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Richard

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[54] **OPEN HEARTH-ROOM-HEATING DEVICES WORKING ON CLOSED CIRCUIT**

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[30] **Foreign Application Priority Data**

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Dec. 18, 1973 France 73.45154

[52] **U.S. Cl.** ..... **126/120;** 23/260; 23/277 C; 55/232; 55/247; 55/316; 55/468; 55/DIG. 30

[51] **Int. Cl.²** **F24B 1/18**

[58] **Field of Search** ..... 126/120, 299 A; 55/232, 55/247, 316, 468, DIG. 30; 23/260, 277 C

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Assistant Examiner—Peter D. Ferguson
Attorney, Agent, or Firm—Brisebois & Kruger

[57] **ABSTRACT**

The present invention relates to room-heating devices of the live-combustion type comprising a hearth open to the atmosphere in which the combustion is effected, and working on a closed circuit without any evacuation chimney, said device comprising in combination: suction means for creating an upward flow of the gaseous mixture formed by the primary air necessary for the combustion and the gases generated by said combustion, and solid particles or smoke also generated by said combustion and conveyed by said gaseous mixture; said gaseous mixture and said solid particles being passed through purifying means comprising devices for separating said combustion gases from said solid particles and for holding back said particles so as to deliver a purified gaseous fluid, a re-cycling circuit being coupled to the outlet of said purifying means for re-cycling the purified fluid to the hearth of said device.

The invention is especially applicable to installations for apartment fireplaces.

23 Claims, No Drawings

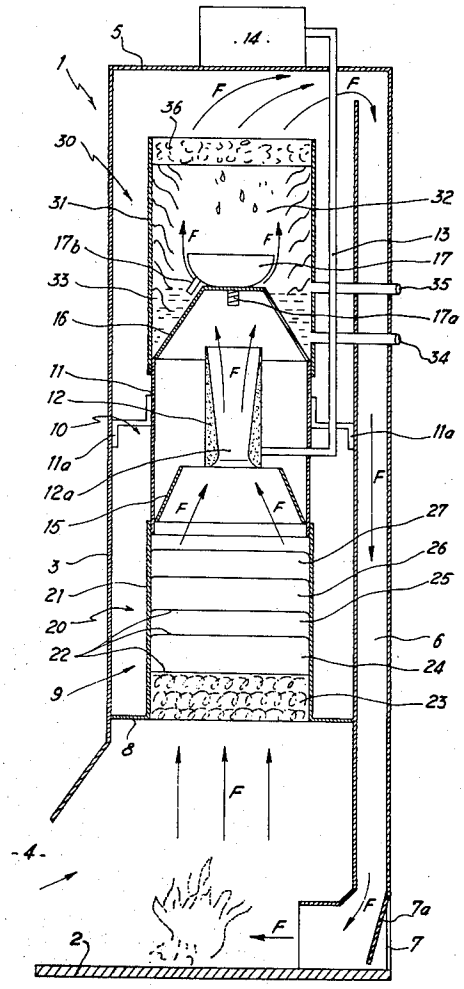
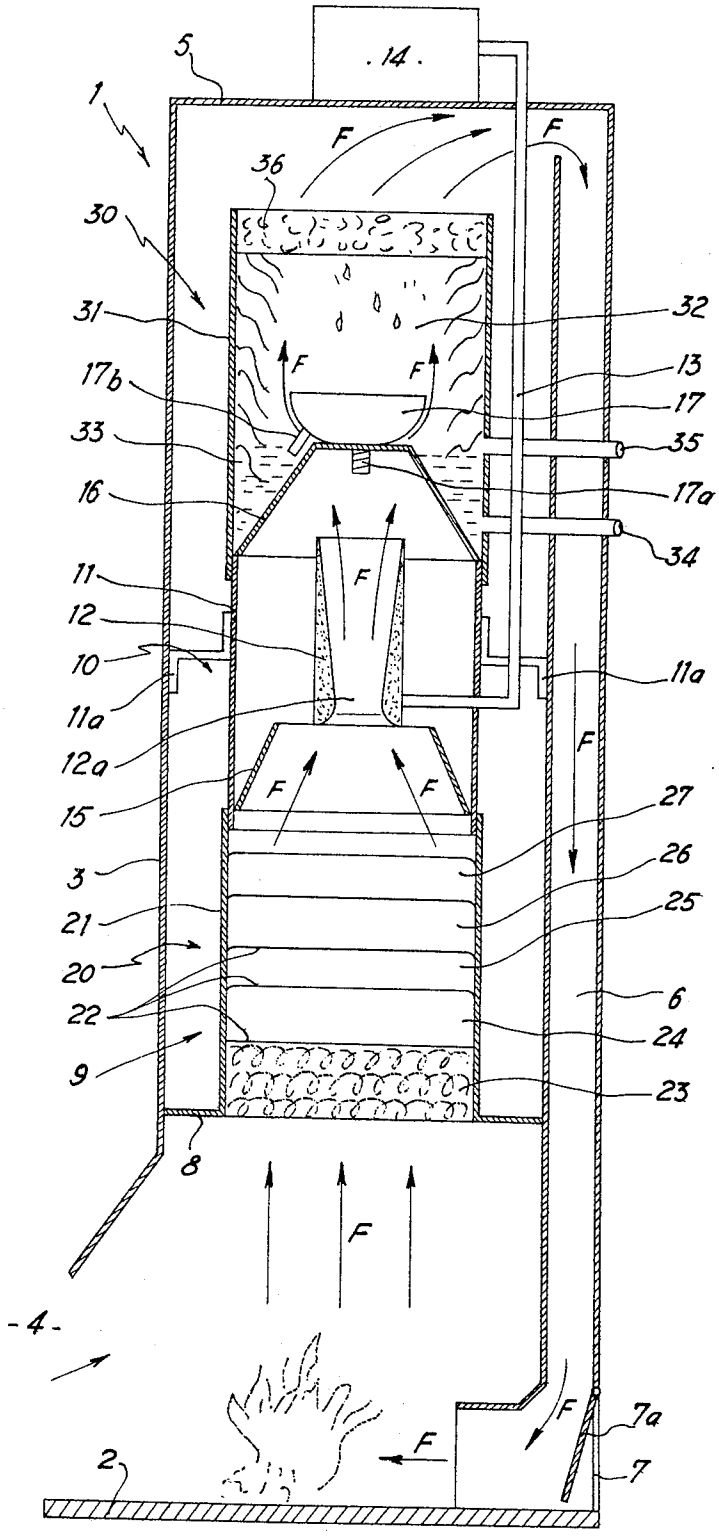


