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Culbertson

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[54] PROPORTIONING-MIXING APPARATUS

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[52] **U.S. Cl.** ..... **137/604,** 98/38 A, 98/38 B, 239/417.3

[51] **Int. Cl.** **F16k 19/00**

[58] **Field of Search** ..... 98/38, 38 A, 38 B; 137/604, 606; 236/13; 239/417.3

[56] **References Cited**

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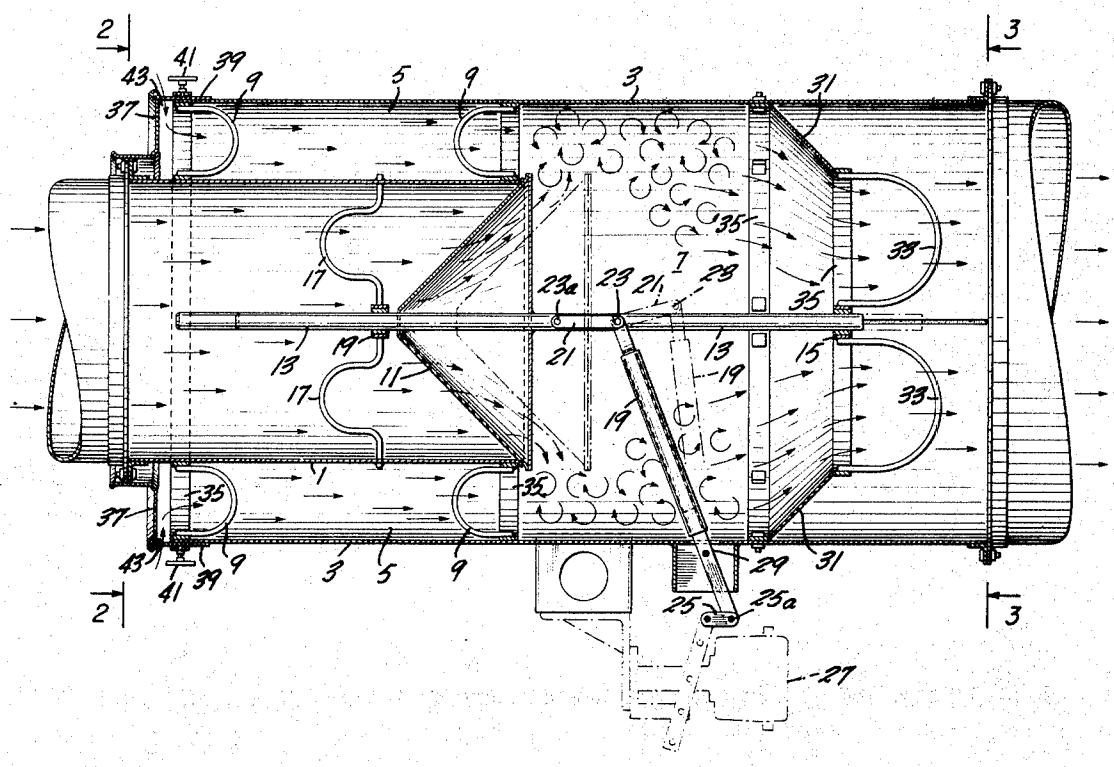
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Primary Examiner—Robert G. Nilson

[57] **ABSTRACT**

A mixing apparatus for proportionately mixing one fluid stream with another comprising an inner tube for the passage of one fluid stream, an outer tube concentric with said inner tube and defining a passageway therewith for the second fluid stream, the inner tube terminating interiorly at a distance from the outlet end of said outer tube. An axially movable conical member is provided in the outer tube having a base which in its normal position effectively seals the outlet end of the inner tube and whose apex portion extends interiorly in the inner tube for effective distribution of the fluid stream passing through the inner tube into a mixing zone in the outer tube. The outer tube is provided with angularly disposed baffle plates interiorly near its outlet end in order to promote turbulence and to insure a more thorough mixing of the fluid streams. A manually adjustable baffle plate at the inlet end of the outer tube controls the passage area of the fluid stream flowing through the outer tube and insure proper functioning of the mixing unit.

