

[54] APPARATUS DISPOSING WASTE GAS BY BURNING

[75] Inventors: **Takusen Itoh; Kenji Onose; Takayoshi Ueda; Noboru Okigami; Iwao Miyabayashi**, all of Osaka, Japan

[73] Assignee: **Hitachi Shipbuilding & Engineering Co., Ltd.**, Osaka, Japan

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[58] Field of Search **431/5, 8, 89, 202; 23/277 C**

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Primary Examiner—William F. O'Dea

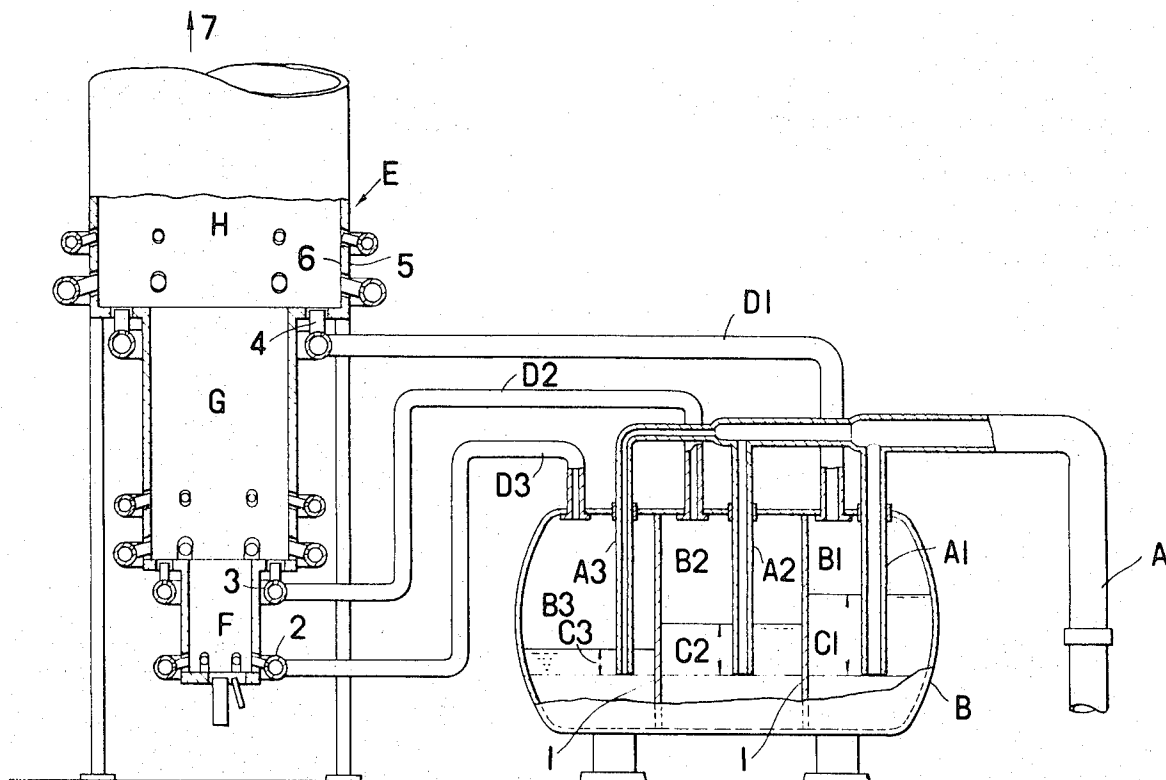
Assistant Examiner—William C. Anderson

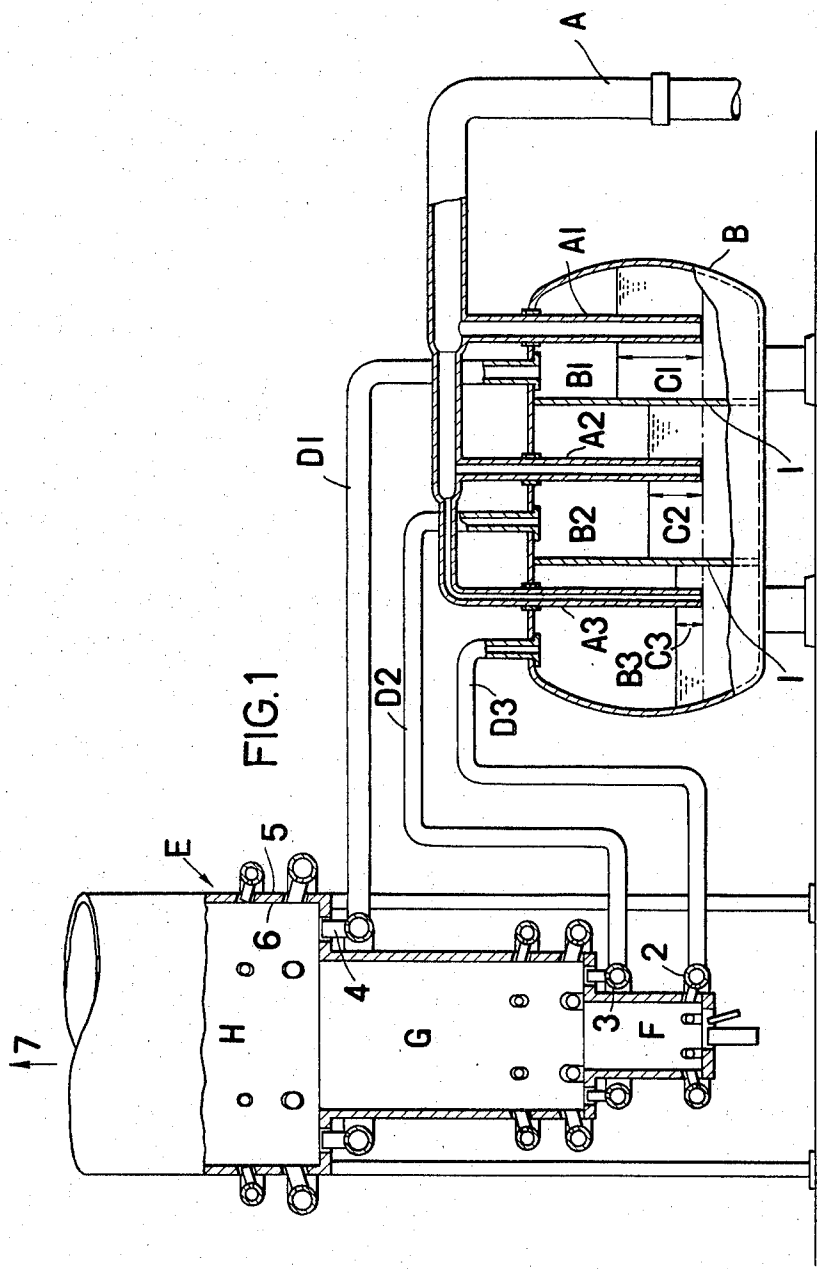
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] ABSTRACT

A method for disposing of combustible waste gas by burning and an apparatus embodying the method is disclosed. At the front end of a main pipe carrying waste gas are provided a plurality of branch pipes adapted to branch waste gas steppedly according to the flow rate in the main pipe. The open ends of the branch pipes are inserted into individual sections of water-sealed drums and submerged in water-seal to different depths. Between the upper portion of each water-sealed drum and a combustion furnace is provided a connecting pipe respectively to dispose individually the waste gas supplied through the connecting pipes by burning in the combustion furnace. The combustion furnace is formed of a continuous cylindrical body of several stages with a larger inner diameter at the upper stage and smaller diameters at successively lower stages. In the inner bottom of each stage and in the closed bottom of the lowermost stage and adjacent them are provided respectively disposable gas injection nozzles and air suction ports, so that combustion is to be carried out from the closed bottom of the lowermost stage.

