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(11) **EP 1 106 937 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.06.2001 Bulletin 2001/24

(51) Int Cl.7: **F24H 1/26, F24H 9/00**

(21) Application number: **99650113.6**

(22) Date of filing: **10.12.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

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(54) **A boiler**

(57) There is provided an enclosed boiler (1) having sidewall means (4,5,6,7) in the form of water carrying side wall tanks which define an enclosure within which is mounted a heat exchanger (10) through which flame and hot gases are led from an oil burner (12) to an exhaust gas flue (15). The heat exchanger (10) comprises an upper transverse baffle plate (20) and a lower transverse baffle plate (21) and a central core formed by four rectangular plates (22). A number of upright baffle plates (24) project from the core (23) to meet the sidewall

means (4,5,6,7) to form various passageways. Gas is then delivered into the heat exchanger means (10) and is delivered up and down the heat exchanger between the core, the upper transverse baffle plate (20) and the lower transverse baffle plate (21) between the baffle plates until they are delivered out of the heat exchanger (10). The hot exhaust gas thus travels up and down between the two transverse baffle plates causing them to travel a considerable distance over the surface of the water carrying tanks of the boiler (1).

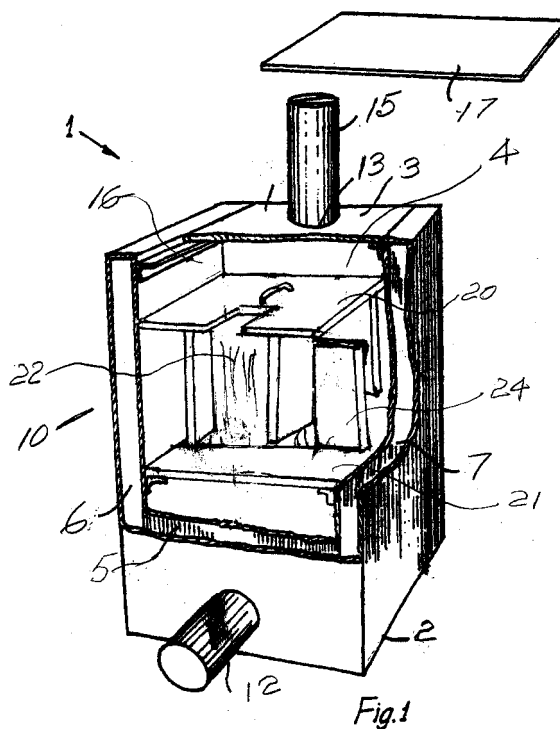


Fig.1

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Description

[0001] The present invention relates to an enclosed boiler and in particular to an enclosed boiler of the type comprising:

a base;

atop;

sidewall means extending between the base and the top and defining therewith an enclosure through which hot gases are led from a hot gas inlet to a flue gas outlet;

the sidewall means are generally rectangular in cross section and comprise a front portion, a rear portion and a pair of side portions extending between the front and rear portions;

hollow walls arranged for carrying hot water to be heated forming at least part of the portions comprising the sidewall means;

an accessway in the enclosure through which access is gained for cleaning; and

heat exchanger means within the enclosure for directing hot gases for the heat transfer as the gases are led through the enclosure.

[0002] Such a boiler is described and claimed in our European Patent Specification No. 0 616 676 (Alley Enterprises Limited). In particular this patent specification describes one particular type of heat exchanger means for mounting in the boiler, which heat exchanger means comprises:

at least two generally rectangular transverse baffle plate means extending transversely across the enclosure;

the transverse baffle plate means being spaced-apart one above the other to define therebetween a transverse flue gas passageway through which hot gases are led;

each transverse baffle plate means defining an opening;

the openings defined by adjacent transverse baffle plate means being offset;

the openings in one transverse baffle plate means defining an inlet through which hot gases are introduced into the transverse passageway and the opening defined by a following transverse baffle plate means defining an outlet through which the

hot gases are led from the passageway; and

deflecting means associated with the transverse baffle plate means for directing hot gases for heat transfer as the gases are led through the passageway.

[0003] The present invention is directed towards providing an improved construction of such boiler and in particular to an improved heat exchanger means for such a boiler.

[0004] The principal problem being encountered by all these boilers at present is firstly the need to provide sufficient thermal efficiency and secondly to provide that thermal efficiency in the smallest possible space. As housing becomes more expensive, space utilisation becomes all the more important and indeed it is one of the major problems now being encountered by manufacturers of such boilers namely to provide a boiler of the minimum cubic capacity which at the same time can be relatively easily maintained and serviced generally. The present invention is directed towards providing such a boiler.

Statements of Invention

[0005] This invention is characterised in that the heat exchanger means comprises:

an inner core mounted in the enclosure;

upright baffle plates between the core and the sidewall means defining gas passageways therebetween;

transversely arranged baffle plates sealing the passageways adjacent each end thereof;

a combustion gas inlet in a passageway communicating with the hot gas inlet;

a combustion gas outlet in another passageway communication with the flue gas outlet; and

each upright baffle plate having a transfer opening communication with an adjacent passageway, the openings being vertically offset to provide alternate rising and falling of passageways for the hot gases as they are led between combustion gas inlets and outlets around the core.

[0006] This arrangement of baffle plates ensures that a very high thermal efficiency is obtained in the boiler.

[0007] In one embodiment of the invention the core is substantially equi-spaced from the sidewall means. This has the advantage of ensuring that the heat transfer around the boiler is as constant as possible.

[0008] Preferably the core is rectangular in cross-section.

tion. This has the advantage of ensuring that with a rectangular section boiler, as is common, the core mirrors the interior surface of the boiler such that the space between is of substantially constant cross-section, except at the four corners.

[0009] In one embodiment of the invention the combustion gas outlet communicates with the flue gas outlet via the core. This is a particularly efficient way of ensuring that you can have an equal number of passageways and permits the leading of the combustion gases through effectively 360° around the core.

[0010] In another embodiment of the invention the flue gas passageways communicating with the hot gas inlet and the flue gas outlet are opposite each other on either side of the core such that as flue gases are led around the flue through substantially 180°. While this doesn't allow quite the same length of travel around the core, it has the advantage of scavenging the boiler quicker.

[0011] In one embodiment of the invention the core is in the form of a cylinder. In certain circumstances, particularly if the enclosure of the boiler should be circular in cross-section such a construction would be advantageous.

[0012] In another embodiment of the invention the heat exchanger means comprises:

a top plate forming an upper transverse baffle plate;

a bottom plate forming a lower transverse baffle plate;

four rectangular core plates connecting the top and bottom plates to form an enclosed core; and

rectangular plates forming the upright baffle plates connected to the core and to at least one of the top and bottom plates and in which the transfer openings are provided by a gap between a transverse edge of the plate forming the upright baffle plate and the top or bottom plate.

[0013] This has been found to be a particularly suitable construction for fabrication.

[0014] In this latter embodiment preferably the bottom plate has an opening communicating with the interior of the core and an opening communicating with a passageway to form the combustion gas inlet and in which the top plate seals the core and has an opening communicating with a passageway to form the combustion gas outlet.

[0015] Alternatively,

the bottom plate seals the interior of the core and has an opening communicating with a passageway to form the combustion gas inlet;

the core communicates through an opening in one of the core plates with a passageway; and

the top plate has an opening communicating with the interior of the core to form the combustion gas outlet.

[0016] Both of these constructions are again particularly easy for manufacture and thus suitable for fabrication by most boiler manufacturers.

[0017] In another embodiment at least one of the transverse passageways sealing the core is a hollow wall for carrying hot water to be heated.

[0018] Preferably in this latter embodiment there is provided a boiler comprising:

a top plate formed from a hollow water carrying top wall sealing the core and three passageways;

a bottom plate forming a lower transverse baffle plate and having an opening connecting with the core;

four equi-spaced rectangular plates forming the upright baffle plates connected to the core;

an opening in the core adjacent the top wall feeding the passageway between the two plates, one of which plates connects between the bottom plate and the top and each of the other plates connects to only one of the top wall and the bottom plate; and

transfer openings provided by a gap between the transverse edge of the plates forming the baffle plates and the top wall or bottom plate.

[0019] Ideally the heat exchanger means forms a plurality of interconnecting parts for ease of removal. It will be appreciated that manufacturing the heat exchanger in a number of parts will facilitate removal in that the accessway provided can be smaller than is necessary if the heat exchanger is manufactured as one composite piece.

[0020] Ideally the core includes hollow walls arranged for carrying hot water to be heated. This further increases the heat transfer.

[0021] Ideally the cross-sectional area of the core is between 20% and 50% of the enclosure cross-sectional area.

[0022] Preferably the cross-sectional area of the passageway is greater than or equal to the cross-sectional area of the transfer opening.

Detailed Description of the Invention

[0023] The invention will be more clearly understood from the following description of some embodiments of the invention, given by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a perspective partially cut-away view of a

boiler according to the invention;

Fig. 2 is a partially exploded view from the rear of baffles forming heat exchanger means in accordance with the invention;

Fig. 3 is a diagrammatic plan view of the heat exchanger means mounted in the boiler;

Fig. 4 is a sectional view along the lines IV-IV of Fig. 3;

Fig. 5 is a sectional view along the lines V-V of Fig. 3;

Fig. 6 is a plan view similar to Fig. 3 of an alternative arrangement of heat exchanger means according to the invention;

Fig. 7 is a cross-sectional view along the lines VII-VII of Fig. 6;

Fig. 8 is a cross-sectional view along the lines VIII-VIII of Fig. 6;

Fig. 9 is a cross-sectional view along the lines IX-IX of Fig. 6;

Fig. 10 is a plan view similar to Fig. 3 of an alternative arrangement;

Fig. 11 is a cross-sectional view along the line XI-XI of Fig. 10;

Fig. 12 is a plan view similar to Fig. 3 of a further alternative arrangement;

Fig. 13 is a plan view similar to Fig. 3 of a still further alternative arrangement;

Fig. 14 is a perspective partially exploded view of another construction of boiler according to the invention;

Fig. 15 is a perspective view of portion of an alternative construction of heat exchanger means according to the invention;

Fig. 16 is a plan view similar to Fig. 3 of the arrangement of the heat exchanger means of Fig. 13;

Fig. 17 is a perspective view of an alternative construction of boiler according to the invention;

Fig. 18 is a plan view similar to Fig. 3 of the heat exchanger means of the boiler of Fig. 15;

Fig. 19 is a sectional view along the lines XVII-XVII

of Fig. 16;

Fig. 20 is a sectional view along the lines XVIII-XVIII of Fig. 16;

Fig. 21 is a front view of a wall mounted boiler according to the invention;

Fig. 22 is a vertical section through the boiler of Fig. 21;

Fig. 23 is a horizontal section similar to Fig. 3;

Fig. 24 is a perspective view of the heat exchanger means used in the boiler; and

Fig. 25 is a view similar to Fig. 23 of a still further construction of wall mounted boiler.

[0024] Referring to the drawings and initially to Figs. 1 to 5 thereof, there is illustrated an enclosed boiler according to the invention indicated generally by the reference numeral 1. The boiler 1 is of generally rectangular shape in cross-section and comprises a base 2, a top 3 and sidewall means extending between the base 2 and top 3. The sidewall means are water carrying sidewall tanks and comprise a rear front and side portions formed from a main rear tank 4, a main front tank 5 and a pair of main side tanks 6 and 7 respectively. These define an enclosure within which is mounted a heat exchanger means indicated generally by the reference numeral 10 through which flame and hot gases are led from a hot gas inlet supplied by an oil burner 12 to a flue gas outlet 13 feeding an exhaust gas flue 15. Water is circulated through the tanks 4, 5, 6 and 7 by a water circulating pump from a water inlet to a water outlet all of which is not shown. Typically these would feed a hot water central heating system. The top 3 has an access-way 16 with a removable cover 17 through which access is gained for the maintenance and cleaning of the boiler as will be described below.

[0025] The heat exchanger means 10 which is illustrated in more detail in Fig. 2 comprises a removable top plate 20 forming an upper transverse baffle plate and a bottom plate 21 forming a lower transverse baffle plate. Four rectangular core plates 22 forming a core 23 are mounted on the bottom plate 21. A plurality of rectangular plates 24 forming baffle plates extend outwardly from the core 23. The plates 24 and the various tanks 4, 5, 6 and 7 define with the core 23 gas passageways. The gas passageways are identified by the reference letter U for gas passageways in which the gas rises and by the reference letter D for gas passageways within which the gas falls and by various numerals to distinguish the various gas passageways U and D from each other. Any gas passageway which forms the entrance to the heat exchanger means 10 is identified by the letters ENT and the reference letter D or U as appropriate and similarly

the gas passageway forming the last passageway before the hot gases exit the heat exchanger means 10 is identified by the additional letters EX. Each plate 24 is connected to either the top plate 20 or the bottom plate 21 and is spaced apart from at least one of them, such that a transverse opening 25 is provided by a gap between the transverse edge of the plate 24 forming the upright baffle plate and the top plate 20, or the bottom plate 21. In this embodiment the bottom plate 21 has an opening 26 communicating with the interior of the core 23 and an opening 27 communicating with the passageway UEN (see Fig. 4) to form a combustion gas inlet. The top plate 20 seals the core 23 and has an opening 28 communicating with the passageway UEX to form a combustion gas outlet which as can be seen from Fig. 1 communicates with a space above the top plate 20 and beneath the top 3.

[0026] In the drawings sectional lines are only shown where clarity requires them.

[0027] In use, the burner 12 delivers flame through the hot gas inlet 11 beneath the bottom plate 21 and up through opening 27 into the passageway UEN and across into the passageway D1 through the opening 25 in the plate 24 between the passageway UEN and the passageway D1. This can be seen clearly from Fig. 4. The hot gases are delivered down the passageway D1 to the bottom of the passageway D1 to the opening 25 where they enter the passageway U1 as can be seen from Fig. 5. From thence the hot gases pass up the passageway U1 through the opening 25 into the passageway D2 and down the passageway D2. They are then delivered out the passageway D2 through the opening 25 into the passageway UEX and out the heat exchanger means 10 through the opening 28. Similarly hot gases are delivered up the passageway UEN into the passageway D3 and hence from the passageway D3 to the passageway U2 to D4 and again then to UEX. The gases have thus split around the core 23 and have traveled up and down the main rear tank 4, the main front tank 5 and the side tanks 6 and 7.

