COMMONWEALTH OF AUSTRALIA

Patents Act 1952

P 00 001
Form 1
Regulation 9

APPLICATION FOR A STANDARD PATENT OR A STANDARD PATENT OF ADDITION

592604

Insert full name(s) of applicant(s)

(71) I/We SORG GMBH & CO. KG

Insert address(es) of applicant(s)

of Im Aller 23 8770 Lohr / Main, Federal Republic of Germany

Insert title of invention

(54) hereby apply for the grant of a ☑ standard patent ☐ patent of addition for an invention entitled

GLASS MELTING FURNACE OF IMPROVED EFFICIENCY

(tick appropriate box)

which is described in the accompanying ☐ provisional ☑ complete specification.

$185 -

Insert name of actual inventor

(72) The actual inventor ~~(s)~~ of the said invention is/are HELMUT PIEPER

Insert address for service of notices in Australia

(74) My/our address for service is SANDERCOCK, SMITH & BEADLE, 207 Riversdale Road, (P.O. Box 410) Hawthorn, Victoria, 3122 Attorney Code SA

for Convention cases only

(ONLY TO BE USED IN THE CASE OF A CONVENTION APPLICATION)

Details of basic application(s) –

NUMBER	COUNTRY	DATE OF APPLICATION	ISO Code
86 100 878.7	Europe (Federal Republic of Germany	23 January 1986	

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 7.11.87

Insert day, month and year form signed

Dated this 8th day of December, 19 86

Signature of applicant or Australian attorney

SORG GMBH & CO. KG

TO (Signature)

SANDERCOCK, SMITH & BEADLE

THE COMMISSIONER OF PATENTS

This form must be accompanied by either a provisional specification (Form 9 and true copy) or by a complete specification (Form 10 and true copy).

FORM 7 & 8

AUSTRALIA
PATENTS ACT 1952

PATENT DECLARATION FORM
(CONVENTION OR NON-CONVENTION)

DECLARATION IN SUPPORT OF APPLICATION FOR A PATENT

Insert name of applicant.

In support of the application made by SORG GMBH & CO. KG

Insert title of invention.

for a patent for an invention entitled: GLASS MELTING FURNACE OF IMPROVED EFFICIENCY

Insert full name(s) and address(es) of person(s) making declaration. If applicant a company person must be authorised to make declaration.

I/We Helmut Sorg
of Sorg GmbH & Co. KG
Im Aller 23
8770 Lohr / Main
Federal Republic of Germany

do solemnly and sincerely declare as follows:

Delete alternatives which do not apply

* 1. (a) ~~I am/We are the applicant(s) for the patent.~~
* OR (b) I am authorized by the abovementioned applicant to make this declaration on its behalf.

Insert name(s) and address(es) of actual inventor(s).

* 2. (a) ~~I am/We are the actual inventor(s) of the invention.~~
* OR (b) HELMUT PIEPER of Buchenstrasse 19, 8770 Lohr / Main, Federal Republic of Germany

is/~~are~~ the actual inventor(~~s~~) of the invention and the facts upon which the applicant(~~s~~) is/~~are~~ entitled to make the application are as follows:—

Insert details of entitlement to apply, e.g. Applicant is assignee of inventor(s)

by employment contract and assignment of Jan. 6, 1986

Delete 3 and 4 if application non-convention. Otherwise insert details of basic application(s).

3. The basic application(~~s~~) as defined by Section 141 of the Act was/~~were~~ made in the following country or countries on the following date(~~s~~) by the following applicant(s)

in Europe (Federal Republic of Germany) on 23 January 19 86
~~by~~ 86 100 878.7
~~in~~ ~~on~~ ~~19~~
by Sorg GmbH & Co. KG
in _____ on _____ 19 _____
by _____
in _____ on _____ 19 _____
by _____

4. The basic application(~~s~~) referred to in paragraph 3 of this Declaration was/~~were~~ the first application(~~s~~) made in a Convention country in respect of the invention the subject of the application.

