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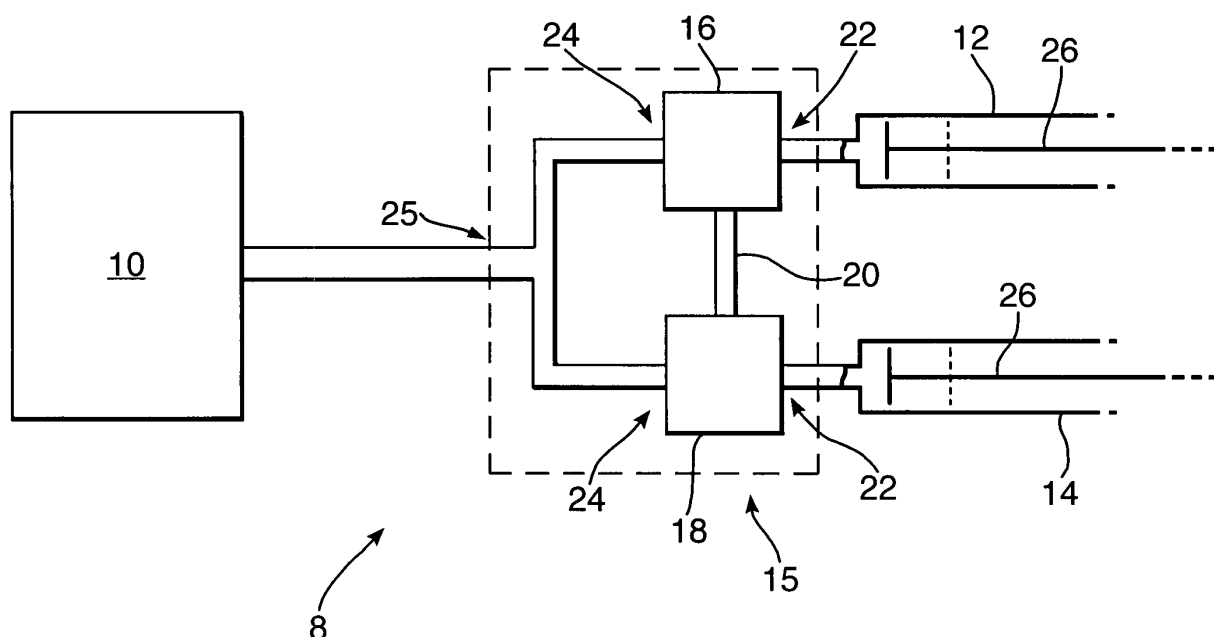
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(54) **A metering mechanism**

(57) A hydraulic system 8 comprises: a pump 10 which forms a source of hydraulic fluid; a plurality of hydraulic devices in the form of hydraulic rams 12, 14 and a metering mechanism 15 comprising a plurality of metering devices 16, 18 associated with respective rams. The metering devices 16, 18 are connected by a connection 20 so that the flow of fluid or pressure at the outlets

22 thereof are substantially equal regardless of the resistance to flow downstream of each metering device. When the hydraulic system is in use, pump 10 supplies hydraulic pressure to the inlets 24 of the metering devices 16, 18 and said metering devices control the flow of fluid so that the hydraulic rams receive an equal flow of fluid. Accordingly, the pistons 26 of the rams are controlled to extend and retract by an equal distance.

Fig.1.



Description

[0001] The present invention relates to a metering mechanism for metering the supply of hydraulic fluid between a source of hydraulic pressure and a plurality of hydraulic devices.

[0002] Figure 5 shows a prior art hydraulic system comprising a pump 50 in fluid communication with two hydraulic devices in the form of hydraulic rams 52, 54. Pump 50 and rams 52, 54 are connected by ducts 56. In use, pump 50 provides a source of hydraulic pressure which causes fluid to flow along ducts 56 as shown by arrows in Figure 5 and into rams 52, 54 where it causes movement of respective pistons 58, 60. In a parallel arrangement of rams as shown, the flow of fluid into the rams is dependent on the resistance to movement of the rams. Therefore, if the resistance of both rams is the same then a predetermined pressure provided by pump 50 causes the flow into each ram to be equal and the pistons to extend by the same distance. If on the other hand the resistance to movement of ram 52 is greater than ram 54, then the flow of fluid into ram 52 is less than into ram 54 and therefore, piston 60 extends a greater distance than piston 58, as shown by the phantom lines in Figure 5. In this latter circumstance, fluid is diverted from ram 52 into ram 54.