1 Claim, 4 Drawing Figures



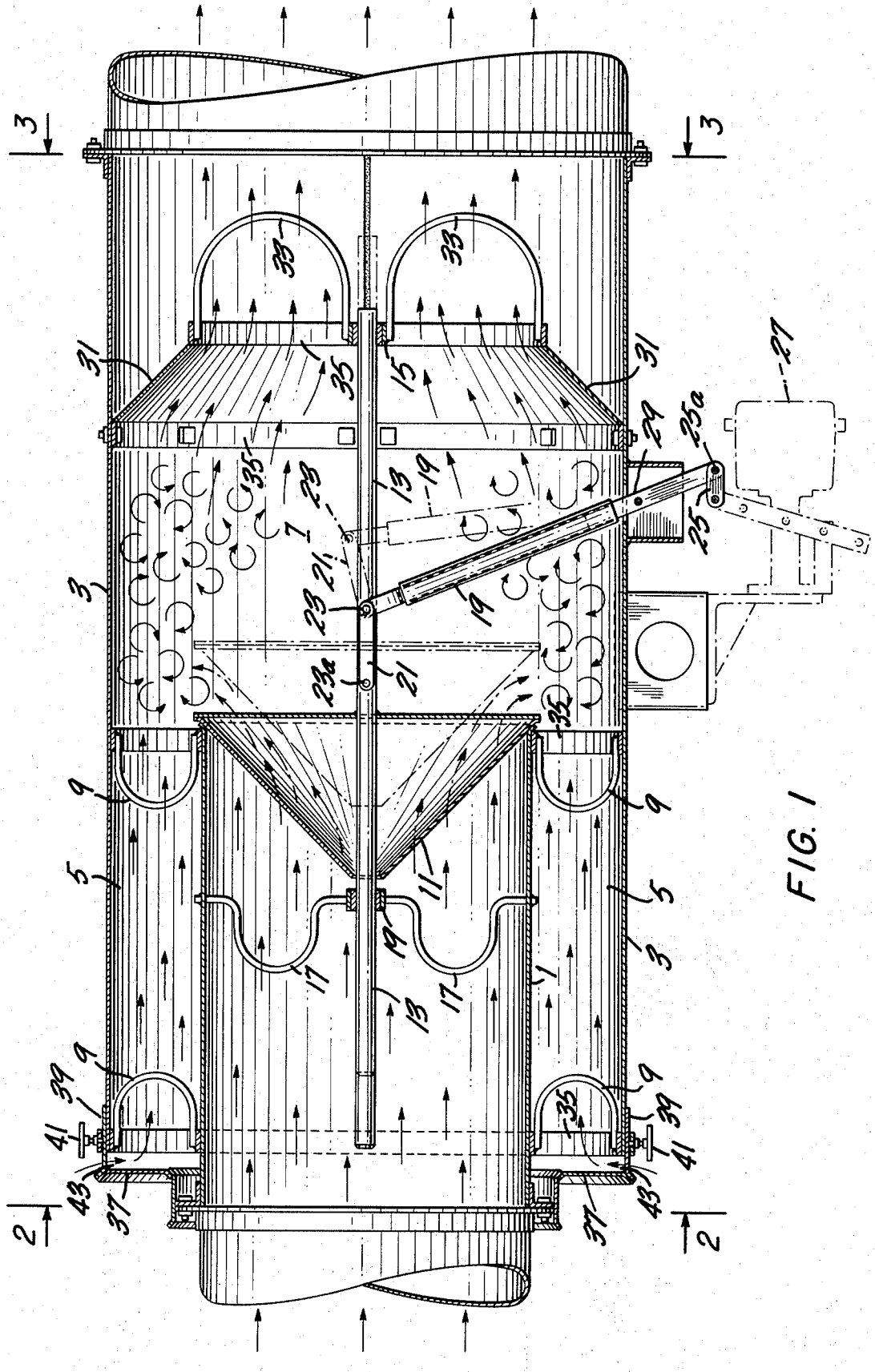

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FIG. 1

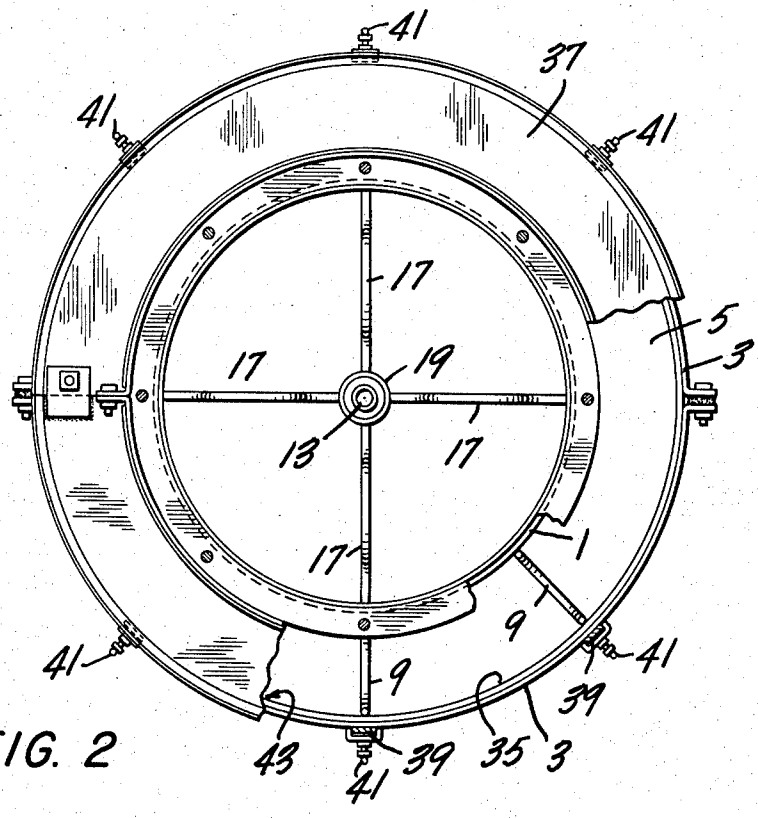

