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Remarks:

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(54) **Improved system for manufacturing, manipulating and laying up concrete**

(57) System (1) for manufacturing, manipulating and laying-up concrete, comprising a main drum (10) able to rotate comprising aggregates and cement, characterized in that it comprises at least one auxiliary tank (20) independent from the main drum (10) comprising water and at least one secondary auxiliary tank (40) independent from the main drum (10) comprising an admixture, the system (1) also comprising a control system (30) connected to the auxiliary tank (20) and to the secondary

auxiliary tank (40), governing the flow of water and admixtures supplied to the main drum (10), the control system (30) being configured so that the main drum (10) begins to rotate commanded by said control system (30) when the dosage of water from the auxiliary tank (10) to the main drum (10) starts, such that the main drum (10) keeps rotating until the control system (30) instructs the system (1) that the concrete mixture is prepared and ready for being laid.

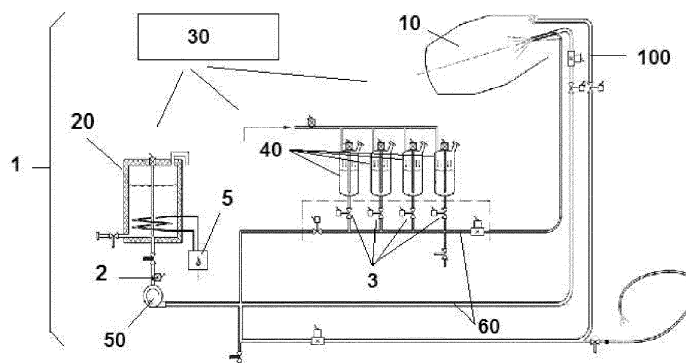


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a system for manufacturing, manipulating and laying up concrete, in particular to an improved system for manufacturing, manipulating and laying-up concrete or accelerated concrete that can be used in a any range of climatic conditions.

BACKGROUND OF THE INVENTION

[0002] In the state of the art, a mixture of the components that make up the concrete (water, aggregates, cement and admixtures) in a certain proportion is performed, the concrete being then transported in a vehicle from the site of preparation (concrete plant) to the place where it will be laid. Once the concrete is prepared, there exist typically about 90 minutes to deliver the concrete (to job site) in acceptable conditions for laying up and for the development of its properties. At present, it is common, as concrete is going to lose mechanical properties until it is laid up, using concrete having much higher properties than necessary, but taking into account the reduction of these properties occurring at transport. This means having very high costs and emissions because of an over dosification of cements and/or additives, which are not necessary.

[0003] On the other hand, for preventing concrete setting during its transport to the job site, it is necessary that the container in which the concrete is kept within the vehicle rotates constantly until the discharge of the concrete and its laying, which leads to a high fuel consumption, to high emissions Of CO₂ to the atmosphere and to road safety risks by decreasing vehicle stability as the container is rotating constantly. Furthermore, as the container is constantly rotating, the aging of the cite container is very high and the containers have to be changed after short working time, which presents the problem of high costs and low duration.

[0004] What has been said makes it that the displacements from a concrete plant to the job site are very limited, requiring that the concrete plant is close to the job site. If this does not occur, as in most of the cases, there is usually a loss in the quality of concrete. On the other hand, standard concrete has the problem of a high time being required for being put into service once they have been laid up in site, being necessary to wait between 14 to 28 days (depending on concrete types) until its mechanical and laying up properties are adequate.

[0005] As mentioned above, it follows that the known traditional systems cannot be used effectively in cases in which it is necessary to do reparations and emergency works, for example in cases of disasters or in cases where civil or industrial reparations of high added value by their urgency are required, as well as in military-type applications. In addition, these known systems have

many drawbacks when they have to be used in inaccessible places or places where there are adverse weather conditions, which are commonly understood as temperature conditions over 43°C with very short time to lay up concrete, and a high risk of not getting a good quality and a durable concrete and below -5°C, because of the risk of concrete getting frozen and because of the loss of its properties and the slow development of its properties at such low temperatures.

