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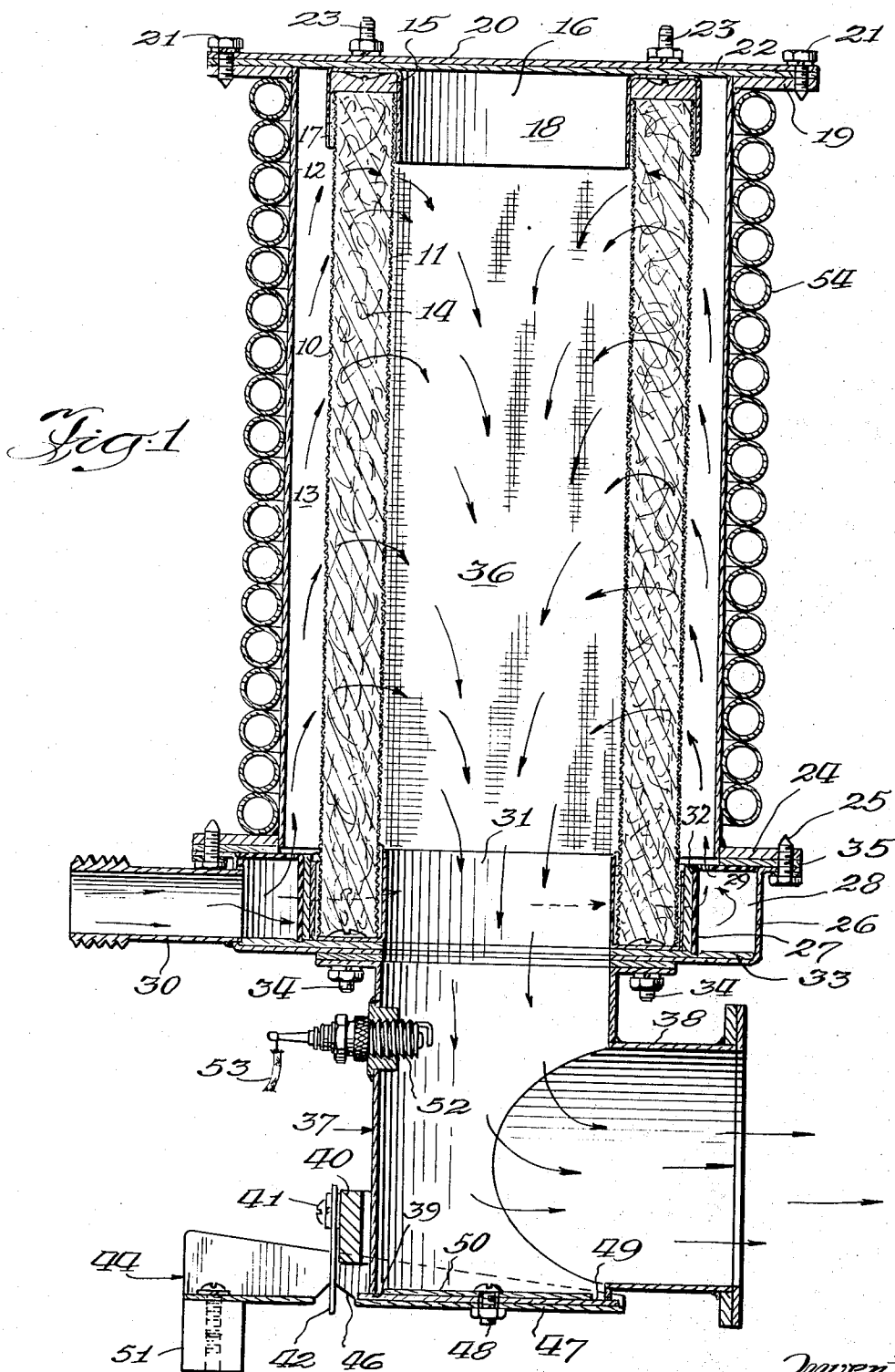
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CATALYTIC BURNER FOR GENERATING GAS ATMOSPHERES