[0028] Because of the arrangement of the various baffle plates a very high heat transfer efficiency is obtained because the hot gases travel a considerable distance over the surface of the water carrying tanks of the boiler giving a large proportion of their heat before discharge to the exhaust gas flue.

[0029] For cleaning the cover 17 is removed and the top plate 20 and then the rest of the heat exchanger means 10 is removed from the boiler 1.

[0030] Referring now to Figs. 6 to 9 inclusive, there is illustrated an alternative construction of boiler indicated generally by the reference numeral 30 in which parts similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment it can be seen clearly the flue gases are carried the whole way around the core 23. In this embodiment the hot gases enter through the passageway UENT and then proceed down the passageway D1

up the passageway U1 down the passageway D2 and alternatively up and down the passageways D1 to D5 and from D5 they are delivered into the passageway UEXT where they are delivered out the flue. The advantage of this arrangement is that the gas has now been led effectively round 360° rather than 180° of the embodiment of Figs. 1 to 5 inclusive.

[0031] Referring now to Figs. 10 and 11 there is illustrated an alternative construction of boiler indicated generally by the reference numeral 40 and again parts similar to those described with reference to the previous drawings are identified by the same reference numerals.

[0032] Referring to Fig. 12 there is illustrated in plan view another arrangement of boiler indicated generally by the reference numeral 50 and again parts similar to those described with reference to the previous drawings are identified by the same reference numerals. The operation can be readily easily seen and doesn't require any further explanation.

[0033] Fig. 13 illustrates a still further construction of boiler indicated generally by the reference numeral 60 again in which the gases are led through almost 360°.

[0034] Referring to Fig. 14 there is illustrated a still further construction of boiler indicated generally by the reference numeral 70 and again parts similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment there is provided an accessway 71 in the main front tank 5 into which can be inserted a heat exchanger identified by the reference numeral 72 this is identical in every respect to the heat exchanger means 10 except that it is constructed in a number of separate pieces to allow ease of insertion and removal.

[0035] Referring to Figs. 15 and 16 there is illustrated a still further construction of boiler indicated generally by the reference numeral 80 in which parts similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment there is provided a heat exchanger means indicated generally by the reference numeral 81 having a cylinder like core 82 and a plurality of radially arranged upright baffle plates 83 and 84. The plate 84 extends between the top and bottom transverse baffle plates.

[0036] Referring to Fig. 17 there is illustrated a still further construction of boiler indicated generally by the reference numeral 90 again parts which are similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment there is provided an inner core 91 in the form of a water carrying tank against which are mounted a plurality of baffle plates 92. It will be appreciated that the baffle plates 92 cannot in this embodiment be affixed permanently to the core 91, but will preferably be mounted thereon by, for example, being slotted into grooves or the like on the outer surface thereof.

[0037] Referring now to Figs. 18 to 20 there is illustrated a still further construction of boiler indicated generally by the reference numeral 100, again parts similar

to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment all the passageways are the same size and the bottom of the core 23 is sealed by the bottom plate 21 and the exhaust gases are delivered from the passageway UEN right through to the passageway U5 and from the passageway U5 to the top of the passageway DEX where they are delivered down the passageway DEX through an opening 101 into the core 23 of the boiler and through an opening 102 in the top plate 20 to the gas flue 15.

[0038] Referring to Figs. 21 to 24 inclusive there is illustrated an alternative construction of wall mounted boiler indicated generally by the reference numeral 110, in this embodiment parts similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment the oil burner 12 is mounted below the base 2 and the front tank 5 contains an accessway having a removable cover 11 to allow access into the enclosure. Within the accessway is mounted a heat exchanger means 112. The heat exchanger means 112 comprises a top plate formed from a hollow water carrying top wall 113 which is connected to the main side tank 6. The heat exchanger means 112 is also provided with a bottom plate 114 communicating through an opening 115 with a hollow cylindrical core 116 from which project radially outwards four equi-spaced rectangular plates 117 and 118. The plates 117 are again provided with openings 25, however, it will be noted that the plate 118 connects between both the top wall 113 and the bottom plate 114 forming the lower transverse baffle plate. The core 116 is provided with an opening 119 adjacent the top wall 113. The core 116 effectively forms the entrance passageway and feeds through the opening 119 into the passageway D1 as is shown clearly in Figs. 22 and 24.

[0039] Referring to Fig. 25 there is illustrated in a view similar to Fig. 24 an alternative construction of wall hung boiler indicated generally by the reference numeral 120 in which parts similar to those described with reference to the previous drawings are identified by the same reference numerals. This boiler 120 is essentially identical to the boiler illustrated in Figs. 22 to 24 inclusive, except that instead of a cylindrical core, there is provided a rectangular core 121.

[0040] It has been found that ideally the cross-sectional area of the core is between 20 and 50% of the enclosure cross-sectional area. This ensures that most of the hot gases are directed against the boiler walls and not carried out the boiler without adequate heat transfer having occurred. Preferably the cross-sectional area of the passageway is greater than or equal to the cross-sectional area of the transfer opening. This has been found to provide sufficient slowing down of the gases to ensure that sufficient time is taken for the hot gases in the boiler to ensure adequate heat transfer.

[0041] It is envisaged that instead of just the one heat exchanger means such as is illustrated in Fig. 2, that

more than one heat exchanger means could be mounted one on top of the other. For example, the heat exchanger means 10 of Fig. 2 could be mounted on top of another heat exchanger means 10 as long as they were reversed. Thus, two double layers of gases passing both horizontally and vertically could be achieved.

[0042] In the specification the terms "comprise, comprises, comprised and comprising" or any variation thereof and the terms "include, includes, included and including" or any variation thereof are considered to be totally interchangeable and they should all be afforded the widest possible interpretation and vice versa.

[0043] The invention is not limited to the embodiment hereinbefore described, but may be varied in both construction and detail.

Claims

1. An enclosed boiler (1,30,40,50,60,70,80,100,110, 120) of the type comprising:

a base (2);

a top (3);

sidewall means (4,5,6,7) extending between the base (2) and the top (3) and defining therein an enclosure through which hot gases are led from a hot gas inlet (11) to a flue gas outlet (15);

the sidewall means (4,5,6,7) are generally rectangular in cross section and comprise a front portion (5), a rear portion (4) and a pair of side portions (6,7) extending between the front and rear portions (5,4);

hollow walls arranged for carrying hot water to be heated forming at least part of the portions comprising the sidewall means (4,5,6,7);

an accessway (16) in the enclosure through which access is gained for cleaning; and

heat exchanger means (10) within the enclosure for directing hot gases for the heat transfer as the gases are led through the enclosure, characterised in that the heat exchanger means (10) comprises:

an inner core (23) mounted in the enclosure;

upright baffle plates (24) between the core (23) and the sidewall means (4,5,6,7) defining gas passageways (U,D) therebetween;

transversely arranged baffle plates (20,21) sealing the passageways adjacent each end thereof;

a combustion gas inlet (27) in a passageway (UEN) communicating with the hot gas inlet (11); 5

a combustion gas outlet (28) in another passageway (UEX) communicating with the flue gas outlet (15); and 10

each upright baffle plate (24) having a transfer opening (25) communicating with an adjacent passageway (U,D), the openings (25) being vertically offset to provide alternate rising and falling of passageways (U,D) for the hot gases as they are led between the combustion gas inlet (27) and outlet (28) around the core. 15 20

2. A boiler as claimed in claim 1 in which the core (23) is substantially equi-spaced from the sidewall means (4,5,6,7). 25

3. A boiler as claimed in claim 1 or 2 in which the core (23) is rectangular in cross-section. 30

4. A boiler as claimed in any preceding claim in which the combustion gas outlet (28) communicates with the flue gas outlet (15) via the core (23). 35

5. A boiler as claimed in any preceding claim in which the passageways (UEN,UEX) communicating with the hot gas inlet (27) and the flue gas outlet (28) are adjacent each other and the flue gases are led around the flue through substantially 360°. 40

6. A boiler as claimed in any of claims 1 to 4 in which the flue gas passageways (U,D) communicating with the hot gas inlet (27) and the flue gas outlet (28) are opposite each other on either side of the core (23) such that as flue gases are led around the flue through substantially 180°. 45

7. A boiler as claimed in any preceding claim in which the core (83) is in the form of a cylinder. 50

8. A boiler as claimed in any of claims 1 to 6 in which the heat exchanger means (10) comprises: 55

a top plate (20) forming an upper transverse baffle plate;

a bottom plate (21) forming a lower transverse baffle plate; 55

four rectangular core plates (22) connecting the

top and bottom plates (20,21) to form an enclosed core (23); and

rectangular plates (24) forming the upright baffle plates connected to the core (23) and to at least one of the top and bottom plates (20,21) and in which the transfer openings (25) are provided by a gap between a transverse edge of the plate (24) forming the upright baffle plate and the top or bottom plate (20,21).

9. A boiler as claimed in claim 8 in which the bottom plate (21) has an opening (26) communicating with the interior of the core (23) and an opening (27) communicating with a passageway (UEN) to form the combustion gas inlet and in which the top plate (20) seals the core (23) and has an opening (28) communicating with a passageway (UEN) to form the combustion gas outlet (28).

10. A boiler as claimed in claim 8 in which:

the bottom plate (21) seals the interior of the core (23) and has an opening (27) communicating with a passageway (UEN) to form the combustion gas inlet;

the core (23) communicates through an opening (101) in one of the core plates (22) with a passageway (DEX); and

the top plate (20) has an opening communicating (102) with the interior of the core (23) to form the combustion gas outlet.

11. A boiler as claimed any of claims 1 to 6 in which at least one of the transverse passageways sealing the core (116) is a hollow wall (113) for carrying hot water to be heated.

12. A boiler as claimed in claim 11 comprising:

a top plate formed from a hollow water carrying top wall (113) sealing the core (116) and three passageways (U,D);

a bottom plate (114) forming a lower transverse baffle plate and having an opening (115) connecting with the core (116);

four equi-spaced rectangular plates (117,118) forming the upright baffle plates connected to the core (116);

an opening (119) in the core (116) adjacent the top wall (113) feeding the passageway between the two plates (117,118), one of which plates (118) connects between the bottom plate (114)

and the top (113) and each of the other plates (117) connects to only one of the top wall (113) and the bottom plate (114); and

transfer openings (25) provided by a gap between the transverse edge of the plates (117) forming the baffle plates and the top wall (113) or bottom plate (114). 5

13. A boiler as claimed in any preceding claim in which the heat exchanger means (10,72) forms a plurality of interconnecting parts for ease of removal. 10

14. A boiler as claimed in any preceding claim in which the core (23) includes hollow walls (91) arranged for carrying hot water to be heated. 15

15. A boiler as claimed in any preceding claim in which the cross-sectional area of the core (23) is between 20% and 50% of the enclosure cross-sectional area. 20

16. A boiler as claimed in any preceding claim in which the cross-sectional area of the passageway (U,D) is greater than or equal to the cross-sectional of the transfer opening (25). 25

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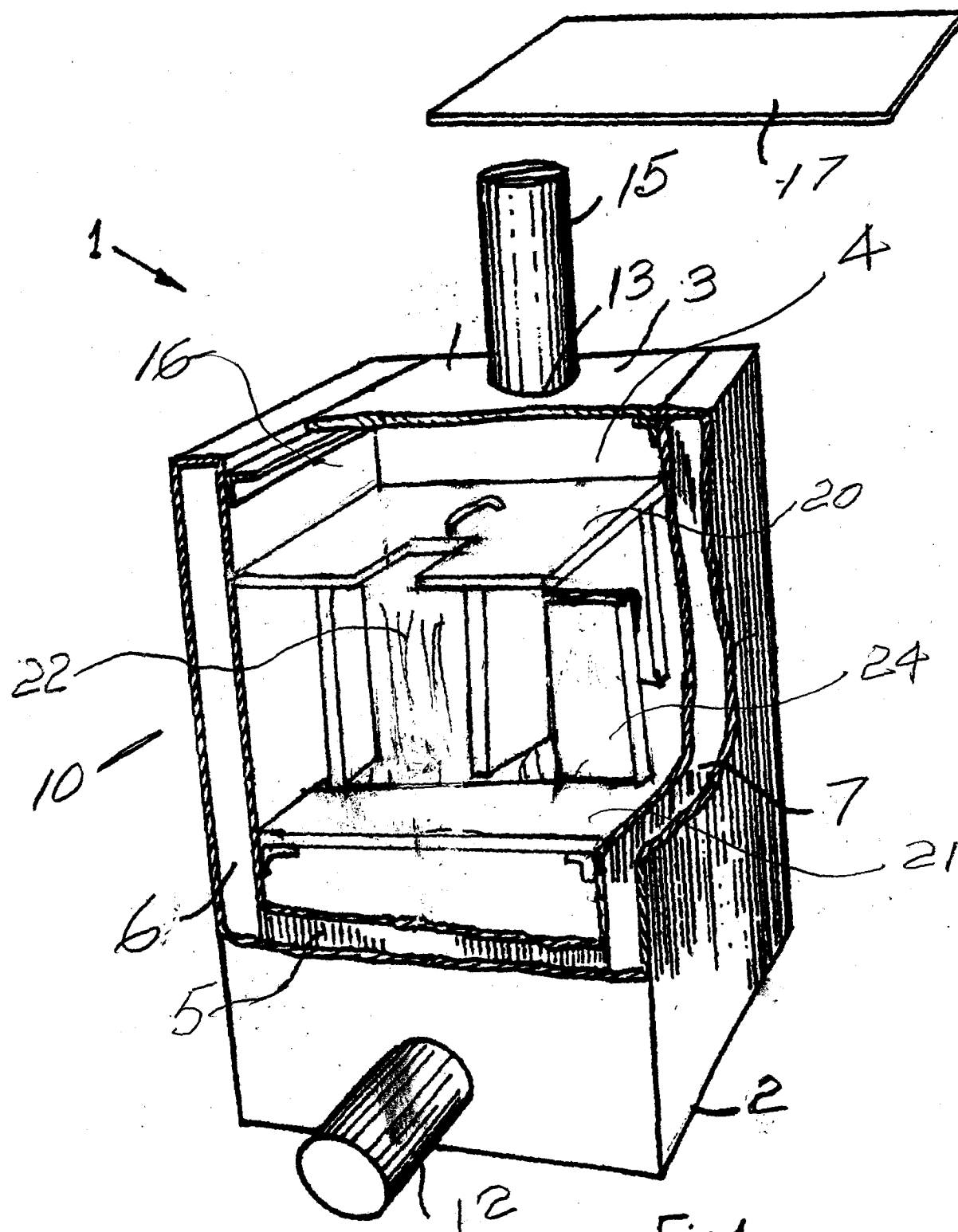


