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(54) Formwork member, formwork, pouring and curing plant and related method for making building elements

(57) A formwork member (3) and a related formwork allows an effective curing of the concrete regardless the external temperature, and comprises: a first heating layer (6), placed substantially adjacent to the curing concrete (2); and a second insulating layer (5), placed at the exterior of said first heating layer (6).

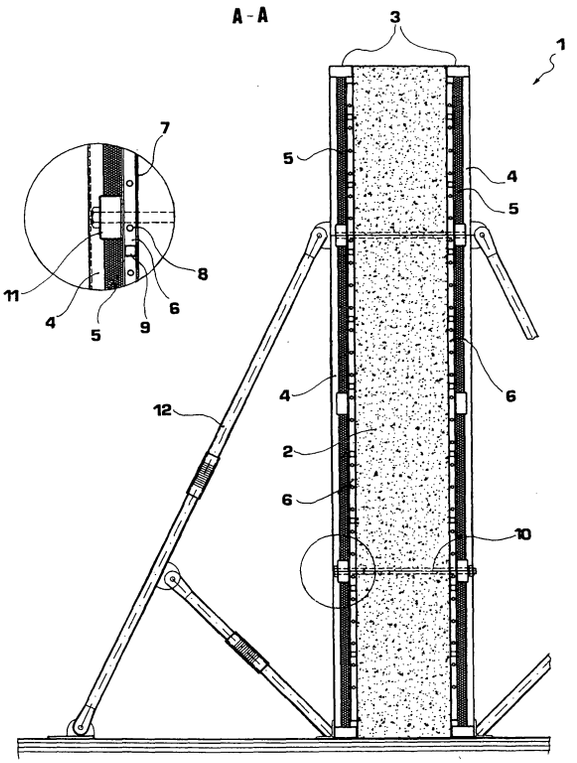

FIG. 2

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Description

[0001] The present invention is related to a formwork member, and to a formwork obtained by assembling such member as well, a plant for the pouring and the curing using said formwork for making building elements as wall, basements, pillars etc.

[0002] In the building art, formworks are known since ancient times ; the function thereof is to contain and shape cement-based material to achieve the curing or the maturation thereof, so allowing the making of a building element.

[0003] The maturation consists in a chemical reaction of hydration: water reacts with the cement transforming the concrete grains in crystals which, interacting with each other, cure the element.

[0004] In the maturation, the concrete need to breath, because the hydration process is an exothermic reaction causing the water evaporation from the liquid concrete. The weather conditions, in this phase, are fundamental because too low temperatures may produce ice crystals in the structure which, once melted, may weaken the resulting structure.

[0005] To obviate to these problems, additives may be used in the concrete, but it is not desirable to not condition the concrete composition according to the weather. Further, the harshness of the climate may slow down the maturation process and influence the humidity content within the concrete.

[0006] In the state of the art, formworks are known whose members comprise an insulating layer to keep the internal heat of the maturing building element, but they do not solve the above problem in a completely satisfactory manner.

[0007] The technical problem at the root of the present invention is to provide a formwork member and hence a formwork and a related method of poring and curing allowing to obviate to the drawback mentioned with reference to the prior art.

[0008] Such a problem is solved by a formwork member as above specified, comprising:

* a first heating layer, placed substantially adjacent to the curing concrete; and

* a second insulating layer, placed at the exterior of said first heating layer.

[0009] The main advantage of the formwork member according to the present invention lies in allowing a temperature control of the maturation process, releasing it from the formwork external temperature.

[0010] According to the same inventive principle, the present invention is also related to a pouring and curing method, wherein the concrete is poured in a formwork carried out by formwork member as above defined, and wherein the heating layer of the formwork member is heated at least to a temperature of 70˚C.

[0011] In a preferred embodiment of the above method, said heated layer is heated since 90 minutes after the curing starting, but preferably not later than 12 minutes.

