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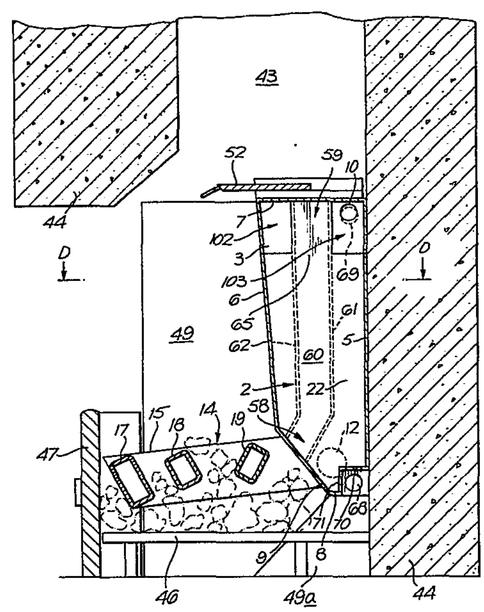
(54) **A heating system.**

(57) A heating system for transferring heat from a heat source in a combustion space to a heat exchange fluid includes an enclosed chamber (2) to serve as a reservoir for heat-exchange fluid and a tubular heat exchange manifold (14) communicating with the chamber and projecting therefrom into the combustion space above and adjacent to the heat source. In a domestic heating system, the manifold (14) comprises two side tubes (15, 16) projecting substantially horizontally from the base of a back boiler (1), with a plurality of inclined cross tubes (17, 18, 19) connecting the side tubes (15, 16), which side tubes communicate with the boiler chamber (2). One of the side tubes (16) communicates with a «low resistance zone» (23) within the chamber which is created by a baffle plate (22) acting as a partition extending vertically from the base (8) of the chamber to near its roof (7) and bridging front (6) and back (5) walls of the chamber. The chamber can be designed to surround a flue duct (60). In use, a fire is set on a firegrate (46) situated below the tubular manifold (14), but solid fuel may also be placed in between and on top of the manifold tubes. The system can also be applied to an industrial boiler (85).



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DESCRIPTION

A HEATING SYSTEM

The present invention relates to a heating system for transferring heat from a heat source to a heat exchange fluid. In particular, the invention provides for a domestic heating system of the type which includes a back boiler. The system has improved heat exchange attributes, and improved flow of heat exchange liquid through the system.

Hitherto, domestic heating systems have employed a back boiler adapted to fit into a fireplace surrounding the back and/or sides of the hearth. Domestic boilers of the type having a back chamber with two side chambers interconnected by a series of cross-pipes providing a firegrate are known, as for example those described in Irish Patents Specifications Nos. 26,285 and 40,706 and in U.K. Patents Specifications Nos. 820,210 and 946,744. In another arrangement, U.K. Patent Specification No. 1,137,482 describes a domestic back boiler with a tubular grid extending horizontally and forwardly from the base of the back chamber below the firegrate. Domestic firegrates provided by an arrangement of tubes in the form of a heat-exchange manifold are also described in U.K. Patents Specifications Nos. 230,536 and 1,543,529 and in International Patent Application No. PCT/EP80/00121 (Publication No. WO81/01324).

One of the problems encountered with back boilers and heat exchangers including a series of pipes providing a firegrate is that the heat exchange liquid contained therein does not circulate adequately. When this results in the liquid exceeding its boiling point, steam may be produced and this is generally to be avoided. More efficient circulation can be achieved when the outlet from the pipes opens into a partly enclosed zone within the boiler chamber, as described in U.K. Patent Specification No. 946,744. However, in order to extract more heat from a domestic fire it is desirable to increase the area of the primary heat exchange surfaces, i.e. those surfaces affected directly by hot flue gases, while avoiding the generation of steam within the heat exchange pipes. Heat exchangers of the general type which are adapted to lie completely below the source of heat do not provide any effective primary heat exchange surfaces resulting in a loss in efficiency.

According to the invention, there is provided a heating system for transferring heat from a heat source to a heat exchange fluid, comprising in combination:

(a) an enclosed chamber to serve as a reservoir for the heat exchange fluid,
(b) a tubular heat exchange manifold, which manifold communicates with the chamber and projects from the chamber over and adjacent to the heat source.

If the heat source is a solid fuel fire, the manifold may advantageously project at such a height that the solid fuel may be disposed below and on top of the manifold, and also in the spaces between the tubes of the manifold, so that heat from the burning fuel is transferred directly to the manifold.

According to one aspect of the invention, there is provided a domestic heating system for transferring heat from a heat source to a heat exchange fluid, comprising an enclosed chamber to serve as a reservoir for heat exchange fluid, a heat exchange manifold communicating with the chamber and mounted at the base of the chamber so as to project forwardly from the chamber over and adjacent to the heat source, said manifold comprising first and second side tubes extending from the chamber and a plurality of cross tubes connecting said side tubes. Preferably both of the side tubes communicate with the chamber via respective tube openings in the chamber wall. However it is sufficient if the second of said side tubes communicates with the chamber at a manifold outlet, this side tube being on the opposite side of the manifold from an inlet conduit connected to the first of said side tubes.

The inlet conduit is normally connected to a chamber inlet port, which is preferably adjacent to a tube opening communicating with the first of said side tubes at a manifold inlet.

The side tubes of the manifold are distinguished from side tanks in a conventional boiler in that the tubes are located at the base of the chamber and have a height substantially less than half the height of the chamber e.g. about one quarter the height of the chamber.

The manifold preferably projects substantially horizontally from the chamber but with the mid-plane of the manifold inclined downwardly to the front at a small angle (e.g. 5 to 15^{o}).

According to a preferred embodiment, the manifold has three substantially parallel cross tubes interconnecting the two side tubes, both of which communicate with the chamber via their respective openings. Suitably, at least the cross tubes are of polygonal cross section, particularly triangular or quadrilateral cross section, preferably a parallelogram having 2 major and 2 minor sides and included angles of about 95^{o} and 85^{o}. Most desirably, each of the cross tubes has a major face tilted at about 20^{o} - 30^{o} to the vertical.

Advantageously, the inlet port is located adjacent to the first side tube opening, i.e. the manifold inlet. Alternatively, the inlet port can be located in proximity to the second side tube opening, i.e. the manifold outlet.

Further according to the preferred embodiment of the invention there is provided a means for defining a part of the volume of the chamber as a zone of low fluid density when heated fluid is circulated through the chamber. Preferably, the means comprises a substantially vertical baffle plate extending from the base of the chamber to near the top of the chamber, and bridging front and back of the chamber, to partially partition off a zone of low fluid density within the chamber directly above an opening in the chamber where the chamber communicates with the manifold outlet.

Suitably, the chamber defines a first flue duct between the back wall of the fireplace in which it is installed and the back of the chamber and sufficient space is left between the manifold and the base of the fireplace to accomodate a standard firegrate with coals or other solid fuel placed thereon.

In another embodiment of the invention, the chamber surrounds a flue duct. Suitably, the flue duct has a front wall, a rear wall, and two side walls one of which is preferably coincident with the baffle plate.

