

Dec. 6, 1938.

J. P. BROSIUS

2,138,998

BURNER UNIT

Filed June 24, 1936

2 Sheets-Sheet 1

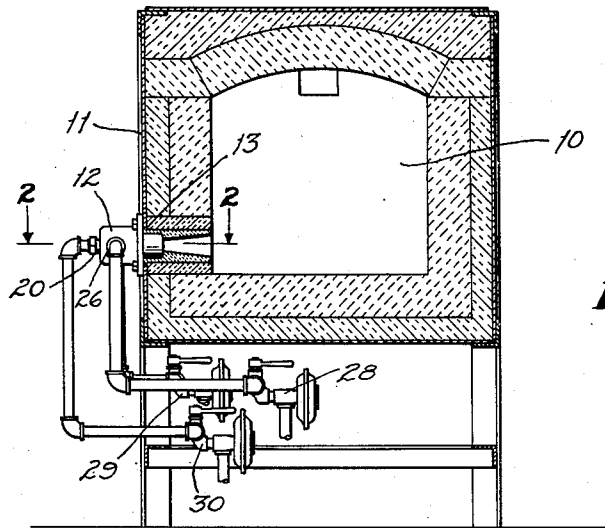


Fig. 1

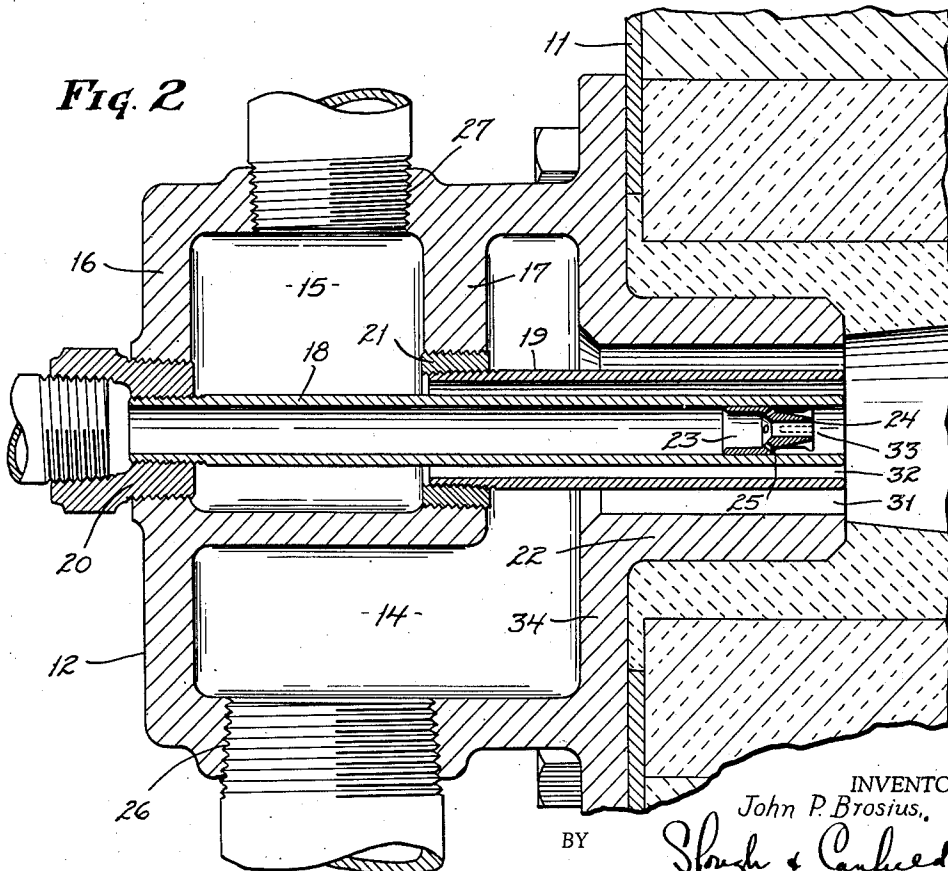


Fig. 2

BY

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2 Sheets-Sheet 2

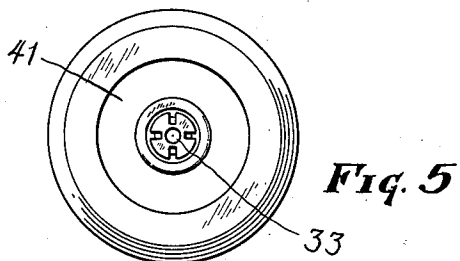
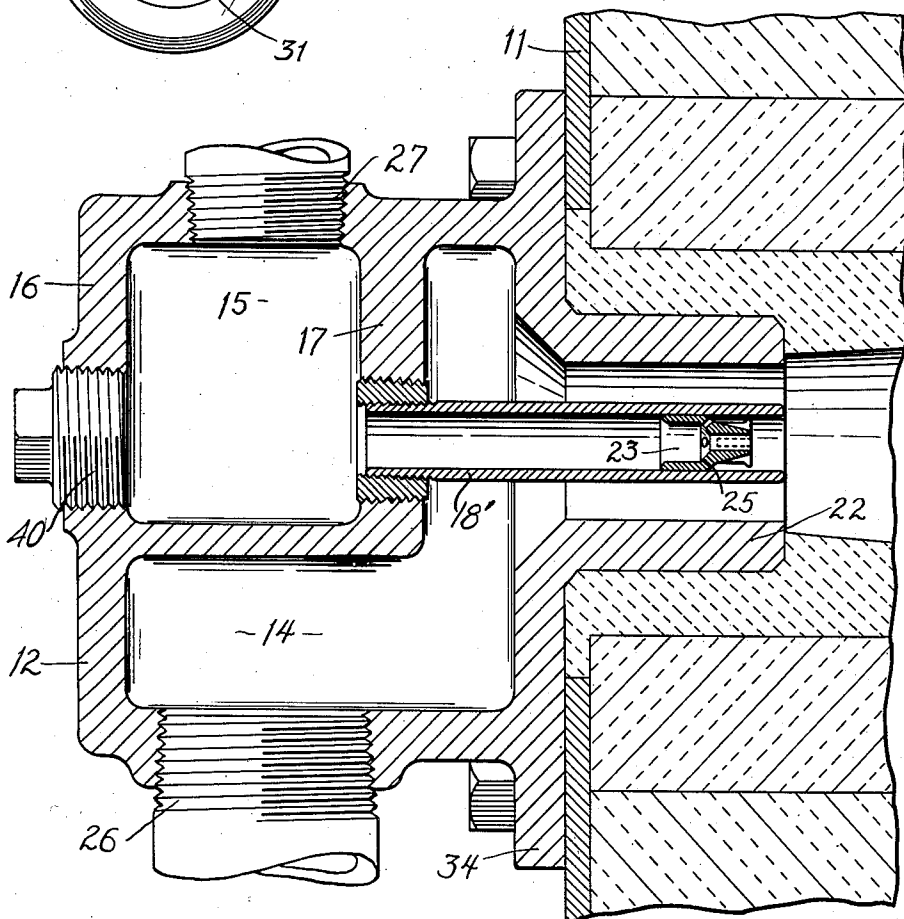
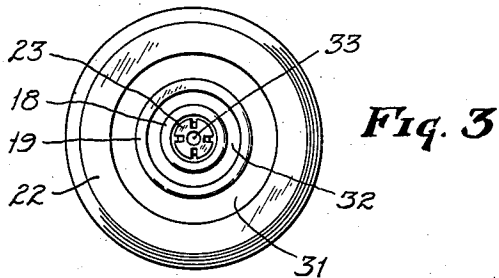


Fig. 4

Fig. 5

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UNITED STATES PATENT OFFICE

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BURNER UNIT

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6 Claims. (Cl. 158-7)

This invention relates to improvements in gaseous or vapor fuel burners and more particularly to burners of this type wherein it is desired to premix a predetermined quantity of air and the gaseous or vapor fuel prior to delivery to the burner.