FIG-1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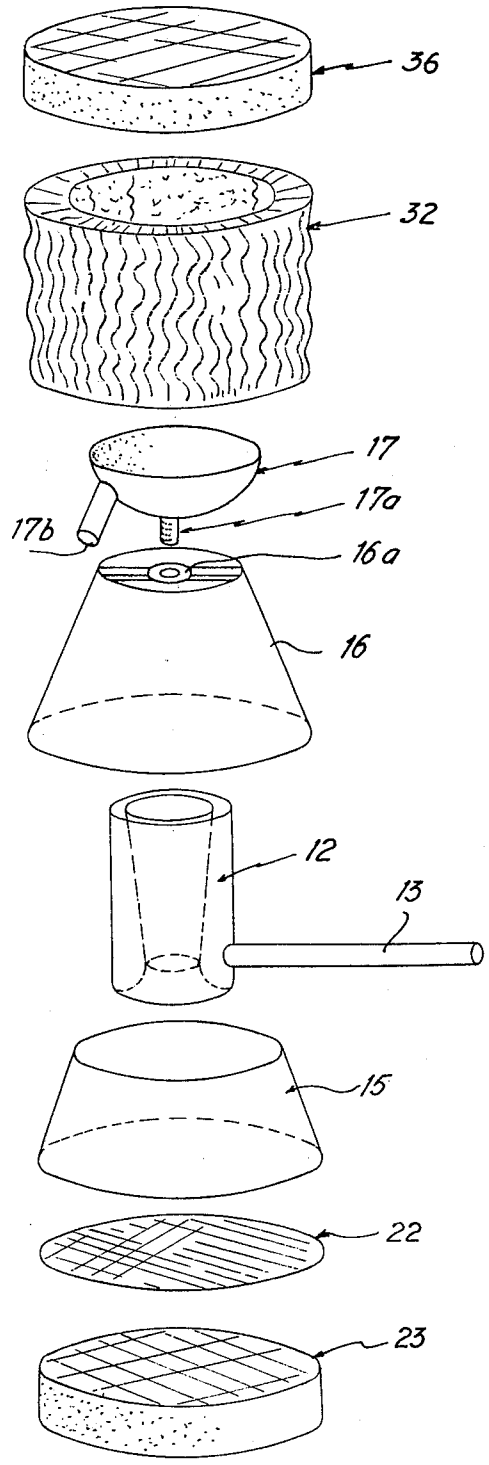


FIG. 2

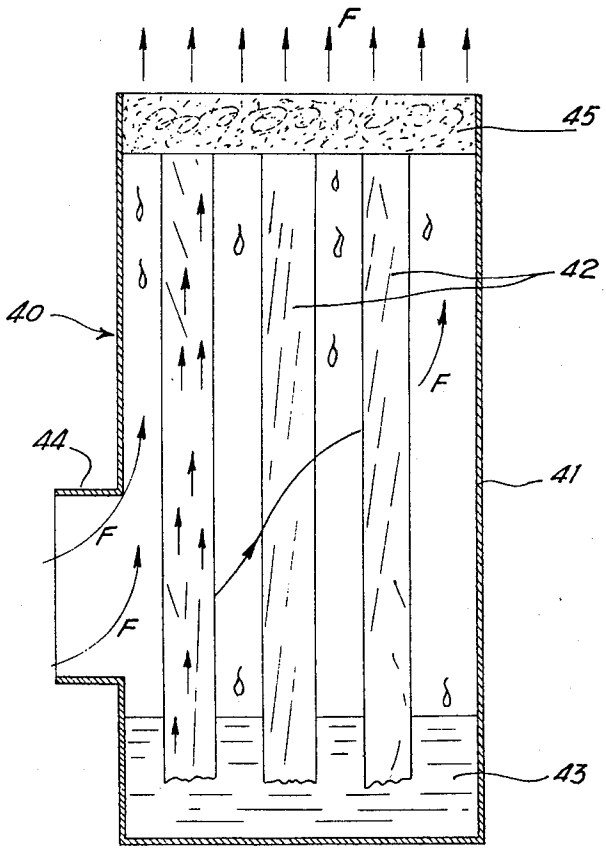


FIG. 3

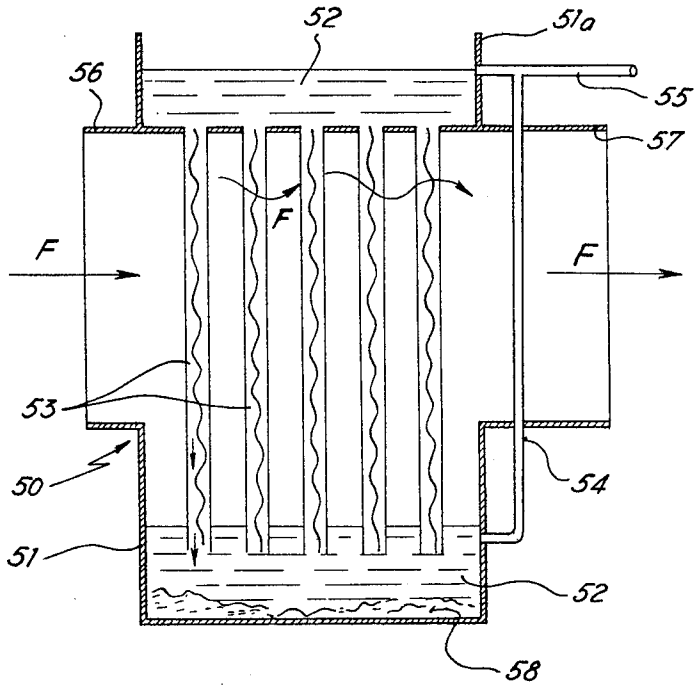
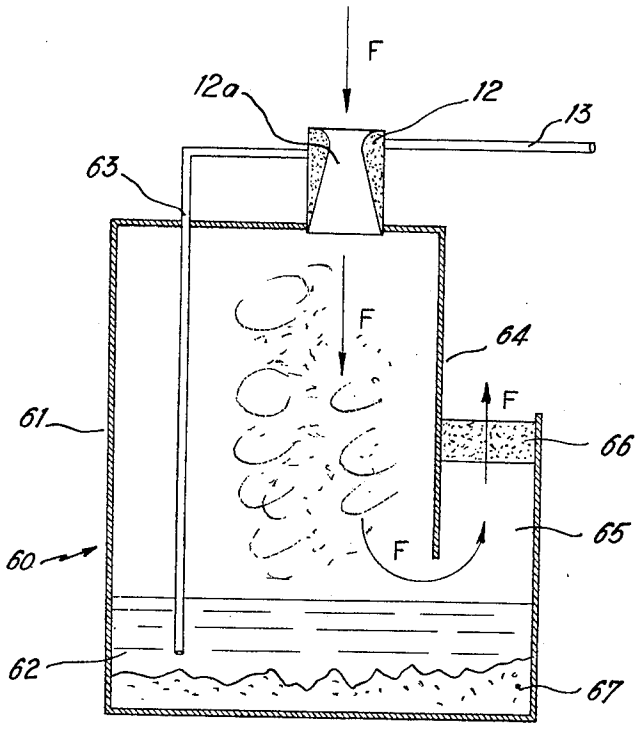