Fig.1

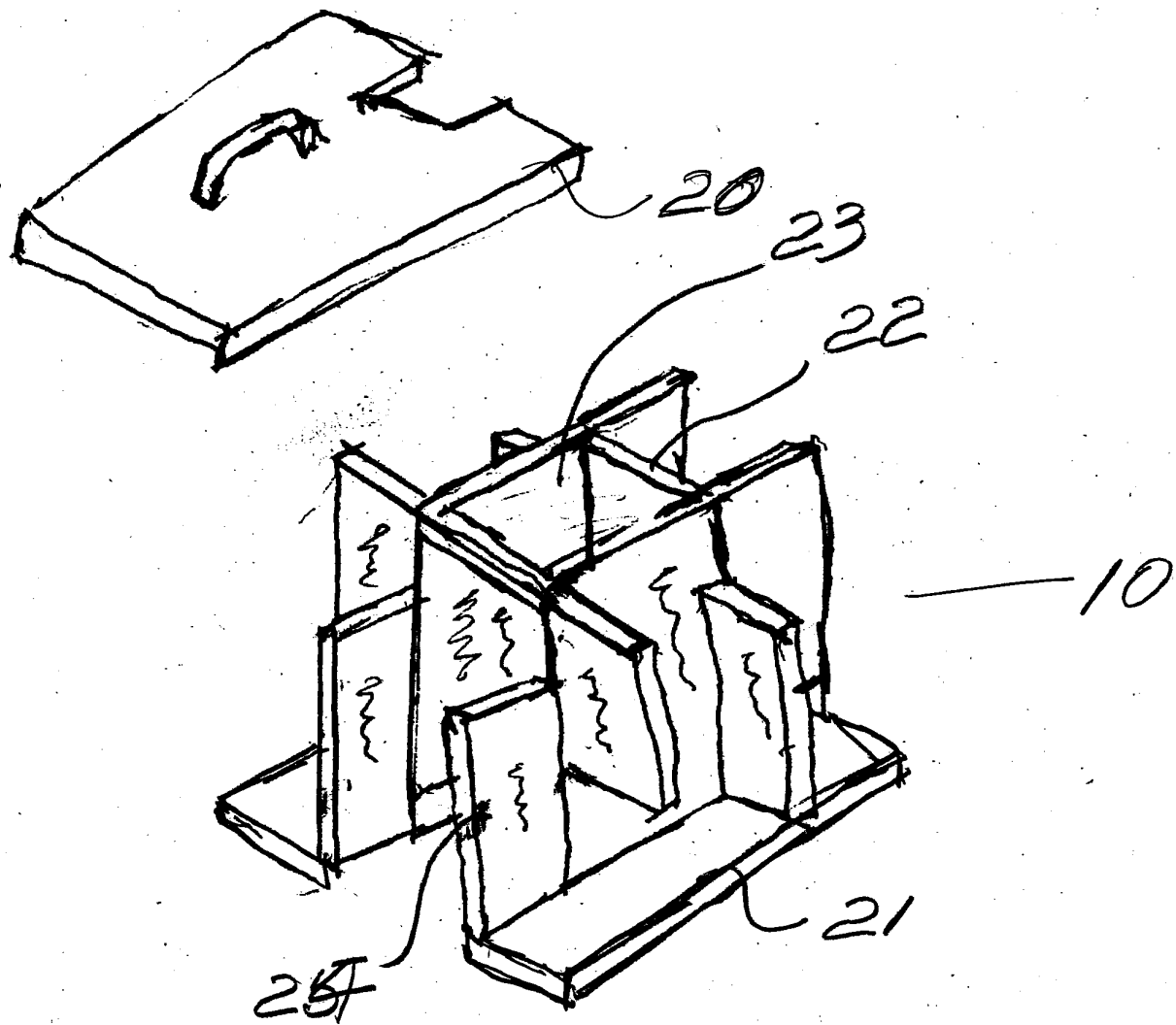


FIG 2

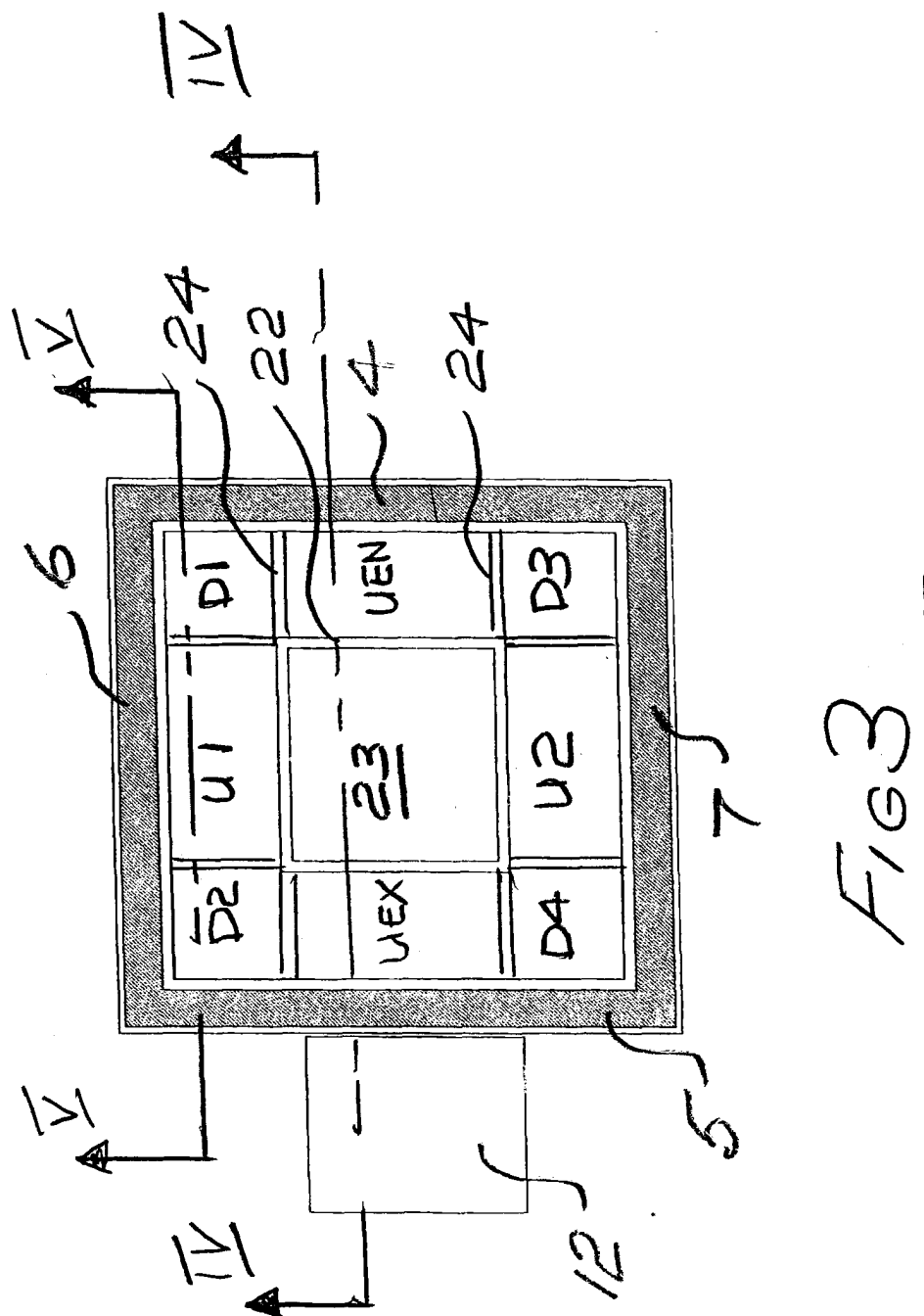
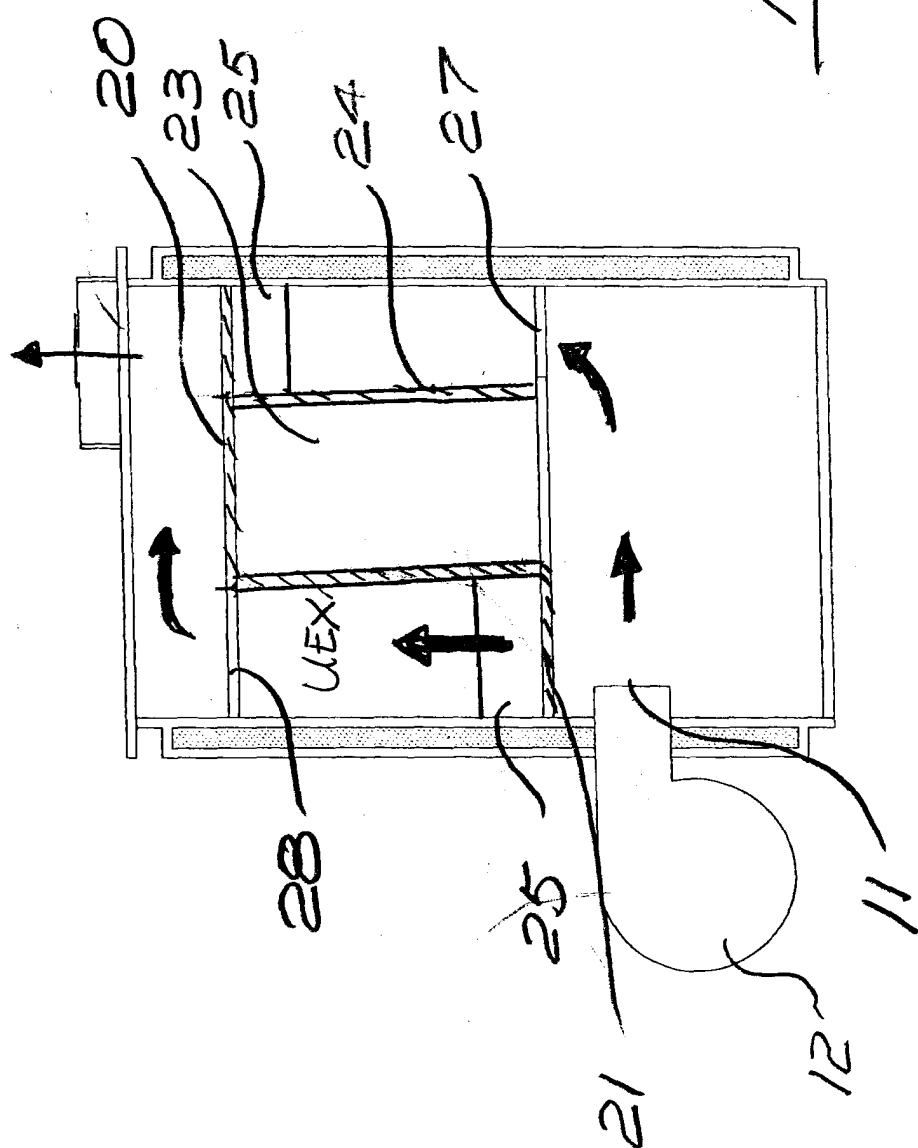
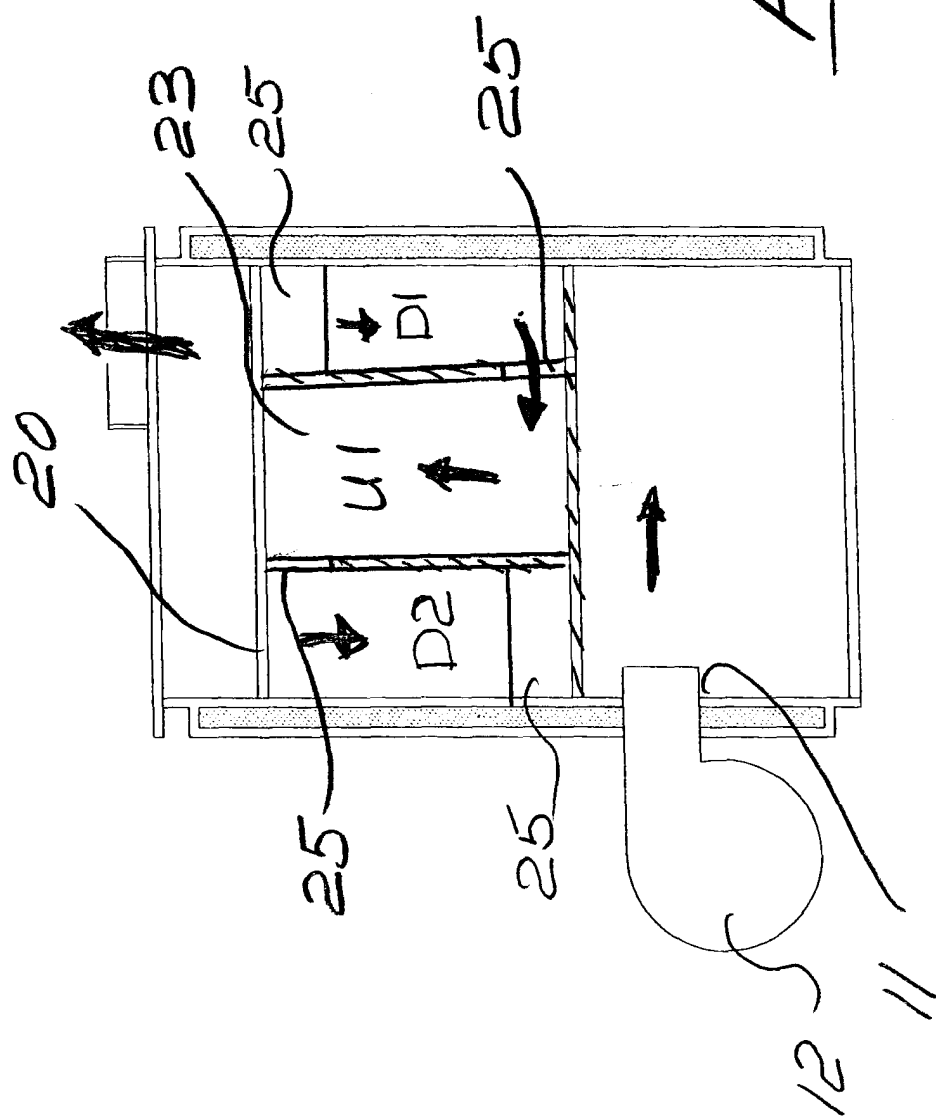
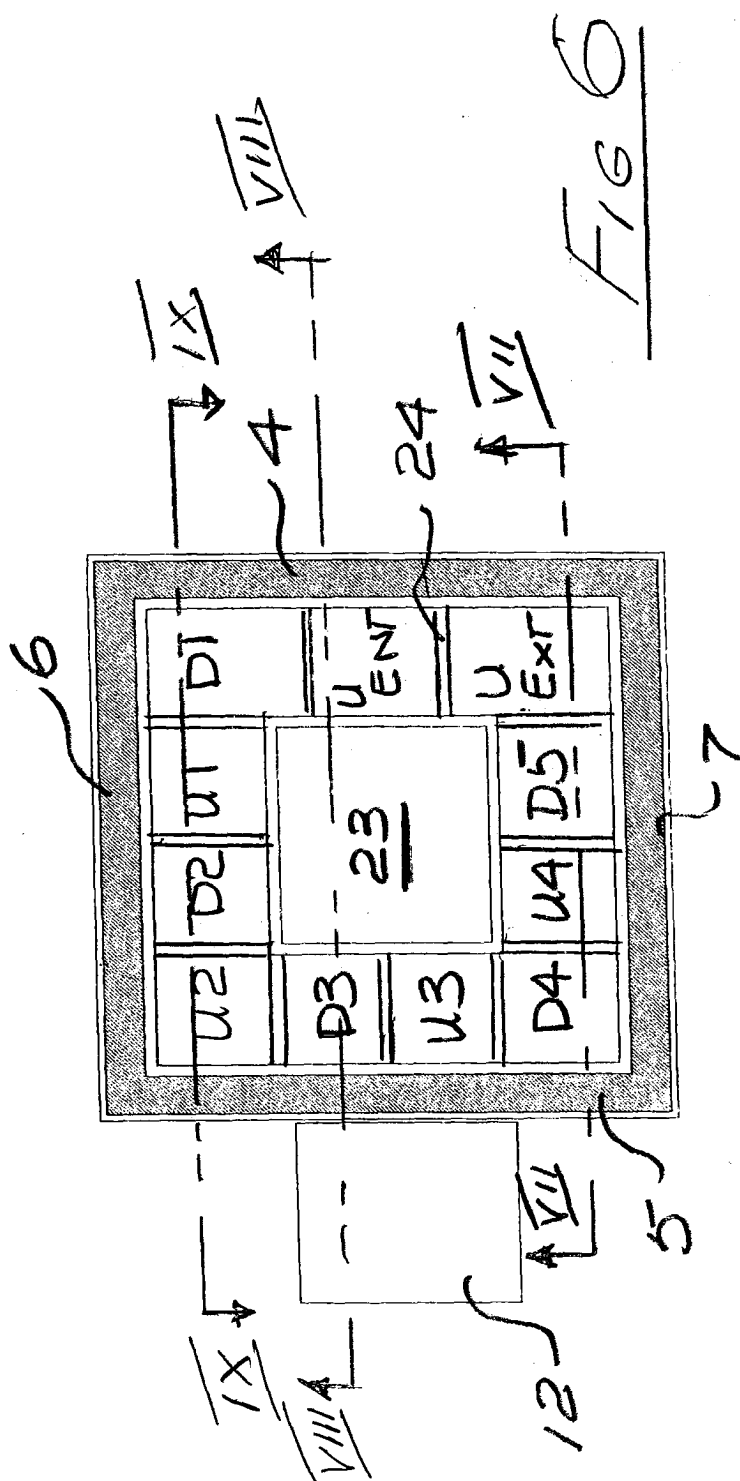


