May 12, 1925.

1,537,335

C. N. CROSS

GAS BURNER

Filed March 14, 1921

Fig. 2

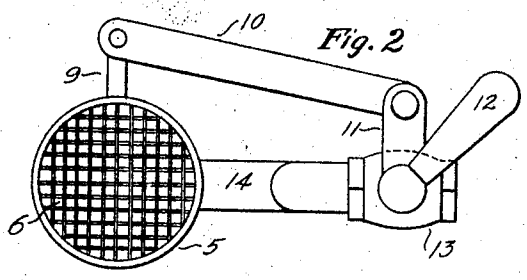
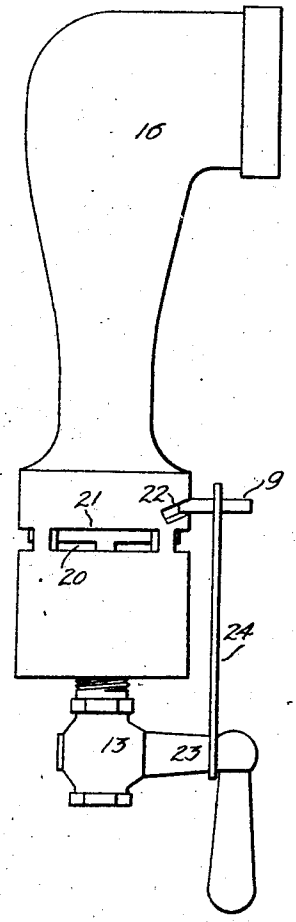


Fig. 3



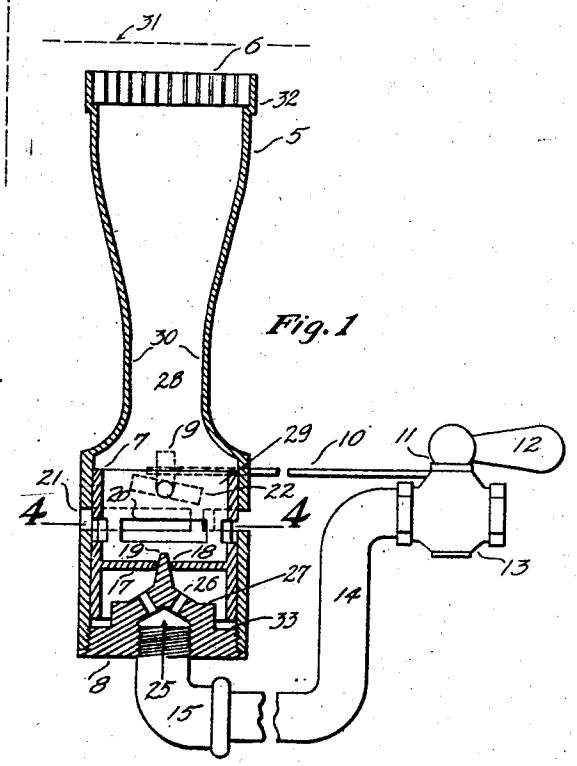


Fig. 1

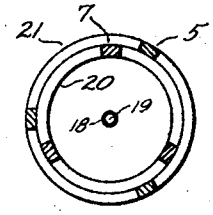


Fig. 4

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UNITED STATES PATENT OFFICE.

CHARLES N. CROSS, OF STANFORD UNIVERSITY, CALIFORNIA.

GAS BURNER.

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To all whom it may concern:

Be it known that I, CHARLES N. CROSS, a citizen of the United States, and a resident of Stanford University, county of Santa Clara, and the State of California, have invented a new and useful Gas Burner, of which the following is a specification.

My invention relates to gas burners and particularly to gas burners into which the admission of air and gas are jointly and simultaneously controlled.

There are two limiting conditions in the operation of all gas-burners. First, if the velocity of the air-gas mixture leaving the burner ports is too great the flame is blown away from the burner and the gas cannot be efficiently utilized. Second, if the exit velocity of the mixture is too small the flame flashes back. With the larger ratios of air to gas desirable at high rates of gas consumption the range in exit velocity between "flash back" and "blow from ports" is small thus limiting the efficiency and usefulness of the burner. By decreasing the ratio of air to gas as the rate of gas consumption is decreased very low rates of gas flow in a given burner may be obtained without danger of "flash back". Then at the maximum rate of burning gas a greater ratio of air to gas is desirable to give high temperatures and consequently high efficiency of heat utilization. However, if the ratio of air to gas becomes too large the velocity of the mixture at high rates of burning reaches a value at which the flame is blown from the burner ports. Hence an object of my invention is to so vary the ratio air to gas in the mixture as the rate of gas consumption is changed so as to maintain the exit velocity between the two limiting velocities above described. When such control obtains the efficiency of heat utilization is highest.

A further object of the invention is to so control the velocity of flow of the air and gas mixture as it enters the zone of inflammation as to give an unusually high flame temperature.

It has been found by experiment that to produce maximum flame temperature the velocity of the mixture as it enters the burning zone must be controlled within narrow limits, and the gas and air must be thoroughly mixed and intermingled in order to realize the highest possible flame temperatures.