If desired, coal or other solid fuel can also be placed on and between the manifold tubes, but it should not be allowed to impede a draught of air past the tubes when the fuel is burning.

According to a further aspect of the invention there is provided an industrial boiler system having a central combustion space and flue duct surrounded on four sides by an enclosed chamber, the chamber including an inlet and an outlet port, a tubular heat exchange manifold communicating with the chamber and mounted at the base of the chamber so as to project substantially horizontally into the combustion space above and adjacent to the heat source, the manifold comprising first and second side tubes extending from the chamber and a plurality of cross-tubes connecting the side tubes.

In the industrial boiler system, the means for defining part of the volume of the chamber as a zone of low fluid density comprises two substantially vertical parallel baffle plates which extend from the base of the chamber to near the roof of the chamber, bridging inner and outer walls of the chamber.

Four embodiments of the invention will now be described in detail with reference to the accompanying drawings in which:-

Figure 1 is a sectional plan view of a first embodiment of the invention viewed along the section line A-A in Figure 2.

Figure 2 is a sectional front elevation viewed along the section line B-B in Figure 1.

Figure 3 is a sectional side elevation of the heating system in situ in a fireplace viewed along the section line C-C in Figure 1.

Figure 4 is a sectional plan view of a second embodiment of the invention viewed along the section line D-D in Figure 5.

Figure 5 is a sectional side elevation viewed along the section line E-E in Figure 4.

Figure 6 is a sectional plan view of a third embodiment of the invention viewed along section line F-F in Figure 7.

Figure 7 is a side elevation of the third embodiment of the invention.

Figure 8 is a perspective view of the heating system of the present invention installed in a domestic stove.

Referring to Figures 1 to 3 of the accompanying drawings a domestic solid fuel heating system comprises a back boiler 1 having an enclosed chamber 2 formed by side walls 3, 4, back wall 5, front wall 6, and roof 7. The base of the chamber 2 comprises a flat portion 8 and a sloping chamfered portion 9.

An outlet port 10 communicates with the upper part of the chamber 2 through side wall 3. An inlet conduit 11 branches into two inlet feed pipes 12, 13, feed pipe 12 communicating with the lower part of the chamber 2 through an inlet port in side wall 3, while feed pipe 13 communicates with first side tube 15 of manifold 14.

The manifold 14 is formed of hollow tubing of substantially rectangular cross-section, and is disposed in front of the back boiler 1 extending from the chamfered portion 9 of the base of the chamber 2 of the boiler so that it projects into the combustion space.

The manifold 14 comprises first and second side tubes 15, 16 spaced at each side of the boiler and interconnected by three cross tubes 17, 18, 19. Each of the cross tubes is of generally rectangular cross section and is tilted forwardly so as to present one of the major faces of each cross tube as a primary heat exchange surface at an angle of between 20° and 40°, preferably about 20° to 30°, to the vertical. The edges of the tubes are rounded. Side tubes 15, 16 are closed at their outer ends, but communicate with the base of the chamber 2 at their respective openings 20, 21 where the side tubes are welded to the boiler 1. The forwardmost cross-tube 17 is of similar cross-section to the side tubes 15, 16. Opening 20 is the manifold inlet opening and opening 21 is the manifold outlet opening.

The manifold is inclined downwardly to the front at a slight angle (about 10^{o}) to the horizontal as shown in Figure 3.

The tilting of the cross-tubes and the inclination of the manifold are advantageous for deflecting a horizontal draught of air around each cross tube in turn. Alternatively, the cross-tubes can be arranged so as to be tilted rearwardly, or with one of the tubes being tilted rearwardly and the remaining tubes being tilted forwardly, as shown in Figures 4 and 5. When burning coal or other solid fuel, the fuel is supported on, and in between, the manifold tubes, which has the effect of increasing turbulence of the draught around the manifold tubes. Fuel is also supported on a conventional firegrate 46 placed underneath the manifold. However, if coal were to be densely packed around the manifold tubes, the effect of increased turbulence would be greatly reduced, with a subsequent reduction in effective primary heat-exchange surface.

The chamber 2 includes a baffle plate 22 extending vertically from the base of the chamber to near the roof 7 of the chamber and bridging the front wall 6 and the back wall 5 of the chamber, to partially partition off a zone 23 in the chamber 2 hereinafter referred to as a "low resistance zone". The baffle plate 22 is situated close to sidewall 4 of the chamber, but spaced therefrom to allow manifold outlet opening 21 of side tube 16 to communicate with the zone 23.

Figure 3 shows the back boiler 1 arranged in situ in a fireplace comprising walls 44 of refractory material, and a main chimney flue 43. A standard firegrate 46 is placed below the manifold 14, with a normal fireguard 47, including draught control, placed in front of the firegrate 46. The manifold 14 projects into the combustion space of the fireplace. The back boiler 1 is spaced from the back wall of the fireplace to define a flue 48 between the back wall of the boiler and the back wall of the fireplace. The back boiler 1 is mounted in place on side supports 49, 50 which are formed by plates welded to the base of the boiler 1.

Refractory tiles 49a and 50a are preferably placed on each side of the boiler chamber to provide vertical sides to the combustion space in use. The tiles 49a, 50a are arranged so as to rest against the side tubes 15, 16 of the manifold.

Water is the preferred heat exchange liquid, and the system is designed to hold about 7 gallons (or 32 litres) of water, but this may be varied according to the number of radiators fed from the system. Water flowing into the inlet conduit 11 branches into two streams in feed pipes 12, 13. Water flowing through feed pipe 12 passes directly into the chamber 2, while water flowing through feed pipe 13 passes into the manifold 14, through side tube 15, cross tubes 17, 18, 19, side tube 16 and back to the chamber 2 via manifold outlet opening 21, as indicated by dashed-line arrows in Figures 1 and 2. Water also passes to the manifold via manifold inlet opening 20 directly from the chamber 2. If desired, feed pipe 13 may be omitted, so that all of the water passes via manifold inlet opening 20. Water entering the chamber 2 at manifold outlet opening 21 flows upwards through the"low resistance zone" 23 of the chamber. Without the baffle plate 22, water emerging from the manifold through opening 21, when at a higher temperature than water in the chamber 2, would meet a resistance to flow from the denser, cooler water in the chamber. The baffle plate 22 therefore serves to partition off zone 23 within the chamber 2 to inhibit mixing of relatively denser cooler water in the chamber with relatively less dense water at higher temperature emerging from the manifold.

The "low resistance zone" increases circulation of water through the boiler. Also the slight downward inclination of the manifold, and the fact that the manifold is fed separately through feed pipe 13, promote better circulation through the manifold. Figures 1 to 3 show dashed-line arrows which denote the normal water circulation in the boiler and manifold.

A slidable damper plate 52 may be provided over the roof 7 of the boiler to regulate the flow of flue gases through the back flue 48. The damper may be made of cast iron. When the back flue 48 is closed, the front wall 6 of the boiler becomes a primary heat exchange surface.