Place and date of Signature.

Declared at Lohr this 3rd day of March, 19 87

Sorg GmbH & Co. KG

NO ATTESTATION
OR SEAL

Signature(s) of declarant(s).

To: The Commissioner of Patents,
Australia

SANDERCOCK, SMITH & BEADLE, P.O. Box 410, Hawthorn, 3122, Australia
cables: Sandpat Melbourne
telex: 34491, Sandpat

(12) PATENT ABRIDGMENT (11) Document No. AU-B-66353/86
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 592604

(54) Title
GLASS MELTING FURNACE

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(56) Prior Art Documents
AU 70852/74 19.63, C03B 5/02
AU 430806 56227/69 19.6, C03B 5/00
US 4001001

(57) Claim

10. A method of operating a glass melting furnace which has a rectangular glass melting tank with a narrow side with feed means for feeding a mixture at the narrow side of the tank across the full width thereof and a section of burners positioned adjacent to an opposite narrow side for supplying energy, the furnace also having heat exchangers for energy exchange between combustion gases and combustion air supplied to the burners and openings for exhausting the exhaust gas disposed adjacent to the mixture feeding position, the furnace further having a roof extending between the burner section and the mixture feeding section and at least one radiation protective barrier which depends from the roof and extends to a position spaced a

small distance from the molten glass surface, there being electrodes within the mixture feeding section for supplying electric energy in the region of the mixture feeding section, the method comprising cooling the exhaust gases, while preheating the mixture floating on the molten glass mass, to a temperature of from 800° to 1000° C. before the gases are exhausted from the tank.

592604

COMMONWEALTH OF AUSTRALIA

Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Class Int. Class

Application Number:
Lodged: 66353/86

Complete Specification—Lodged:
Accepted:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: SORG GMBH & CO. KG

Address of Applicant: Im Aller 23, 8770 Lohr / Main
Federal Republic of Germany

Actual Inventor: HELMUT PIEPER

Address for Service: SANDERCOCK, SMITH & BEADLE
207 Riversdale Road, (P.O. Box 410)
Hawthorn, Victoria, 3122

Complete Specification for the invention entitled:

GLASS MELTING FURNACE OF IMPROVED EFFICIENCY

The following statement is a full description of this invention, including the best method of performing it known to me:—

The present invention relates to a glass melting furnace in which a mixture (or batch is fed at a narrow side of a rectangular glass melting tank onto the molten glass mass (or bath) across the full width thereof, the furnace comprising burners positioned adjacent to the opposite narrow side for supplying energy, and heat exchangers for energy exchange between the combustion (exhaust) gases and the combustion air supplied to the burners, wherein the openings for exhausting the exhaust gas are disposed adjacent to the mixture feeding position, and a method of operating this glass melting furnace.

Although operating with recuperators or regenerators, glass melting furnaces generally suffer from the drawback of a relatively low efficiency. This is due not only to the lacking insulation of the glass tanks, but rather due to the fact that the exhaust gas heat is considerably higher than the thermal energy required to preheat the combustion air. Here, limits exist with respect to inreasing the temperature of the combustion air, because in such a case the heat exchange becomes very complex on the one hand, while the concentration of the poisonous NO_x increases greatly on the other hand.

Various attempts have been made for expediently utilizing the heat excess in the exhaust gas, even by preheating the mixture (or bath) prior to its feeding into the glass melting tank. However, these attempts proved unsuccessful since the preheating may result already in premelting of some constituents of the mixture and such constituents tend to stick to the heat exchanging surfaces, whereas, on the other hand, unmixing occurs under a direct contact of the exhaust gas with the mixture, besides the premelting of certain constituents, or certain constituents of the mixture are carried over or entrained such that the dust concentration in the exhaust gas increases unduely, or very expensive dust filters become necessary, respectively.

