United States Patent

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Gummersbach, Rhineland, Germany
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[33] Germany
[31] No. 1,751,356

[54] **DEVICE FOR BURNING MOIST FINE GRANULAR SUBSTANCES AND FINE GRANULAR SUBSTANCES CONTAINED IN LIQUID MEDIA**

8 Claims, 7 Drawing Figs.

[52] U.S. Cl. 110/7
[51] Int. Cl. F23g 7/00
[50] Field of Search 110/7, 8

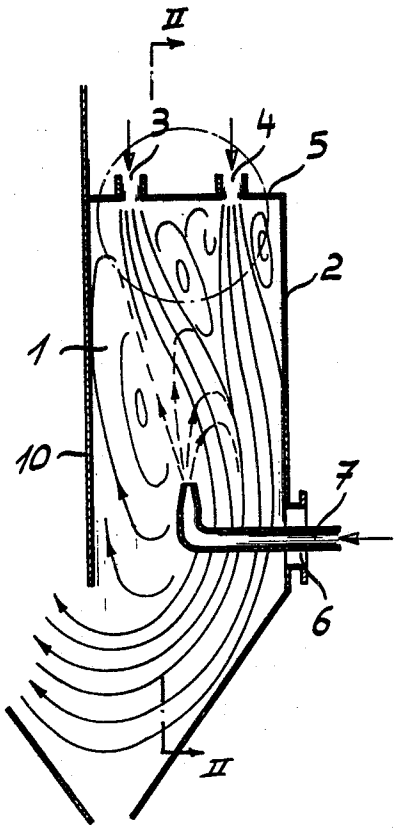
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3,373,704 3/1968 Jung 110/7

Primary Examiner—Kenneth W. Sprague
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ABSTRACT: An apparatus for burning residues and moist fuel in a combustion chamber, in which the ceiling of said combustion chamber has arranged therein one or more rows of air-feeding nozzle means with the mouths of said air-feeding nozzle means directed at an angle of from 5 to 30° with regard to the respective adjacent front and rear walls of said combustion chamber.



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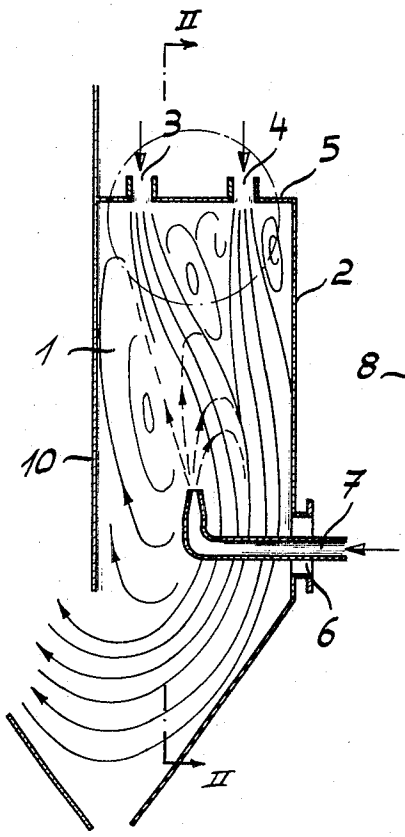


