

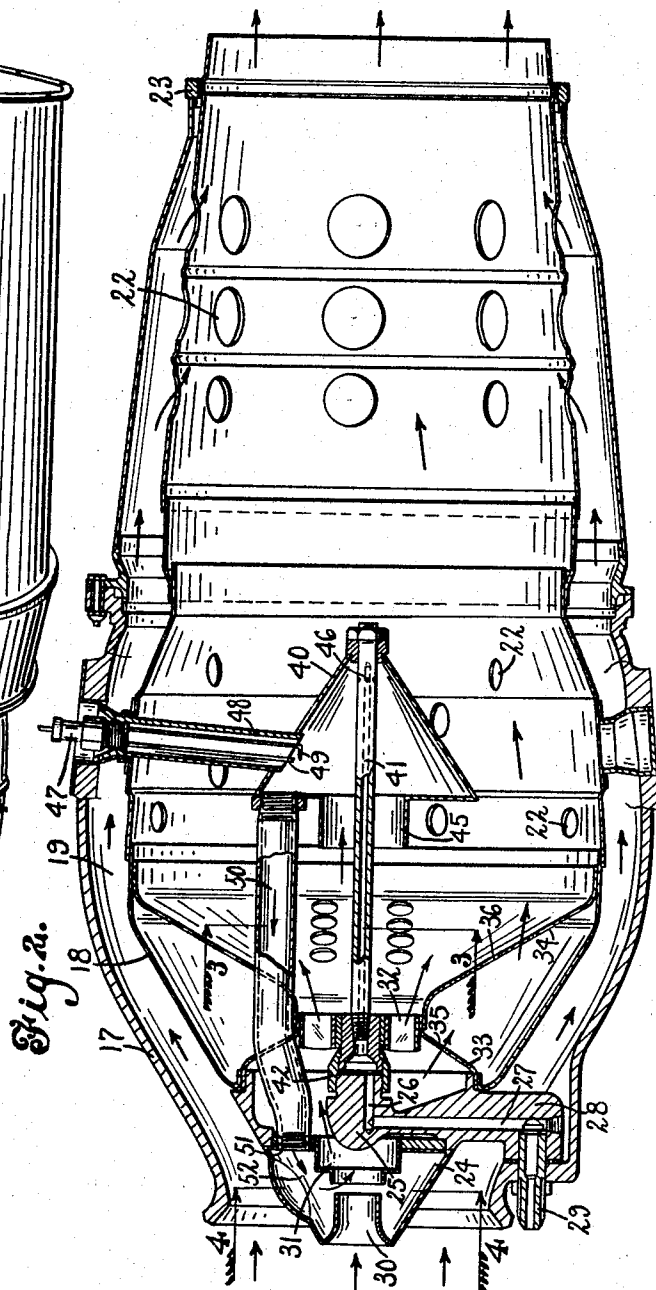
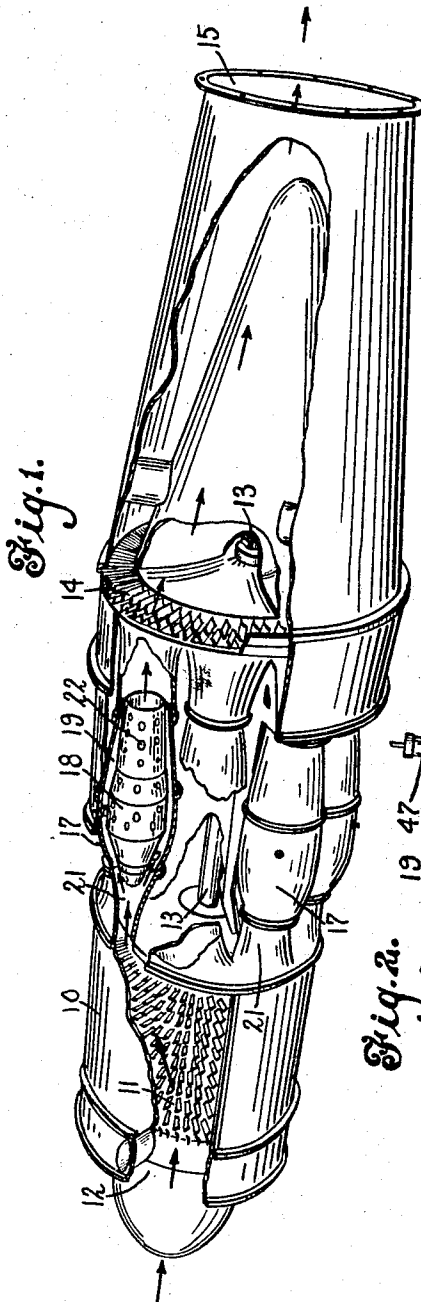
May 23, 1967