Filed Nov. 6, 1963

2 Sheets-Sheet 1



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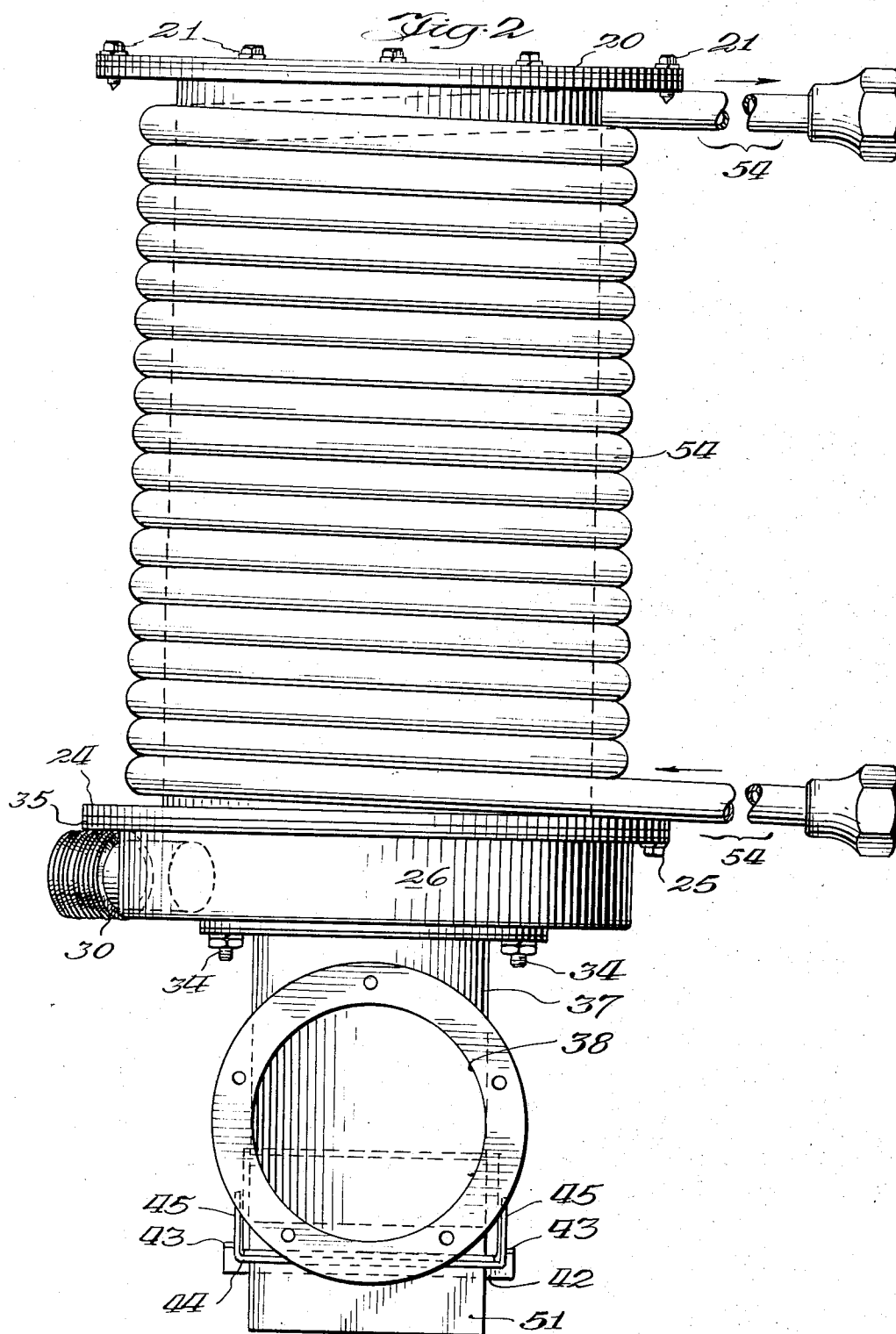
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CATALYTIC BURNER FOR GENERATING GAS ATMOSPHERES

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ABSTRACT OF THE DISCLOSURE

A catalytic hydrocarbon fuel burner having a cylindrical catalyst bed which is water cooled, and a pressure relief damper which operates under a preselected internal pressure.

