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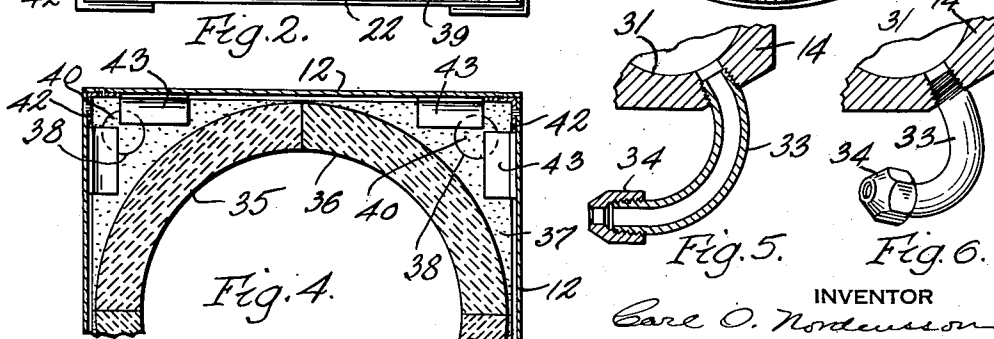
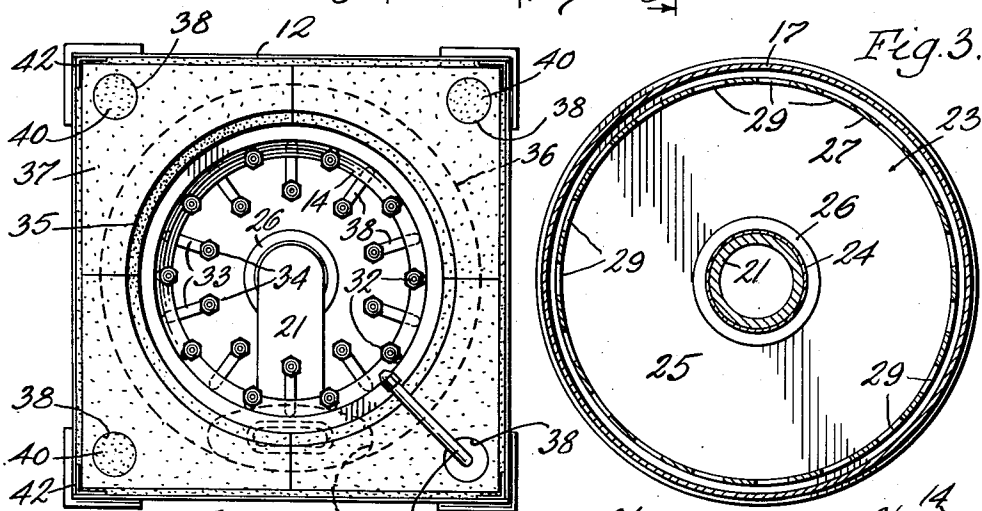
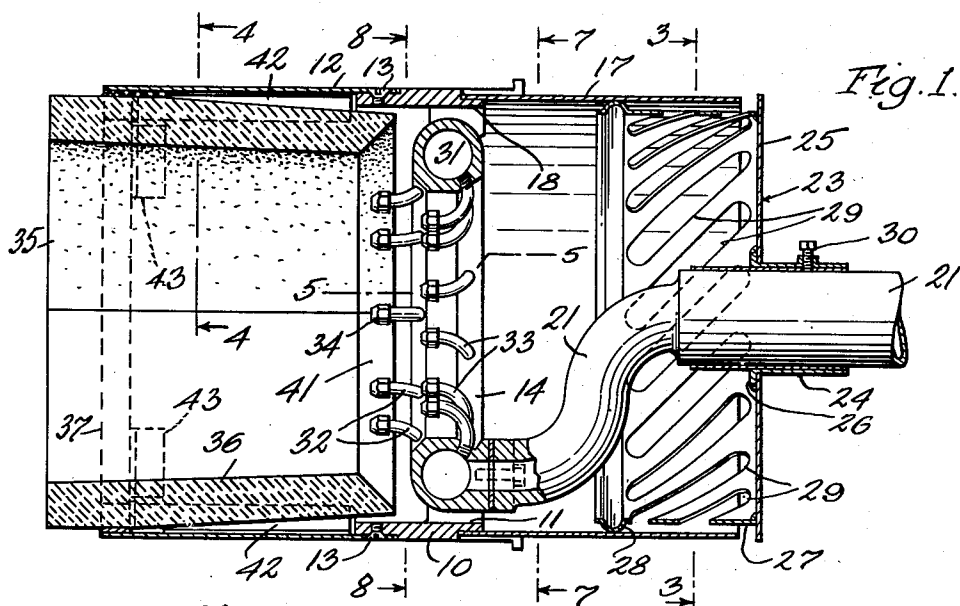
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2,222,822

