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(54) Title: MANUFACTURING METHOD OF A HEAT-RESISTANT MATERIAL, HEAT-RESISTANT STRUCTURE, STRUCTURAL MATERIAL AND DRY MATTER COMPOSITION

(57) Abstract: The invention relates to a method for manufacturing a heat-resistant and heat-insulating structure. According to the invention, a dry matter composition is formed containing 10-60 w-% fine fraction the particle size of which is < 0.1 mm and which includes a dry component that binds air bubbles, and 40-90 w-% coarse fraction the particle size of which is > 0.1 mm, and 5-20 w-% water is mixed into the dry matter composition to form a substantially homogenous and flowing structural material, and the structural material is moulded into the desired structural shape, and water is evaporated from the structural material to form a heat-resistant and heat-insulating structure. Furthermore, the invention relates to a heat-resistant and heat-insulating structure, as well as to a structural material and dry matter composition for use in the manufacture of a heat-resistant and heat-insulating structure.



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MANUFACTURING METHOD OF A HEAT-RESISTANT MATERIAL,
HEAT-RESISTANT STRUCTURE, STRUCTURAL MATERIAL AND DRY
MATTER COMPOSITION

The invention relates to a production method
5 of a heat-resistant and heat-insulating structure as
defined in the preamble of claim 1, a heat-resistant
and heat-insulating structure as defined in the pream-
ble of claim 18, a structural material as defined in
claim 20, and a dry matter composition as defined in
10 the preamble of claim 21 for use in the manufacture of
a heat-resistant and heat-insulating structure, and
the use of a heat-resistant and heat-insulating struc-
ture as defined in the preamble of claim 22 in metal-
lurgic processes, heat production processes, cooling
15 processes and processes that require a high tempera-
ture.

A heat-resistant and heat-insulating struc-
ture or structural material is herein used to mean a
structure or structural material which can be used as
20 a structure and an insulator also at high tempera-
tures, even up to 1500°C, without transformations,
e.g. on the so-called hot surfaces of process equip-
ment, such as furnaces, heat exchangers, etc.

Previously known are various heat-resistant
25 insulating masses for use as insulation structures at
high temperatures in the field of industry. The insu-
lation capability of heat-resistant masses can be im-
proved by increasing the porosity of the mass, e.g. by
regulating the particle size distribution and shape of
30 the particles, by burning or thermally decomposing
components originally added to the mixture, by arrang-
ing hollow or porous components in the mass or by
forming gas bubbles in the mass.

Known in prior art from publication US
35 4158685 is a method and composition for manufacturing
a fire-resistant, insulating and foamed structure. In
the method, a mixture of water and dry matter is

formed, the dry matter containing at least 7.5 w-%, e.g. 10 w-%, cement and 0-50 w-%, e.g. 20 w-%, clay/aluminium oxide, and in addition e.g. 70 w-% fire-resistant aggregate, such as 20 w-% alumina and 50 w-% chamotte. The cement consists mainly of calcium aluminates. After that, a foamed mixture of water, foaming agent and air is formed, which mixture is mixed with a water/dry matter mixture to form a foamed suspension. The water content in the final mixture is 25-40 w-%. The suspension is moulded, and the article is dried and thermally treated.

Known in prior art from publication US 4307197 is a composition containing 45-80 w-% MgO, 1-7 w-% fire-resistant clay-filler, 1-15 w-% fire-resistant glass wool fibre, 3-10 w-% aqueous colloidal silica binder and 0-15 w-% graphite, foaming agent and dispersing agent. One exemplary composition contains 70-80 w-% MgO, 2-7 w-% fire-resistant kaolin clay, dried in a furnace, 5-10 w-% silica alumina glass wool fibre, 5-10 w-% graphite, 0.1-0.5 w-% foaming agent and 5-7 w-% binder. The concentration of moulding water in the mixture is 30-40 w-%.

Known from publication EP 0677495 A2 is an inflatable, fire-resistant and insulating composition containing a dry component and a liquid binding agent. The dry component contains about 10-90 w-% an innoxious, low-density, fire-resistant and insulating material and about 10-90 w-% a high-density fire-resistant material, the total density being about 641-2082 kg/m³. The binding component contains aqueous colloidal silica. The fire-resistant composition contains binding agent to such an extent that there is in the composition about 20-80 w-% aqueous colloidal silica in relation to 100 w-% of dry component.

