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(71) Applicant: **Usov, Konstantin**
198215 St. Petersburg (RU)

(72) Inventor: **Usov, Konstantin**
198215 St. Petersburg (RU)

(74) Representative: **Partio, Erja et al**
Papula Oy
Mechelininkatu 1 a
FIN-00180 Helsinki (FI)

(54) **Ball machine**

(57) The apparatus contains a spherical shell (1) with windows (2) and an open cavity (12), a disk (3) with four cavities (6) and drill holes for fingers (10) with two cylindrical projections (7), a driving semi-disk (4) with a shaft and an immobile support (11), a controlling semi-disk (5) with a shaft and a mobile support (13), each semi disk having two lugs (8) and a cylindrical mortise (9). A change of the volume in the working chambers takes place every 90°.

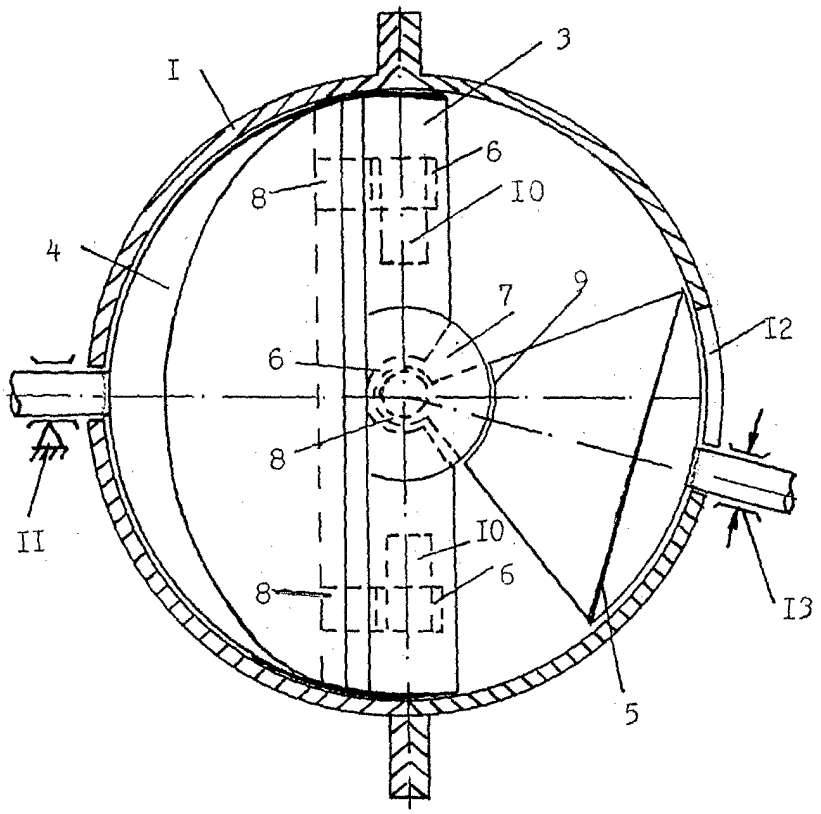

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] This invention relates to the sphere of mechanical engineering. The field of use of the apparatus according to the invention includes the fields of pressure-operated engines. The invention can be utilized in hydraulic circuits and hydraulic transmissions, in pipeline transport, in compressor and cooling plants in artificial hearts and any anywhere where pumping of liquid is needed.

BACKGROUND OF INVENTION

[0002] Previously known is a rotary machine containing a ball body with inlet and outlet windows, an actuating device composed of a shaft and two disks linked with a ball joint and installed at a permanent angle to each other. This machine is non-adjustable (USA Patent No. 1880313, cl. 418-68, 1930).

The closest prior art is (USSR Patent, No. 1565521, F 01 C 3/00, 1989), a positive-displacement machine, which contains a gang-mounted spherical shell with inlet and outlet windows and two disks fitted upon the shell - the driving disk and the driven one. These disks are connected hingedly, and mounted upon the shaft so as to form two working chambers; the driven disk has a groove with a gudgeoned ring installed in it. The disks are brought outside the shell, which ensures performance control and reversing, while extending functional capabilities of the machine. The driven disk has a cylindrical central part with a recess along the disk diameter; the driving disk has two interconnected half-round cavities located oppositely, and a projection coupled with the cylindrical surface of the recess, while the shaft is placed in the half-round cavities.

[0003] The disadvantage of the positive-displacement machine of the prior art is current surge due to the working chambers being mutually symmetric and the inlet and outlet processes alternating every 180°. Consequently, two inlet and two outlet processes take place in the machine during one revolution of the shaft.