[0003] The hydraulic system shown in Figure 5 can be used for lifting, for example, with rams 52 and 54 fixed relative to respective sides of a lifting platform. If a load is not distributed evenly on the platform or if the platform is at an angle to horizontal, the resistance to movement of one ram is not the same as the resistance of the other arm. In the prior art system, the piston of one ram extends more than the piston of the other ram, which causes uneven loading leading to jamming, deformation or failure. Previously, this problem has to some extent been mitigated by strengthening the lifting structure so that it is sufficiently rigid to resist uneven lifting forces. However, such strengthening is costly and increases weight.

[0004] The present invention seeks to solve or at least mitigate the above mentioned problem.

[0005] Therefore, the present invention provides a metering mechanism comprising a plurality of metering devices for metering the supply of fluid from a source of hydraulic pressure to outlets thereof in fluid communication with respective hydraulic devices, wherein each metering device comprises a first gear rotatable in a first direction and a second gear rotatable in a second direction, said gears intermeshing with each other and being rotatable in response to the supply of hydraulic pressure from said source for metering flow of fluid from said source to said outlet thereof, wherein the first gears of said metering devices are connected such that relative rotation between said first gears is restricted so that respective said outputs receive substantially an equal flow of fluid when said source provides hydraulic pressure.

[0006] A hydraulic system comprising: a metering mechanism as described in the preceding paragraph, a

plurality of hydraulic devices in fluid communication with respective said outlets of the metering devices; and at least one source of hydraulic fluid wherein, in use, said at least one source of hydraulic pressure supplies pressurised fluid to the metering devices and said metering devices control the flow of fluid so that said hydraulic devices receive an equal flow of fluid.

[0007] In order that the present invention may be well understood, an embodiment thereof, which is given by way of example only, will now be described with reference to the accompanying drawings, in which:

Figure 1 is a simplified drawing of a hydraulic system;

Figure 2 is a simplified drawing of a metering device;

Figure 3 is a plan view of two metering devices with components shown in phantom lines;

Figure 4 is cross-section taken along line A-A in Figure 2; and

Figure 5 is a simplified drawing of a prior art hydraulic system.

[0008] Referring to Figure 1, a hydraulic system 8 is shown which comprises: a pump 10 which forms a source of hydraulic fluid; a plurality of hydraulic devices which in the example shown are hydraulic rams 12, 14 and a metering mechanism 15 comprising a plurality of metering devices 16, 18 associated with respective rams. Alternatively and for example, the hydraulic devices may be any synchronised devices which require an equal flow of fluid for operation such as hydraulically operated valves or hydraulic motors. The metering devices 16, 18 are connected by a connection 20 so that the flow of fluid or pressure at the outlets 22 thereof are substantially equal regardless of the resistance to flow downstream of each metering device. The connection 20 can take any suitable form, such as an electronic, hydraulic or mechanical linkage, and details of connection 20 will be described in greater detail hereinafter. When the hydraulic system is in use, pump 10 can typically supply fluid over a range of pressures sufficient to overcome the internal resistance of the hydraulic system and drive the rams as required. Such pressure is supplied to the inlets 24 of the metering devices 16, 18 and said metering devices control the flow of fluid so that said hydraulic rams receive an equal flow of fluid. Accordingly, the pistons 26 of the rams are controlled to extend and retract by an equal distance, regardless of the load on each piston.

[0009] The metering devices 16, 18 may be provided in a common housing as shown by broken lines in Figure 1 and such a housing may have a single inlet 25 in fluid communication with pressure source 10. Fluid entering inlet 25 is directed along internal ducts to inlet 24 of respective metering devices. Alternatively, a common housing may have inlets for each metering device.