The preparation of known, air-entrained insulation mass compositions is complicated. The masses

are usually prepared in many phases and with several different equipment.

The problem with most of the known compositions is their high water content, which is conventionally more than 25 w-%, which makes the evaporation of water from the structure slow and difficult, and requires a lot of energy. Further, the mechanical resistance, volume stability and insulation properties of known compositions are chiefly not sufficient. Furthermore, the known insulation masses are not self-flowing, and thus not directly mouldable in difficult and confined targets of applications, or arrangeable in complicated casting moulds. A powerful vibration or other external compaction technique must be used in the moulding of the insulation masses, which worsens the porosity and adds to the costs.

One further problem with the known compositions is the formation of the water/dry matter mixture directly. In that case, their preservability is poor, and the compositions must be prepared just before use. Due to this, the transportation is more complicated and costlier. In addition, many previously known insulation masses contain such fibrous components that can be harmful to the health.

The objective of the invention is to overcome the aforementioned disadvantages. One specific objective of the invention is to disclose a new, more easily mountable and more durable composition that is fire- and heat-resistant, as well as method for preparing it. One further objective of the invention is to disclose a new structural material composition in which the content of moulding water is low compared to known compositions, as well as a new, separate dry matter composition.

Characteristic of the method and compositions in accordance with the invention is what has been described in the claims.

The invention is based on a method for forming a heat-resistant and heat-insulating structure. The structure can be used in difficult and confined objects which often are difficult to mould and which may involve a high temperature, e.g. more than 1500°C. According to the invention, a dry matter composition is formed containing 10-60 w-% fine fraction of dry matter the particle size of which is < 0.1 mm and which includes a dry component that binds air bubbles, and 40-90 w-% coarse fraction of dry matter the particle size of which is > 0.1 mm. Prior to the moulding phase, 5-20 w-% water is mixed into the dry matter composition, preferably in the vicinity of the target of application, to form a substantially homogenous and flowing, i.e. a self-flowing structural material without compaction. The structural material is substantially self-flowing and self-smoothing, and can be moulded into the desired structural shape. Water is evaporated from the structural material to form a heat-resistant and heat-insulating and porous structure which preferably does not contain water.

In one embodiment of the invention, the coarse fraction contains a so-called aggregate, which can preferably consist e.g. of different types of chamottes, aluminium oxides, burned bauxite clay, aluminium silicates, magnesium silicates, sillimanite, andalusite, kyanite or other natural silicates, such as e.g. phlogopite, serpentine, and vermiculite, and/or of silica or mixtures thereof or corresponding compounds. The density of the aggregate can be 2.0-4.0 kg/l, depending on the requirements of the insulation capability, heat- and fire-resistance and process conditions. The dry matter composition contains coarse fraction in an amount of 60-70 w-% $\pm$ 10-20 w-% of the total amount of the dry matter. The coarse fraction can contain any known heat- and/or fire-resistant aggregate; important is only that the dry matter compo-

sition can be made self-flowing in conjunction with the addition of a small amount of moulding water.

In one embodiment of the invention, the fine fraction contains a polymer that binds air bubbles. In one embodiment, the fine fraction contains 0.05-0.5 w-% polymer that binds air bubbles as calculated from the total amount of the dry matter. The polymer that binds air can be a tenside or a non-tenside or any polymer that binds air. In one preferred embodiment, as the tenside, an ethoxylated fatty alcohol having the formula $R (OC_2H_4)_nOH$ is used. In an alternative embodiment, as the component that binds the air bubbles, it is possible to use e.g. sodium lauryl sulphate, sodium alkene sulphate, fatty alcohol sulphate, modified tall oil-based resin soap, modified resin soap, a mixture of anionic surfactants, a mixture of anionic and non-ionic surfactants or the like.

In one embodiment of the invention, the fine fraction contains a binding agent. In one embodiment, the fine fraction contains less than 20 w-% binding agent, more preferably 8-16 w-% as calculated from the total amount of dry matter. As the binding agent it is possible to use e.g. calcium aluminate cement or the like.