The provision of a burner having a positive flame retention nozzle which will substantially maintain a uniform mixture pressure and allow a wide range of turn-down, has become increasingly important since attempts to use previously designed burners to satisfy these requirements have proven unsuccessful. Certain heating operations require an initial high thermal input to effect rapid heating and a relatively small thermal input for maintaining a given temperature condition. Heretofore, this has been effected by using burners of sufficient capacity to provide the maximum thermal requirements and as the heating chamber approaches a desired temperature the thermal input to the burners is progressively decreased to a required minimum.

When the minimum thermal output of the burners is in excess of that necessary to maintain the temperature of the heating chamber in equilibrium, certain of the burners are rendered inoperative until a state of equilibrium is reached and this cycle is repeated as required.

This procedure is highly objectionable for several reasons. For example, rendering certain burners in a battery such as alternate burners inoperative causes a correspondingly wider gap between points of heat input, thereby causing a wider temperature differential between zones of the heating chamber. Again, as the thermal input to the burners is decreased there is a corresponding decrease in the mixture pressure at the burner nozzles and for every such decrease there is a corresponding decrease in the velocity of the gases circulating in the heating chamber. The velocity at which the gases issue from the nozzles determines the shape of the flame since a high velocity flame is relatively long and sharp, whereas a slow velocity flame is short and bushy. A long sharp flame provides more flame surface parallel to the furnace walls than a short stubby flame and the relatively increased flame surface of a long sharp flame radiates more heat to the furnace walls and therefore reduces the flue gas temperature by removing more heat units before the gases pass up the flue. The increased flue gas temperatures, due to low velocity flame, result in a relatively greater heat loss.

Present day burners are limited to their turn-down ratio and there is no means of controlling

the mixture pressure at the burner nozzles with varying thermal input. This is because a constant port area has definite practical limits of the maximum and minimum pressures, a pressure beyond a predetermined value blowing the mixture from the burner without combustion, and a pressure lower than a predetermined value resulting in flash back. The mixture pressure affects the efficiency of the heating chamber to a considerable degree. For a given thermal input with a relatively low mixture pressure a rather short stubby flame is produced, and with a relatively high mixture pressure a long slender flame results. With a given thermal input a long slender flame will have more effective surface area than a short stubby flame. Since the emissivity factor of energy delivered to the heating chamber walls is greater with radiated energy than it is with energy delivered by convection of hot gases, it is apparent that the maximum efficiency of the heating chamber will be obtained with a flame having maximum effective surface area.

Furnaces for industrial purposes usually require a considerable temperature range as from 400° F. to 2000° F. dependent upon the particular use of the furnace as for annealing, tempering, heating refractory material and the like. Heretofore, furnaces or sets of furnaces have been required to cover this temperature range or two sets of burners in each furnace since a single burner having a minimum limit of 400° F. has a maximum limit of 1000° F. and a burner having a maximum limit of 2000° F. would have a minimum limit of 1000° F.

I am familiar with two port burners which can be individually controlled dependent on the temperature desired and which employ refractory tunnels as the flame retention means. I am also familiar with flame retention nozzles which do not require a flame retention tunnel due to a plurality of small orifices at the nozzle port which act to retain the flame. However, neither of these burners in itself can exceed the temperature limits previously mentioned.

I have devised a unit which eliminates these disadvantages in providing a plurality of ports individually controlled as to mixture pressure and adapted to a different range of thermal output, but the limits of each range falling within a lower or higher range. This permits of a mixture pressure for a desired thermal output which, within practical limits, results in efficient heating despite a wide range in thermal requirements and

to a degree not possible with previous burners with which I am familiar.

It is a primary object of my invention, therefore, to provide a burner for gaseous or vapor fuels which may be efficiently operated over a relatively wide range of thermal requirements.

Another object of my invention is to provide a burner of the above type having a composite wide range turn-down ratio.

Another object of my invention is to provide a burner of the above type which is relatively inexpensive to manufacture and is simple in operation.

Another object of my invention is to provide a burner of the above type having a positive flame retention nozzle.

Another object of my invention is to provide a burner of the above type which can be concurrently operated in a heating chamber with other burners of the same type over all ranges of turn-down.