[0006] It would therefore be desirable to develop a system for manufacturing, manipulating and laying concrete with the following characteristics:

- saving fuel and reducing CO₂ emissions;
- having greater safety in the driving from the concrete plant to the job site;
- reducing the limitation of the maximum time available to reach the job site;
- avoiding using over dosification of cements or additives to compensate the lost of properties during transport;
- being able to provide concrete to areas far away from the concrete preparation plants;
- being able to provide concrete in difficult access areas;
- providing a system that is able to prepare concrete independently of the ambient conditions;
- measuring the concrete properties during the manufacturing of concrete in the job site;
- providing a system that is able to manufacture concrete "just in time" and tailored depending on the climatic conditions of the job site where it is going to be laid up (mainly temperature, but also humidity, or others);
- allowing a longer lifetime for the rotatable drum or container where the concrete mixture is prepared.

[0007] Another additional problem is that the hardening of concrete and the time necessary to obtain its proper mechanical and laying up properties depends on different factors, and one of these is temperature: as the ambient temperature decreases, the hardening time of concrete increases in an exponential way. Thus, ambient temperatures below 10°C delay significantly the hardening time. For this reason, the current tendency of hardening concrete at high ambient temperatures poses several problems, such as: more water is require in the process, the hardening is quicker and the mechanical (durability and resistance) properties of the concrete obtained are lower, there exists a higher potential of thermal cracking, the concrete obtained could have a high risk of durability problems as secondary ettringite or ASR detereorations. Furthermore, using additives for accelerating the hardening of concrete, such as calcium derivates (calcium chloride, calcium formate and, particularly, calcium or sodium silicates, calcium or sodium doubles or similar cations) presents several problems of toxicity, durability, price increase and limitations for transportation and for

laying up. Examples in the prior art of additives used for accelerated concrete base on aluminates are known as per KR 101019073, latex as per KR 100774448 or sulphoaluminate as per KR 101011504, for example.

[0008] It is also known in the art, as per WO 2009/144293, for example, a composition for accelerating the hardening time of concrete, specially for using in roads, airports or prefabricated constructions. However, no system for manipulating nor for laying up concrete is being described in the mentioned document.

[0009] Some other documents of the prior art, such as KR 1020090077342 or KR 100908675, disclose additional concrete coatings for shortening the hardening time and which are applied onto an existing concrete structure. These documents do not, however, provide any system for manufacturing, manipulating and laying up on site any accelerated concrete, neither do they disclose concrete mixtures allowing hardening times below 8 hours.

[0010] Some other solutions in the prior art, for example in WO 2008150039, describe a concrete composition able to be used at low temperatures, comprising calcium chloride, calcium formate, particularly calcium or sodium silicates, calcium or sodium doubles or similar cations, aluminates. For accelerated concrete, concrete of calcium aluminate cement is used, or concrete fabricate with mixtures of calcium aluminates cement and Portland® cements, though these compositions have several drawbacks, such as low durability and severe normative restrictions.

[0011] It is known in the prior art, as per documents KR 100690393 and KR 1020060013302, methods for obtaining accelerated concrete compositions, with several additives used for a rapid hardening of concrete. However, none of these documents describes a system that can provide accelerated concrete to be use and tailored in the work site.

[0012] Document EP 1103533 describes a method and an apparatus for obtaining low density concrete foam in site, for example. This document does not, however, cannot provide any concrete material different from a low density foam, so the application is very limited to specific works and sites.

[0013] Documents as WO 2011064644, EP 2266770 or EP 2238071 describe devices suitable for producing accelerate concrete: these devices, however, cannot provide a tailored concrete material specific for a use under certain conditions, and is not able to be used for providing concrete able to work at any temperature range with suitable mechanical resistances.

[0014] It shall thus be desirable to provide a system than can manufacture, manipulate and lay up concrete, particularly accelerated concrete, that can, at the same time, be able to work independently on the ambient temperature conditions.

[0015] Thus, the present invention is intended to solve the above- mentioned problems.

SUMMARY OF THE INVENTION

[0016] The present invention relates to a system for manufacturing, manipulating and laying-up concrete that can be used in any climatic conditions: the system of the invention can be used for manufacturing, manipulating and laying up standard concrete and also accelerated concrete; even more, standard systems used in the manipulation of standard concrete can be redesigned into these improved systems for manipulating and laying-up concrete that can be used independently of the climatic conditions, including extreme temperature conditions. The system of the invention minimizes emissions and maximizes the efficiency of the mentioned process of manipulating and laying-up accelerate concrete. Particularly, the system of the invention is used for accelerate concrete that is laid up and gets proper mechanical conditions in less than 8 hours, approximately.