In one embodiment of the invention, the fine fraction contains a fine fraction and/or fine-grained aluminium oxide that has been formed from an aggregate and/or material selected from the group consisting of chamotte, aluminium oxide, aluminium silicates, magnesium silicates, sillimanite, andalusite, kyanite, other natural silicate, silica or a mixture thereof. In one embodiment, the fine fraction contains 1-35 w-%, calculated from the total amount of aggregate, fine fraction and/or fine-grained aluminium oxide that has been formed from an aggregate and/or material selected from the group consisting of chamotte, aluminium oxide, aluminium silicates, magnesium silicates, silli-

manite, andalusite, kyanite, other natural silicate, silica or a mixture thereof. The fine fraction preferably contains 1-15 w-% fine-grained aluminium oxide from the total amount of dry matter. The aluminium oxide can be so-called special aluminium oxide, e.g. re-
5 active aluminium oxide or calcinated aluminium oxide.

In one embodiment of the invention, the fine fraction contains at least one additive. As the possible additives it is possible to use an additive regulating the need for water, an additive improving the
10 flowability, an additive improving the dispersing, an additive improving the chemical resistance, an additive and/or a stabiliser that prevents the air bubbles from surfacing, or a corresponding additive.

15 In one preferred embodiment, the dry matter preferably contains 30-50 w-% fine fraction.

In one embodiment of the invention, the dry matters are mixed to form a substantially homogenous dry matter composition. In one embodiment, the dry
20 matter composition is put into bags and transported into a storehouse or into the vicinity of the target of application. The storage period of dry matter is at least 6 months.

In one embodiment of the invention, the dry
25 matter is mixed with moulding water, e.g. with some conventional mixer, preferably a minimum of 3 minutes to form a structural material, e.g. in the vicinity of the target of application.

In one embodiment of the invention, the wet
30 structural material mass formed from water and dry matter by mixing is moulded into the desired shape in less than 2 hours after the dry matter composition and water has been mixed. In one embodiment, the wet structural material mass is moulded by means of moulds
35 directly into the target of application, preferably without vibration, to achieve the desired result. In one embodiment, a structural part is formed from the

wet structural material mass, which structural part can be attached to the desired target of application.

In one embodiment, slight vibration can be used in the compaction of the structural material into the mould or target of application. In vibration one must note that it raises part of the created air bubbles into the surface of the structure, thus worsening the insulation capability of the structure being generated.

In one embodiment of the invention, after the moulding, water is removed substantially from the structural material by evaporation to form a heat-resistant and heat-insulating structure. In one embodiment, water is evaporated from the structural material at a temperature of 20-400°C. In one embodiment, the structural material is heated first to a temperature of less than 100°C, whereby the material starts to slowly dry. Water can be evaporated preferably by steps.

In one embodiment of the invention, the heat-resistant and heat-insulating structure is treated with heat, e.g. at 400-1200°C, after the structural material has been dried, e.g. after the evaporation of water. In one embodiment, the heat-resistant structure is sintered after the evaporation of water to improve the mechanical resistance. The sintering can be performed e.g. at about 1500°C.

The insulating capability of the structure in accordance with the invention is preferably improved by means of the relatively high porosity of the structure, which is achieved by means of a component, such as polymer, included in the fine fraction and binding air bubbles, as well as by means of the porous spots created in the drying of the moulding water. By means of the polymer and the amount of water it is possible to regulate the porosity. In one preferred embodiment, the pore volume of the structure is about 35-50% by

volume, more preferably about 40-45% by volume, as calculated from the volume of the entire structure. Preferably, about half of the pore volume is created through the air bubbles bound by the polymer and half
5 when the water evaporates from the structure. By achieving pores in the structure it is also possible to prevent steam explosions created in the evaporation of water.

In one preferred embodiment, the fire and
10 heat resistance of the insulating structure is more than 1500°C, preferably even 1800°C. The fire and heat resistance can be determined according to volume 2 of DIN standard 51063, by means of Seger's beam test. The fire- and heat-resistant structure can be determined
15 so that when, based on the aforementioned test, the beam is bigger or as big as No. 18, the structure can withstand a temperature of more than 1500°C.

