(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 058 001**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 82300342.1

(22) Date of filing: 22.01.82

(51) Int. Cl.^{3}: **F 24 B 7/02**

(30) Priority: 23.01.81 IE 117/81
26.02.81 IE 399/81

(43) Date of publication of application:
18.08.82 Bulletin 82/33

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: McSweeney, Fanahan
1 Abbey Street
Fermoy County Cork(IE)

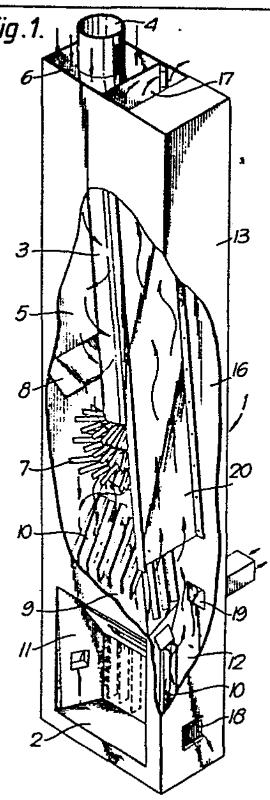
(72) Inventor: McSweeney, Fanahan
1 Abbey Street
Fermoy County Cork(IE)

(74) Representative: Harrison, David Christopher et al,
MEWBURN ELLIS & CO 2/3 Cursitor Street
London EC4A 1BQ(GB)

(54) **Heating apparatus.**

(57) Heating apparatus comprising a combined chimney breast and fireplace unit (1) has a flue pipe (3) extending upwardly from the region of the fireplace (2) to a flue gas exit (4) in an upper region of the chimney breast. An air heating duct (5) conveys air in heat exchange relationship with the exterior surface of the wall of the flue pipe (3) from an air inlet (6) in the upper region of the chimney breast to the region of the fireplace (2). Air heating passages (12) surround the fireplace (2) and communicate with the air heating duct (5) for conducting air received from the duct (5) in heat exchange relationship with exterior surfaces of walls (11) defining the fireplace (2) to a hot air duct (16) for conveying at least part of the heated air to a hot air outlet (17) in the upper region of the chimney breast. The air heating duct (5) and the hot air duct (16) are separated within the unit (1) by a partition wall (20) extending upwardly within the unit (1) from the region of the fireplace (2) to the region of the flue gas exit (4) and hot air outlet (17) in the upper region of the chimney breast. The unit (1) may be associated with further extension units to carry the flue pipe and ducts through further storeys of a house and a roof space, and to bring about at the same time further heat exchange between hot flue gases in the flue pipe and air or water conducted through the units.

Fig.1.



EP 0 058 001 A1

Heating Apparatus

This invention relates to heating apparatus for private houses and commercial buildings and in particular to heating apparatus for use in a domestic residence. It is an object of the invention to provide apparatus of this kind of improved efficiency and in particular to provide heating apparatus which offers enhanced heat recovery from an open fire compared with a conventional open fireplace and chimney construction, so that substantially all of the useful heat that would otherwise escape via the chimney may be caught. It is a further object of the invention to provide heating apparatus suitable for installation in convenient manner in a domestic residence and in particular to provide heating apparatus for fitting into a house or a room in a house in which no fireplace or chimney was provided in the original construct- ion of the building.

According to a first aspect of the invention, there is provided a combined chimney breast and fireplace unit having a flue pipe extend- ing upwardly from the region of the fireplace to a flue gas exit in an upper region of the chimney breast, an air heating duct for conveying air in heat exchange relationship with at least the exterior surface of the wall of the flue pipe from an air inlet in the upper region of the chimney breast to the region of the fireplace, air heating pass- ages surrounding at least part of the fireplace and communicating with the air heating duct for conducting air received from the heating duct in heat exchange relationship with at least exterior surfaces of walls defining the fireplace from the air heating duct to a hot air duct for conveying at least part of the heated air to at least one hot air outlet from the unit located in the upper region of the chimney breast, the air heating and hot air ducts being separated within the unit by a partition wall extending upwardly within the unit from the region of the fireplace to the region of the flue gas exit and the hot air outlet in the upper region of the chimney breast.

The term "combined chimney and fireplace unit" refers to a structure having a combustion region in which a fire can be lit and in which a portion of the structure located upwardly of the combustion region takes the place, in the installed unit, of the chimney breast wall in a conventionally constructed brick or blockwork chimney.

Preferably the flue pipe extends upwardly within the unit at an angle to the vertical longitudinal axis of the unit and the partition wall is substantially planar and extends upwardly within the unit substantially parallel to the flue pipe. Such an angular disposition of the flue pipe serves to promote turbulence in the flow of flue gas in the flue pipe and thereby to improve heat exchange with the air streaming through the air heating duct. The contraflow arrangement of the air and flue gas flows is also beneficial in terms of efficient heat exchange.

In a preferred embodiment, a metal shell defines the outer walls of at least a part of the chimney breast and the air heating and hot air ducts are defined by the partition wall and by portions of the shell for heat exchange between air flowing in the ducts and the shell so that the outer walls of at least part of the chimney breast may be heated by hot air flowing within the ducts for heat exchange with the environment surrounding the unit. Thus the shell also acts in similar manner to a radiator, to heat its immediate surroundings.

The shell may also form a sheath for the fireplace of the unit which defines at least in part outer walls of the air heating passages surrounding at least part of the fireplace, so that these outer walls may be heated by hot air flowing within the passages for heat exchange with the environment surrounding the unit and thereby further enhance the heating effect of the part of the shell defining outer walls of the chimney breast, as noted above.

In an advantageous construction of the combined chimney breast and fireplace, the shell is substantially rectangular in transverse section and the flue pipe is substantially coaxially disposed within the air heating duct at the flue gas exit and air inlet in the upper region of the chimney breast, the air heating duct being dimensioned in this region so that continuations of at least the air heating duct and the flue pipe can be located between conventionally spaced floor or roof joists to pass through a floor or roof. In this way, installation of the unit in a house not provided with a fireplace or chimney is particularly simplified, and may be achieved in economical manner.

The partition wall may be arranged to direct all of the air emerging from the air heating duct into the air heating passages, or alternatively some of the air may be allowed to sweep around the lower end of the wall to enter the hot air duct directly. Heat exchange fins may be provided on the flue pipe to increase heat transfer to the air in the air heating duct, while baffles in the duct may generate additional turbulence and serve to direct the flow of air towards the hot flue pipe. Additional heating surface area may be provided in the fireplace region by means of a draft flue and heating tubes. It is also advantageous to provide finlike strips of metal on the walls defining the fireplace in contact with the hot air flowing through the air heating passages surrounding the fireplace, to strengthen the structure of the fireplace and also promote further heat exchange.

It is preferred, in an installation embodying apparatus acording to the invention, to force the air to be treated through the ducts and passages by means of a blower or fan, and in addition, a hot air outlet or outlets may be provided to allow hot air flow directly from the unit to the space surrounding the unit. Means for directing a portion of the hot air to the base of a fire in the fireplace are also advantageously provided in order to minimise extraction of air from the space in which the unit is installed, by the fire due to combustion.

For an installation in a house having two or more storeys, the heating apparatus according to the invention also comprises at least one extension unit having a flue pipe extending upwardly from a flue gas inlet communicating with the flue gas exit of the combined chimney breast and fireplace unit or communicating with a flue gas exit of another extension unit of the apparatus to a flue gas exit in an upper region of the extension unit, an air heating duct for conveying air in heat exchange relationship with at least the exterior surface of the wall of the flue pipe of the extension unit from an air inlet in the upper region of the extension unit to an air outlet communicating with the air inlet of the combined chimney breast and fireplace unit or communicating with an air inlet of another extension unit of the apparatus, and a hot air duct extending upwardly from a hot air inlet communicating with the hot air outlet of the combined chimney breast or fireplace unit or communicating with a hot air outlet of another extension unit of the apparatus for conveying at least part of the hot air received at the hot air inlet to at least one hot air outlet from the extension unit located in the upper region thereof.

In a preferred construction of the extension unit, a metal shell defines the outer walls of at least the air heating duct of the extension unit and the air heating and hot air ducts are separated from one another by a wall comprising an insulating layer and extending upwardly from the region of the lower end of the extension unit to the region of the upper end of the unit. In this way, the temperature of the hot air is maintained close to its value at entry to the unit throughout its transit of the extension unit. Suitably the extension unit is also arranged with the flue pipe and air heating duct coaxial and is dimensioned for continuations of this pipe and duct to fit between adjacent floor or roof joists without requiring these to be cut.

In similar manner to the combined unit, the extension unit may also serve to heat the space through which it passes in the manner of a radiator and also fins may be affixed to the flue pipe to promote heat transfer to the air. Preferably at least one controllable hot air outlet to the surrounding space is also provided.

The units of the apparatus according to the invention as described above provide for enhanced recovery of the heat given off by combustion of fuel in the fireplace or firebox of the apparatus and, in particular, they provide for this to be achieved with an open fire, which is an inefficient means of burning fuel in so far as conventional chimneys are concerned, but which nonetheless appeals to householders for less tangible reasons. However despite the good level of heat recovery achieved in the combined unit and by virtue of one or more extension units, it has been found that the flue gases continue to reach the flue gas exit from these units at a temperature sufficiently high for them to be capable of yielding further worthwhile quantities of heat.

Accordingly, the apparatus according to the invention further comprises a roof space extension unit having a flue pipe extending from a flue gas inlet communicating with the flue gas exit of the combined chimney breast and fireplace unit or communicating with the flue gas exit of an extension unit of the apparatus to a flue gas exit communicating with a chimney exhausting to atmosphere, at least a portion of the flue pipe of the roof extension unit being surrounded by a jacket for the flow of a fluid medium in heat exchange relationship with at least the exterior surface of the wall of the flue pipe through the space defined between the jacket and the wall of the flue pipe.

In one embodiment of the roof space extension unit the fluid medium is water and water heated in the unit is conducted to a hot water cylinder. In another embodiment, the fluid medium is air, and a blower is provided for supplying air to the space defined between the jacket and the wall of the flue pipe. The air from the roof space extension unit may then be further heated in a vertical extension unit and/or a combined unit of the apparatus or alternatively it may be conducted directly to a space to be heated. Fins may be provided on the flue pipe in either of the embodiments, in order to promote heat exchange. In a further embodiment of the roof space extension unit, both air and water are heated by flow through spaces defined by separate jackets and the flue pipe.

The roof space extension unit may be arranged with its flue pipe disposed at a low angle with respect to the horizontal without this having any detrimental effect on the draught present in the flue pipe. This angle may be as low as 5°. Such an arrangement allows the extension unit to be carried across a roof space to maximise its length and heat transfer capabilities and also to be brought to the most favourable location for the chimney outlet. Despite the low angle of the flue, it has been found that the draught in the flue of the apparatus according to the invention may be actually improved compared with a flue of higher angle to an extent sufficient to require an additional damper in the flue near the chimney to control flue gas flow through the roof space extension unit, in addition to the normal damper provided near the fireplace.

An alternative form of roof space heat exchanger may be provided which is also suitable for use with heating equipment of other kinds. According to this aspect of the invention, there is provided a roof space heat exchanger comprising at least one double-walled chamber for the flow of a fluid medium through a cavity defined between the double walls of the chamber, the inner walls also defining a space for the flow of flue gas therethrough for heat exchange with the fluid medium.

In a preferred embodiment, the chamber is supplied with water for flow thereof through the cavity or space defined between the walls and a plurality of double-walled fins are also provided extending downwardly into the flue gas flow space from an upper wall of the inner walls in order to promote heat exchange between the flowing flue gas and the water. The chamber is suitably also provided with doors in a side wall, through which access can be gained to the flue gas space for inspection and cleaning.

In an alternative and particularly advantageous embodiment of the roof space heat exchanger, a plurality of chambers is provided, and each chamber is in air-tight interconnecting relationship with the adjacent chamber or chambers for the flow of flue gas therebetween. Preferably, the flue gas inlet to the first chamber is in a lower region thereof while the flue gas exit from the last chamber is in the upper region of that chamber, and the interconnection between adjacent chambers is in each case provided in their lower regions. The floor of each chamber is advantageously arranged to slope downwardly to a sump and drain conduit through which accumulated dirt and soot may be washed out of the chamber. Each chamber is also provided with an insulated door which seals it for use, but allows access for cleaning and inspection. By virtue of the sump, the chamber can be easily cleaned down by spray means, and the levels of the interconnections between the chambers are arranged to permit dirt to accumulate below them and not impede the flow of gas through the chambers.

The roof space heat exchanger may be included in an installation comprising the combined chimney breast and fireplace unit and optionally also one or more extension units according to the invention, in order to extract the maximum amount of heat from the flue gases and to provide a relatively clean exhaust from the final chimney or stack. Draught inducing means such as a blower may be required at the outlet end of the heat exchanger in some circumstances. Control means may be associated with the various units of the apparatus in order to regulate the air flow and optionally also the draught in the flue pipe, in order to ensure that the required amount of heat is distributed to the space or spaces to be heated and also to the hot water tank, where water heating is included in the system.