GAS BURNER UNIT

Filed June 4, 1937

2 Sheets-Sheet 1



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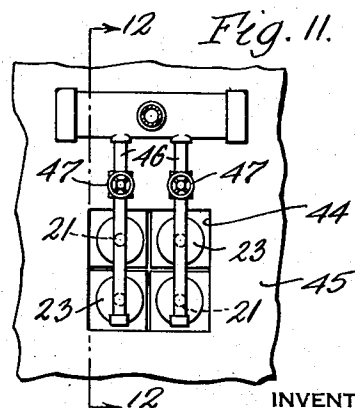
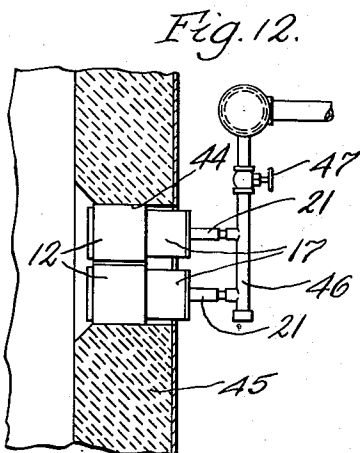
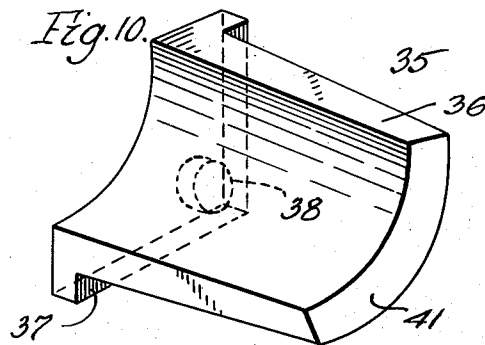
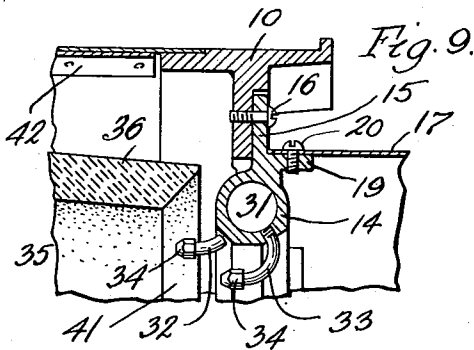
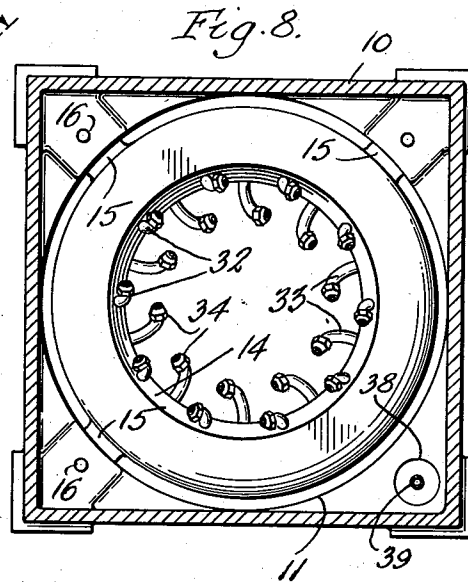
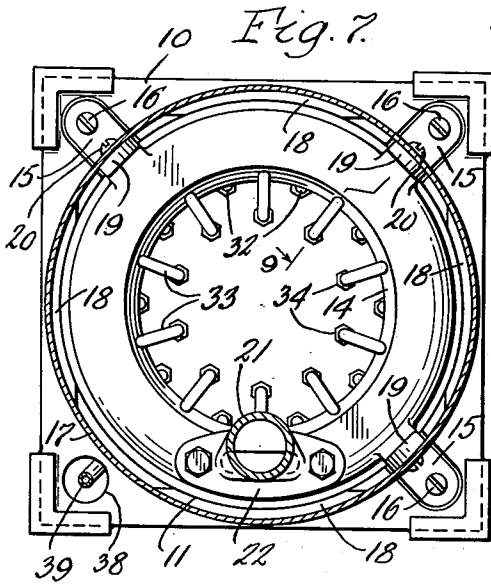
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GAS BURNER UNIT