[0017] The system for manufacturing, manipulating and laying up concrete allows transferring the dry concrete mix (aggregates and cement) to the job site, allowing that, once on site, the whole mixture is mixed by adding water and admixtures. Therefore, depending on the site conditions (such as temperature) and on the hardening time required, concrete is manufactured just in time, before going to be laid up, and customized or tailored depending on the specific requirements needed and on the laying up conditions.

[0018] The system of the invention comprises a main drum rotatable an comprising aggregates and cement, and several auxiliary tanks independent from the main drum, these auxiliary tanks comprising admixtures and water, being connected to the said main drum through various accuracy measurement devices, so that a given volume of water and admixtures in a given time is supplied to the main drum.

[0019] In addition, the system of the invention comprises a control system that governs the flow of water and admixtures that the auxiliary tanks supply to the main drum, this control system also governing the timing and the order of the dosages, the temperature values and the mixing times, among other parameters, both of the water and of the admixtures added to the mixture. The parameters governing the control system are configured when the system for manipulating and laying of the invention exits the concrete plant, so that no human intervention is required on that system until the concrete mixture is discharged for the laying at job site. On the other hand, the control system is configured so that the main drum begins to rotate commanded by said control system when the dosage of water from the auxiliary tanks to the main drum starts, such that the main drum keeps rotating until the control system instructs the system for manipulating and laying of the invention that the concrete mixture is prepared and ready for being laid.

[0020] Other features and advantages of the present invention will become apparent from the following detailed description of an illustrative embodiment of its ob-

ject in relation to the accompanying figures.

DESCRIPTION OF FIGURES

[0021] Figure 1 is a schematic view of the system to obtain concrete and its various components, according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] A preferred embodiment of the present invention, as shown in Figure 1, refers to a system 1 for manufacturing, manipulating and laying up a concrete mixture, preferably comprising a main drum 10 able to rotate, more preferably a conical rotatable drum, such that this drum 10 comprises aggregates and cement in a certain proportion with a certain weight, defined preferably in a concrete plant, the aggregates and cement having been supplied to the main drum 10.

[0023] The system 1 further comprises a first auxiliary tank 20 independent from the main drum 10, this first auxiliary tank 20 comprising water for mixing the concrete mixture and for cleaning the main drum 10. The mentioned first auxiliary tank 20 is connected to the main drum 10 via a primary accuracy measurement device 2, particularly a precision dispenser, providing a given volume of water at a give time to the main drum 10.

[0024] The first auxiliary tank 20 mentioned above may comprise a heater and temperature control device 5 for the water being provided to the main drum 10, so as to control the temperature of the concrete mixture obtained.

[0025] The system 1 of the invention further comprises at least one secondary auxiliary tank 40, preferably from three to six secondary auxiliary tanks 40, independent from the main drum 10 primary and from the first auxiliary tank 20, these secondary auxiliary tanks 40 comprising different admixtures. Each one of the secondary auxiliary tank 40 is connected to the main container 10 through a measurement device 3. Also, the first auxiliary tank 20 is connected to the main drum 10 through the primary accuracy measurement device 2, particularly precision dispensers batching, such that the secondary auxiliary tanks 40 and the first auxiliary tank 20 provide the main drum 10 the precise amounts of admixture and water at the predetermined times. These secondary auxiliary tanks 40 are pressurized to impulse the admixtures to the main drum 10, and are also thermally isolated.

[0026] The admixtures, coming from the secondary auxiliary tanks 40, are metered to the main drum 10, through a common pipe 60, and also connected to an water impulse pump 50, as to ensure that, after each dose of an admixture, the pipe 60 is cleaned by injecting controlled amounts of cleaning water, coming from the first auxiliary tank 20.

[0027] The system 1 of the invention includes also an injection water pipe 100 to ensure the cleaning of the inside of the main drum 10.