In order that the invention may be more clearly understood, a number of embodiments thereof will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a part cut-away pictorial view of a combined chimney breast and fireplace unit for heating apparatus according to the invention;
Figure 2 is a sectional side view of the unit of Figure 1, substantially along the longitudinal axis of the flue pipe thereof and also shows one construction of means for admitting cold air into the air heating duct of the unit;
Figure 3 is a sectional front view of the unit of Figure 1;

Figure 4 is a sectional view of the unit of Figure 1 on the line IV - IV of Figure 3:
Figure 5 is a pictorial view of the fireplace region in a unit similar to that of Figure 1 but of larger dimensions;
Figure 6 is a front view of the fireplace region of Figure 5;
Figure 7 is a sectional front view of the fireplace region of Figure 5 and also shows an alternative arrangement of the partition wall in the unit at its lower end, for guiding the air flow in the vicinity of the lower end of the flue;
Figure 8 is a part cut-away pictorial view of an arrangement for conducting air from within the unit to provide combustion air for a fire in the fireplace;
Figure 9 is a front sectional view of the arrangement shown in Figure 8;
Figure 10 is a part cut-away pictorial view of an extension unit for attachment to the unit of Figure 1 to conduct flue gases and hot air vertically upwards through a further storey of a building;
Figure 11 is a sectional side view of the extension unit of Figure 10, substantially along the longitudinal axis of the flue pipe thereof and also shows means for admitting cold air into the air heating duct of the unit, and for collecting hot air from the rising hot air duct;
Figure 12 is a sectional view of the extension unit of Figure 10 on the line XII - XII of Figure 1;
Figure 13 shows a first construction of a roof space or attic extension unit, including a water heater;
Figure 14 is a transverse sectional view of the water heater shown in Figure 13;
Figure 15 shows a second construction of attic extension unit including an air heater;
Figure 16 is a transverse sectional view of the air heater shown in Figure 15;
Figure 17 shows a further construction of attic extension unit, including both a water heater and an air heater;
Figure 18 is a sectional view of a bungalow, showing a heating installation including heating apparatus according to the invention;
Figure 19 is a sectional view of a two-storey house including heating apparatus according to the invention, shown in front view;

Figure 20 is a similar sectional view to Figure 19, with the heating apparatus shown in side view;
Figure 21 is a schematic diagram of the system for controlling the heat output in heating apparatus according to the invention;
Figure 22 is a pictorial view of a unit generally similar to that of Figure 1 in association with a first construction of a chamber-type heat exchange unit for installation in an attic space;
Figure 23 is a longitudinal sectional view of the heat exchange unit of Figure 22;
Figure 24 is a transverse sectional view of the heat exchange unit of Figure 22;
Figure 25 is an end view of the heat exchange unit of Figure 22 from the flue gas entry end;
Figure 26 is a pictorial view of a unit generally similar to that of Figure 1 in association with an alternative construction of a chamber-type heat exchange unit for installation in an attic space;
Figure 27 is a longitudinal sectional view of the heat exchange unit of Figure 26;
Figure 28 is a detail view in section of a portion of an air-tight joint between adjacent chambers of the heat exchange unit of Figure 26; and
Figure 29 is a transverse sectional view of a chamber of the heat exchange unit of Figure 26.

As shown in Figure 1, heating apparatus according to the invention includes a combined chimney breast and fireplace unit 1, which has a fireplace or firebox 2 and a flue pipe 3 extending upwardly through the unit from the region of the fireplace 2 to a flue gas exit 4 in the upper region of the unit. The term "combined chimney breast and fireplace unit" as used herein, refers to a fabricated structure having inter alia a combustion region in which a fire can be lit and in which a portion of the structure located upwardly of the combustion region takes the place in the installed unit of the chimney breast wall in a conventionally constructed brick or blockwork chimney. In the unit of this kind shown in Figure 1, an air heating duct 5 is also provided for conveying air in heat exchange relationship with the exterior surface of the wall of the flue pipe 3 from an air inlet 6, also in the upper region of the unit 1, to the region of the fireplace 2. The flue pipe 3 is disposed substantially coaxially with the air heating duct 5 at the flue gas exit 4 and air inlet 6, but as will be seen from the sectional view of Figure 3, the flue pipe 3 extends at an angle to the vertical longitudinal axis of the unit 1, so that additional turbulence will be imparted to flue gas leaving the combustion region and travelling upwardly through the flue pipe 3.

Fins 7 are provided on the exterior surface of the wall of the flue pipe 3 to improve heat exchange between the air flowing downwardly through the duct 5 and the hot gases flowing upwardly inside the flue pipe 2. The fins 7 are of a light gauge aluminium or similar metal which possesses good heat conducting capabilities and they are affixed to the flue pipe in such a manner as to ensure good transfer of heat from the pipe to the fins. Baffles 8 are also provided within the duct 5 to direct air passing through the duct towards the flue pipe for heat exchange therewith, and to create additional turbulence in the air flow.

The fireplace 2 is connected to the flue pipe 3 by a throat section 9 which, as can be seen from Figure 3 in particular, tapers inwardly in at least one dimension, from the main combustion region of the fireplace towards the flue pipe. The fireplace, the throat and the flue pipe are fabricated from metal, and are preferably formed from stainless steel so as to be resistant to acid attack. Metal strips 10 are affixed such as by welding to walls 11 defining the combustion region of the fireplace on the sides thereof directed away from the combustion space, to form strengthening members for reinforcing the walls and preventing them from being distorted by the heat of combustion or by the battering or pounding they experience during the loading of solid fuel into the fireplace. Similar strips 10 are also affixed to the corresponding surfaces of the walls defining the throat 9.

Referring again to Figure 1, air heating passages 12 surround the fireplace on the sides, rear and floor thereof, and are defined between the walls 11 and an exterior metal shell 13, which as can be seen from the Figure, in this construction is a continuation of the outer wall of the chimney breast portion of the combined unit, and defines inter alia, also part of the wall of the air heating duct 5. The strips 10 extend outwardly from the walls 11 and from the walls defining the throat 9 into these air heating passages, and function additionally as heat exchanging fins for improving the heat transfer between the hot gases of combustion and the air being heated. Air received from the air heating duct 5 is conducted through these air heating passages and is thus heated up further from its condition on leaving the duct 5.

The fireplace 2 also includes a draught flue 14, as shown most clearly in section in Figure 2, and heating tubes 15, for the flow of hot gases therethrough in each case, to provide additional heating surface area and thereby improve the heat transfer efficiency of the unit.

The greater part of the heated air leaving the air heating passages 12 passes into a hot air duct 16 which leads it back up through the unit to a hot air outlet 17 from the unit located in the upper region of the unit 1 adjacent to the air inlet 6. However, part of the heated air from the passages 12 may be vented directly to the exterior of the unit through grilled or louvred vents 18 provided in the walls of the shell 13 in the region of the fireplace 2, which vents are preferably provided with means for adjusting the quantity of air passing through them, such as for example, a sliding shutter, or in the case of louvres, the vanes may be pivotably mounted and movable between fully open and fully closed configurations. In addition, a further outlet 19, also located in the vicinity of the fireplace, leads to a duct for conducting hot air from the unit 1 to an adjacent room or other space to be heated.

As can be seen from Figure 1, the air heating duct 5 and the hot air duct 16 are separated within the metal shell 13 of the unit 1 by a metal partition wall 20, which extends upwardly through the structure and, as can best be seen from the sectional view in Figure 3, this wall 20 is disposed substantially parallel to the direction of the flue pipe 3 and therefore is also arranged at an angle to the vertical longitudinal axis of the unit 1. The partition wall 20 separates the flow of air in the heating duct from that in the hot air duct and at its lower end it directs the greater part of the air flowing through the air heating duct 5 into the air heating passages 12 surrounding the fire-place. Considerable turbulence is generated in this region where the wall terminates and this turbulence contributes to improvement in the heat transfer. In addition to the functions set out above, the partition wall also serves a structural purpose in that it serves to rigidify the metal shell 13 and to prevent disturbing or annoying vibrations or noise arising from expansion or contraction of the unit 1 during operation.

It will be clear from the drawings that in addition to generating hot air for use in heating the space surrounding the unit 1 and for transmission to other spaces to be heated, the metal shell 13 of the unit 1 will also become hot during use of the heating apparatus according to the invention and thus function as a radiator and convector in its own right. It may be found that the degree of heating of the shell is too great for comfort or safety and in this case the lower portions of the shell in the region of the fireplace and throat may themselves be sheathed insulatingly or enclosed to reduce the heat transfer from the unit 1 to the space or room in which it is installed. This additional heating derived from the structure itself is an especially advantageous feature of the combined chimney breast and fireplace unit of the heating apparatus according to the invention and the effect is enhanced by the direction of air flow within the unit during the first part of its heating being oppositely directed to that of the flue gas.

A suitable size of the unit 1 is approximately 500 mm (2 feet) wide by 250 mm (1 foot) deep, and its height is adapted to suit the height of the room in which it is located. It may however be of different dimensions where required and while a rectangular section is favoured for constructional convenience, other cross-sectional shapes are not excluded. It is an advantage of the construction described herein with the dimensions cited above that the coaxial disposition of the flue pipe 3 and the air heating duct 5 at the flue gas exit 4, allows the upwards continuations of these to be contained within the spacing of conventionally spaced roof or floor joists in a domestic house, thus facilitating installation of the apparatus according to the invention, in that cutting of the joists will not normally be required. In certain circumstances it may also be possible to fit the hot air outlet 17 together with the flue gas exit 4 and the air inlet 6 between a single pair of joists. In this instance, the outlet 17 is positioned immediately adjacent the inlet 6 as shown in Figure 1. Alternatively the outlet 17 may be brought up on the opposite side of a joist from the inlet 6, but again the cutting of joists is avoided.

The combined chimney breast and fireplace unit of the heating apparatus according to the invention is suitable for installation both in new houses and in older houses. It is especially well suited to installation in houses in which no fireplace or structural chimney was provided at the time of building but is no less useful for providing a fireplace and chimney in a convenient and economical manner in a new house, without it being necessary to undertake the heavy and costly structural work required to build in a conventional fireplace and chimney. It is effective in collecting and distributing a substantially greater proportion of the heat released during combustion of fuel in an open fire than is the case with a conventional brick or blockwork fireplace and similarly constructed chimney. It also provides a unit of not unattractive appearance, especially when the metal shell is suitably clad with a decorative sheath, and retains the traditional appearance of the open fire, while improving on the notoriously poor efficiency of this form of heating.

If desired, it is possible for the entire metal shell itself to be encased within a sheath optionally having an insulated wall portion in the vicinity of one wall of the shell and louvres or vents to allow air heated by other walls of the shell to flow outwardly from the shell to heat the room in which the unit is located. In this way comfort and safety can be combined with any desired ornamental character of the sheath, so that the appearance of conventional fireplace designs can be retained, if required.

Referring now to Figure 2, the features shown therein have already been referred to in connection with Figure 1, with the exception of the air elbow 21 shown on an upward extension of the unit 1, which upward extension is indicated in outline form only. As can be seen the elbow 21 directs air towards the inlet 6, while the flue pipe continues vertically upwards from the elbow. By bringing the flue pipe upwards within the air heating duct, the combustible floor or roof timbers are to an extent protected against the heat of the flue gases, although it is preferred to wrap the entire duct with insulating material to ensure such protection. In this way, safety is promoted while additional heating of the air is achieved by virtue of its uninterrupted flow in contact with the hot flue pipe. Figure 2 also shows a damper 22 which as shown is in the throat region of the unit, and may be manually controlled in order to regulate the draught in the flue pipe.

Figure 3 is a vertical section through the unit 1 on a plane at right angles to that of Figure 2, and again the features shown therein are fully described above, with the exception of a temperature sensor 23 which measures the temperature of the air in the hot air duct near the hot air outlet 17 of the unit 1.

Figure 4 is a cross-section of the unit 1 on the line IV - IV of Figure 3, and again the features shown therein have been described in the foregoing text.

Figures 5, 6 and 7 show a larger example of the fireplace region of the unit 1 than that illustrated in the previous Figures. This version of the fireplace is intended for larger installations in larger buildings, and may be used in a factory, for example, for burning waste material, thus giving useful heat while also fulfilling an incinerating function. The features shown therein have again been fully described in connection with the earlier Figures, apart from a modification of the lower end of the partition wall 20, which modification is shown in the front sectional view of Figure 7.
In this case the partition wall terminates substantially sealingly against the upper end of the throat 9 so that substantially all of the

air streaming downwardly through the air heating duct 5 will be directed into the air heating passages surrounding the fireplace, and substantially none of this air bypasses the passages to enter the hot air duct 16 directly. In the case of the construction of the lower end of the partition wall as shown in Figures 1 and 3, it will be seen that a limited proportion of the air from the air heating duct may enter the hot air duct directly around the lower end of the partition wall.

Another modification in the fireplace region of the unit 1 is shown in Figures 8 and 9. A tube 25 is provided leading from a funnel-shaped inlet 25 within the air heating passages 12 or the hot air duct 16 to outlets 26 located in a base region of the fireplace below the grate, when installed, so that air from inside the shell of the unit can be conveyed to the outlets 26 for upward flow through the grate of the fireplace and to provide combustion air for a fire burning on the grate. This serves to improve the efficiency of the combustion and also helps to reduce the amount of air which the fire draws from the room in which the unit is installed. The rate of flow of air through the tube 24 may be controlled by the valve 27 located in the tube near its entry, which valve is manually adjustable by control wheel 28 projecting through the wall of the metal shell 13.