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FIG. 2

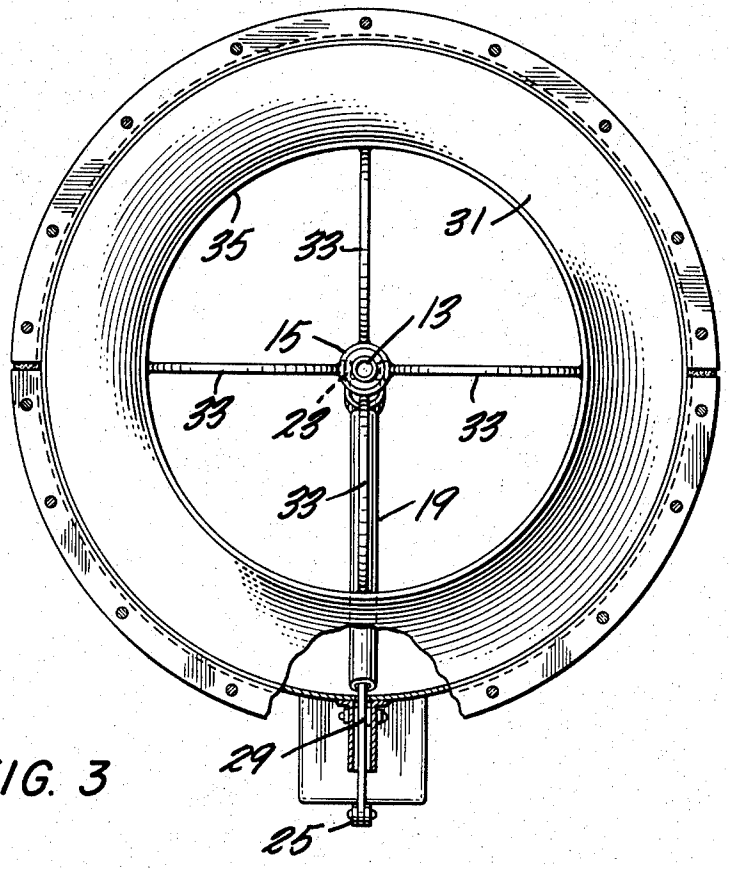

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FIG. 3