Fig. 1

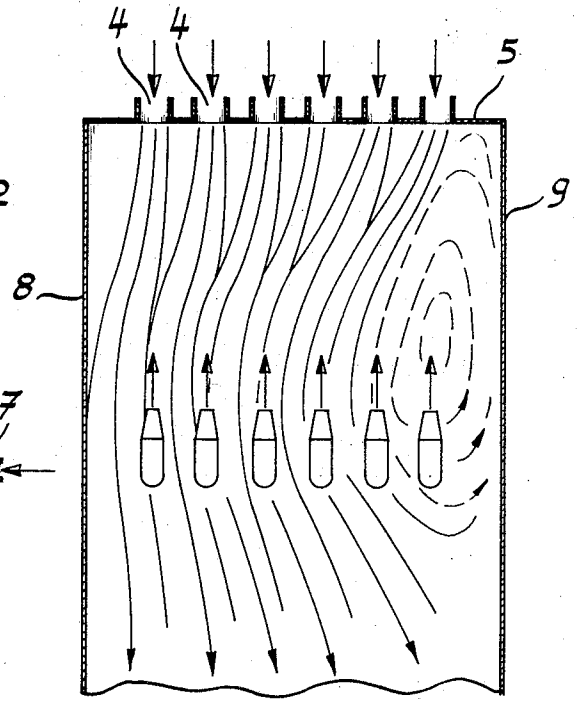


Fig. 2

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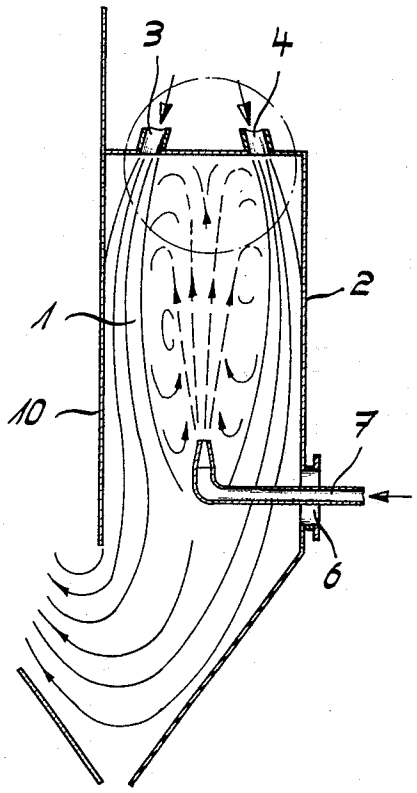


Fig. 3

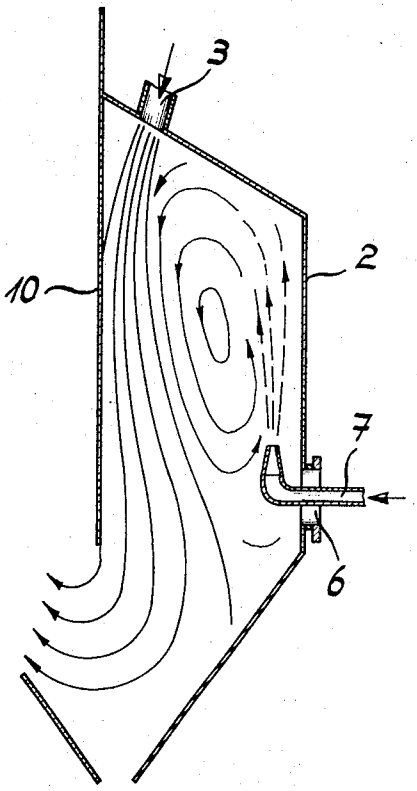


Fig. 4

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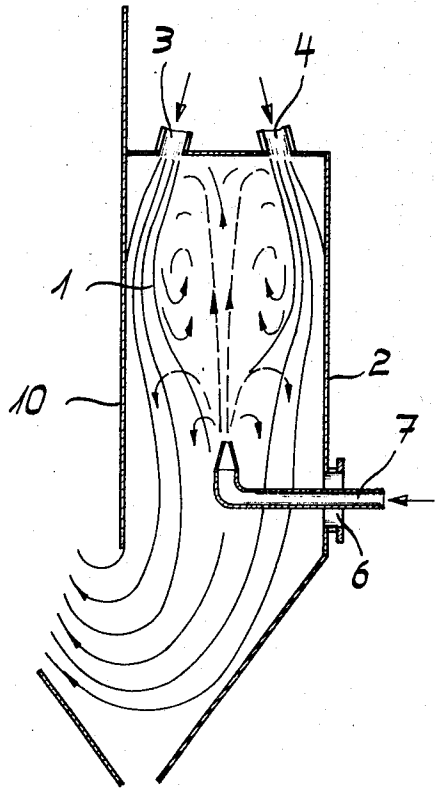


Fig. 5

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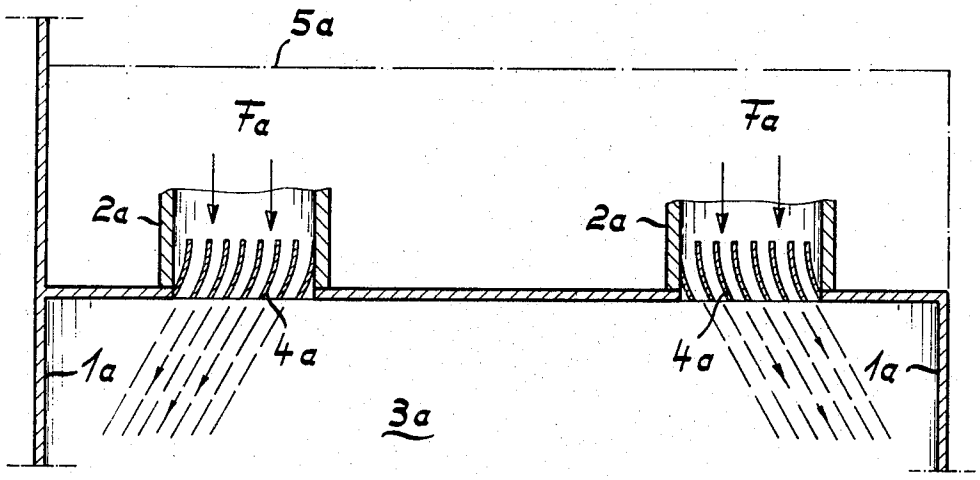