An upward extension unit of the heating apparatus according to the invention will now be described with reference to Figures 10, 11 and 12 of the drawings. This unit is intended to extend vertically upward from the combined chimney breast and fireplace unit 1, to carry the flue and air ducts through, for example, the first floor of a two-storey house, or it may constitute a further extension of a previous vertical extension unit in the case of a multi-storey house. As shown in Figure 10, the vertical extension unit 29 has a flue pipe 30 extending upwardly from a sealing connection with the flue gas exit of the flue pipe 3 of the unit 1 to a flue gas exit 31 of the extension unit, which is located at the top of the extension unit 29. A metal shell 32 defines an air heating duct 33 which is substantially coaxial with the flue pipe 30 and serves to convey air downwardly from an air inlet at the top of the extension unit to an air outlet in communication with the air inlet of the combined unit 1. Fins 34 are affixed to the flue pipe in similar manner to those on the flue pipe 3 of the unit 1, to augment the heat transfer between the upwardly moving gases in the flue and the downwardly flowing air in the duct 33. It will again be remarked that the efficiency of this heat transfer is enhanced by the contraflow arrangement, in which the air to be heated passes through the air heating duct in the opposite direction to that of the flue gases streaming through the flue pipe.

In the particular case where the hot air leaving the hot air outlet 17 of the chimney breast and fireplace unit 1 is also required to be carried upwards through a further storey of a building, a hot air duct 35 may be attached to the side of the air heating duct 33, from which it is separated by a wall 36 comprising an insulating layer, for preventing the hot air from being possibly cooled by the air in the air heating duct, which at this stage may well be cooler than the air in the hot air duct. Where both ducts can be carried up through the floor from the unit 1 between a single pair of joists, both ducts may be contained within a single external shell, but insulation must still be provided in the partition wall within the shell which separates the ducts. It will be appreciated that the ducts and flue pipe must be sealingly connected to the corresponding ducts and pipes in any adjoining unit or units, and also that these connections between units must be surrounded by a suitable insulating material where they pass through or close to wooden structural members.

As in the case of the unit 1, a part of the air passing through the duct 35 may be released through a controllable vent 37 into the room or space in which the vertical extension unit is installed. The remainder of the air may be taken away to be directed to other rooms or spaces to be heated, as indicated in schematic form only in Figure 11, which also indicates an elbow for air being supplied to the unit 29 similar to the elbow 21 shown in Figure 2 with similar protection of floor or roof timbers by virtue of the cooling effect of the air heating duct being located between the hot flue pipe and the combustible material. Figure 12 is a transverse section on the line XII - XII of Figure 11, and shows features already described in relation to Figures 10 and 11. It will also be appreciated that where it is not required to duct air through a roof space from the vertical extension unit 29, the hot air outlet may comprise a vent near the upper end of the hot air duct, releasing hot air to the space in which the unit is located. The same arrangement may also be applied to the combined unit 1, where the building layout necessitates this.

An attic or roof space extension unit of the heating apparatus according to the invention is shown in Figure 13. This Figure also shows a combined chimney breast and fireplace unit 1 having a flared-out portion 39 which may be formed by the actual metal shell itself, or may be a sheath affixed to the outside of the shell for safety reasons as already referred to above, or for purely decorative reasons to give the unit 1 a suitable measure of styling for the location in which it is to be installed. The air inlet elbow 21 is also shown, as is the hot air outlet elbow which in this case is connected to a hot air conduit 40, by means of which the hot air may be conducted to more distant locations for supply to a space or spaces to be heated thereby.

Considering now the extension unit itself, this consists of a flue pipe 41 which extends upwardly at an angle to the vertical from a sealing connection with the upper end of the flue pipe 3 of the unit 1 to a chimney 42 through which the flue gases are exhausted to the atmosphere. As shown, the chimney 42 is fabricated from metal and is provided with a cap to prevent ingress of moisture into the flue pipe. An inspection cap 43 is provided on the lower bend at the commencement of the flue pipe 41 to facilitate examination and cleaning of the interior of the flue pipe. A portion of the flue pipe 41 is surrounded by a jacket 44 provided with an inlet 45 and an outlet 46 for the flow of water through the space defined between the jacket and the flue pipe. Despite the efficient heat transfer arrangements provided in the units 1 and 29, it has been found that flue gases leaving these units, whether in a single storey or a multi-storey house, still contain a not inconsiderable quantity of heat, and accordingly further heat can be extracted from the gases in the flue pipe 41 and transferred to the water flowing through the space defined between the jacket and the flue pipe.

Metal fins 47 are provided on the exterior of the wall of the flue pipe, as shown in cross-section in Figure 14, to improve the rate of heat transfer to the water, and the jacket is lagged, as indicated by the numeral 48, to minimise heat losses. The jacketed heat exchange space can contain between 2 and 50 litres of water but a preferred capacity is about 10 litres.

An alternative construction of roof space heat exchanger is shown in Figure 15, in which a flue pipe 49 extending upwardly in generally similar manner to the flue pipe 41 in the construction of Figure 13, is surrounded over the greater part of its length by a jacket 50 through which air is conducted, driven by a fan or blower 51. The lower end of this jacket is sealingly connected to the air inlet of a vertical extension unit 29 or a combined unit 1, so that air entering the space defined between the jacket 50 and the flue pipe wall undergoes a partial pre-heating, again in contraflow to the flue gases, before being heated up further in the air heating ducts of the other units. As shown in cross-section in Figure 16, the flue pipe in this instance also has fins affixed to its external surface, but these are longer than in the case of the water heating arrangement described, and resemble the fins attached to the flue pipes of the units 1 and 29. The spacing between the pipe and the jacket is also greater than for water heating. However, it is again advantageous to lag the jacket.

As in the case of the water heating arrangement provided on the flue pipe 41 of the attic extension unit described in relation to Figure 13, the hot gases leaving the unit 1 or 29 retain a considerable body of heat, a goodly proportion of which is delivered up to the air flowing through the space defined between the jacket 49 and the flue pipe 48. As shown in Figure 15, the chimney 51 is in this case formed from light-weight reinforced concrete, so that its external appearance is substantially similar to that of a conventional chimney. However, the open pot provided on it is less desirable than the arrangement shown in Figure 13, in that it admits moisture to the flue pipe, although the chimney may be considered aesthetically more pleasing.

Yet another construction of attic extension unit of the heating apparatus according to the invention is shown in Figure 17, in which both air and water are heated by the flue gases. The flue pipe 53 is carried across the roof space of the house from a unit 1 or 29 to a chimney 54 at a relatively shallow angle which may be as low as 5° to the horizontal. This is done in order to maximise the length of the flue pipe and to give maximum opportunity to transfer heat to the air and water. Surprisingly, in the heating apparatus according to the invention, it has been found that the disposition of a flue pipe at this low angle is not detrimental to the draught therethrough, and even improves it, and a satisfactory draught has been maintained in installations where lengthy runs of flue have been taken across substantially the entire extent of the roof space of a house. It is thus an advantageous feature of the apparatus according to the invention that the installation of the combined unit 1 in a particular room or area of a house does not place any constraint on the placing of the chimney on the roof of the house and the most suitable location can be chosen, whether for reasons of appearance or to minimise nuisance in respect of smoke. However, it will also be appreciated that while the embodiments of attic extension units shown all relate to flue pipes which are at an inclination to the vertical to a greater or lesser degree, where suitable, the flue pipe may also be carried upward in a substantially vertical manner.

Considering now again Figure 17, it will be seen that a water heater 55 is provided on the lower part of the flue pipe 53, and this water heater is formed in substantially similar manner to that more fully described in relation to Figure 13. An air heater 56 is then provided on the remaining part of the extent of the flue pipe and, as shown, this heater is of considerably greater length than the water heater. A joint 57 may be provided in the flue pipe intermediate the two heaters in order to facilitate installation of the unit. The water heater is provided with an inlet and an outlet in similar manner to that of Figure 13, but the arrangement in respect of the air heater differs from that shown in Figure 15. Instead of forming in effect an extension of the air heating duct of a unit 1 or 29, the air heater of Figure 17 is self-contained. Air is taken in through a common inlet

58, which may be in the hallway of the building and from which a portion is taken through a filter 59 and driven by a blower 60 into the air inlet of a unit 1 or 29. Alternatively the intake may be elsewhere within the building or it may be in the roof space, and in some instances it may even be outside. The remainder of the intake air passes through a duct or conduit 61 from where a blower 62 forces it through the heating space defined between the jacket of the air heater 56 and the flue pipe 53. It will be seen that in this instance the direction of flow of the air is the same as that of the flue gases, but this is not necessarily the case in every such installation. The heated air is brought from the upper end of the jacket of the air heater to the rooms or space to be heated by conduits 63.

Inspection caps 64 are provided at each end of the flue pipe 53, in the elbows or bends leading from the unit 1 or 29 and leading to the chimney respectively, to facilitate examination of the interior of the flue and cleaning.

The chimney shown is again formed from metal such as aluminium, or is of lightweight reinforced concrete but in this instance a construction is provided adapted to prevent ingress of rain or other moisture. The flow of air through the heater 56 is adjusted by varying the speed of the blower 62. A manually operable controller 65 is provided, which is also linked with a sensor 66 for measuring the temperature of the air at or near the exit from the air heater, so that the fan is switched on or speeded up when the air temperature in the air heater rises to some preselected value and is switched off or slowed down when the temperature falls to a preselected second value. Any suitable thermostat, such as a bimetallic switch, will serve this purpose. The control of the fan may also be linked with the room temperature in one of the spaces to be heated, so that the preservation of an agreeable level of space heating can be combined with the most efficient extraction of heat from the flue gas.

Figure 18 shows a bungalow equipped with heating apparatus according to the invention. The features shown will be clear from the foregoing description of the individual units without need for further explanation, but attention will be directed to the air supply arrangement for the air heater in the roof space and the unit 1 in which a single blower 67 is used to drive the air towards each of the units. The connection of the water heater to the hot water cylinder 68 will also be clear. The hot water rises into the cylinder 68 in known manner and the cold water connections and header arrangements are also conventional.

Where the flue pipe passes through the combustible material of the roof structure, as at 69, it is surrounded by insulating material, such as asbestos, and similar protection is applied to any other hot pipes or ducts passing through or adjacent to timber or other flammable materials, as already mentioned. It will also be seen that the intake 70 for the air entering the units to be heated is placed in the ceiling of a hallway and this is a preferred location. Alternatively, intakes may be carried from individual rooms.

In Figure 18, the arrangement of the apparatus according to the invention when installed in a two-storey house is illustrated. Again the features shown do not require description in detail, but the alternative flue arrangements may be remarked. The flue pipe may either be across the roof space to exhaust at a more favourable location. it may also be noted that by bringing the flue pipe across the roof space at a low angle, it may in some instances be possible to make use of an existing chimney in the house.

Figure 20 shows the installation of Figure 19 in a view at right angles to that of Figure 19, and again it will not be necessary to provide further detailed description. It will however be pointed out that the arrangement of the dividing walls between the rooms of the house is such as to simplify making best use of the various forms of heat output provided by the heating apparatus.

Figure 21 is a simplified schematic diagram of the control system for the blower of an air heater or combined unit and extension units of apparatus according to the invention. The numerals are the same as those used in connection with Figures 17, 62, 65 and 66 designating the fan or blower, controller and sensor respectively, while 71 represents the electric power source for the control system.

Figures 22 to 24 show a form of roof space or attic heat exchanger which is particularly suitable for use with the units 1 and 29 of the apparatus according to the invention but which may also be used with stoves or combustion units of other kinds. It consists of a double-walled chamber 72, the inner wall of which defines a space for the flow of flue gas through the chamber. Water is arranged to flow through the cavity within the walls, i.e. the space 73 defined between the double walls of the chamber, so that it may be heated up by the hot flue gases swirling through the chamber. Virtually all of the heat of the flue gases entering the chamber through the flue gas inlet 74 can be removed from them during their passage through the chamber, thus maximising the return from the fuel burned and giving a good efficiency of the apparatus. In this instance, natural draught may not be sufficient in all installations and a draught-inducing fan may be disposed in the flue gas outlet 76 from the chamber 72. The speed of the fan may be controlled in relation to the exit temperature of the flue gases.

Heat exchange may be further promoted by means of double-walled fins extending downwardly into the flue gas space of the chamber which provide a series of recessed regions within the chamber to cause swirling and turbulence in the flowing flue gases. These fins may themselves be provided with lateral planar fins not containing water extending outwardly from their exterior surfaces. The unit may suitably be 3 to 4 metres long, and about 1 metre deep and tall. The water capacity can vary between 10 and 500 litres, and a preferred figure is about 100 litres. In order to allow access to the interior of the heat exchanger for cleaning purposes, smoke-tight insulated doors are provided on one side of the unit through which access may be gained for removing deposits of soot and the like. A self-draining spray system may be fitted. The entire unit is preferably lagged, as indicated at 79.

Another construction of the roof space heat exchanger is depicted in Figures 26 to 29. In this case, instead of a single chamber, a series of double-walled chambers 80 is provided, each of which is connected in a smoke-tight manner with the adjacent chamber or chambers through a joint 81 which may include an asbestos or like material gasket to ensure sealing. The openings between the individual chambers are in each case provided in the lower part of the chamber so that each chamber 80 in effect forms a flue gas space corresponding to that between each successive pair of fins in the construction of Figures 22 to 25. Thus the gas from the flue inlet 82 swirls through the chambers 80 one after the other with a degree of turbulence being generated at each passage from a chamber to the succeeding one.