Other objects of my invention, and the invention itself, will become increasingly apparent from a consideration of the following description and drawings, wherein:

Fig. 1 is a sectional view of a heating installation embodying my invention;

Fig. 2 is an enlarged sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is an end elevational view of a neck portion of the unit of Fig. 2 and

Figs. 4 and 5 are views similar to Figs. 2 and 3 respectively, of a modification of my invention.

Referring now to the drawings, I have indicated generally at 10 a heating chamber having mounted in a wall 11 thereof a burner unit generally indicated at 12. The wall 11 may be provided with the usual opening 13 for the reception of the unit 12 which is bolted to the furnace side plates. The unit 12 comprises a relatively large housing divided into smaller chambers 14 and 15. The chamber 14 comprises walls 16 and 17 coaxially perforated to mount tubular members 18 and 19 respectively. The wall 16 has a sleeve 20 threaded thereinto and the sleeve is also internally threaded to receive a threaded end of tubular member 18, the threads preferably tapering to provide a tight joint as is customary with pipe connections. Although I have illustrated a threaded connection it is understood that any suitable mounting forming a sealed joint may be employed.

Tubular element 19 is mounted in a similar manner in the perforated wall 17 by a threaded sleeve 21, the elements 18 and 19 being co-axially disposed, the inner wall of element 19 being spaced from the outer wall of element 18 to provide a longitudinally extending passage therebetween.

An end wall of unit 12 is provided with a generally centrally disposed outwardly extending tubular neck portion 22 within which portions of element 18 and 19 remote from the mounting portions are co-axially projected with the inner walls of neck portion 22 spaced from the outer wall of element 19 to form a passage therebetween and with the outer end faces of elements 18 and 19 preferably terminating in the plane of the end face of neck portion 22.

The inner tubular element 18 adjacent its outer end, has a generally tubular element 23 sealed therein, preferably by welding, the element 23 having an outer portion 24 of reduced diameter and the shoulder connecting the enlarged and reduced portions being provided with a plurality of

divergent perforations 25. Tubular element 18 is sometimes referred to as a flame retention nozzle which will support a flame in itself under minimum pressure conditions without the use of a frustro-conical tunnel in the furnace wall as illustrated in Fig. 1 referred to as a flame retention tunnel.

Laterally disposed threaded perforations 26 and 27 form inlet connections for the chambers 14 and 15 respectively from pre-mixing devices indicated generally at 28 and 29. In like manner the sleeve 20 forms an inlet connection from a pre-mixing device 30. The pre-mixing devices 28, 29 and 30 constitute no essential part of my invention and any suitable device well known in the art and adapted to pre-mix air and a combustible gas or vapor in a desired ratio and deliver the mixture at a desired pressure, may be used.

It will now be understood that pre-mixed combustible gas or vapor and air at a desired pressure and ratio will be delivered to chamber 14 through inlet 26 and thence to a port indicated at 31 and whose area is determined by the diameters of the inner wall of neck portion 22 and the outer wall of element 19.

In like manner a mixture will be delivered through inlet 27 to chamber 15 and to a port 32 formed by the outer wall of element 18 and the inner wall of element 19, and likewise to a port 33 whose area is dependent upon the diameter of the inner walls of reduced portion 24 of element 23.

The areas of ports 31, 32 and 33 are preferably so designed that the maximum practical and efficient range of port 32 includes the minimum range of port 31, and the maximum range of port 33 includes the minimum range of port 32. Thus, when the heating chamber 10 is being brought up to a desired temperature the thermal input will be supplied through all the ports 31, 32 and 33 operating simultaneously and as the heating progresses the total thermal input to the heating chamber is reduced by first reducing the thermal input through port 31 by regulation of device 28. When the thermal input is reduced to a point approaching the minimum limit of port 31 the device 28 may be cut out of service and the thermal input supplied through port 32 which has a range of lesser thermal input than port 31, is progressively reduced through regulation of device 29. If the thermal input to heating chamber 10 continues to be greater than desired port 32 is rendered inoperative and port 33 supplied by regulating device 30 becomes the controlling unit. Thus an efficient range of mixing pressures is maintained over a wide fluctuation of thermal input varying from the maximum of the sum of ports 31, 32 and 33 to the minimum of port 33 alone.