FIG 3







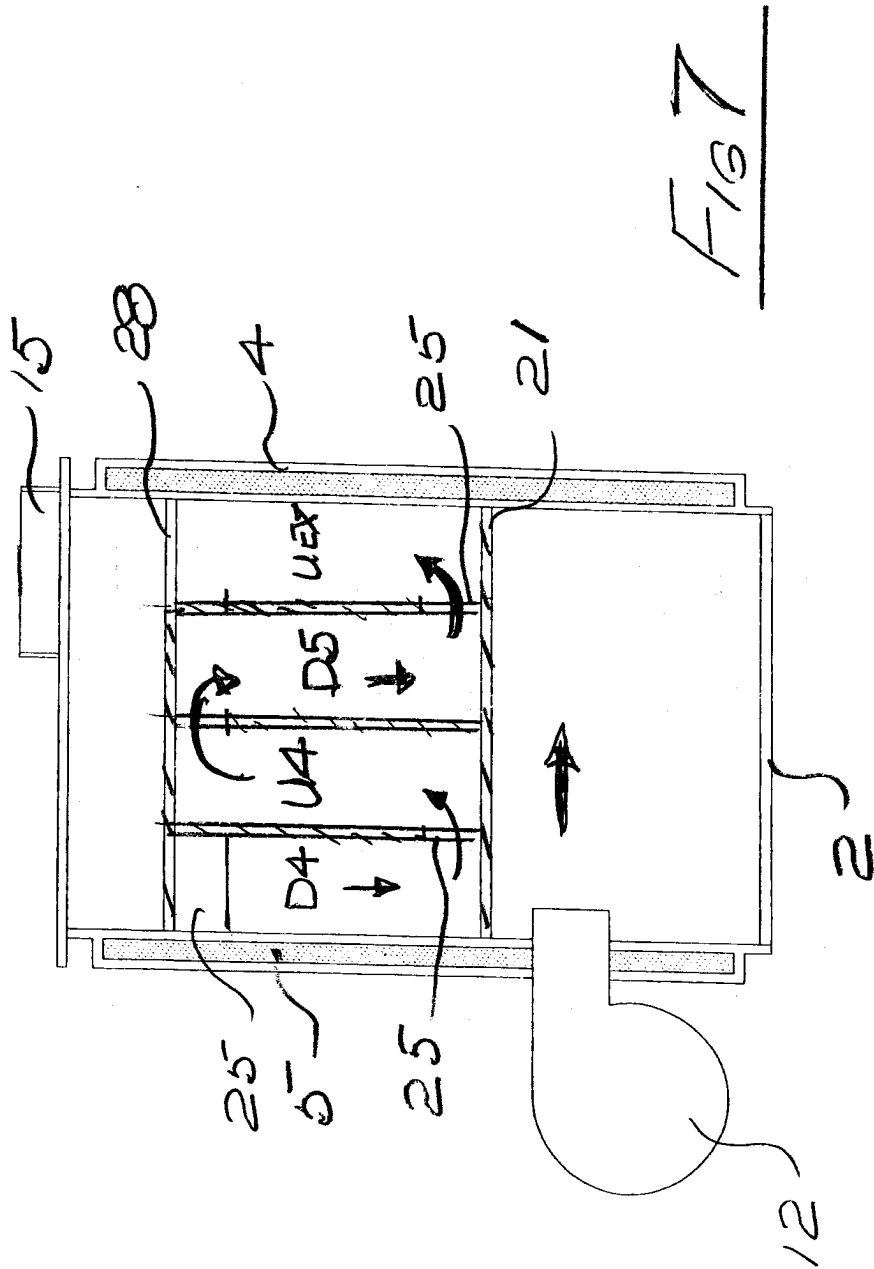


Fig 7

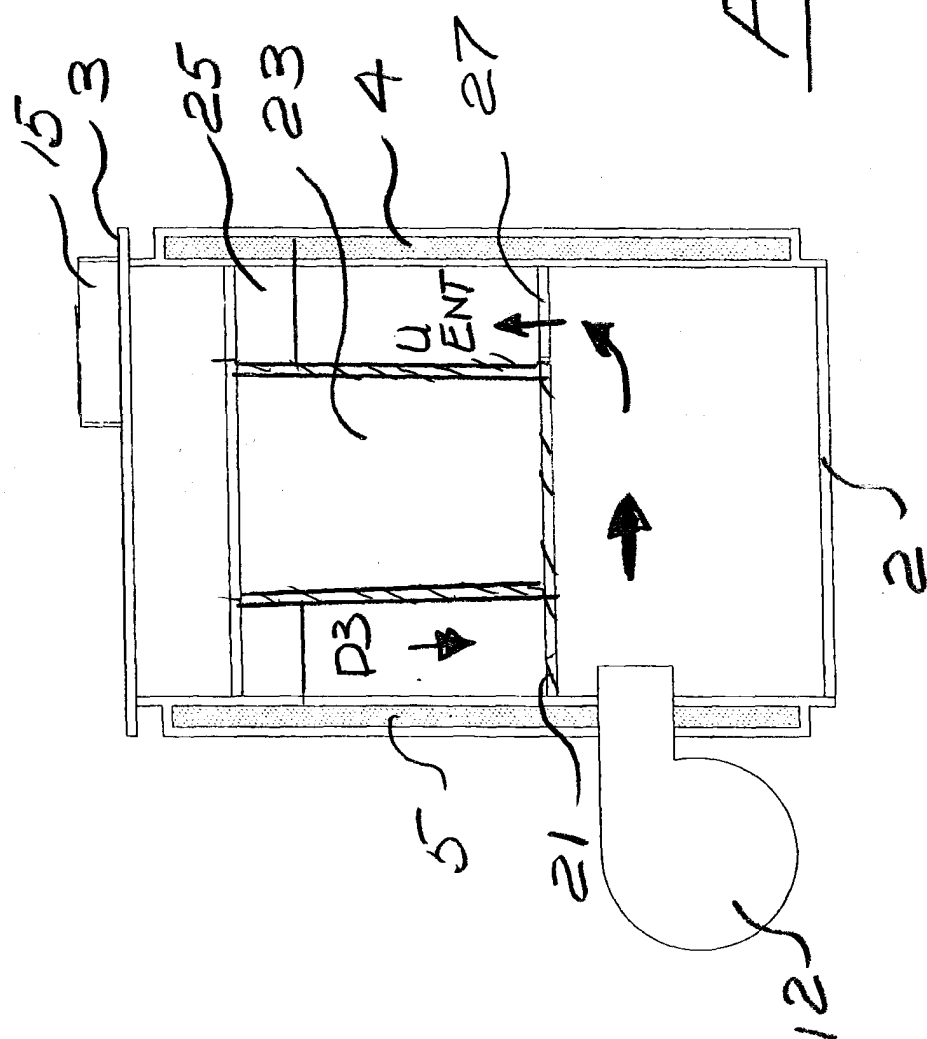
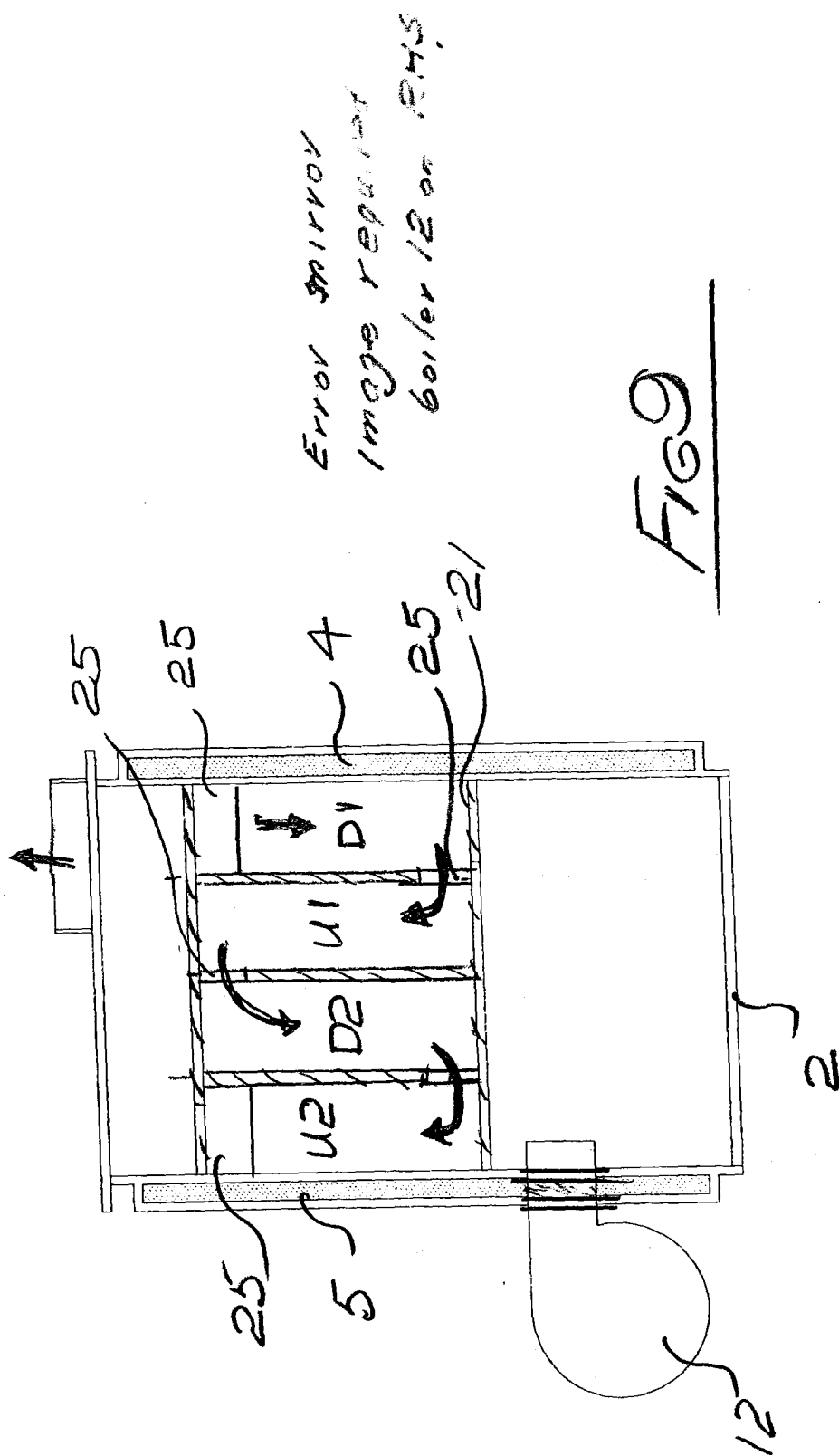
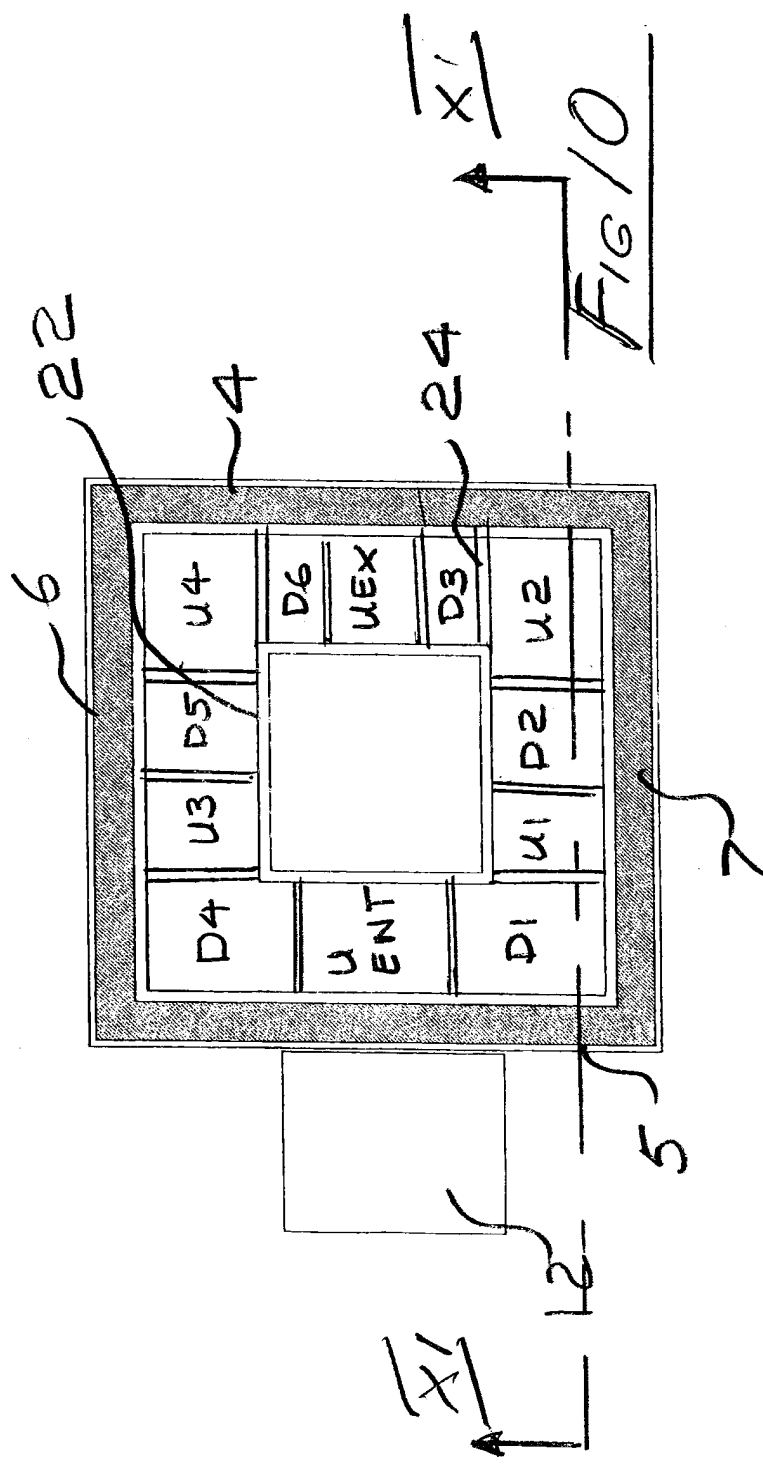