Filed June 4, 1937

2 Sheets-Sheet 2



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2,222,822

GAS BURNER UNIT

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Application June 4, 1937, Serial No. 146,382

4 Claims. (Cl. 158—99)

This invention relates to gas burners of the type suitable for furnaces and low pressure heating boilers as well as for all kinds of industrial heaters and high pressure boilers including heating and power boilers, stills, driers and kilns of all types, annealing, baking and core ovens, lead and gypsum pots, potato chip tanks, etc.

The primary function of a gas burner is to mix gas and air, and generally the merit of the gas burner may be indicated to some extent by the thoroughness of the mixing of the air and combustible gas. This is particularly true in burners employing all primary air, and the present invention is particularly adapted for use in mixing the combustible gas and primary air. Thorough mixing of the combustible gas and air before ignition takes place results in quick and complete combustion near the end of the burner with a short flame and requires a minimum amount of excess air. Excess air reduces the temperature produced by the combustion, yet some excess air is necessary in order to insure complete combustion of all the gas. A thorough and complete mixing of the gas and air must be obtained if the amount of excess air is to be reduced to a minimum. With thorough and rapid combustion of the gas with a minimum of excess air, the result is a higher furnace temperature and greater heat transfer from the combustion gases to the heating surfaces, and therefore the stack loss is materially reduced with consequently higher efficiency in the heating device. The reduction of the excess air to a minimum also reduces the oxidation of the heating surfaces and of the furnace lining, with resulting minimum upkeep expense for the heating device.

One object of the invention is to generally improve and simplify gas burner units, and particularly those utilizing all primary air in which substantially all of the air necessary for combustion is mixed with the gas before ignition takes place.

Another object of the invention is to provide a gas burner unit in which all the air required for combustion is mixed with the gas before ignition, with which complete, early and rapid mixing of the combustible gas and air is obtained, with which maximum furnace temperatures may be obtained from a given quantity of combustible gas, with which maximum heat transfer from the combustion gases to the heating surface may be obtained, and with which oxidation of the furnace lining and heating surfaces is reduced to a minimum.

Another object of the invention is to provide an improved gas burner unit which will have maximum flexibility of capacity without lowering its combustion efficiency, which will operate efficiently on either low, medium or high gas pressures, and which will burn all of the gases in commercial use even including blast furnace and producer gases.

A further object of the invention is to provide an improved gas burner unit which will be practically free from backflash and pulsation, which may be used effectively in combination with oil burning equipment with quick change over from one fuel to the other without any change in the furnace or disturbance of the burner setting, which is easy to install and operate, which is relatively light, yet strong and rugged in construction, with which a pilot light may be supplied as a part of the burner assembly, and which will be relatively inexpensive.

Another object of the invention is to provide an improved gas burner unit having a sensitive, easily operated air control which is suitable for automatic as well as hand regulation, with which the amount of air admitted for mixture with the combustible gas may be easily regulated and equally distributed with reasonable accuracy of control of the amount of air, and with which the air admitted is given somewhat of a whirling turbulence.