Fig. 6

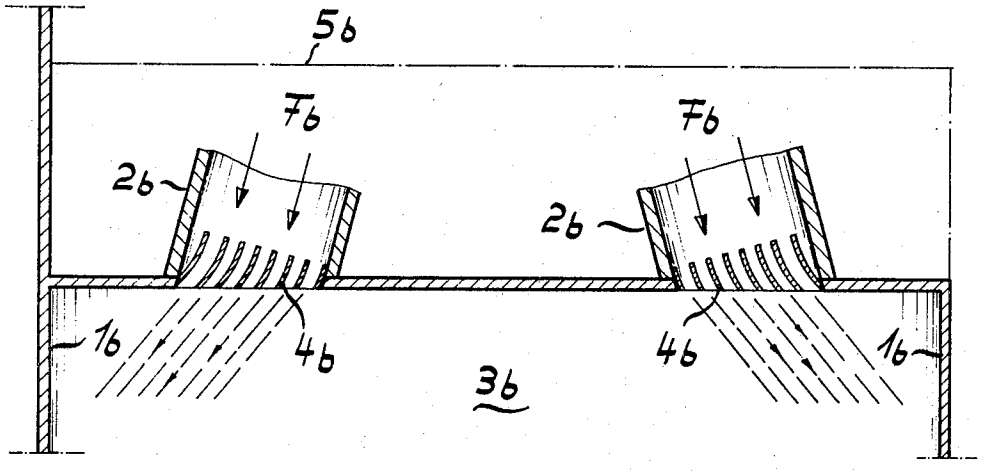


Fig. 7

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DEVICE FOR BURNING MOIST FINE GRANULAR SUBSTANCES AND FINE GRANULAR SUBSTANCES CONTAINED IN LIQUID MEDIA

The present invention relates to a device for burning residues or moist fuel as mixtures of burnable and nonburnable liquid or solid fine granular substances as they are present, for instance, in the liquor obtained in connection with the production of cellulose or in the coal mud. The present invention is a further improvement of my invention set forth in U.S. Pat. No. 3,373,704 issued Mar. 19, 1968. According to the invention set forth in the above-mentioned patent it is suggested to produce stable back circulation turbulence by means of rows of air nozzles which are arranged in the ceiling of the fire box and extend parallel to the front wall while the mouths of said air nozzles are directed at an angle toward the front and rear wall.

The fuel which first reacts rather slowly is from below directed into the upwardly directed portion of said back circulation turbulence to bring about that the fuel is first dried and preheated and only then comes into contact with the combustion air. The length of this back circulation turbulence is important for a complete combustion. If this turbulence or the whirls end already ahead of the atomizer nozzles, moist fuel particles are carried away by the upwardly directed flue gas and are in part in an unburned condition carried out of the fire box which is undesired, particularly when reemploying the obtained liquor ash. If, on the other hand, the said turbulence or whirls is or are considerably longer, these difficulties are not encountered. However, in such an instance the said nozzles are surrounded by the upwardly directed hot back flow which might under certain circumstances be harmful to the life of said nozzles.

It is, therefore, an object of the present invention to provide an arrangement in which the dimensions of the fire box or combustion chamber, the composition and quantity of the fuels, and the length of the back circulation whirls or turbulence are so tuned to each other that an optimum combustion will be obtained.

These and other objects and advantages of the invention will appear more clearly from the following specification, in connection with the accompanying drawings, in which:

FIGS. 1 to 4 illustrate different flow pictures in connection with the present invention.

More specifically, FIG. 1 diagrammatically shows a vertical longitudinal section through the combustion chamber, said section being taken along a plane perpendicular to the front wall of said combustion chamber.

FIG. 2 is a section taken along the line II–II OF FIG. 1.

