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[54] **METHOD AND APPARATUS FOR CHARGING A BURNER**

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[51] **Int. Cl.** **F23m 3/12**

[58] **Field of Search** 431/9, 168, 173, 185, 353

[56] **References Cited**

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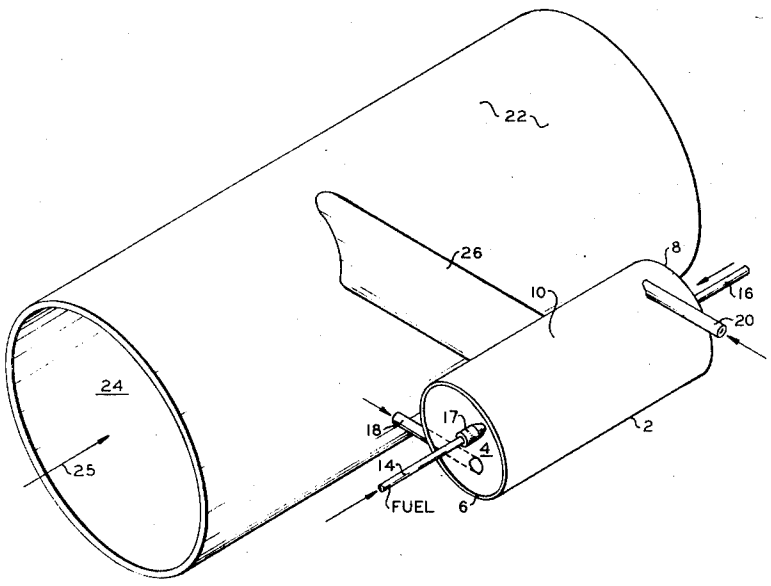
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[57] **ABSTRACT**

Apparatus and method for mixing fuel and combustion-supporting gas streams at an attitude for causing the mixture to rotate in a first direction and passing the rotating mixture into a burner at an attitude for causing the mixture to rotate in the first direction within the burner for decreasing the pressure drop of the fluids passing into the burner.

