Sept. 22, 1953 C. W. MORCK, JR., ET AL 2,652,890

INTERNALLY FIRED GAS BURNER

Filed Aug. 12, 1948

Fig. 1.

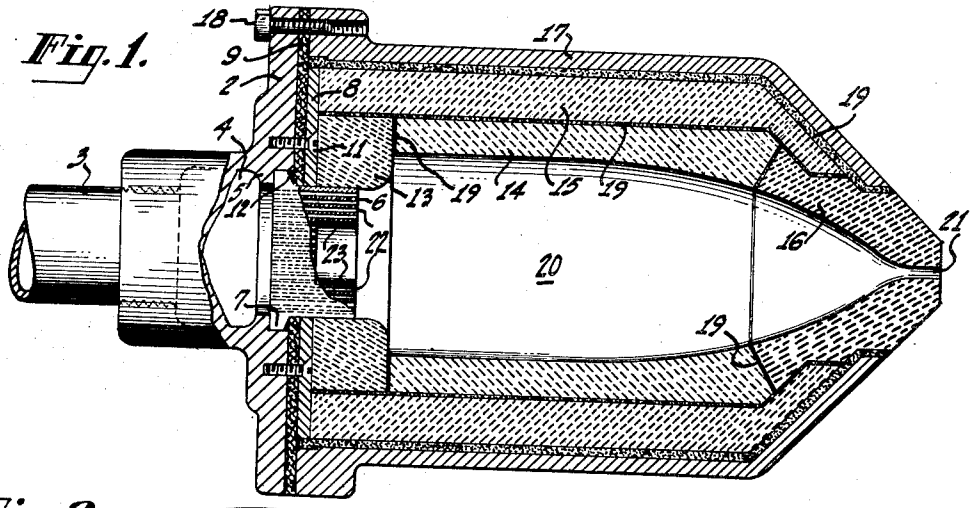


Fig. 2.

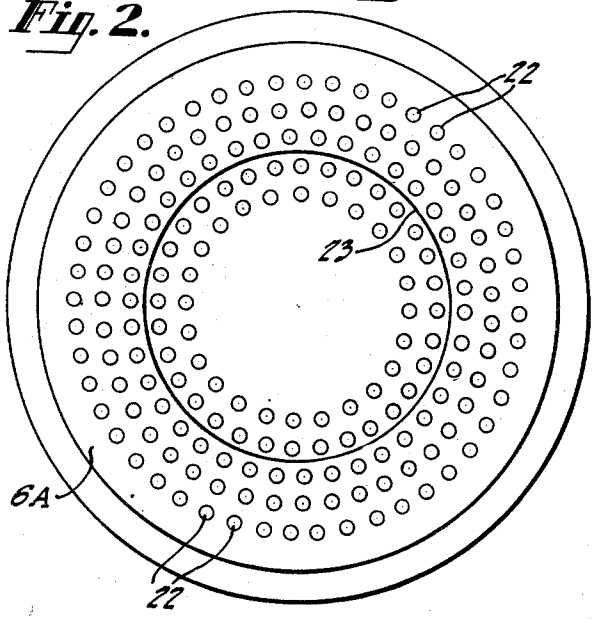


Fig. 3.

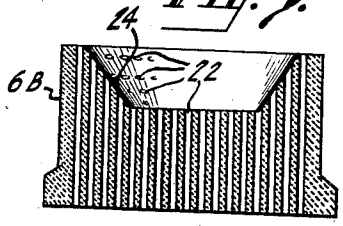


Fig. 4.

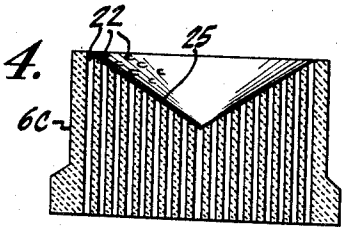
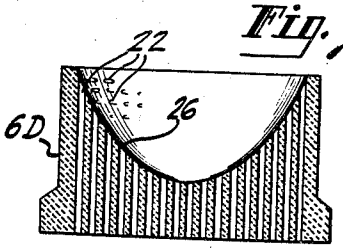


Fig. 5.