FIG. 4



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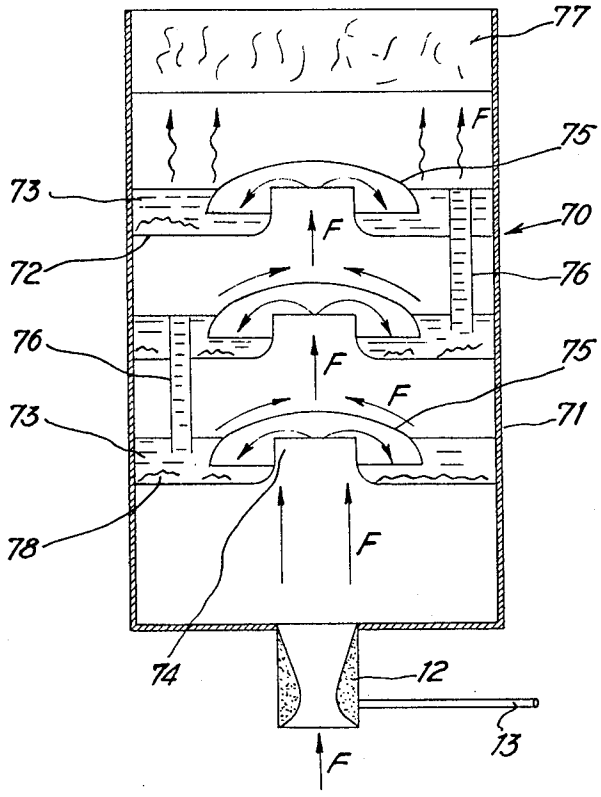