Each chamber 80 has an individual water inlet 83 to feed water into the cavity or water space of the chamber defined between the inner and outer walls of the chamber. An individual outlet 84 from each chamber feeds into a hot water cylinder 85. Each chamber is also provided with an insulated access door 86. The floor of each chamber is also arranged to slope downwardly to a sump 87 from which a drain pipe 88 leads away to a waste outlet, each sump being connected into a common drain. A valve 89 is provided in the drain pipe 88, to be opened only during cleaning of the interiors of the chambers which is carried out by spraying the walls to remove deposits of soot on them. The interconnection or joint 81 between each chamber is placed sufficiently high above the floor of the chamber to allow an amount of dirt and soot to build up on the floor without curtailing the flow of flue gas through and between the chambers. The flue inlet 82 is also arranged in the lower part of the first chamber, similarly to the joint 81, but is at a rather higher level at its lowest point, than the lowest point of the interconnecting passage to the following chamber. The outlet from the last chamber to the chimney is taken off from the upper part of the chamber so that the flue gases sweep upwardly through this chamber as they exit from the heat exchanger. The remaining features of this heat exchanger are similar to those already described in connection with the previous embodiment and are similarly identified. The momentum of the hot gases may be sufficient to maintain the flow through the chambers, but if required, a draught-inducing fan may be placed in the flue outlet, and controlled as previously described.

A sufficient number of chambers may be installed to remove substantially all of the useful heat present in the flue gases at entry to the roof space heat exchanger. It is a particular advantage of this construction of the heat exchanger that it can be easily assembled in the roof space of an existing house without necessitating any structural work, in that each individual chamber can be brought into the roof space through a normal attic opening for assembly in situ.

Both the single chamber and the multi-chamber embodiments of the roof space heat exchanger may be adapted to heat air rather than water. For this, the space defined between the double-walls will be of greater volume and the spacing of these walls is increased, so as to allow the air to flow in sufficient volume through the air-heating space of the exchanger. In other respects, the construction of the air version of the heat exchanger remains substantially unaltered from that already described.

It will be appreciated that while the invention has been described with respect to the particular embodiments of it described herein, it extends to all equivalent constructions within the scope of the disclosure.

CLAIMS

1. Heating apparatus comprising a combined chimney breast and fireplace unit having a flue pipe extending upwardly from the region of the fireplace to a flue gas exit in an upper region of the chimney breast, an air heating duct for conveying air in heat exchange relationship with at least the exterior surface of the wall of the flue pipe from an air inlet in the upper region of the chimney breast to the region of the fireplace, air heating passages surrounding at least part of the fireplace and communicating with the air heating duct for conducting air received from the heating duct in heat exchange relationship with at least exterior surfaces of walls defining the fireplace from the air heating duct to a hot air duct for conveying at least part of the heated air to at least one hot air outlet from the unit located in the upper region of the chimney breast, the air heating and hot air ducts being separated within the unit by a partition wall extending upwardly within the unit from the region of the fireplace to the region of the flue gas exit and the hot air outlet in the upper region of the chimney breast.

2. Heating apparatus according to claim 1, wherein a metal shell defines the outer walls of at least a part of the chimney breast, the air heating and hot air ducts being defined by the partition wall and by portions of the shell for heat exchange between air flowing in the ducts and the shell so that the outer walls of at least part of the chimney breast may be heated by hot air flowing within the ducts for heat exchange with the environment surrounding the unit.

3. Heating apparatus according to claim 1 or 2, wherein the shell is substantially rectangular in transverse section and the flue pipe is substantially coaxially disposed within the air heating duct at the flue gas exit and air inlet in the upper region of the chimney breast, the air heating duct being dimensioned in this region so that continuations of at least the air heating duct and the flue pipe can be located between conventionally spaced floor or roof joists to pass through a floor or roof.

4. Heating apparatus according to any preceding claim, comprising at least one extension unit having a flue pipe extending upwardly from a flue gas inlet communicating with the flue gas exit of the combined chimney breast and fireplace unit or communicating with a flue gas exit of another extension unit of the apparatus to a flue gas exit in an upper region of the extension unit, an air heating duct for conveying air in heat exchange relationship with at least the exterior surface of the wall of the flue pipe of the extension unit from an air inlet in the upper region of the extension unit to an air outlet communicating with the air inlet of the combined chimney breast and fireplace unit or communicating with an air inlet of another extension unit of the apparatus, and a hot air duct extending upwardly from a hot air inlet communicating with the hot air outlet of the combined chimney breast and fireplace unit or communicating with a hot air outlet of another extension unit of the apparatus for conveying at least part of the hot air received at the hot air inlet to at least one hot air outlet from the extension unit located in the upper region thereof.

5. Heating apparatus according to claim 4, wherein a metal shell defines the outer walls of at least the air heating duct of the extension unit and the air heating and hot air ducts are separated from one another by a wall comprising an insulating layer and extending upwardly from the region of the lower end of the extension unit to the region of the upper end of the unit.

6. Heating apparatus according to any preceding claim, comprising a roof space extension unit having a flue pipe extending from a flue gas inlet communicating with the flue gas exit of the combined chimney breast and fireplace unit or communicating with the flue gas exit of an extension unit of the apparatus to a flue gas exit communicating with a chimney exhausting to atmosphere, at least one portion of the flue pipe of the roof space extension unit being surrounded by a jacket for the flow of a fluid medium in heat exchange relationship with at least the exterior surface of the wall of the flue pipe through the space defined between the jacket and the wall of the flue pipe.

7. Heating apparatus according to claim 6, wherein the or each flue pipe portion of the roof space extension unit surrounded by a jacket is disposed at an angle to the horizontal not exceeding 45°, and not less than 5°.

8. A roof space heat exchanger comprising at least one double-walled chamber for the flow of a fluid medium through a cavity defined between the double walls of the chamber, the inner walls also defining a space for the flow of flue gas therethrough for heat exchange with the fluid medium.

9. A roof space heat exchanger according to claim 8, wherein a plurality of chambers is provided, and each chamber is in airtight interconnecting relationship with the adjacent chamber or chambers for the flow of flue gas therebetween.

10. Heating apparatus according to any of claims 1 to 7, including a roof space heat exchanger according to claim 8 or 9, wherein a flue gas inlet of the roof space heat exchanger communicates with the flue gas exit of the combined chimney breast and fireplace unit or communicates with the flue gas exit of an extension unit of said apparatus, and a flue gas exit of the roof space heat exchanger communicates with a chimney exhausting to atmosphere.

Fig.2

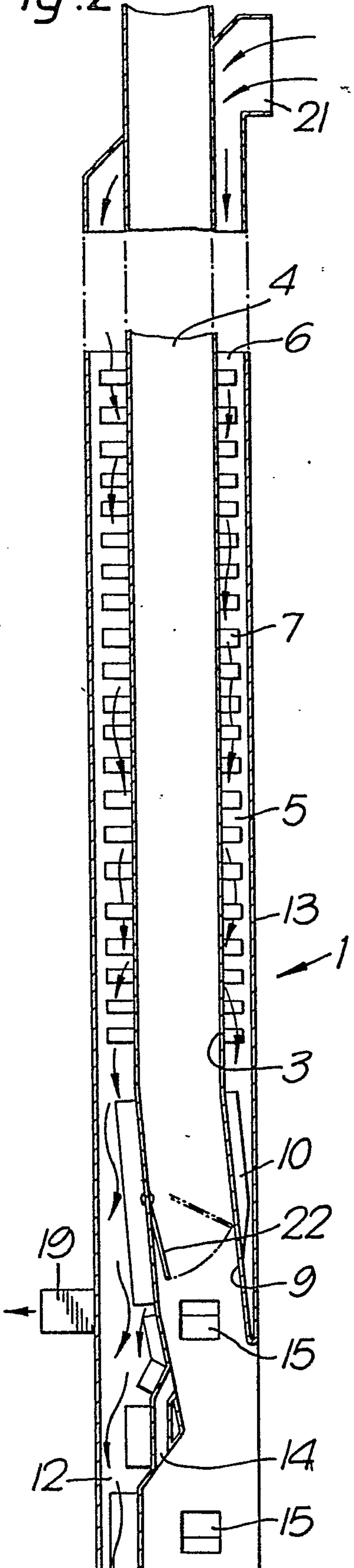
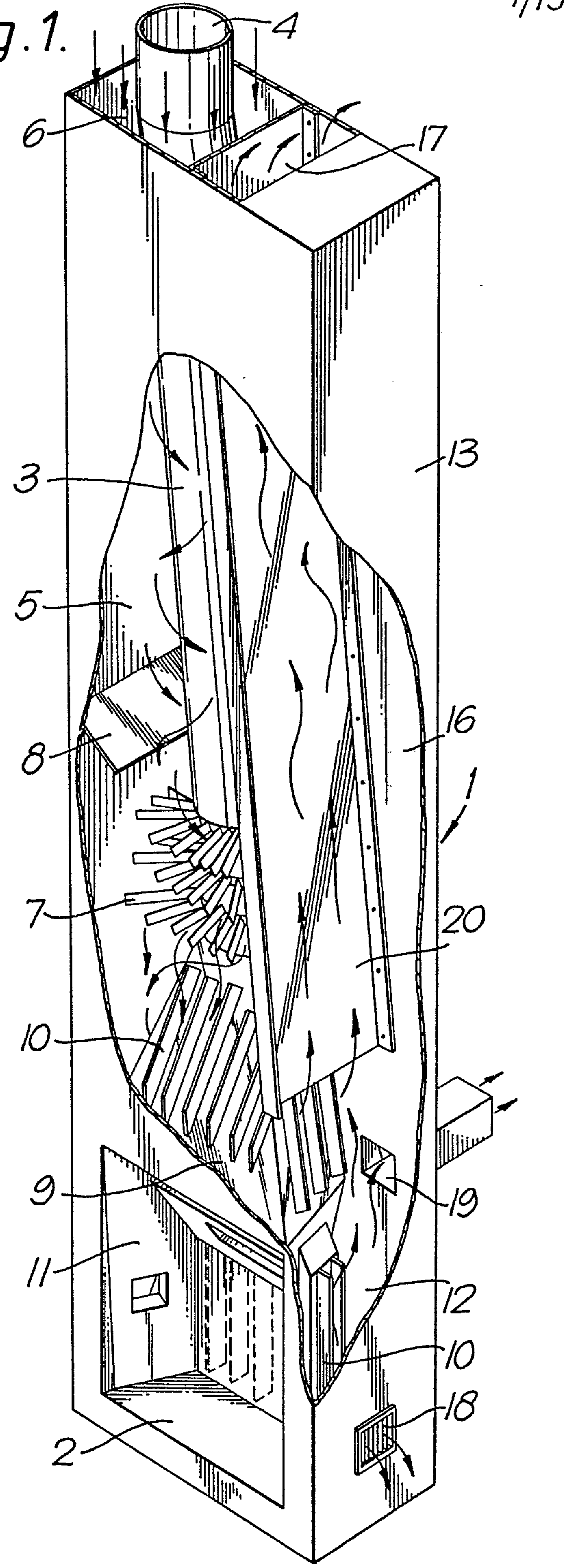

21
4
6
7
5
13
1
3
10
22
19
9
15
12
14
15
10
2

Fig.1.


4
6
17
13
3
5
16
8
1
7
20
10
9
19
11
12
10
18
2

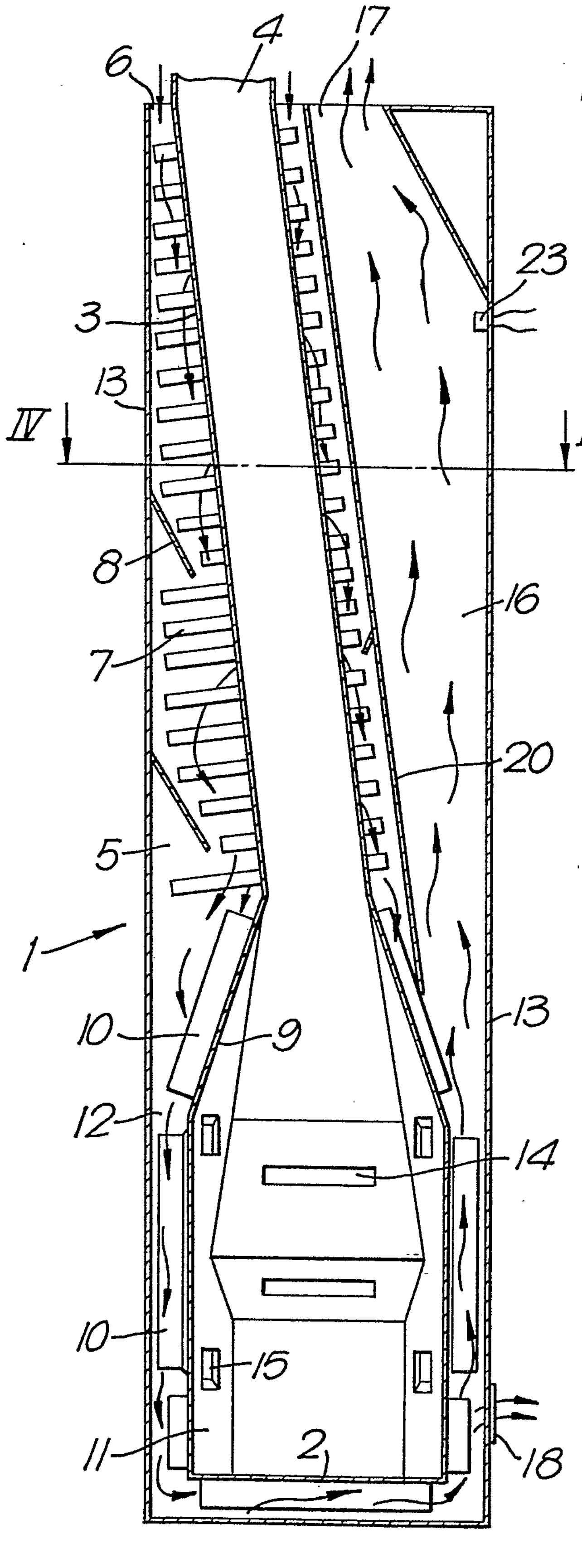

4
6
17
23
3
13
IV
IV
8
16
7
20
5
1
13
10
9
12
14
10
15
11
2
18

Fig. 3.