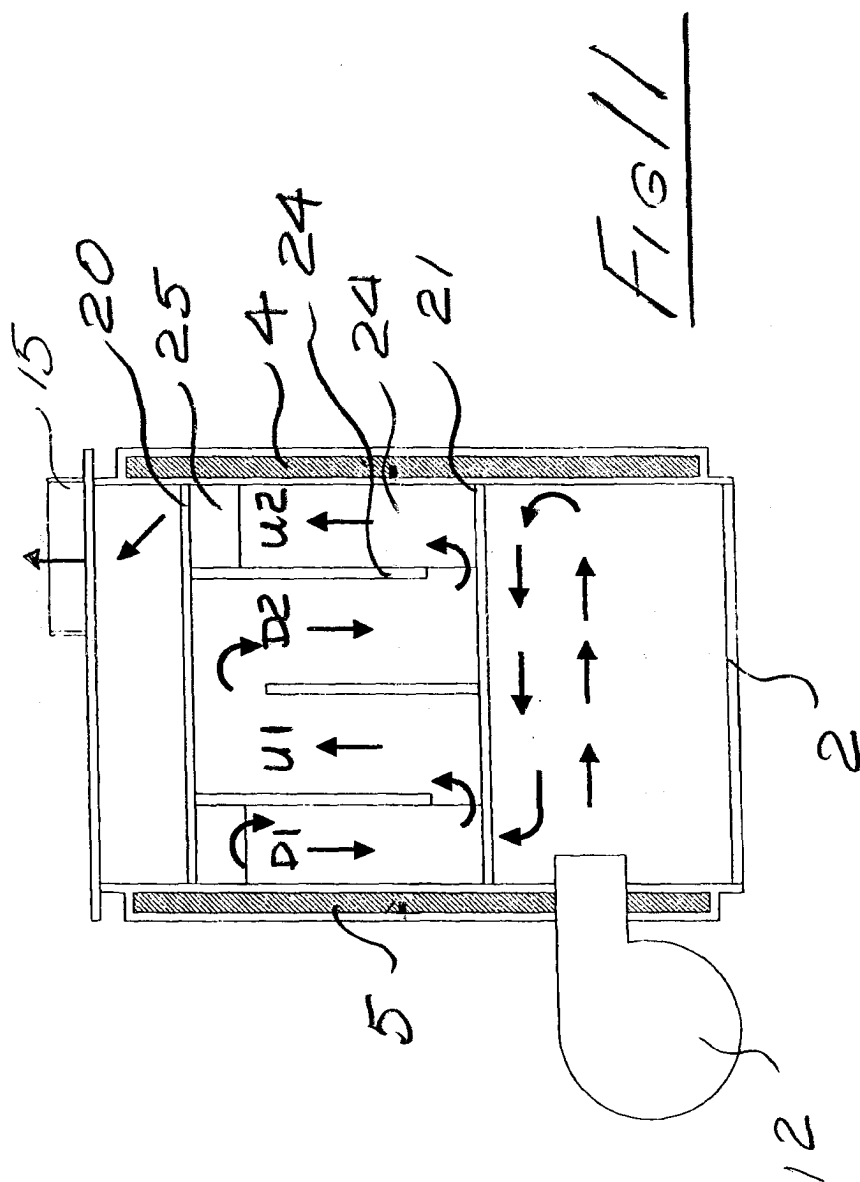


Fig 8



Error mirror
Image repaired
boiler 12 on P.H.S.





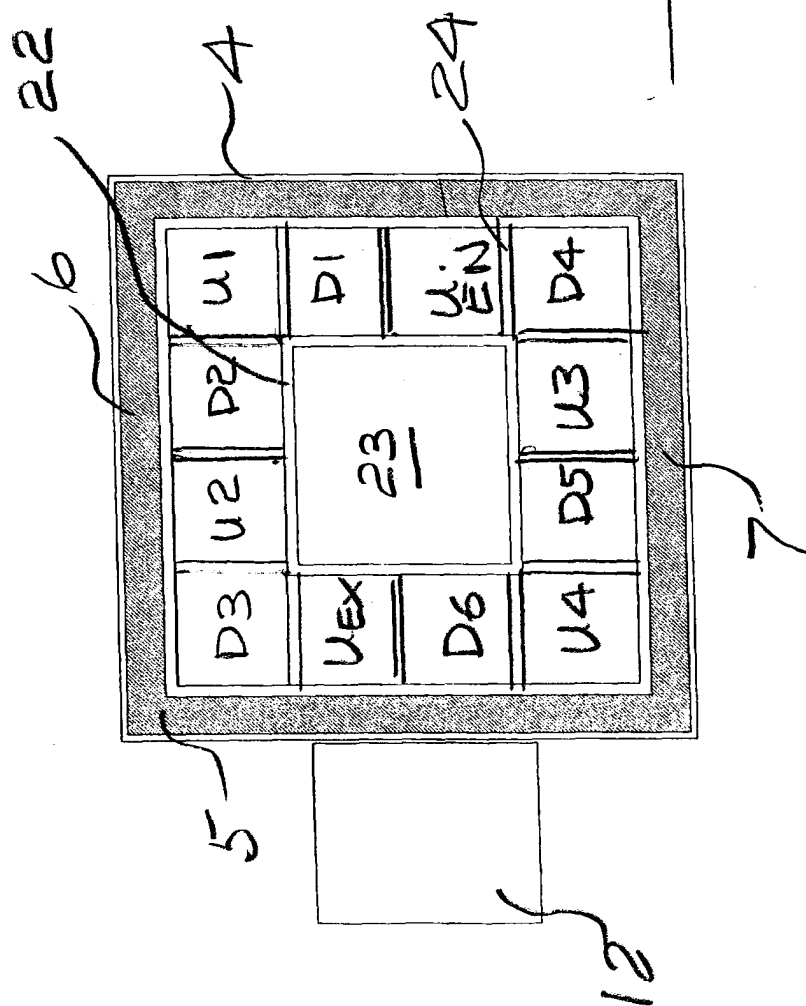
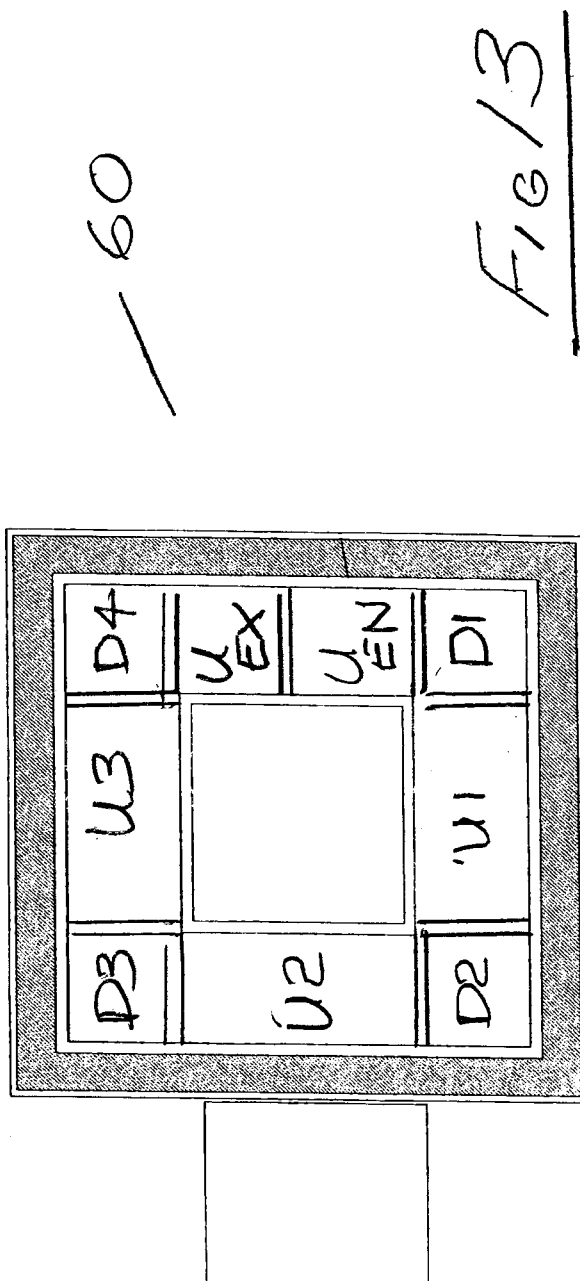