2 Claims, 6 Drawing Figures





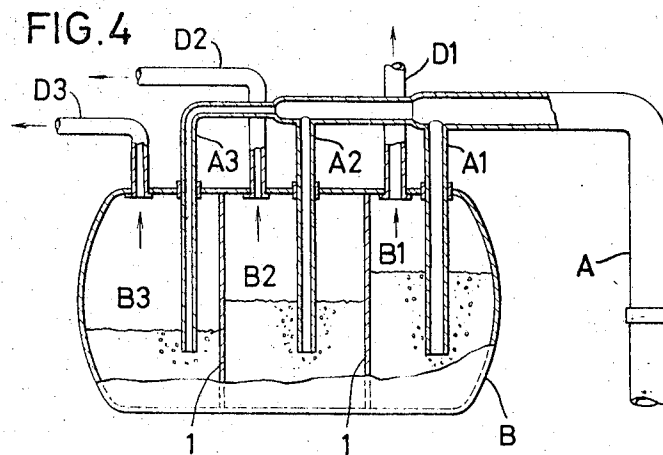
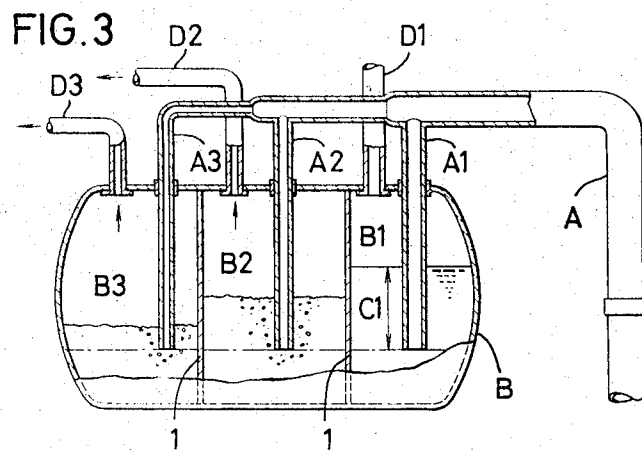
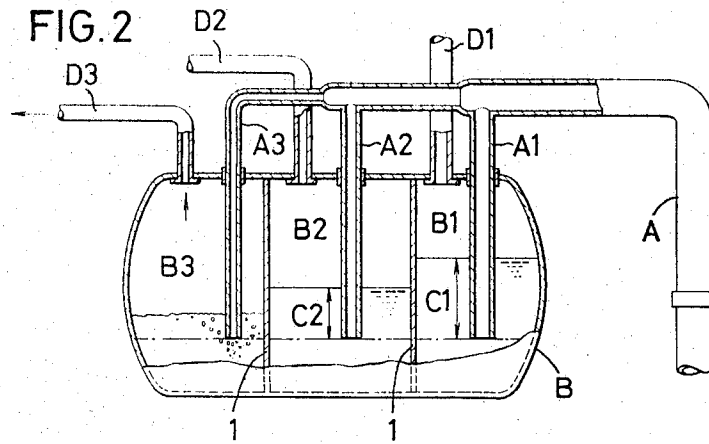