The manifold is preferably welded to the base of the boiler. The manifold can be welded by the "root and cap" method, where the joins are welded on each side simultaneously.

A second embodiment of the invention will now be described with reference to Figures 4 and 5 of the drawings. In this embodiment, the boiler chamber surrounds a flue duct 60 which has an inlet opening 58 in wall 9 of the boiler and an outlet opening 59 in roof 7, and having a rear wall 61, a front wall 62, and two side walls 63, 64. The side wall 64 is formed by the baffle plate 22, a portion 65 of which is extended to the roof 7 of the boiler, but still leaving passages 102, 103 to the front and rear of the flue duct 60 communicating with the "low resistance zone" 23.

The walls 61, 62, 63, 64 of the flue duct 60 are primary heat exchange surfaces. The main body of water in the boiler chamber is thus exposed to a greater primary heat exchange surface area than in the first embodiment. Advantageously, that part of the baffle plate 22 formed by the side wall 64 of the flue duct is also a primary heat exchange surface and this acts to maintain water in the "low resistance zone" at a higher temperature, which enhances upward flow of water through the "low resistance zone".

In order to make the boiler more adaptable in use, an alternative inlet conduit 68, and an alternative outlet port 69 can be provided in the sidewall 4 of the boiler. When the boiler is being installed in a fireplace, there is thus the option of attaching an outflow pipe to either the outlet port 10 in sidewall 3 or the outlet port 69 in sidewall 4, and likewise a return flow pipe to either the inlet conduit 11 in sidewall 3 or the inlet conduit 68 in sidewall 4. The ports 10, 69 and conduits 11, 68 not in use can be plugged.

The alternative inlet conduit 68 communicates directly with the boiler chamber, through an opening in the baffle plate 22 at the base of the chamber between the rear wall 61 of the flue duct 60 and the rear wall 5 of the chamber.

Because water from the return flow pipe attached to the alternative inlet conduit 68 will be at a relatively low temperature it is necessary to isolate the conduit 68 from hot water in the "low resistance zone" if the temperature of the water in the lower part of the "low resistance zone" is to remain unaffected. This is achieved by the plates 70, 71 which form a tunnel at the base of the boiler.

As shown in Figure 5, the cross-tube 19 is tilted rearwardly, while the cross-tubes 17, 18 are tilted forwardly as in the first embodiment. This has two advantages; (a) the gap between the top of tube 18 and tube 19 is greater and thus facilitates setting a fire by allowing coals to be placed more easily on grate 46 below the manifold, and (b) the rearward tilt of tube 19 tends to deflect a draught of air around its major surfaces and to slow down that draught before it enters the flue 60. The gaps between the bottom of adjacent cross-tubes are still substantially equal.

The boiler as shown in Figure 5 can be mounted in a fireplace to allow for a rear flue duct 48 between the rear wall 5 of the boiler and back wall 44 of the fireplace as in Figure 3, if desired.

As shown in Figures 4 and 5 the fireguard 47 and firegrate 46 can be specially adapted to fit with the dimensions of the manifold. In particular, the fireguard can be squared at its edges in order to surround the front of the manifold which may in practice project from the fireplace although the major portion of the manifold is in the combustion space of the fireplace.

Figures 6 and 7 show a third embodiment of the invention, which is an application to an industrial type of boiler. The combustion space 84 is surrounded on four sides by a boiler 85 having four inner walls 86, 87, 88, 89 and four outer walls 90, 91, 92, 93. At the base of walls 91, 86, i.e. the front of the boiler, there is a fueling opening to the combustion space which is closed by a door 82. A tubular manifold comprising side tubes 94 and cross-tubes 95 projects from wall 88 into the combustion space 84 and is spaced from the base of the boiler so as to accomodate a grate or firebox 83 underneath the manifold. Side tubes 94 communicate with the boiler chamber at their respective openings 96, 97. Opening 96 communicates directly with a "low resistance zone" 98, partitioned off from the boiler chamber by two baffle plates 99 which bridge walls 88 and 93 of the boiler and extend from the base of the boiler to near its roof. An inlet conduit 100 is located in wall 93 of the boiler adjacent opening 97, while an outlet conduit 101 is located near the top of the boiler in wall 93 above the level of the top of baffle plates 99. Arrows indicate the flow of water through the boiler and manifold.

Figure 8 shows a further application of the heating system of the present invention to a domestic heating stove 105. In this case, the boiler chamber, manifold and firegrate are mounted inside an enclosed combustion space provided by the stove. A dismountable door 106 is provided at the front of the stove for access to the combustion space for fueling purposes. Air intake to the combustion space can be controlled by a perforated slidably adjustable damper plate 107.

It has been found that the most advantageous flow of heat exchange liquid through the system can be achieved by careful adjustment of the following factors:-

(1) The height of the baffle plate or plates extending from the base of the boiler chamber to near the top of the chamber.

(2) The volume of the partially partitioned off zone defined by the baffle plate or plates herein referred to as the "low resistance zone".

(3) The volume of a second zone at the top of the boiler chamber between a horizontal plane coincident with the top of the baffle plate(s) and the roof of the boiler.

The height (1) of the baffle plate determines the volumes (2) and (3) above. The volume (2) of the "low resistance zone" is preferably made approximately equal to the volume of the manifold tubes, for example in the embodiment of figures 4 & 5, the manifold and "low resistance zone "preferably each have a capacity of about 0.7 gals (3.2 litres), when a total volume of the chamber plus manifold is about 7 gals (32 litres). The ratio between the volume of the manifold and that of the "low resistance zone" may suitably vary from about 0.7 : 0.5 to 0.7 : 1.0.

The volume of the second zone (3) is preferably made approximately equal to 25% of the total volume of the boiler chamber, excluding the manifold tubes.

These factors are satisfactorily met in one example of the embodiment of Figures 4 & 5 when the height (1) of the baffle plate is between 13" and 14" (31 and 33 cms), given that the height of the boiler is 17" (41 cms).

Water in the manifold tubes reaches a temperature of about 180^{o}F (82^{o}C) while at the top of the baffle plate water at about 170^{o}F (76^{o}C) mixes with cooler water in the body of the chamber, under optimum working conditions.

Due to the increased output of the heating system of the present invention, circulation of water through radiators associated with the system can be increased by employing 1¼" (3.2 cm) diameter circulation pipes, instead of the normal 1" (2.5 cm) diameter pipes.

The following test results are given by way of example to illustrate the output and efficiency of a domestic heating system in accordance with figures 4 & 5 as hereinbefore described:-

TEST RESULTS

TEST 1 - Damper Opening 3 mm

Average Water Temp. OUT	=	59.14^{o}C
Average Water Temp. IN	=	6.00^{o}C
Δt		53.14^{o}C
Water Flow Rate	=	1.4154 kg/min (3.121 lb/min)
Boiler Output	=	$\frac{1.4154}{60}$ x 53.14 x 4.187 = 5.25 kW
	=	(3.121 x 60 x 53.14 x $\frac{9}{5}$ = 17,912
BTU/hr)		
Fuel Input	=	1.35 kg of "Coalite" per hour at a moisture content of 18% (assumed). Equivalent value of test fuel = 1.12 kg/hr at a CV of 13,360 BTU/lb.