[0012] Always according to the invention, a pouring and curing plant for the making of a building element comprises one or more formworks carried out by formwork members as above defined, and heating means of the heating layer of said formwork members.

[0013] The present invention will be described hereinafter, according to a preferred embodiment thereof, given with exemplificative and non limitative purpose in connection with the annexed drawings wherein:

* Figure 1 shows a front view of a formwork member according to the invention;

* Figure 2 shows an elevation cross-sectional view of a formwork involving members of the preceding figure, with a building element curing; and

* Figure 3 schematically depicts a pouring and curing plant according to the invention.

[0014] With reference to figures 1 and 2, a formwork including formwork members according to the preferred embodiment of the present invention is indicated 1 as a whole. It encloses a wall 2 in reinforced concrete and comprises opposing formwork members 3 to form a shell.

[0015] Each formwork member 3 comprises a framework 4 made of steel tubular members, supporting the body or the panel of the member, substantially plate-shaped. The formwork member 3 comprises an insulating layer 5 made of an appropriate material, e.g. polyurethane or polystyrene with a suitable thickness, for example 40 mm.

[0016] The formwork member 3 further comprises a heating layer 6, adjacent to said insulating layer 5. Considering the formwork 1 with respect to the building element in production, the insulating layer 6 is the first layer placed substantially adjacent to the concrete curing, and the insulating layer 5 is the second layer placed at the exterior of said first heated layer.

[0017] The heating layer 6 is embodied by a pair of parallel sheets 7 enclosing heating members 8. The sheets 7 are kept at a constant distance by spacing members 9, constituted by tubular sections longitudinally extending with respect to the heating layer 6.

[0018] In the present embodiment, the heating members 8 are carried out by pipes run through by a heating liquid, made of metal, preferably copper. It is understood that the heating members 8 are in thermal transfer communication with the concrete, the pipes being in contact with the steel sheet 7 which is in contact with the concrete.

[0019] However, the pipes are electrically insulated to not create dielectric bridges.

[0020] The sheet steel will be appropriately selected to allow the reuse of the formwork member.

[0021] The gap between the sheets 7 is suitably filled up with a thermal storage material, for example water-based, i.e. a mixture of water antifreeze agent, in appropriate proportions, e.g. 65%-35%.

[0022] The formwork 1 further comprises tie members 10 keeping the formwork members 3 in their position and crossing the above layers 5, 6, with nut-and-bolt works placed at the insulating layer 5. External posts 12 are also provided.

[0023] With reference to figure 1, the framework 1 comprises a rectangular-shaped frame 20, with horizontal tubular sections supporting said layers 5, 6.

[0024] Inside the heating layer 6, the pipes 8 extend between a pair of manifolds, delivery 21 and receiving 22. The pipes can be coupled in parallel or in series, with a coil configuration.

[0025] With reference to figure 3, a pouring and curing plant pf a building element comprises formworks as previously described, with framework members comprising heating members forming distinct thermal circuits indicated as A, B, C and D.

[0026] These circuits are supplied with a heating fluid through a heat generator, a delivery conduit 31 and a return conduit 32. The fluid circulation is driven by a station 33 having a circulation pump and a possible storage reservoir 34 constituting a fluid supply.

[0027] Said heat generator 30 is embodied by a boiler and constitutes heating means of said heating layers 5.

[0028] In the present embodiment, the fluid is a heat-carrier fluid suitable to this task. It can be water or comprise a mixture of water and an antifreeze agent, in suitable proportions, e.g. 65%-35%. A conventional antifreeze agent can be used.

[0029] At the delivery conduit, the plant comprises a first delivery valve 36, a relief valve 40, a delivery thermometer 39. At the return conduit, the plant comprises a return thermometer 38, a by-pass valve 37 and a discharge valve 35.

[0030] It is understood that the circuits in which the plant is sub-divided are coupled in parallel, to minimize the temperature difference between the delivery and the return conduits.