[0028] The system 1 of the invention also comprises a

control system 30 base on a PLC, this control system 30 being connected via a field bus of the type CAN BUS® to absolutely control all of the various devices mentioned above for the system 1. This control system 30, duly programmed with software developed for specific tasks, sends and receives information from and to all the devices to which it is connected, governing such devices in accordance with the reference values for each type of concrete mixture made together with the mode of its laying. The control system 30 also receives preferably in the concrete plant, the aggregate and cement data that are loaded into the main drum 10, also receiving preferably in the concrete plant the reference values for the dosage of each admixture and for the water to be supplied to the concrete mixture, as well as the data of the cycles and the mixing times in the mixture.

[0029] The control system 30 is configured so that the main drum 10 begins to rotate commanded by said control system 30 when the dosage of water of the first auxiliary tank 20 to the main drum 10 begins, such that the main drum 10 keeps rotating until the control system 30 indicates that the concrete mixture is prepared and ready for being laid.

[0030] Joining in the concrete mixture in the main drum 10 of other admixtures and different amounts of each of them, forces the control system 30 controls the various secondary auxiliary tanks 40 mentioned above, and thus the different admixtures, so that the maximum deviation of quantities and temperatures of the admixtures concerned does not affect the mechanical properties of the final concrete mixture obtained.

[0031] The system 1 of the invention performs the mixture and obtention of the concrete mixture at job site: thus, the main drum 10 comprises aggregates and cement, joining them with water and admixtures from the first auxiliary tank 20 and secondary auxiliary tanks 40, respectively, directly at job site. Because of the incorporation to the mixture on site of the water and admixtures, the volume of the later elements must be on average higher than usual, being at the same time desire to have all the components mixed in a short period of time and as evenly as possible.

[0032] Preferably, the system 1 of the invention is incorporated into a vehicle. According to various modifications of the invention, when the system 1 is incorporated into a vehicle, it may further comprise an undercarriage crawler track type to enable access to difficult areas, such as wind farms. Thus, the incorporation of new undercarriage allows the use of the system 1 for the use of the concrete mixture prepared at job site, in places of difficult access, such as wind farms.

[0033] The control system 30 of the system 1 of the invention controls mainly the Mowing parameters in the production of the concrete mixture:

- temperature of water provided by the first auxiliary tank 20;
- temperature of the concrete mixture obtained;

- volume of water dispensed by the first auxiliary tank 20;
- volume of admixtures provided by the auxiliary tanks 40;
- volume of the concrete mixture poured unloaded;
- dosing time of water in the first auxiliary tank 20 through the primary accuracy measurement device 2;
- dosing time of admixtures in the secondary auxiliary tanks 40 through the measuring devices 3;
- time for the batching of the concrete mixture poured unloaded;

[0034] The control system 30 mentioned above may be implemented in a PLC through a given control hardware, implemented according to the specifications of the process and the concrete mixture requirement.

[0035] The system 1 of the invention is preferably used for accelerated concrete that is laid up and gets proper mechanical conditions, of up to 60 MPa as the maximum compression load that can be withstand according to tests of ASTM C39 Standards, in less than 8 hours, preferably. Tests show that in less than 8 hours from the lay up, accelerated concrete provided by the system 1 of the invention has a compression load typically of 30 or 40 MPa, approximately. Moreover, the system of the invention is used for concrete that can work at temperatures above 45°C and below -5 °C, thus providing a system 1 that is able to work at any temperature range. Besides, the system 1 is able to provide concrete tailored and made on site as a function of the ambient temperature conditions where concrete is going to be laid up, of the hardening time and of the stiffness needed after the mentioned hardening time, by means of the control system 30 in the system 1. As the system 1 makes the concrete and lays it up in site, the system 1 of the invention can be used independently on the distance of the work site where the concrete mixture is needed.

[0036] One object of the system 1 of the invention is to have higher energy efficiency: because the main drum 10 is not rotating continuously, as in the prior art to prevent the concrete from hardening, the energy consumption of the system 1 is much smaller than that known so far. It is estimated that, when the system 1 is implemented in a vehicle, it consumes an average of 2,000 litres less fuel per year than in the case of the traditional truck mixer.