The invention enables one to achieve a method for forming a heat- and fire-resistant, porous and
20 heat-insulating structure that is simpler and considerably more advantageous than before. In the method of the invention for forming a heat- and fire-resistant structural material and structure no several, separate phases nor special equipment, such as a foam generator, mass pump or vibration devices, are needed.
25

According to the invention, a dry matter composition containing substantially all the dry matters needed in the formation of a heat-resistant structure but not containing liquid is formed. The dry matter
30 composition can be transported into the vicinity of the target of application as a dry matter, which reduces the costs and adds to the storage period of the composition and thus the life cycle. The dry matter composition can be stored for a period of 6 months or
35 more. The moulding water can be mixed into the dry matter only in the area of application.

The invention has the advantage that the structural material composition is homogenous, self-flowing and self-smoothing, in which case it can be easily and directly shaped into the desired shape, or
5 it can be moulded directly into the target of application. No separate compaction or vibration is needed in the moulding.

Further, the invention has the advantage that in the structural material composition, the concentra-
10 tion of moulding water is low. Due to the low concentration of moulding water, the structural material is easier, faster and more advantageous to dry, and the energy requirement is low in the drying.

The invention enables one to achieve a me-
15 chanically firm and durable structure having an excellent heat and fire resistance. The structure has good insulation capabilities as well as mechanical properties, e.g. compression and bending strength and stress resistance. The volume stability of the structure is
20 very good; after burning at a maximum operating temperature, the shrinkage is almost 0%, or the structure may even expand, which is considered a positive property. Also the form stability of the structural material in conjunction with drying is very good. Further-
25 more, the structural material and structure in accordance with the invention can be used to substitute previously known structures which consist of two or more structural layers to be mounted separately.

Furthermore, an advantage of the invention
30 are the advantageous manufacturing costs of the structure, which are due to the inexpensive raw material and equipment costs. No additives need to be added to the composition in the moulding phase. Furthermore, the compositions of dry matter and structural material
35 do not contain substances harmful to the health, instead their handling is safe.

The heat-resistant and heat-insulating structural material and structure of the invention are well applicable for use in various targets of application, and the method of the invention is applicable for use
5 in preparing various heat-resistant structures in various conditions which require an insulating material for high temperatures, such as furnaces, heat exchangers, boilers, columns and other corresponding equipment and processes in metal industry, oil refineries, chemical pulp industry, metallurgic industry,
10 power plants, etc. The structural material can be used for forming various articles, coatings and back linings of a different size.

In the following, the invention will be described in more detail with reference to the examples of its embodiments.
15

Example 1

20 In a test, a dry matter composition was prepared containing in total about 95 w-% chamotte and aluminium oxide in a fine and coarse fraction; as the polymer binding air bubbles, about 0.1 w-% an ethoxylated fatty alcohol tenside (trade name Silipon
25 RN8018) having the formula $R(OC_2H_4)_nOH$; as the binding agent, about 5 w-% calcium aluminate cement, and in addition less than 0.1 w-% additives. The aforementioned dry components were mixed with one another to form a homogenous dry matter composition. The granular
30 size of the dry matters ranged between 0-6 mm, of which 30 w-% was fine fraction (particle size less than 0.1 mm) and 70 w-% was coarse fraction (particle size more than 0.1 mm). The dry matter was put into bags and transferred into the direct vicinity of the
35 target of application, wherein moulding water was added to the dry matter composition, and the dry matter/water mixture was stirred for 4 minutes in such a

manner that the water content in the created structural material was about 10 w-%. As a result, a structural material in a self-flowing state was achieved.

5 Example 2

The structural material as shown in Example 1 was formed to be a fire-resistant, heat-insulating structure by moulding the wet structural material into
10 a mould in two hours from the addition of the moulding water. The moulding technique is a technique known per se, and is not described more fully herein.

The structural material was dried after the removal of the mould first by air drying in room temperature for 1 day, after which the actual drying was
15 performed in phases while raising the temperature, and the end phase was performed at 400°.

The density of the produced structure was about 1.8 kg/l, total porosity was about 41% by volume
20 (110°C), cold crushing strength 20 MPa, hot pressing strength (1000°C) 35 MPa, hot length (1000°C) 0.68% and the change in length after the burning at 1300°C - 0.15% and at 1500°C +1.2%.