Fig. 4.

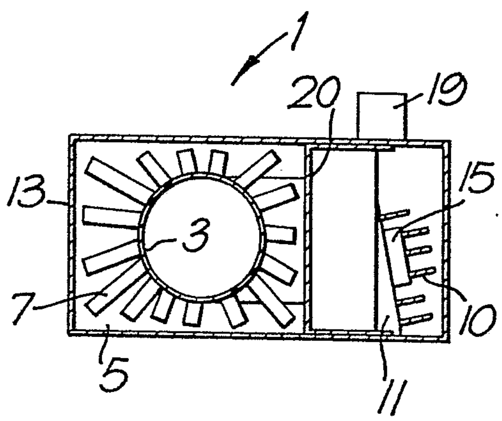

1
20
19
15
13
3
7
10
5
11

Fig. 5.

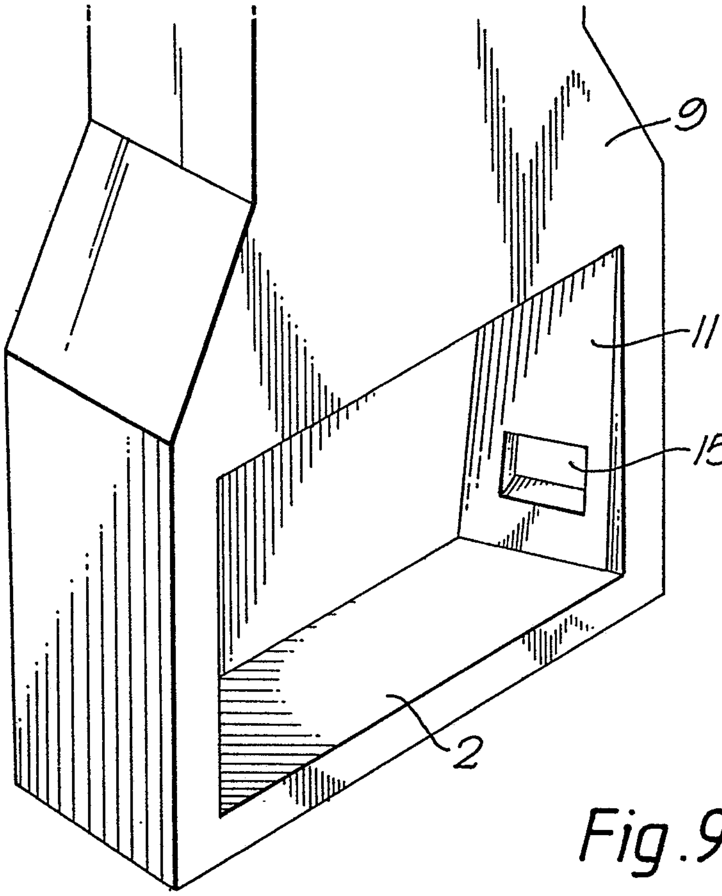


Fig. 8.

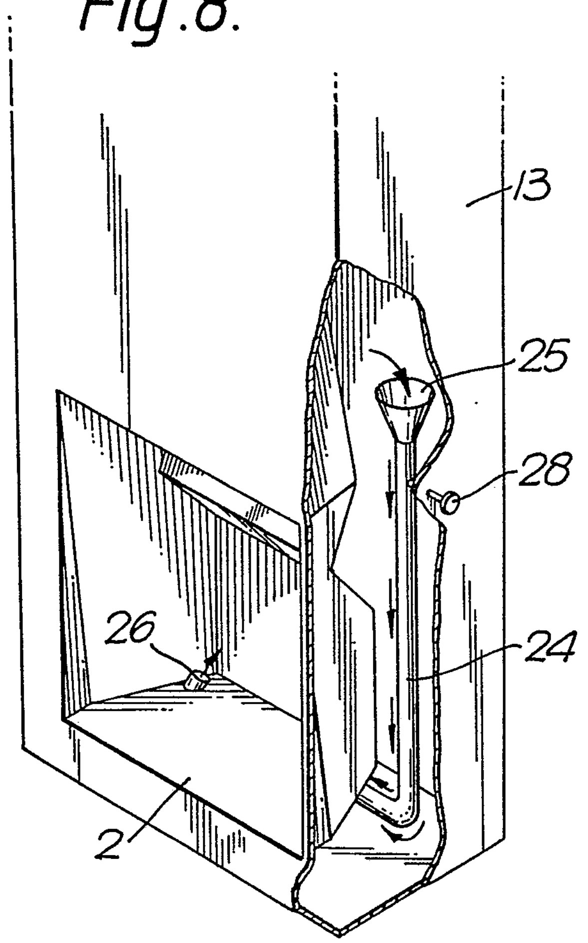


Fig. 9.

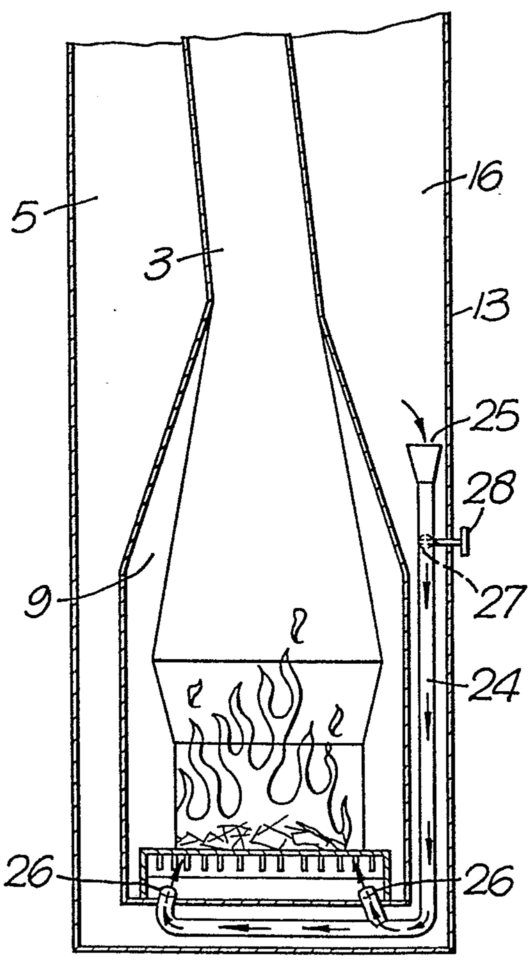


Fig.6.

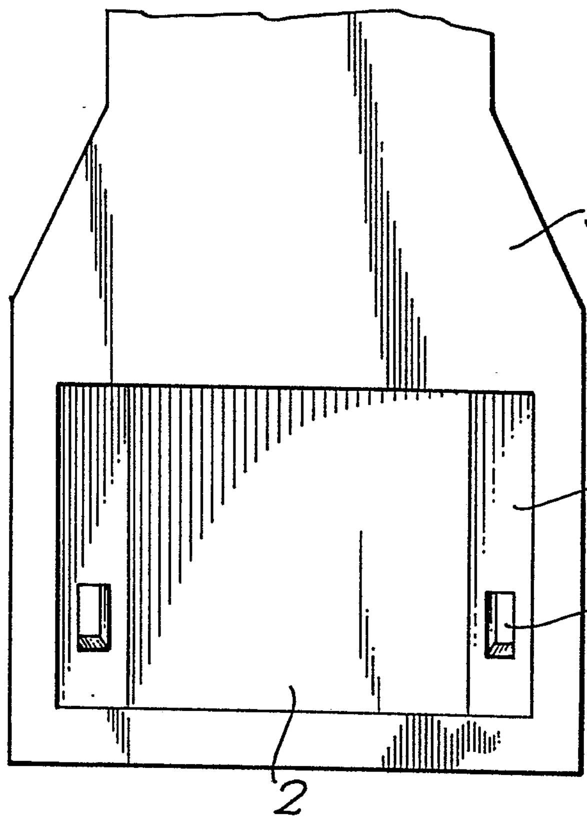


Fig.7.

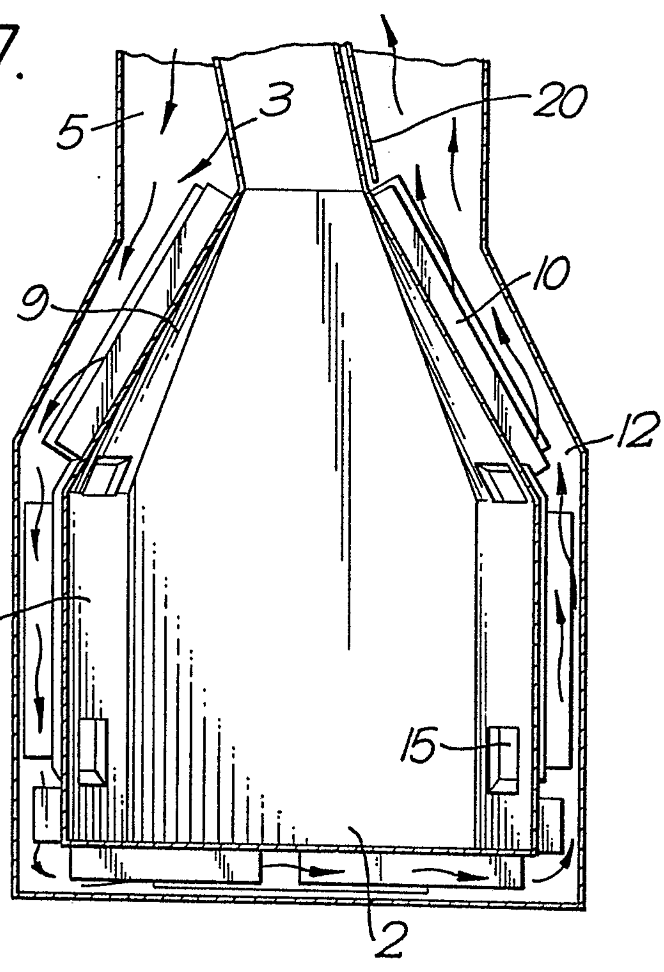


Fig.10.

