June 17, 1952 T. L. CLIFT 2,600,733

GAS MIXING APPARATUS

Filed Dec. 6, 1950

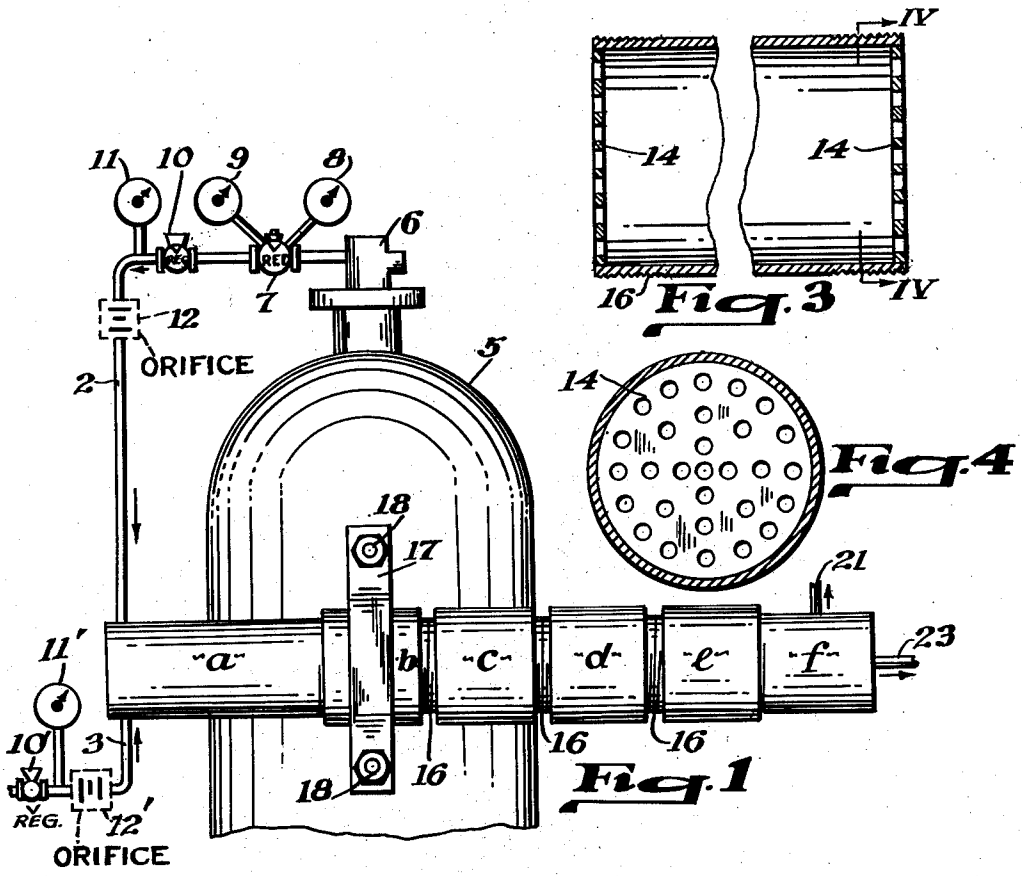

Fig. 1

Fig. 3

Fig. 4

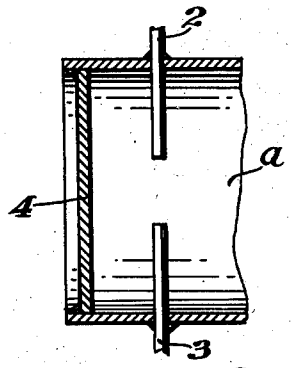

Fig. 2

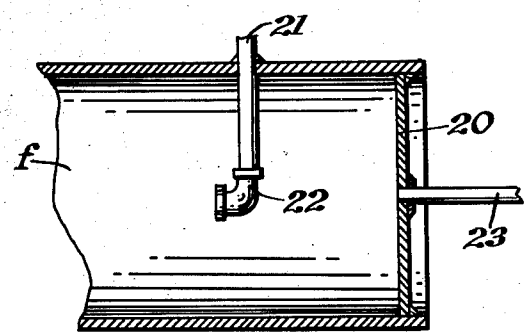

Fig. 5

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Patented June 17, 1952

2,600,733

UNITED STATES PATENT OFFICE

2,600,733

GAS MIXING APPARATUS

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Application December 6, 1950, Serial No. 199,509