FIG 12



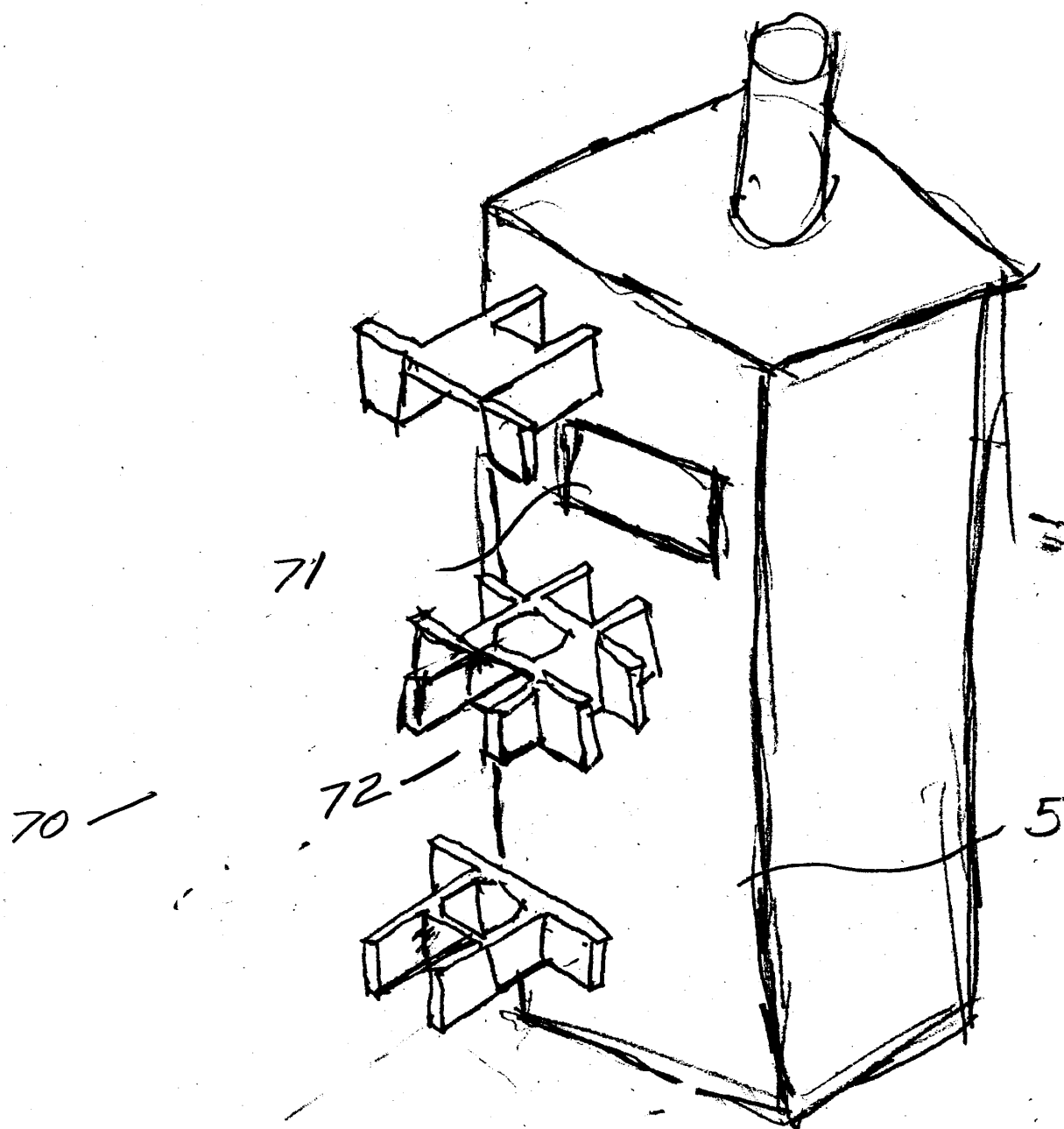


FIG 14

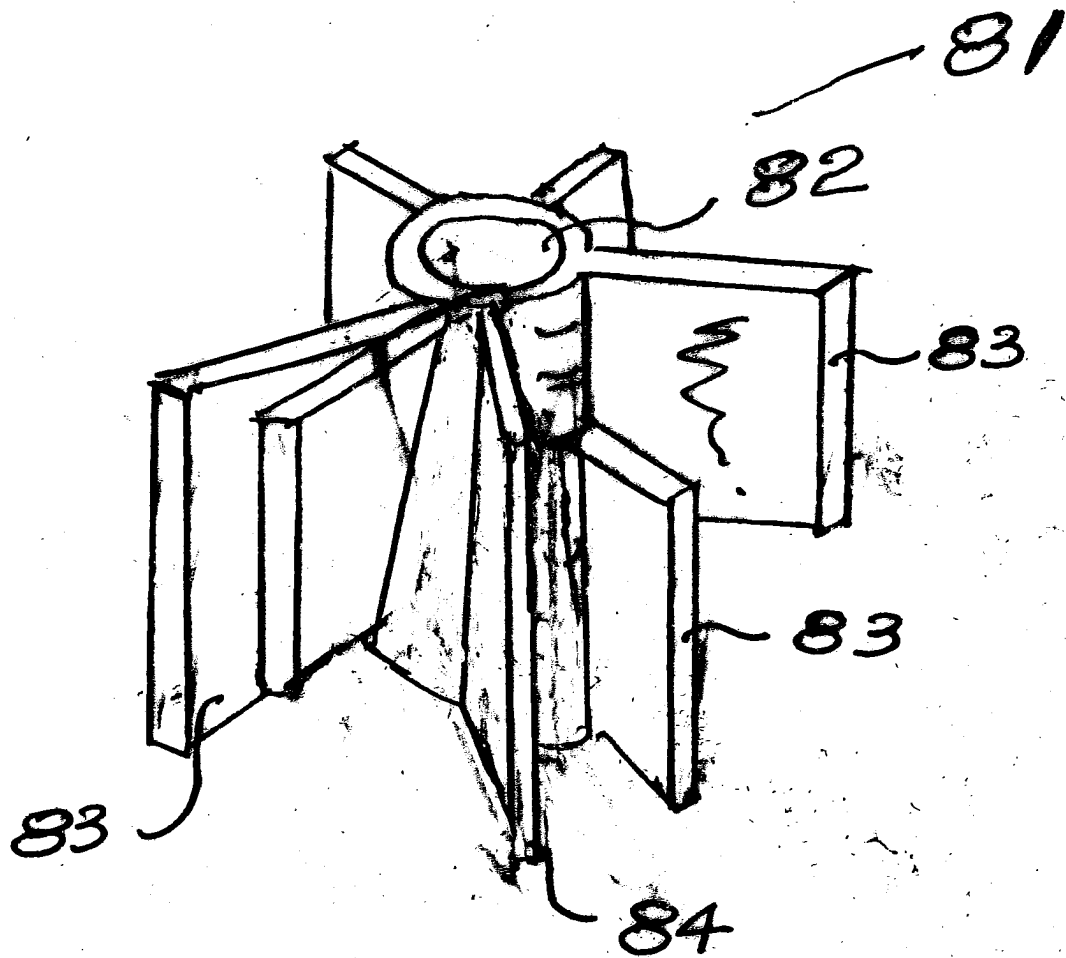
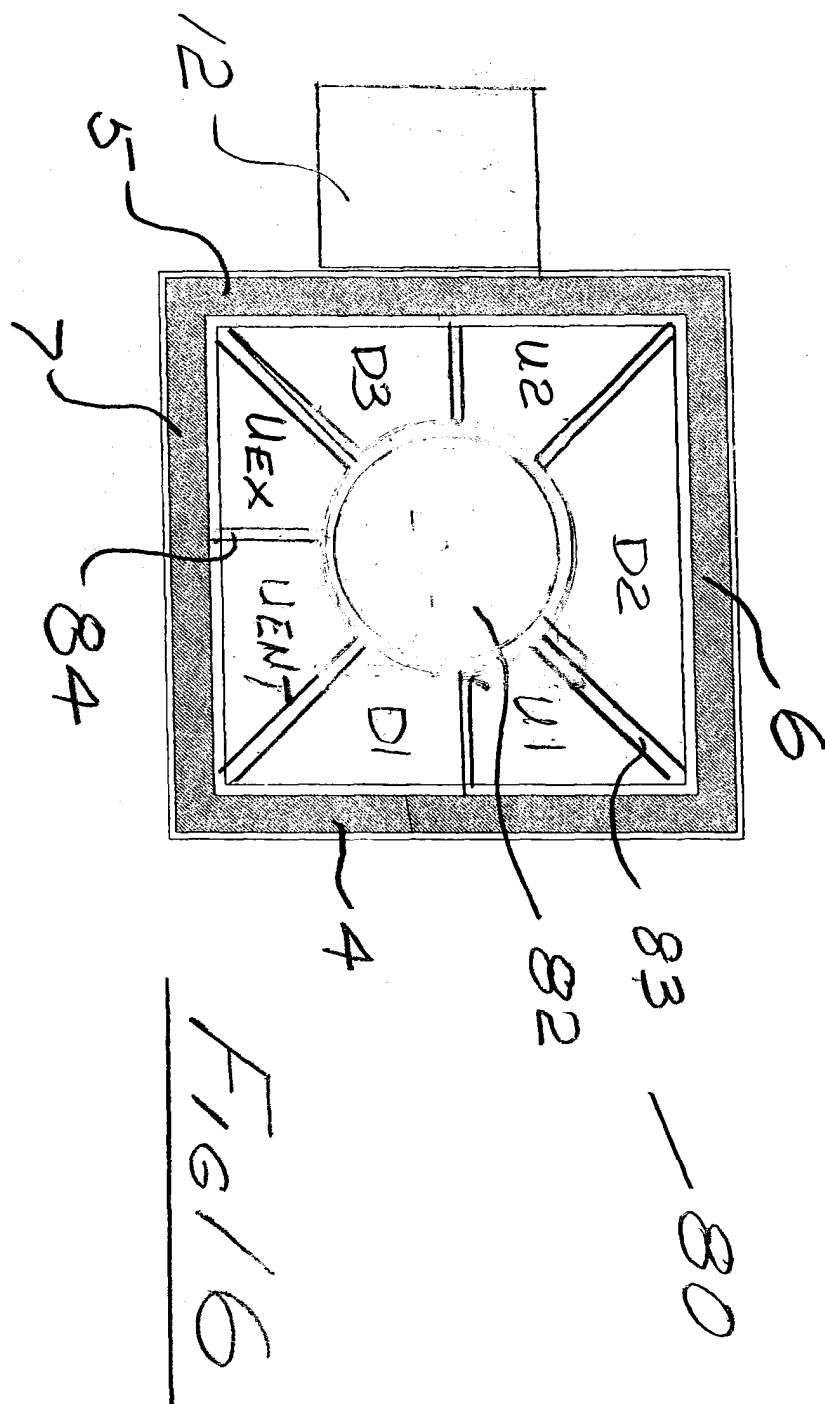