R. REICHHELM
GASIFIER AND BURNER

3,320,743

Filed Sept. 1, 1965

2 Sheets-Sheet 1



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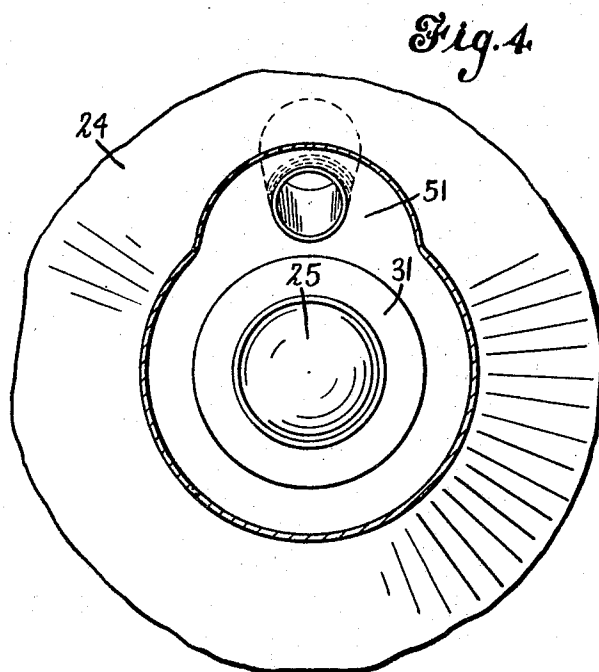
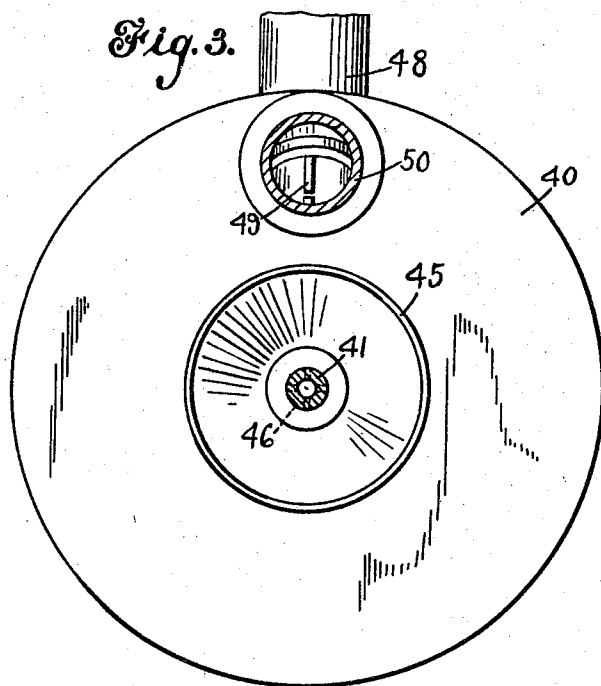
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1

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GASIFIER AND BURNER

Robert Reichhelm, Wallingford, Conn., assignor to Combustion Efficiency Corporation, Darien, Conn.
Substituted for abandoned application Ser. No. 188,365, Oct. 4, 1950. This application Sept. 1, 1965, Ser. No. 496,215

8 Claims. (Cl. 60—39.71)

This application is a refiling of application S.N. 188,- 365, filed Oct. 4, 1950, now abandoned.

This invention relates to a gasifier and burner and more particularly to an apparatus designed to convert a liquid hydrocarbon fuel into a gas and thereafter burn the gas, so produced or generated, for some useful purpose and in an efficient manner. As illustrated in the drawings, the principles of my invention have been applied to a gasifier and burner for use in a jet engine, such as, for example, may be used in propelling airplanes, although it will be understood that the principles of the invention are not limited to this application but may be employed in other apparatuses where it is desired to gasify a liquid fuel and then effect a useful combustion of this fuel.