Another object of the invention is to provide an improved gas burner unit which will be relatively compact, easily installed in masonry walls, and any number assembled in coupled relation for insertion as a single element in a furnace wall, which will provide for thorough mixing of the combustible gas and air and maximum preheating of the gas and air mixture before ignition, and with which the manifold may be easily removed from the unit at the outside of the heating device for inspection, adjustment or change of the gas jets, without disturbing the burner setting in the wall of the heating device.

Other objects and advantages will be apparent from the following description of an embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a longitudinal sectional elevation through a gas burner unit constructed in accordance with this invention and designed primarily for use as an industrial burner;

Fig. 2 is an end elevation of the same as viewed from the left in Fig. 1;

Fig. 3 is a transverse sectional elevation through the same, the section being taken approximately along the line 3—3 of Fig. 1;

Fig. 4 is a transverse sectional elevation through another portion of the same, the section being taken approximately along the line 4—4 of Fig. 1;

Fig. 5 is a sectional plan through a portion of the burner manifold and one of the discharge jets, the section being taken approximately along the line 5—5 of Fig. 1;

Fig. 6 is a view similar to Fig. 5 except that that discharge jet is not in section and has been rotated angularly somewhat about its connection to the manifold in order to change the direction of discharge of the gases therefrom;

Fig. 7 is a transverse sectional elevation through another part of the unit, the section being taken approximately along the line 7—7 of Fig. 1;

Fig. 8 is a sectional elevation through still another portion of the unit, the section being taken approximately along the line 8—8 of Fig. 1;

Fig. 9 is a sectional plan of a portion of the same, the section being taken approximately along the line 9—9 of Fig. 7;

Fig. 10 is a perspective of one of the sections of the refractory lining;

Fig. 11 is a front face elevation of an industrial heater having in proper position in a wall therein a battery of four burner units that are constructed in accordance with this invention; and

Fig. 12 is a sectional elevation through the same, the section being taken approximately along the line 12—12 of Fig. 11.

In the illustrated embodiment of the invention, the improved gas burner unit includes a rectangular burner frame or casing 10, which may be of cast metal such as cast iron or steel, and this burner casing or frame is provided with an opening or passage 11 therethrough from face to face which is circular at one zone of its length. A rectangular mixing casing 12 which is open at both ends is telescoped over a reduced end flange on the burner frame 10 and is secured against removal therefrom in any suitable manner such as by screws 13. A gas distributing manifold 14 is disposed within the opening or passage 11 of the burner casing 10, and preferably is spaced somewhat from the wall of the passage 11 to provide for the passage of air past the manifold at the exterior of its periphery. This manifold 14 is preferably a closed loop and circular, but it may of course be made of sections or of other shapes if desired. As shown, it is made of a single casting and is provided with radial ears or lugs 15, Figs. 7 to 9, which abut against that end face of the burner casing which is opposite from the casing 12, the lugs 15 being removably secured to the burner frame in any suitable manner, such as by screws 16.

A cylindrical casing 17 is open at both ends and at one end abuts against the end face of the burner frame 10 at the face opposite from the casing 12, and preferably the casing 17 telescopes over flanges 18 on the end face of the burner casing 10 and also over lugs or ears 19 extending endwise from the distributing manifold 14, Figs. 7 and 9. The casing 17 may be secured in position in any suitable manner such as by screws 20 which pass through the casing 17 into the lugs or ears 19. Thus the casing 17 will be secured to the manifold 14 and through the latter will be detachably secured to the burner casing 10, and when the screws 16 are removed, the casing 17 and the manifold 14 may be removed

together as a unit. It will be noted that the screws 16, by which the casing 17 and the manifold 14 are attached to the end face of the burner casing 10, are outside of the casing 17 so as to be easily accessible when removal of the manifold 14 and casing 17 from the rest of the unit is desired.