FIG. 3 is a section similar to that of FIG. 1, but differing therefrom primarily in that the nozzles are inclined with regard to the ceiling of said combustion chamber.

FIG. 4 is a section similar to that of FIGS. 1 and 3, but differing therefrom in that the ceiling of the combustion chamber is inclined while at the same time there is provided only one row of nozzles with the nozzles inclined to the surface of said ceiling.

FIG. 5 diagrammatically shows flow arrangement having too short a back circulation whirl or turbulence.

FIGS. 6 and 7 show fragmentary enlargements of nozzle portions illustrated by FIGS. 1, 3 and 5, respectively, having guide elements and modifications of the nozzles represented therein.

The device or furnace according to the present invention is characterized primarily in that the adjusting angles of the air nozzles at the ceiling of the combustion chamber are variable.

Numerous actual tests have shown that when the angle between the air nozzles and the front or rear wall of the combustion chamber amounts to approximately 10°, the back circulation whirl or turbulence has a length which corresponds to the simple distance from the front and rear wall. With an angle of 25°, the said length amounts to 1.5 times the said distance. Intermediate values can be obtained by a linear interpolation. With adjusting angles below 5°, a change of the flow into a nonsymmetric or nonstable form will occur. Adjusting angles beyond 30° have proved impractical because the back circulation whirl or turbulence again becomes shorter. The above relationship and angles apply only to the combustion chamber shape as it is shown in FIGS. 3 and 4 and for a ratio of combustion chamber cross section to air nozzle exit cross section of approximately 18.

For purposes of improving the heretofore known constructions of the type involved, it is suggested to increase the ratio of the cross-sectional surface of the firing chamber to the cross-sectional surface of the air nozzle by narrowing the nozzles and increasing the pressure. Also in this instance, the length of the back circulation whirl or turbulence is increased.

Furthermore, it is suggested in conformity with the present invention to vary the direction of the combustion air leaving the nozzles at the chamber ceiling and/or to vary the exit cross section of said nozzles by guiding elements so that when changing the composition and/or the quantity of the fuel, the length of the back circulation whirl or turbulence can be so adjusted that an optimum combustion will be obtained.

Referring now to the drawings in detail, FIGS. 1—4 illustrate the flow pictures which are similar to those of assignees' U.S. Pat. No. 3,373,704 above referred to. More specifically, FIG. 1 shows a combustion chamber 1 in a vertical cross section which is perpendicular to the front wall 2 and also shows the nozzle rows 3 and 4 in the chamber ceiling 5 for the supply of combustion air. FIG. 1 furthermore illustrates the atomizing nozzles 7 extending through the openings 6 in the front wall 2. The arrangement of the nozzles in the longitudinal plane which is parallel to the front wall will become evident from FIG. 2.

The air jets leading into the combustion chamber and parallel to the longitudinal walls flow in conformity with the illustrated flow lines so as to form a single strand which extends along the front wall and along one of the two sidewalls 8 and 9. In the area covered by said strand, an extended recirculation whirl or turbulence is formed with a back flow which is directed upwardly preferably along the back wall 10. In this unsymmetric flow, the starting conditions for the reaction of the fuel atomized into the back flow or the air strand are extremely different. The fuel passed directly into the air strand is, in view of the delayed ignition, even with increased air excess not completely burned or only in a nonadmissibly large distance in the downward flow direction in the combustion chamber.

With the method according to the present invention, as distinguished over U.S. Pat. No. 3,373,704, the air jets leaving the nozzle rows 3 and 4 are in conformity with FIG. 3 directed against the rear wall 10 or front wall 2. In this way the illustrated symmetric flow form occurs when the central back flow carrying the nozzle injected fuel which back flow in the upper portion of the combustion chamber is drawn into the partial flows of the combustion air which flows downwardly along the walls. Furthermore, the inclined position of the air nozzles brings about that the individual jets expand on the walls in the direction which is perpendicular to the intermediate plane and thereby flow together so as to form a flow which is uniformly distributed over the width of the wall. In this way the constriction of the downward flow detached from a sidewall will not occur which otherwise occurs with wall parallel inflow according to FIG. 2.

FIG. 4 shows an arrangement with only one nozzle row 3 directed against the rear wall 10. With this arrangement, the fuel is introduced through the nozzles into the back flow area adjacent the front wall. The inclined position of the ceiling favors the back flow into the outer zone leading to the area of the mouth of the air nozzles.