As will be explained in detail hereinafter, the fuel to be gasified is discharged into a gasifying chamber or the like in which sufficient air is present to bring about a combustion of a part, but only a relatively small part, of the fuel. The heat from this combustion serves to gasify the remainder of the fuel, and this gasified fuel is then conveyed to the air stream, which flows into the combustion chamber and also the gasifying chamber so that it is mixed with air entering the burner or combustion chamber to there secure a premixture of gasified fuel and air which promotes efficient combustion.

As illustrated, the gasifying chamber or gasifying apparatus is mounted within the combustion chamber so that the gasified fuel burns in a space around the gasifying chamber, and the air supply which supplies combustion air for the complete combustion of the fuel in the combustion chamber also supplies the relatively smaller amount of air which supports combustion of a part of the fuel in the gasifying chamber to gasify the remainder.

One object of the invention is to provide an efficient and simple apparatus for gasifying a liquid fuel and delivering this fuel to a combustion chamber or to an apparatus in which the gasified fuel may be burned.

Another object of the invention is to provide an improved gasifier and burner in which a liquid fuel may be gasified by the consumption of a part of the fuel, and the gasified fuel, together with the products of combustion, then delivered to a combustion chamber with a quantity of air to support combustion of the gasified fuel.

Still another object of the invention is to provide an improved gasifier and burner for liquid hydrocarbon fuel which will be simple in construction, and relatively efficient and reliable in operation.

To these and other ends the invention resides in the novel features and combinations of parts as well as in the novel procedure to be hereinafter described and claimed.

In the accompanying drawings:

FIGURE 1 is a perspective view of a jet engine embodying my invention, some parts being broken away to show the interior mechanism.

FIGURE 2 is a sectional view of one of the burners of such an engine, this burner embodying my invention.

FIGURE 3 is a somewhat enlarged sectional view on line 3—3 of FIG. 2, and

FIGURE 4 is a somewhat enlarged sectional view on line 4—4 of FIG. 2.

To illustrate a preferred embodiment of my invention, I have shown in the drawings a jet engine comprising a casing 10 of generally tubular form, this casing being

2

an outer shell within which the mechanism of the engine is contained. In the forward part of the casing is a compressor, shown generally at 11, by which air is drawn into the casing 10, which is open at its forward end as shown at 12. The compressor is carried upon a shaft 13 rotatably mounted within the casing 10 in a suitable manner, this shaft extending rearwardly and having mounted upon its rear end turbine blades 14 by means of which the shaft is rotated by the products of combustion which pass rearwardly from the burner, as will be more fully described hereinafter. These hot gases pass through the turbine blades and then are expelled from the rear end of the casing, as shown at 15, serving to operate the turbine and rotate the shaft 13 and the compressor 11 to draw in combustion air through the opening 12. The parts heretofore described are more or less conventional and form no part of the present invention.

Within the casing 10 are a plurality of gasifiers and burners embodying my invention, which will now be described. As these are identical, the description of one of such gasifiers and burners will suffice. As shown, however, a plurality of them may be provided in the casing 10 around the shaft 13, each of these burners and gasifiers in turn being provided within a casing 17 of generally tubular shape.

Each of the casings 17 may be termed the outer burner casing, and within each of such casings is disposed an inner burner casing 18. This latter casing is, as shown in FIG. 2, of a shape generally similar to the outer burner casing 17, but of smaller dimensions so as to be spaced therefrom, leaving an annular passage between two casings as shown at 19.

The outer burner casing 17 is open at its forward end and, as shown in FIG. 1, is connected with the compressor 11 by a passage or throat 21 through which air is forced by the compressor through the annular space 19 between the inner and outer burner casing to provide oxygen to support combustion for gasifying the fuel in the gasifying chamber and also to provide combustion air for burning the gasified fuel in the combustion chamber. It may here be noted that the inner burner casing 18 is provided with a plurality of openings 22 at various and numerous places in its periphery and along its length, so that a part of the air which is delivered to the annular space 19 passes through these openings into the inner casing. The air which passes through the space 19 serves to cool the burner which, as will be obvious, becomes quite hot, and the annular space 19 is reduced in size and finally closed at its rear end, as shown at 23, so that this air will eventually pass into the inner casing and be expelled at the open rear end thereof.

