

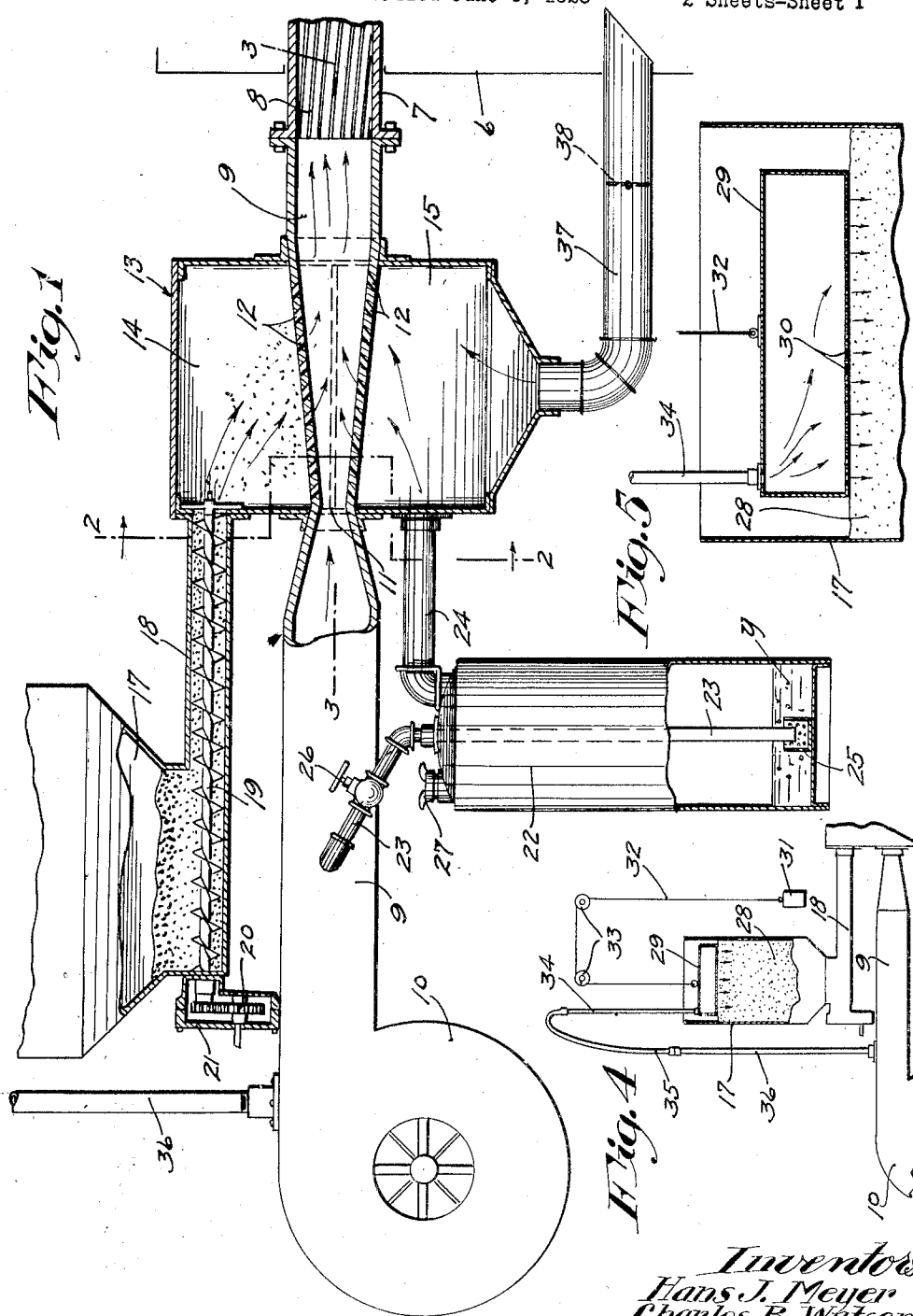
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1,476,994