FIG. 6

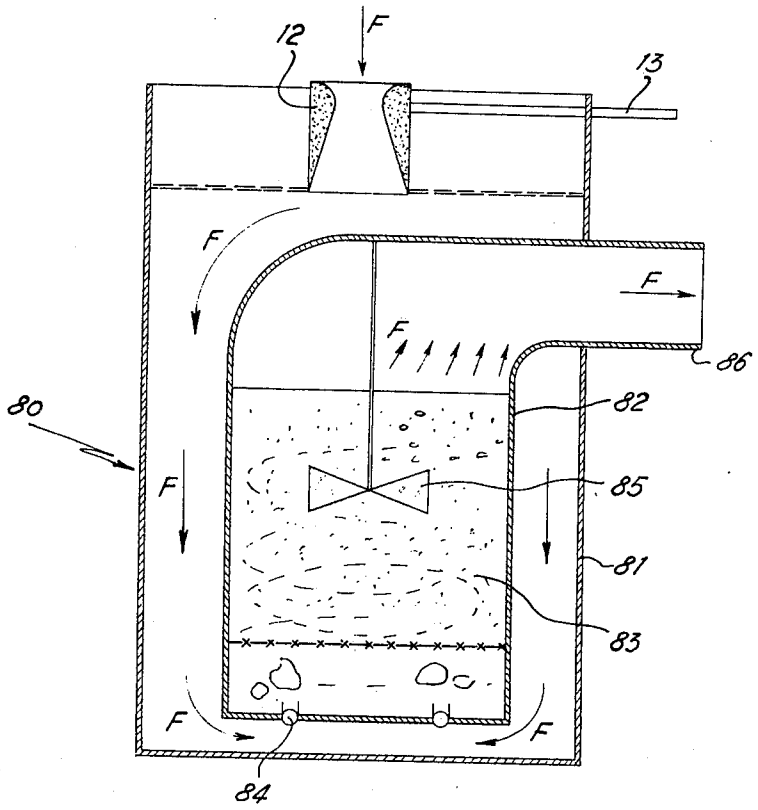


FIG. 7

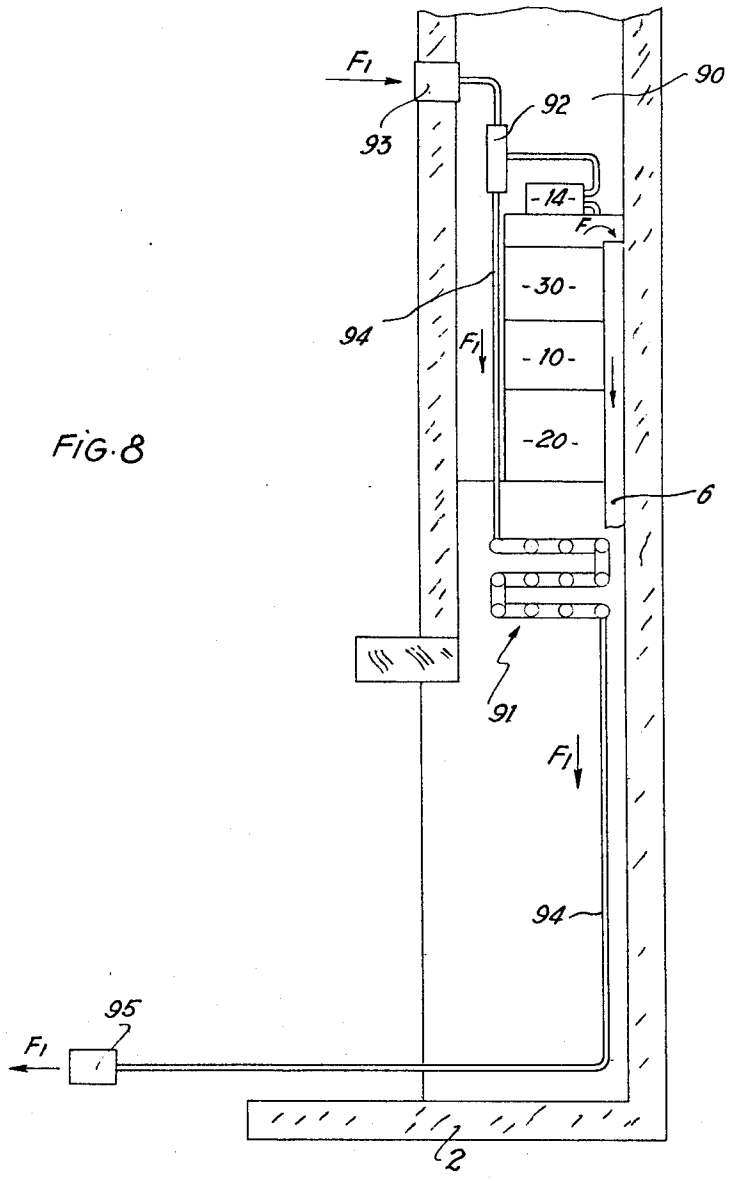
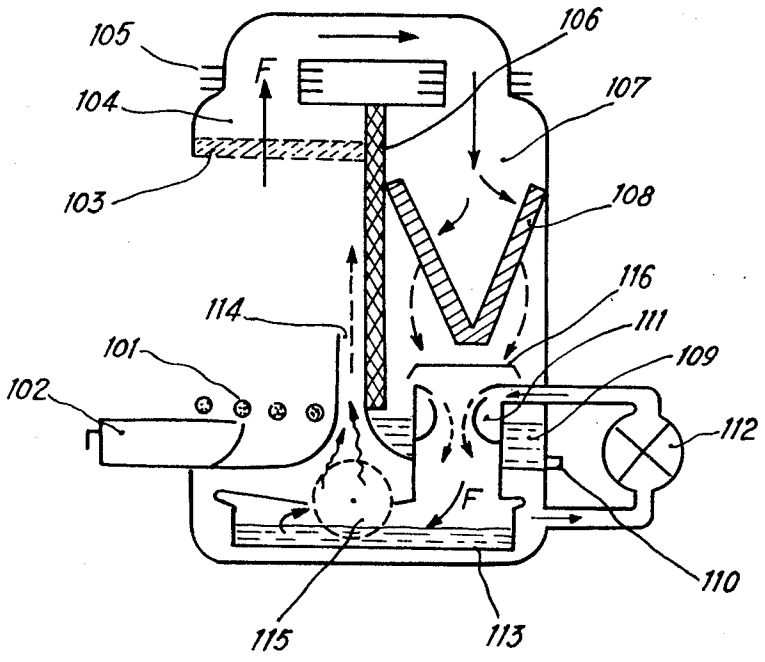


FIG. 8

FIG. 9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OPEN HEARTH-ROOM-HEATING DEVICES WORKING ON CLOSED CIRCUIT

The present invention relates essentially to a live-combustion heating device for a dwelling house, in particular an apartment fireplace, comprising a hearth open to the atmosphere in which the combustion is effected.

At the present time there exists a very considerable demand for apartment fireplaces which are most frequently intended for burning wood, these fireplaces being appreciated both by reason of their decorative effect and of the note of rusticity which they introduce into modern life. Up to the present time however, the installation of an apartment fireplace presumed the existence or the creation of an evacuation conduit for the amoke, discharging into free air. Now, numerous living premises of modern construction, apartments or individual houses, are not provided with such conduits and this, up to the present time, has rendered the installation of fireplaces very difficult, if not impossible.

Furthermore, the evacuation conduits which are provided in many rooms of older construction were most frequently built on a purely empirical basis so that it frequently happens that their operation is defective. In consequence of insufficient natural draught, the gases generated by combustion, of which certain, such as carbon monoxide, are furthermore toxic, and also the smoke carried by these gases, cannot normally be evacuated to the exterior of the room, so that a down-draught is produced from the chimney, thus dangerously polluting the atmosphere of the room in which it is installed.

The present invention has for its object to avoid these drawbacks and proposes a heating device of the type referred to above, which is especially characterized in that it comprises, in combination, suction means provided in order to create above the hearth an upward flow of the gaseous mixture constituted by the primary air necessary for combustion and the gases generated by that combustion, together with solid particles or smoke, also produced by this combustion and conveyed by the said gaseous mixture, purifying means into which pass the gaseous mixture and the solid particles which it conveys, the said purifying means being provided in order to separate and retain the said gases produced by the combustion together with the said solid particles, and to deliver at their outlet a purified gaseous fluid, and a circuit for recycling the said purified fluid, coupled to the outlet of the purifying means.

The device according to the invention creates an artificial draught, so that its operation is not in any way dependent on the good properties or even on the existence of a conduit opening into the atmosphere, which conduit is a necessity for chimneys working by natural draught.

The elimination from the gaseous mixture drawn in by the suction means of the gases produced by the combustion, that is to say of toxic or at least unhealthy gases, together with the solid particles, that is to say smoke carried by this gaseous mixture, makes it possible to obtain a purified gaseous fluid charged with heat, which can be sent back to the hearth, thereby improving the combustion and possibly permitting the re-burning of the carbon monoxide which may subsist in the said fluid.

The device according to the invention is characterized by the fact that the suction means referred to comprise a static nozzle having a pressure-reducing effect, coupled to a source of fluid under pressure, for example a compressor.

A discharge nozzle of this kind is a device which is extremely simple to construct, and is thus economic and with reliable and silent operation. The regulation of its output, that is to say the regulation of the chimney draught is effected by acting on the flow-rate and the pressure of the source of compressed fluid, which permits great flexibility of operation.

The device according to the invention is also characterized by the fact that the purifying means abovementioned comprise a first and a second filtering device respectively arranged on the upstream and downstream sides of the above suction means, and coupled to these latter in a removable manner.