In view of this, it is the object of the present invention to provide a glass melting furnace which is free from the above-discussed drawbacks, which has a significantly enhanced efficiency compared to conventional furnaces, but which nevertheless lends itself to be constructed economically, and in which lower NO_x concentrations and lower dust concentrations in the exhaust gas are present, without requiring in the furnace or for the heat exchange any component parts which are difficult to control or which exhibit high temperatures.

It is contemplated that the temperatures in the furnace upper portion and the temperatures in the heat exchangers (recuperators) used are even lower than in the customarily used conventional furnaces.

In addition to the above-mentioned advantages, the furnace according to the invention should lend itself to be constructed economically and operated safely or reliably, while permitting essentially an exchange of fossile and electric energies.

In the furnace as outlined at the beginning, according to the invention this object is solved in that the roof of the furnace includes between the burner section and the mixture feeding section at least one radiation protective barrier which extends to a position spaced a small distance from the molten glass surface, and electrodes for supplying electric energy in the region of the mixture feeding position are provided within the mixture feeding section.

In order to ensure sufficient preheating of the mixture, advantageously the mixture feeding section has a length at least twice the length of the burner section, and in order to avoid an efficiency-reducing heat transfer by radiation from the burner section, preferably at least one further radiation protective barrier may be provided in the mixture feeding section.

In order to avoid freezing of the molten glass mass (or bath) below the entering mixture, the electrodes provided in the mixture feeding section may be positioned within the tank bottom.

Further beneficial embodiments, particularly for increasing the efficiency and reducing the expenditure, are described in subclaims 2, 4 to 8.

Advantageously, the method of operating the glass melting furnace according to the invention may be characterized by cooling the exhaust gases, while preheating the mixture (or batch) floating on the molten glass mass, to a temperature of from 800 to 1000° C before they are exhausted from the tank space.

Without any substantial technical expenditure, the recuperators may be adapted to heat the air in a countercurrent flow to a temperature of from 600 to 800° C, and in

order to obtain the aspired good efficiency, the mixture (or batch) may cover (or float on) the glass melt surface at least in the mixture feeding section.

As can be seen, the glass melting furnace according to the invention, in conjunction with the method of operating this furnace, is adapted to solve the existing problems in a particularly beneficial manner and for the first time. The principle of the invention resides in feeding the mixture onto the molten glass and preheating it thereon by means of the exhaust gas, thereby cooling the exhaust gas to such a degree that the residual energy my be used almost fully for preheating the combustion air. Here, maintaining of the liquid (molten) state of the glass and controlling an optimum flow pattern in the mixture preheating region of the tank are ensured while supplying relatively low amounts of electric energy.

Below, exemplary embodiments of the invention are explained with reference to drawings, wherein: -

Figure 1 is a longitudinal section view of a glass (melting) tank according to the invention;

Figure 2 is a horizontal sectional view of a tank similar to the according to Figure 1; and

Figure 3 is a horizontal sectional view of a tank according to another embodiment of the invention.

As shown in the drawings, the glass melting furnace according to the invention comprises an elongate, rectangular tank having a burner section 2 and a mixture (or batch) feeding section 3 which join each other, with the mixture feeding section 3 having a length equal to

from 2 times to 2-1/2 times the length of the burner section. The term burner section 2 refers to the tank portion in which the burners 20 are positioned which operate by burning oil or gas.

Further, the tank includes a transverse wall 16 at the side of the burners, a transverse wall 17 at the side of the mixture feeding section, and longitudinal walls 18. The furnace upper portion is formed by a roof 1. The tank bottom is denoted by 9.

In the mixture feeding section 3, bottom electrodes 6 are provided which act to prevent freezing of the molten glass mass in this section, especially in the very region where the mixture layer is floating. Furthermore, freezing is prevented from occuring by inducing in the mixture feeding section a flow or stream which constantly transfers glass heated to high temperature from the burner-side region to the region where the mixture is supplied or fed.