A gas supply pipe 21 is coupled at one end, such as by a coupling 22, to the manifold 14 and is then curved or bent into a central portion of the passage through the casing 17 and then extends outwardly through the open or outer end of the casing 17, as shown in Fig. 1. A valve, shutter or closure 23 is provided upon this outwardly projecting end of the pipe 21 for adjustment therealong, and includes a sleeve 24, which slides freely on the pipe 21, and a disk or plate 25 through which the sleeve 24 passes and which is secured against a flange 26 on the sleeve 24 intermediate the ends of the latter. The valve 23 is preferably cup shaped or drum shaped and has a cylindrical wall 27 extending from the disc or end wall 25 and telescoping with the outer end of the casing 17. Preferably the cylindrical drum portion 27 telescopes loosely within the open end of the casing 17, and at its inner end is provided with an outwardly drawn peripheral bead 28 which by engagement with the inner wall of the casing 17 tends to steady the valve 23 in its telescoping adjustments along the casing 17, and at the same time stiffens the wall in which it is formed and also prevents the passage of any large quantity of air between the inner wall of the casing 17 and the cylindrical drum or wall 27 of the closure.

One of the telescoping walls of the valve or shutter and the casing 17 is provided with slots or slot-like apertures which progress generally in a direction endwise of the casing 17 and preferably also with a circumferential component so that the slots actually extend in a direction both endwise of the casing 17 and also somewhat in a circumferential direction, as shown clearly in Fig. 1. Preferably these slots are provided in the cylindrical wall or drum section 27 and are designated by the reference character 29, because in the illustrated embodiment of the invention the drum portion 27 telescopes within the casing 17. Thus, as the valve or closure 23 is shifted endwise along the pipe 21 or is adjusted telescopically with respect to the casing 17, varying portions of the slots 29 will be uncovered for the entrance of air into the conduit formed of the casings 10, 12 and 17, providing a very sensitive control for the air throughout approximately the full range of adjustment of the shutter. The oblique positions of the slots 29, that is, the location of the slots so that they progress with components circumferentially and also endwise, appear to improve the uniformity, thoroughness or completeness of the mixture of the gas and air within the conduit formed of the casing sections 10, 12 and 17, and this is believed to be due to the tendency of the oblique slots 29 to impart somewhat of a whirling turbulence to the air upon its entrance to the casing 17.

This whirling turbulence may be further increased by selection of the direction in which the streams of combustible gas are discharged into the air current, as will be explained presently. While the valve or shutter 23 may be adjusted automatically in order to regulate the amount of air admitted, such automatic regulation has been omitted from the illustrated embodiment of the invention in the interest of simplicity and

clearness, and a simple, manual device such as a set screw 30 is illustrated for the purpose of securing the valve 23 in a desired position. Usually in industrial furnace, heater and boiler

5 installations, a battery of these burner units is employed, and therefore the number of burner units ignited or in use may be varied when a change in the heating effect is desired.

The gas distributing manifold 14 has a distributing passage 31 which, as shown, progresses in a direction around the interior of the burner frame such as in the form of a closed loop, and the center line of the passage 31 is approximately in a plane which is crosswise of the longitudinal

10 axis of the conduit formed of the casing sections 10, 12 and 17. A plurality of gas discharge jets 32 and 33 are provided on the manifold 14, and discharge small streams of gas into the conduit generally in the direction of air flow and these

15 small streams have somewhat of an injector action to induce air flow along the conduit. The maximum possible volume of air passing through the conduit is governed, not only by the draft in the furnace or heater, but also by the pressure

20 at which the combustible gas is discharged into the conduit, because the induction effect of the gas streams on the air flow depends upon the velocity of discharge of such gas streams into the air in the conduit. The jets 32 are arranged at

25 intervals along the manifold 14 on one side of the plane through the center line of the passage 31, and these jets leave the manifold at an acute angle to the plane of the center line of the passage 31 but after leaving the manifold 14 they are

30 bent arcuately so as to discharge the small streams of combustible gas along the air passage through the conduit formed of casing sections 10, 12 and 17, in the direction of air flow as shown in Fig. 1.