These first and second filtering means, the functions of which are complementary, may thus readily be replaced when the substances, devices, etc., which they comprise and which are necessary for the purification effect, are exhausted or have reached saturation.

The first filtration device preferably comprises in succession in the direction of flow of the gaseous mixture, means for retention of the solid particles, means for adsorbing gases such as H_2S , NH_3, etc., means for fixing water vapour, porous means forming a molecular sieve for the retention of the gaseous molecules of predetermined size, and catalytic means for the conversion of the carbon monoxide to carbon dioxide.

The second filtration device referred to above comprises means for retaining the carbon dioxide by reaction of this latter with an alkaline solution with a view to the formation of a carbonate insoluble in water.

The device according to the invention effects not only the elimination of smoke and the bad-smelling or toxic combustion gases, but also the elimination of the CO_2, by reason of the re-cycling employed, since the gaseous fluid would not be brought back to the hearth without being purified from CO_2.

The device according to another form of embodiment of the invention, is characterized by the fact that the suction means referred to further comprise a second static nozzle placed on the downstream side of the first nozzle and constituted by a member in the form of a spherical cap arranged coaxially with the said tubular element, with its convex portion turned towards this latter so as to form a deflecting surface for the gases coming in laminary flow from the first nozzle, and cause a turbulent flow of the said gases at the outlet of the second nozzle.

This second nozzle, by causing a turbulent flow and in consequence a stirring effect on the gases, makes it possible to obtain an intimate contact of these gases with the materials of the purifying devices which are located at the outlet of the said second nozzle and especially facilitate the elimination of the carbon dioxide gas (CO_2).

The device according to the invention has other characteristic features and numerous other advantages, which will become apparent from the subsequent description concerning a certain number of forms of application, described by way of examples and without any limitative nature, reference being made to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view in cross-section of an apartment fireplace according to a first form of embodiment of the invention, provided with suction means and purification means for the combustion gases;

FIG. 2 is a diagrammatic view in exploded perspective of the said suction means together with the filtering devices which form the said purification means;

FIG. 3 shows diagrammatically a first alternative form of construction of the filtering device for the elimination of CO_2;

FIG. 4 shows diagrammatically a second alternative form of construction of the said filtering device;

FIG. 5 shows diagrammatically a third form of embodiment of the said filtering device;

FIG. 6 shows diagrammatically a fourth alternative form of construction of the said filtering device;

FIG. 7 shows diagrammatically a fifth alternative form of construction of the said filtering device;

FIG. 8 shows diagrammatically and in cross-section a fireplace according to the invention, provided with a heat-exchanger;

FIG. 9 shows diagrammatically in cross-section an apartment fireplace in accordance with a second form of embodiment of the invention.

Referring to FIG. 1, it is seen that the apartment fireplace according to a first form of embodiment of the invention and indicated generally by the reference 1, comprises essentially a hearth 2 in which the combustion is effected and a metallic casing 3 or the like, made for example of sheet steel plates arranged above the hearth 2. This casing 3 is provided at its lower portion and on its front face with an opening 4 communicating with the open atmosphere, and the casing is closed at its upper portion by a wall 5 which is preferably removable.

A conduit or duct 6 provided in the interior of the casing 3 at the rear portion of this latter, directly connects the upper part of the said casing to the hearth 2, this conduit serving for the re-cycling of gases, as will be explained later. The conduit 6 is provided at its lower portion with an orifice 7 for the admission of fresh air, communicating with the exterior, and this orifice may be closed by an oscillating shutter 7*a*.

Inside the casing 3 and therefore above the hearth 2 is housed an element 9 of generally cylindrical form, which comprises on the one hand suction means, indicated generally at 10, the function of which is to create an upward flow of the gaseous mixture formed by the primary air admitted through the opening 4 and the gases produced by combustion, this gaseous mixture conveying solid particles or smoke, also produced by combustion, and on the other hand purifying means placed on each side of the said suction means and indicated generally by 20 and 30 respectively, these purifying means having the function of separating and retaining the said combustion gases and also the said solid particles or smoke, so as to deliver purified air. A wall 8 closes at its lower portion the space formed between the said cylindrical element 9 and the casing 3.

The arrows F of FIG. 1 and the following figures indicate the travel of the gaseous flux circulating in the various parts of the device.

The suction means 10 referred to above comprise essentially a casing 11 of circular section, preferably of sheet steel, in the interior of which is mounted a static pressure-reducing nozzle 12 constituted by a tubular element of generally cylindrical shape, arranged coaxially with the casing 11. This tubular element 12 is provided with an internal constriction 12*a* into which discharges a conduit 13 supplied with compressed air from a compressor 14, arranged at the upper portion of the casing 3. The compressed air which comes into the constriction 12*a* is expanded at very high speed, thus creating upstream of the nozzle 12 a high depression resulting in a suction from the bottom upwards of the primary air admitted through the orifice 4, and of the gases produced by the combustion. Two deflectors 15 and 16 in the shape of truncated cones, are placed inside the casing 11, concentrically with this latter, repsectively on the upstream and on the downstream sides of the nozzle 12, these deflectors having the function of creating a concentric reduction of the rising flow of gas. The casing 11 may be permanently fixed to the casing 3 by lugs 11a.

The suction means 10 further comprise a second static nozzle 17 placed in series with the nozzle 12 and downstream of this latter. This second nozzle 17 has the form of a spherical cap arranged coaxially with the nozzle 12 and with its convex portion turned towards this latter. The nozzle 17 is supported in an adjustable manner by the deflector 16, by means of a threaded end 17*a* intended to be screwed on a support 16*a* threaded internally of the deflector 16, as shown in FIG. 2. By screwing the end member 17*a* more or less on its threaded support 16*a*, the useful passage space for the flow of gas between the deflector 16 and the nozzle 17 can be varied at will. The nozzle 17 further comprises an evacuation conduit 17*b*, the function of which will be explained later.

The purifying means 20 which are located upstream of the said suction means 10 and constitute the first filtering device, comprise essentially a casing 21 of circular section and provided so as to fit on the casing 11, to which it can be fixed in a removable manner by means of a retention system of any kind, for example with studs or springs, permitting easy placing in position and removal. The casing 21 is divided into superimposed stages by grids or the like such as 22, serving to support various filtering or adsorbent substances.