Feeding of the mixture is preformed in a conventional manner across the full width of the transverse wall 17; however, means 13 are provided which close or isolate the feeding space from the interior of the tank. Such isolation may be effected by the mixture per se (Figure 1); alternatively, lock gates, sluices or similar conventional means may be employed.

In detail, the tank is constructed in accordance with conventional technology as is described also in prior applications by the same applicant, such that a more detailed description can be omitted. This applies particularly to the configuration of the walls, of the furnace arch roof, the bottom, the burners, the electrodes and the outlet 19 at the end of the burner section 2 remote from the mixture feeding section, as well

as the configuration of the exhaust gas outlet openings 22 dirctly adjacent to the mixture feeding position.

Interiorly of the tank, a radiation protective barrier 5 is positioned at the feed-side end of the burner section 2, which barrier extends (depends) from the roof to a position closely above the molten glass surface 4 and which prevents radiation from entering the mixture feeding section 3. As is known, at high chamber temperatures most of the energy is transmitted or transferred by radiation; accordingly, it is essential to the invention to concentrate within the burner section 2 the energy supplied by the burners 20.

In view of the fact that, further, considerable amounts of radiation are emitted from the surface of the molten glass and especially from the protective barrier 5 toward the feed side, the mixture feeding section 3 includes another radiation protective barrier (or wall) 7 in the vicinity of the mixture feeding position, and still another protective barrier 8 intermediate the protective barriers 5 and 7. This structure safely prevents that radiation energy has a noticeable effect on the heating of the mixture, because such heating is to be performed substantially exclusively by the exhaust gas which flows from the burner section 2 through the mixture feeding section 3 and to the exhaust gas outlet openings 22.

Facultatively, the bottom 9 can include a sill 14 at the feed-side end of the burner section 2, which sill acts to set a flow pattern in which hot glass flows back to the floating mixture layer and in this position prevents freezing of the glass in conjunction with the bottom electrodes 6.

After its outflow from the tank, the gas cooled to from 800 to 1000° is supplied first to a high-temperature countercurrent flow recuperator and then to a low-temperature countercurrent flow recuperator from which the glass flows out at a temperature of from about 300 to 350° C. At this temperature, the inherent energy of the exhaust gas has been largely transferred to the combustion air, while the dew point is clearly exceeded such that corrosion and depositing (settling) problems are avoided.

In the recuperators 10 (high temperature) and 11 (low temperature), the combustion air is preheated from normal (ambient) temperature to a temperature of about 600 to 800° C by the cooled down exhaust gas, and then supplied to the burners 20 through pipelines 21. The combustion, taking place under the relatively low air temperatures, provides for the advantage that the flame temperatures are relatively low and therefore higher concentrations of NO_x cannot occur. Accordingly, the exhaust gas ist not only cooled down considerably, but also contains extremely low concentrations of NO_x such that the glass melting furnace according to the invention may be operated even in areas of low permissible emission values, e. g. in cities, particularly as a dust filter may be used without problems owing to the low exhaust gas temperatures.

According to Figure 3, heat transfer from the exhaust gas to the mixture feeding section 3 may be improved in that the longitudinal walls are formed as double walls 12 through which the exhaust gas flows from the outlet openings 22 to the high-temperature recuperator 10. As shown in Figure 2, the recuperators 10 and 11 also may be combined in a unit and positioned directly adjacent to the outlet openings 22.

In view of operation of the tank, it is important that the mixture feeding section 3 performs in its feed-side end the preheating of the mixture exclusively, while substantial melting of the mixture takes place only at the burner-side end of the mixture feeding section; then, the glass is refined within the burner section 2 before the glass in withdrawn or discharged in a conventional manner through a bottom outlet 19 at the end remote from the feed side of the burner section 2. Furthermore, by means of the radiation protective barriers 5, 7 and 8 a gas (flow) velocity of about 10 to 15 m/sec is induced above the mixture, which also provides for a certain convective heat transfer or transmission in addition to the radiation heat transfer. Here, the radiation protective barriers are constructed, for example, in accordance with ~~scheitrecht~~ arches like large doghouse arches.