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INTERNALLY FIRED GAS BURNER

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2 Claims. (Cl. 158—116)

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The present invention relates to gas burners of the type in which a combustible mixture of gas and air are burned in a combustion chamber, and more particularly to a burner of this type in which slow igniting fuels may be burned without the production of an objectionable noise.

It has previously been proposed to use burners of the type in which a combustion chamber is provided. In burners of this type a combustible mixture of fuel and air is introduced through a screen at one end of the combustion chamber where it is burned. Hot products of combustion are ejected through an orifice at the opposite end of the combustion chamber at a high velocity and at a temperature substantially equal to that in the chamber. When such burners are operated with a combustible mixture consisting of air and a fuel with a comparatively slow flame propagation rate, such as natural gas or butane, an objectionable noise is produced. This noise takes the form of a roar or whine that increases in volume as the quantity of fuel burned per unit time is increased.

The exact reason for the noise is not known, but it is believed to be due in large part to the flame snapping off and on the surface of the screen. The flame tends to be blown away from the screen, and in the open this would happen. But because the flame occurs within a chamber it is not extinguished, but will burn in the chamber and snap back to the screen. Part of the noise is also believed to be due to the fluttering of the flame as it moves around in the combustion chamber as a result of its unstable condition.

It is an object of the present invention to provide a burner of the type described in which the noise is eliminated when the burner is used with fuels having slow flame propagation rates. This is primarily accomplished by using a screen through which the combustible mixture is introduced into the combustion chamber which has a recess formed in its downstream face. This recess permits the combustible mixture to expand and reduce in velocity to an extent that ignition may take place promptly. The expanding mixture as it leaves the screen moves the flame into contact with the side walls of the combustion chamber closely adjacent the screen face so that these walls are heated to incandescence. The heat radiated from the walls helps to produce early combustion of the mixture while it is still approximately at the screen face.

It is a further object of the invention to provide a screen to be used in a burner of the type described through which a combustible mixture

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is passed. The screen consists of a ceramic member that has in it a plurality of ports through which the mixture is passed and it is provided with a recess on its downstream side. This recess may take a number of shapes, but in each case it is of a size to permit expansion of the mixture to an extent sufficient to reduce its velocity below the flame propagation point.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a sectional view of a burner of the present invention;

Figure 2 is a plan view of another form of burner screen that may be used; and

Figures 3, 4 and 5 are views, partly in section, of burner screens having different shaped recesses formed in their faces.

Referring to Figure 1 there is shown a burner incorporating the present invention. This burner includes a casting 2 forming a base thereof which is mounted upon a pipe 3 through which a combustible mixture of fuel and air is supplied to the burner. A chamber 4 is formed in the base and has around its upper edge a shoulder 5 upon which is mounted the base portion of a screen 6. This screen 6 has formed on it a shoulder 7 which abuts the shoulder 5 so that the screen is located properly. In order to maintain the screen rigidly in position in the base there is provided a plate 8 which has in it an opening to receive the screen but which is smaller than the shoulder 7 formed thereon. This plate and a suitable gasket 9 are placed over the screen and fastened to the base by means of screws 11. Ordinarily the burner screen and the base are connected with a gas tight joint, and to this end a space between shoulder 7 and gasket 9 is filled with some suitable cement, such as asbestos cement, as shown at 12.

Mounted on the plate 8 and surrounding the burner screen is a refractory ring 13 that supports on its upper surface a substantially cylindrical member 14 of some suitable high temperature refractory. Surrounding the member 14 is a second refractory cylinder 15 that is made of some suitable ceramic which will serve as an in-

sulating member to reduce loss of heat from the interior of the member 14. These ceramic members along with a ceramic tip member 16 form a combustion chamber 20 having an exit slot 21 through which products of combustion may pass. The ceramic members are held in place on the base 2 by means of a metallic casing member 17 that is attached to the base 2 by bolts 18. The various parts are cemented together during assembly by some refractory cement as shown at 19 so that a rigid, air-tight body is formed.