[0037] Regarding road safety, assuming that the system 1 is integrated into a concrete mixer trucks vehicle, since the main drum 10 is held stationary (not rotating) until arriving at the job site, vehicle carries the load in a centred position, therefore there are no inertia moments applied on it, so the vehicle is much more stable. This leads to a positive impact on road safety and contributes to reduce occupational risks of the truck vehicle driver, and therefore those of other users of public roads.

[0038] Another major advantage of the system 1 is to reduce CO₂ emissions: taking into consideration the energy estimate given above, assuming CO₂ emissions of

750 g/km and a typical consumption of 30 litres/100 km, the impact in the environment would be reduced by 4,5 tonnes Of CO₂ per vehicle per year.

[0039] With respect to productive approach, since the transport of material is dry, geographic barriers are solved, being able to cover any job site, regardless of the distance between the job site and the concrete plant.

[0040] It is also possible to transport high-strength concrete with the system 1, which means that you can use in any work a rapid hardening concrete. Traditionally, because these concrete mixtures have very short hardening periods, it has not been possible its use with conventional transportation. However, by the use of the system 1, these concrete mixtures could be useful in applications requiring a very small reaction time, rapid works that have to be done, at extreme high or low temperature conditions, such as:

- civil protection in disaster cases;
- military Applications;
- skyscraper or very high buildings;
- prefabricated structures (as the productivity is improved);
- repairation of roads pavement;
- repairation of airport tracks;
- repairation of train sleepers;
- underground constructions, such as tunnelling, as the working time is highly reduced;
- any work that has to be done in a short time, thus being labour work highly minimized.

[0041] As a summary, some of the main advantages of the system 1 of the invention are indicated herewith:

- the system 1 provides concrete that can be used in any range of temperatures, including extreme ranges of both low and high temperatures;
- negative secondary defects, such as cracking, are minimized;
- the system 1 allows to have the advantages of concrete manufactured in site (production control, reduction of waste materials) without having the problems associated to that (quality dispersion, limited use to non-structural applications);
- human errors are minimized;
- the system 1 can be used in remote areas and do not have the traditional limitation of 1 hour distance maximum;
- quality of products obtained can be tested in site;
- the quality of additives for the accelerated concrete in the system 1 of the invention is standard and cost-effective;
- the system 1 is preferably used in reparations needed in a very short time or for works that need to be finished very quickly;
- improved logistics for laying concrete due to the short period of time between adding the liquid portion to the solid part of the concrete (aggregates & sand);

- Improved quality of the concrete due to the better fabrication process of it, and the possibility to fine tune all the elements composing the concrete.

[0042] In the preferred embodiments described above modifications within the scope define by the following claims can be introduced.

Claims

1. System (1) for manufacturing, manipulating and laying-up concrete, comprising a main drum (10) able to rotate comprising aggregates and cement, **characterized in that** it comprises at least one auxiliary tank (20) independent from the main drum (10) comprising water and at least one secondary auxiliary tank (40) independent from the main drum (10) comprising an admixture, the system (1) also comprising a control system (30) connected to the auxiliary tank (20) and to the secondary auxiliary tank (40), governing the flow of water and admixtures supplied to the main drum (10), the control system (30) being configured so that the main drum (10) begins to rotate commanded by said control system (30) when the dosage of water from the auxiliary tank (10) to the main drum (10) starts, such that the main drum (10) keeps rotating until the control system (30) instructs the system (1) that the concrete mixture is prepared and ready for being laid.
2. System (1) according to claim 1, wherein the control system (30) governs the following parameters of the water in the auxiliary tank (20) and of the admixture in the secondary auxiliary tank (40): timing and order of these dosages, the temperature values and the mixing times.
3. System (1) according to any of claims 1-2, wherein the secondary auxiliary tank (40) and the auxiliary tank (20) are connected to the main drum 10 through a measurement device (3) and through a primary accuracy measurement device (2), respectively, to provide the main drum (10) the precise amounts of admixture and water at the predetermined times.
4. System (1) according to any of the previous claims, wherein the auxiliary tank (20) comprises a heater and a temperature control device (5) for the water being provided to the main drum (10).
5. System (1) according to any of the previous claims, wherein the secondary auxiliary tank (40) is pressurized to impulse the admixtures to the main drum (10), and is also thermally isolated.
6. System (1) according to any of the previous claims, wherein the admixtures coming from the secondary

auxiliary tank (40) are metered to the main drum (10) through a common pipe (60), being also connected to a water impulse pump (50) to ensure that, after each dose of an admixture, the pipe (60) is cleaned by injecting water from the first auxiliary tank (20).

