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(54) **A combustion plant including at least one tubular furnace.**

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DE-A- 2 348 909
DE-A- 3 345 611
FR-A- 2 248 470
FR-A- 2 377 005
GB-A- 1 465 310

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Description

The present invention refers to a combustion plant including at least one tubular furnace, having at one end a burner provided with means for receiving gaseous fluid taking part in the combustion, and having its opposite end connected to an after-combustion chamber, by way of a restricted passage.

Such a combustion plant is known from GB-A 1 465 310.

Many industrial exhausts contain environmentally harmful components, for instance hydrocarbons from various solvents. It has been proposed to destruct such gases by combustion, fuel being added to raise the temperature sufficiently. Known apparatus for this purpose are comparatively expensive and complicated, as vast amounts of gas must be heated to about 900°C, which is the temperature required for combustions. Similar plants may be used for the destruction of gases with a low energy content, for instance gases having an annoying odour. Also on these applications additioned fuel will be required, which increases the operating costs.

An aim of the present invention is to propose a simple and efficient combustions plant, which makes possible an energy saving, while handling big gas volumes.

The invention is characterized in the inlet for the gaseous combustion fluid being slotformed, and connected tangentially to the tubular furnace, and in an axially displaceable disc having a centrally located opening surrounding the burner, for dividing the gaseous fluid flow into a primary part to the burner and a secondary part forming a rotating flow within the tubular furnace.

The disc is preferably provided with a funnel-shaped member directed axially into the tubular furnace for initially keeping the primary and the secondary gas flows apart.

The after-combustion chamber preferably has a diameter noticably exceeding that of the tubular furnace, and has, at least at parts of its envelope shell, slots being directed tangentially outwards in the direction of the rotation of the combustion gas flow, the slots communicating with a collecting chamber enclosing the after-combustion chamber.

The after-combustion chamber may communicate with a number of smoke gas tubes, arranged concentrically around the tubular combustion chamber and connected to the burner end, the space surrounding the smoke gas tubes forming part of a water circulating system.

An efficient pre-heating of an obnoxious gas to be burned is obtained if the gas is led in a path around the tubular combustion chamber and then through tubes being parallell to the tubular furnace before it reaches the burner, the combustion products being transferred from the after combustion chamber to a separate heat exchanger of the condensing type.

A very compact and efficient plant is obtained if the after-combustion chamber is common for two aligned combustion tubes directed towards each other, and arranged so the combustion gases entering the chamber rotate in the same direction.

Some embodiments of the invention will below be described with reference to the accompanying drawings, in which

Figure 1 shows a longitudinal section through a boiler having a combustion plant according to a first embodiment of the invention,

Figure 2 on a larger scale shows the burner end of the furnace,

Figure 3 shows a longitudinal section through a second embodiment of the invention,

Figure 4 shows an end view of the plant according to Figure 3, as seen in the direction of the arrows IV - IV,

Figure 5 shows a section along line V -V in Figure 3, and

Figure 6 shows a third embodiment of the invention.

The boiler shown in the drawing has an elongate, tubular furnace 10, at one end of which a burner 11 is mounted. The opposite end of the furnace communicates by way of a restricted passage 12 with an after-combustion chamber 13. A number of gas passage tubes 14 run parallell to the furnace tube and com municate in the embodiments according to Figure 1 and 3 with a collecting chamber 15, adjacent to the burner. A water shell 16 encloses in these embodiments the tubular furnace 10, the after-combustion chamber 13 and the smoke gas tubes 14. The water shell is in a conventional manner encased in insulations 17. The combustion gases are exhausted through a conduit 18. Water is supplied to the shell 16 by way of a conduit 19, and leaves the shell by a conduit 20.

The boiler structure so far described is of a known design and ensures a high degree of efficiency, when it is provided with a conventional oil burner.

The design has now been modified according to the invention in order to ensure a controlled combustion at a higher temperature. This is obtained by pressurized gas being supplied to the furnace 10 by means of a fan 21 (see Fig. 4) through a slot-formed inlet 22, merging tangentially into the tubular furnace. The gas inlet 22 is subdivided into a primary part 22a and a secondary part 22b, by means of a displaceable disc 23. This is provided with a central opening 23a, in which the nozzle 11 of the burner is fitted. A funnel-shaped member 24, co-axial with the burner nozzle projects into the furnace tube, and keeps initially the primary and the secondary gas flows apart.