[0010] Although the hydraulic system shown comprises two rams 12, 14 and two metering devices 16, 18, more than two rams/devices can be used as required.

[0011] Each metering device when taken in isolation allows fluid to flow only when a pressure gradient exists between inlet and outlet thereof. Increase and decrease in flow is dependent on the pressure gradient. Therefore, for a predetermined inlet pressure, flow decreases if the outlet pressure increases. Outlet pressure increases if the load on the associated hydraulic device increases. In a system of parallel rams as shown in Figure 1, the load on rams 12, 14 may not always be equal, and consequently, the pressure gradient across metering devices 16, 18 will not be equal even if the inlet pressure of both metering devices is the same. Connection 20 allows the transmission of hydraulic force between metering devices.

[0012] Looking at an example in which the load on ram 14 is greater than the load on ram 12, the pressure gradient across metering device 18 will be relatively smaller and the pressure gradient across metering device 16 will be relatively larger. Therefore, connection 20 allows the transmission of the forces between metering devices 16, 18 such that the rotation of respective gears within each device is identical. In other words, flow is restricted in one device to the same as that of the other device, and since both rams have the same volume, pistons 26 extend by an equal distance.

[0013] There now follows a more detailed description of metering devices 16, 18 and connection 20 with reference to Figures 2 to 4.

[0014] Referring to Figure 2, metering device 16 of metering mechanism 15 comprises first spur gear 28 and second spur gear 30 which intermesh and have axes of rotation X and Y, respectively. It should be noted that reference is made herein to a first gear and a second gear for convenience of description, but either gear may be considered the first gear or the second gear.

[0015] A housing 32 defines pumping chamber 34 in which gears 28 and 30 rotate. For the sake of clarity, individual gear teeth are not shown. In use, pump 10 causes a pressure gradient across device 16 between inlet 24 and outlet 22, which causes the gears to rotate and fluid to flow from the inlet to the outlet. First gear 28 rotates about axis X in a first direction and second gear 30 rotates about axis Y in a second, or opposing, direction. The close tolerances between the intermeshing gear teeth of both gears and between the teeth and the chamber wall ensure that substantially no fluid flow occurs without rotation of the gears.

[0016] Figure 3 shows metering devices 16, 18 in a common housing 32 of metering mechanism 15. Both devices are provided in a common housing for space efficiency, but equally, separate housings could be provided. Metering device 18 has the same function as metering device 16 described above, and comprises first spur gear 36 and second spur gear 38 which intermesh and have axes of rotation X and Y, respectively. First

gear 36 rotates about axis X in the same direction as first gear 28, and second gear 38 rotates in the same direction as second gear 30.

[0017] Housing 32 defines a further pumping chamber 40 in which gears 36 and 38 rotate. In the embodiment shown, the first gears 28, 36 have a common shaft 42 supported by thrust bearings 46 for rotation about axis X, and the second gears 30, 38 have a common shaft 44 supported by thrust bearings for rotation about axis Y.

[0018] As shown in Figure 4, second gears 30, 38 have a common shaft and cannot rotate about axis Y with respect to each other. The first gears 28, 36 may additionally or alternatively be incapable of rotation relative to each other about axis X. It is sufficient that only one pair of gears is restricted in this way since the first and second gears intermesh and therefore rotation of one of a first and second gear is dependent on rotation of the other of a first and second gear.

[0019] When the metering mechanism 15 is in use, pump 10 provides a source of hydraulic pressure and is in fluid communication with the inlets of the metering mechanism. When the load on rams 12, 14 is equal, the pressure gradient across metering devices 16, 18 is equal and the turning moment applied by gears 30, 38 about shaft 44 is equal in magnitude and direction. When the load is larger on, for example, ram 12, there is a larger pressure gradient across metering device 18 than across metering device 16. Therefore, the turning moment applied to shaft 44 by gear 38 is larger than that applied by gear 30. Since the angular velocity of shaft 44 is determined by both gears 30, 38, gear 38 increases the angular velocity of gear 30, and gear 30 retards the angular velocity of gear 38. Accordingly, flow at outlets 22 is equal and therefore extension of pistons 26 is equal.