FIG. 5 shows an arrangement with a back circulation whirl or turbulence which is too short.

FIGS. 6 and 7 provide enlarged representation of nozzle portions previously shown in views of FIGS. 1, 3 and 5. The views of FIGS. 6 and 7 diagrammatically illustrate in the drawings the provision of guide elements and modification of

the nozzles. For further influencing of the flow or stream direction of the nozzles in a purely constructive manner of consideration, so-called guide elements can be built into the structures involved as illustrated in FIGS. 6 and 7. An actual adjustment or displacement of the nozzles themselves may be more complex than the diagrammatic illustration. However, a minimal adjustment or alteration of flow or stream direction to have the sought-after effect upon combustion procedure can be readily accomplished by building in guide elements. It is to be understood that it is not absolutely necessary that the nozzles themselves be in an inclined position but rather the guide elements can be installed within the nozzles which are substantially parallel to the chamber wall construction.

In FIG. 6 itself there is shown how nozzles 2*a* are arranged parallel to the chamber wall 1*a*. Guide elements 4*a* are built into the nozzles and secured in the area surrounding the location where the nozzles connect with the chamber space 3*a*. These guide elements direct or control the direction (arrows, F*a*) of the arriving flow or stream in the course onto the chamber wall 1*a* and simultaneously the open outlet cross section of the nozzles 2*a* is restricted or narrowed due to the installation of the guide elements 4*a* and therewith the influence thereof is provided also upon the stream or flow speed.

In FIG. 7 the nozzles 2*b* are inclined toward the chamber wall 1*b*. Guide elements 4*b* can be installed in the area of interconnection of the nozzles into the chamber space 3*b* also with the inclined positioning of the nozzles. The guide elements 4*b* have an influence upon the stream or flow direction (arrows, F*b*) as indicated previously. Due to the provision of the guide elements 4*b*, the open or free outlet cross section is changed and thereby there is provided also an influence upon the stream or flow speed.

The dotted lines 5*a* and 5*b* in FIGS. 6 and 7, respectively, represent an air reservoir or, in other words, an air supplying channel into which the individual nozzles 2*a* and 2*b* respectively discharge or flow.

It is, of course, to be understood that the present invention is, by no means, limited to the particular embodiments illustrated in the drawings, but also comprises any modifications within the scope of the invention.

I claim:

1. An apparatus for burning residues and moist fuel which comprises: combustion chamber means having front and rear wall means and a ceiling, at least one row of air-feeding nozzle means arranged substantially parallel to said front wall means with the nozzle means directed at an angle with regard to the respective adjacent wall means, said angle being within the range of from 5 to 30°, and fuel feeding nozzle means leading from the outside of said combustion chamber means into the lower portion of said combustion chamber means and having the mouths thereof pointing upwardly and located approximately halfway between said front and rear wall means.

2. An apparatus according to claim 1, in which the mouths of said air-feeding nozzle means are directed at an angle only with regard to said rear wall means for producing a single back circulation whirl and in which said fuel feeding nozzle means pass through one of said front and rear wall means and extend upwardly, the angle of said air feeding nozzle means with regard to said rear wall means being within the range of from 5 to 30°.

3. An apparatus according to claim 1, in which said air-feeding nozzle means are adjustable as to the angle they define with the respective wall means of said combustion chamber means.

4. An apparatus according to claim 1, in which the free cross section of the air-feeding nozzle means is variable for selectively varying the ratio of the cross-sectional surface of said combustion chamber means to the free cross-sectional surface of said air feeding nozzle means for varying the length of the back circulation whirl formed in said combustion chamber means.

5. An apparatus according to claim 1, which includes guiding elements associated with said air-feeding nozzle means for guiding the flow of air leaving said air-feeding nozzle means in a desired direction within said combustion chamber means.

6. An apparatus according to claim 1, which includes guiding elements associated with fuel feeding nozzle means for guiding the fuel leaving said fuel feeding nozzle means in a desired direction within said combustion chamber means.

7. An apparatus according to claim 1, in which the ceiling of said combustion chamber means has arranged therein two rows of air-feeding nozzle means arranged on opposite sides of the plane of symmetry vertically extending through said combustion chamber means and in substantially parallel arrangement to said front and rear walls thereof, the air-feeding nozzle means of said two rows being inclined in a direction forming the image to each other.

8. An apparatus according to claim 1, in which the ceiling is inclined with regard to said front and rear wall means and in which the air-feeding nozzle means have their mouths directed at an angle to the rear wall means.