(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 019 962**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **80200449.9**

(22) Date of filing: **12.05.80**

(51) Int. Cl.³: **F 23 D 1/00**, F 23 M 9/00, F 26 B 23/02

(30) Priority: **10.05.79 NL 7903693**

(43) Date of publication of application: **10.12.80**
Bulletin 80/25

(84) Designated Contracting States: **BE DE FR GB NL SE**

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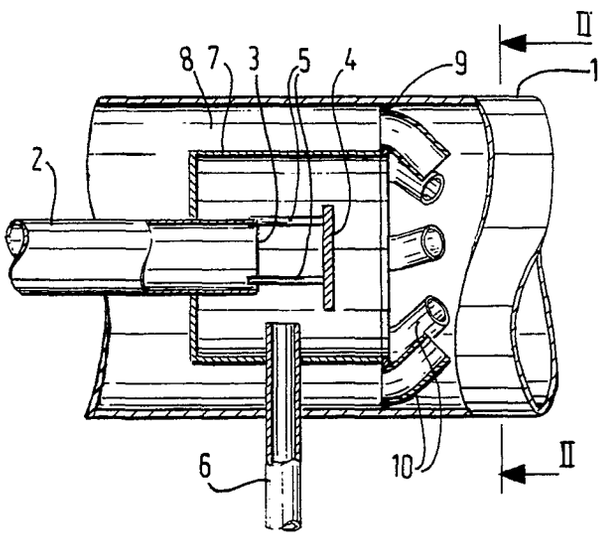
(54) Method and burner for burning powdered fuel, and apparatus and method for drying moist material using such a burner.

(57) Burner (12) in which a mixture of powdered fuel and a flow of oxygen-containing gas is supplied by a duct (2) and ignited by a burner (6) at the outlet (3).

A violent turbulent motion is created in the burning flow of fuel and gas by positioning an impedement (4) in the flow near the flame base.

Application of the burner (12) in a drying apparatus (14).



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TITLE MODIFIED
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Method and apparatus for burning powdered fuel and use thereof.

The invention relates to a method of burning powdered fuel by preparing a mixture of this fuel and a flow of oxygen containing gas and by igniting the same. Such a method is generally known and is employed in various large heating systems. Disadvantages of this method are that the combustion of the solid fuel is poor, that the heat economy is susceptible of being improved, that products treated with the combustion gases are contaminated with unburnt residues, that filters in the combustion gases are likely to be damaged and that the fuel mixture can be ignited only with difficulty. Remedies for some of these disadvantages are, for example, a long combustion chamber or a chamotte lining of the combustion chamber, which is fired to incandescence, or preheated combustion air for ensuring complete combustion or satisfactory ignitability, but this results in increase in cost and structural limitations. Therefore, said method is not suitable for use in compact systems having short combustion chambers and for applications in which the flame comes into contact with substances of comparatively low temperature, for example, in drying systems.

The invention has for its object to provide an improved method which is characterized in that the burning flow of fuel

and gas is caused to perform a strong, irregular turbulence by arranging an impedement in said flow near the base of the flame. In order to enhance the effect a rich fuel mixture may be directed to an impedement, after which a turbulent flow of oxygen containing gas is added. In this manner the parts coming into contact with the flame are exposed to comparatively low temperature, whereas nevertheless the desired short flame is obtained.

The invention furthermore relates to an apparatus for carrying out said method, said apparatus comprising a feeding conduit for powdered fuel and a transport gas for the same, said feed conduit opening out in a combustion chamber, the apparatus comprising furthermore at least one auxiliary or ignition burner near the mouth of the fuel feed conduit and feeding conduits for an oxygen containing gas opening out in said chamber.

It is known in such an apparatus to produce a turbulence of the gas and the fuel, for which purpose the secondary combustion air is supplied through one or more tangential feeding conduits or a sequence of regularly disposed helical blades is provided. Such an apparatus provides, it is true, a very uniform, but comparatively low flame, which is ignited only with difficulty and in which incandescent solid particles are carried along over a large distance. In order to avoid these drawbacks the apparatus according to the invention comprises at least one impact plate directly in front of the fuel conduit opening beyond the auxiliary or ignition burner. This impact plate produces an irregular turbulence of the already burning flow of fuel and gas, so that an intimate mixing of the constituents is obtained and a combustion of the fuel particles is ensured within a small distance from the opening of the fuel supply conduit.