[0020] Connection 20 may take the form of a rigid shaft 44 as shown in Figures 2 to 4, but equally may take any suitable form provided that the connection restricts relative rotation between the appropriate gears.

[0021] After prolonged use, fluid may leak around the gears of the metering devices 16, 18 such that the hydraulic devices or rams as shown lose synchronisation. It is advantageous to provide each metering device with a duct from the outlet 22 to the inlet 24 thereof thereby bypassing the gear mechanism such that the duct can be opened in order to re-set the system to a starting condition. The by-pass ducts may be formed integrally with the housing of each metering device or with the common housing of the metering devices, or alternatively may be formed by means exterior to such a housing.

Claims

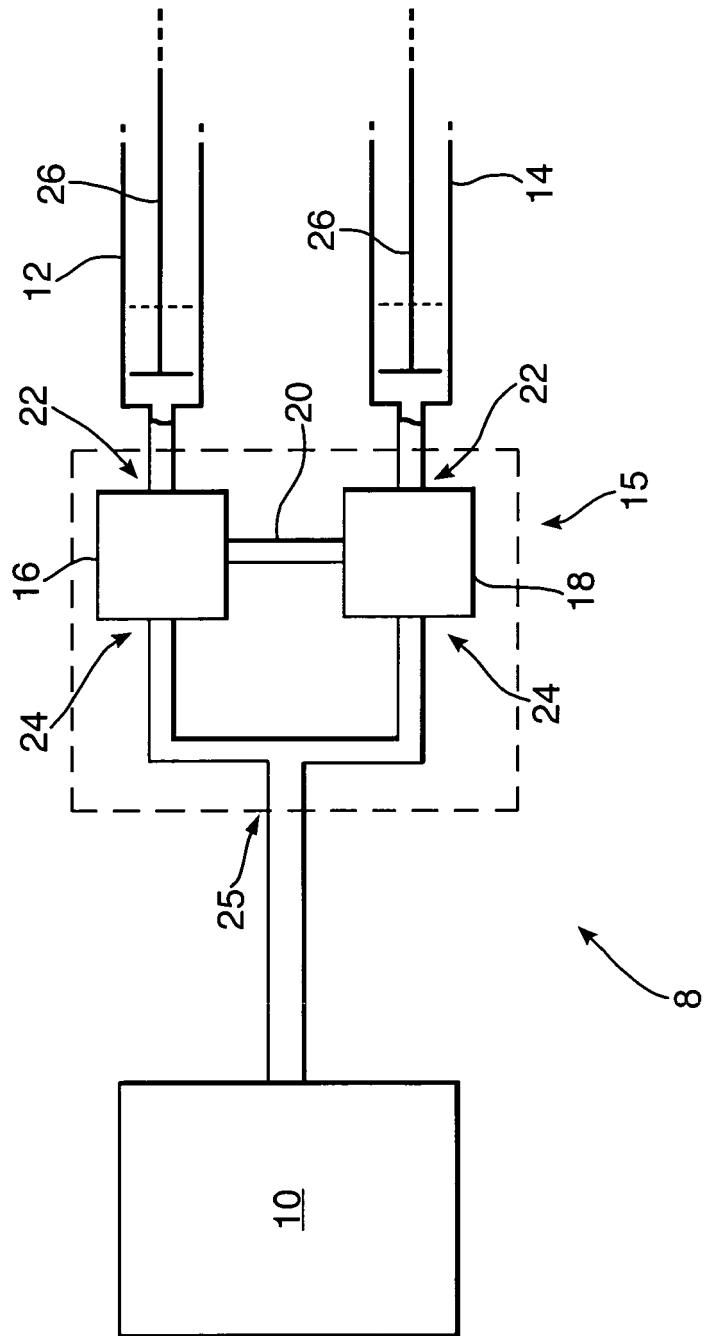
1. A metering mechanism comprising a plurality of metering devices for metering the supply of fluid from a source of hydraulic pressure to outlets thereof in fluid communication with respective hydraulic devices, wherein each metering device comprises a first gear

rotatable in a first direction and a second gear rotatable in a second direction, said gears intermeshing with each other and being rotatable in response to the supply of hydraulic pressure from said source for metering flow of fluid from said source to said outlet thereof, wherein the first gears of said metering devices are connected such that relative rotation between said first gears is restricted so that respective said outputs receive substantially an equal flow of fluid when said source provides hydraulic pressure. 5 10