FIG. 5

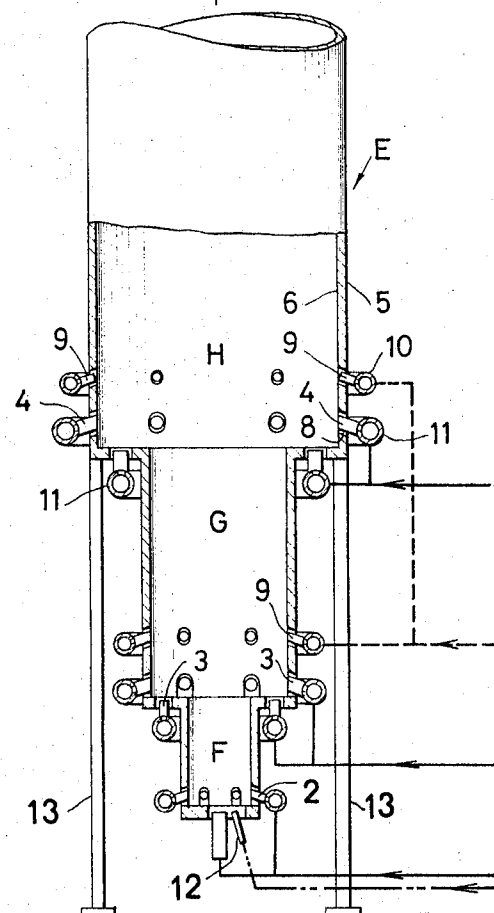
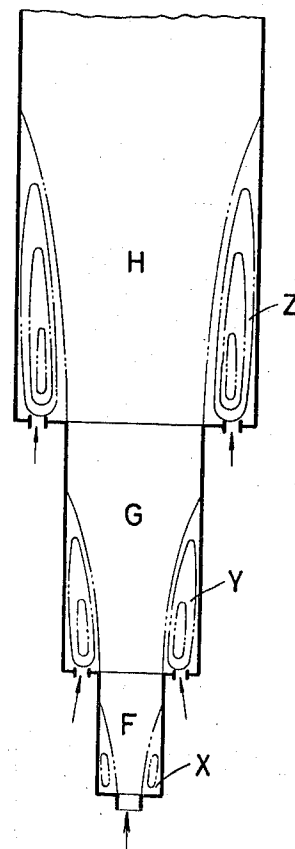


FIG. 6



APPARATUS DISPOSING WASTE GAS BY BURNING

The present invention relates to a method for disposing of combustible waste gas by burning and an apparatus putting the method into practice, wherein a combustion furnace is constituted to effectively and properly disposed waste gas discharged from various plants and the like by burning to carry out complete combustion.

Heretofore, as the method for disposing of combustible waste gas by burning, the method of using a flare stack has been generally known most.

With this method, combustible waste gas was discharged from the top of high flare stack into the open air and disposed immediately by burning.

With this method, however, as burnt in the open air, waste gas is not burnt completely. Consequently, black smoke or unburnt gas is partially discharged and not only contaminates the air but also creates noise and increases atmospheric illumination, and results in the generation of so called public contamination.

Accordingly, by only moving the place of disposition to other place or increasing the height of stack, such problem can not be settled, and essentially, and improvement of the method or apparatus promoting complete combustion of combustible waste gas is desired ardently.

The present invention provides a method for disposing of waste gas by burning and an apparatus which implements the method to promote complete combustion of combustible waste gas, which has been desired heretofore.

In the drawing,

FIG. 1 is a schematic drawing showing the mode of the practice of a method disposing combustible waste gas by burning according to the present invention.

FIGS. 2 through 4 are illustrations showing the action of branch drum shown in FIG. 1.

FIG. 5 is a section showing the principal parts of the combustion furnace burning the waste gas led through the branch drum.

FIG. 6 is an illustration of gas flow when waste gas is burning in the combustion furnace in FIG. 5.

In FIG. 1, A is a main pipe leading waste gas discharged from a plant, and has three branch pipes A1, A2, A3 branched therefrom, which are adapted to branch the waste gas steppedly according to the flow rate of the waste gas flowing the main pipe.

B is a branch drum and is formed with three chambers that are sectioned by partition plates 1, 1, to correspond to the branch pipes A1, A2, A3, and thereby constitute air-tight chambers of water-sealed drums B1, B2, B3, respectively independent from each other.

In these water-sealed drums B1, B2, B3 water is poured to form steppedly different water levels C1, C2, C3 having high, middle and low heights by means of a water level regulator (not shown) and openings at the front ends of the branch pipes A1, A2, A3 mentioned above are submerged in the water.