[0031] In the pouring and curing method according to the invention, the heating fluid into the heating members 8 is kept at a temperature of at least 80˚C, preferably within the range 80˚-90˚C.

[0032] Some tests allowed to understand that the curing process is optimized if the heating fluid is circulated at least 90 minutes after the pouring, preferably after a time period within the range 90-120 minutes.

[0033] In this way, the concrete quickly acquires its own compression strength in a reduced time, even two days. The heating can be maintained for a period of 24 hours, in any case at least 8 hours.

[0034] It is understood that the above heating can be carried out through different techniques with respect to the above, without departing from the base inventive concept.

[0035] For example, the heating members can be made by electrical heater or by a hot-air circulation system in a gap within the heating layer.

[0036] According to a variant, the above described ducts 8 may be replaced by paths formed by leaves transversal to the sheets 7.

[0037] To the above described formwork member, formwork, pouring and curing plant and method a skilled man, to achieve further and contingent needs, may introduce several additional variants and modifications, however all of them falling within the protection scope of the present invention, as defined in the appended claims.

Claims

1. Formwork member (3) comprising:

* a first heating layer (6), placed substantially adjacent to the curing concrete (2); and
* a second insulating layer (5), placed at the exterior of said first heating layer (6).

2. Formwork member (3) according of claim 1, wherein the heating layer (6) is embodied by a pair of parallel sheets (7) enclosing heating members (8) .

3. Formwork member (3) according of claim 2, comprising thermal storage material between said pair of sheets (7).

4. Formwork member (3) according of claim 3, wherein said thermal storage material is water-based.

5. Formwork member (3) according of claim 4, wherein said thermal storage material is a mixture of water and antifreeze agent.

6. Formwork member (3) according of claim 2, wherein the heating members (8) are made by pipes run through by a heating liquid in thermal transfer communication with the concrete.

7. Formwork member (3) according of claim 6, wherein the pipes run through by a heating liquid extend between a pair of manifolds (21, 22).

8. Formwork member (3) according to any of the preceding claims 2 to 7, wherein the heating members (8) form distinct thermal circuits (A, B, C, D) coupled in parallel.

9. Formwork member (3) according of claim 6, wherein the pipes run through by a heating liquid are electrically insulated.

10. Formwork member (3) according to any of the preceding claims, wherein a framework (4) is provided,

comprising a rectangular-shaped frame (20) with tubular sections supporting said layers (5, 6).

11. Formwork (1), assembled by formworks members (3) according to any of the preceding claims.

12. Pouring and curing plant for the making of a building element comprising one or more formworks (1) carried out by formwork members (3) according to any of the preceding claims 1 to 10, further comprising heating means (30) of the heating layer (5) of said formwork members (3).

13. Pouring and curing plant according of claim 12, wherein said heating means comprises a heat generator (30) with a boiler, connected through a delivery conduit (31) and a return conduit (32) to said heating layers (5).

14. Pouring and curing plant according of claim 13, wherein said heat generator (30) is connected to a station (33) with a circulation pump and a storage reservoir (34).

15. Pouring and curing plant according to any of the preceding claims 12 to 14, wherein the fluid comprises a mixture of water and antifreeze agent, in suitable proportions.

16. Pouring and curing method wherein the concrete is poured in a formwork (1) according to claim 11, wherein the heating layer of the formwork members is heated to a temperature of at least 80˚C.

17. Pouring and curing method according of claim 16, wherein the heating layer of the formwork members is heated to a temperature within the range 80˚ to 90˚.

18. Pouring and curing method according of claim 16 or 17, wherein the heating layer of the formwork members is heated at least 90 minutes after the pouring.

19. Pouring and curing method according of claim 16 ○ 17, wherein the heating layer of the formwork members is heated after a period of time within the range of 90 to 120 minutes.