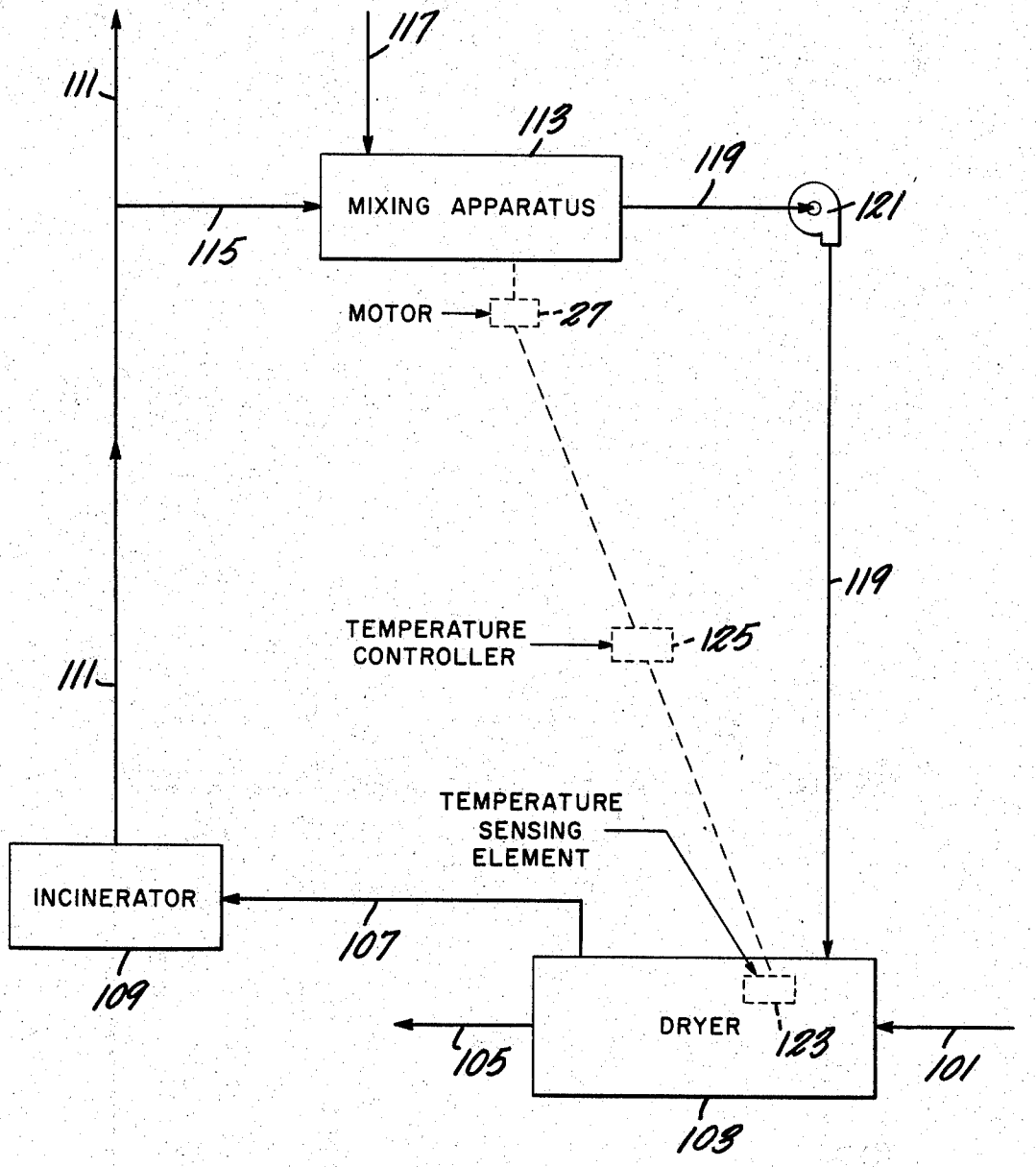

117
111
113
119
MIXING APPARATUS
121
115
MOTOR
27
119
TEMPERATURE
CONTROLLER
125
111
TEMPERATURE
SENSING
ELEMENT
INCINERATOR
107
109
DRYER
123
105
101
103