In the operation of the burner a combustible mixture of fuel, such as gas and air in suitable proportions, is supplied through the pipe 3 from a mixing machine. This mixture passes through chamber 4 and ports 22 that are formed in the screen 6 and into the combustion chamber 20. When the burner is first operated the combustible mixture under suitable pressure is permitted to flow through the pipe 3 and into the chamber 20. This mixture will exhaust through slot 21 where it is ignited. The pressure of the mixture is then reduced so that the flame backfires into the combustion chamber 20 and burns in front of screen 6. Thereafter the pressure of the supply of the fuel and air may be increased to increase the temperature of the combustion chamber and of the hot products of combustion which are ejected at high velocity through slot 21. In burners of this type temperatures as high as 3000° F. may be obtained and the hot products of combustion are ejected from slot 21 at velocities as high as 800 or 900 feet per second. In the normal operation of a burner of the type disclosed, using a gas with a high flame propagation rate, combustion takes place on the surface of screen 6 as the mixture emerges from the openings 22 in this screen. It has been noted, however, that when burners are used with gaseous fuels having a slow flame propagation rate, such, for example, as natural gas or butane, that an objectionable noise is produced by the burners. It is believed that this noise takes place as a result of the flame snapping to and from the surface of the screen because of the high pressure and velocity of the mixture that is being supplied thereto and also because the flame burns at some point in the combustion chamber above the surface of the screen with considerable vibration. In any event the noise is highly objectionable and the present invention is directed to a construction by means of which it may be overcome.

It has been found that the velocity distribution curve of the gas-air mixture flowing through a screen takes substantially the form of a parabola with the velocity lower adjacent the edges of the screen and increasing toward the center thereof. Therefore the burner screen must be shaped in such a fashion that the velocity of the mixture in the center portion of the screen is slowed down until it is substantially equal to the velocity at the edges thereof, and below the speed of flame propagation for the fuel being used at the supply pressure.

The burner screen of the present invention is provided with a central recess 23 in its downstream face. The mixture entering the combustion chamber through the ports in the recess expands and is reduced in velocity to such a degree that it can be ignited by the time it reaches the upper surface of the screen. That portion of the mixture which issues from the ports on the surface of the screen outside of the recess will burn and has a piloting effect to ignite the remainder of the mixture. It has also been found that a screen of the construction described there is a tendency for the flame to spread and impinge upon the side walls of ring 13 immediately above the screen and against the lower portion of the wall of member 14. This action increases the temperature of the combustion chamber walls in the lower portion thereof over that which is normally obtained so that the heat radiated from these portions of the walls helps to increase the speed of ignition of the mixture. This helps the burning of the mixture to take place at the surface of the screen, to thus eliminate the noise. In tests made with a mixture of butane and air the flame was blown from a screen having a flat surface at 10" water column while with a screen having a recess in its face the flame was not extinguished with a mixture pressure of 100" water column.

As a specific example, a screen may be made of some material, such as aluminum oxide and have a diameter of $2\frac{1}{32}$". With a screen of this type, there are provided a series of 222 ports of .067" diameter that are placed in nine concentric rows. Recess 23 is formed between the third and fourth row of ports from the outside of the screen and is 1¼" in diameter and ⅜" deep. With a screen constructed in this fashion, it has been found that the velocity of the fuel mixture coming through the screen is reduced in the recess to such an extent that combustion may take place at approximately the surface of the screen.