The discharge jets 33 are arranged also along the manifold 14 but on the side of the plane of the passage 31 opposite from the jets 32, and the jets 33 also in leaving the manifold project outwardly away from the plane through the center line of the passage 31 but at an acute angle thereto. After leaving the manifold, the jets 33 are curved arcuately so as to discharge small streams of combustible gas also along the conduit formed of sections 10, 12 and 17 in the direction

40 of air flow. The jets 33 are preferably staggered with respect to the jets 32 in the passage, so as to obtain a more uniform distribution of the gas in different parts of the air stream passing along the conduit. This staggered arrangement is

45 shown particularly in Fig. 2. It will also be noted that the jets 33 extend radially further into the passage through the loop formed by the manifold 14 than do the jets 32.

The jets 32 and 33 at their free ends are also preferably provided with detachable nozzles or spuds 34 for determining the character and size of the stream of gas which is discharged. The jets 32 and 33 are preferably threaded into holes provided in the manifold 14, and thus may be

50 angularly adjusted on the manifold by partial rotation in a threading direction so that the gas streams discharged by the jets may be in directions somewhat angularly, obliquely or tangentially to the direction of air flow through the conduit. Such an adjustment of one of the conduits 33 from the position shown in Figs. 2 and 5 is shown particularly in Fig. 6, and an example of such an adjustment of all of the jets 32 and 33 is shown in Fig. 8. If the jets are adjusted so

55 that they have somewhat tangential or oblique

angles with the center line of the conduit, as shown in Fig. 8, the discharged streams will not only draw air through the conduit but will impart a spiraling or spiral whirling of the air and gas streams in the conduit, with resulting greater

5 length of travel of the gases and air in the conduit and a more rapid, thorough and complete mixture of the combustible gases and air. The degree of such turbulence and whirling may of course be varied by appropriate angular adjustment of the jets in the manifold 14 so as to vary

10 the lateral deflection of the streams of combustible gas, but preferably all the jets have the same angular positions with respect to the axis of the conduit.

The casing 12 is provided with a refractory lining 35 which may be made of any suitable refractory material, but preferably of a light refractory material which will withstand a temperature of at least 2400° F. The lining is preferably divided longitudinally into a plurality of sections formed separately in order to reduce the tendency for the lining to crack and for ease of manufacture, and has a length which is sufficient to effect thorough mixing of the gas and air and obtain a maximum preheat of the mixture before ignition thereof. The refractory sections are preferably securely cemented together at their joints and into the casing 12 with a suitable refractory cement. One of these refractory lining sections is shown in perspective in Fig. 10, from which it will be noted that the lining is provided with a central cylindrical portion 36 projecting from an end face of a rectangular flange or head 37.

The flange or head 37 may be provided with apertures 38 at each of the corners, which apertures increase the lightness of the lining and reduce its tendency to crack, and one of these apertures 38 may be utilized for the passage of a pilot supply pipe 39, Figs. 2, 7 and 8. The other passages 38 may be closed, such as at an end thereof, if desired by any suitable refractory plugs 40, Fig. 2. The lining 35 may conveniently extend somewhat beyond the open end of the casing 12 so as to form a continuation thereof, and the inner end face of the lining is preferably bevelled inwardly as at 41 so as to form a converging or constricting passage section immediately in front of and spaced somewhat from the manifold 14, so that any air passing between the manifold 14 and the burner casing 10 will be deflected by the bevelled portion 41 toward the center of the conduit for mixture with the streams of combustible gas and air. The bevelled

45 constriction also tends to create turbulence in the air stream.

The rectangular casing 12 may be formed in any suitable manner, but preferably it comprises four plates of sheet metal assembled to form a rectangular body, and the abutting edges of the plates at the corners are connected to angle bars 42 such as by rivets or screws. The angle bars reinforce the casing at the corners. The sheet metal plates of which the casing 12 is formed may also carry angle bars 43 on their inner faces and adjacent to the corners which serve as stops or abutments to limit the extent to which the refractory lining is inserted into the casing 12.