12 Claims, 2 Drawing Figures



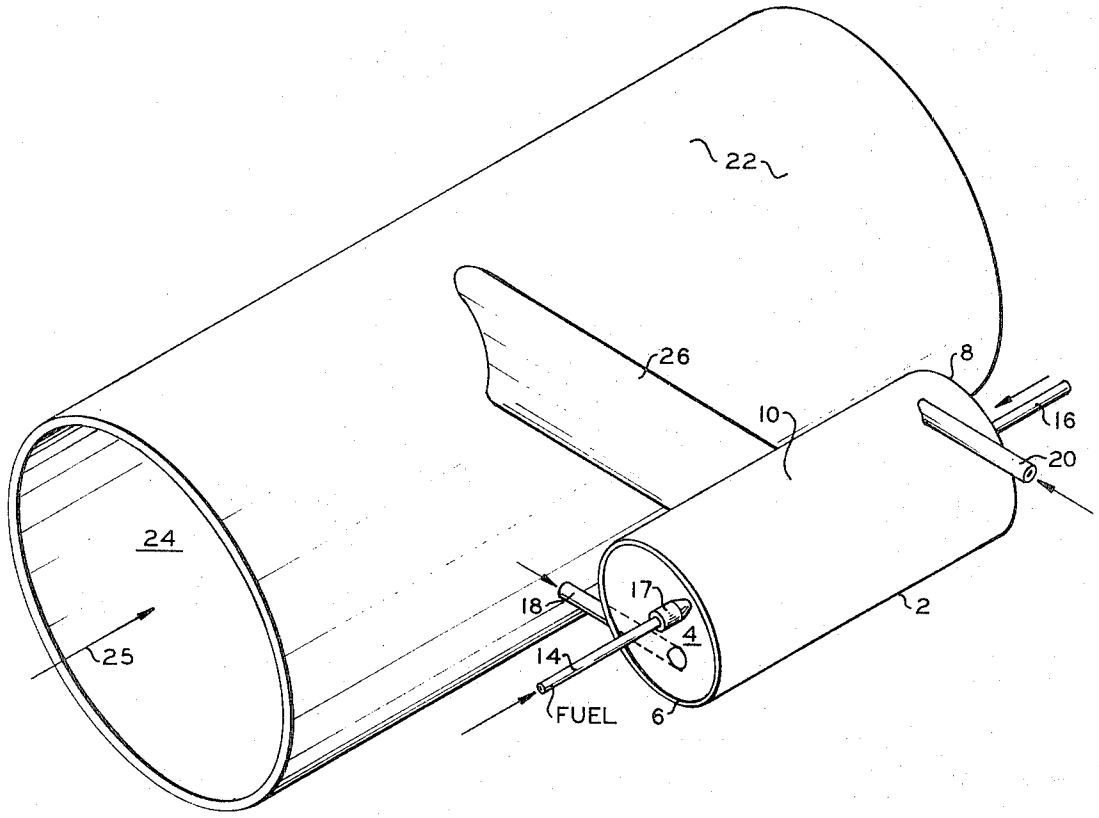


FIG. 1

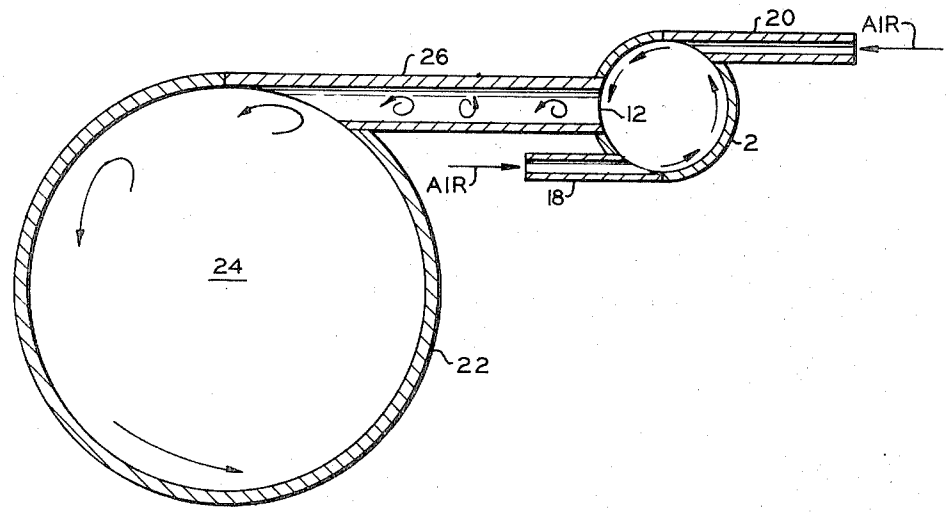


FIG. 2

METHOD AND APPARATUS FOR CHARGING A BURNER

It is desirable to decrease the pressure drop and decrease the equipment and labor required to mix a fuel stream with a combustion-supporting gas stream and charge the mixture to a burner. This invention therefore resides in an apparatus and a method which are improvements over heretofore like apparatus and methods.

This invention resides in an apparatus and method for mixing fuel and a combustion-supporting gas, such as air, streams in an attitude for causing a mixture to rotate in a first direction, passing the rotating mixture into a burner in an attitude for causing the mixture to rotate in the first direction within the burner for decreasing the pressure drop of the fluids passing into the burner.

Other aspects, objects, and advantages of the present invention will become apparent from a study of the disclosure, the appended claims, and the drawings.

The drawings are views of the apparatus of this invention.

FIG. 1 shows the apparatus associated with a carbon black reactor, wherein make oil is charged axially, with or without a sheath of air therearound, and hot combustion gases are charged tangentially surrounding the make oil to produce carbon black, and

FIG. 2 is a frontal view of the apparatus with the rotation of the fluid relative to the apparatus depicted by arrows.

Referring to FIGS. 1 and 2, a generally cylindrical mixing element 2 has a chamber 4 of a first size, an axis, first and second ends 6,8 and a middle portion 10 having an opening 12 into the chamber 4. The opening 12 is preferably of a size which is substantially equal to the opening of chamber 4.