The disc 23 is displaceable from outside the burner by means of an adjusting screw 25, passing through the end wall 26 of the furnace tube. When the disc is displaced inwards, the primary part of the inlet 22 is increased, while simultaneously the secondary part is reduced. This arrangement ensures a full dynamic effect, independent of the occasional degree of distribution, as compared with conventional designs where either part-flow is throttled.

The primary gas will flow in the same direction as the jet of fuel issued by the burner nozzle. Its content of oxygen will maintain combustion in a long, narrow flame, the highest temperature being obtained at the end of the flame.

The secondary gas flow will follow the shell of the tubu lar furnace 10 and will rotate vertically towards the restricted passage 12. As the secondary gas is comparatively colder than the primary gas being heated by the flame, it will have a higher density and will thus, to a higher degree, be affected by the centrifugal force. The mixing of the secondary gas with the flame will be deferred, substantially until the gases reach the restricted passage 12. There the secondary gas will be mixed with the hot combustion products, and a final combustion occurs at high temperature in chamber 13.

In a conventional plant the gas supplied to the burner is air. In a gas-destruction plant the contaminated gas, possibly mixed with air, is handled by the fan, and the amount of fuel supplied through the burner will be determined with respect to the amount of combustible matter carried by the gas.

The rotating secondary gas flow will efficiently catch drops of oil or solid particles from the flame, so they will not be coked upon the hot furnace tube.

The plant shown in Figure 3 contains two complete furnaces 10, directed axially towards each other, and having a common after-combustion chamber 13. The inlets for the combustion gas are arranged in such a manner that the gas flows, looking from one end of the plant, will rotate in opposite directions. When the gas flows enter the after combustion chamber 13, they will, however, rotate in the same direction. The forceful rotation in this chamber may be used for separating out particles of soot or other solid combustion products. To that end the shell 27 of the after-combustion chamber 13 is provided with slots 28, which are directed tangentially outwards in the direction of rotation of the gases. The slots may be located at portion of the shell surface only, the portion being enclosed by a collecting wall 27a.

The gases of combustion have a temperature of about 900°C, and thus a low density. The solid particles will be forced outwards against the collecting wall 27a, after having passed the slots 28, while the combustion gases will flow out through the smoke tubes 14. Figure 5 shows a pocket 29 for collecting the particles, which will be removed by means of a fan 30. The invention may advantageously be used for the combustion of byproducts from the cellulose pulp production.

Figure 6 shows a further modification which ensures a high degree of preheating of the combustion gas, which may be exhausts from spray booths of the car industry.

Whenever applicable the same reference numerals are used. The tubular furnace 10 is not water-cooled, but the tubes 14a surrounding the furnace are externally swept by the incoming gases.

The gas is supplied under pressure through a conduit 30. The space enclosing the furnace 10 and the tubes 14a is subdivided by a number of baffle plates 31, provided with suitably located openings, so the gas entering by way of conduit 30 will pass in a more or less helical path around the tubes to a turning chamber 32, from which the gases pass to the fan 21 by way of conduit 32a. The gases leaving the furnace tube 10 by way of the restriction 12 rotatate in chamber 13, where possible particles are separated, whereupon the gas flows through the tubes 14a back towards a collecting chamber 33. The flow of the incoming gas outside the tubes 14a will ensure a high degree of pre-heating, which facilitates the following combustion.

In a conventional destruction plant you may have to add fuel for raising the temperature of the gas at, say 50°C to 750°C, i.e. an addition corresponding to 700°C. In a plant according to Figure 6 you can raise the gas temperature, before the burner to about 500°C, which means that the added fuel will have to cover a rise in temperature of a further 250°C, i.e. about one third of the conventional need.

The combustion gases leaving the collecting chamber 33 are conveyed to a heat exchanger 34 of the condensing type by way of a conduit 33a. The heat reclaimed may be used for heating water which enters through pipe 35 and leaves the heat exchanger by way of pipe 36. Condensate is drained by way of pipe 37.