Boiler Output:

per 1.13 kg of test fuel	=	5.30 kW
per 1.36 kg of test fuel	=	6.37 kW
Radiation Output	=	1.5 kW (standard figure for a 400 mm fire)
Boiler Efficiency	=	$\frac{5.25 \times 3412 \times 100}{1.35 \times 2.205 \times 10{,}915} = 55.1\%$
Overall Efficiency	=	$55.1\% + \frac{1.5 \times 3412 \times 100}{1.13 \times 2.205 \times 13{,}360}$
	=	55.1% + 15.3%
	=	70.4%

The manifold positioned in the combustion space over the firegrate provides a substantial area of primary heating surface through which heat is transferred to the water. The system of the invention utilises heat often wasted in a fireplace and increases the quantity of heat transferred to the water per unit of energy available from the fire. It increases boiler performance as compared to conventional back boilers and reduces the installation costs normally encountered with large boilers.

Significantly, heat is initially radiated by radiators fed from the boiler of the invention in a shorter time than is usual for conventional back boiler systems.

The boiler chamber and manifold of the heating system may be constructed of mild steel, stainless steel, copper, bronze, or any other suitable metal, although mild steel is preferred. Areas exposed to direct contact with the heat source should be 6 mm in thickness, while remaining areas should be 4 mm in thickness.

The system of the invention can be adapted for use with other fuels apart from solid fuel e.g. oil or gas. For instance, oil or gas burners can be placed directly below each cross-tube of the tubular manifold to provide a heat source.

CLAIMS

1. A heating system for transferring heat from a heat source to a heat exchange fluid, comprising in combination:

(a) an enclosed chamber (2) to serve as a reservoir for the heat exchange fluid,

(b) a tubular heat exchange manifold (14), which manifold communicates with the chamber (2) and projects from the chamber over and adjacent to the heat source.

2. A heating system as claimed in claim 1 wherein the tubular heat exchange manifold (14) is mounted at the base of the chamber (2) so as to project forwardly from the chamber over and adjacent to the heat source, which manifold comprises first (15) and second (16) side tubes extending from the chamber (2) and a plurality of cross tubes (17, 18, 19) connecting the side tubes (15, 16).

3. A heating system as claimed in claim 2 wherein the tubes (15-19) are of substantially rectangular cross-section.

4. A heating system as claimed in claim 3 wherein the cross tubes (17-19) are tilted so that the major faces of each tube make an angle from 20^{0} to 30^{o} to the vertical.

5. A heating system as claimed in any of claims 1 to 4 wherein the manifold (14) projects from the chamber at an angle of from 5^{o} to 15^{o} to the horizontal.

6. A heating system as claimed in any preceding claim including a means for defining a part of the volume of the chamber as a zone of low fluid density when heated fluid is circulated through the chamber.

7. A heating system as claimed in claim 6 wherein the means for defining part of the volume of the chamber as a zone of low fluid density (23) comprises one or more substantially vertical baffles (22) for partially partitioning off the zone of low fluid density (23) directly above an opening (21) in the chamber where the chamber communicates with a manifold outlet.

8. A heating system as claimed in claim 6 wherein the said part of the volume of the chamber (23) is approximately equal to the volume of the manifold tubes (15-19).

9. A heating system as claimed in any preceding claim wherein the chamber surrounds a flue duct (60).

10. A heating system as claimed in claim 1 having a central combustion space (84) and flue duct surrounded by the enclosed chamber (85), a tubular heat exchange manifold communicating with the chamber and mounted at the base of the chamber so as to project substantially horizontally over and adjacent to the heat source, the manifold comprising first and second side tubes (94) extending from the chamber and a plurality of cross-tubes (95) connecting the side tubes (94).

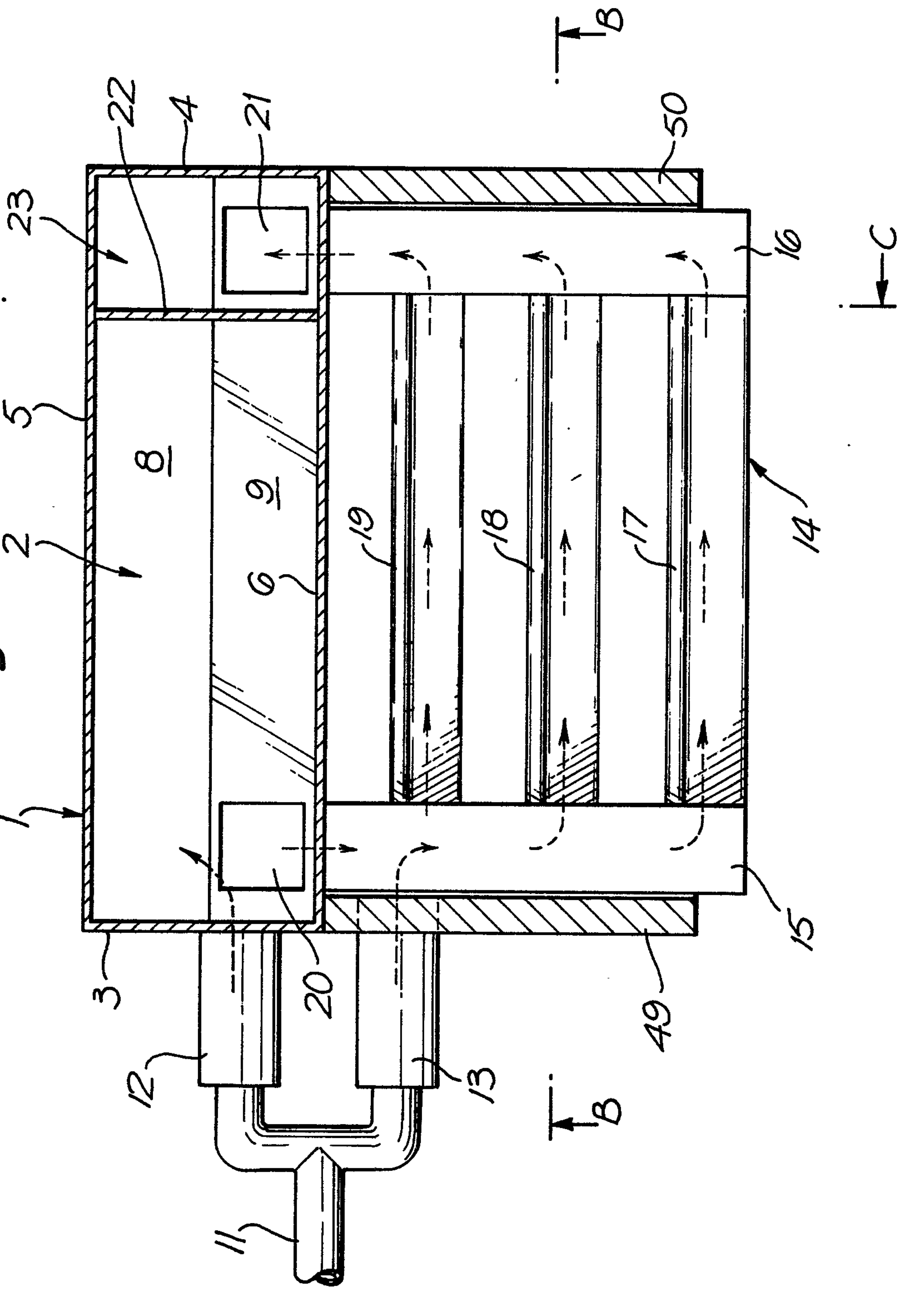

Fig.1.