D1, D2, D3 are connecting pipes connected between the upper portions of the water-sealed drums B1, B2, B3, and an adjoining combustion furnace E.

Said combustion furnace E is formed with a plurality of cylindrical bodies having different diameters in an integral continuous body with a larger diameter cylindrical

body at the upper end and smaller bodies at successively lower positions.

Namely as shown in FIG. 1, the combustion furnace has a plurality of stages which are assembled integrally and which include, from the lowermost stage a first combustion chamber (F), a second combustion chamber (G), and a third combustion chamber H, which increase in diameter from the lower to the upper stage and the assembly thereof is decided according to the quantity and quality of the waste gas to be disposed the disposing capacity thereof and the like.

Into the first combustion chamber F at the lowermost stage of said combustion furnace E is projected a nozzle 2 at the end of the connecting pipe D3. Into the second combustion chamber G is projected a nozzle 3 at the end of the connecting pipe D2 and into the third combustion chamber H is projected a nozzle 4 at the end of the connecting pipe D1 which leads from the water-sealed drum B1.

In the branch drum B in FIG. 1, the waste gas conveyed through the main pipe A is led into the branch pipes A1, A2, A3 and tends to go to the water-sealed drums B1, B2, B3 overcoming the water pressure in each water-sealed drums B1, B2, B3 having respectively a steppedly different depth of water seal C1 C2 C3.

And, hereupon, when the flow rate (supply pressure) of the waste gas is small, as shown in FIG. 2, the waste gas is discharged into the water from the opening at the front end of said branch pipe A3 the depth of water-seal of which is least and rises in the water-seal as bubbles, and is conveyed to the end nozzle 2 in the first combustion chamber F at the lowermost stage of the combustion furnace E through the connecting pipe D3 thereof, and thereat, is disposed as required by burning with a burner ignited by a pilot burner.

And, when the quantity of the waste gas discharged from plant is increased gradually, then as shown in FIG. 3, the gas pressure in the main pipe A and the branch pipes A1, A2, A3 is naturally increased, thereupon the waste gas overcomes the water-seal of the branch pipe A2 and is led to the end nozzle 3 in the second combustion chamber G of the combustion furnace E passing through the connecting pipe D2, and then the required burning disposal is carried out.

In the case shown in FIG. 3 the burning disposal is carried out in both the first combustion chamber F and the second combustion chamber G.

When the quantity of the waste gas discharged from plant is increased further, then as shown in FIG. 4, the gas pressure in the main pipe A and the branch pipes A1 A2 A3 is increased, and thereupon the waste gas overcomes the water-seal of not only the branch pipes A3 A2 but also the branch pipe A1 and is led to the end nozzle 4 in the third combustion chamber H of the combustion furnace E, passing through the connecting pipe D1, and then the required burning disposal is carried out.

In the case shown in FIG. 4, the burning disposal is carried out in the first combustion chamber F, the second combustion chamber G and the third combustion chamber H.

And, contrary, to that described above, when the flow rate of waste gas is gradually reduced, then the gas pressure in the branch pipes A1, A2 A3 is also gradually lowered, and the gas pressure can overcome the water-seal C2, C3 of the branch pipes A2, A3, but not

the water seal C1 of the branch pipe A1, then the supply of the waste gas to the connecting pipe D1 is stopped and the waste gas flows from the remaining branch pipes A2, A3 through the connecting pipes D2, D3 and through the process above mentioned into the combustion furnace, and hereupon the burning disposal is achieved.

In the embodiments in FIGS. 1 through 4, on considering the quantity of waste gas flowing in the main pipe A, the branch drum B is shown as an apparatus having three sets of the branch pipes A1, A2, A3 corresponding to, for example, high, medium and low pressure, the water-sealed drums B1, B2, B3 connected thereto, the connecting pipes D1 D2 D3 connected from the water-sealed drums to the combustion furnace, and burners, pilot burners and the like. However the invention is not to be limited by the embodiments illustrated and the number of elements should be selected according to the quantity of waste gas discharged and the range of the variation thereof to carry out effective burning disposal of waste gas.

