July 14, 1959 L. JACOLEV 2,894,569

BURNER FOR GAS GENERATORS

Filed Jan. 25, 1952

Fig. 1

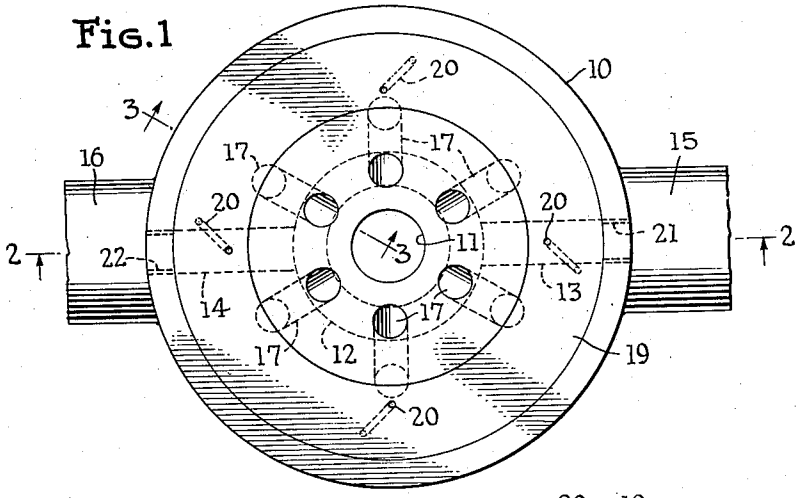


Fig. 2

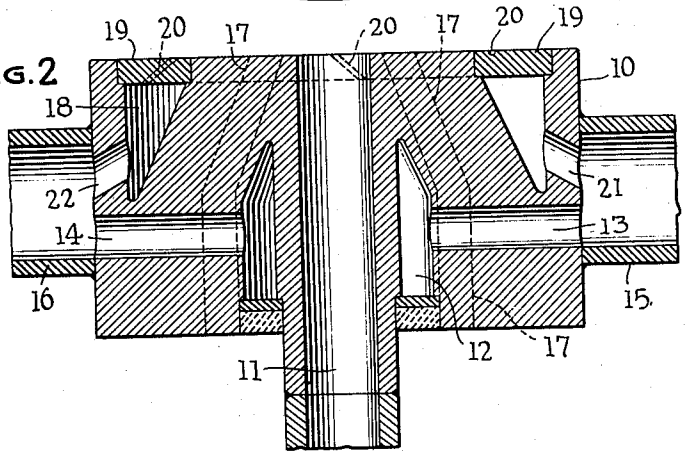


Fig. 3

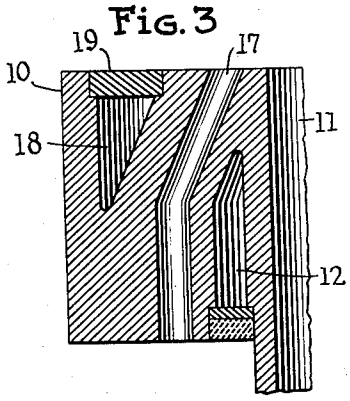
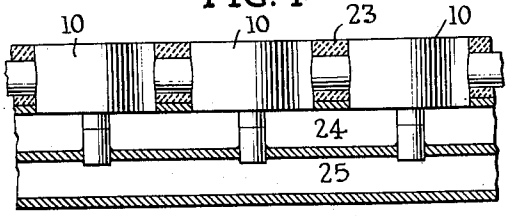


Fig. 4



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BURNER FOR GAS GENERATORS

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2 Claims. (Cl. 158—99)

This invention relates to fluid fuel burners, and more particularly to fluid fuel burners of the kind used in flow-type gas generators. The latter are essentially closed, unpacked reaction chambers, housing burners, and are primarily used for the partial combustion of fuels to produce valuable products, as for example, carbon monoxide and hydrogen useful in the synthesis of hydrocarbons, oxygenated hydrocarbons and ammonia. The burner of this invention is also useful for the production of acetylene.

For illustrative purposes, the apparatus of the invention shown on the attached drawings, is for use as a burner for partial combustion of methane to form carbon monoxide and hydrogen. This reaction is well known to the art, and in general is represented by the following formula:

$$2CH_4+O_2\rightarrow 2CO+4H_2$$

Obviously, other reactants could be used in burners of this type. The particular reaction indicated only typifies such processes.

Reaction temperatures of the order of 2500° to 3000° F., or higher, may be experienced in this process. One of the biggest problems encountered is to provide an adequate cooling means to insure that the individual burner elements are held at a sufficiently low temperature to prevent failure of the elements due to exposure to excessively high temperature.

It is the primary object of this invention to provide a burner structure for separately introducing and intimately mixing a gasiform hydrocarbon and an oxygen-containing gas, with adequate cooling means to permit satisfactory burner operation over substantial time periods.

It is a further object of this invention to provide an efficient means for the introduction of steam into a flow-type generator having an unpacked reaction zone.