In order to prevent the stream from returning to regularity it is preferred to provide various impact plates, one of which is preferably annular and is arranged, with respect to the first impact plate, at a larger distance than the latter from the opening of the fuel feeding conduit, said plate extending inwardly from the wall of the chamber. If

the oxygen containing gas is supplied in two or more phases, which is preferred in order to improve the ignitability of the fuel mixture, it is advisable to dispose the annular impact plate in the direction of flow in front of the opening of the feeding conduits for secondary, oxygen containing gas in order to obtain intimate mixing of the fuel and the gas and to correctly control the flame. The irregular turbulence is maintained to the optimum, when the supply conduits for secondary gas open out in the chamber in an irregular array. For this purpose separate feed tubes having relatively different axial directions may open out in the combustion chamber, which construction is preferred when an annular air supply gap having differently directed guide blades is provided in the wall of the combustion chamber. A very intimate mixing and hence a short flame is obtained by arranging said supply tubes so as to open out at an angle of 90^{o} to 60^{o} to the centre line of the combustion chamber.

The combustion apparatus according to the invention is particularly suitable for use as a burner in a drying system comprising a drying chamber with inlet and outlet members for the material to be treated and a burner opening out in said chamber.

Thanks to the short flame of this combustion apparatus it can be avoided that appreciable amounts of unburnt fuel get into the mixture to be dried.

The invention furthermore relates to a method of drying wet material in a drying chamber through which hot combustion gases are passed. In such a method it has been common practice to use gaseous or liquid fuel, when contamination of the product to be dried by constituents originating from the fuel had to be avoided. By using a burning, irregularly turbulent mixture of a solid fuel in an oxygen containing gas to produce the combustion gases it is possible to avoid said contamination and to use nevertheless the solid fuels preferred for economic or environment-technical reasons.

The invention will be described more fully with reference to the drawing.

Fig. 1 is a schematic, axial sectional view of a burner in accordance with the invention in a preferred embodiment.

Fig. 2 is a cross-sectional view taken on the line II-II in Fig. 1.

Fig. 3 is a schematic, axial sectional view of a simplified embodiment of the burner in accordance with the invention.

Fig. 4 is a side elevation of a drying drum provided with a burner as shown in Fig. 1.

Figs. 1 and 2 show a cylindrical combustion chamber 1, in which open out axially a feeding conduit 2 for powdered, solid fuel and air as a transport gas at 3. Directly in front of the opening 3 an impact plate 4 is disposed transversely of the axial direction of the feeding conduit 2, said impact plate being connected by means of three supports 5 so as to be axially displaceable. Between the impact plate 4 and the opening 3 an auxiliary or ignition burner 6 laterally extends across the wall of the combustion chamber 1 in order to ignite and, if necessary to maintain the flame of the stream of fuel and air before attaining the impact plate. As a result of the irregular turbulence caused by the impact plate 4 air and solid substance are intimately mixed without appreciable segregation.

Altough the impact plate 4 is shown in the form of a flat, round disc, the circumference may be wave-shaped and as a further alternative a profiled plate may be used. The combustion chamber 1 partly has a double wall so that between the concentric inner and outer walls 7, 1 an annular channel 8 is formed for the supply of secondary combustion air. The opening of this channel is located in the direction of flow of the air beyond the impact plate 4.

At the outflow the annular channel is closed by a ring 9 in which a plurality of outlet tubes 10 mainly extending transversely of the axis of the combustion chamber are fastened so that a turbulent stream pattern of the emanating air and an intimate mixing with the burning mixture are obtained.

Fig. 3 shows a simplified embodiment of the device according to the invention, in which corresponding parts are designated by the same reference numerals as in Figs. 1 and 2.

In this embodiment the opening of the annular channel 8 is located beyond a second annular impact plate 11, which has the shape of a conical surface having a large vertex. This second impact plate 11 prevents the burning mixture from becoming again a regular stream.

Fig. 4 showns an example of application for which the device according to the invention is particularly suitable, i.e. a burner for a drying drum.

The burner 12, which may be constructed in the manner illustrated in Figs. 1, 2 or 3, is arranged substantially axially in a head wall 13 of a rotating drum 14. This drum 14 is supported in a conventional manner on rollers 15, its axis being horizontal. The material to be dried is led via the supply device 16 shown schematically in counterflow to the combustion gases through the drum 14 and conducted out of it on the side of the burner 12 through an outlet 17 provided on the head wall. Despite the relatively short distance covered by the burning mixture before it comes into contact with humid material to be dried, unburnt constituents of this mixture will not or only hardly be found in the dried material conducted away.

Although this description refers to a drying device as shown comprising a drum rotating about its axis, it is, of course, also possible to use other drying chambers, for example, stationary chambers comprising blades moving therein, in which the material to be dried drops across the hot gases or perpendicular towers in which the material to be treated drops along distribution blades and thus comes into contact with the hot gases in a well distributed state.