This first filtration element 20, known as the solid filtration element, comprises essentially, from the bottom upwards, that is to say in the direction of the flow of the rising fluid:

- — a mattress 23 of wires of steel, silica or alumina, the purpose of which is to retain the solid particles, soot, smoke, etc., in suspension in the gaseous mixture;
- — a layer of active carbon 24, preferably in granular form, having the function of fixing the smell and certain harmful components of the gaseous mixture by adsorbing gases such as H_2S;
- — a layer of silica gel 25 or of dehydrated substances with a micro-porous structure, which retains the water vapour in the gaseous mixture;
- — a layer of porous material 26 having pores of predetermined dimensions: this material, known under the Registered Trade-Mark SILIPORITE, forms a molecular sieve absorbing certain gaseous molecules of pre-determined size, such as for example the molecules of gas produced by the combustion of plastic materials which may have been burned in the hearth 2, or alternatively compounds such as ammonia, acetylene, ethylene, etc.;

— a layer of metallic oxides **27**, such as for example manganese dioxide, copper oxide, cobalt oxide and silver oxide, these oxides being preferably arranged in superimposed beds which have the function of causing oxidation of the carbon monoxide and its conversion to carbon dioxide, and to polymerize certain organic compounds.

It is known that the period of service of the metallic oxides is essentially a function of the humidity. The fact of placing the layers of oxides **27** at the upper part of the filter, especially above the silica gel, enables them to be effectively protected against humidity and in consequence prolongs their service life.

This first filtration device constitutes essentially a solid filter which is the first to receive the gases to be purified and which is intended to be replaced, after a certain period of service, by a new filtration device identical but provided with new or regenerated substances.

The purifying means **30** which are located downstream of the suction means **10** and constitute the second filtration device, essentially comprise a casing **31** of circular section intended to be fitted on the casing **11.** This casing **31,** like the casing **21,** may be fixed to the casing **11** by virtue of retention means with studs or springs, permitting easy placing in position and removal.

This second filtering device **30,** known as the liquid filtration element, comprises essentially an annular filter **32** constituted by a porous material such as blotting paper arranged in superimposed bands folded in a herringbone pattern. This filter has its lower portion immersed in an alkaline solution **33,** for example a solution of soda or potash which fills the bottom of the filtration element **30,** that is to say the annular portion between the casing **31** and the frusto-conical deflector **16.** A conduit **34** enables the filtration device **30** to be supplied with alkaline solution from a tank (not shown) while an overflow orifice **35** ensures a constant level of the said alkaline solution.

The filtering device **30** is provided at its upper portion with a mattress **36** of stainless steel wires or alternatively of silica or alumina wires, which has the function of retaining the small drops in suspension of the alkaline solution vapour, by condensing them. The liquid droplets thus formed return to the bottom of the filtration device **30,** either directly or through the nozzle **17** and its evacuation conduit **17**b.

The filter **32** is inpregnated over the whole of its height by upward capillary action of the alkaline solution in which its lower portion is immersed.

The carbon dioxide contained in the mixture which passes through the herringboned annular filter **32** thus impregnated with alkaline solution forms, by reaction with this solution, an insoluble carbonate which is precipitated, the carbonate thus formed being deposited on the herringbones over the whole height of the filter. By virtue of this method of mounting, the filtration device **30,** like the filtration device **20,** can be easily replaced when the herringbones are completely blocked up by the deposit of carbonate.

The operation of the device described above is as follows: when the fire is lighted in the hearth **2,** the compressor **14** is started-up and this brings the nozzle **12** into operation and starts the suction of the primary air necessary for combustion of the gases produced by the combustion and of the solid particles (smoke, suit) also produced by this combustion. The upward flow thus created passes successively through the mattress **23** which retains the solid particles in suspension, the layer **24** of activated carbon which fixes the bad smelling gases such as H_2S and certain harmful gases, the layer **25** of silica gel or the like which retains the moisture, the molecular sieve **26** which absorbs the gases which may be produced by a combustion of plastic materials, and finally the layer of metallic oxides **27** in which the carbon monoxide is oxidized and converted to CO_2.

The flow of gas which thus passes out of the first filtration device **20** has been freed from solid particles and also from all toxic compounds which have been retained or converted during the course of its passage through the various layers of filtration, so that this flow of gas is essentially constituted by air charged with CO_2, this CO_2 being formed either during the combustion or by oxidation of carbon monoxide. This mixture of air and CO_2 passes through the suction device **10** from which it proceeds through the interstice between the frusto-conical pressure-reducer **16** and the second nozzle **17.** It is then in contact with the alkaline solution which holds back the CO_2. The purified gaseous fluid thus obtained then passes through the metallic mattress **36** in which it is freed from its moisture, and then returns to the hearth flowing from top to bottom in the conduit **6.**

It should be observed that the flow of gas composed of air and CO_2 passes out of the first nozzle **12** at high speed and in laminary flow. It then encounters the second nozzle **17,** which, due to its spherical form, converts the laminary flow to a turbulent flow, thus permitting a powerful stirring effect on the gases, which facilitates intimate contact between the CO_2 and the alkaline solution contained in the annular filter **32.** This upward turbulent flow of the gaseous mixture in the filtration device **30** has the further advantage of aiding the capillary upward movement of the solution in the filter **32.** It should also be noted that the use of a filter impregnated by capillary action of the alkaline solution has the advantage of having practically no loss of pressure.

The purified fluid which is returned to the hearth receives during its passage, by virtue of the orifice **7** provided at the lower part of the conduit **6,** a supply of fresh air, adjustable by means of the shutter *7a*, which ensures a gaseous mixture suitable for combustion. It will be observed that the re-cycling of the purified flow of gas to the hearth ensures the burning of any carbon monoxide which may subsist, either in the state of traces or in larger proportions, which may accidentally occur in the case where the filter for fixing the carbon monoxide has become saturated. This return to the hearth ensures the complete elimination of the carbon monoxide, and therefore gives complete safety in operation.

There has been shown in FIG. **3** another form of construction of the second filtration device. The filtration device shown, indicated generally by the reference **40,** comprises essentially a casing **41** provided internally with a plurality of wicks or thin strips **42** made of a porous material such as blotting paper, these wicks having their lower extremities immersed in an alkaline solution **43** which fills the bottom of the casing **41.** The wicks **42** are thus impregnated by upward capillary action with the alkaline solution. The gaseous mixture consisting of air charged with CO_2 and coming from the suc-

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tion device 10 is admitted through a conduit 44 to the interior of the casing 41, so that during its passage it passes closely over the wicks 42 impregnated with alkaline solution, which holds back the CO_2 by forming an insoluble carbonate retained in the wicks. The purified air then passes through a mattress of metallic fibres 45, in which it is freed by coalescence of the droplets of water which it is conveying. It is then returned to the hearth through the conduit 6.