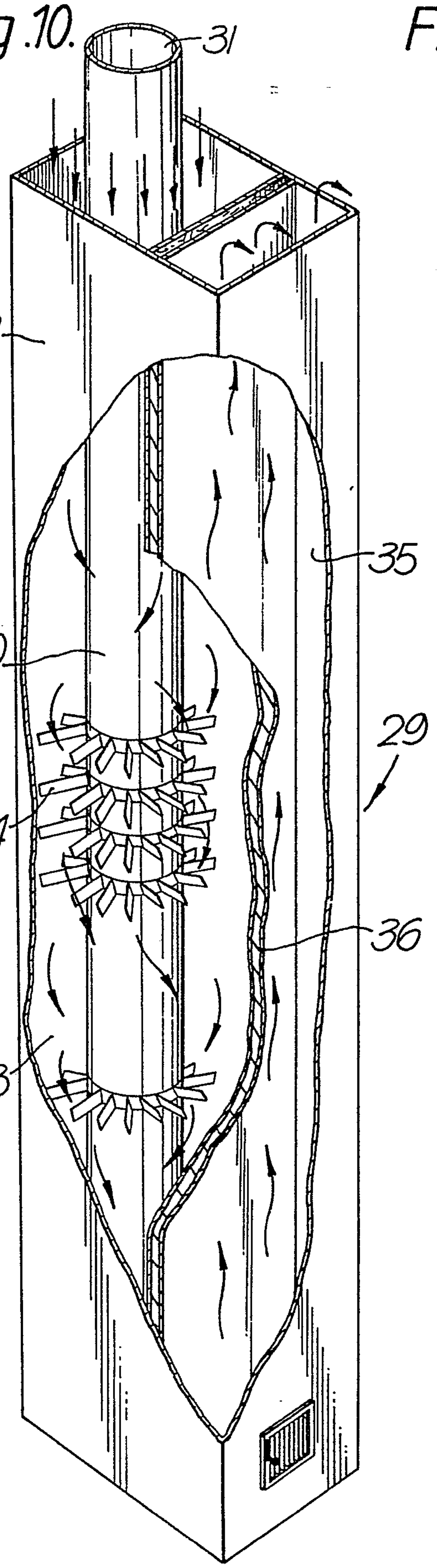
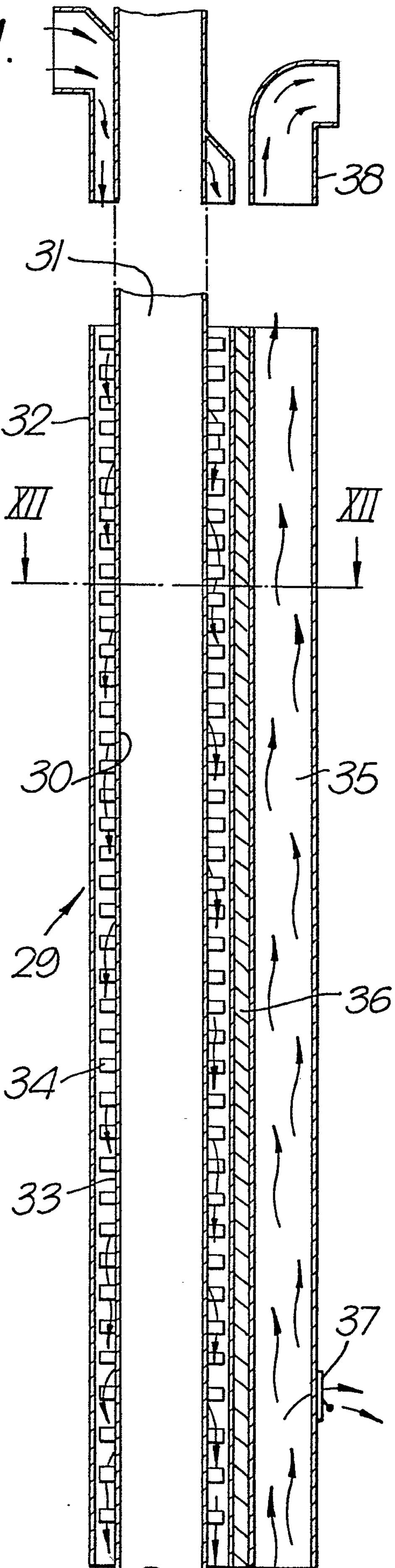


Fig.11.



0058001

6/15

Fig. 13.

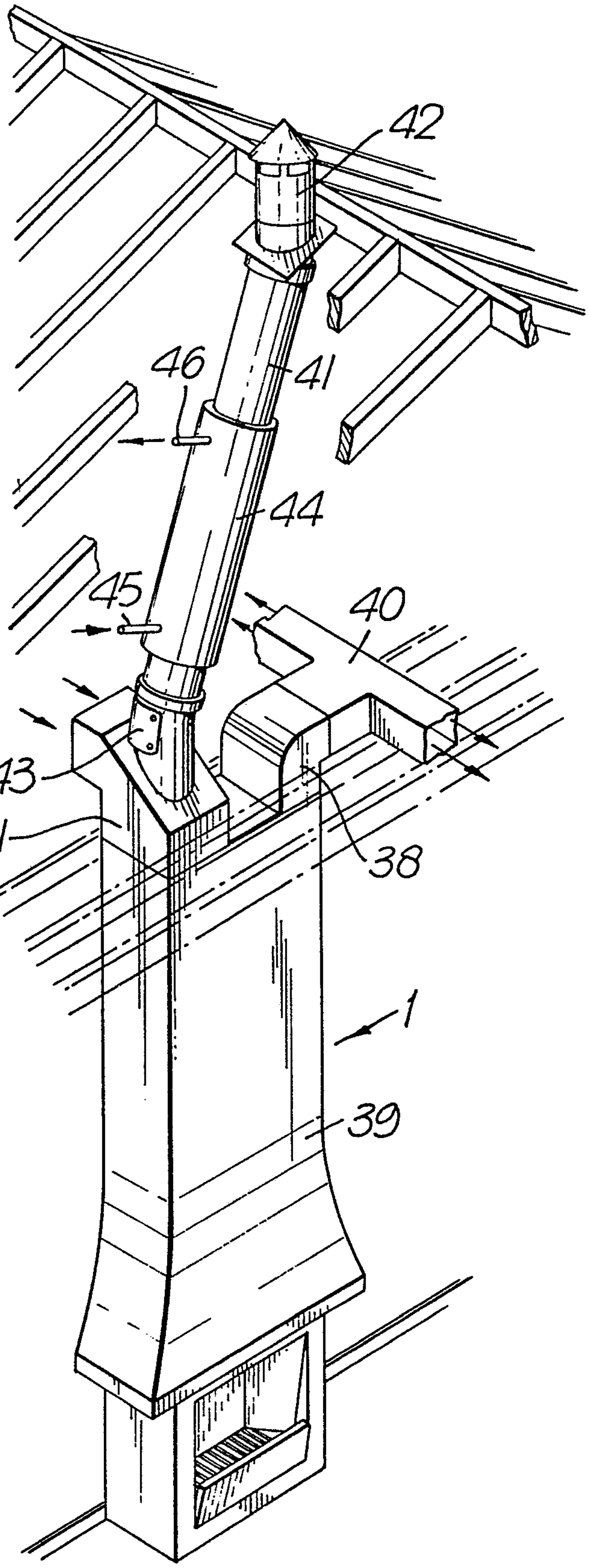


Fig. 12.

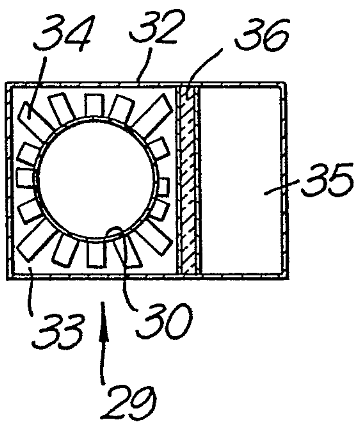


Fig. 14.

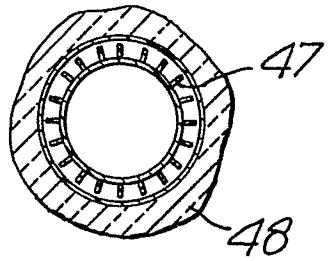


Fig. 15.

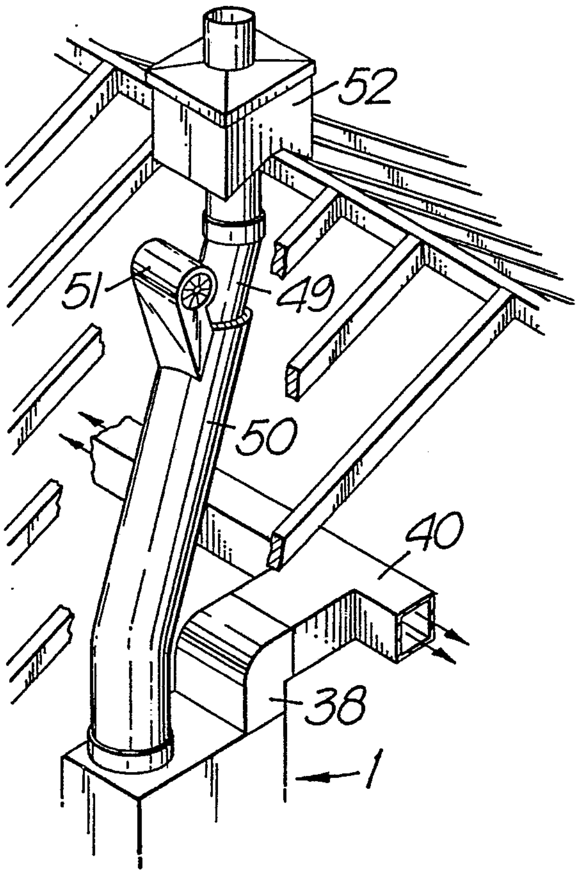
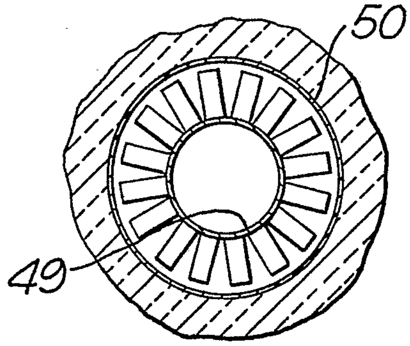


Fig. 16.



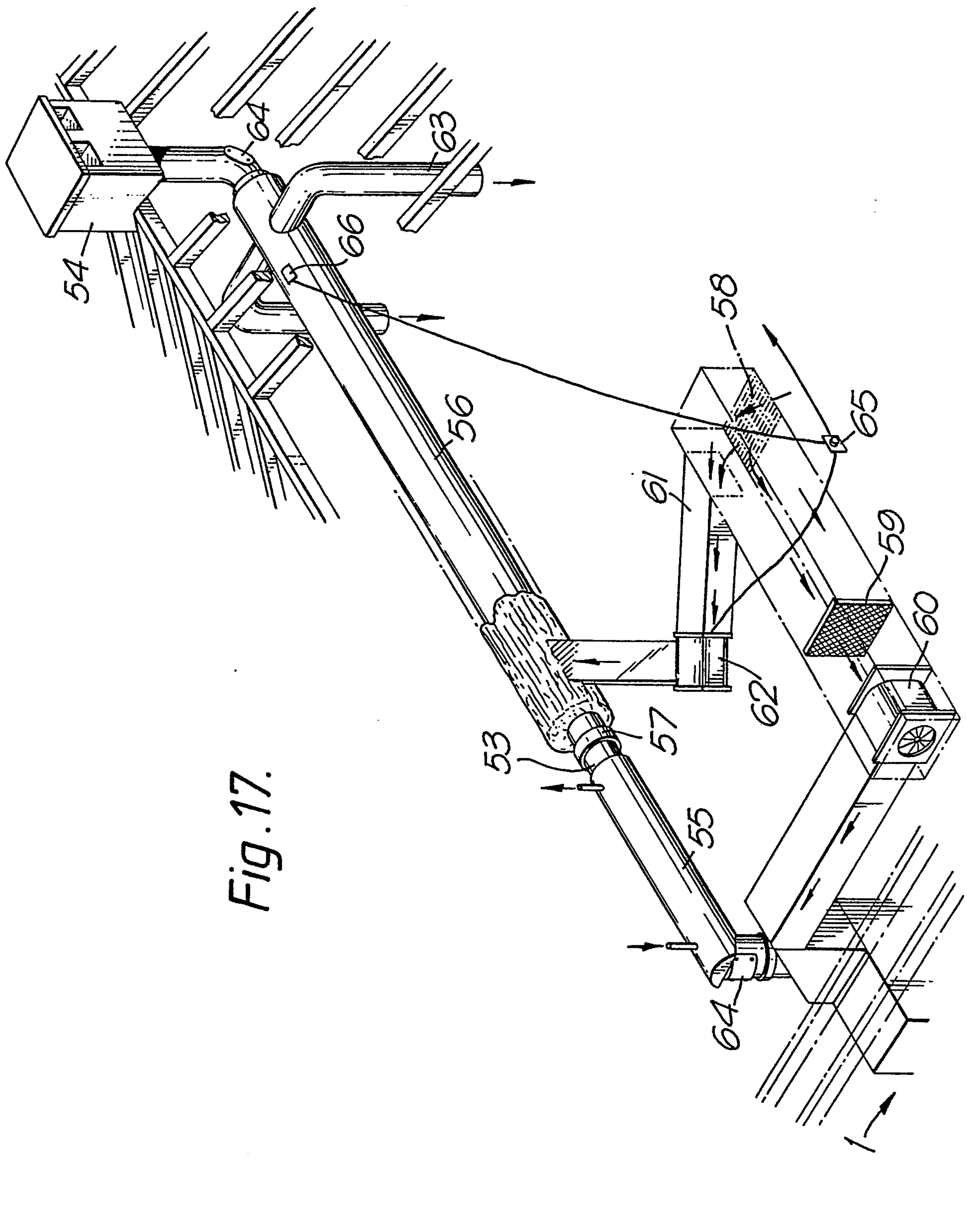


Fig.17.