While steam has been used in the past, in reactions of this general type, it is usually used with a liquid rather than a gasiform hydrocarbon as the fuel. When steam is introduced into the reaction zone, it usually is mixed with the fuel in the supply line to the burner. Steam is used to control the reaction temperature, and serves also to increase the amount of hydrogen in the product. Where, for example, natural gas (which is principally methane) is used as the fuel, steam is generally not necessary for temperature control and sufficient hydrogen for the hydrocarbon synthesis reaction is already available from the hydrocarbon. The unexpected results obtained from the injection of steam into an unpacked reaction zone, in accordance with this invention, are thought to be of primary importance in this art. The above and other objects of this invention will be apparent from the following description when read in conjunction with the attached sheet of drawings, in which:

Figure 1 is a top plan view of a preferred embodiment of the burner structure of this invention,

Figure 2 is a section on the line 2—2 of Figure 1,

Figure 3 is a section on the line 3—3 of Figure 1, and

Figure 4 is illustrative of one possible arrangement for a plurality of the burners shown in Figures 1, 2, and 3.

Referring now to Figures 1, 2, and 3 of the drawings, the burner head is indicated generally by the reference numeral **10**. A central passageway **11** is formed axially through the burner head, and serves to convey oxygen-containing gas through the burner to the flame area. Immediately surrounding the central passage **11** is an annular chamber **12** connected by a pair of radial passageways **13** and **14** to conduit means **15** and **16** for supplying a coolant, such as water, directly to the chamber **12**, at the interior of the burner head and withdrawing the same therefrom, respectively. Surrounding the annular chamber **12** are a plurality of passageways **17** which serve to conduct fuel gas through the burner head to the flame area.

As a means for supplying steam to the reaction zone, there is a second annular chamber **18** within the burner head and surrounding the passageways **17**. The flame-exposed side of chamber **18** is closed by an annulus **19**. The latter has a plurality of angularly disposed passageways **20** of relatively small diameter, which link the chamber **18** to the reaction zone. Water, supplied and withdrawn through conduits **15** and **16**, is admitted to and withdrawn from the annular chamber **18** through passageways **21** and **22** respectively. Water, in passing from the annular chamber **18** to the reaction zone through passageways **20**, is vaporized to steam and injected into the reaction zone with a substantial swirling motion. The latter is apparently effective to provide a protective blanket of steam between the flame and the flame-exposed portion of the burner.

Referring now to Figure 4, a plurality of the burner heads **10** are assembled in a straight line manner, and may have refractory material **23** packed in between the individual heads. Conduit means **24** may then be used to supply the fuel gas and conduit means **25** will carry the oxygen-containing gas to the burner head.

The presence of steam in an unpacked reaction zone has been found to have a number of advantages. First, the passage of water through chamber **18** provides cooling, and the vaporization of water to form steam in passing through the burner head, en route to the reaction zone, provides additional cooling for controlling the temperature of the burner head itself. Secondly, steam is distributed over the face of the burner, providing a steam blanket between the burner and the flame. Thirdly, the controlled admission of steam to the reaction zone can be used to control the temperature therein. Fourthly, the mere presence of steam in the reaction zone reduces the amount of carbon formed in the reaction zone, and normally discharged with the product gas. Fifthly, by sweeping the burner face with jets of steam, the formation of hard carbonaceous deposits at the face of the burner heads is reduced due to the mechanical cleansing action of the jets and to chemical reaction between the steam and carbon. Additionally, the steam may, if desired, be directed into the path of the reaction products to quench the reaction for the production of acetylene, or partial oxidation products.

The term oxygen-containing gas as used herein, includes substantially pure oxygen, or oxygen-enriched air.

From the foregoing, it will be apparent to those skilled in the art that this invention provides a greatly improved method and apparatus for operation of a synthesis gas flow-type generator, especially adapted for use with natural gas or other fuel gas.

I claim:

1. A burner head for use in a synthetic gas generator, said head having a flat surface exposed to the flame of a

reaction zone and having a central axial reactant passageway and a plurality of reactant passageways concentrically disposed with respect thereto, all of said reactant passageways terminating in openings in said flame exposed surface, said head including a first annular cooling chamber located between said central axial passageway and said plurality of passageways, and a second annular cooling chamber located exteriorly of said plurality of passageways, means for providing a coolant to said cooling chambers, said second cooling chamber being located below said flame exposed surface, said head also including a series of passageways extending from said second cooling chamber through said head and opening through said flame exposed surface, each passageway of said series being disposed at an acute angle with respect to the axis of the burner and with respect to a radial plane of the burner such that separate streams of steam are directed tangentially into the reaction zone with substantial swirling motion about the axis of the burner head to provide a coolant blanket between the flame of the reaction zone and said flame exposed flat surface.

2. An annular type burner head, for use in a synthetic gas generator, having a flame exposed flat surface with openings which are the ends of passageways providing reactants separately for said gas generation, said passageways comprising a central axial passageway for the provision of one of said reactants and a plurality of passageways spaced in concentric relationship thereto for providing the other of said reactants, cooling chambers for said head comprising an inner chamber located between said central axial passageway and said plurality of passageways, and an outer chamber located concentrically exteriorly of said plurality of passageways, means for supplying coolant such as water to said chambers, said outer chamber having outlets to said flame exposed surface defined as passageways angularly disposed at an acute angle with respect to the axis of the burner and with respect to a radial plane of the burner to provide coolant tangentially into the reaction zone with swirling motion about the axis of the burner head to form a protective blanket of steam between the flame of the reaction zone of said generator and said flame exposed flat surface.

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