Also any desired combination of ports may be used as required, such as any two or all three ports operating concurrently, excepting that for practical purposes the positive flame retention port 33 should be used in all combinations. Referring to Figs. 4 and 5, I have illustrated a modification of my invention generally similar to that previously described but wherein the intermediate tubular element 19 is eliminated thereby providing two burner ports rather than three. A plug 40 is inserted in chamber 15 and chamber 15 now supplies pre-mixed combustible vapor or gas to the flame retention nozzle through element 18' and chamber 14 to a relatively large port 41. The main difference between this modification and that described in connection with Figs. 1-3 inclu-

sive is that the turn-down ratio of large port 41 is less than the composite turn-down ratio of ports 31 and 32.

Although I have shown and described modifications of my invention I contemplate that numerous extensions and departures may be made therefrom without departing from the spirit of my invention and the scope of the appended claims.

Having thus described my invention what I claim is:

1. The combination with a high temperature furnace having an opening formed in the wall thereof, a plurality of devices for pre-mixing air and gaseous or vapor fuel in proportion for substantially complete combustion, manual means for individually controlling the pressure at which the mixture is delivered from each of said devices, of a burner unit having a tubular neck portion insertible within the furnace opening and having a plurality of individual chambers formed therein, each of said chambers having a tubular extension of different cross-sectional area projected within the housing neck portion and disposed co-axially therewith, means connecting each of said chambers with a different pre-mixing device, and flame retention means disposed co-axially within said neck portion and forming part of the central tubular extension.

2. The combination with a plurality of devices adapted to supply pre-mixed gaseous or vapor fuel and air under individual variably controllable pressure, of a burner unit having a plurality of individual chambers formed therein, means for supplying each of said chambers with a mixture from a different device, each of said chambers having a tubular outlet port of different cross-sectional area co-axially inter-related and terminating substantially in a common plane, and a flame retention means forming part of the central port.

3. The combination with a plurality of devices adapted to supply pre-mixed gaseous or vapor fuel and air, each device having a manually operable valve to control the pressure at which the mixture is supplied, of a burner unit having a plurality of separate chambers formed therein, means connecting each of said devices to a different chamber whereby the mixture supply and

pressure to each chamber may be selectively controlled by the valves, each of said chambers having an outlet conduit extending in concentric relation to a common opening in the unit wall, and a flame retention means mounted in the unit and forming part of the central conduit.

4. The combination with a plurality of devices adapted to supply premixed gaseous or vapor fuel and air, each device having a manually operable valve to control the pressure at which the mixture is supplied, of a burner unit having a plurality of separate chambers formed therein, means connecting each of said devices to a different chamber whereby the mixture supply and pressure to each chamber may be selectively controlled by the valves, each of said chambers having an outlet conduit extending to a common opening in the unit wall, and a flame retention means mounted in the unit forming part of one conduit and adapted to be selectively operated with the other conduits.

5. The method of providing a flame of maximum heating value over a wide thermal output and temperature range which includes supplying pre-mixed gaseous or vapor fuel and air, selectively from a plurality of independent sources to a common combustion zone, arranging the mixture to enter the combustion zone in successive envelopes about a central mixture, and combining the central mixture with selective mixtures from the other sources under variably controllable pressure to provide a long slender flame.

6. The combination with a plurality of devices adapted to supply pre-mixed gaseous or vapor fuel and air, each device having a manually operable valve to control the pressure at which the mixture is supplied, of a burner unit having a plurality of conduits terminating in concentric relation at an opening provided in the wall of the burner unit, said unit being adapted to be associated with a furnace to supply fuel mixture thereto, each conduit being connected to a different mixing device whereby the mixture supply and pressure to each conduit may be selectively controlled by the valves, and a flame retention means forming part of the central conduit and adapted to operate continuously during operation of the burner.

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