As illustrated more particularly in FIG. 2, the inner burner casing 18 is provided with a tip 24 at its forward end which serves to admit air and fuel to the gasifier and burner, as will now be explained. This tip is provided with a nose portion 25 within which is a fuel passage 26, which passage communicates with a second passage 27 in an arm 28 secured to or formed integrally with the nose 25, and the passage 27 communicates with a fuel inlet member 29, which leads to a source of supply of a suitable fuel.

The tip 24 is also provided with an air opening 30 of venturi shape to admit air into the inner burner casing 18, the opening communicating with the throat 21 so as to receive air from the compressor, and the opening or passage 30 is directed toward a cooperating intake member 31 spaced from the member 30 so as to permit the entrance of gasified fuel into the air stream at this point. The air which passes through the member 31 will pass around the nose 25 and pass rearwardly into the inner burner casing 18.

3

Supported within the casing just rearwardly of the nose is a turbulator or swirler 32, this member being provided with a plurality of spaced vanes helically arranged with respect to the direction of the passage of the air so as to cause a swirling of the air and to break up to some extent the column of air and cause it to be thrown outwardly in a radial direction. This swirler 32 is carried by supporting members 33 and 34, which members are provided with openings 35 and 36 to permit the passage of a part of the air, entering through the tip 24, around the swirler 32, and into the inner burner casing 18.

Also supported within the inner casing 18 is a gasifying chamber 40, this chamber being carried upon the fuel pipe 41, which pipe is secured at its forward end to a nipple 42, secured in turn to the nose 25, so that the interior of the fuel pipe 41 is in communication with the passage 26 in the nose 25. The gasifying chamber 40 is provided with an open sleeve or thimble 45 at its forward face which surrounds the fuel pipe 41 and which limits gasifying air to this chamber around the pipe. As shown, the gasifying chamber is of substantially conical form, and adjacent its reduced end the pipe 41 is provided with a plurality of fuel or oil openings 46 to discharge the fuel into the chamber 40 in relatively fine streams. It will be understood that the oil will be introduced under any suitable pressure into the chamber 40 through the openings 46, and that the entire quantity of fuel consumed by the burner passes through these openings, the amount of fuel consumed being suitably regulated by regulating the amount delivered to the burner through the passages leading to these openings.

An ignition device in the form of a spark plug 47 is mounted within a pipe 48 leading from the gasifying chamber to the outer burner casing 17 so that the plug is accessible at the surface of the outer casing. From this plug electrodes 49 lead into the gasifying chamber so as to effect ignition of the fuel therein.

A fuel pipe 50 is secured to the forward face of the gasifying chamber and communicates, at its rear end, with this chamber. This pipe extends forwardly to have a threaded engagement with a partition member 51 in the pipe 24 so that the forward end of the pipe 50 communicates with a space 52 in the tip surrounding the members 30 and 31. It may here be noted that the fuel delivered to the gasifying chamber 40 through the openings 46 is only partly consumed in this chamber and the remainder of the fuel gasified. The products of combustion in the gasifying chamber, as well as the gasified unburned fuel, then pass through the pipe 50 to the space 52, from which they enter into the air stream through the space between the members 30 and 31 so as to be carried rearwardly by the air stream into the combustion chamber within the inner combustion shell 18, where complete combustion of the fuel takes place.

In operation, air enters through the venturi inlet 30 and passes rearwardly through the swirler 32 and also through the openings 35 and 36 into the space within the inner combustion burner casing or shell 18. A part of the air passing through the swirler flows through the combustion chamber and into the gasifying chamber 40 through the thimble 45, and fuel is introduced into this chamber through the openings 46 in the pipe 41. The air in the chamber 40, mixed with products of combustion and gasified fuel, however, is only sufficient for combustion of a relatively small part of the fuel, and when the latter is ignited by the terminals 49 of the spark plug 47, enough of the fuel burns to gasify the remainder of the liquid fuel. The mixture of the gasified fuel and the products of combustion in the gasifier chamber 40 pass out through the pipe 50 and are led forwardly into the chamber 52 and the venturi air inlet to be returned to the combustion chamber mixed with the air. The air delivered to the combustion chamber is usually in excess of that required for combustion, so that, while there is complete combustion, this air will also serve to cool the casing.

