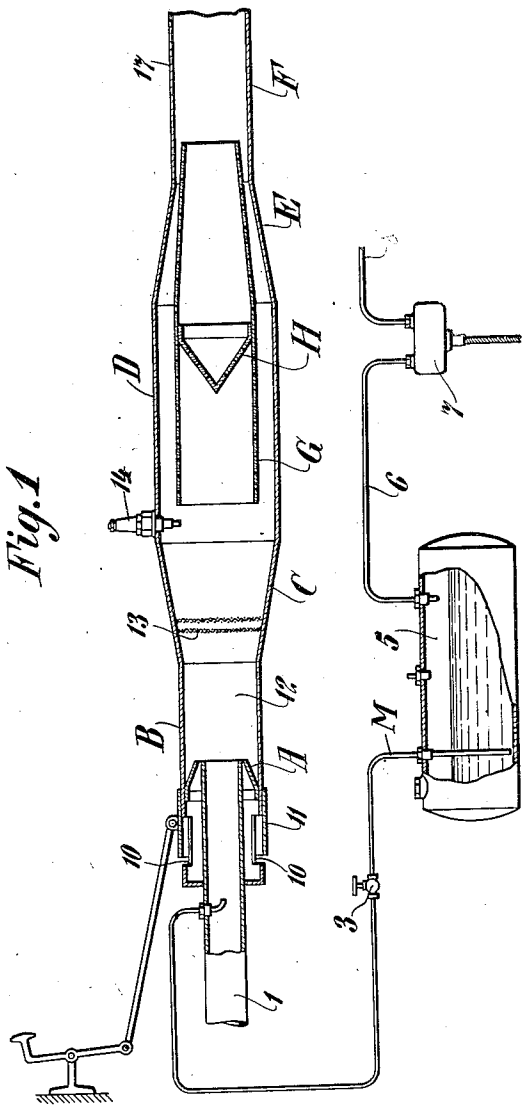
Dec. 1, 1931. L. C. HYATT 1,834,126

BURNER FOR EXHAUST GASES

Original Filed May 6, 1927 2 Sheets-Sheet 1

Fig. 1



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Fig. 2

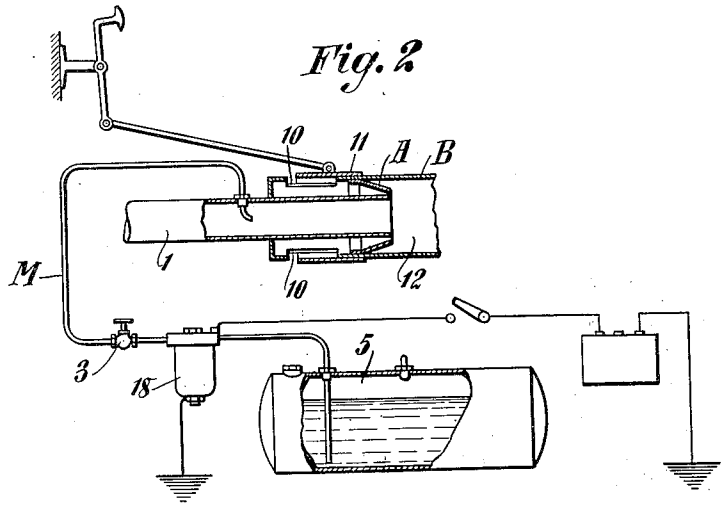
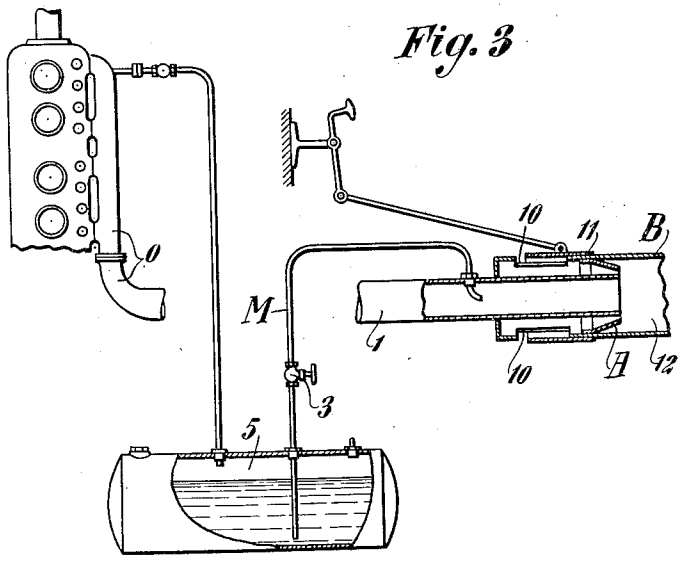