Further, the electric energy supplied may be controlled to have such a ratio to the energy supplied by the burners that the NO_x mass flow does not exceed the permissible values. With a higher portion of electric energy, the NO_x mass flow is reduced, while it is increased with a reduction of this portion.

Regarding the recuperators 10 and 11, the first one serves as a radiation recuperator, while the second one is based on convection as the heat transfer mode. This recuperator 11 may be provided therein a cleaning system (dust remover), system Schack, or of a type similar to a spherical recuperator. In this way, it is also ensured that the exhaustgas contains only an extremely low dust concentration such that subsequent dust removal may be unnecessary under circumstances.

The glass melting furnace according to the invention can be constructed economically since inexpensive refractory

materials may be used in the mixture feeding section owing to the lower temperatures.

According to the invention, it is contemplated that the entire glass melting furnace and the conduits or pipelines for the exhaust gas as well as for the heated combustion air are properly insulated. Nevertheless, it is surprising to the expert that the specific energy consumption may be reduced to the heretofore unequalled value of from 3100 to 3400 kilojoules per kg of glass.

~~The claims form part of the disclosure of this specification.~~

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS :-

1. A glass melting furnace comprising a rectangular glass melting tank with a narrow side; feed means for feeding a mixture at the narrow side of said tank across the full width thereof; a section of burners positioned adjacent to an opposite narrow side for supplying energy; heat exchangers for energy exchange between combustion gases and combustion air supplied to the burners; openings for exhausting the exhaust gas disposed adjacent to the mixture feeding position, said furnace having a roof extending between the burner section and the mixture feeding section; at least one radiation protective barrier which depends from said roof and extends to a position spaced a small distance from the molten glass surface; and electrodes within the mixture feeding section for supplying electric energy in the region of the mixture feeding section.

2. The glass melting furnace of claim 1, wherein the mixture feeding section has a length greater than that of the burner section.

3. The glass melting furnace of claim 2, wherein the mixture feeding section has a length at least twice the length of the burner section.

4. The glass melting furnace according to any one of the preceding claims, wherein at least one further radiation protective barrier is provided in the mixture feeding section.

5. The glass melting furnace according to any one of the preceding claims, wherein the tank has a bottom and the electrodes are positioned within the tank bottom.

6. The glass melting furnace according to any one of the preceding claims, having walls in the mixture feeding section for returning the combustion gases, said walls being formed as double walls.

7. The glass melting furnace according to any one of the preceding claims, wherein the exchangers are formed as recouperators and divided in a high-temperature and a low-temperature section.

8. The glass melting furnace according to any one of the preceding claims, further comprising means for isolating the mixture feeding section.

9. The glass melting furnace according to any one of the preceding claims, wherein the tank bottom includes a sill below the first mentioned radiation protective barrier.

10. A method of operating a glass melting furnace which has a rectangular glass melting tank with a narrow side with feed means for feeding a mixture at the narrow side of the tank across the full width thereof and a section of burners positioned adjacent to an opposite narrow side for supplying energy, the furnace also having heat exchangers for energy exchange between combustion gases and combustion air supplied to the burners and openings for exhausting the exhaust gas disposed adjacent to the mixture feeding position, the furnace further having a roof extending between the burner section and the mixture feeding section and at least one radiation protective barrier which depends from the roof and extends to a position spaced a small distance from the molten glass surface, there being electrodes within the mixture feeding section for supplying

electric energy in the region of the mixture feeding section, the method comprising cooling the exhaust gases, while preheating the mixture floating on the molten glass mass, to a temperature of from 800° to 1000° C. before the gases are exhausted from the tank.

11. The method of claim 10 wherein the heat exchangers are reccuperators and heat the air to a temperature of from 600° to 800° C. in a countercurrent flow.