Summary of the invention

This invention relates to a generator for generating an atmosphere containing oxygen, carbon dioxide and inert gas by the low temperature burning of a hydrocarbon fuel in the presence of air.

As is disclosed in Bedrosian et al. U.S. Patent No. 3,102,778, assigned to the same assignee as this application, atmospheres of the above type may be generated by burning under catalytic conditions a hydrocarbon fuel in the presence of air. This atmosphere may then be used for introduction into an enclosure in which perishable animal and plant materials may be stored for long periods of time without serious degradation.

In the above patent there is disclosed semi-diagrammatically as an element of the apparatus a catalytic burner. One of the features of the present invention is to provide an improved catalytic burner for generating the above-described atmosphere that is lower in oxygen and higher in carbon dioxide than ordinary air.

Other features and advantages of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a longitudinal central sectional view through a catalytic burner embodying the invention.

FIGURE 2 is a side elevational view of the burner of FIGURE 1.

Catalytic burners of this type employ a granular catalyst in which the burning takes place at relatively low temperatures. The low temperatures are used here in order to prevent the formation of measurable amounts of oxides of nitrogen which would have a deleterious effect on the products being stored. Catalysts of this type are well known and are commercially available, being supplied primarily to the petroleum industry for hydrocarbon modification. Typical catalysts used successfully include chrome-alumina and platinum-alumina.

In the illustrated embodiment there is provided a generally cylindrical first gas pervious member 10 in the form of a metal screen and a second gas pervious member 11 also in the form of a metal screen. Outwardly of the member 10 there is provided an enclosing casing 12 that is also cylindrical with the casing 12 and screens 10 and 11 being substantially concentric. The outer screen 10 is spaced from the casing 12 in order to provide a gas space 13 therebetween.

The tops of the screens 10 and 11 are provided with a circular spacer 15 and the spacer together with the tops of the screens are enclosed by a cap 16 that has an outer flange 17 outwardly of the outer screen 10 and an inner flange 18 inwardly of the inner screen 11. The combination of the flanges 17 and 18 and the spacer 15 secures the top of the catalyst bed 14.

The top of the cylindrical casing 12 is provided with an outwardly extending circular flange 19 attached there-

to as by welding. This flange in turn is attached to a circular plate top 20 on the burner by a series of peripheral spaced screws 21. Between the top 20 and the flange 19 is a sheet 22 of temperature resistant gasket material such as "Fiberfrax." The gasket sheet 22 is also between the metal top 20 and the top of the cap 16. The cap 16 is attached to the top 20 by a series of circularly arranged bolts 23.

The bottom of the cylindrical casing 12 is provided with an outwardly extending flange 24 that is similar to the top flange 19. Attached to this flange as by a series of circularly arranged screws 25 is a metal orifice housing 26 that is generally circular and whose sides are located outwardly of the lower end of the outer screen 10. Positioned within the orifice housing 26 is a circular orifice ring 27 which cooperates with the outer side and bottom of the housing 26 to provide a circular gas flow passage or manifold member 28 at the bottom of the apparatus serving as a manifold. This orifice ring 27 is of angular construction as shown in FIGURE 1 and cooperates with the angular outer lower corner of the housing 26 to define the sides of the passage 28. The orifice ring 27 is provided with a circularly arranged series of orifice passages or exit means 29 in its upper surface that communicate with the gas space 13.

On one side of the orifice housing 26 there is provided a pipe connection 30 for the inward flow of a hydrocarbon gas and air mixture for burning in the generator.

Between the orifice ring 27 and the lower end of a bottom cap 31 that is similar in construction to the top cap 16 there is provided a sheet of heat resistant gasket material 32 that is similar to the previously described gasket material 22. A similar sheet of gasket material 33 is provided between the bottom of the orifice housing 26 and the bottom edge of the ring 27, the bottom of the lower end cap 31 and the inner end of the pipe 30.