Fig. 3



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Patented Dec. 1, 1931

1,834,126

UNITED STATES PATENT OFFICE

LOUIS C. HYATT, OF ALBANY, NEW YORK, ASSIGNOR TO CONSOLIDATED CAR-HEATING COMPANY, INC., OF ALBANY, NEW YORK, A CORPORATION OF NEW YORK

BURNER FOR EXHAUST GASES

Original application filed May 6, 1927, Serial No. 189,320. Divided and this application filed May 4, 1928. Serial No. 275,141.

This application is a division of my application for improvements on bus heaters filed by me May 6, 1927, bearing Serial No. 189,320.

In the accompanying drawings,

Fig. 1 is a sectional view diagrammatically illustrating the invention;

Figs. 2 and 3 are similar views illustrating slight modifications.

My invention relates to the art of burning exhaust gases, particularly those from an internal-combustion engine, either to provide heat or to purify the exhaust of its poisonous and obnoxious ingredients, or for both purposes. It involves novel apparatus and novel methods, although the present application is restricted to the apparatus aspect of the said invention.

It is now known that the exhaust gases from an internal-combustion engine contain a greater or less percentage of unburned fuel which can be utilized for a second combustion. It has been proposed to ignite the exhaust after mixing air with it by an external agency, such as an electric spark, and to continue the combustion by means of the flame thus inaugurated. Thereby the combustion will continue even if the electric spark is cut off. In practice, however, much difficulty has been encountered in maintaining the said combustion due to several unique peculiarities of the said exhaust. One of such peculiarities is that the exhaust is not under a constant pressure but comes in puffs corresponding to the consecutive explosions in the engine cylinders. Moreover, the pressure when the engine is working hard is much greater than when it is running light, while even under light loads its velocity is high. Another pecularity is that the composition of the exhaust varies widely under the different operating conditions of the engine and it also differs widely in the several different makes of engines. A serious result of this is that the combustion of the exhaust can not be maintained continuously but will go out at unexpected times and will not be resumed automatically even if an electric spark is present. These two difficulties of variable pressure and variable composition I have successfully overcome by the means hereinafter described.

The pressure-variation involves wide changes in the velocity of the exhaust stream and in the volume of gas to be treated. I have discovered that the relation of stream velocity to the velocity of flame propagation is largely responsible for the inability to keep the combustion going. In brief, the stream velocity may become so great that the flame propagation can not keep pace with it, the incoming flow of gas which has not yet been raised in temperature up to the kindling point becomes so great that the flame is extinguished. On the other hand, it is not feasible to limit the stream velocity by obstructing to any material extent the carrying capacity of the pipe or conduit through which it passes because the resulting back-pressure would impair the action of the engine. In exhaust burners of this type heretofore proposed the exhaust has been directed through a zig-zag route comprising a set of tube sections through which the exhaust stream passes seriatim, the resistance presented by the several sections being the added sum of the individual ones. Moreover, the said sections have been arranged concentrically and the outer ones of large diameter have a greater surface, while the friction of the gas-flow varies as the square of the surface area. Hence in such burners the retarding effect becomes excessive as the volume and velocity rise. It has also been difficult to maintain an adequate mixing space for the incoming gas and air streams under the violent fluctuations of stream velocity and the resulting dislocation of the flame. Referring to Fig. 1 of the drawings, I will first describe the construction by which I overcome the aforesaid pressure and velocity difficulties. In this figure, 1 represents the exhaust pipe. At its outer extremity this pipe is surrounded by a frusto-conical sleeve A, suitably mounted on the pipe but separated therefrom by an annular space. Outside of sleeve A is a tube B closed around pipe 1 at its left-hand end and provided with slots 10 covered by a movable tubular damper 11, the position of which may be adjusted