2. A mechanism as claimed in claim 1, comprising mechanical linkage means for connecting the first gears of said metering devices so that relative rotation between the first gears is restricted. 15
3. A mechanism as claimed in claim 2, wherein said linkage means comprises a shaft common to said first gears and rotatable by said first gears. 20
4. A mechanism as claimed in claim 2 or 3, wherein said metering devices and said linkage means are housed in a common housing.
5. A mechanism as claimed in claim 4, wherein said common housing comprises an inlet for receiving the supply of hydraulic pressure from said source, said inlet being common to each of said metering devices. 25
6. A mechanism as claimed in any one of the preceding claims, wherein each metering device comprises a bypass duct between said inlet and said outlet thereof for equalising the hydraulic pressure therebetween. 30 35
7. A hydraulic system comprising: a mechanism as claimed in any one of claims 1 to 6, a plurality of hydraulic devices in fluid communication with respective said outlets of the metering devices; and at least one source of hydraulic fluid wherein, in use, said at least one source of hydraulic pressure supplies pressurised fluid to the metering devices and said metering devices control the flow of fluid so that said hydraulic devices receive an equal flow of fluid. 40 45
8. A system as claimed in claim 7, comprising a single source of hydraulic pressure common in fluid communication with the inlets of said metering devices.
9. A system as claimed in claim 7 or claim 8, wherein the hydraulic devices are hydraulic rams. 50

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Fig.1.