According to the form of construction shown in FIG. 4, the second filtration device, indicated generally by the reference 50, comprises a casing 51 provided at its upper portion with a tank 51*a* filled with an alkaline solution 52. Flexible capillary strips 53 descend vertically from the bottom wall of the tank 51*a* up to the proximity of the bottom of the casing 51. The alkaline solution 52 flows down drop by drop by gravity along the strips 53 coming to accumulate at the bottom of the casing 51. The gaseous mixture consisting of air charged with CO_2, admitted through the pipe 56, thus passes in close contact over the wicks 53 impregnated with alkaline solution, and then passes out of the outlet pipe 57 after having been freed from the CO_2.

The supply to the upper tank 51a is effected by means of a tube 54 which causes the lower part of the casing 51 to communicate with the said tank 51*a*, the suction of the solution being effected by means of compressed air supplied for example by the air compressor 14 and led through a pipe 55 opening into the conduit 54. The insoluble carbonates formed by reaction of the CO_2 with the alkaline solution accumulate at the bottom of the casing 51, as shown at 58.

There has been shown in FIG. 5 another form of construction of the second filtration device operating by spraying. The filtration device shown in FIG. 5, indicated generally by the reference 60, comprises a casing 61 communicating directly at its upper portion with the first nozzle 12. The casing 61 contains an alkaline solution 62 which fills its lower portion and which is injected directly, by means of a conduit 63, into the throttle portion 12*a* of the nozzle 12, which is supplied, as is already known, with compressed air through the conduit 13.

The flow of gas charged with CO_2 which passes through the nozzle 12 is thus intimately mixed with the alkaline solution thus atomized in the upper portion of the casing 61. The purified air, freed from CO_2, passes out of the casing 61 and underneath the baffle 64, rising into the chamber 65 and passing through the metallic mattress 66 which frees it from its moisture, and then passes into the conduit 6 which leads back to the hearth. The insoluble carbonates are deposited at the bottom of the casing 61, as shown at 67.

The separation of the CO_2 may also be effected by bubbling the gaseous mixture through an alkaline solution. A filtering device using the bubbling method is shown in FIG. 6. The device, indicated generally by the reference 70, comprises a casing 71 provided internally with superimposed platforms 72 containing an alkaline solution 73. Each platform 72 is provided in its central portion with a tubular passage or burst 74 surmounted by a dome 75. Each platform communicates with the platform beneath by an overflow pipe 76. The rising flow of gas coming from the nozzle 12 passes through the orifices 74 and, due to the presence of the cylindrical domes 75, is compelled to bubble into the alkaline solution of each of the platforms 72. The purified air is

returned to the conduit 6 after having passed through a metallic mattress 77. The precipitate is deposited on the platforms, as shown at 78.

Finally, there is shown in FIG. 7 another form of construction of the second filtration device functioning by bubbling into an alkaline solution. The filtration device shown in FIG. 7, indicated generally by the reference 80, comprises essentially a casing 81 which receives from the nozzle 12 the gaseous mixture consisting of air charged with CO_2. Inside the casing 81 is placed a receptacle 82 filled with an alkaline solution 83. The receptacle 82 is provided at its lower portion with ball admission valves 84, permitting the passage of the gaseous mixture under pressure, consisting of air and CO_2 and discharged from the nozzle 12.

This gaseous mixture passes in the form of bubbles through the alkaline solution in which it becomes freed from its CO_2 by the formation of insoluble carbonates. A stirring device or agitator 85, driven in rotation by an electric motor (not shown), causes a turbulent movement of the solution and in consequence a helicoidal trajectory of the bubbles, which facilitates intimate contact of the CO_2 with the said solution. The purified air is sent back through the outlet conduit 86 and the conduit 6 to the hearth 2.

In the form of embodiment shown in FIG. 1, the metallic casing 3 plays the part of a heat exchanger. The flow of hot gases coming from the hearth gives up calories to the sheet steel walls which transfer heat in turn to the ambient air. It may however be an advantage, in particular in the case of a brick-built fireplace to provide a heat-exchanger which is arranged directly above the hearth, and through which a fluid to be heated is passed.

Such a fireplace has been shown in FIG. 8, in which the same reference numbers designate the same elements as in FIG. 1, the fireplace being provided with suction and purifying means housed in the masonry conduit 93 and provided with a heat-exchanger 91 consisting of tubes heated by the combustion gases coming from the hearth before these gases pass into the purifying means, in which tubes the ambient air to be heated is circulated in counterflow.

A depression nozzle 92, connected to the compressor 14, sucks-in the air from the room through a filter 93 preferably located at the level of the ceiling and delivers it through a conduit 94 into the exchanger 91 in which it receives the heat of the combustion gases, and then into the room through a second filter 95 located at the level of the ground. The arrows F indicate the course of the air. There is thus obtained a total-heat fireplace, the heat of which is entirely recovered and is distributed into the room, simultaneously by radiation, convection and conduction, whereas in the case of a conventional fireplace, 5 to 20% of the heat is lost.

It is also possible to circulate water in the exchanger 90 so as to supply radiators for heating the premises.

A second form of embodiment of a more compact form of the device is shown in FIG. 9.

There can in particular be seen in the first portion of the device a hearth grate 101 on which the combustion is effected, and under which is provided a drawer 102 for removing cinders and ash.

The gases generated by the combustion and also the smoke have an upward convection flow and pass through a first filter 103 which stops the solid particles. This filter 103 is an element of the first filtration device

already referred to. At its outlet into the zone **104**, the flow of gas has a temperature situated in the vicinity of 200°C. This flow then passes into the heat-exchanger **105** which is preferably of the type with fins and which occupies the top of the heating device in this form of construction.

Leaving this exchanger, the flow of gas passes into the second part of the device which is separated from the first by a refractory plate **106**. The temperature reached by the flow of gas in the zone **107** is of the order of 30°C. There is thus a change from approximately 200°C. in the zone **104** to the vicinity of 30°C. in the zone **107**. Such a cooling action causes a condensation of water vapour and this condensation results in its turn, in this portion of the device, in a depression which accelerates the upward movement of the flow of gas in the first portion of the device.