SUMMARY OF THE INVENTION

[0004] It is the main objective of the invention claimed to reduce current surge, which is achieved by a number of structural changes of the prototype product. The ball machine utilizes one disk, with two semi-disks instead of the second one; the shaft comprises two parts, each of them forming an integral unit with the corresponding semi-disk. The driving semi-disk shaft has an immobile support, the support of the controlling semi-disk shaft being mobile. The disk has special cavities with drill holes for connection with the semi-disks, and the latter have lugs. For mating the semi-disks, the disk has cylindrical projections of the both sides, while the semi-disks have cylindrical mortise of a corresponding flexure. With such structural changes the working volume is changed every 90°, and the number of windows is reduced from four down to two.

[0005] The control and reversing of the ball machine is carried out by the controlling semi-disk, whose shaft along with the mobile support is brought outside the shell. The open cavity is packed in the shell due to the fact that the controlling semi-disk at the place of mating with the shell surface is made as a spherical cap.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention is illustrated with the following drawings: Fig. 1 - end view with a vertical section of the shell, Fig.2 - plane view with a horizontal section of the shell, Fig.3 - controlling semi-disc end view with a half-shell removed, Fig.4 - diagrams to explain the action of the ball machine.

DETAILED DESCRIPTION OF THE INVENTION

[0007] The ball machine contains spherical shell 1 with inlet and outlet windows 2. Located inside the shell are disk 3, driving semi-disk 4 and controlling semi-disk 5, which are hingedly connected with disk 3 forming two working chambers I - IV. Disk 3 has four cavities 6 and two cylindrical projections 7, while each of semi-disks 4 and 5 has two lugs 8 and cylindrical mortise 9. In the assembled condition the semi-disks are connected with the disk with the help of fingers 10 which form a hinge joint together with the lugs. The power shaft of driving semi-disk 4 has immobile support 11, the shaft of controlling disk 5 is brought outside the shell through an open cavity in shell 12; this shaft has mobile support 13 and is connected with the controlling device (omitted in the drawing). Windows 2 are cylindrical, with a diameter equal to that of cylindrical projections 7. The sections of disk 3 which overlap windows 2 at the time of a change-over of inlet (outlet) processes at the side of the chambers (in which the processes are still going on) are designed so as to avoid a full overlap of the windows, thus ensuring a termination of the processes going on in the chambers.

[0008] The ball machine operates in the capacity of a pump in the following way. The state of the working chambers in the position is shown in figure 4. a. The value of the chamber I volume is minimum, the volume in chambers II and III equals the medium value between the minimum and maximum volume. As the actuating device is rotating clockwise (Fig. 4,a), windows 2 in chambers I and IV will open and inlet and outlet processes will start in chambers I and IV respectively; at the same time inlet and outlet processes will be going on in chambers II and III respectively. After a turn of the actuating device by 90 ° the processes which have been on in chambers II and III will be terminated, disk 3 will close windows 2 to these chambers, while in chambers I and IV the processes will go on. Early in the next quarter of the actuating device

revolution disk 3 will open windows 2 to chambers II and III, and inlet and outlet processes will start in chambers II and III respectively; at the same time inlet and outlet processes will be going on in chambers I and IV respectively. This quarter of the revolution over, disk 3 will close windows 2 to chambers I and IV. The processes which have been on in chambers I and IV will terminate, while in chambers II and III the processes will go on. In the third quarter of the actuating device revolution inlet and outlet processes will start in chambers I and IV respectively, while inlet and outlet processes in chambers II and III respectively will go on and terminate. In the final quarter of the actuating device revolution inlet and outlet processes will terminate in chambers I and IV respectively; at the same time, inlet and outlet processes will start and proceed by one half in chambers II and III respectively. In one revolution of the actuating device the capacity (working volume) of the ball machine will be determined with use of the following expression: Vb.m. = 4 (V_{max}-V_{min}), where

Vb.m. is the capacity (working volume),

V_{max} is the maximum volume of a working chamber,

V_{min} is the minimum volume of a working chamber.

[0009] The description of the ball machine operation demonstrates that inlet and outlet processes in each chamber occupy 180°, but as a change of volume in the working chambers takes place every 90°, inlet and outlet processes in the ball machine go on continuously, which reduces power fluid surge.

[0010] The ball machine is adjusted by changing the angle between controlling semi-disk 5 and disk 3, which is achieved by fixing the shaft with mobile support 13 on corresponding cavity 12. The adjusting angles are counted starting from mark "0" on open cavity 12, this position corresponds to right angle between semi-disk 5 and disk 3. In this case the capacity equals zero.