Referring now particularly to Figs. 11 and 12, a battery of such burner units is assembled in the burner opening 44 in the furnace or heater wall 45, and because of the rectangular shape of the burner casing 10 and mixing casing 12, any desired number of these burner units may be as-

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sembled in the burner opening in a wall of the combustion chamber with cement applied between the units and the wall of the opening 44 so as to tightly seal the same. Inasmuch as the pilot supply pipe 39 passes through the refractory lining within the casing 12, and through an aperture in one of the corners of the burner casing 10, the pilot burner pipe will not interfere with the assembling of these various units in a furnace wall. The pipes 21 for supplying combustible gas to the different units may be connected to common headers 46 controlled by valves 47. If the burner unit is to be employed for low pressure heating boilers and for furnaces having automatic controls, each burner unit may, at its outer or air entrance end, be enclosed in an auxiliary air box with a damper automatically controlled in a manner now common in various types of burners, to cut off the supply of air into the burner unit when the fuel is shut off. The damper of such an enclosure would operate independently of the valve 23 which regulates the quantity of air admitted during operation of the unit.

The operation of the burner unit appears to be clear from the foregoing description, but will be briefly summarized. The pilot light being lighted at all times, receives its supply of gas through the pipe 39 and this pilot, as observed in Fig. 2, is disposed somewhat across the stream of air leaving the conduit of the unit at the outer end of the refractory lining. A combustible gas is supplied through the pipe 21 to the manifold 14, and this gas is distributed through the passage 31 in the manifold to the various discharge jets 32 and 33. These jets discharge a large number of small streams of the combustible gas into different portions of the conduit passage in the direction of air travel along the conduit, and these streams of gas, by somewhat of an injector action, aid the flow of air along with the gas into the furnace combustion chamber through the refractory lining of the casing 12.

The quantity of air admitted is regulated by the valve or shutter or closure 23, which is adjusted telescopically along the pipe 21 until but little more than the necessary amount of air is included to obtain complete combustion when the burner is operated at desired or normal capacity under normal gas pressure. The air entering through the oblique slots 29 will be given somewhat of a turbulence in the conduit, and thus an even distribution through the conduit and around all of the jets, and this turbulence may be increased or varied when desired by adjusting the angular positions of the jets 32 and 33, such as into the positions shown in Fig. 8 for example. I have found that adjustment of the jets into the positions shown in Fig. 2 to discharge streams of gas in directions approximately parallel to the longitudinal axis of the conduit is frequently advantageous when the gas delivered to the manifold 14 is under a relatively high pressure such as of approximately $\frac{1}{2}$ to 3 lbs. and that the angular adjustment of the jets into increasingly angular positions such as shown in Fig. 8 is frequently desirable when gas is supplied to the manifold 14 at relatively low pressures such as below approximately $\frac{1}{2}$ lb.

The air and discharged streams of gas will mix quickly and thoroughly while travelling along the portion of the conduit with the refractory lining, and through the whirling movement, a slightly larger linear travel of the mixture is obtained in a given overall length of conduit.

The combustible mixture will be ignited as it leaves the refractory lining.

The heat from the combustion chamber, into which the combustible and burning mixture is discharged, will heat the refractory lining of the conduit, which will in turn radiate some of this heat to the ingoing gas and air mixture and thus preheat it before admission to the combustion chamber of the furnace or heater, thus obtaining a rapid combustion of the gases when once ignited. The casing 12 and the refractory lining therefore are made of such length that a thorough mixing of the gas and air, and a maximum desired preheating of the mixture, are obtained before discharge into the heater. Thus each burner unit is simple and sturdy, yet of light weight, and of flexible capacity. When one desires to inspect any burner, or to adjust the angular positions of the jets 32 and 33 such as in order to vary the turbulence set up in the air current by the discharged combustible gas, it is merely necessary to remove the screws 16 and then remove the pipe 21, the casing 17 and the manifold 14 as a unit, leaving the burner casing 10, the casing 12 and the lining 35 in position in the furnace wall. They may be replaced by reverse steps. Experience has demonstrated that a burner unit of this type is practically free from backflash and pulsation, and careful tests have indicated that remarkable efficiency is obtained.