A line 14 is connected at one end to a pressurized fluid fuel, fuel oil or gas, for example, supply (not shown) and at the other end to one of the ends 6 or 8 of the mixing element 2. Preferably, lines 14,16 are connected to the fuel source and to respective first and second ends 6,8 of the mixing element. In order to assure more uniform mixing of fuel and air, it is preferred that a nozzle 17 be associated with each of the lines 14,16 for spraying the fuel into the chamber 4 and that the fuel lines 14,16 open coaxially into the chamber 4 and be directed toward one another in opposed directions.

A line 18 is connected at one end to a pressurized combustion-supporting gas, e.g., air, supply (not shown) and at the other end to the mixing element at a location adjacent an associated fuel line 14 or 16 and spaced from the chamber openings 12. The line 18 opens tangentially into the chamber 4 for mixing and producing combustion gases from the air and fuel streams and causing the mixture to rotate about the longitudinal axis of the chamber 4 in a first direction which is either clockwise or counterclockwise as viewed from a selected end of the chamber 4, for example, as shown in FIGS. 1 and 2, rotation is counterclockwise as viewed from the first end 6.

The combustion zone of the carbon black reactor, hereafter referred to as a burner 22, has a generally cylindrical chamber 24 and a longitudinal axis directed in generally a common direction relative to the longitudinal axis of the mixing element 2.

A conduit 26 has one end connected to the mixing element 2 in communication with the opening 12 and the other end connected to the burner 22 and opening tangentially into the burner chamber 24.

The inside diameter of the conduit 26, the diameter of the chamber 4, the opening 12, and the tangential opening into the burner chamber 24 are preferably each of substantially a common size in order to decrease breakup of the vortex as the rotating mixture of hot combustion gases passes from the chamber 4 into chamber 24. Breakup of the vortex as the rotating mixture passes from the mixing element 2 into the burner chamber 24 can be further reduced by maintaining the length of the conduit 26 not greater than about two times the outside diameter of said conduit 26. The conduit 26 opens into the burner chamber 24 at a location and is directed relative to the longitudinal axis of the burner for producing a clockwise rotation in the burner chamber where the first direction of rotation is clockwise and for producing a counterclockwise rotation where the first direction of rotation is counterclockwise. Carbon black-producing oil, for example, is added axially into chamber 24 by way of conduit 25. Carbon black smoke (carbon black in combustion gases) is recovered from the opposite or downstream end of chamber 24 and conventionally processed. Although the apparatus of this invention is associated with an oil furnace type carbon black reactor for example purposes, it should be understood that the burner can be utilized with other apparatus.

In the method of this invention, at least one fluid fuel stream is brought into contact with at least one air or oxygen-containing stream in the chamber 4 of the mixing element 2 for mixing said streams together. The attitude of contacting of the streams or attitude of passing the streams into the chamber 4 is sufficient to cause the mixture to rotate in a first direction which is clockwise or counterclockwise relative to the axis of the chamber 4 as viewed from a selected first or second end 6,8 of the mixing element 2.

The rotating mixture is rotated through the conduit 26 and passed tangentially into the burner 22 as shown in FIG. 2. Owing to the entry location of the mixture passing from the conduit 26 into the burner chamber 24, the vortex of the mixture in the conduit 26 is in the same rotational direction as the vortex of the mixture in the burner chamber 24. By so maintaining the vortex of the mixture in common directions in the mixing chamber 4, the conduit chamber 24, and the conduit 26, the pressure drop of the mixture passing through the system is maintained at a minimum thereby decreasing the requirements of the system.

In a conventional furnace type carbon black reactor wherein the hot combustion gases are added tangentially to the carbon black reactor, but which do not have the rotational flow of my invention, a pressure drop (or loss) between the fuel oil/air inlet and the reactor outlet of about 3 psi occurs. When using the system and apparatus of my invention, with the rotational flow detailed hereinabove, the pressure drop (or loss) is calculated to be only about 1 psi. When processing hundreds of thousands of cubic feet of air or combustion-supporting gas per hour in a carbon black reactor, this pressure drop savings amounts to considerable savings of air compression equipment and operating expense.

Other modifications and alterations of this invention will become apparent to those skilled in the art from the foregoing discussion and accompanying drawings, and it should be understood that this invention is not to be unduly limited thereto.