The disc 23 is operated by a manual control means 25, but an automatic governing device can evidently be used. This may be guided by signals from some temperature sensor, for instance located in the after-combustion chamber 13. The tubular furnace 10 may in certain applications be mounted vertically.

In the case of a vertical steam boiler the tubular furnace will have to pass first a gas collecting or turning chamber, and then the steam room before its outside will be cooled the water in the drum part.

The rotating secondary air flow will form a film along the inner wall of the furnace tube ensuring an efficient cooling of the upper part thereof. During a start-up, when there is no steam in the upper part of the drum, the disk 23 makes possible an easy adjustment of the air flow relationship betwen primary and secondary air. A small amount of primary air and a corresponding fuel supply results in a low flame temperature, while the proportionally much bigger secondary air ensures satisfactory cooling. As steam is generated the proportions are changed and the flame temperature increases.

Claims

1. A combustion plant including at least one tubular furnace (10), having at one end a burner (11) provided with means for receiving gaseous fluid taking part in the combustion, and having its opposite end connected to an after-combustion chamber (13), by way of a restricted passage (12), **characterized in** the inlet (22) for the gaseous combustion fluid being slotformed, and connected tangentially to the tubular furnace (10), and in an axially displaceable disc (23) having a centrally located opening (23a) surrounding the burner (11), for dividing the gaseous fluid flow into a primary part to the burner and a sec-

ondary part forming a rotating flow within the tubular furnace.

2. A combustion plant according to claim 1, **characterized in** the disc (23) being provided with a funnel-shaped member (24) directed axially into the tubular furnace (10) for initially keeping the primary and the secondary gas flows apart.

3. A combustion plant according to either of claims 1 or 2, **characterized in** the after-combustion chamber (13) having a diameter noticeably exceeding that of the tubular furnace (10), and having at least at parts of its envelope shell (27), slots (28) being directed tangentially outwards in the direction of the rotation of the combustion gas flow, the slots (28) communicating with a collecting chamber (29) enclosing the after-combustion chamber.

4. A combustion plant according to any of the preceeding claims, **characterized in** the after-combustion chamber (13) communicating with a number of smoke gas tubes (14), arranged concentrically around the tubular combustion chamber (10) and connected to a collecting chamber (15) adjacent to the burner end, the space surrounding the smoke gas tubes (14) forming part of a water circulating system (19, 20).

5. A combustion plant according to any of claims 1-3, **characterized in** the gaseous fluid being led in a path around the tubular combustion chamber and then through tubes (14a) being parallel to the tubular furnace (10) before it reaches the burner (11), the combustion products being transferred from the after-combustion chamber (13) to a separate heat exchanger (34) of the condensing type.

6. A combustion plant according to any of the preceeding claims, **characterized in** the after-combustion chamber (13) being common for two aligned combustion tubes (10) directed towards each other, and arranged so the combustion gases entering the chamber (13) rotate in the same direction.

Patentansprüche

1. Verbrennungsanlage mit mindestens einer rohrförmigen Verbrennungkammer (10), die einen mit einer Einrichtung zur Aufnahme von an der Verbrennung teilnehmenden gasförmigen Fluid versehenen Brenner (11) aufweist und mit ihrem gegenüberliegenden Ende über einem verengten Durchgang an einer Nachverbrennungskammer (13) liegt, dadurch gekennzeichnet, daß der Einlaß (22) für das gasförmige Brennfluid schlitzförmig ausgebildet ist sowie tangential an der rohrförmigen Verbrennungskammer (10) liegt und daß eine axial verschiebbare Scheibe (23) mit einer den Brenner umgebenden mittig angeordneten Öffnung (23a) zum Teilen des gasförmigen Fluidstroms in einen ersten zum Brenner gehenden Teil sowie einen zweiten Teil vorgesehen ist, der einen drehenden Stromfluß innerhalb der rohrförmigen Brennkammer bildet.

2. Verbrennungsanlage nach Anspruch 1, dadurch gekennzeichnet, daß die Scheibe (23) mit einem trichterförmigen Teil (24) versehen ist, das axial in die rohrförmige Verbrennungskammer (10) zum anfänglichen Auseinanderhalten des ersten und zweiten Gasstromflusses gerichtet ist.