[0011] As the shaft of driving semi-disk 4 clockwise (Fig.4a), window two on the left will be the inlet window and window 2 on the right - the outlet one. As the shaft with mobile support 13 is moving in open cavity 12 towards mark "0", the capacity will be decreasing, and at mark "0" will equal zero. As the shaft with mobile support 13 upcrosses mark "0" and moves on along open cavity 12 (Fig.4b) with the same rotation sense of the driving disk 4 shaft, the power fluid current will be reversed, window 2 on the right becoming the inlet window and window 2 on the left - the outlet one. The directions of power fluid currents are shown with arrows (Fig.4)

Claims

1. An apparatus containing a gang-mounted spherical shell with inlet and outlet windows with an actuating device located in it so as to form working chambers **characterized in that** the actuating device is made of one disk and two semi-disks - the driving and controlling ones, interconnected so that the change of the volume in the working chambers takes place every 90°, and the shell has an open cavity intended for the controlling semi-disk to be brought outside the shaft body through it, the packaging of the open cavity being ensured by the controlling semi-disk made as a spherical cap at the place where it mates the shell.

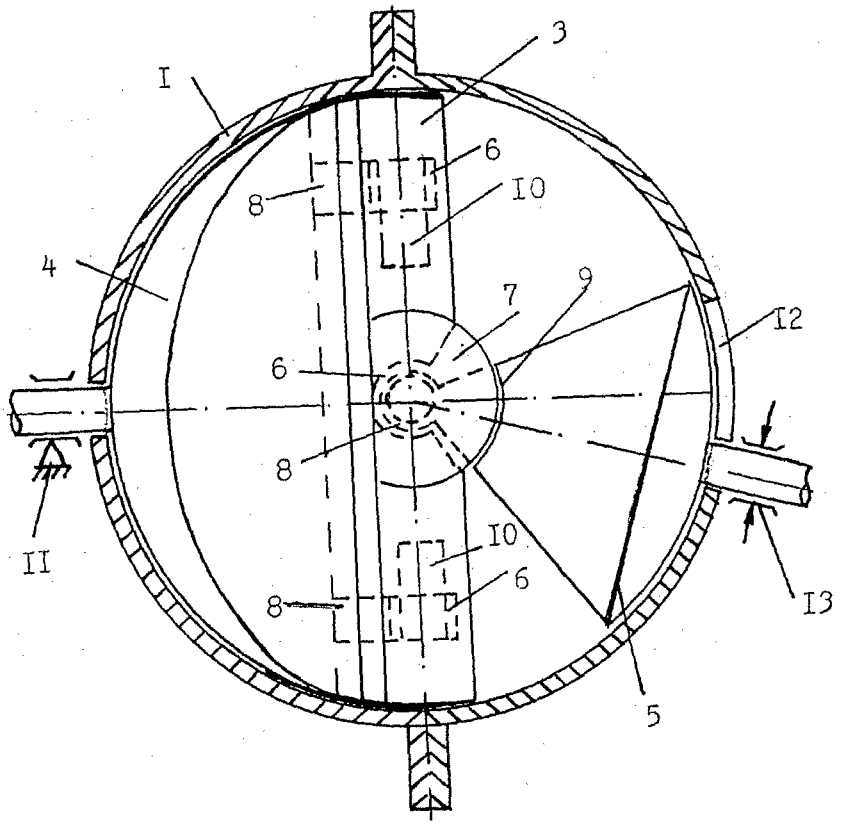

Fig. 1

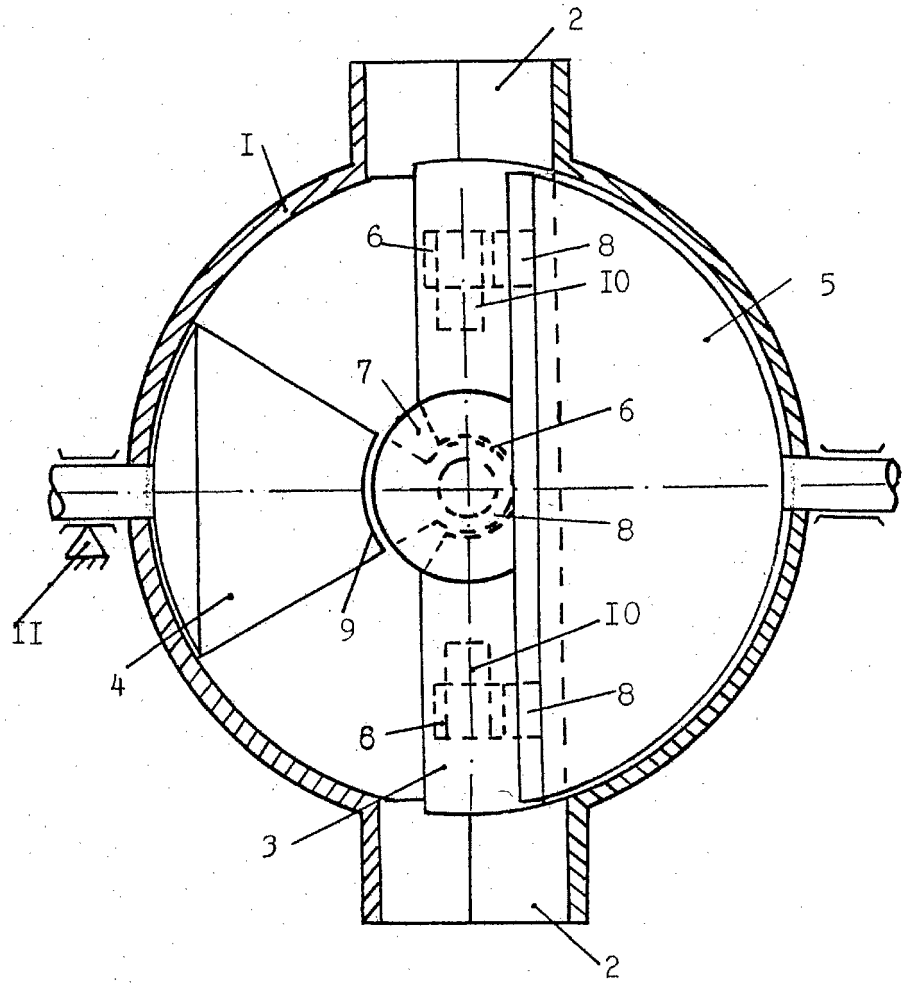

Fig. 2

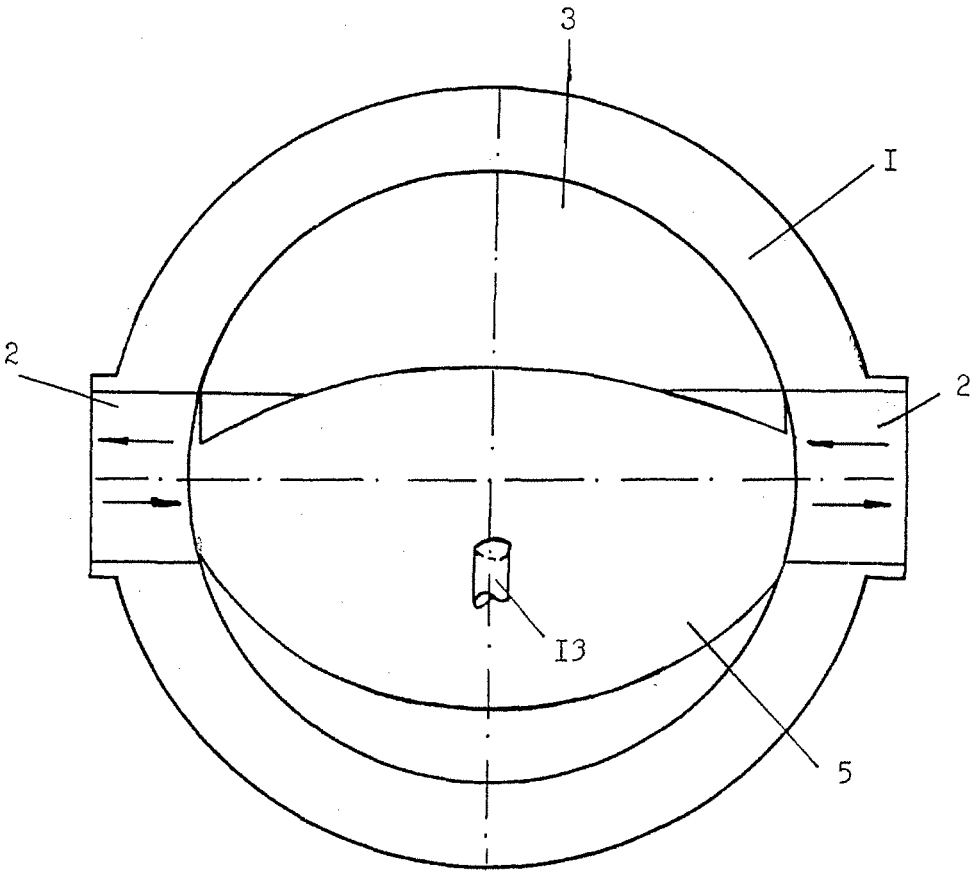