25 Example 3

This test examined the use of the structure as shown in Examples 1 and 2 in a dummy basin as a so-called well block, inside which an instrument was
30 mounted, through which molten steel flows in a metal production process. The results were compared with the results obtained from the use of a previously known and used well block.

Table 1 shows the operating properties of
35 both the structure (Structure 1) of the invention and those of a corresponding previously known structure 2).

Table 1

Properties	Structure 1	Structure 2
Highest operating temperature, °C	1550	1600
Porosity, % by volume	41	17
Mass consumption, kg/m ³	1700	2800
Granular size	0-6	0-6

Structure 1 has a clearly higher porosity due
5 to the composition in accordance with the invention,
wherein the porosity is obtained by means of both the
air bubbles bound by the polymer and the evaporation
of the amount of water.

The time between the examinations with both
10 well blocks was about eight days. The well blocks in
accordance with the invention were used during the
test period in 150 dummy basins and in a total of 550
meltings. Reference well blocks (Structure 2) were
used in 113 dummy basins and 338 meltings.

15 The examination showed that the heat content
of molten metal remains better, i.e. the temperature
at the upper end of an instrument inside a so-called
well block remains higher when using the structure in
accordance with the invention. Thus, the structure in
20 accordance with the invention has a better insulating
capability. Similarly, when using the structure in ac-
cordance with the invention, the slag purity of steel
is better. Furthermore, the structure in accordance
with the invention is easier to handle and mount due
25 to its lightness.

Example 4

This example discloses additional applications for the structural material and method as shown
5 in Examples 1 and 2.

Examples of applications in metallurgic industry:

- insulation lining of lids of a dummy basin, i.e. the casting directly into the lid structure; an
10 advantage compared to the use of a conventional insulating mass is good workability and mechanical strength;

insulating casting of a wall structure of a walking beam furnace of a rolling mill directly into
15 the object; an advantage over the use of a conventional insulation mass is good workability and the subsequent fast lining work and good mechanical strength, which reduces the need for repair and thus the furnace downtime; and

20 the insulation of the columns of a pusher-type furnace of a rolling mill using the structural parts produced and dried by the method of the invention; an advantage over a corresponding conventional product made by pressing is a good insulation capability and mechanical strength and thus a smaller need
25 for repair.

An embodiment example of a heat production process: air ducting of the arched and afterburning pipe of the fire head of thermal boilers, is used in
30 boilers 20 kW-2 MW; the structural material in accordance with the invention is moulded in moulds to form structural parts of suitable size, the parts obtained are dried, and the dried parts are fitted into the desired object in a thermal boiler; an advantage over
35 conventional insulation materials is a good insulation capability, workability of the material and mechanical strength.

The method in accordance with the invention is applicable in various embodiments for use in forming various fire- and heat-resistant and heat-insulating structures and structural materials, and
5 the fire-and heat-resistant and heat-insulating structural materials and structures are applicable in various embodiments for use in any kind of fire- and heat-resistant insulating.

The embodiments of the invention are not limited to the examples referred to above, instead they
10 can vary within the scope of the accompanying claims.

CLAIMS

1. A method for manufacturing a heat-resistant and heat-insulating structure, characterised in that a dry matter composition is formed by mixing, the dry matter composition containing 10-60 w-% fine fraction the particle size of which is < 0.1 mm and which includes a dry component that binds air bubbles, and 40-90 w-% coarse fraction the particle size of which is > 0.1 mm, and 5-20 w-% water is mixed into the dry matter composition to form a substantially homogenous and flowing structural material, and the structural material is moulded into the desired structural shape, and water is evaporated from the structural material to form a heat-resistant and heat-insulating structure.

2. The method as defined in claim 1, characterised in that the coarse fraction contains an aggregate substantially consisting of chamotte, aluminium oxide, aluminium silicate, magnesium silicates, sillimanite, andalusite, kyanite or other natural silicates and/or silica or mixtures thereof or the like.

3. The method as defined in claim 1 or 2, characterised in that the fine fraction contains a polymer that binds air bubbles.

4. The method as defined in claim 3, characterised in that the fine fraction contains 0.05-0.5 w-% polymer that binds air bubbles.