3. Verbrennungsanlage nach einem der vorhergehenden Ansprüche 1 oder 2, dadurch gekennzeichnet, daß die Nachverbrennungskammer (13) einen Durchmesser, der größer ist als der der rohrförmigen Verbrennungskammer (10), und zumindest an Teilen des umhüllenden Mantels (27) Schlitze (28), die tangential nach außen in Richtung der Rotation des Brenngas-Stromflusses weisen und mit einer die Nachverbrennungskammer einschließenden Sammelkammer (29) in Verbindung stehen.

4. Verbrennungsanlage nach einem der vorhergehenden Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Nachverbrennungskammer (13) mit mehreren Rauchgasrohren (14) in Verbindung steht, die konzentrisch um die rohrförmige Verbrennungskammer (10) angeordnet und mit einer angrenzend an das Brennerende liegenden Sammelkammer (16) verbunden sind, wobei der die Rauchgasrohre (14) umgebende Raum Teil eines Wasserumlaufsystems (19, 20) bildet.

5. Verbrennungsanlage nach einem der vorhergehenden Ansprüche 1 bis 4, dadurch gekennzeichnet, daß das gasförmige Fluid in einer Bahn um die rohrförmige Verbrennungskammer und hiernach durch die Rohre (14a) geführt wird, die zur rohrförmigen Verbrennungskammer (10) parallel verlaufen, bevor es den Brenner (11) erreicht, wobei die Verbrennungsprodukte von der Nachverbrennungskammer (13) zu einem getrennten Kondensation-Wärmetauscher (34) überführt werden.

6. Verbrennungsanlage nach einem der vorhergehenden Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Nachverbrennungskammer (13) zwei ausgerichteten, zu einander hin weisenden Verbrennungsrohren (10) gemeinsam und dabei so angeordnet ist, daß die in die Kammer (13) eintretenden Verbrennungsgase in derselben Richtung rotieren.

Revendications

1. Installation de combustion comprenant au moins un four tubulaire (10), ayant, à une première extrémité, un brûleur (11) muni d'un dispositif destiné à recevoir un fluide gazeux participant à la combustion, et dont l'extrémité opposée est raccordée à une chambre de combustion postérieure (13) par un passage rétréci (12), caractérisée en ce que l'entrée (22) du fluide gazeux de combustion a la forme de fentes et est connectée tangentiellement au four tubulaire (10), et un disque mobile axialement (23) a une ouverture centrale (23a) qui entoure le brûleur (11) afin qu'il divise le courant de fluide gazeux en une partie primaire destinée au brûleur et une partie secondaire formant un courant tournant dans le four tubulaire.

2. Installation de combustion selon la revendication 1, caractérisée en ce que le disque (23) est muni d'un organe (24) en forme d'entonnoir dirigé axialement dans le four tubulaire (10) afin qu'il maintienne initialement séparés les courants primaire et secondaire de gaz.

3. Installation de combustion selon la revendication 1 ou 2, caractérisée en ce que la chambre de combustion postérieure (13) a un diamètre nettement supérieur à celui du four tubulaire (10), et a au

moins, dans des parties de son enveloppe (27), des fentes (28) qui sont dirigées tangentiellement vers l'extérieur dans le sens de rotation du courant de gaz de combustion, les fentes (28) communiquant avec une chambre collectrice (29) entourant la chambre de combustion postérieure.

4. Installation de combustion selon l'une quelconque des revendications précédentes, caractérisée en ce que la chambre de combustion postérieure (13) communique avec un certain nombre de tubes de fumées (14), disposés concentriquement autour de la chambre tubulaire de combustion (10) et raccordés à une chambre collectrice (15) qui est adjacente à l'extrémité du brûleur, l'espace entourant les tubes de fumées (14) faisant partie d'un circuit de circulation d'eau (19, 20).

5. Installation de combustion selon l'une quelconque des revendications 1 à 3, caractérisée en ce que le fluide gazeux est conduit suivant un trajet formé autour de la chambre tubulaire de combustion et passant dans des tubes (14a) qui sont parallèles au four tubulaire (10), avant qu'il n'atteigne le brûleur (11), le produit de combustion étant transféré de la chambre de combustion postérieure (13) à un échangeur de chaleur (34) qui est séparé et qui est du type à condensation.