What is claimed is:

1. A method for charging fluid fuel and combustion-supporting gas streams into a generally cylindrical combustion chamber of a burner and for reducing the pressure drop of the fluids charging the burner, comprising:

contacting at least one fluid fuel stream with at least one combustion-supporting gas stream for mixing said streams together with the attitude of contacting being sufficient to cause the mixture to rotate in a first direction, said first direction being one of a clockwise or counterclockwise direction about an axis directed in a generally common direction relative to the longitudinal axis of said combustion chamber; and

rotating the mixture in the first direction through a conduit and injecting said mixture from the conduit tangentially into the combustion chamber, the rotating mixture entering the burner chamber at a tangential attitude for producing a clockwise rotation in the combustion chamber where the first direction is clockwise and for producing a counterclockwise rotation in the combustion chamber where the first direction is counterclockwise.

2. A method, as set forth in claim **1,** wherein said fluid fuel comprises oil.

3. A method, as set forth in claim **1,** wherein said burner is part of a carbon black reactor.

4. A method, as set forth in claim **1,** wherein contacting said at least one fluid fuel with said at least one combustion-supporting gas stream comprises spraying the fuel stream axially into a generally cylindrical mixing element chamber and passing the combustion-supporting gas stream tangentially into the mixing element chamber and into contact with the fuel stream for causing the resulting mixture to rotate in the first direction.

5. An apparatus for charging fluid fuel and combustion-supporting gas streams into a cylindrical chamber of a burner and reducing the pressure drop of the fluids charging the burner, comprising:

a mixing element having a generally cylindrical mixing chamber of a first diameter with a longitudinal axis and first and second ends, said mixing element having a middle portion having an opening into the middle portion of said mixing chamber,;

means for passing a first fluid fuel stream into the mixing chamber at said first end thereof;

means for passing a first combustion-supporting gas stream tangentially into the mixing chamber at a location spaced from said opening and adjacent the location of entry of said first fuel stream for mixing the first combustion-supporting gas and the first fuel stream and causing the resulting mixture to rotate about the longitudinal axis of said mixing chamber in a first direction, said first direction being one of a clockwise or counterclockwise direction relative to the longitudinal axis of the mixing chamber;

a burner having a combustion chamber with a longitudinal axis directed in generally a common direction relative to the longitudinal axis of the mixing chamber;

a conduit having one end connected to the mixing element in communication with said opening into the mixing chamber and the other end connected to the burner and opening tangentially into the combustion chamber, said conduit opening into the combustion chamber at an attitude for producing a clockwise rotation in the combustion chamber where the first direction is clockwise and for producing a counterclockwise rotation in the combustion chamber where the first direction is counterclockwise.

6. An apparatus, as set forth in claim **5,** wherein the size of said opening into the middle portion of said mixing chamber, the inside diameter of said conduit, and said first diameter are substantially equal;

additionally comprising means for passing a second fuel stream into the mixing chamber at said second end of the mixing chamber; and

means for passing a second combustion-supporting gas stream tangentially into the mixing chamber at a location adjacent the location of entry of said second fuel stream, said second combustion-supporting gas stream being directed relative to the longitudinal axis of said mixing chamber for causing the second combustion-supporting gas stream to rotate about the longitudinal axis of the mixing chamber in the first direction.

7. An apparatus, as set forth in claim **5,** wherein said first fuel stream comprises oil and the burner is part of a carbon black reactor.

8. An apparatus, as set forth in claim **5,** wherein said means for passing said first fuel stream comprises means for spraying the first fuel stream into the mixing chamber.

9. An apparatus, as set forth in claim **5,** wherein said first fuel stream passes generally axially into the mixing chamber.

10. An apparatus, as set forth in claim **6,** wherein said first and second fuel streams comprise oil and the burner is part of a carbon black reactor.

11. An apparatus, as set forth in claim **6,** wherein said means for passing said first fuel stream and said means for passing said second fuel stream each comprise means for spraying the respective fuel stream into the mixing chamber.

12. An apparatus, as set forth in claim **6,** wherein said first and second fuel streams pass generally axially into the mixing chamber.

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