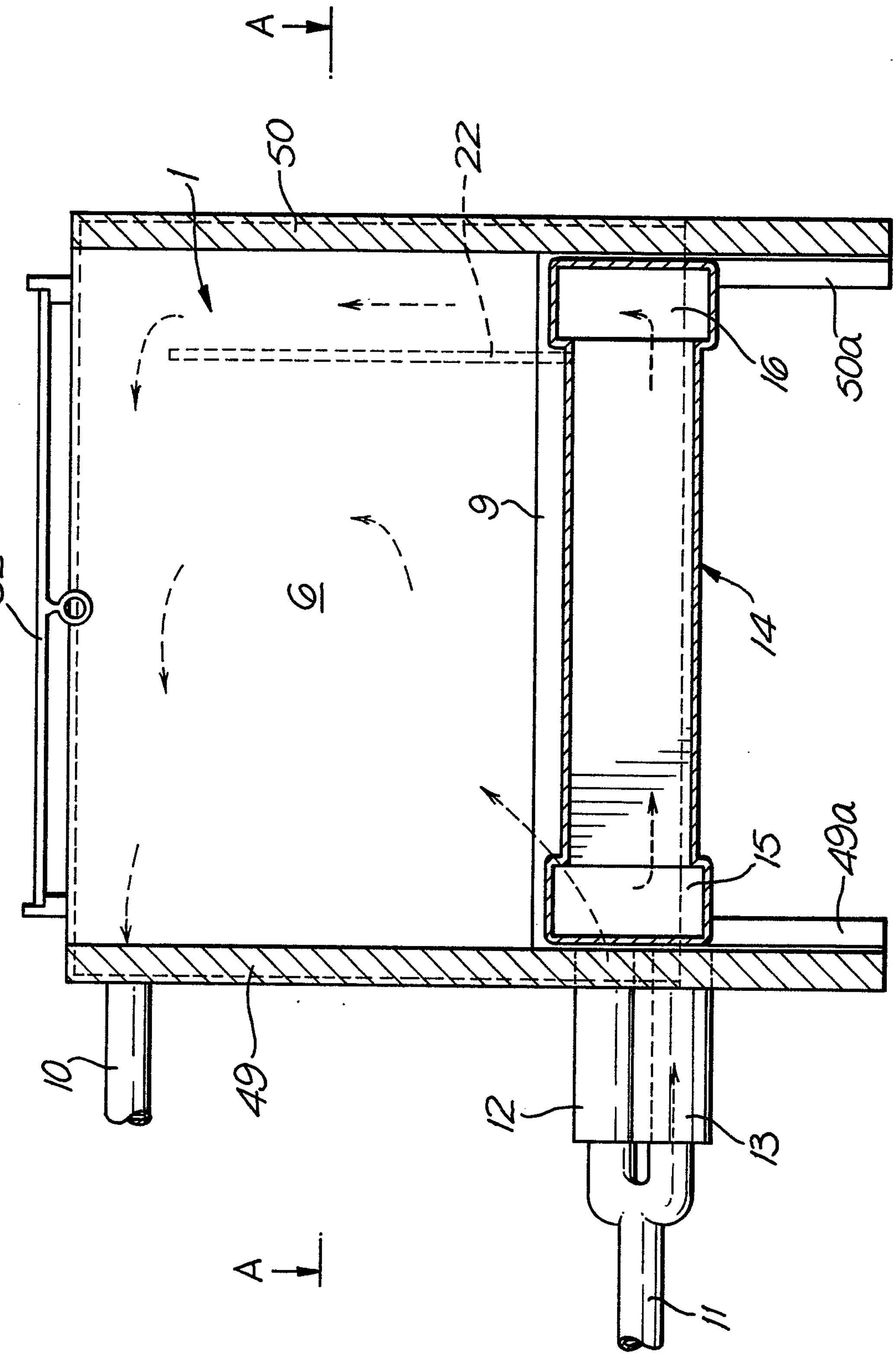

Fig.2.

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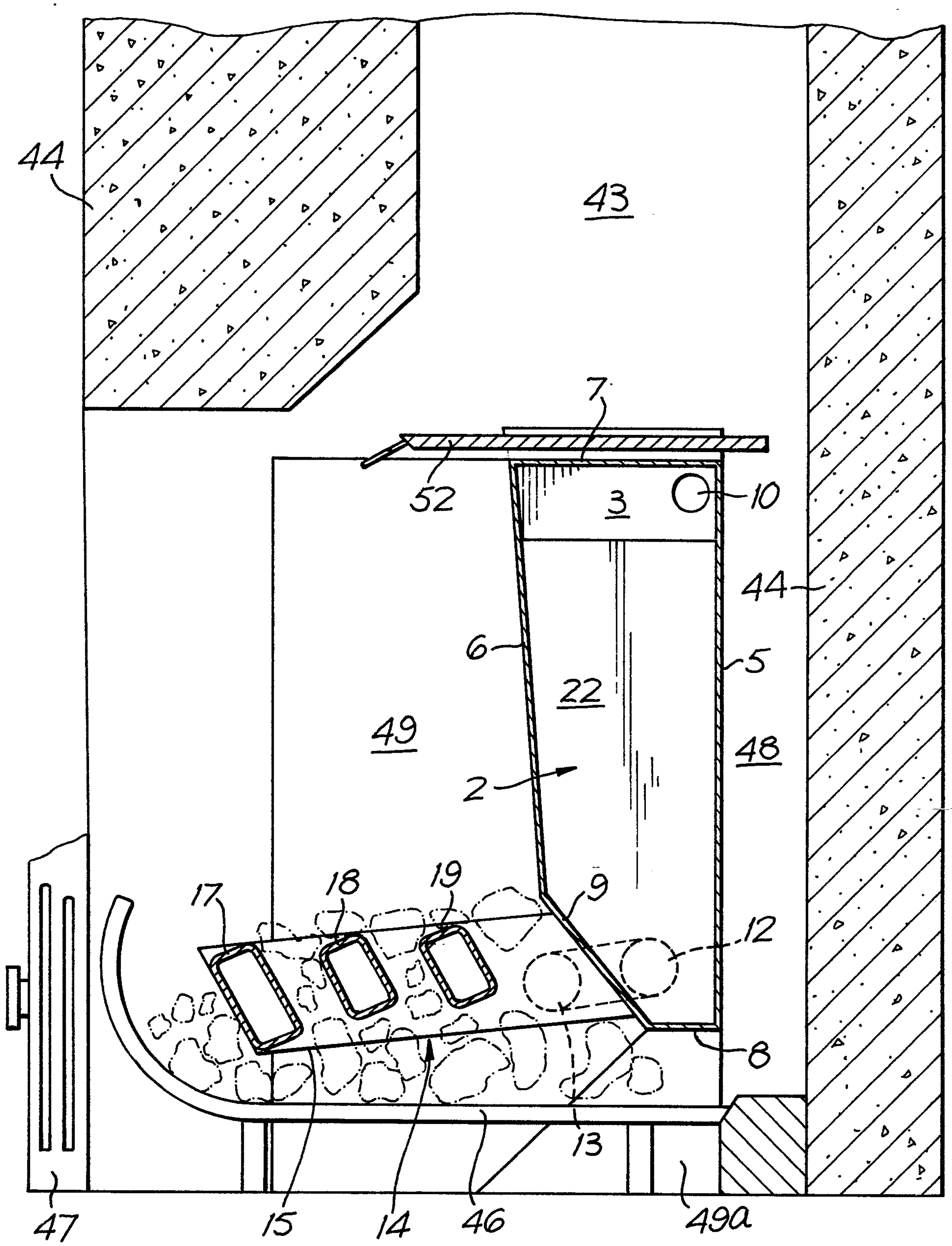
Fig.3.