6. Installation de combustion selon l'une quelconque des revendications précédentes, caractérisée en ce que la chambre de combustion postérieure (13) est commune à deux tubes alignés de combustion (10) dirigés l'un vers l'autre, et est disposée de manière que les gaz de combustion entrant le chambre (13) tournent dans le même sens.

FIG. 1

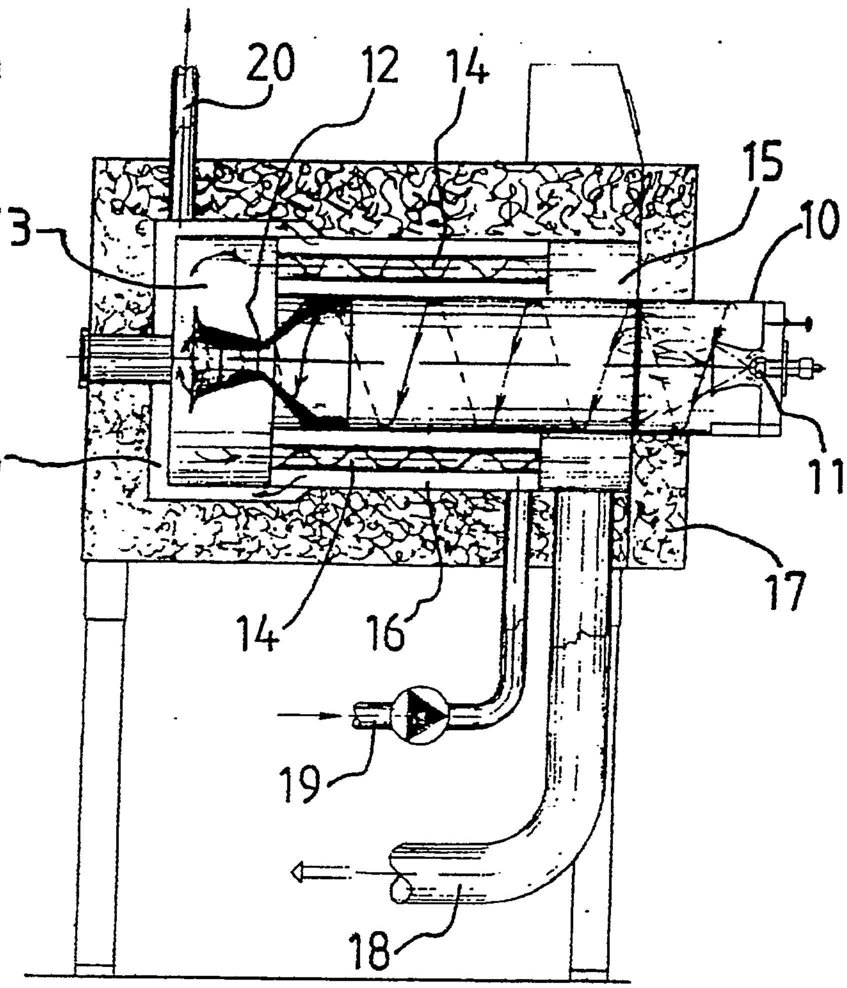