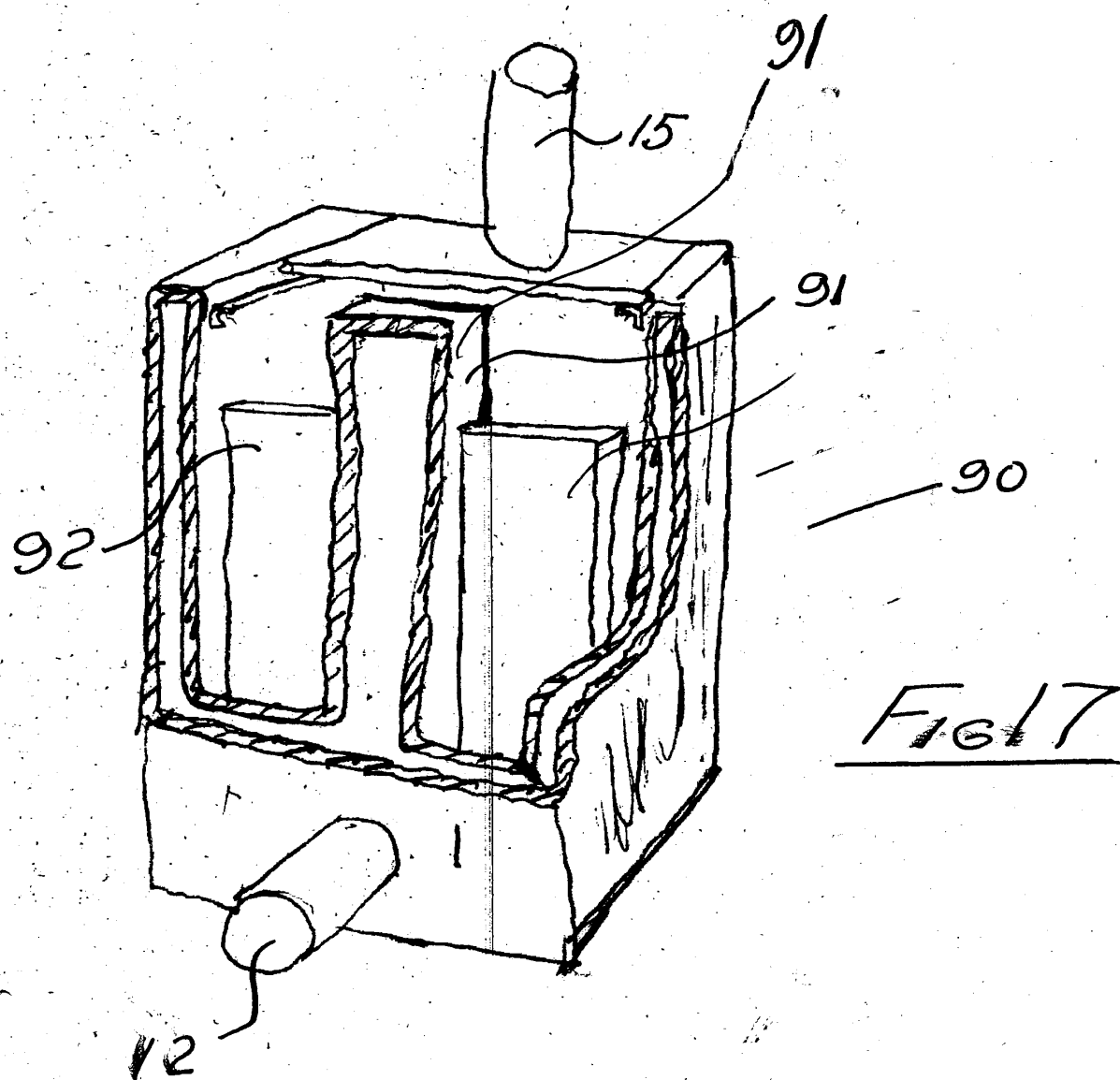
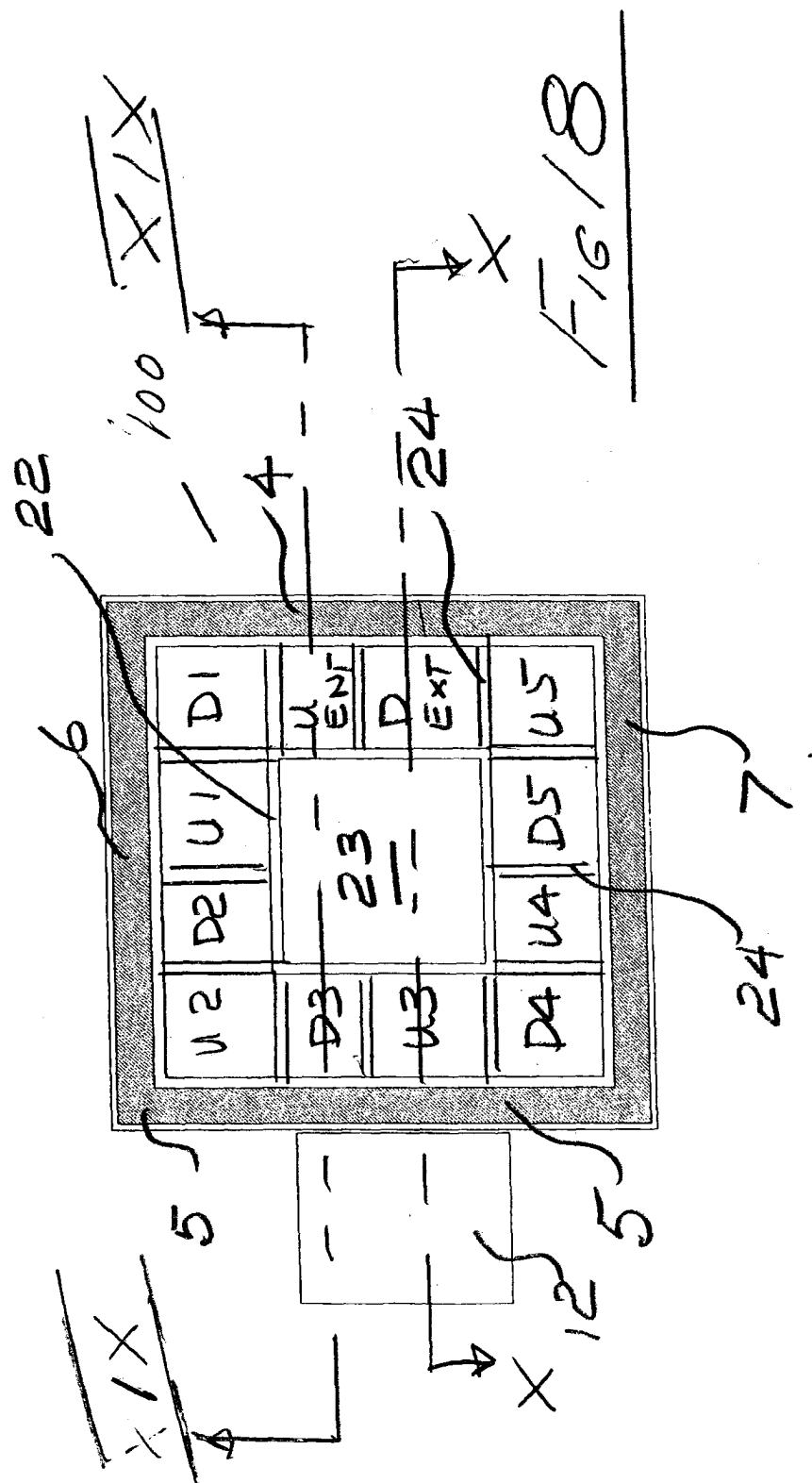
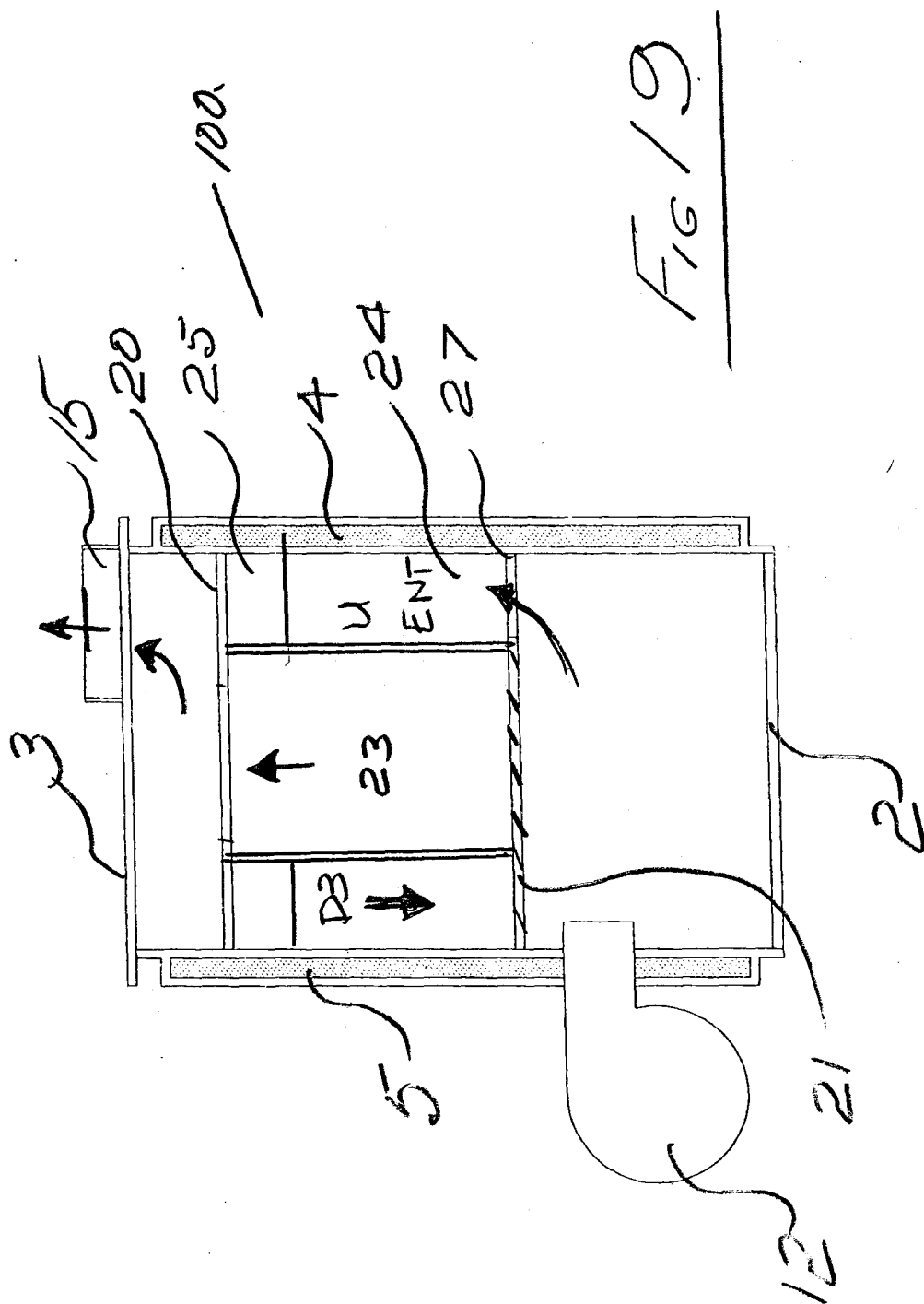