by any suitable means, such as a lever, as shown. The air to be mingled with the exhaust enters through said slots 10 by injector suction the volume of air admitted being controlled by the position of the damper. The tube B is continued to the right by frusto-conical tube sections C and E with a cylindrical tube D interposed between them, while tube F conducts away the hot and purified gas-stream. At the entrance end of D is located a spark-plug 14, which is preferably kept in action by any known means. For instance, it may be included in the common ground connection of the several spark-circuits of the engine. It will be understood that the exhaust gas emerges from the tube 1 in a compact stream comparable to the water-stream from a fire-hose, having a fixed direction from which it is not readily diverted. This effect becomes more pronounced as the velocity rises. Assuming that the gas becomes ignited at spark-plug 14, the starting point of the flame will tend to vibrate back and forth violently with the violent fluctuations in velocity of the gas stream. This is due to the effort of the flame to maintain itself; the flame will move to the left as the stream velocity decreases and to the right as it increases (as viewed in Figure 1) until said velocity becomes so great that the flame can not follow owing to the limit in velocity of flame-propagation. In order to maintain an adequate mixing chamber 12 in tube A I place at the right of said chamber a metal screen 13 which will stop the leftward play of the flame at that point. Within tubes D, E and F, I place what I term a stabilizer which consists of a tube G, shown as slightly tapered, formed of perforated metal, or at least of metal perforated at each end as shown. The perforations may be of any desired character. Across the centre of tube G is a conical deflector H which is also formed of perforated metal. The diameter of tube G is such as to leave a free annular space around it inside of tube D. This space is gradually reduced to the end of tube E, but not closed.

The action of the apparatus thus far described is as follows:—At low exhaust-velocity the gas will still emerge from exhaust pipe 1 in the form of a compact jet, being, however, able to receive into it, in mixing chamber 12, the air sucked through the slots 10 and frusto-conical sleeve A. If the Davy screen 13 and the aforesaid stabilizer were not present, the stream of mixed exhaust gases and air would preserve its jet-like character clear through into the tube 17. In other words, in spite of the slight expansion permitted by the increased diameter of chamber C, the velocity of the mixture would be such that the stream forms with a central core-like portion which travels at a much higher speed than the peripheral portion of said stream. Nor, if the screen 13 and stabilizer are in place will the effect be materially different for the screen 13 and the deflector H are so designed as to present little obstruction to the travel of the stream, it being important to avoid the creation of back-pressure. If the velocity of the stream increases the excess volume of added mixture, the core-like portion of said stream will be checked at deflector H and tend to spill over, as it were, through the perforated walls of the stabilizer into the annular space outside of tube G, some of it being even reversed in direction. It is thereby maintained in the flame area and within range of the igniting capacity of the spark-plug. Also flame jets from the burning mass inside of tube G are projected through the holes in walls of that tube into the gas that has overflowed into the annular space around that tube. From said annular space the burning mixture and products of combustion find a free outlet without crowding the opening in deflector H. This outlet is partly through the annular space around the right-hand end of tube G and partly through the perforated walls of said tube G into the space outside of the aforesaid core or jet. The contraction of the annular space tends to direct part of the flow into the tube to add a suction draft to the part which traverses deflector H. In brief, the excess gas resulting from the increased velocity is not crowded through deflector H but finds added conductive capacity outside of said deflector and yet is kept within the igniting range of the flame burning within tube G. By this means the outflow through tube F as the velocity and quantity rise is not confined within the central jet-core but is more nearly uniform over the entire cross sectional area of that tube. The flame is not interrupted and no material back-pressure has been created.

Coming to the feature of changing composition of the gas and its effect on combustion-maintenance, I have discovered that the percentage of burnable matter in the exhaust, which I will here refer to as fuel, can not be reduced below a certain minimum—say about 16 per cent.—without interrupting the combustion. But if kept at this minimum or slightly above it, practically the entire fuel contents will be burned. Thus, by adding two or three per cent. of fuel, which is, in itself, an insignificant factor in the heating, the aforesaid 16 per cent., which would otherwise be lost, can be utilized, while the combustion-interruption can be eliminated. Referring again to Fig. 1, a small tank of liquid fuel, such as kerosene, is shown at 5. From a point inside this tank, near the bottom, a small tube M extends to a point on exhaust pipe 1 just back of the aforesaid tube B, where it opens into the pipe. A needle-valve 3 controls the flow in this pipe M. I provide pressure on liquid in the tank by any suitable

means, such as a pressure-pump 7 driven by the engines and introducing air by pipes 6 and 8. Thus a small inflow of liquid fuel into the exhaust will be maintained so long as the engine is operating and of a magnitude corresponding to the engine speed. Knowing the aforesaid minimum percentage of fuel required to maintain combustion this artificial injection of fuel can be made approximately sufficient to prevent the percentage falling below that minimum, while any excess is unobjectionable and can even be made to contribute to the heating effect. So far as concerns its function of maintaining continuity of combustion, it need be no material factor in the heating.