FIG. 2

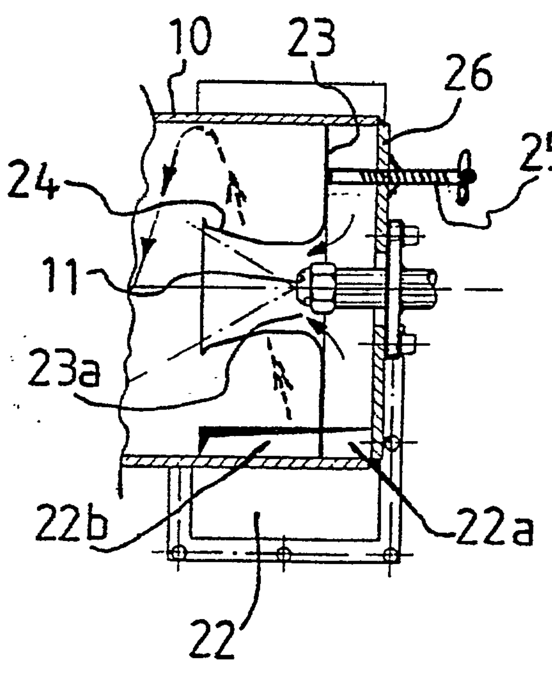


FIG. 3

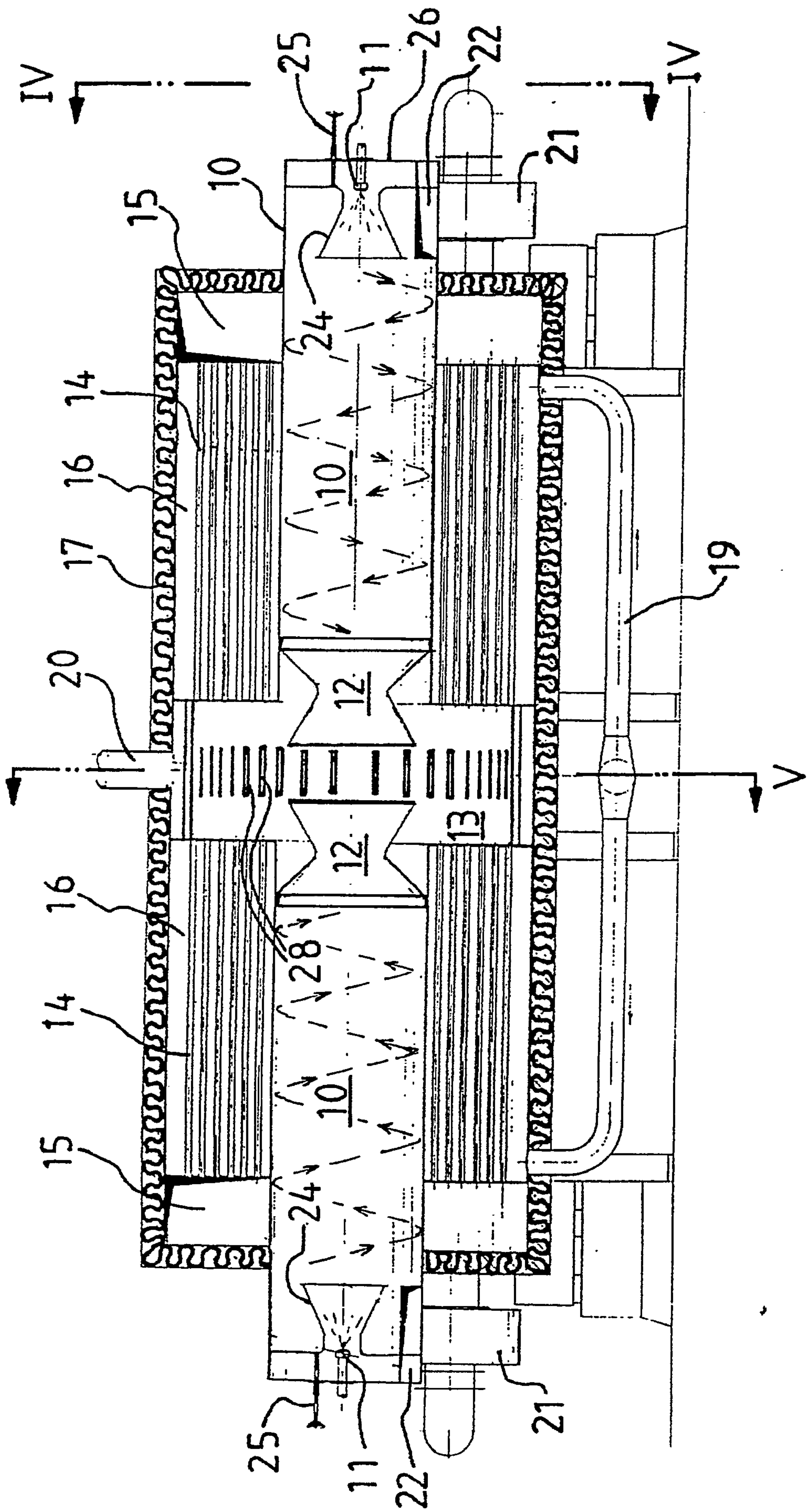


FIG. 4

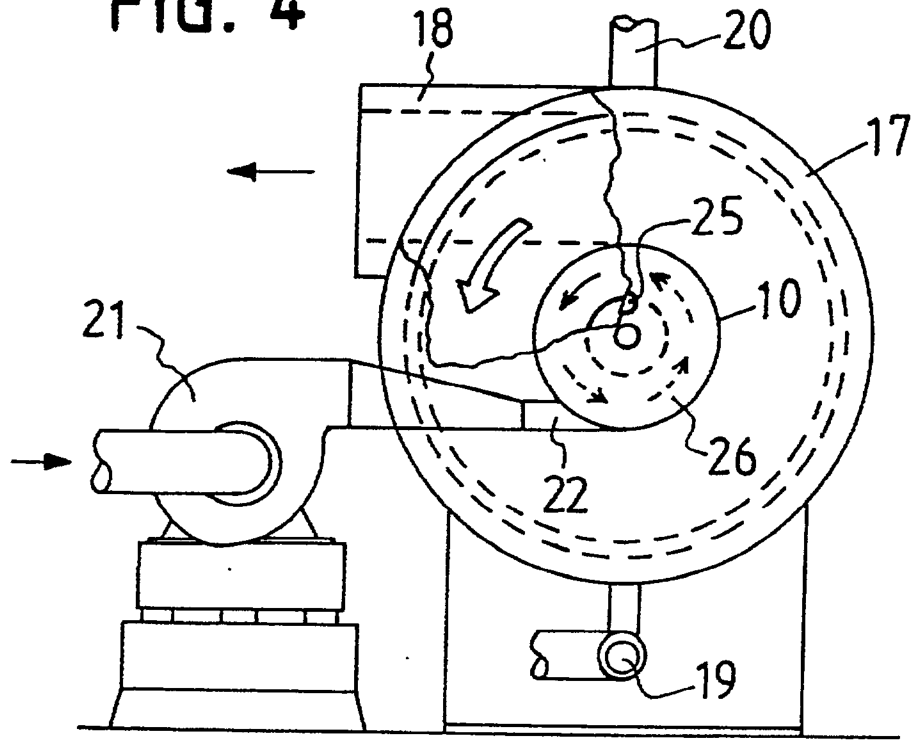
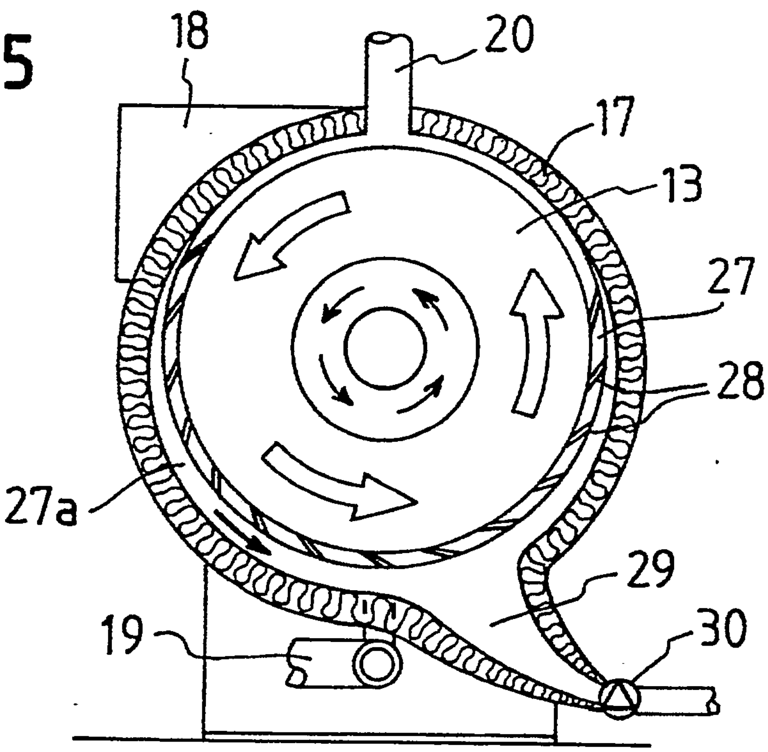