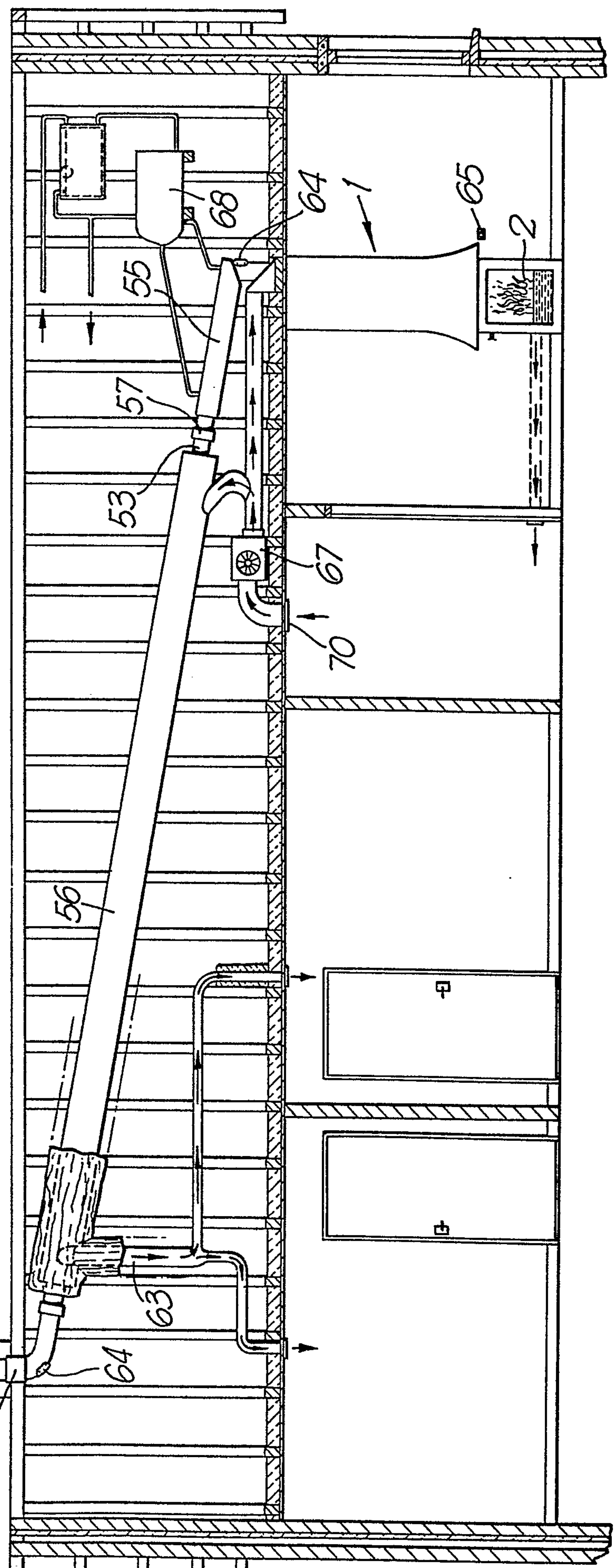
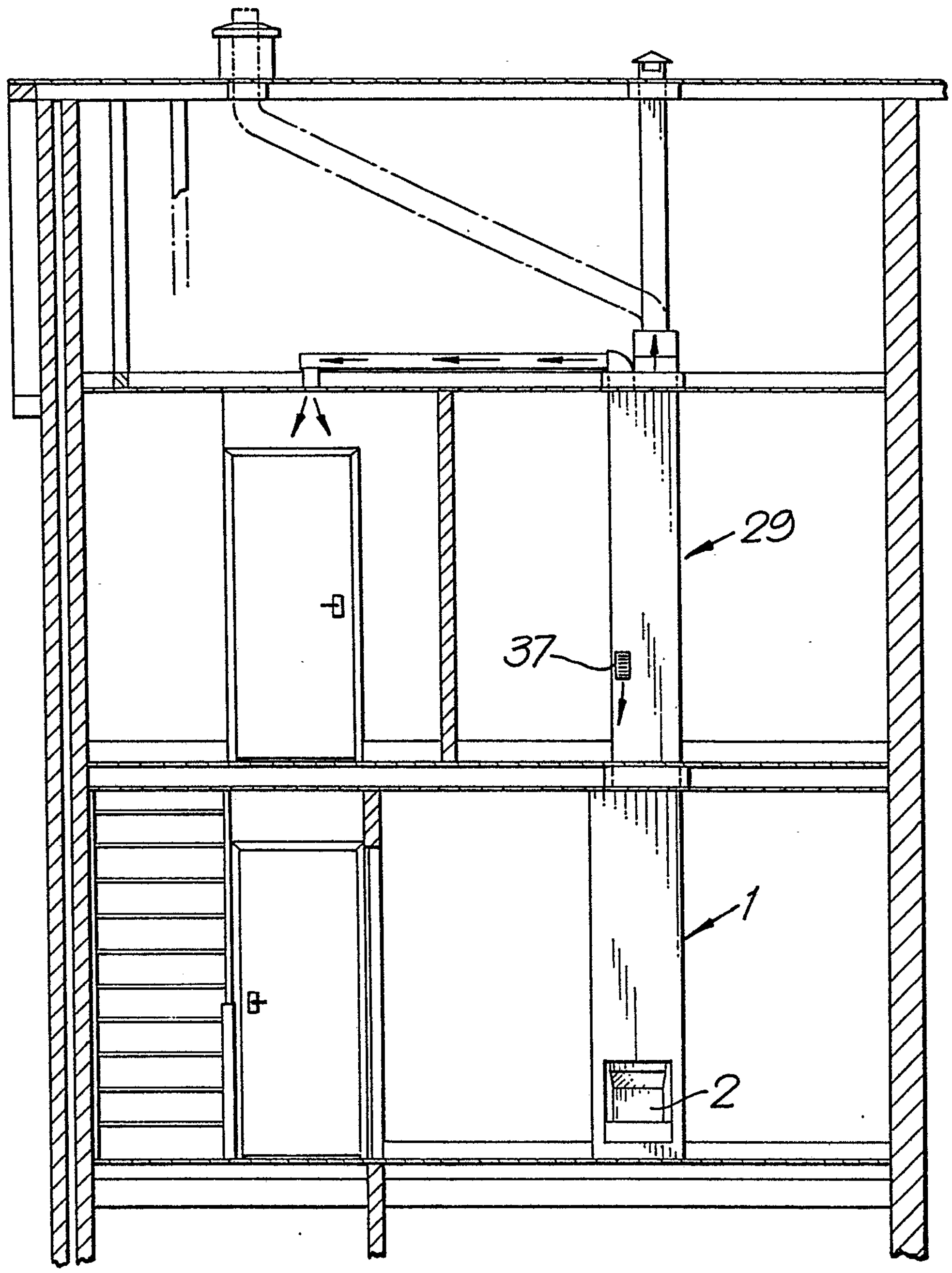


Fig. 18.

Fig. 19.



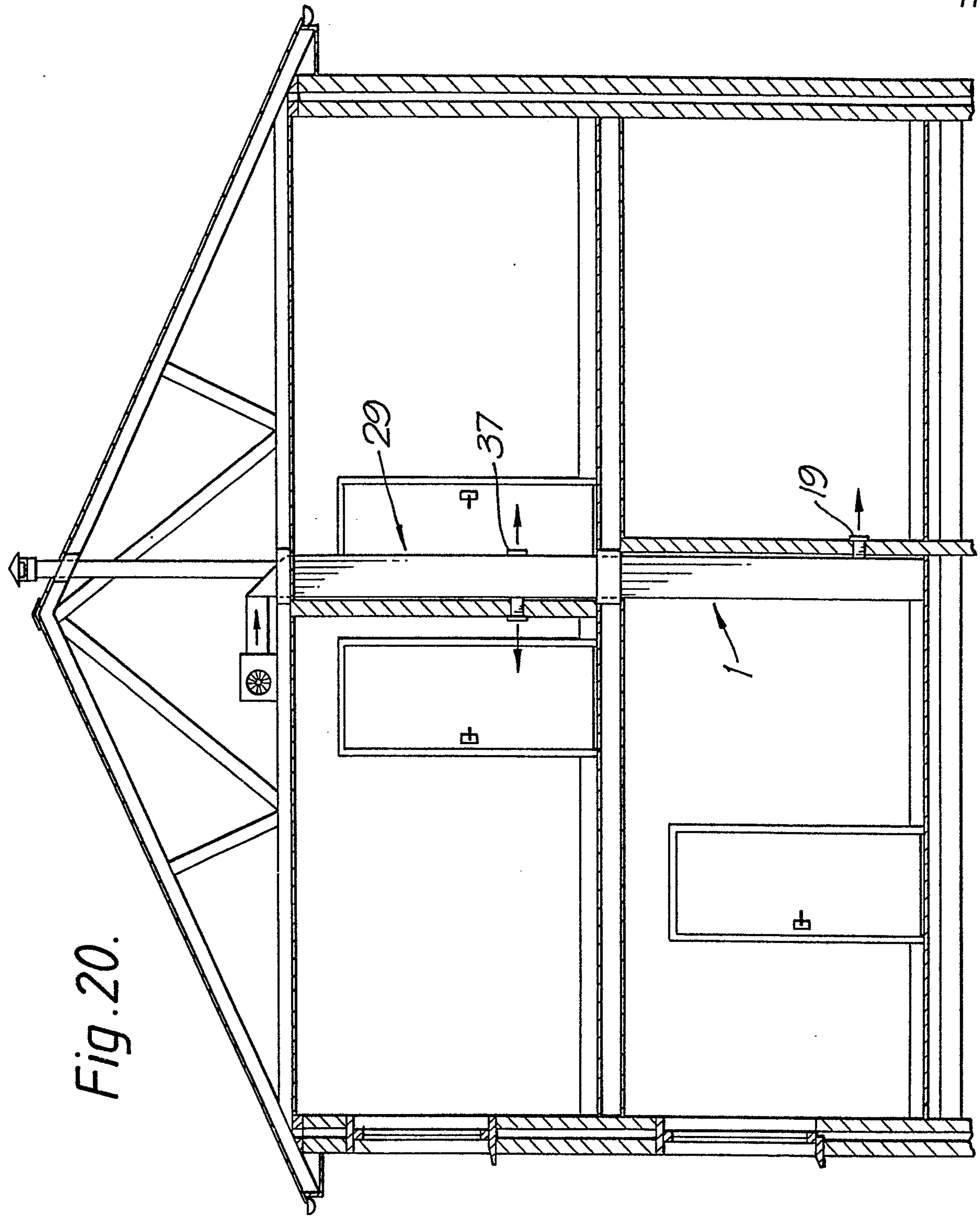


Fig.20.

Fig. 22.

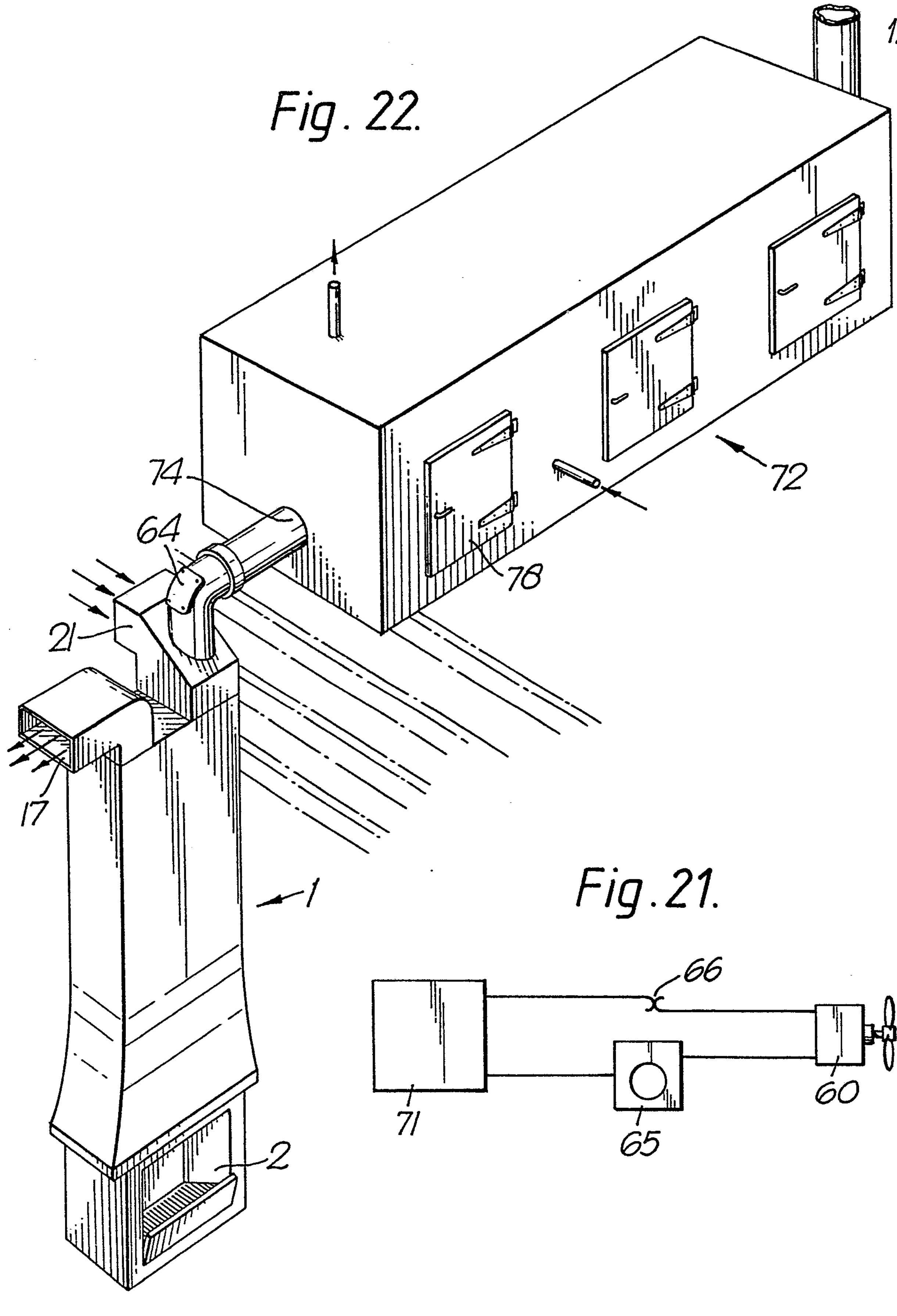


Fig. 21.