12. The method of claim 10, wherein the mixture floats on the molten glass surface at least within the mixture feeding section.

13. A glass melting furnace substantially as hereinbefore described with reference to the accompanying drawings.

14. A method of operating a glass melting furnace substantially as hereinbefore described.

DATED THIS 2nd November 1989

SMITH SHELSTON BEADLE

Fellows Institute of Patent

Attorneys of Australia.

Patent Attorneys for the Applicant

SORG GMBH & CO. KG

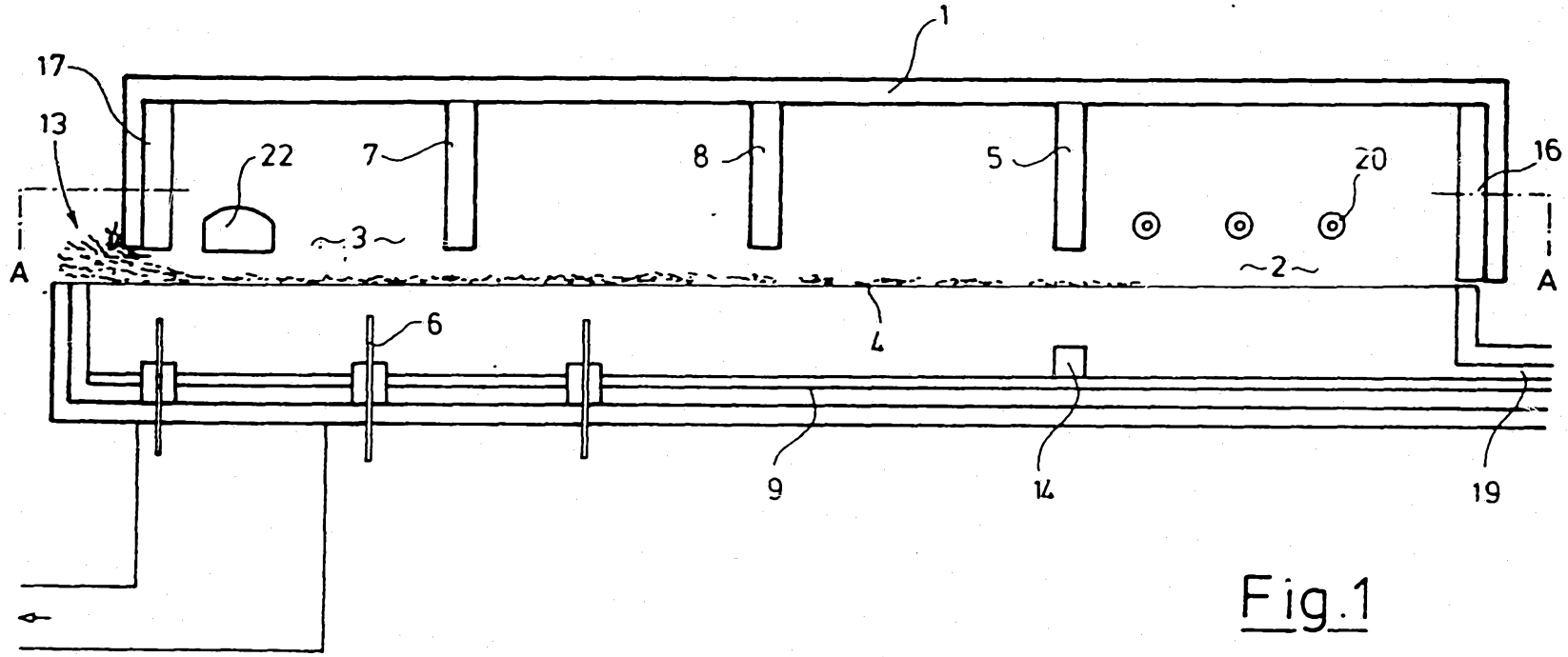

Fig.1

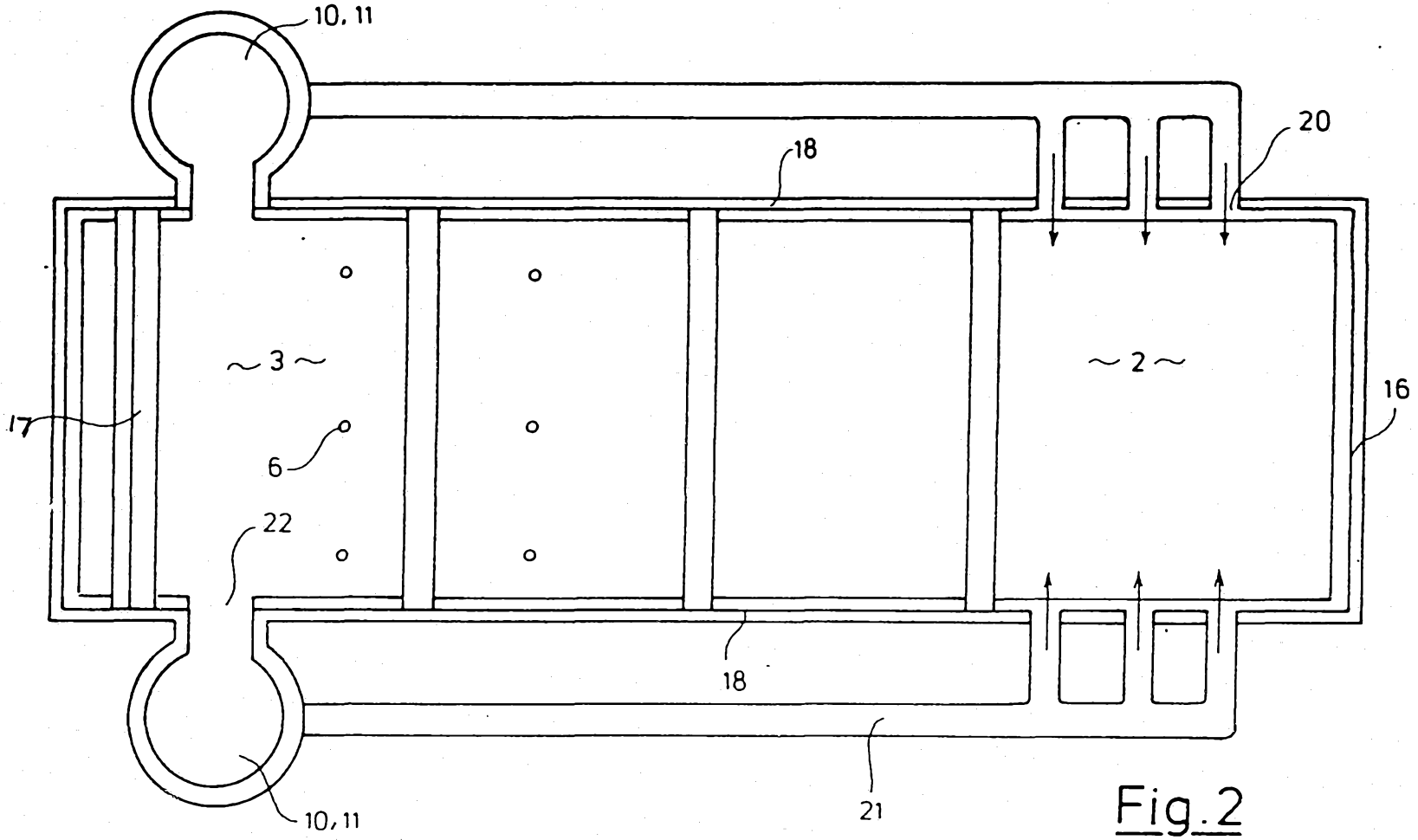

Fig. 2

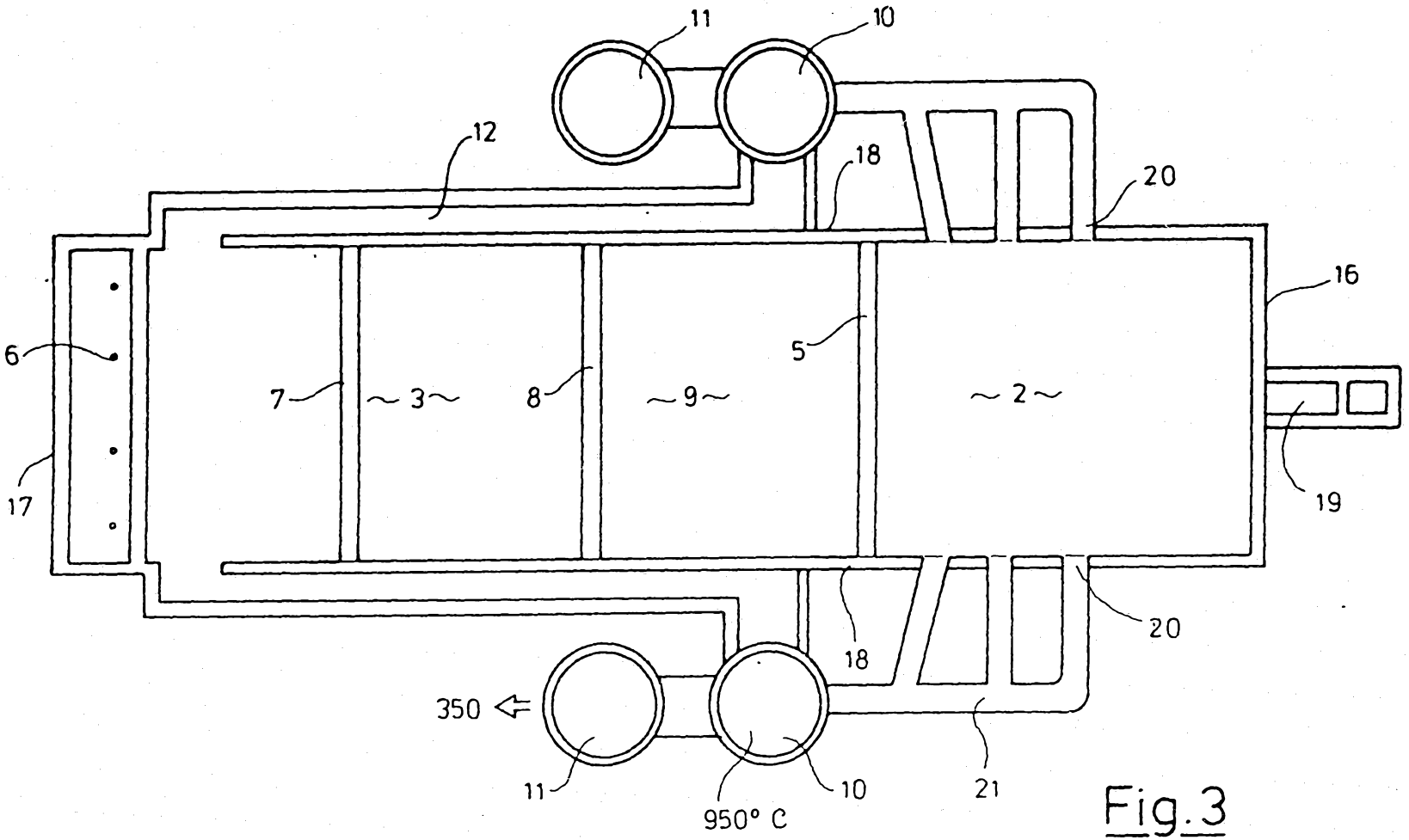

Fig.3