H. J. MEYER ET AL
FUEL COMMINGLER AND BURNER

Filed June 4, 1923

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2a

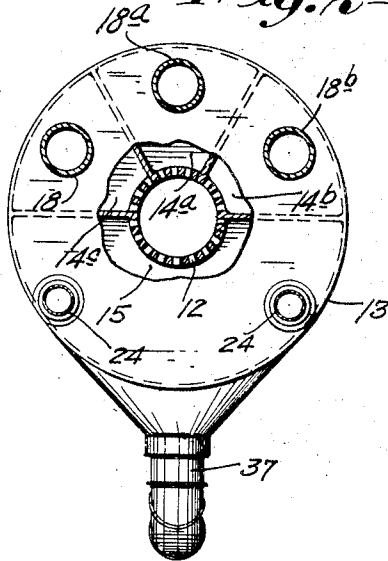


Fig. 2

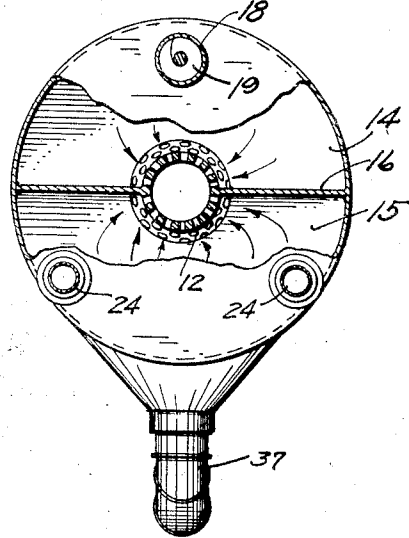


Fig. 3

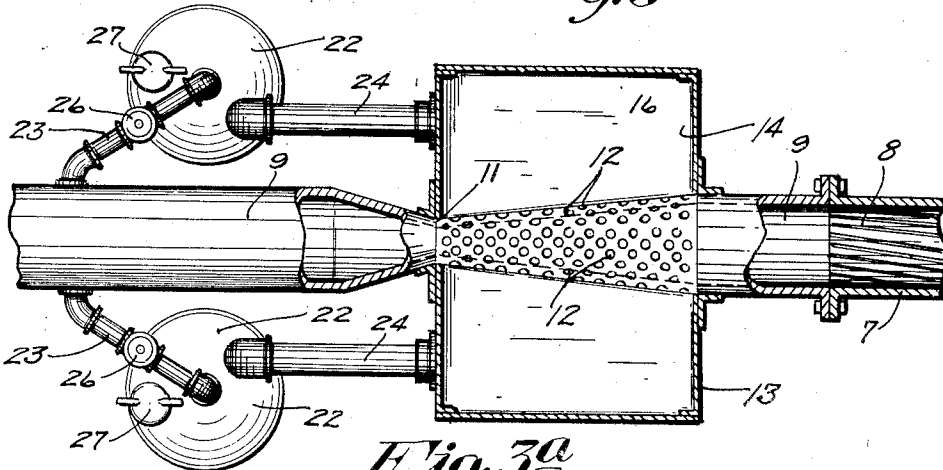
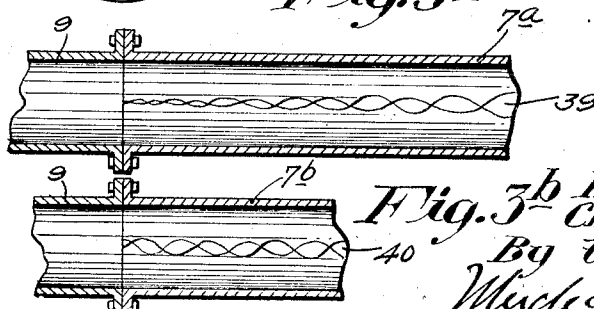


Fig. 3a



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UNITED STATES PATENT OFFICE.

HANS JULIUS MEYER AND CHARLES BRUCE WATSON, OF MINNEAPOLIS, MINNESOTA.

FUEL COMMINGLER AND BURNER.

Application filed June 4, 1922. Serial No. 643,361.

To all whom it may concern:

Be it known that we, HANS JULIUS MEYER and CHARLES BRUCE WATSON, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Fuel Comminglers and Burners; and they do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to the art of producing efficient combustion and provides a highly important improvement in the synthetic formation of fuels and in the mixing and delivery thereof to combustion chambers. The combustible elements of the synthetic fuel may be finely divided solids, liquids or gases, in various combinations and proportions.