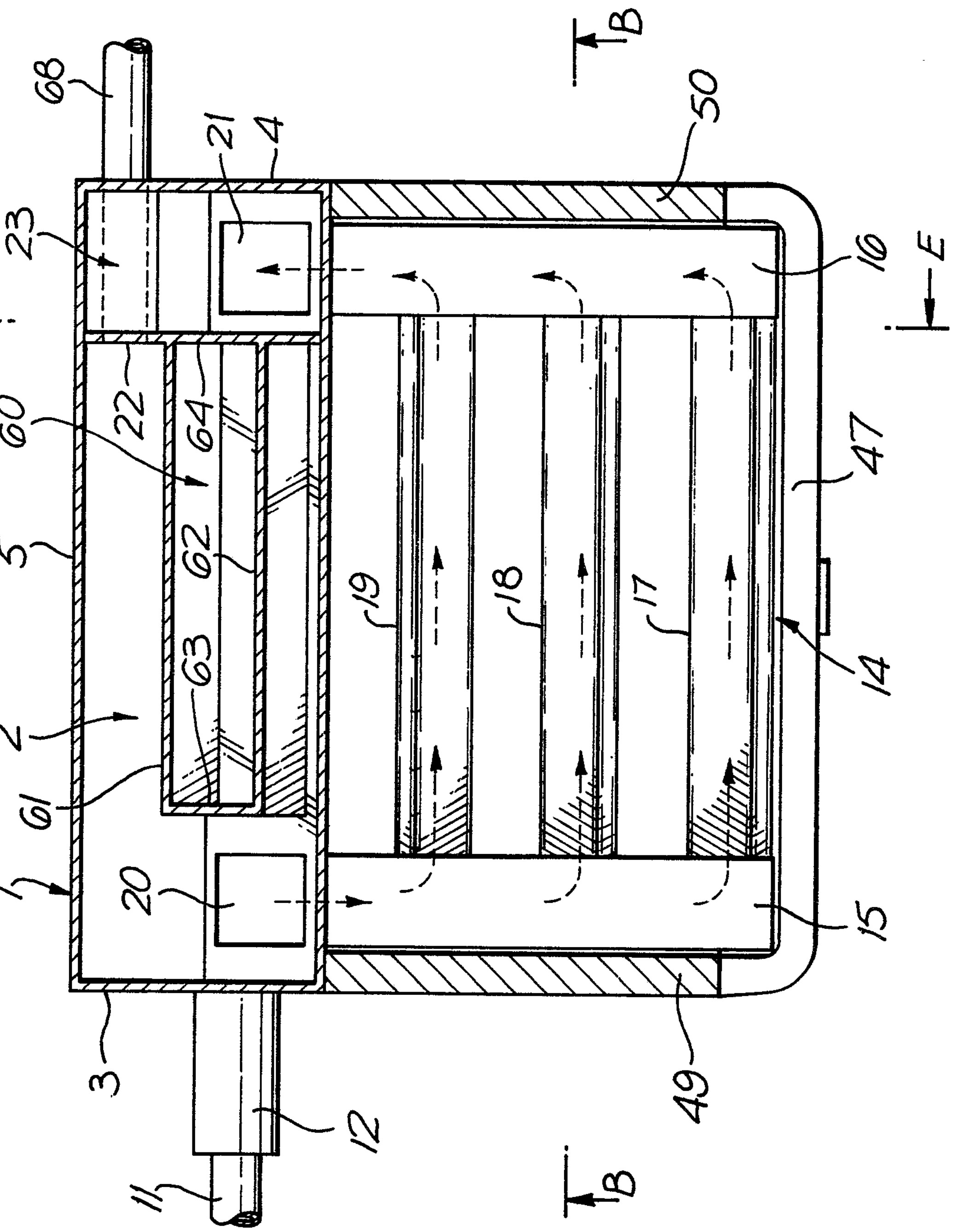

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Fig.4.

Fig.5.