As can be seen in FIGURE 1 the bottom cap 31 is exactly the same as the upper cap 16 and is also fastened in place by a series of bolts 34. Both of the caps serve to keep the two screens 10 and 11 properly spaced from each other and to maintain the outer screen 10 properly spaced from the casing 12 to define the gas and air inlet space 13.

In order to further complete the gas tight sealing there is provided another annular sheet of gasket material 35 between the bottom flange 24 and the tops of the orifice housing 26 and orifice ring 27. This gasket material is the same as that previously described and is held in place by the screws 25.

As mentioned earlier, the burning of the hydrocarbon fuel in the presence of air takes place in the catalyst bed 14. The products of combustion then flow through the bed into the interior space 36 that is within the interior cylindrical screen 11.

This space 36 communicates at the bottom with a right angle elbow 37 of metal which has one leg vertically aligned with the axis of the space 36 and the other leg 38 extending outwardly.

The bottom of the elbow 37 beneath the horizontal leg 38 is open as indicated at 39. Mounted on the bottom of the elbow 37 adjacent the opening 39 is a support 40 that is welded or otherwise attached to the side of the elbow duct 37 that is opposite the leg 38. Fastened to this support 40 as by a plurality of screws 41 is a U-shaped knife edged pivot 42. The pivot 42 has its knife edges 43 extending outwardly and facing upwardly, as shown in FIGURE 2. Fulcrumed on these knife edges 43 is a weighted lever 44 having spaced sides 45 each provided with a V notch 46 and resting on a knife edge 43. The inner end of this lever 44 is provided with a closure cap 47 to which is attached by means of a bolt 48 a circular

gasket 49 which is the same as the gasket material previously described and a covering stiffening washer 50. The end of the lever 44 that is opposite the cap 47 is provided with a weight 51 attached thereto in order to counterbalance the cap 47 to normally closed position, as shown in the drawings.

The elbow 37 is provided with a spark plug 52 having the usual wire lead 53. The spark plug is used to initiate combustion in the burner.

In practice, the burner bed 14 is operated at less than 2000° F. and preferably more than about 1200° F. A satisfactory operating temperature within the bed 14 is about 1600° F.

In order to cool the catalyst bed 14 and thus keep the temperature within the bed at less than 2000° F., for example, there is provided a helical coil 54 for a cooling medium such as water. This coil is in intimate contact with the outer surface of the casing 12 and cools the casing. This casing in turn cools the catalyst bed 14 by absorbing heat that is radiated from the bed to the casing.

In operation the mixed hydrocarbon gas which may be ordinary fuel gas and air is led in through the pipe 30 and into the gas space 13. From here the mixture flows into and through the catalyst bed 14 as indicated by the arrows. The initial ignition takes place within the space 36 and elbow conduit 37 as combustion is initiated by the spark plug 52. Immediately, ignition moves to the inner surface of the bed 14 as defined by the screen 11 and the hydrocarbon gas burns with a blue flame adjacent the screen 11. This heats the catalyst bed 14 very rapidly and as soon as the catalyst reaction temperature is reached, which is about 800° F. for natural gas, the combustion moves into the bed 14. Thereupon the temperature within the bed rises rapidly and heat then begins to radiate to the outer casing 12 which is cooled by the helically arranged cooling water pipe 54. The temperature within the bed 14 continues to rise until the radiation to the casing 12 and heat losses out the ends of the burner equal the heat of combustion minus the heat content of the exhaust gases leaving the conduit 37. In general, with natural gas this will be a temperature of about 1600° F. which is well below the temperature at which nitrogen from the air combines with oxygen to form the harmful nitrogen oxides.

In the embodiment shown the gas-air mixture is 40 cubic feet per hour of natural gas and 440 cubic feet per hour of air with this mixture flowing in through the pipe 30. This is sufficient to produce exhaust gases flow from the outlet 38 at the rate of about 400 cubic feet per hour measured at a temperature of about 1400° F. These conditions are sufficient to produce an exhaust gas containing about 2.5% oxygen and about 10.5% carbon dioxide.