The invention involves an improved process and provides an apparatus or device which will permit or control the combination of the various combustible substances and which will thoroughly mix and diffuse the air, fuels formed synthetically or separately for the ultimate purpose of liberating heat units at a maximum rapidity and with a maximum efficiency. The improved apparatus or device differs materially from those hitherto used for similar purposes, in that, by a new application of the well known principles involved in the use of Venturi contracta in combination with other important features to be hereinafter disclosed, we are able to more thoroughly diffuse air and the various fuels in more exact proportions than has hitherto been accomplished, and thus to produce a unit volume of combustible far more economical and efficient, in respect to heat content, and to deliver this volume to the combustion chamber at a desirable low velocity.

Prior attempts to accomplish the above noted desirable results have produced various devices which deliver the fuel and air to the combustion chamber in more or less stratified form, and which utilizes the combustion chamber as the place wherein is performed the function of combining the air and fuel in the proper portions.

Our invention provides an apparatus or device which makes not only possible but

decidedly practicable the use of fuel in synthetic forms. We can use the various fuels in many different combinations, such, for example, as a combination of low grade pulverized peat, diffused air and a small quantity of highly volatile and attenuated vapor, which latter, in itself, may be a combination of one or more vapors of varied characteristics, depending upon the locality and market conditions. Instead of pulverized peat, any of the pulverized coals or the like may be used. In other instances, all of the component elements of the synthetic fuel may be in liquid or vapor form. This makes possible a great many combinations of fuels and substances from which the greatest heat value can be obtained at the lowest possible cost for any given locality.

In carrying out our invention, we employ a radially perforated Venturi tube in which we take advantage of the sucking phenomena by which fuels, gases, air, etc., drawn in through the perforations, are taken up by the stream of air and diffused with the air in a contracted form, and then the mixture is expanded in the divergence of the tube, thus reducing the velocity of the mixture. At the point of maximum expansion, this mixture comes under the influence of a helicoid that is approximately horizontally disposed and parallel to the path of the mixture, and this helicoid gives a centrifugal motion to the mixture, which assists the diffusing action and brings each particle of the pulverized solids into intimate contact with other particles and vapors. This results in mechanical and chemical mixtures of uniform density and structure, and thus, in using a fuel of low volatile content with a highly volatile vapor, the vapor completely surrounds and adheres to the fuel until subject to the heat of the furnace, where the fuel is then more rapidly ignited and caused to release its heat content far more quickly than under any of the methods or with any of the apparatuses hitherto employed.

Our invention further provides improved means, in the nature of a pneumatic agitator, for maintaining agitation of pulverized fuel, such as coal dust, in the main supply hopper. This pneumatic agitator is in the form of a perforated float connected to a source of air under pressure, and arranged to ride on top of the pulverized fuel and,

by the delivery of numerous streams of air downward onto the same, to keep the mass in loose condition, so that it will be properly fed under the action of gravity.

From what has been said, it will be obvious that the invention is capable of a large range of modification. However, the accompanying drawings illustrate what is at present believed to be a preferred form of the apparatus or device.

Referring to the drawings, wherein like characters indicate like parts throughout the several views,

Fig. 1 is a view partly in side elevation and partly in vertical section, showing one form of our improved apparatus;

Fig. 2 is a transverse vertical section taken approximately on the irregular line 2—2 of Fig. 1;

Fig. 2^a is a view corresponding to Fig. 2, but illustrating a slightly modified construction;

Fig. 3 is a view partly in plan and partly in horizontal section on the line 3—3 of Fig. 1;

Figs. 3^a and 3^b are details in horizontal section illustrating modified forms of the rifled delivery end or helicoid of the fuel delivery tube;

Fig. 4 is a view partly in side elevation and partly in vertical section, illustrating particularly the feed hopper and the pneumatic agitator provided therein; and

Fig. 5 is a fragmentary vertical section showing the upper portion of the feed hopper and the float of the pneumatic agitator.

