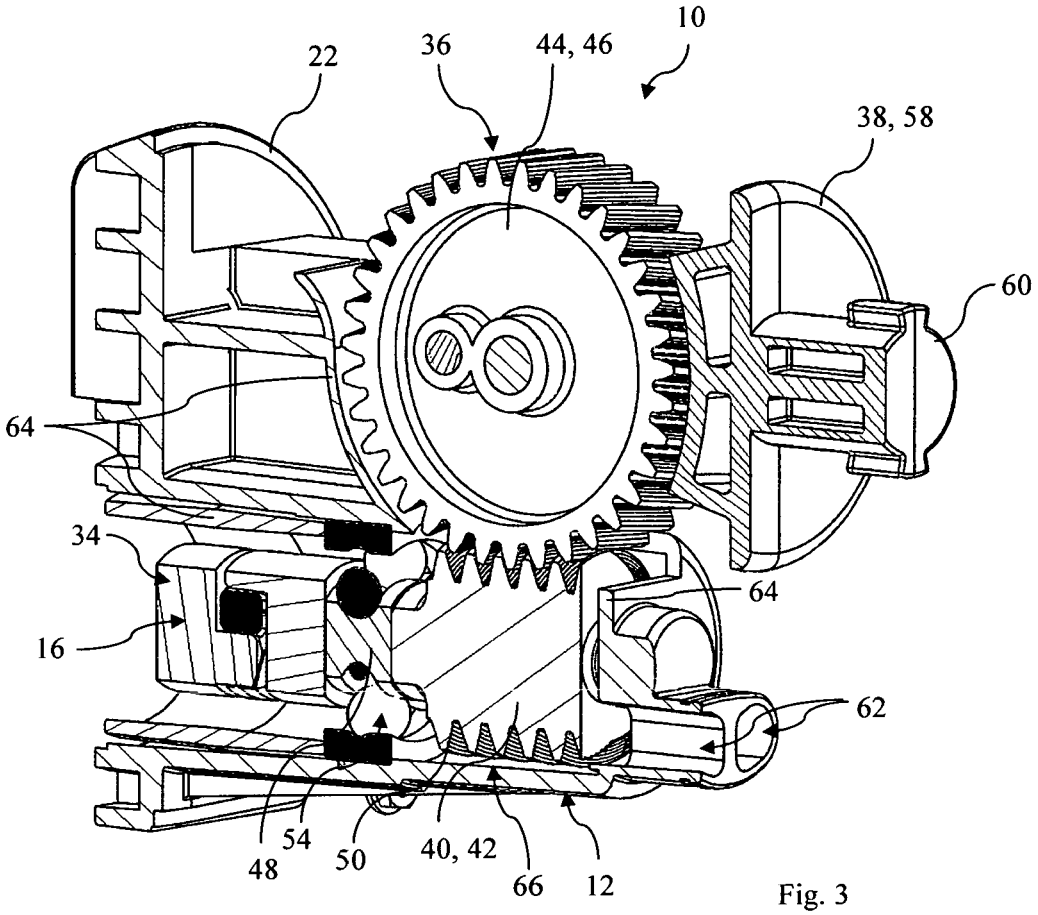

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 08 25 1807

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 35 21 300 A1 (ATSUGI MOTOR PARTS CO LTD [JP]) 19 December 1985 (1985-12-19) * page 13, paragraph 3 - page 14, paragraph 1; claim 1 * * figures 2,3 * -----	1-9, 12-14 10,11	INV. F04B43/02 F04B43/04 F04B53/08 F04B9/02 F04B9/04
D,Y	GB 2 282 419 A (MUNSTER SIMMS ENGINEERING LIMI [GB]) 5 April 1995 (1995-04-05) * figure 2 * -----	10,11	
A	JP 60 075779 A (MATSUSHITA ELECTRIC WORKS LTD) 30 April 1985 (1985-04-30) * the whole document * -----		
A	US 3 877 842 A (GREENE ROBERT RAYMOND ET AL) 15 April 1975 (1975-04-15) * the whole document * -----		

TECHNICAL FIELDS SEARCHED (IPC)
F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 October 2008	Olona Laglera, C

CATEGORY OF CITED DOCUMENTS

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31-10-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3521300 A1	19-12-1985	AU 4370885 A	19-12-1985
		JP 61004879 A	10-01-1986
		ZA 8504460 A	26-02-1986
GB 2282419 A	05-04-1995	NONE	
JP 60075779 A	30-04-1985	NONE	
US 3877842 A	15-04-1975	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 9419768 A **[0004]**