4

This charge of gasified fuel is ignited by the flame from the gasifying chamber but burns in the burner casing 18, and the discharge of hot gases from the open rear end of the combustion chamber operates the turbine 14.

It will be seen, therefore, that all of the fuel is introduced into the gasifying chamber and then brought back by the pipe 50 to the intake air nozzle, where it is mixed with the air entering the burner, thus effecting a premixture of the gasified fuel and air delivered to the combustion chamber which promotes efficient combustion. The flame in the gasifying chamber is induced into the pipe 50 by a flow of gases but will be choked off before it enters the chamber 52, as there will not be sufficient oxygen to support combustion at that point, the mixture, of course, being over rich. The flame, however, existing in the pipe 50 will insure the continued burning of the fuel within the gasifying chamber 40 even though the flame there might be extinguished for any reason. Therefore, after the burner is once set in operation, it will continue to function without the continued functioning of the spark plug.

While I have shown and described a preferred embodiment of my invention, it will be understood that it is not to be limited to all of the details shown, but is capable of modification and variation within the spirit of the invention and within the scope of the claims.

What I claim is:

1. A gasifier and burner comprising a housing providing a combustion chamber, said chamber having air inlet means adjacent one end and outlet means adjacent the other end, a gasifying chamber in said combustion chamber between said inlet and outlet means, said gasifying chamber having an opening directed toward and in communication with said air inlet means to receive therefrom only a small fraction of the air, means for delivering liquid fuel to said gasifying chamber wherein only a portion of the fuel is consumed, and flame choking means to conduct such gasified fuel from the gasifying chamber to said air inlet means forwardly of the combustion chamber for delivery as a flameless mixture composed of products of combustion and unburned gasified fuel to the combustion chamber with the air passing therein, said conducting means comprising a tubular member having a length many times its widest cross-section dimension, said tubular member passing through the combustion chamber to the forward end thereof.

2. A gasifier and burner comprising a housing providing a combustion chamber, a gasifying chamber within said combustion chamber and spaced rearwardly from the forward end thereof, fuel inlet means for discharging all the liquid fuel into the gasifying chamber, means for igniting said fuel in the gasifying chamber, air inlet means for introducing a stream of air into the forward end of the combustion chamber, said gasifying chamber being in the path of said air stream and having a forwardly directed opening to receive a part of the air whereby only a portion of the fuel introduced into said gasifying chamber is consumed and the remainder of said fuel gasified by the heat of combustion of said consumed portion, said gasifying chamber having an outlet opening, and a flame choking duct leading from said opening to said air inlet means forwardly of the combustion chamber to deliver gasified fuel to the air stream entering the combustion chamber through said inlet means and prior to its entry into the combustion chamber.

3. A gasifier and burner as in claim 2 wherein the forwardly directed opening in the gasifying chamber permits only restricted amounts of air thereto to support combustion of only a part of the fuel, and wherein said flame choking duct is long and narrow so as to choke the flame from said combustion occurring in the gasifying chamber.

4. A gasifier and burner comprising a housing providing a combustion chamber, a gasifying chamber within said combustion chamber and spaced rearwardly from the forward end thereof, fuel inlet means for discharging a

5

liquid fuel into the gasifying chamber, means for igniting said fuel in the gasifying chamber, air inlet means for introducing a stream of air into the forward end of the combustion chamber, said gasifying chamber being in the path of said air stream and having a forwardly directed opening to receive a part of the air, said gasifying chamber having an outlet opening, and a flame-choking duct leading from said opening to said air inlet means forwardly of the combustion chamber to deliver gasified fuel to the air stream entering the combustion chamber through said inlet means and prior to its entry into the combustion chamber, and the forwardly directed opening in the gasifying chamber opens into the combustion chamber to permit the flame in the gasifying chamber to ignite the fuel in the combustion chamber.