7 Claims. (Cl. 259—4)

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To mix gases uniformly presents inherent difficulties, and particularly where there is material difference in the specific gravities of the gases to be mixed, also particularly where the mixing operation is to be performed in a short time and without undue complication of apparatus. Notably, in mixing gases for purposes of calibration of instruments, as for instance providing mixtures of carbon dioxide and air in precision for calibrating instruments used in detecting and recording carbon dioxide content in boiler flue and stock determinations, the requirements are rigid. By the present invention, construction may be had which allows accurate mixing of gaseous components, and in continuous manner, and with relative simplicity. Other objects and advantages of the invention will appear from the following description.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is a fragmentary side elevational view showing an embodiment of the invention;

Fig. 2 is a fragmentary axial section of the left-hand portion of the mixing chamber;

Fig. 3 is a fragmentary axial section of an intermediate portion of the chamber;

Fig. 4 is a transverse section taken on plane indicated by line IV, Fig. 3; and

Fig. 5 is a fragmentary axial vertical section of the right-hand end of the apparatus.

As shown at Fig. 2, the initial contact of the gases to be mixed is provided by head-on jetting of gas stream against gas stream under pressure from pipes 2, 3, near the closed end 4 of a mixing chamber. The pipe 2 is connected with the source of high pressure gas, for example, a container or cylinder 5 with outlet head 6, and reducing valve 7, with high pressure gauge 8 and lower pressure gauge 9. From the reducing valve, pipe 2 connects through a pressure regulator or a constant differential flow regulator 10 and gauge 11 and flow orifice 12 to the mixing chamber. The opposed gas pipe 3 leads from a source of gas under pressure, also through a pressure regulator 10', gauge 11' and flow-orifice 12'. As thus seen, the two streams of gas, under pressure, violently impinge head-on in the mixing chamber

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and swirl thence through a series of baffles 14. Preferably, the mixing chamber as a whole, for convenience, is made up of assemblable sections *a*, *b*, *c*, *d*, *e*, *f*, and in whichever sections desired, as for example the sections 16 between each of the sections *b*, *c*, *d*, *e*, two baffle plates each are carried. These baffles 14, as shown in Figs. 3 and 4 are desirably of disc form, held in the section casing suitably, as shown by welding, each baffle plate having evenly spaced holes, the diameter of which may depend somewhat on the gases being mixed. The number of baffle plates, and the number of sections *b*, *c*, etc., can also be varied as desired. With particular convenience, the sections making up the mixer may be screw-threadedly connected. Thus, assembly and disassembly is facilitated. In some instances, the sections *a* and *f* may be pipe of suitable size for the particular situation involved, and sections *b*, *c*, *d*, *e*, may be pipe couplings connecting intermediate sections 16. The assembly is suitably supported, safeguarding the connecting lines 2, 3, and in one form may be conveniently held to the gas container 5 by holding clamp 17 and screw-threaded means 18. Beyond the series of baffles, the section *f* is closed at the end 20, and provides discharge means. Preferably, this is in the form of a discharge pipe 21 having an elbow bend 22 directed in the axial center. This pipe, with suitable control valve may thus lead off a mixed gas product as desired. An additional discharge pipe 23, suitably valve controlled, is also desirably provided axially positioned in the end plate 20.