CLAIMS

1. A method of burning powdered fuel by preparing a mixture of this fuel and a flow of oxygen-containing gas and by igniting this mixture, characterized in that a violent turbulent motion is created in the burning flow of fuel and gas by positioning an impedement in the flow near the flame base.

2. The method according to claim 1, characterized in that a rich mixture is guided against an impedement and thereafter a whirling, secondary flow of gas, containing oxygen is added.

3. The method according to claim 2, characterized in that said secondary flow of gas containing oxygen is directed, at several locations, substantially towards the axis of the combustion chamber.

4. Apparatus for burning powdered fuel, comprising a duct for supplying fuel and a conveying gas, the outlet of said duct opening into a combustion chamber, a support- or ignition burner near said outlet, and ducts for supplying a gas containing oxygen having outlets respectively opening into said chamber, characterized by at least one baffle plate facing the outlet of said fuel supply duct downstream of said support- or ignition burner.

5. Apparatus according to claim 4, characterized by a

central baffle plate and an annular baffle plate at a larger distance of said fuel supply duct outlet than said central baffle plate, said annular baffle plate extending inwardly from the wall of said combustion chamber.

6. Apparatus according to claim 5, characterized in that said annular baffle plate is located upstream of the outlets respectively of said ducts for supplying a secondary flow of gas containing oxygen.

7. Apparatus according to any one of claims 4, 5 or 6, characterized in that the supply ducts for supplying a secondary flow of gas containing oxygen open into said chamber along non-uniformly distributed directions.

8. Apparatus according to any one of the claims 3-7, characterized in that said duct for supplying a secondary flow of gas containing oxygen open into said chamber along directions, respectively, enclosing angles between 90° and 60° with the axis of said chamber.

9. A drying apparatus comprising a drying chamber with associated devices for supplying and discharging material to be treated and a burner opening into said drying chamber, characterized in that the burner is constituted by an apparatus according to any one of claims 3-8.

10. A method of drying moist material in a drying chamber through which warm combustion gasses are guided, characterized in that said combusting gasses are formed by a burning, turbulent mixture of a solid fuel and a gas containing oxygen.

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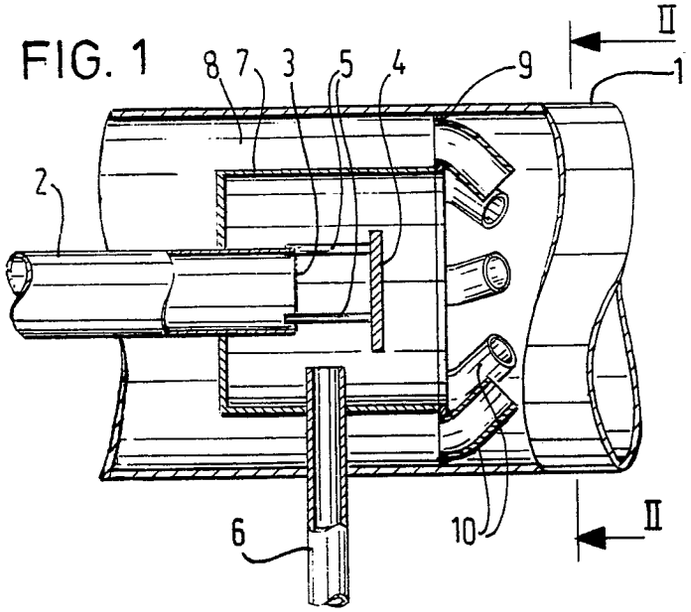
FIG. 1