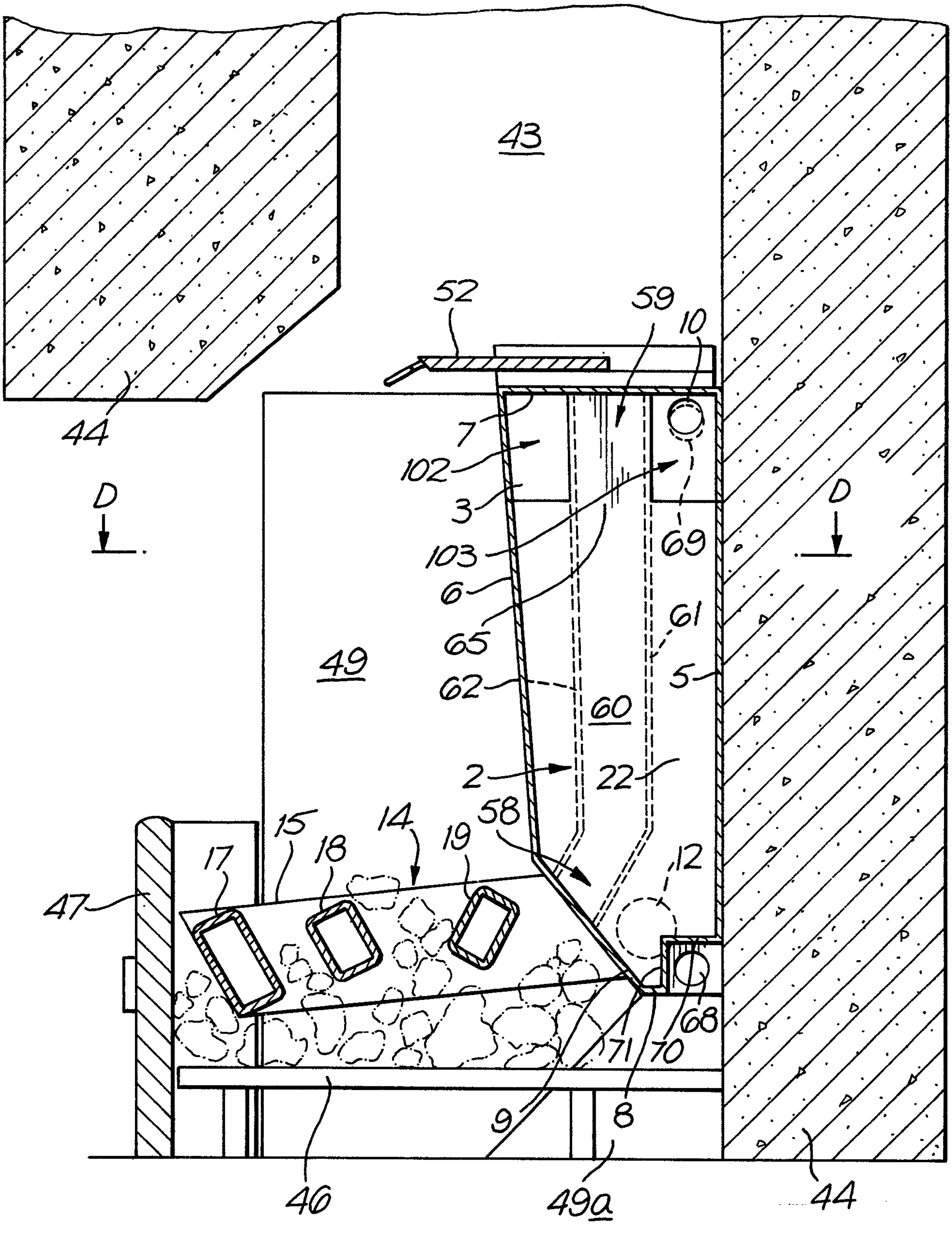
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Fig.6.

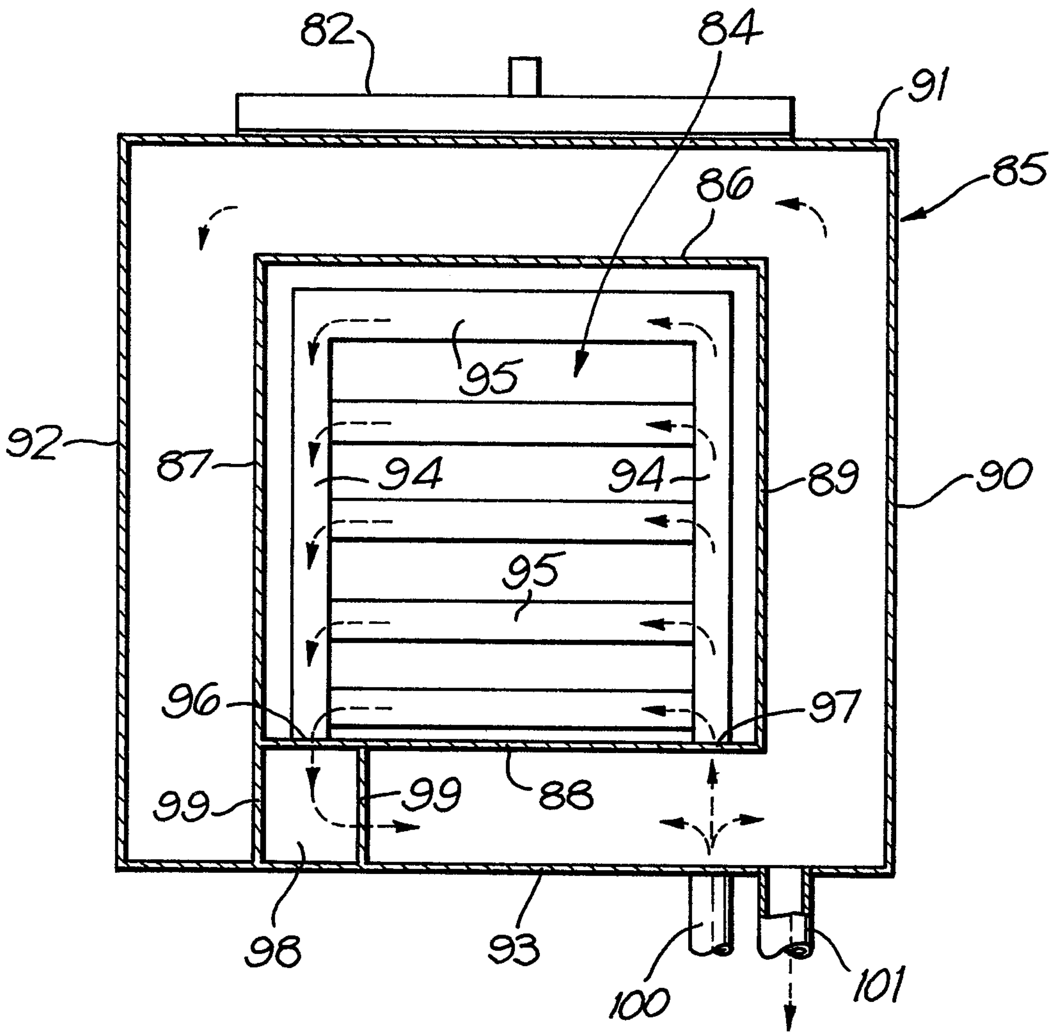


Fig. 7.