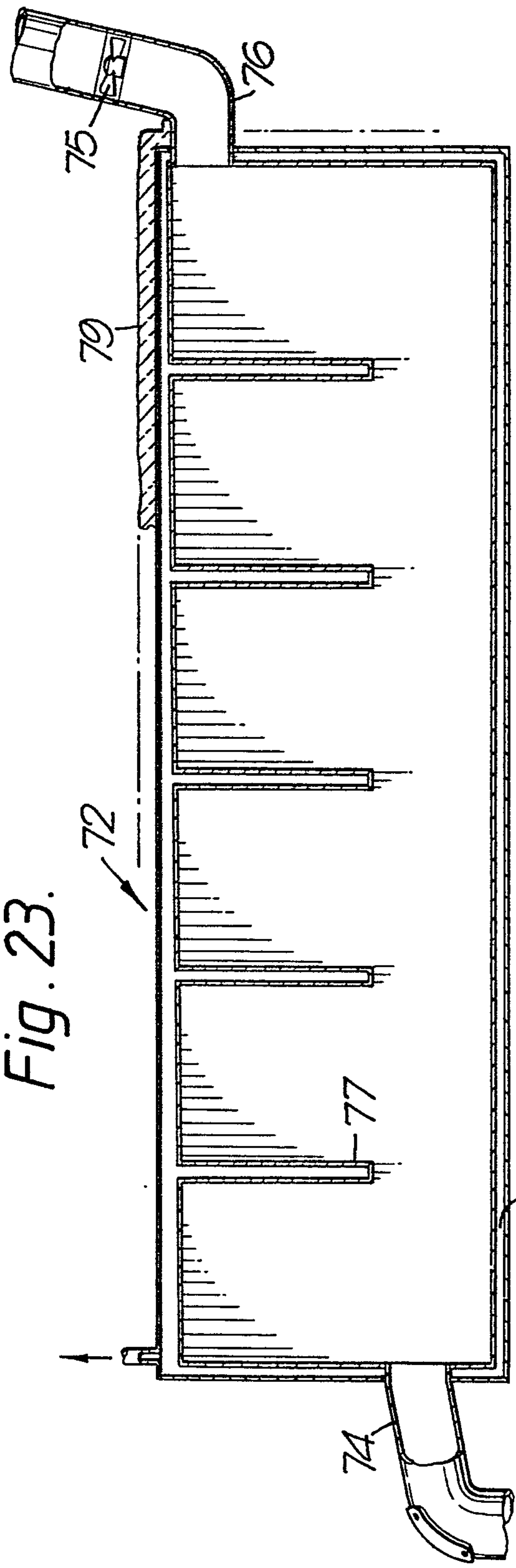


Fig. 23.

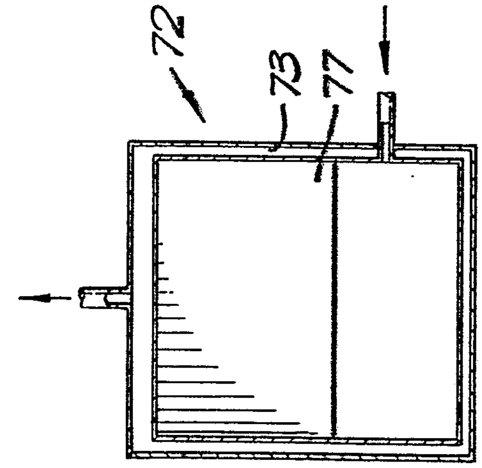


Fig. 24.

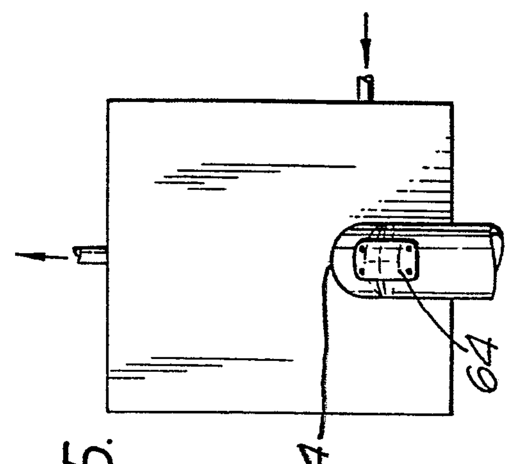


Fig. 25.

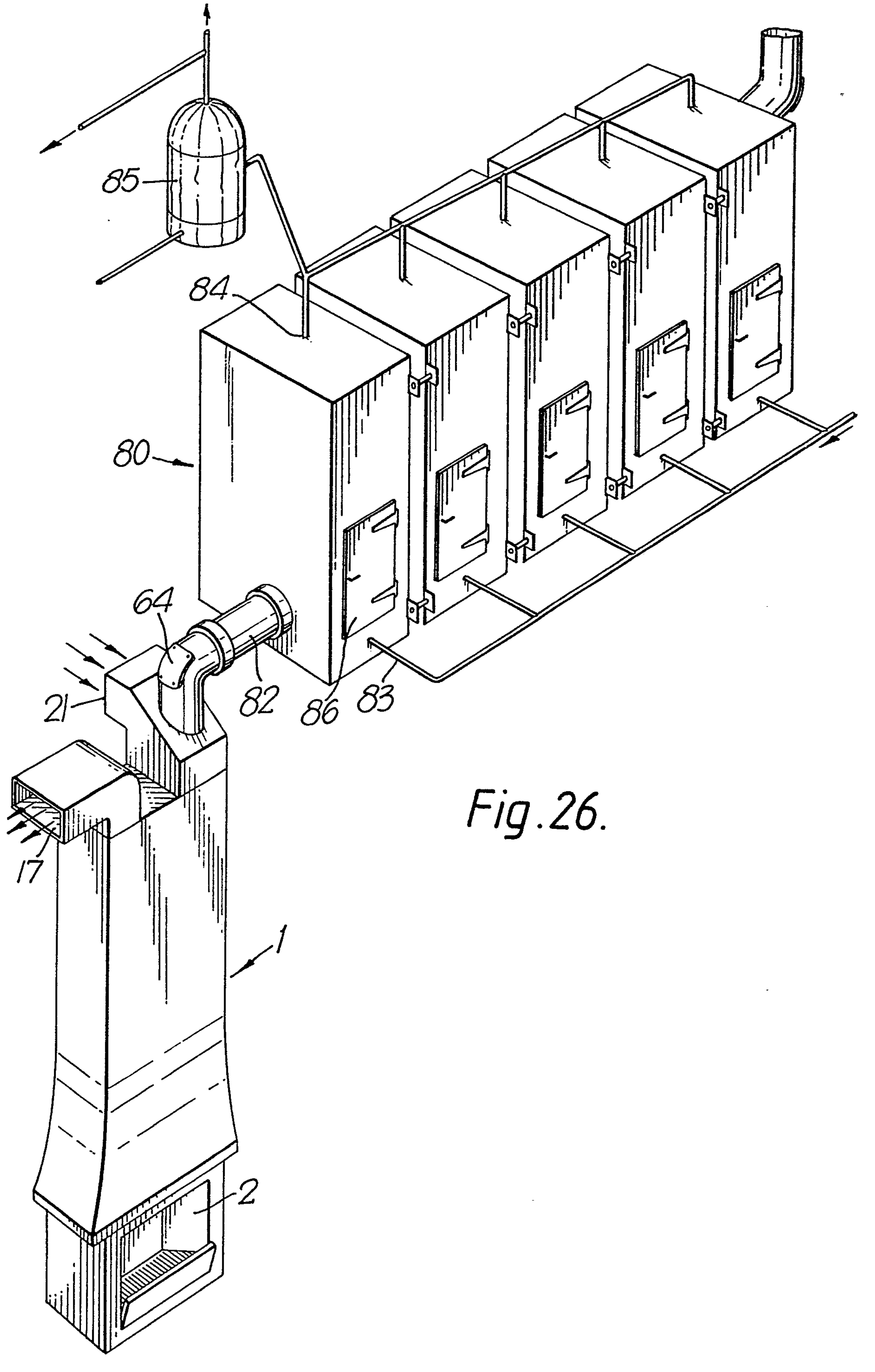


Fig. 26.

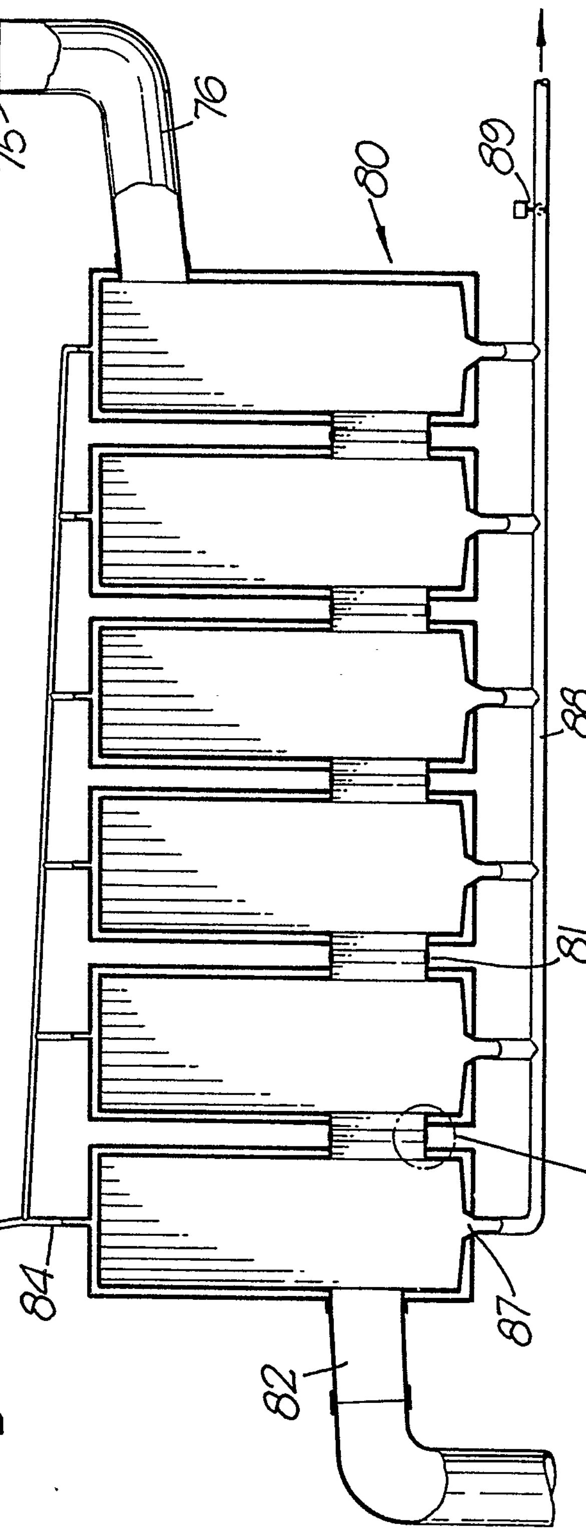


Fig. 27.

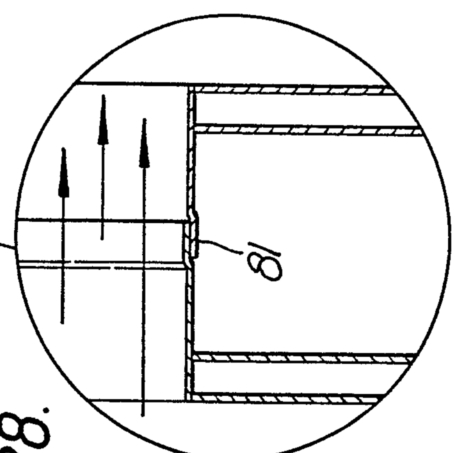


Fig. 28.

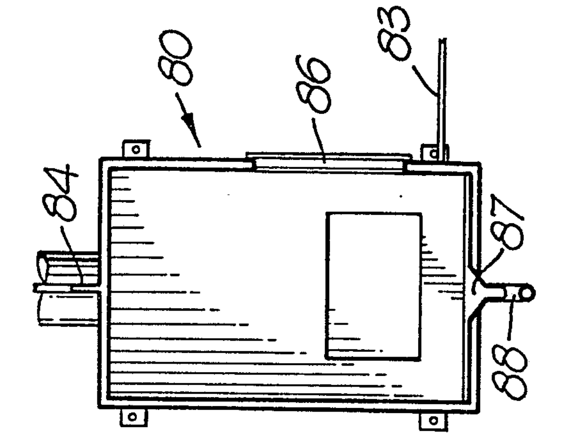


Fig. 29.

0058001

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 82 30 0342

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	US - A - 3 888 231 (GALLUZZO)		F 24 B 7/02
	* column 6, lines 22-63; figures 2,3 *	1,2	
	--		
Y	FR - A - 2 294 403 (LAMBERT)		
	* page 8, lines 1-18; figures 1,2,4 *	1,2	
	--		TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
P,X	WO 81/01323 (MERUS MILIEU)		
	* page 7, lines 6-30; page 8, lines 13-22; figures 1,8 *	1,2	F 24 B F 28 D
	--		
A	US - A - 2 681 057 (GEORGE)		
A	US - A - 4 010 728 (HEMPEL)		

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14-04-1982	VANHEUSDEN