On rare occasions, particularly when starting up, there may occur an explosive flash of burning hydrocarbon gas within the space 36 or the outlet conduit 37 which generates considerable pressure. The lever arrangement 44 is provided to relieve this pressure. Thus, whenever such an explosion occurs the internal pressure pivots the cover 47 outwardly to expose the opening 39 and thereby vent the explosion. As soon as the explosive force has ceased the counterweight 51 thereupon pivots the cover cap 47 to its closed position as shown in the drawings.

Having described my invention as related to the embodiment shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: an outer enclosing first gas pervious member of closed transverse cross section; an inner enclosing second gas pervious member also of

closed transverse cross section located within and spaced from said first member to provide space for retaining a bed of catalyst; an enclosing casing around said first pervious member also of closed transverse cross section spaced from said first member to provide an enclosing fuel-air space; a fuel-air manifold member having exit means therein for projecting a fuel-air mixture into said fuel-air space substantially throughout the transverse cross sectional area thereof; and a gas impervious barrier member between said manifold member and said bed preventing direct communication between the manifold and the bed.

2. The burner of claim 1 wherein said exit means comprises means for projecting a plurality of jets inwardly of said fuel-air space and between said second pervious member and casing.

3. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: an outer enclosing first gas pervious member of closed transverse cross section; an inner enclosing second gas pervious member also of closed transverse cross section located within and spaced from said first member to provide space for retaining a bed of catalyst; an enclosing casing around said first pervious member also of closed transverse cross section spaced from said first member to provide an enclosing fuel-air space; means at one end of said space for projecting a mixture of fuel and air into said space substantially uniformly throughout the transverse cross sectional area thereof; and means at said one end for blocking gas flow directly between said means for projecting and said bed of catalyst.

4. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: an outer enclosing first gas pervious member of closed transverse cross section; an inner enclosing second gas pervious member also of closed transverse cross section located within and spaced from said first member to provide space for retaining a bed of catalyst; an enclosing casing around said first pervious member also of closed transverse cross section spaced from said first member to provide an enclosing fuel-air space; means for cooling said enclosing casing; means at one end of said space for projecting a mixture of fuel and air into said space substantially uniformly throughout the transverse cross sectional area thereof and adjacent said casing; and means at said one end for blocking gas flow directly between said means for projecting and said bed of catalyst.

5. The burner of claim 4 wherein said projecting means comprises a manifold having jet means for thusly projecting said mixture in a plurality of spaced jets.

6. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: an outer enclosing first gas pervious member of closed transverse cross section; an inner enclosing second gas pervious member also of closed transverse cross section located within and spaced from said first member to provide space for retaining a bed of catalyst; an enclosing casing around said first pervious member also of closed transverse cross section spaced from said first member to provide an enclosing fuel-air space; means for introducing a fuel-air mixture into said fuel-air space; an exit conduit means from the interior of said second gas pervious member for conveying combustion products from said interior; fuel ignition means in said exit conduit means; means forming an opening in said exit conduit; and a normally closed closure for said opening displaceable under a preselected internal pressure in said conduit to open said opening and relieve said pressure.

7. The burner of claim 6 wherein said closure is hingedly mounted and is counterbalanced to closed position.

8. A catalytic burner for burning a hydrocarbon fuel in the presence of air, comprising: a generally cylindrical essentially vertical outer first gas pervious member; a generally cylindrical essentially vertical inner second gas

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pervious member spaced from said first member to provide space for retaining a bed of catalyst; a generally cylindrical essentially vertical casing around said first member and spaced therefrom to provide an enclosing fuel-air space; means for cooling said enclosing casing; means at one end of said space for projecting a mixture of fuel and air into said space substantially uniformly throughout the transverse cross sectional area thereof and comprising a manifold having jet means for thusly projecting said mixture in a plurality of spaced jets along the inner surface of said casing; an exit conduit means from the interior of said second gas pervious member for conveying combustion products from said interior; fuel ignition means in said exit conduit means; means forming an opening in said exit conduit means; and a normally closed closure for said opening displaceable

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under a preselected internal pressure in said conduit to open said opening and relieve said pressure, said closure being hingedly mounted and counterbalanced to closed position.

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