With a burner unit of this type, one may obtain for a given furnace draft, the combustion of more gas per square inch of throat area when higher gas pressures are used than with low pressures, and the apertures of the burner spuds may be changed if necessary to vary the quantity of combustible gas delivered. With each change in the quantity of gas delivered by the spuds, whether by variations in the orifices of the spuds or by regulation of the quantity or pressure of gas delivered to the manifold, the air valve 23 should be regulated accordingly to deliver the proper proportion of air necessary for complete combustion, and with a minimum of excess air. Burner units of this type have a relatively large range of capacities, such as, for example, from approximately 250 cubic feet per hour at a gas pressure of approximately 2 inches W. G. to 4000 cubic feet per hour at a gas pressure of approximately 2 pounds per square inch, with substantially equal combustion efficiency throughout the range.

The rectangular shape of the burner frame and of the mixing casing is advantageous for the reason that the rectangular shapes of this type are more easily fitted into masonry walls and fitted to one another in batteries, as will be observed from Figs. 11 and 12.

It will be understood that various changes in the details, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. A gas burning unit comprising a tubular conduit having an air entrance opening at one end and a refractory lining within the opposite end thereof and extending inwardly along the conduit for a substantial distance, means for discharging a gaseous fuel into the conduit at a point intermediate the ends of said conduit, said refractory

lining having a head which fits the exit end of said conduit, said lining between its inner end and said head being approximately cylindrical and largely spaced somewhat from the conduit wall, to reduce the tendency for the lining to crack, said head having an aperture from face to face at one side of said cylindrical portion, a pilot burner disposed somewhat across the outlet end of said lining, and a pipe supplying fuel to said pilot burner passing endwise through said lining in said aperture whereby said conduit may be tightly set in the wall of the heater and said pilot burner will be within the portion of that conduit that is mounted in the heater wall.

2. In a gas burner unit of the type having a tubular mixing conduit with an air entrance at one end, the combination therewith of an air regulating, tubular closure telescoping with the air entrance end of said conduit and adjustable in a direction endwise thereof, and having its inner end open and at its outer end substantially closed, one of the telescoping walls of said closure and said conduit having slots arranged at intervals around its periphery and each progressing generally in a direction endwise thereof to vary the amount of air admitted to said conduit as said closure is adjusted in a direction endwise of said conduit.

3. In a gas burner unit of the type having a tubular mixing conduit with an air entrance at one end, the combination therewith of an air regulating, tubular closure telescoping with the air entrance end of said conduit and adjustable in a direction endwise thereof, and having its

inner end open and at its outer end substantially closed, one of the telescoping walls of said closure and said conduit having slots arranged at intervals around its periphery and each progressing generally in a direction endwise and also peripherally thereof so as to have direction components progressing both endwise and peripherally of the shell to vary the amount of air admitted to said conduit as said closure is adjusted in a direction endwise of said conduit.

4. In a gas burning unit, a rectangular frame having a discharge extension at one end thereof, and an inwardly extending flange that provides a central restricted passage running lengthwise of the frame, a gas manifold frame abutting against said flange at the face of the flange opposite from said discharge extension and extending into said restricted passage, a tubular air supply shell telescoping with said manifold frame so as to extend therefrom in the direction opposite from said discharge extension, for conducting air to said restricted passage, means disposed outside of the passage formed by said air inlet shell for coupling said manifold frame to said flange and accessible for coupling and uncoupling at the end of said rectangular frame from which the air supply shell extends, said manifold having means for discharging gas into said restricted passage through said frame, whereby when said rectangular frame is secured in the wall of a furnace, said manifold frame and air supply shell may be uncoupled and removed as a unit by access from the outside of the furnace.

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