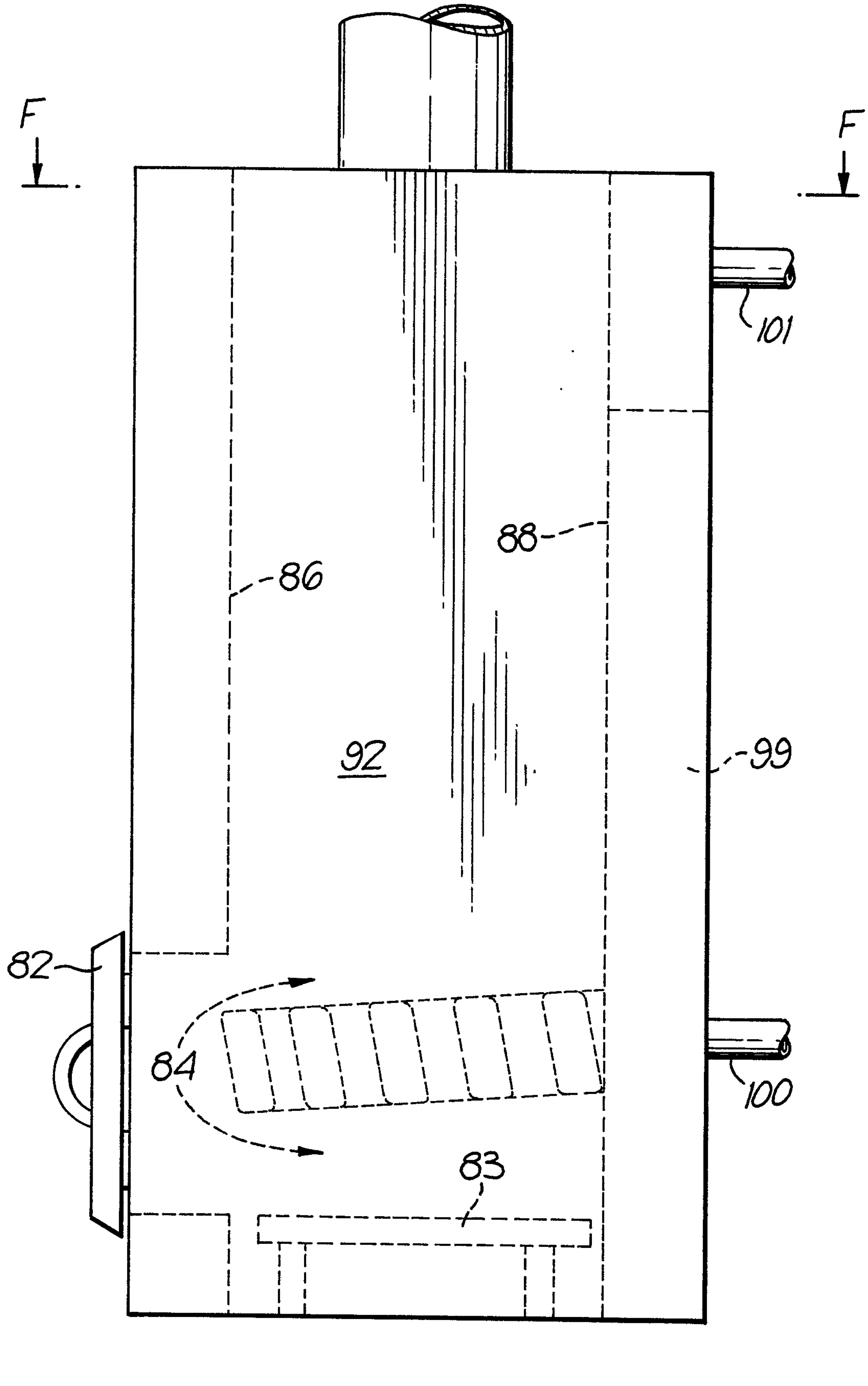
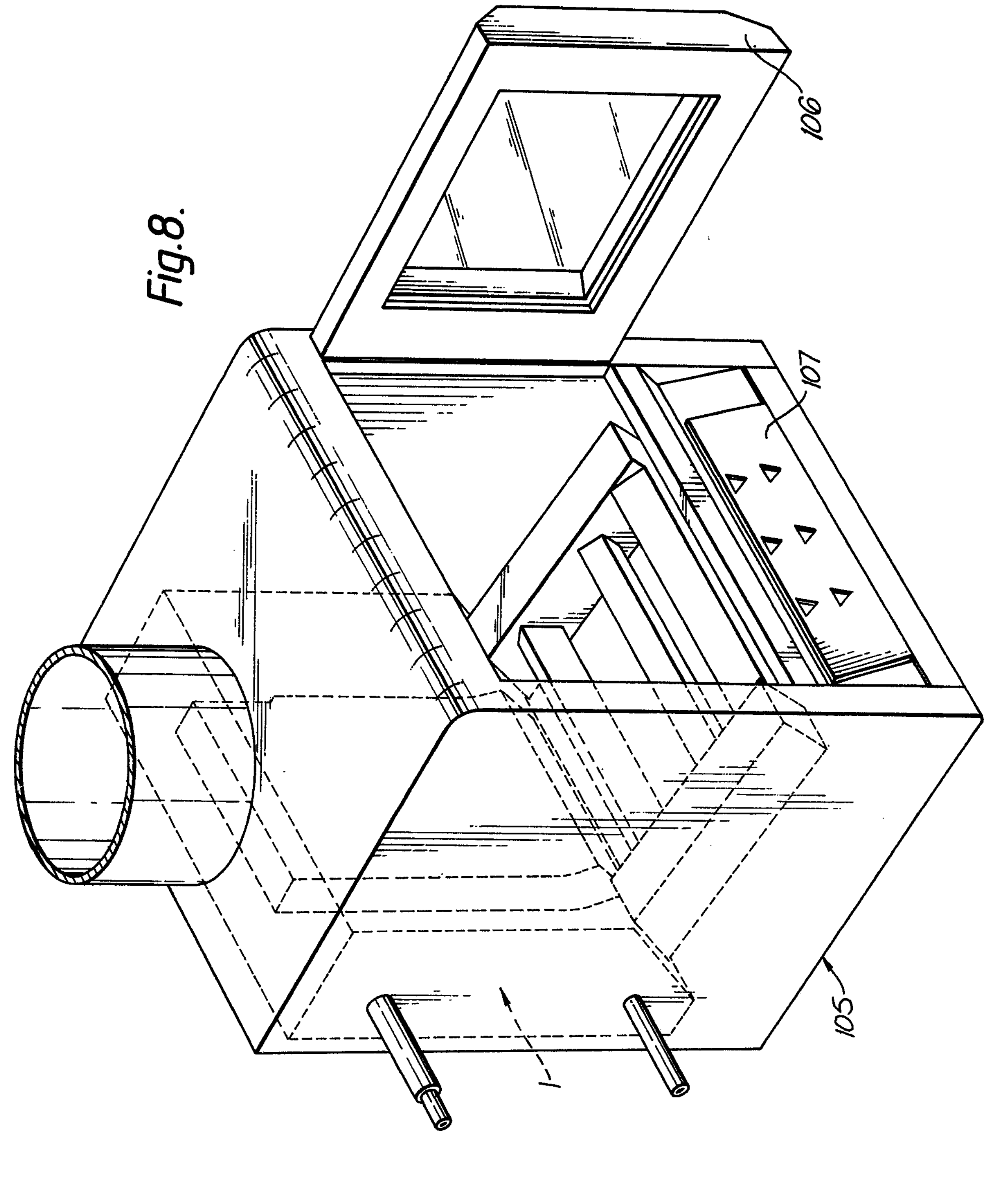


Fig.8.



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EUROPEAN SEARCH REPORT

Application number

EP 82 30 0899

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)
X	GB-A- 144 808 (J. SCHOFIELD SHAW) * page 3, lines 90-114; figures 1-3 *	1,4	F 24 B 9/04
Y		2,3	

X	FR-A-2 294 404 (JULIE) * page 3, lines 1-16; figures 1-3 *	1,9	
Y		2	

P,X	FR-A-2 478 789 (COURRIER) * page 3, lines 1-20; figures 1/2, 2/2 *	1,2	
	---		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
Y	US-A-1 432 538 (DE ARMOND) * page 2, lines 45-70; figures 1-7 *	3	F 24 B

A	FR-A-2 428 791 (PRANEUF)		

A	US-A-2 172 711 (NEWTON)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-05-1982	VANHEUSDEN J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
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