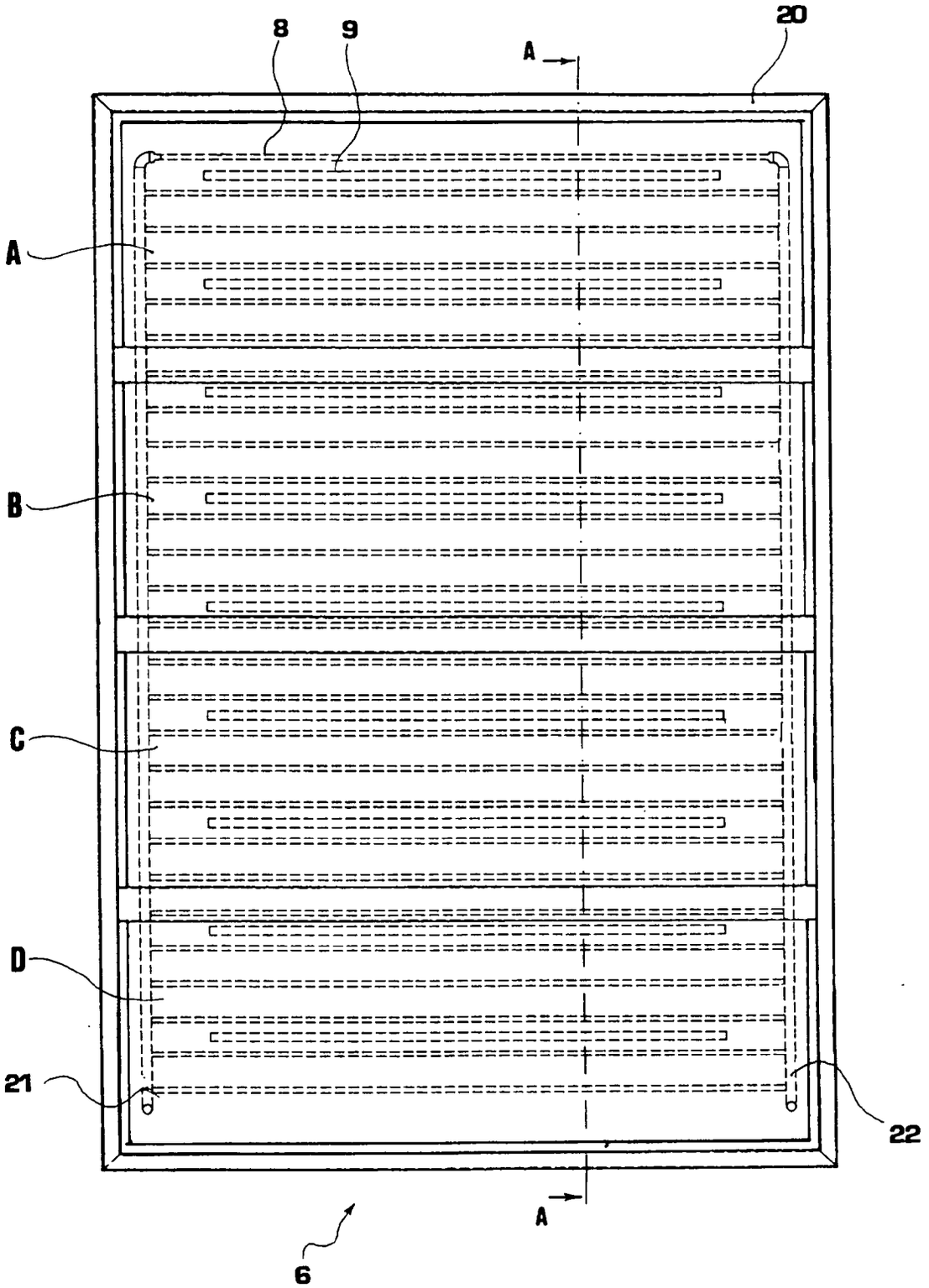

FIG.1

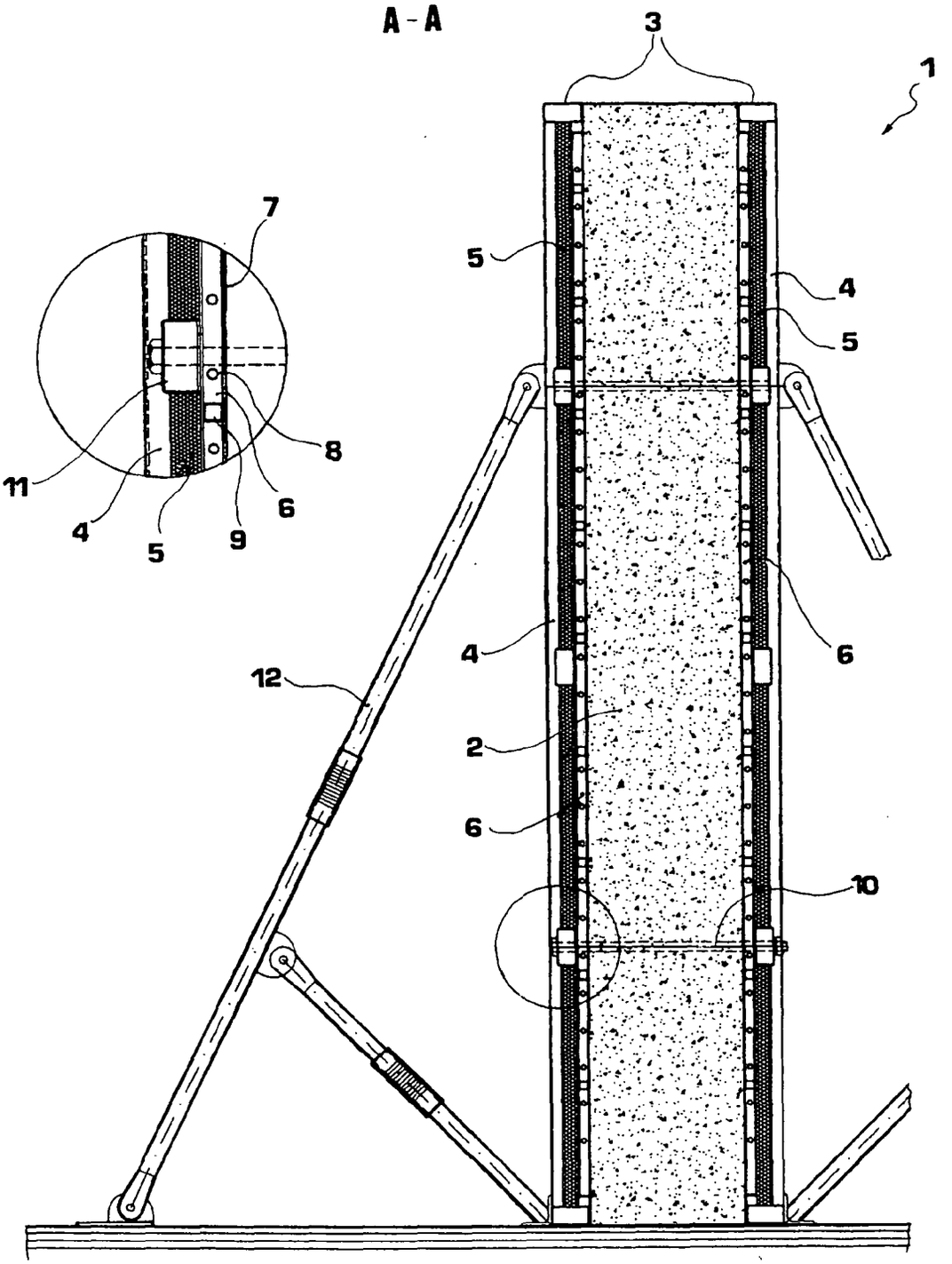

FIG.2

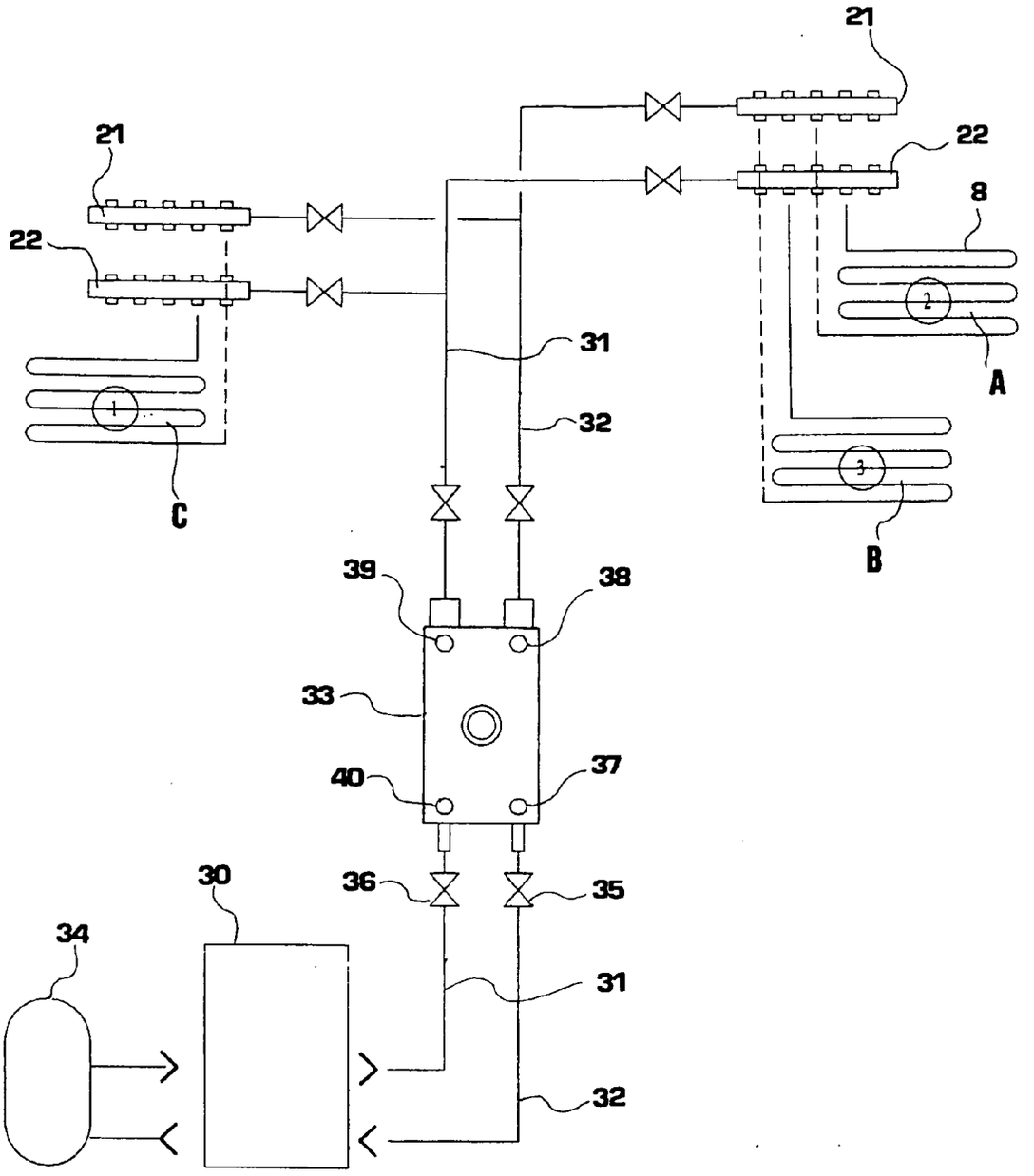

FIG.3

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EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5138

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 July 2007	Scharl, Willibald

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EUROPEAN SEARCH REPORT

Application Number
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