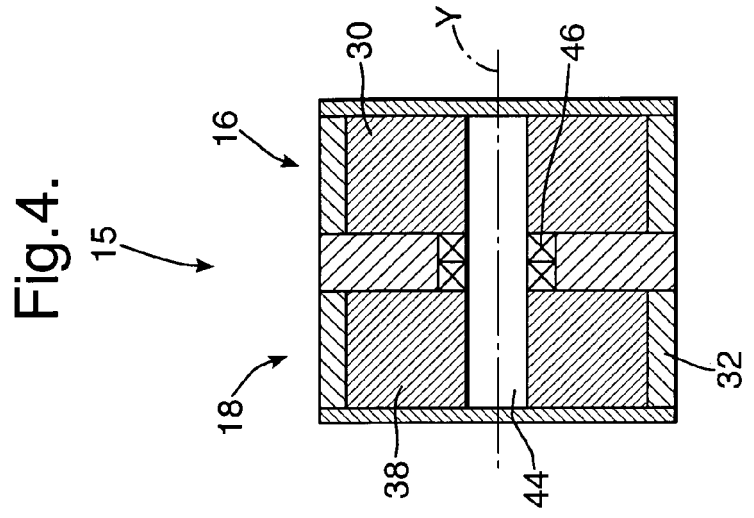
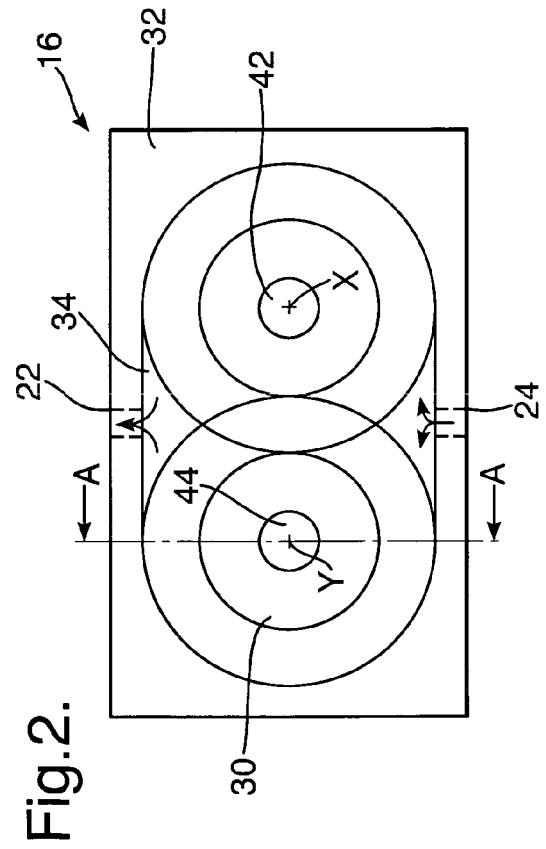
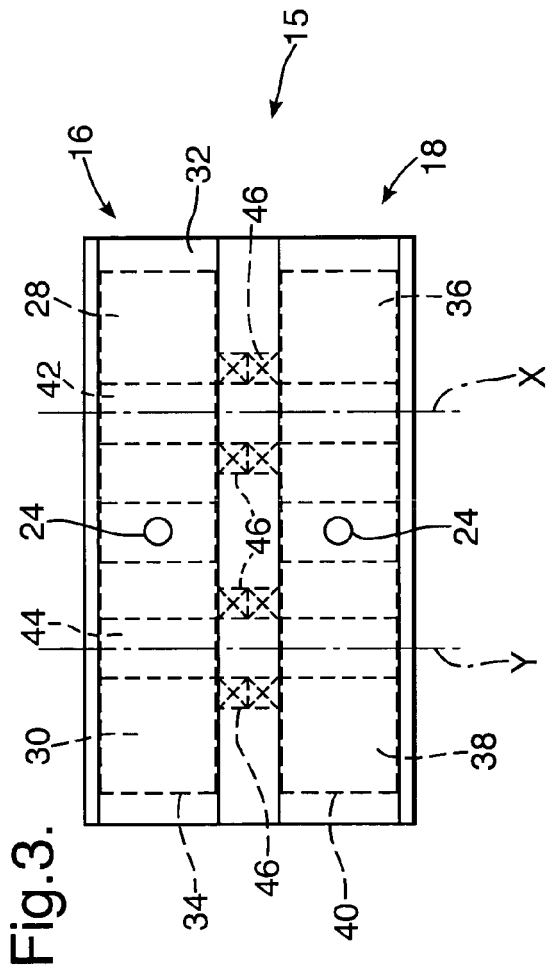
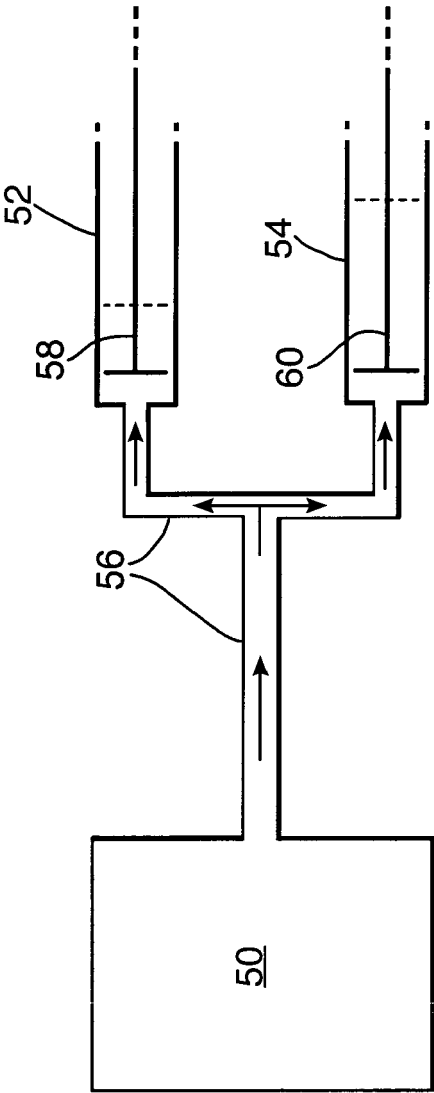


Fig.5.





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 March 2006	Examiner Toffolo, 0
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			

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

EP 05 27 0082

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
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