In Fig. 1, the numeral 6 indicates diagrammatically the front end of a furnace, which furnace may be of any well known or suitable structure. Opening into the combustion chamber of this furnace, through the front thereof, is a fuel delivery tube 7, the interior of which is rifled or provided with spiral ribs 8 for a purpose already briefly noted and to be hereinafter further considered. The outer end of the fuel delivery tube 7 is connected to the discharge end of a Venturi tube 9, the receiving end of which tube is connected to the discharge end of a power-driven fan or blower 10. The contracta or smallest diameter of the Venturi tube 9 is at 11, and the said tube flares or increases in diameter in both directions from said contracted point. The flaring conical delivery portion of the Venturi tube 9 is provided with radially and circumferentially spaced perforations 12, for a very important purpose, which will be presently noted. The perforated flaring delivery portion of the Venturi tube 9 extends through and is surrounded by a casing 13, which, in the arrangement illustrated in Figs. 1, 2, 3 and 4, is divided into upper and lower compartments 14 and 15 by a horizontal partition 16.

A finely divided solid fuel, such, for ex-

ample, as pulverized coal or peat, will be delivered into the upper compartment 14, supplied from a large hopper 17 provided with a horizontal discharge spout 18 which, as shown, opens through the rear wall of said compartment 13. To force the pulverized fuel from the hopper 17 into the compartment 13, the spout 18 is shown as provided with a spiral conveyor 19 adapted to be driven from a suitable power device, not shown, through gears 20 contained in a gear housing 21, which latter, as shown, affords a connection between the top of the blower 10 and the bottom of the hopper 17.

One or more different kinds of fuel will be introduced into the lower compartment 15, and for illustration, it may be assumed that vaporized kerosene and vaporized gasoline are to be the two fuels introduced into said chamber 15. To arrange for this, we provide two vaporizing tanks 22 adapted to contain more or less of the respective hydrocarbon vapors. Air supply tubes 23 tap opposite sides of the receiving portion of the Venturi tube 9 and are extended downward through the tops nearly to the bottoms of the respective vaporizing tanks 22. Vapor delivery tubes 24 tap the tops of the tanks 22 and open into the lower compartment 15, preferably at opposite sides thereof. Ad- visably, small cups 25 are placed on the bottoms of the tanks 22 and the lower ends of the air tubes 23 open directly into these cups. Air tubes 23 are shown as provided with valves, and the tanks 22 are provided with filler necks normally closed by caps 27.

In Fig. 4 the pulverized fuel contained in the tank 17 is designated by the numeral 28. Arranged to ride on top of this mass of pulverized fuel is a so-called float in the form of a hollow metal shell 29, the sides and top of which are imperforate but the bottom of which has numerous perforations or air discharge passages 30. The weight of this float 29 will be nearly but not quite sustained by a counterweight 31 connected to said float by a cable 32 arranged to run over guide sheaves 33. The float 29 has an upstanding rigidly connected air tube 34, the upper end of which is connected by a flexible air tube 35 to the upper end of an air tube 36, the lower end of which is rigidly connected to the discharge spout of the blower 10 and receives a limited amount of air therefrom.

The numeral 37 indicates a warm air pipe that leads into the bottom of the lower compartment 15 from the lower portion of the furnace 6 and is provided with a damper 38

Operation.

The apparatus above described for the production and burning of synthetic fuels, when in operation, will act substantially as follows:

The solid pulverized fuel from the hopper

17 will be delivered into the upper fuel chamber 14 in an even and properly regulated stream by the action of the spiral conveyor 19, and will fall within said chamber in the form of a shower. When the valves 26 are opened, a proper part of the air delivered from the blower 10 will be delivered through the air tubes 23 into the vapor generating tanks 22 and will produce pressure in said tanks above atmospheric pressure. Inasmuch as the delivery ends of the tubes 23 are below the level of the liquid, to wit: kerosene or gasoline γ contained in said tanks 22, the air will be caused to bubble up through said liquids, producing agitation therein so that the air rising above said liquids will be richly charged with hydrocarbon, vapor, and these hydrocarbon vapors will be forced through the vapor pipes 24 into the lower fuel chamber 15.