FIG. 4

PROPORTIONING-MIXING APPARATUS

FIELD OF INVENTION

This invention relates to a mixing apparatus and is particularly related to a proportionating-mixing apparatus designed for controlled mixing of two or more fluid streams having different temperatures and/or concentrations in order to provide a homogeneous fluid stream having a desired predetermined temperature and/or concentration.

BACKGROUND OF THE INVENTION

The use of fluid mixers is a matter of common industrial experience and indeed there is a variety of mixers which are intended for mixing different gaseous or liquid streams in order to provide a homogeneous stream having a desired characteristic. However, so far as is known, such mixers are either complicated in design, construction and/or operation, or they fail to insure the high degree of proportioning efficiency which is required to achieve the desired characteristic. For example, if it is desired to mix two gaseous streams which are, say, at 70°F. and 1,400°F., respectively, in order to provide a gaseous stream having a temperature of, say 500°F., the mixer employed must be capable of efficient intermixing of the individual gas streams so as to provide a homogeneous stream at essentially the desired temperature. While most known mixers are capable of providing a gas stream having a temperature which is relatively close to either temperature of the individual gas streams, they generally fail to provide a homogeneous stream at 500°F. So far as is known, there are no adequate mixers which are capable of providing a homogeneous gas stream at a temperature within the mid-range temperatures of the individual gas streams.

SUMMARY OF THE INVENTION

This invention provides a unique mixing apparatus which is capable of proportionately mixing two or more fluid (gas or liquid) streams in order to provide a homogeneous stream having a desired and predetermined characteristic. The apparatus of this invention generally comprises a relatively short inner tube for the passage of one fluid stream and a relatively longer outer tube concentric with said inner tube and defining a passageway therewith for the passage of the other fluid stream. At the exit end of the inner tube there is provided an axially movable conical member having a base which, in its initial (normal) position, effectively seals the exit end of the inner tube. The outer tube is provided with a pair of angularly disposed baffle plates near the exit end of this tube designed to promote further turbulence and to insure more thorough mixing of the fluid streams before leaving the mixing unit. The outer tube is also provided with a manually adjustable baffle at its inlet in order to control the amount of fluid stream passing through the outer tube. All these and other features of this invention will be more fully described hereinafter in connection with the appended drawings and detailed description of the preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a side view, partly sectional, of an apparatus embodying the features of this invention;

FIG. 2 is a front end elevational view of the apparatus shown in FIG. 1, i.e., the end at which the fluid streams enter the unit;

FIG. 3 is a rear end elevational view of the apparatus shown in FIG. 1, i.e., the exit end; and

FIG. 4 is a schematic diagram illustrating a typical system in which the apparatus of this invention may be used.

In the drawings, like numerals are employed to designate like parts.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, and specifically to FIG. 1, there is shown a relatively short inner tube 1 and a relatively longer outer tube 3 concentric with said inner tube and defining a passageway 5 therewith. The inner tube 1 terminates interiorly of the outer tube 3 at some distance away from the exit end of said outer tube so as to define a mixing zone 7 wherein the fluid streams are thoroughly mixed. The inner tube 1 and the outer tube 3 are secured together by means of struts or spokes 9 in order to impart structural integrity to the assembly. Several such spokes may be used to insure rigidity of structure.

At the exit end of the inner tube 1 there is provided a conical member 11 with its apex projected interiorly of said inner tube 1 as shown in FIG. 1, and having a base which at its normal position effectively seals the exit end of the inner tube hence preventing the fluid stream passing through said inner tube 1 from entering said mixing zone 7. As a practical matter, however, when the conical member 11 is in its initial normal sealing position, this seal is not entirely leak-proof and hence a very small amount of fluid enters the mixing zone. This amount, however, is ordinarily too insignificant to affect the normal operation of the unit.