And in the water-sealed drums B1 B2 B3, the depth of the water-seal is disclosed as varied, but the same effect may also be obtained by changing the length of each branch pipe submerged in the water with the water level in each water-sealed drum equal.

As above mentioned, with the present invention, in the process for disposing of waste gas by burning in the combustion furnace, the waste gas discharged from the plant is separated and branched according to the flow pressure of the gas by using the water-sealed drums having different water-seal depths corresponding to the quantity of the waste gas being discharged by means of the branch drum B and is sent respectively into each combustion chamber and disposed individually therein, so that the waste gas varying widely from the maximum flow rate to the minimum flow rate may be branched collectedly and disposed according to the flow rate thereof. The burning disposal aimed at may be carried out remarkably efficiently and also safely against the rapid variation of waste gas, and as shown in FIG. 1 the combustion furnace may be installed on the earth, and the burning disposal of waste gas which is easy in maintenance, inspection and operation maybe readily carried out as compared to the use of a conventional flare stack.

The details of the combustion furnace E shown in FIG. 1 will be set forth referring to FIGS. 5, 6. The combustion furnace E has cylindrical outer wall 5 made of steel plate and the like to dispose of combustible waste gas by burning, and the inside of the outer wall 5 has refractory inner wall 6 coated integrally by means as lining and the like using, for example, refractory plastics and the like.

The combustion furnace E is formed in an integral continuous body with a plurality of cylindrical bodies having different inner diameters with a larger inner diameter cylindrical body at the upper and successively smaller bodies at lower levels. The combustion chamber illustrated has a plurality of stages integrally assembled such that the second combustion chamber G is larger in inner diameter than the first combustion chamber F, and the third combustion chamber H is larger in inner diameter than the second combustion chamber H, and so on. That is, the higher up the stage is, the larger the inner diameter and the assembly may be decided according to the quantity and quality of the

waste gas to be disposed, and, the disposable capacity. 7 is the exhaust port of the combustion furnace. In each combustion chamber F G H of the combustion furnace is respectively nozzle 2 3 4 for injecting into the combustion chamber the disposable gas carried thereto by the connecting pipe after passing through the water-sealed drums of the branch drum B shown in FIG. 1.

In the space adjacent the circumference of the nozzles 2 3 4 are provided suction ports 8 for sucking air for combustion, the outside of the air suction port being open to the air. A steam injector 9 is provided for removing smoke from the combustion furnace and ring headers 11 are provided, respectively, for the nozzles 2, 3 and 4. Ring headers 10 are provided for the steam injectors 9.

Said nozzles 2, 3, 4 and air suction ports 8 are arranged respectively in the closed bottom of the first combustion chamber F and in the inner bottom of each stage of the second and third combustion chambers G, H, and in the space in the position adjacent them.

These are to provide a proper combustion atmosphere for disposable gas and to promote the burning action thereof.

12 is an ignition torch and is provided in the closed bottom of the lowermost first combustion chamber F and one or more pilot gas burners are used.

13 are suitable supporting legs to support said combustion chamber from the earth.

FIG. 6 is a model figure of the flowing condition at combustion of the disposable gas in the combustion chambers in FIG. 5, X, Y, Z illustrate respectively the vortex flow section at combustion generated in each stage of the combustion chambers.

And, the full line in FIG. 5 presents the piping for supplying the disposable gas, the dotted line the piping for supplying steam, and the chain line of two dots the piping for supplying pilot burner gas, respectively.