Under the action of the blower, the air will move with the greatest velocity through the contracted portion 11 of the Venturi tube, and as it moves onward through the perforated flaring delivery portion of said tube, its velocity will tend to decrease as the air expands, but it will produce partial vacuum in the fuel chambers 14 and 15 and, hence, will draw the pulverized fuels from the chamber 14 and the hydrocarbon vapors from the lower compartment 15 into the Venturi tube, thereby effecting the initial commingling thereof with each other and with the main air blast. Because of the large number of air passages in the Venturi tube, this commingling of the fuels with each other and with the air will be accomplished almost instantly and very completely, and the violent agitation that will take place in the Venturi tube and particularly in the discharge portion thereof, including the tube 7, will insure the most complete and thorough commingling of the pulverized solid fuel particles and the vaporized hydrocarbon fuels. In fact, under this manner of commingling of the fuels, each and all of the fine particles of the solid fuel will not only be completely surrounded by the vapor fuel, but the solid particles will absorb more or less of the vapor fuel. The rifling or spiral ribs 8 of the delivery tube 7 will set up a whirling motion of the commingled fuels, or, in other words, of the synthetic fuel, so that it will be delivered into the furnace in the form of a rotating blast, which further insures commingling of fuels and a complete and intense combustion, which will take place very quickly. This quick and intense combustion insures burning of all of the combustible particles of the synthetic fuel, which, of course, results in a maximum heat efficiency and abatement of the smoke nuisance, which latter is always present when there is an incomplete combustion.

When the warm or hot air pipe 37 is used

and the damper 38 is open, hot air or vapors from the furnace will be drawn into the lower chamber 15 and these will be commingled with the several fuels in the Venturi tube, thereby preheating the synthetic fuel and making its combustion still more rapid.

While the actions above described are taking place, a limited amount of air from the blower will be delivered through the air tubes 36, 35 and 34 into the float 29 and will be discharged against the mass of pulverized fuel 28, thereby agitating and loosening the same so that the said fuel will not bridge but will continuously flow to the bottom of the hopper. Obviously, as the mass of fuel 28 lowers, the float 29 will follow the same down to the bottom of the tank, or hopper. When the hopper is to be refilled with fuel, the float may be readily lifted out of the way.

Modifications.

The apparatus above described in detail is designed for the delivery to the Venturi tube of only one kind of pulverized or finely divided solid fuels, but in Fig. 2^a, there is illustrated an arrangement for the delivery of three different kinds of solid pulverized fuels, which may be assumed to be pulverized coal, coke dust and sawdust. Hence, in this modified arrangement, the upper compartment of the casing 13 is divided into three chambers 14^a, 14^b and 14^c, and each of said chambers is provided with its own fuel delivery spout 18^a, which may correspond to the tube 18 of the previously described construction. It may be assumed that the pulverized coal will be delivered into the chamber 14^a, but the coke dust will be delivered into the chamber 18^b and that the sawdust will be delivered into the chamber 14^c.

The above described arrangements or constructions illustrate the important fact that, by our invention, any desired number of different kinds of solid pulverized or finely divided fuels may be commingled with any desired number of vaporized or fluid fuels.

Figs. 3^a and 3^b illustrate a modified form of helicoid for producing spiral rotation and centrifugal motion to the synthetic fuel or mixture at the point of maximum expansion. In Fig. 3^a, the fuel delivery tube 7^a is provided with an internal spiral 39 that is tapered and increases in diameter in the direction of the travel of the air blast and fuel through said tube. In Fig. 5, the fuel delivery tube 7^b is provided with a spiral 40 which is like the spiral 39, except that it is not tapered.

It is highly important to note that in all of the arrangements described, the various different fuels or combustible substances are thoroughly and substantially perfectly commingled before they are delivered into the

combustion chamber or furnace, or, at any rate, that this commingling is fully accomplished or completed at the delivery end of the fuel delivery tube and before it reaches the point of ignition within the combustion chamber or furnace.

What we claim is:

1. In a fuel commingler and burner, a Venturi tube having fuel intake means in its expanding delivery portion, means for delivering fuel to said fuel intake means, and means for forcing a blast of air through said Venturi tube.