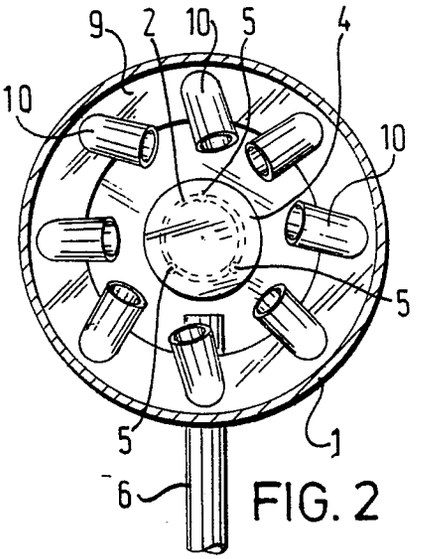


FIG. 2

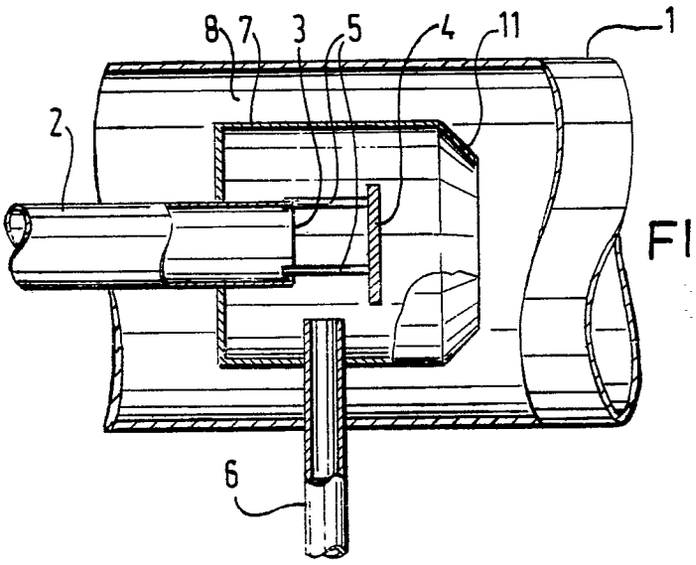
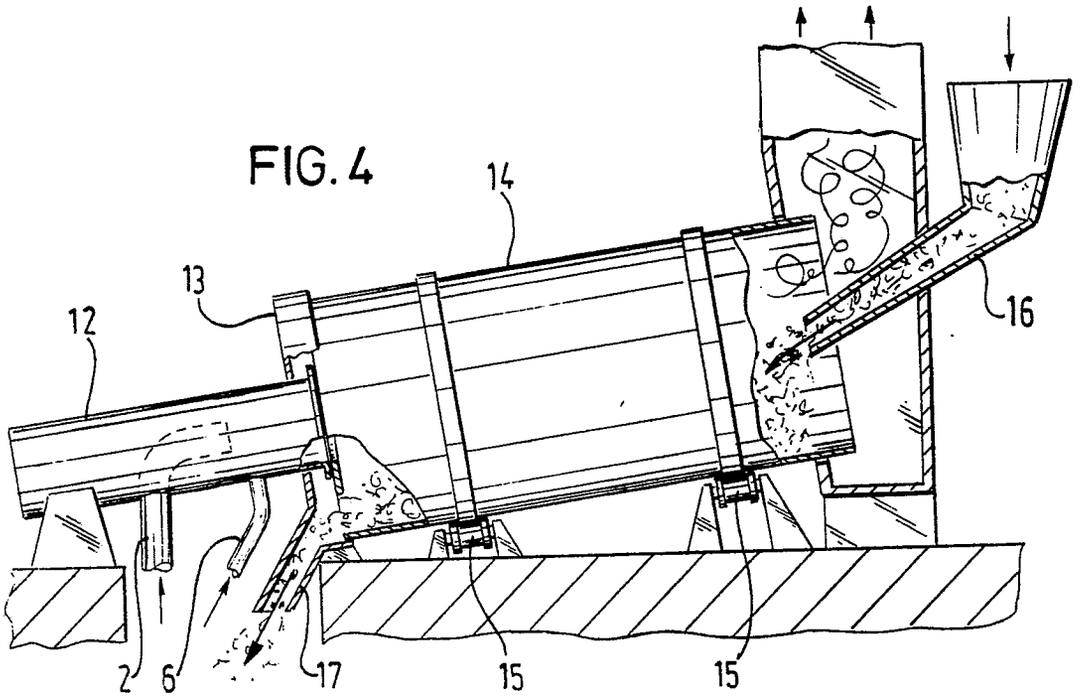


FIG. 3

FIG. 4



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EUROPEAN SEARCH REPORT

0019962
Application number
EP 80 20 0449

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	DE - B - 1 166 406 (M.A.N.) * Column 1, lines 1-6, 18-23, 43-47; column 2, lines 25-43; column 3, lines 3-6; figures 1,2,5 *	1,2,4-6
	DE - C - 428 952 (B.A.M.A.G.) * Complete document *	1,4
	US - A - 1 720 089 (MURRAY) * Page 1, lines 67-84; page 1, line 95 - page 2, line 2; figure 1 *	1,3,4
	GB - A - 331 555 (GOOSSENS) * Page 1, lines 17-35, 47-58; page 2, lines 9-52, 68-89; figures 1,4 *	3,7,8
	FR - A - 594 947 (COMPAGNIE DES MINES D'OSTRICOURT) * Page 1, lines 26-51; figures 1-6 *	3,7,8
	DE - C - 955 668 (PORTLAND) * Page 2, line 85 - page 3, line 46; figures *	9,10
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CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 23 D 1/00
F 23 M 9/00
F 26 B 23/02

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

F 23 D
F 23 M
F 26 B
F 24 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20-08-1980	PHOA

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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

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CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

TECHNICAL FIELDS SEARCHED (Int. Cl. 3)