Conical member 11 is welded on or is otherwise suitably secured to a centrally disposed axially movable member such as a rod 13 which cooperates with the conical member 11 to impart axial (longitudinal) movements thereto. At one end the rod 13 projects interiorly of said inner tube 1 beyond the apex of the conical member 11, and terminates at the other end in bearings 15 as shown in FIG. 1. The rod 13 is secured interiorly of the inner tube 1 by means of struts or spokes 17 one end of which is welded or otherwise suitably secured to the wall of the inner tube 1 and the other end of which is engaged through the bearings 19 in order to provide structural integrity to the rod 13 and to insure its proper alignment in the inner tube 1. Axial movement of the rod 13 is effected by the lever 19 one end of which is movably linked to the trailing arm 21 which is secured to the rod 13 as shown at 23 and 23*a*, and the other end of which is also movably linked to the link arm 25 as at 25*a*. The link arm 25 is actuated by the motor 27 in response to a signal from some external source (see FIG. 4). The lever 19 projects exteriorly of the outer tube 3 where it is linked with the aforesaid link arm 25 and a sealing member such as a gasket or a stuffing box (not shown) may be provided at 29 to further insure against leakage of any fluid from the mixing unit.

Also shown in FIG. 1 near the outlet end of the inner tube 3 are angularly disposed baffle plates 31 having

one end welded or otherwise suitably attached to the interior wall of the inner tube 3 and secured at the other end by means of struts or spokes 33 which are engaged in the bearing 15 in order to impart structural rigidity to this assembly. Additional structural rigidity of the entire unit may be insured by the stiffening rings 35 as shown in FIG. 1. The baffle plate 31 is angularly disposed within the outer tube 3, preferably at about 45°, in order to promote further turbulence and to insure more thorough and homogeneous mixing of the fluid streams before leaving the mixing unit.

The outer tube 3 is provided at its inlet with a manually adjustable baffle 37 which is normally slipped onto the outer tube 3 and is secured in position by means of support bars 39 and thumb screws 41. Support bars 39 are singular members adequately spaced to define an area 43 between said support members 39 for the passage of air or other fluids through said area 43 into passageway 5. The manually adjustable baffle 37 is initially adjusted back and fro in order to adjust the passage area 43 and to insure constant flow of fluid through passageway 5 during the operation of the mixing unit. As the position of the manually adjustable baffle 37 is changed back and fro, the passage area 43 is increased or decreased hence changing the pressure drop across this area until a position is found at which the pressure drop is such as to insure continuous flow of fluid through passageway 5 into the mixing zone 7. The manually adjustable baffle 37 is then secured tightly in this position by means of the said support bars 39 and thumb screws 41 and no further adjustment is made until it becomes necessary.

The operation of the mixing apparatus of this invention will now be described in conjunction with FIGS. 1 and 4 hereof wherein FIG. 4 describes schematically a typical operation in which hot gases from a process unit are mixed with cooler gases in order to obtain a homogeneous gas stream having a predetermined desired temperature for delivery to the process unit. While FIG. 4 is described in connection with a drying operation for the removal of solvent from a process stream, the mixing apparatus of this invention may be efficaciously employed in other operations as well, wherever it is desired to mix two or more fluid streams in order to obtain a homogeneous fluid stream having the requisite characteristics.

Thus, referring to FIG. 4, the process stream (for example, paper coated with a solvent-base resinous material) enters via conduit 101 through a dryer 103 which, say, is operating at a temperature of 400°F., and leaves the dryer via conduit 105. The exhaust from the dryer leaves via conduit 107, incinerated in an incinerator 109 and the incinerator fumes are discharged to the atmosphere via conduit 111 at a temperature of, say, about 1,200–1,400°.