By combining the aforesaid stabilizing means and the supplementary fuel supply, I am able to burn the exhaust without interruption under all practical conditions. It may also be remarked that the variations which affect exhaust combustion are wide and violent.

In Fig. 2 I have shown, as the means for feeding the supplementary fuel, an automatic electric pump 18 of the bellows type which is a known device for such purposes. In Fig. 3 the pressure is supplied from the exhaust manifold O of the engine. Any other suitable means may be employed for this purpose. I have also shown the damper 11 as controlled by a lever, which if desired, may be the usual accelerator pedal of the engine. Thereby a call on the engine for greater duty, and consequent greater exhaust velocity, will automatically provide a greater supply of supplementary air.

The fuel for maintaining the minimum percentage required for ignition may be introduced into the exhaust stream at any suitable point prior to combustion, going in with the air supply, for example, or back of that point as shown in the drawings.

What I claim as new and desire to secure by Letters Patent is:

1. A burner for gases of fluctuating velocity issuing from an internal combustion engine comprising a conduit, means for introducing a stream of combustible mixture into said conduit in jet form, a stabilizer presenting parallel routes one of which is in line with the axis of said jet, and ignition means located between the mixture introducing means and the stabilized for firing said mixture, said stabilizer being provided with means for diverting excess gases in the central portion of said stream into said parallel route so as to keep the mixture within range of the igniting capacity of said ignition device.

2. A burner for gases of fluctuating velocity issuing from an internal combustion engine comprising a conduit, means for introducing a stream of gas into said conduit in jet form, an injector for mixing air with said gas, a stabilizer, a local igniter located between said injector and said stabilizer so as to fire the mixture, said stabilizer being provided with a deflector responsive to velocity changes of the stream of mixture for diverting an increasing volume of the mixture into a route parallel with the travel of the main stream, so as to keep the mixture within the range of the firing capacity of said igniter.

3. A burner for gases of fluctuating velocity issuing from an internal combustion engine comprising a conduit, a discharge conduit positioned to introduce exhaust gases into the first mentioned conduit in the form of a jet, means for mixing air with said exhaust gases, a perforated deflector, and an igniter located between said discharge conduit and said deflector, said deflector being placed transversely to the line of travel of the stream of mixed air and gas for diverting around said deflector a portion of the mixture corresponding to the jet velocity, so as to maintain the mixture within range of the igniting capacity of the igniter.

4. A burner for gases of fluctuating velocity issuing from an internal combustion engine comprising a conduit, means for introducing a stream of combustible mixture into said conduit in jet form, a stabilizer, and ignition means located between the mixture-introducing means and the stabilizer for firing the mixture, said stabilizer consisting of a tube of perforated metal in line with the travel of said stream but smaller than said conduit, said tube containing a perforated deflector so as to keep the mixture within range of the igniting capacity of said ignition device.

5. A burner for gases of fluctuating velocity issuing from an internal combustion engine comprising a conduit, means for introducing a stream of combustible mixture into said conduit in jet form, a stabilizer, a flame screen between said stabilizer and said mixture introducing means, and an ignition device between the stabilizer and said screen for firing said mixture, said stabilizer having means for maintaining the mixture within range of the igniting capacity of said ignition device.

6. A burner for gases which have variable composition comprising a conduit, means for introducing a stream of combustible mixture into said conduit, a stabilizer, ignition means located between the mixture introducing means and the stabilizer for firing said mixture, said stabilizer having means for maintaining the mixture within range of the igniting capacity of the ignition device, and an independent fuel supply for maintaining the mixture in combustible condition.

Signed at Albany, county of Albany, State of New York, this 1st day of May, 1928.

LOUIS C. HYATT.