Hence another object of my invention is to provide a burner in which gas and air taken into the burner at the base are most thoroughly mixed and intermingled as they flow through the burner.

Therefore, broadly the objects of my present invention are; to provide a gas-burner in which the velocity of the flowing mixture is so controlled as to give perfect and intense combustion at exceptionally high temperatures and to provide a gas-burner in which the ratio of air to gas may be changed simultaneously with the change in the rate of gas consumption while the burner is in operation.

In the following description of the preferred form of my invention which is illustrated in the drawings accompanying and forming a part of the specification, I do not limit myself to the showing made by the said drawings and description, as I may adopt variations of the preferred form within the scope of my invention as set forth in the claims.

Figure 1 is an elevation of the burner of my invention with connections and control lever. The burner proper is shown in vertical section.

Figure 2 is a plan view of the burner shown in Fig. 1.

Figure 3 is a side view of a modified form of burner. The modification consists of a differently formed burner tube having a right angled turn near its outer end. All the other features of the burner proper are the same as in Fig. 1.

Figure 4 is a sectional view taken on the line 4—4 of Fig. 1.

The gas burner of my invention consists of a fixed base 8 of cylindrical form adapted to be threaded tightly upon a nipple 15, Fig. 1, which is the terminal fitting on the pipe 14 through which the gas is conducted to the burner. The base is formed with a chamber 25 into which the gas from the nipple 15 discharges. The upper wall 27 of the base is provided with openings 26 which permit the passage of gas to the orifice 18. Mounted concentrically upon the upper wall 27 and integral therewith is a conical needle 19. The upper surface of the base forms a ledge 33 which serves as a gas tight seat for the lower end of the sleeve 7 to rest upon when in its lowest position.

Tightly screwed to the burner base is the lower end of the burner tube 5. The tube is fixedly mounted upon the base. The burner

tube extends in cylindrical form above the base enclosing an intake chamber 29 then narrows into a throat 28 with rounded entrance and exit. The diameter of the throat increases slightly in the direction of gas flow. Above the throat the tube gradually flares out to the maximum diameter at the top where a foraminated block or grid 6 is held upon a suitably arranged flange 32. Air inlet ports 21 are formed in the wall of the intake chamber. A short helical slot 22 is cut through the tube into the intake chamber.

The throat is a very important feature of the burner tube. It serves three offices. First, variation in the ratio of the length of the parallel walls to the diameter of the throat is the most important factor in controlling the velocity of the entering air and gas as they approach the burning zone at 31. Second, the ratio of throat length to diameter has a very marked effect on the thoroughness of the mixing of the air and gas before ignition takes place. The mixing is performed largely by the turbulent flow of the gas stream. Turbulence is largely dependent upon velocity and viscosity of the moving fluid as can be shown mathematically. Thirdly, changing the ratio of the length of the parallel walls of the throat to its diameter also has a very great effect on the amount of air drawn in through the ports 21 by the injector effect of the gas jet entering through the orifice 18. It has been found that the maximum injector effect is produced, so far as it depends upon the throat design, when the walls of the throat diverge slightly toward the exit end of the burner. The total angle of divergence of about four degrees has been found to give superior results. However, a smaller or a greater angle may be used depending upon the rated capacity of the burner, the quality of the gas and the pressure of the gas supply. A throat length of one inch and a throat diameter of $\frac{5}{8}$ inch have been found by experiment to be satisfactory dimensions for a burner which will consume approximately 20 cubic feet of gas per hour under a pressure of 5 inches of water. However I do not wish to limit myself to the above throat proportions as the proportions vary with change of the capacity of the burner.

Within the end of the tube adjacent the base is a partitioned sleeve 7. The sleeve makes a close sliding fit in the tube yet it is readily rotated about its longitudinal axis. The rotation serves to move the sleeve axially by means of a pin 9 attached to the sleeve and projecting through the helical slot 22. The sleeve has a transverse partition 17. The partition has a concentrically located orifice 18 which registers with the needle 19 to form a needle valve. The rotational and axial movements of the sleeve serve to change the effective opening of the orifice thus furnishing a fine control over the flow of gas entering the burner tube. The sleeve is also provided with air ports 20, which can be made to register with the air ports 21 in the burner tube, thus effecting a positive control over the amount of air drawn into the intake chamber 29 by the injector action of the gas jet entering through the orifice 18. Hence the movements of the partitioned sleeve perform two functions simultaneously and in the correct ratio. Firstly, the movements regulate the gas flow. Secondly, they regulate the rate of air flow through ports 21 in proportion to the flow of gas. The correct proportionality between the gas and air rates of flow for different kinds of gas and different burner capacities (after the dimensions of the throat are once fixed) is obtained by properly corelating the slope of the helical slot 22, the length and taper of the pin 19, and the diameter of the orifice 18.

The preferred number of air ports is 3, each, in the tube and in the sleeve. However another number may be used.

The angle through which the sleeve may be rotated should be approximately 80 degrees. However it could conveniently be made anything between 60 degrees and 100 degrees.