The operation will be understood from the foregoing. For example, if it is desired to make up a mixture of CO_2 and air for calibrating usage, carbon dioxide gas at around 500 lbs. per sq. in. may be taken from the container 5 through the reducing valve 7, regulator 10 and flow-orifice 12, the pressure being reduced as desired, for instance to 5 lbs. per sq. in., and constant pressure, as measured by the gauge 11 on the upstream side of the orifice 12, is supplied through the pipe 2. In the particular usage described, this flow-orifice may be 1/64 in. By proper adjustment of the regulator 10, the desired rate of carbon dioxide flow is provided. In like manner, the desired proportioned flow of compressed air may be provided through the regulator 10' and the flow-orifice 12', for example usually about 3 or 4 lbs. per sq. in. at the gauge 11'. The two gas streams abut violently head-on in the mixing section *a*, and swirling through the spaced baffles 14 are rapidly and completely

mixed, and the mixed product is drawn off, as by pipe 21.

Illustrative of percentage mixing which may be attained with accuracy, the following runs for 14.4% and 9% respectively of CO_2 are noted:

	For 14.4%	For 9%
Gauge 8 (lbs. per sq. in.)	635	635
Gauge 9 (lbs. per sq. in.)	41	41
Gauge 11 (lbs. per sq. in.)	5	4.2
Gauge 11′ (lbs. per sq. in.)	2.75	3.0
Per Cent. CO_2 in Air in Line 21	14.4	9.0

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In gas mixing apparatus, a compressed gas container, an outlet pipe therefrom having a reducing valve, a pressure regulator, pressure gauge and flow-orifice, a cylindrical multi-section mixing chamber into which said pipe enters radially near one end, means for holding said mixing chamber to said container, another pipe for a compressed gas with a pressure regulator, pressure gauge and flow-orifice and entering said mixing chamber diametrally spaced to the aforesaid pipe for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes and extending to perforated baffles in sections screw-threadedly connected on serially, a discharge section, a discharge pipe having an elbow bend in the axial center of said section and an exit radially directed through the side wall, and another discharge pipe extending axially of said section.

2. In gas mixing apparatus, a compressed gas container, an outlet pipe therefrom having a reducing valve, a pressure regulator, gauge and flow-orifice, a cylindrical multi-section mixing chamber into which said pipe enters radially near one end, another pipe for a compressed gas with a pressure regulator, pressure gauge and flow-orifice and entering said mixing chamber diametrally spaced to the aforesaid pipe for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes and extending to perforated baffles in sections screw-threadedly connected on serially, a discharge section, a discharge pipe having an elbow bend in the axial center of said section and an exit radially directed through the side wall, and another discharge pipe extending axially of said section.

3. In gas mixing apparatus, pressure gas supplied pipes each with a pressure regulator, gauge and flow-orifice, a cylindrical multi-section mixing chamber into which said pipes enter diametrally spaced for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes, perforated baffles through which the gas mixture then flows, said baffles being in sections screw-threadedly connected on serially, a discharge section, and a discharge pipe having an elbow bend in the axial center of said section and an exit radially directed through the side wall.

4. In gas mixing apparatus, pressure gas supplied pipes each with a pressure regulator, gauge and flow-orifice, a cylindrical multi-section mixing chamber into which said pipes enter diametrally spaced for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes, perforated baffles through which the gas mixture then flows, a discharge section, and a discharge pipe having an elbow bend in the axial center of said section and an exit radially directed through the side wall.

5. In gas mixing apparatus, a multi-section mixing chamber, pressure gas supply pipes entering said chamber diametrally spaced to each other for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes, perforated baffles through which the gas mixture then flows, said baffles being in sections screw-threadedly connected on serially, and a discharge section with a discharge pipe.

6. In gas mixing apparatus, a multi-section mixing chamber, pressure gas supply pipes entering said chamber diametrally spaced to each other for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes, and a series of perforated baffles through which the gas mixture then flows.

7. In gas mixing apparatus, a mixing chamber, feed pipes for respective gases entering said chamber diametrally spaced for the jetting of the gas streams head-on against each other, an expansion mixing space surrounding the ends of said entering pipes, a series of spaced perforated baffles through which the gas mixture then flows, and outlet means therebeyond.

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