There is shown in Figure 2 a plan view of another form which the screen 6 may take. In this figure screen 6A is shown as being provided with a series of ports similar to those in screen 6 except that the center port and three adjacent rows of ports in the center portion of the recess 23 have been closed. This screen is provided with 37 less ports than that provided in the screen disclosed in Figure 1. Considering the diameter of the ports and the number of ports, this produces a reduction of approximately 17% in port area through the screen. Such a reduction, however, does not reduce the supply of fuel as much as might be expected. For example, in a burner having all of the ports, such as that shown in Figure 1, when gas is supplied at 81" water column, the pressure within the combustion chamber 20 is 69½" water column and 111 cubic feet of butane-air mixture are burned per hour. With a screen of the type shown in Figure 2 and being supplied at 81" water column, the combustion chamber pressure will be 64" water column and 107 cubic feet per hour of the butane-air mixture will be burned. This is a reduction of only 1.5% fuel for a 17% reduction in port area. It is believed that the increased pressure drop across the screen causes a corresponding increase in flow of the gas mixture through the screen. There is provided, however, a larger space per unit of port area for the gas to expand so that there will be a correspondingly greater reduction in velocity of the gas in the combustion chamber. In this case also complete combustion can occur at approximately the surface of the screen. In some cases it is desirable to have a smaller velocity of the gases ejected through slot 21 in the top of the combustion chamber since these gases will then not have quite the force that they would have if all of the ports were provided in the screen. There will be no

appreciable change in temperature of the gases however.

In Figure 3 there is shown a burner screen 6B in which the recess takes a slightly different shape. This figure shows a recess 24 provided with conical shaped side walls and with a flat bottom. In view of the fact that the angle to the vertical formed by the walls of chamber 24 increases the area of the recess slightly, it need not be quite so deep as was the recess mentioned in connection with the above modifications. The burning of the mixture with a recess of this type is the same as that which occurs with the previously described screens. It is noted that only one row of ports remains on the upper surface of the screen outside the recess. These ports with those in the rows along the sloping sides give the desired piloting effect.

The burner screen 6C of Figure 4 is shown as having a recess 25 that is conical in shape. In this case the reduction in velocity of the gases coming through the screen is progressively increased from the outer edges to the center so that the velocity is below that necessary for flame propagation to take place.

In Figure 5 there is shown a burner screen 6D which has a recess 26 that is parabolic in shape. In this case also there is a reduction in velocity of the gases progressively from the outer edge to the center of the recess. The burning of the mixture with screens of this type is the same as occurs with the screens previously described. The gradual increase in depth of the recess from the edge to the center thereof permits adequate piloting and adequate expansion of the mixture to take place.

It will be seen that the burner screen which is used in conjunction with the burner disclosed herein is provided with a recess on its downstream face which recess is of such a size that the velocity of the combustible mixture coming through the screen is reduced to an extent that it will permit flame propagation to take place. The shape of the recess is not critical as long as it is so designed that the gases will be slowed down sufficiently so that they may ignite promptly and completely burn within the combustion chamber.

While in accordance with the provisions of the statutes, we have illustrated and described the best forms of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of our invention, as

set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a gas burner, the combination of structure forming a combustion chamber having an inlet and a restricted outlet, conduit means to supply a combustible mixture through said inlet to said chamber to be burned therein, a screen located in said inlet and having a flat face on the side adjacent said chamber, said screen being provided with a plurality of ports of substantially the same size through which said mixture flows, and a recess on the face thereof toward said chamber, the recess extending over an area covered by several of said ports, and means to retain said screen in position in said inlet, said recess being cylindrical with its side walls perpendicular to said face and its bottom wall parallel thereto.

2. A screen for use in a gas burner comprising a cylindrical body of refractory material having a pair of end faces, said body being formed with a plurality of passages of substantially the same size extending parallel to the axis thereof from one face to the other, one of said faces being provided with a recess extending inwardly therefrom and concentric with the axis of said body, the sides of said recess being substantially perpendicular to the face in which it is formed and the bottom of said recess being substantially parallel to said faces, said recess being of such a size that some of said passages terminate therein while other of said passages terminate in the face in which said recess is formed and around the edge thereof.

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