Preferably a separate valve or cock 13 of any suitable type is provided in the supply pipe 14 to shut off the admission of gas to the burner base 8. Means are preferably provided for co-ordinating the operation of the cock and the sleeve so that the movements of the needle valve and the air ports are effected simultaneously with the movements of the cock.

The valve 13 is provided with an operating handle 12 which may be turned to open or close the passage into pipe 14. Projecting from the side of the handle is a lever arm 11 which is fixedly attached to the handle. The opposite end of the lever arm is pivotally attached to link 10 and the other end of the link is pivoted to pin 9. The pin 9 extends through the helical slot 22 and is attached to the sleeve 7. Movement of the handle 12 to open or close the cock 13 is thus accompanied by a corresponding rotational and axial movement of the sleeve 7 which in turn opens or closes the needle valve orifice 18 and simultaneously opens and closes the air ports 21. When the sleeve occupies its extreme position toward the base to close the needle valve orifice the air ports 20 are sufficiently out of register with the air ports 21 as to nearly close the area open for the intake of air.

The foraminated block or grid 6 has an important influence upon the proper functioning of my invention. For a burner of the size and proportions shown in Fig. 1

I prefer to use a grid pierced by apertures of square section. The section can be conveniently about .07" on a side. One of the functions of the grid is to produce a large number of short blue cones of flame which give a very rapid combustion and thereby produce an extremely high flame temperature. The length of the blue cones is approximately .10" and the maximum flame temperature occurs a few hundredths of an inch above the top of the blue cones. Because of these facts the utensil being heated can be placed very close to the top of the burner without "smothering" the flame. Under these conditions the flame never "floats" and maximum utilization of the gas is always obtained because of the high flame temperature produced.

From the above it will be clear that rotation of the sleeve 7 by movement of the pin 9 results in admitting gas under pressure through the needle valve orifice 18 into the mixing chamber 29; and also simultaneously opens the air ports 21 through which the proper amount of air is drawn into the stream of gas passing into the throat 28. From the throat the gas and air pass into the enlarged exit end of the tube where it is thoroughly mixed and the velocity reduced to the correct value which gives a series of short intensely hot blue cones of flame as the mixture emerges from the grid apertures.

In Figure 3 I have shown a modified form of burner in which the principal change is in the form of the tube 16. It is constructed with a right angled bend in the exit end giving the mixture an exit direction of flow at 90 degrees to its direction of flow at the inlet end of the burner. The cock 13 is screwed directly to the burner base and the link 24 is rigidly attached to the valve stem 23. The other end of the link is connected loosely by a slot (in the link 24) to the pin 9, thus the movements of the handle of the valve 13 rotates the sleeve. Otherwise the structure and operation of the burner of Fig. 3 is the same as already described in detail for the burner in Fig. 1.

I claim:

1. In a gas burner, an apertured chambered base having mounted thereon a needle, a burner tube fixedly attached to said base, a partitioned sleeve within said tube and arranged to move axially in respect to said tube when rotated, an orifice in said partition of said sleeve, and means for effecting the rotative and axial movements of said sleeve.

2. In a gas burner, an apertured chambered base, means for supplying gas to said base, a burner tube fixedly attached to said base, a partitioned movable sleeve within the end of said tube adjacent said base, a needle mounted on said base, an orifice in said partition of said sleeve, said needle and said orifice being so adapted that the axial and rotational movements of said sleeve controls the passage of gas through said orifice and into said tube, and means for effecting the movements of said sleeve, a grid comprising a foraminated block in said tube.

3. In a gas burner, an apertured chambered base, a needle mounted upon said base, means for supplying gas to said base, a burner tube attached to said base, air inlet ports in said tube, a partitioned movable sleeve within said tube, an orifice in partition of said sleeve, air inlet ports in said sleeve, means for operating said sleeve, and a grid comprising a foraminated block in said tube.

4. In a gas burner, an apertured chambered base, a needle formed upon said base, means for supplying gas to said base, a burner tube attached to said base, air inlet ports in said tube, a partitioned movable sleeve within said tube, an orifice in the partition of said sleeve, air ports in said sleeve, a grid arranged in said tube, a cock to control the flow of gas in said supply means, means for co-ordinating the operation of said cock and said sleeve.

5. In a gas burner, an apertured chambered base, means for supplying gas to said base, a burner tube immovably attached to said base, air inlet ports in end of said tube adjacent said base, a partitioned movable sleeve within said tube, air ports in said sleeve, a valve arranged in said sleeve, means for operating said valve and said air ports simultaneously, a multiported head or block on exit end of said tube.

6. In a gas burner, an apertured chambered base with needle mounted thereon, a burner tube attached to said base, air ports in said tube, a movable partitioned sleeve within said tube, air ports in said sleeve, an orifice in said partition of said sleeve, means to produce movement of said sleeve, a gas cock to shut off flow of gas to said base, means to coordinate movements of said gas cock and said sleeve.

In testimony whereof I affix my signature, in the presence of two witnesses.

CHARLES N. CROSS.

Witnesses:
N. B. CHANEY,
F. D. BANHAM.