As shown in FIGS. 5 and 6, in the combustion furnace E, the combustion apparatus disposing combustible waste gas by burning is formed as a continuous cylindrical body having a plurality of stages of different inner diameter with a larger inner diameter at the upper stages and successively smaller diameter at lower stages. In the inner bottom of each stage and in the closed bottom of the lowermost stage are provided respectively injection nozzles 2, 3, 4 for disposable gas and suction ports 8 for air necessary for combustion in order to carry out ignition at the bottom of the lowermost stage to burn waste gas, so that as for the combustion of the disposable gas in the combustion chambers, the voluminal capacity of the whole combustion furnace may be reduced remarkably without lowering necessary air suction power. Therefore, while the combustion furnace E may be miniaturized remarkably as compared with conventional simple cylindrical combustion furnace, in the vortex flow sections X Y Z generated in each stage by the velocity of the rising flow of the burnt gas from the first combustion chamber at the lowermost stage are provided respectively air suction ports 8, so that the static pressure is reduced, therefore, ventilating power is increased and more air may be sucked, accordingly, while combustion is promoted. The circulating motion of the burnt gas in the chambers becomes vigorous, the complete combustion of the disposable gas is easier to achieve and there is an effect which makes it feasible to obtain heavier load of combustion.

And, on the other hand, in the present invention, as injection nozzles for the disposable gas are arranged only at the closed bottom of the lowermost stage but also at each stage, the regulation of the rate of combustion and the like is possible at all times by controlling the flow rate of these plural nozzles according to the condition of the combustion of the disposable gas in the combustion chambers and even a small quantity of disposable gas may be disposed in the device of the subject invention. And also, the disposable gas injected into the second combustion chamber and the third combustion chamber may be ignited and immediately burnt with flame in the first combustion chamber, in addition thereto, as the second and third combustion chambers are heated up usually by the first combustion chamber, the general requirement for complete combustion of the disposable gas may be satisfied, so that the present invention has an excellent effect such that noise is also reduced.

As above mentioned, the combustion furnace used in the present invention, different from conventional one, is not required to be installed in a position very high from the earth, therefore, the installation thereof may be carried out readily and it is suitable to the social requirement for preventing public contamination.

List of Symbols

A	main pipe	H	third combustion chamber
B	branch drum	1	partition plate
A1	branch pipe	2	nozzle
A2	ditto	3	ditto
A3	ditto	4	ditto
B1	water-sealed drum	5	outer wall
B2	ditto	6	inner wall
B3	ditto	7	exhaust port
C1	water level	8	air suction port
C2	ditto	9	steam injector
C3	ditto	10	ring header
D1	connecting pipe	11	ring header
D2	ditto	12	ignition torch
D3	ditto	13	supporting leg
E	combustion furnace	X	vortex flow section

F	first combustion chamber	Y	ditto
G	second combustion chamber	Z	ditto

What we claim is:

1. An apparatus for disposing of combustible waste gas carried by a main pipe, comprising:

branch means connected to the main pipe for branching waste gas according to the flow rate in the main pipe;

a plurality of branch pipes connected to said branch means, waste gas being channelled into at least one of said branch pipes according to the flow rate in the main pipe;

a plurality of connecting pipes, one pipe communicating with each of said branch pipes for carrying waste gas therefrom, and each having a nozzle at the other end thereof; and

a combustion furnace connected to said connecting pipes, said combustion furnace being a continuous cylindrical body comprised of a plurality of stages arranged in vertical order and communicating with adjacent stages, the uppermost stage having a first diameter and the diameters of successively lower stages being successively smaller than the first diameter, gas injection nozzles provided adjacent the bottom of each stage, air suction ports provided adjacent each of said gas injection nozzles and an ignition means positioned within the lowermost stage.

2. The device of claim 1 wherein said branch means is comprised of at least one water-sealed drum divided into sections by partition plates, one end of each of said branch pipes being submerged below water level in a different section, each branch pipe being submerged to a different depth, and each of said connecting pipes communicating with a different one of said sections of said combustion furnace.

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