5. The method as defined in any one of claims 1-4, characterised in that the fine fraction contains binding agent.

6. The method as defined in claim 5, characterised in that the fine fraction contains less than 20 w-% binding agent.

7. The method as defined in any one of claims 1-6, characterised in that the fine fraction contains a fine fraction and/or fine-grained alu-

minium oxide that has been formed from an aggregate and/or material selected from the group consisting of chamotte, aluminium oxide, aluminium silicates, magnesium silicates, sillimanite, andalusite, kyanite,
5 other natural silicate, silica or a mixture thereof.

8. The method as defined in claim 7, characterised in that the fine fraction contains 1-35 w-% fine fraction and/or fine-grained aluminium oxide that has been formed from an aggregate
10 and/or material selected from the group consisting of chamotte, aluminium oxide, aluminium silicates, magnesium silicates, sillimanite, andalusite, kyanite, other natural silicate, silica or a mixture thereof.

9. The method as defined in any one of claims
15 1-8, characterised in that the fine fraction contains at least one additive.

10. The method as defined in any one of claims 1-9, characterised in that the dry matters are mixed to form a substantially homogenous
20 dry matter composition.

11. The method as defined in any one of claims 1-10, characterised in that the dry matter composition and water is mixed for more than 3 minutes to form a structural material.

25 12. The method as defined in any one of claims 1-11, characterised in that the wet structural material is moulded into the desired shape in less than 2 hours from the mixing of the dry matter composition and water.

30 13. The method as defined in any one of claims 1-12, characterised in that the wet structural material is moulded by means of moulds directly into the application.

14. The method as defined in any one of
35 claims 1-13, characterised in that a structural part is formed from the wet structural material by moulding.

15. The method as defined in any one of claims 1-14, characterised in that water is substantially removed from the structural material to form a heat-resistant and heat-insulating structure.

16. The method as defined in any one of claims 1-15, characterised in that water is removed from the structural material to achieve a pore volume of the structure between 35-50% by volume, preferably 40-45% by volume of the volume of the structure.

17. The method as defined in any one of claims 1-16, characterised in that the heat-resistant, heat-insulating structure is treated with heat after water has been evaporated.

18. A heat-resistant, heat-insulating structure, characterised in that the structure has been formed from a structural material containing 5-20 w-% water and a dry matter composition containing 10-60 w-% fine fraction the particle size of which is < 0.1 mm and which includes a component that binds air bubbles, and 40-90 w-% coarse fraction the particle size of which is > 0.1 mm and which has been moulded into the desired shape, and water has been removed from the structural material by evaporating to form a heat-resistant and heat-insulating structure.

19. The structure as defined in claim 18, characterised in that the pore volume of the structure is 35-50% by volume, more preferably 40-45% by volume of the volume of the structure.

20. A structural material for use in the manufacture of a heat-resistant and heat-insulating structure, characterised in that the structural material contains 5-20 w-% water and a dry matter composition containing 10-60 w-% fine fraction the particle size of which is < 0.1 mm and which in-

cludes a component that binds air bubbles, and 40-90 w-% coarse fraction the particle size of which is > 0.1 mm, and the structural material is substantially homogenous and flowing.

5 21. A dry matter composition for use in the manufacture of a heat-resistant and heat-insulating structure, characterised in that it contains 10-60 w-% fine fraction the particle size of which is < 0.1 mm and which includes a component that
10 binds air bubbles, and 40-90 w-% coarse fraction the particle size of which is > 0.1 mm.

 22. The use of a heat-resistant and heat-insulating structure in metallurgic processes, heat production processes, cooling processes and processes
15 requiring a high temperature.

INTERNATIONAL SEARCH REPORT

International application No.,

PCT/FI 2004/000168

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C04B 35/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5389591 A (GUIGONIS), 14 February 1995 (14.02.1995), column 1, line 6 - line 10; column 1, line 15 - line 22; column 2, line 18 - line 27, column 2, line 29 - column 2, line 51 --	1-22
X	US 5362692 A (BUGAJSKI), 8 November 1994 (08.11.1994), column 2, line 42 - line 69, claim 1, abstract --	1-22
X	US 5885913 A (DELCLOY), 23 March 1999 (23.03.1999), claims 14,16-19, abstract --	1-22

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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