The flow of gas then passes through the filter **108** which is also an element of the first filtration device and which comprises especially active carbon and various metallic oxides, the function of these latter being to convert the carbon monoxide coming from the combustion to CO_2 carbon dioxide. As shown in FIG. **9**, the shape of the filter provides a large surface of contrast between the flow of gases and, in particular the metallic oxides.

The water thus formed is again found in the portion **109**, from which a conventional device **110** enables the water to be extracted when this is considered necessary. In addition, a device **116** known per se makes it possible to prevent the water formed from penetrating into the nozzle **111** and thus compels it to flow directly into the tank **109**.

A closed-circuit acceleration nozzle **111** permits the speed of the flow of gas in this portion of the device to be increased by means of the compressor **112**, the suction of which is effected above the tank **113**. Thus, the flow movement in the entire device is due first of all to convection phenomena and then to a depression, and finally to an acceleration nozzle.

After having been accelerated by the nozzle **111**, the flow of gas passes into the second filtration device and bubbles through a solution, for example alkaline, contained in the tank **113**. Such a solution may be composed of water, soda and alcohol, but any other solution which can stop the CO_2 is suitable. During the course of this bubbling through an alkaline solution, the CO_2 contained in the flow of gas is precipitated in the form of carbonate.

In order to improve the alkaline solution - gas contact, there is arranged a drum **115** constituted by a metal cylinder having its axis of rotation perpendicular to the plane of the drawing. This cylinder is of the wire-mesh type permitting effective stirring of the alkaline solution. In addition, this type of drum permits the droplets of water contained in the flow of gas after its passage through the alkaline solution to be stopped.

According to the form of embodiment illustrated in FIG. **9**, the gaseous fluid is purified from the CO_2 which it contains by bubbling through an alkaline solution, but this latter may be replaced by any other means permitting contact between the said solution and the carbon dioxide, in particular by the methods illustrated in FIGS. **3** to **7**, by the use of a few arrangements so as to permit of their operation.

The purified gas is brought back to the hearth through the conduit **114**. However, by reason of the suction necessary for the compressor, there is only very little gas returned to the hearth.

It will of course be understood that numerous alternative forms of the devices described and shown above may be made, without thereby departing from the scope of the invention.

What I claim is:

1. A gas circulating and purifying device in combination with a fireplace having a hearth open to the atmosphere and on which combustion is effected, said device comprising:

means defining a path for gases extending from an inlet in the upper part of said fireplace to an outlet in its lower part leading to said hearth,

suction means in said path for creating a flow of the gaseous mixture formed by said combustion from said inlet toward said outlet, said suction means comprising a static nozzle in said path and means for directing a flow of fluid under pressure through said nozzle to create a depression upstream of said nozzle, and

purifying means in said path for separating entrained particles from said gaseous mixture and for absorbing noxious gases from said mixture.

2. A device as claimed in claim **1**, in which said purifying means comprise a first and a second filtration devices disposed respectively upstream and downstream of said nozzle.

3. A device as claimed in claim **2**, in which said first filtration device comprises successively, in the direction of flow of said gaseous mixture, means for retaining said solid particles, gas-absorption means for noxious gases means for removing water vapour, porous means forming a molecular sieve for the retention of gaseous molecules of pre-determined size, and catalytic means for the conversion of carbon monoxide to carbon dioxide.

4. A device as claimed in claim **3**, in which said particle-retention means are constituted by a mattress of steel wires.

5. A device as claimed in claim **3**, in which said particle-retention means are constituted by a mattress of material chosen from the group consisting of silica fibres and alumina fibres.

6. A device as claimed in claim **3**, in which said absorption means are constituted by active carbon.

7. A device as claimed in claim **3**, in which said means for removing water vapour remaining in the gases are dehydrated substances with a micro-porous structure.

8. A device as claimed in claim **3**, in which said catalytic means are constituted by a plurality of metallic oxides selected from the group consisting of manganese dioxide, copper oxide, cobalt oxide and silver oxide.

9. A device as claimed in claim **2**, in which said second filtration device comprises means for retaining CO_2.

10. A device as claimed in claim **9**, in which said CO_2 retaining means especially comprise an alkaline solution.

11. A device as claimed in claim **10**, in which said CO_2 retaining means also comprise an element with a capillary structure in contact with said alkaline solution, said element located in said path.

12. A device as claimed in claim **11**, in which said element is constituted by a herringbone filter, the base of which is immersed in said alkaline solution.

13. A device as claimed in claim 11, in which said element is constituted by a plurality of wicks, the base of which is immersed in said alkaline solution.

14. A device as claimed in claim 11, in which said element is constituted by a plurality of strips, the upper portions of which are immersed in a receptacle containing said alkaline solution.

15. A device as claimed in claim 10, in which said CO_2 retaining means are constituted by a receptacle containing the alkaline solution and connected by a conduit to the first nozzle, the CO_2 being eliminated by atomization of said solution in the gaseous mixture passing through said nozzle.

16. A device as claimed in claim 10, in which said CO_2 retaining means comprises an assembly of superimposed tanks containing an alkaline solution through which the gaseous mixture is successively bubbled.

17. A device as claimed in claim 10, in which said CO_2 retaining means are constituted by a receptacle containing said alkaline solution, through which the gaseous mixture is bubbled.

18. A device as claimed in claim 17, further comprising a rotating agitator mounted inside said receptacle and adapted to stir said solution.

19. A device as claimed in claim 18, in which said agitator is a wire-mesh drum having a horizontal axis of rotation.

20. A device as claimed in claim 9, comprising a mattress of steel wires adapted to cause the condensation of droplets of solution carried away by the flow of gas.

21. A device as claimed in claim 1, said device further comprising heat-exchanger means.

22. A device as claimed in claim 16, in which said heat-exchanger means comprises fins.

23. A device as claimed in claim 1, in which said suction means comprise a second static nozzle downstream of said first-mentioned nozzle and consisting of a part-spherical member coaxial with said first-mentioned nozzle and having a convex side facing said first-mentioned nozzle to form a deflecting surface for the gaseous mixture arriving from said first-mentioned nozzle, and cause a turbulent flow of said gaseous mixture at the outlet of said second nozzle.

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