2. In a fuel commingler and burner, a Venturi tube having an expanding delivery portion with a multiplicity of fuel intake passages therein, a fuel chamber delivering to said intake passages, means for delivering fuel to said fuel chamber, and means for forcing a blast of air through said Venturi tube.

3. In a fuel commingler and burner, a Venturi tube having a flaring perforated portion on the delivery side of its point of maximum contraction, fuel chambers surrounding the perforated portion of said Venturi tube, means for delivering different fuels to said fuel chambers, and means for forcing a blast of air through said Venturi tube.

4. In a fuel commingler and burner, a Venturi tube having a flaring perforated portion on the delivery side of its point of maximum contraction, a casing surrounding the perforated portion of said Venturi tube and divided into upper and lower chambers, means for delivering finely divided solid fuel into said upper chamber, means for delivering a vapor fuel into said lower chamber, and means for forcing a blast of air through said Venturi tube.

5. In a fuel commingler and burner, a Venturi tube having a flaring perforated portion on the delivery side of its point of maximum contraction, a casing surrounding the perforated portion of said Venturi tube and divided into a lower and a plurality of upper chambers, means for delivering different kinds of solid pulverized fuel into the several different upper chambers, means for delivering a vapor fuel into said lower chamber, and means for forcing a blast of air through said Venturi tube.

6. In a fuel commingler and burner, a Venturi tube, means for forcing a blast of air through said Venturi tube, and means for delivering a plurality of different fuels into said Venturi tube.

7. In a fuel commingler and burner, a Venturi tube, means for forcing a blast of air through said Venturi tube, and means for delivering a plurality of different fuels into said Venturi tube, said latter means including perforations in said Venturi tube and a plurality of lower and upper cham-

bers surrounding said perforations and into which chambers the different fuels are introduced, the solid fuels being introduced into upper chambers.

8. In a fuel commingler and burner, a Venturi tube having fuel intake means, means for forcing a blast of air through said Venturi tube, a vaporizing tank, a chamber connected to the upper portion of said vaporizing tank and delivering to the intake means of said Venturi tube, and an air delivery tube connected to the receiving portion of said Venturi tube and extended into said vaporizing tank and terminating near the bottom thereof.

9. In a fuel commingler and burner, a Venturi tube having fuel intake means in its expanding delivery portion, means for delivering fuel to said fuel intake means, means for forcing a blast of air through said Venturi tube, and a helicoid at the delivery end of said Venturi tube.

10. The structure defined in claim 9 in further combination with a combustion chamber into which said helicoid is arranged to deliver a spiral blast of fuel.

11. In a fuel commingler and burner, a Venturi tube having a flaring perforated portion on the delivery side of its point of maximum contraction, fuel chambers surrounding the perforated portion of said Venturi tube, means for delivering different fuels to said fuel chambers, means for forcing a blast of air through said Venturi tube, and a helicoid at the delivery end of said Venturi tube.

12. The structure defined in claim 11 in further combination with a combustion chamber into which said helicoid is arranged to deliver a spiral blast of commingled fuel.

13. In a fuel commingler and burner, a Venturi tube, means for forcing a blast of air through said Venturi tube, means for delivering a plurality of different fuels into said Venturi tube, and a helicoid at the delivery end of said Venturi tube.

14. The structure defined in claim 13 in further combination with a combustion chamber into which said helicoid is arranged to deliver a spiral blast of commingled fuel.

15. In a fuel commingler and burner, a Venturi tube, means for forcing a blast of air through said Venturi tube, means for delivering a plurality of different fuels into said Venturi tube, and a combustion chamber into which said Venturi tube is arranged to deliver a blast of commingled fuel.

16. In a fuel commingler and burner, a Venturi tube, means for forcing a blast of air through said Venturi tube, and means for delivering a plurality of different fuels into said Venturi tube, in further combination with a combustion chamber and a hot

air pipe leading therefrom and delivering combustion chamber to said lower fuel to said Venturi tube. chamber.

17. The structure defined in claim 4 in further combination with a combustion In testimony whereof we affix our sig- 10
5 chamber into which said Venturi tube is natures.
arranged to deliver the blast of commingled
fuel, and a hot air pipe leading from said

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