FIG. 5



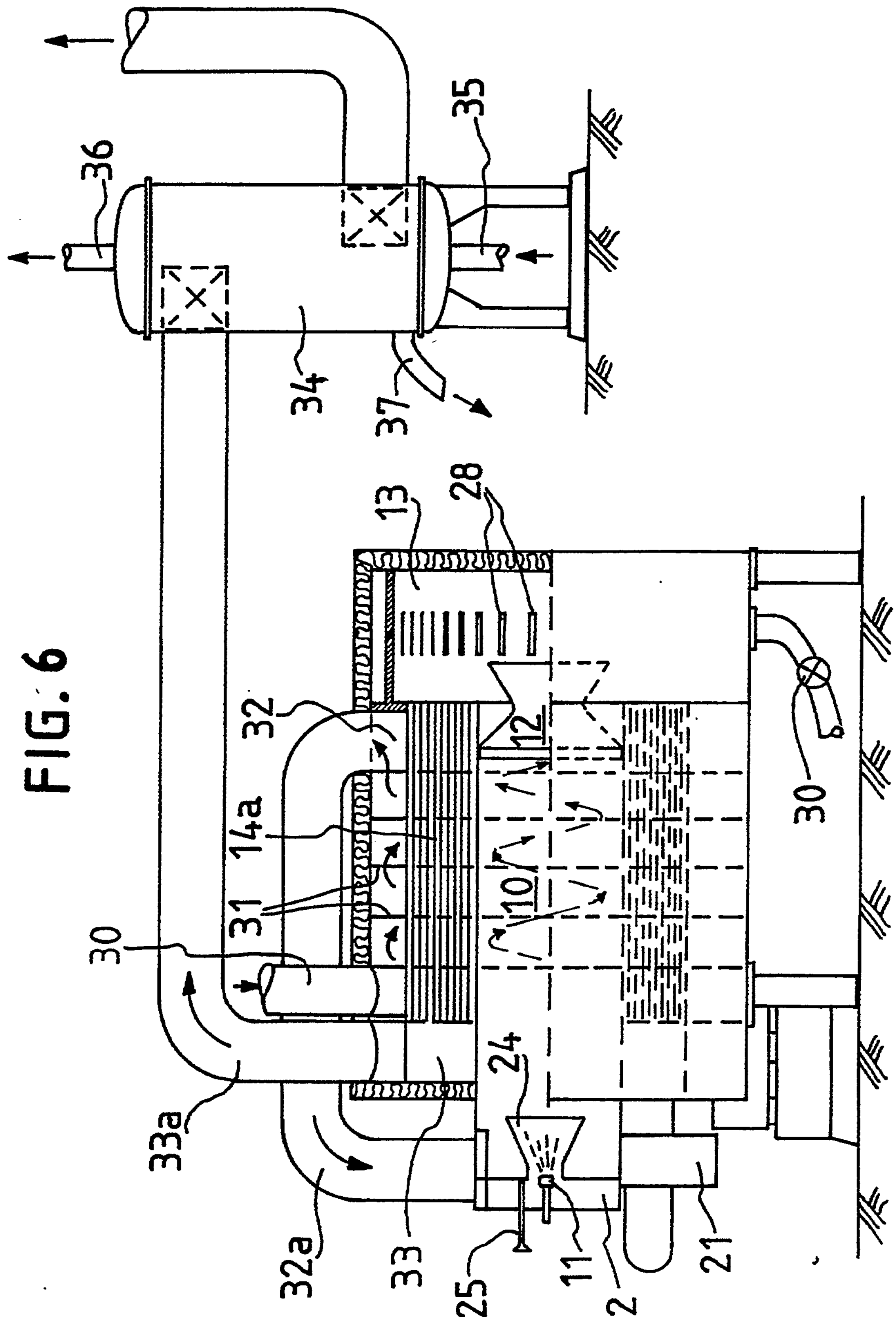


FIG. 6