7. System (1) according to any of the previous claims, wherein it also comprises an injection water pipe (100) for cleaning the inside of the main drum (10) with water from the first auxiliary tank (20).
8. System (1) according to any of the previous claims, wherein the control system (30) is implemented in a PLC through a control hardware, implemented according to the specifications of the process and the concrete mixture requirement.
9. System (1) according to any of the previous claims, used for manufacturing, manipulating and laying-up accelerated concrete that prosper mechanical conditions, of up to 60 MPa, in less than 8 hours.
10. System (1) according to any of the previous claims, used for manufacturing, manipulating and laying-up concrete that can work at temperatures above 45°C and below -5 °C.
11. System (1) according to any of the previous claims, used for manufacturing, manipulating and laying-up concrete tailored and made on site as a function of the ambient temperature conditions where concrete is going to be laid up, of the hardening time and of the stiffness needed after this hardening time, by means of the control system (30).
12. Vehicle comprising a system (1) for manufacturing, manipulating and laying-up concrete according to any of claims 1-11.
13. Vehicle according to claim 12 wherein it further comprises an undercarriage crawler track type to enable access to difficult areas, thus allowing the use of the system (1) for concrete mixtures prepared at job site.
14. System (1) according to any of the previous claims, used for manufacturing, manipulating and laying-up concrete that can work at temperatures above 45 C and below -5 °C.

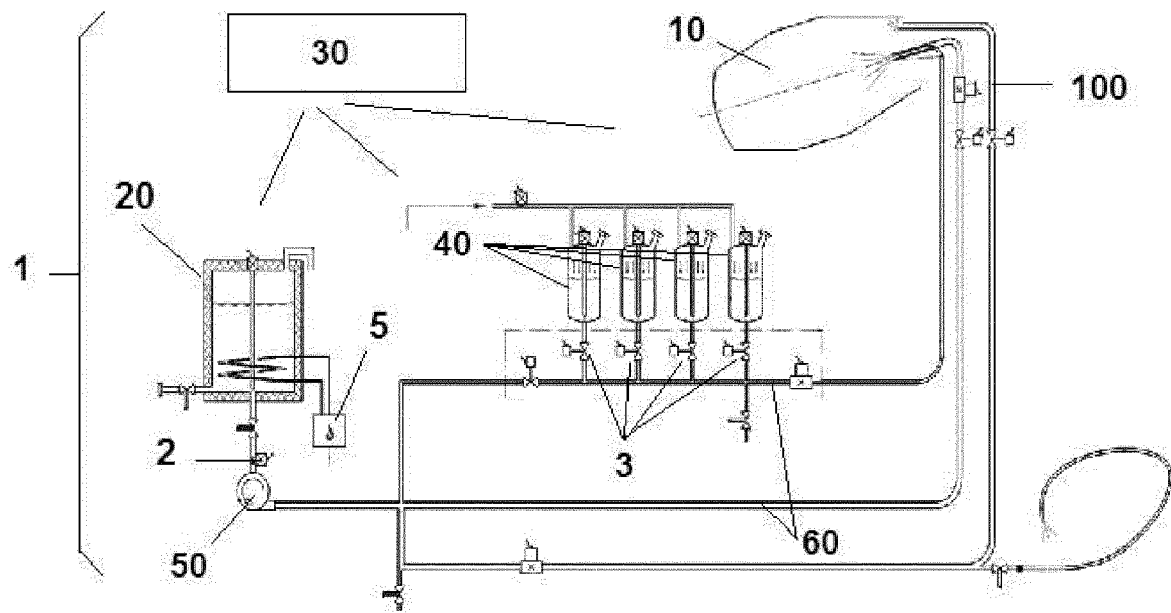


FIG. 1



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Place of search The Hague		Date of completion of the search 9 October 2012	Examiner Voltz, Eric
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EPO FORM 1503 03.82 (P04C01)



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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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