Fig. 3

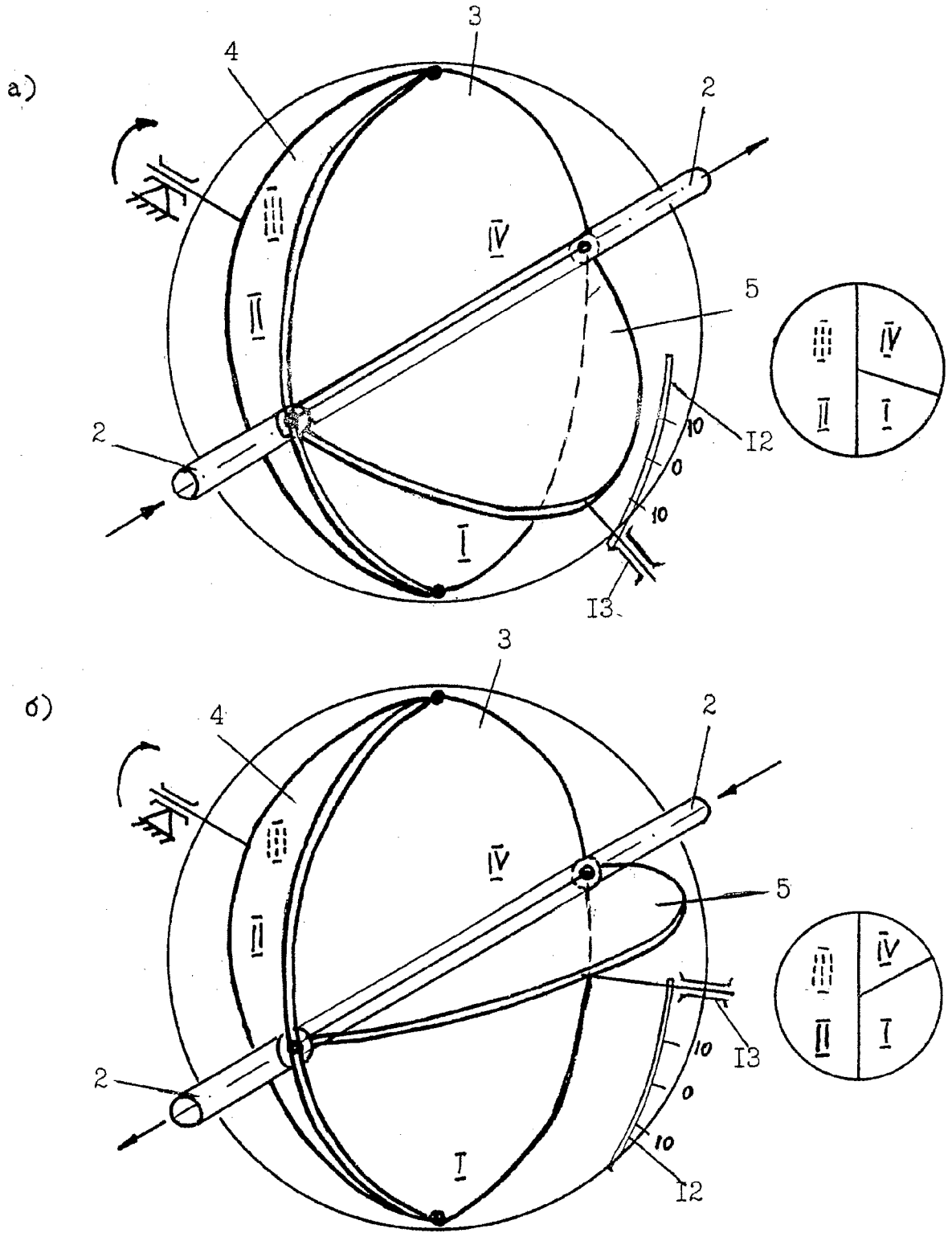

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 5093

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A,D	SU 1 555 521 A1 (LE I INZHENEROV ZHELEZNODOROZH [SU]) 7 April 1990 (1990-04-07) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F04C
F03C
F01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 March 2009	Descoubes, Pierre

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 16 5093

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02-03-2009

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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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- SU 1565521 **[0002]**