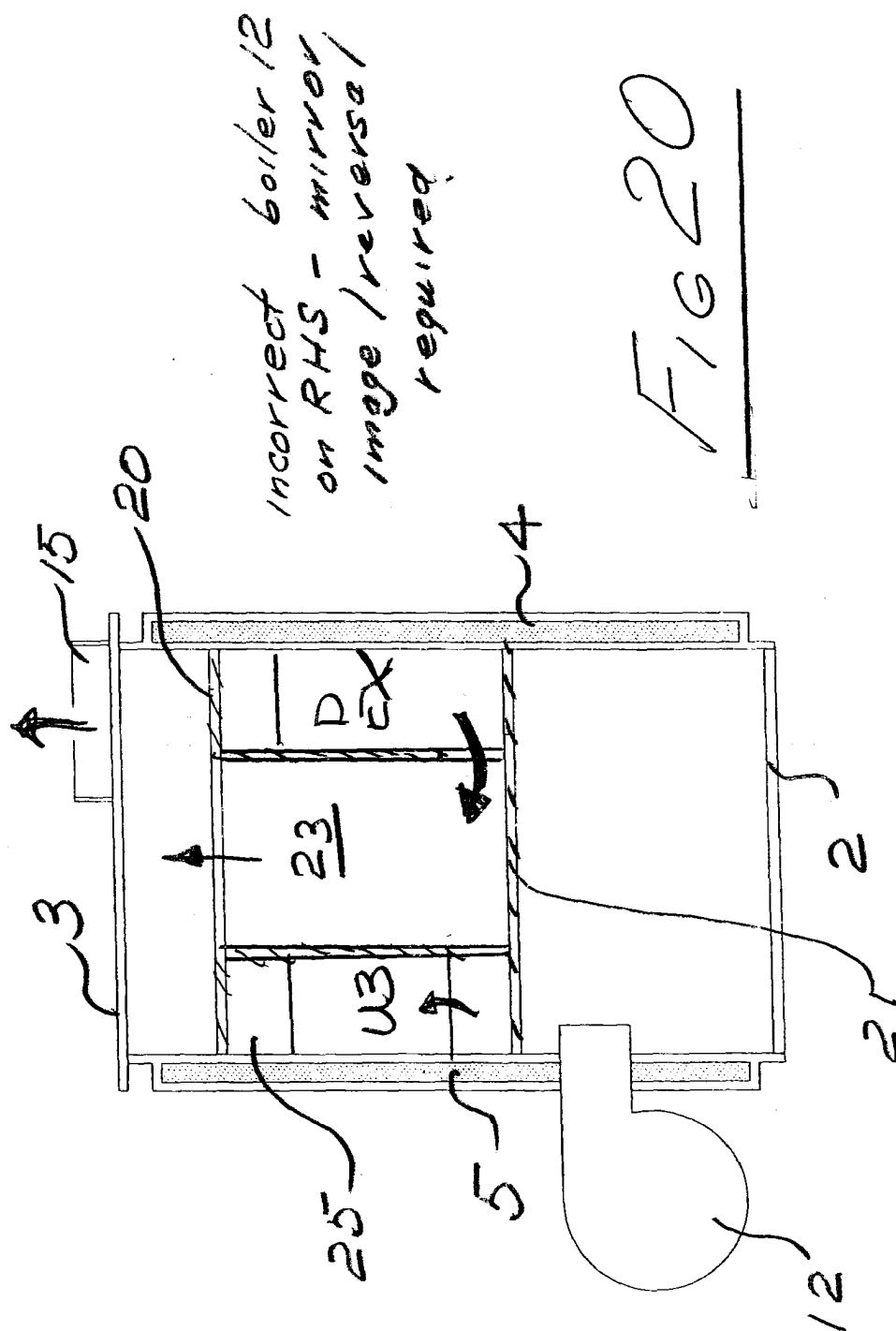
Fig 15











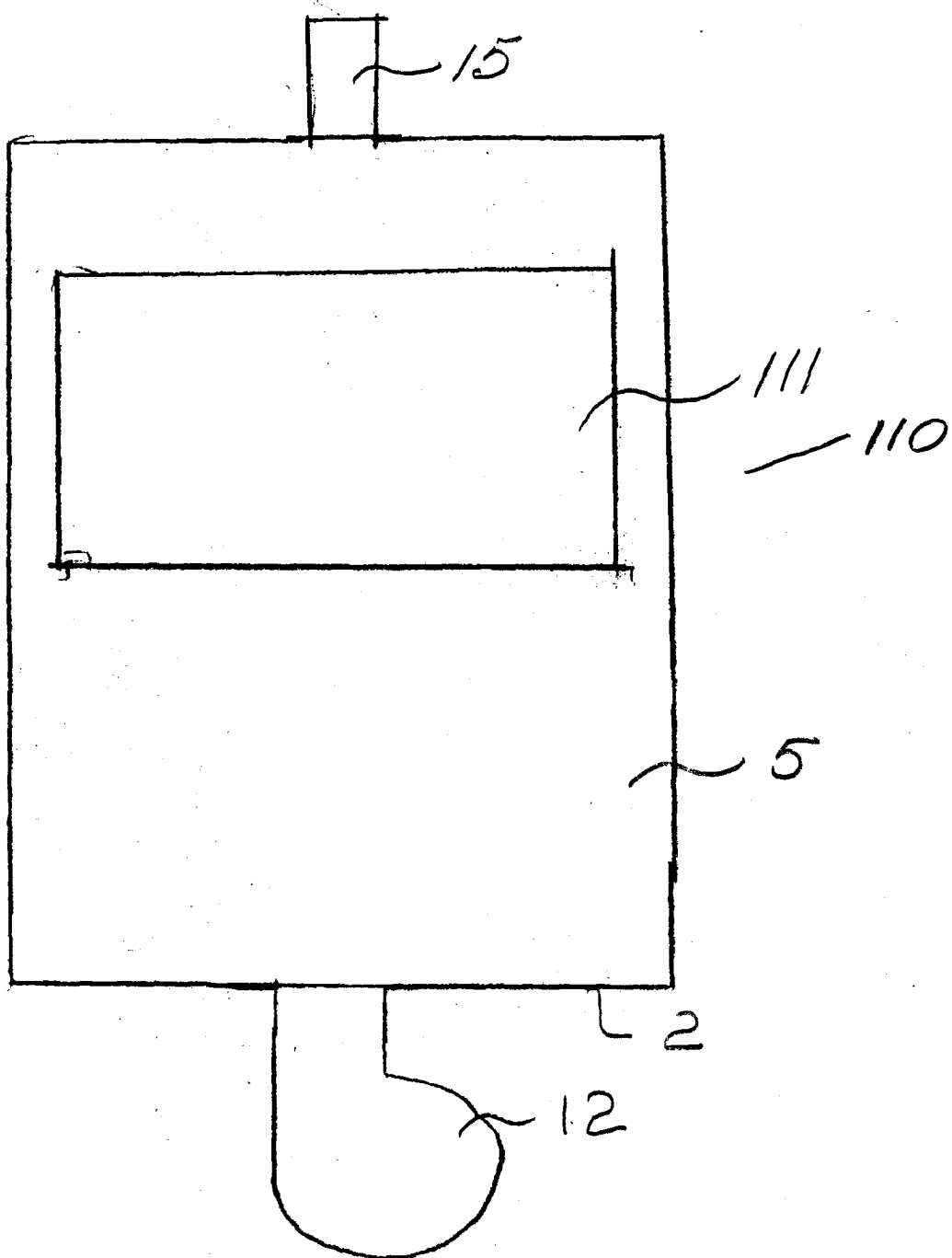


Fig 21

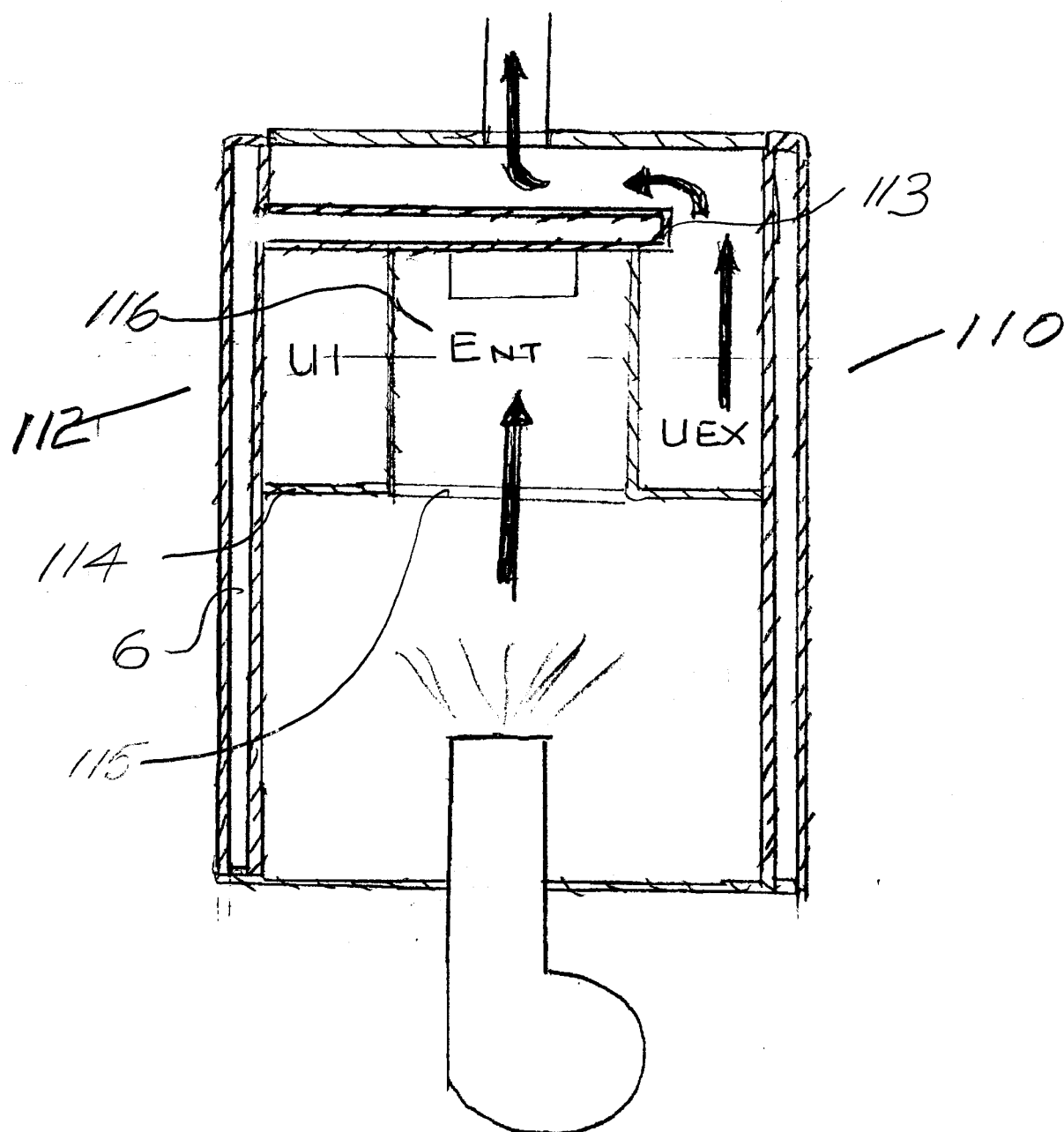
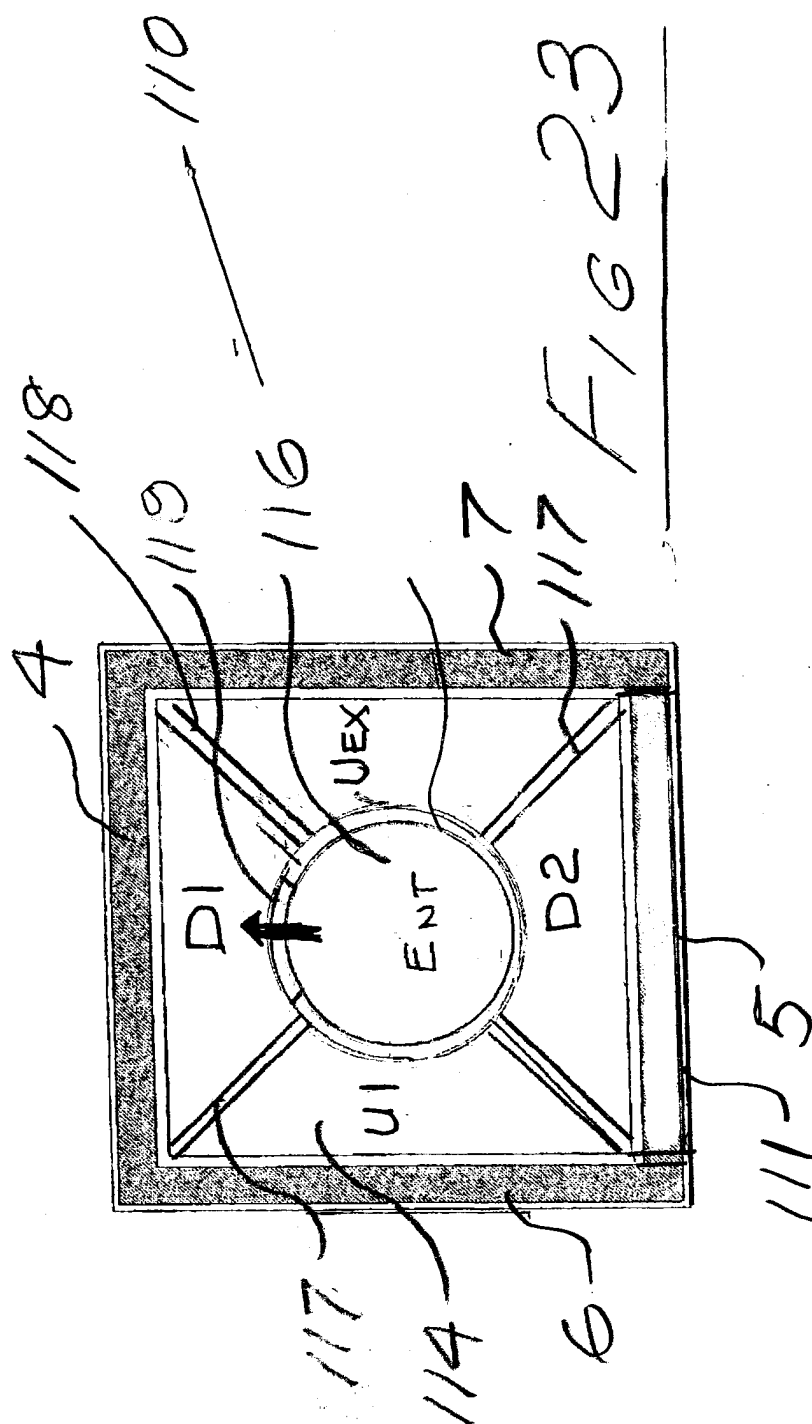


FIG 22



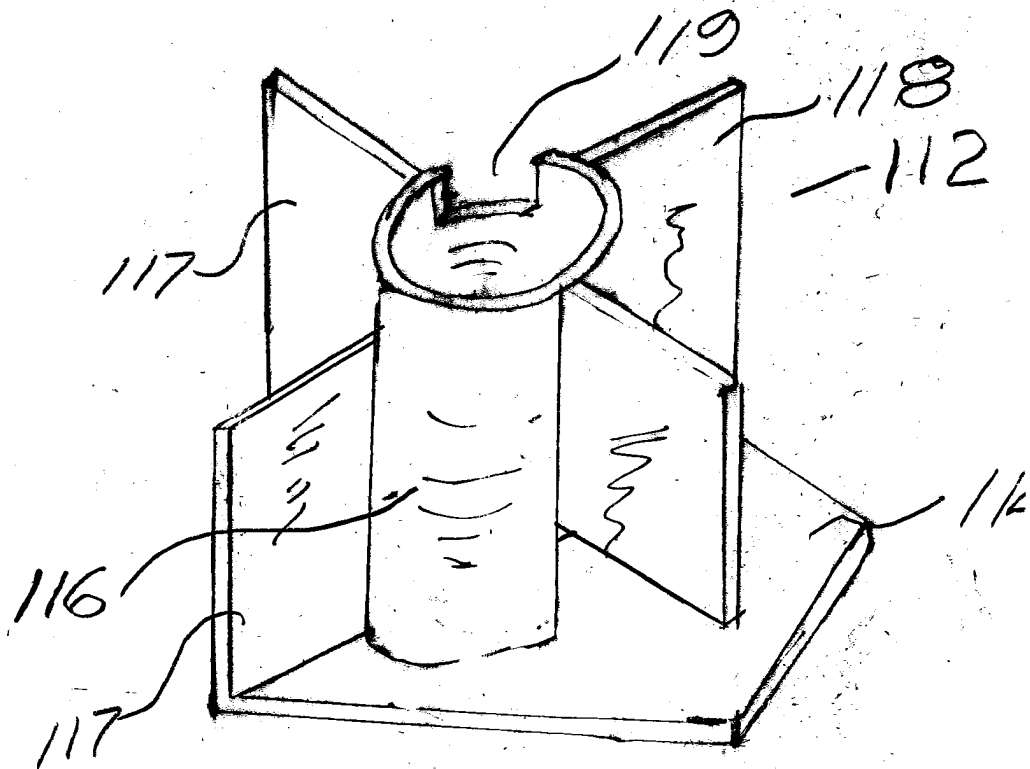
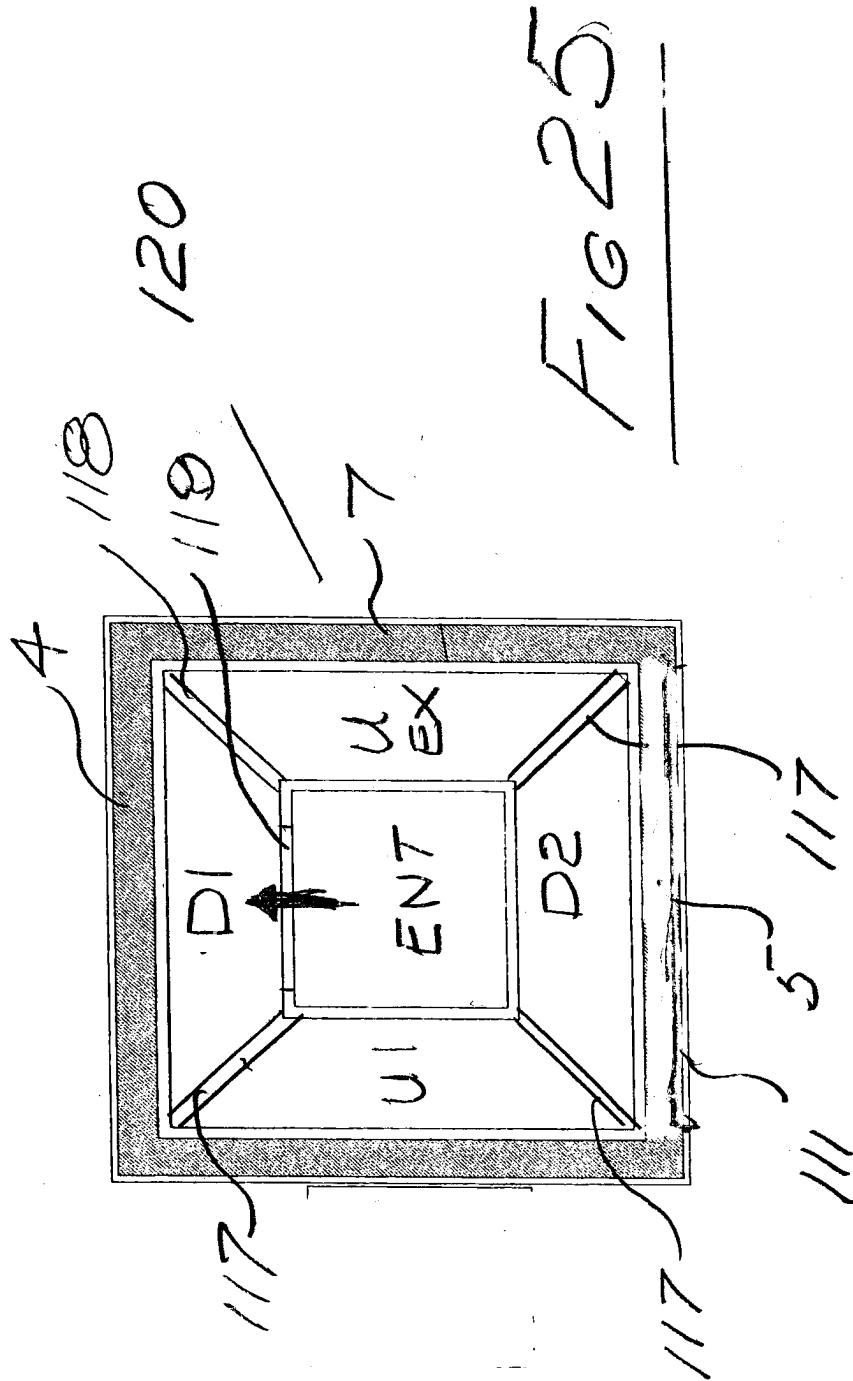


FIG 24





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 65 0113

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.7)
A	GB 2 187 271 A (PUBAVON LTD) 3 September 1987 (1987-09-03) * abstract; figures *	1	F24H1/26 F24H9/00
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F24H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 May 2000	Examiner Van Gestel, H
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09-05-2000

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82