Also shown in FIG. 4 is a proportionating-mixing unit 113 (shown in detail in FIG. 1) for mixing a hot gaseous stream flowing through a conduit 115, tapped off from the incinerator effluent stream 111, and enters the mixing apparatus 113 at the inner tube 1 as shown in FIG. 1. The cold gaseous stream is supplied to the mixing apparatus 113 via conduit 117 which flows through the passage area 43 and passageway 5 of the outer tube 3 shown in FIG. 1. The two gaseous steams are mixed in the mixing apparatus 113 as will hereinafter be described and leave that unit as a homogeneous gas stream through conduit 119 which is then delivered to the dryer by an auxialiary mechanical means such as a blower 121.

Also shown in FIG. 4, the dryer 103 is equipped with a temperature-sensing element 123 which senses the temperature of the gaseous stream delivered to the dryer via conduit 119. When the temperature in the dryer drops below the desired temperature, a signal is transmitted from the temperature-sensing element to a temperature controller 25 which in turn sends a proportionating signal to the motor 27 which in turn actuates the lever 29 causing axial movement of the rod 13 and conical member 11. Thus, referring once again to FIG. 1, conical member 11 will be gradually displaced from its initial position to its phantom position and as it moves axially in that direction, hot gases from the inner tube 1 will contact the cold gases entering the mixing zone 7 through the passageway 5 in the outer tube 3. Actually and throughout the operation of the mixing unit described herein, conical member 11 is always in a somwhat open position and continually moves back and fro in order to provide the proportional amount of hot gases required to achieve the ultimate desired gas temperature. Accordingly, conical member 11 may be aptly referred to as a proportionating cone and the mixing apparatus of this invention referred to as a proportioning-mixing apparatus.

The provision of conical member 11 in accordance with this invention insures substantially equal division and distribution of the fluid stream flowing through the inner tube 1 during the axial movement of the conical member while at the same time causing a change in the direction of flow of this fluid stream as shown in FIG. 1. Accordingly, in addition to proportionating the amount of hot gases required to achieve the ultimate desired temperature, the conical design promotes turbulence in the mixing zone 7 and hence enhances the efficiency of intermixing of the two gaseous streams.

While the proportioning-mixing apparatus of this invention has heretofore been described with a certain degree of particularity in order to facilitate its understanding, it is obvious from the aforesaid description that certain changes and/or modifications may be made in this apparatus which are obvious and which nevertheless fall within the scope of this invention. Furthermore, while the aforesaid description has been directed to the intermixing of two gaseous streams to achieve a single homogeneous gas stream having a desired predetermined temperature, the proportioning-mixing apparatus of this invention is generally adapted for use in mixing gaseous streams having different concentrations, or to the intermixing of liquids. In all of the cases, the process stream is generally introduced into the inner tube while the other stream is conducted through the outer tube. Otherwise, with some minor obvious modifications, the design and the operation of the apparatus of this invention is essentially as hereinbefore described.

What is claimed is:

1. A fluid mixing apparatus comprising a relatively short inner tube having an inlet end and an outlet end for the passage of a first fluid stream; a relatively longer outer tube concentric with said inner tube and defining a passageway therewith for a second fluid stream, said outer tube having an inlet end and outlet end, said inner tube terminating interiorly in said outer tube at a distance away from said outlet end of said outer tube; an axially movable conical member having a base dis-

posed adjacently exterior of said outlet end of said inner tube and essentially sealing said outlet end of said inner tube when said conical member is at its initial normal position, said conical member having an apex portion projecting interiorly in said inner tube; a mixing zone defined by the base of said conical member and said outlet end of said outer tube; a centrally disposed longitudinally movable member extending through the apex of said conical member and having two ends, one end terminating interiorly of said inner tube and the other end terminating at the outlet end of said outer tube, said longitudinally movable member being affixed to said conical member so as to axially bias the movement of said conical member; a lever member for axially biasing said longitudinally movable member; a manually adjustable baffle disposed at the inlet end of said outer tube, and a baffle plate downstream of said mixing zone, said baffle plate being inwardly tapered toward the longitudinal axis of said outer tube.

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