5. A liquid fuel burner comprising:

- (a) means defining a combustion chamber having an air inlet and a combustion gas outlet,
- (b) means defining a gasifying chamber disposed within said combustion chamber,
- (c) means for discharging a liquid fuel into said gasifying chamber,
- (d) means for introducing combustion air into said gasifying chamber in amounts sufficient to support only partial combustion of the liquid fuel therein so that the heat of said combustion is utilized to gasify the remainder of said liquid fuel discharged into said gasifying chamber,
- (e) ignition means for igniting said fuel mixture in said gasifying chamber,
- (f) and, means connecting said gasifying chamber into communication with the air inlet means of said combustion chamber whereby the air passing through said inlet means is mixed with the gasified fuel and products of combustion generated in said gasifying chamber, said connecting means including a conduit of sufficient length to choke off the combustion of the partially combusted liquid fuel before said gasified fuel and products of combustion mix with said air passing through said inlet means, and whereby the flame within said conduit insures continued burning of the fuel being consumed in said gasifying chamber.

6. The invention as defined in claim 5 and including impeller means disposed downstream of said air inlet to impart a whirling motion to said combustion air and gasified fuel mixed therewith.

7. A gasifier and burner of liquid hydrocarbon fuel comprising:

- (a) an outer burner casing,
- (b) an inner burner casing disposed with and spaced from said outer burner casing to define an annular spacing therebetween,
- (c) means for connecting the adjacent rear end portion of said casing to define a closure for said spacing thereat,
- (d) said inner casing defining a combustion chamber,
- (e) said outer and inner casing being open at their respective forward end for receiving a supply of combustion air, and said inner casing being open at its outer end to define an exhaust for the products of combustion generated in said combustion chamber,
- (f) said inner casing having a plurality of openings formed thereinto connecting the annular space defined between said casing into communication with the combustion chamber defined by said inner casing,
- (g) means defining a gasifying chamber disposed within said combustion chamber,
- (h) said gasifying chamber having an inlet opened in communication with said combustion chamber, and an outlet,

6

(i) means for introducing all the liquid fuel into said gasifying chamber,

(j) said inlet permitting sufficient air to enter said gasifying chamber to effect combustion of only a portion of the fuel introduced thereinto whereby the heat of said combustion gasifies the remainder portion of the fuel,

(k) means for conveying the mixture of gasified fuel and products of combustion generated in said gasifying chamber to the inlet to said combustion chamber where said mixture mixes with the combustion air entering said combustion chamber to form a combustible fuel mixture having an excess of oxygen, said conveying means choking off the combustion of the fuel before said mixture mixes with the combustion air entering said combustion chamber, and

(l) means for imparting a swirl to said combustible fuel mixture as it enters said combustion chamber.

8. A gasifier and burner of liquid hydrocarbon fuel comprising:

- (a) an outer burner casing,
- (b) an inner burner casing disposed with and spaced from said outer burner casing to define an annular spacing therebetween,
- (c) means for connecting the adjacent rear end portion of said casing to define a closure for said spacing,
- (d) said inner casing defining a combustion chamber,
- (e) said outer and inner casing being open at their respective forward end for receiving a supply of combustion air, and said inner casing being open at its outer end to define an exhaust for the products of combustion generated in said combustion chamber,
- (f) said inner casing having a plurality of openings formed thereinto connecting the annular space defined between said casing into communication with the combustion chamber defined thereby,
- (g) means defining a conically shaped gasifying chamber disposed within said combustion chamber,
- (h) said gasifying chamber having an inlet open in communication with said combustion chamber, and an outlet,
- (i) means for introducing a liquid fuel into said gasifying chamber,
- (j) said inlet to said gasifying chamber permitting sufficient air to enter into said gasifying chamber to effect combustion of only a portion of the fuel introduced thereinto whereby the heat of said combustion gasifies the remainder portion of the fuel,
- (k) means for conveying the mixture of gasified fuel and products of combustion generated in said gasifying chamber to the air inlet of said combustion chamber where said mixture mixes with the combustion air entering said combustion chamber to form a combustible fuel mixture having an excess of oxygen, and
- (e) the inlet of said gasifying chamber opening to the combustion chamber to permit the flame in the gasifying chamber to ignite the fuel in the combustion chamber.

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