

Oct. 16, 1934.

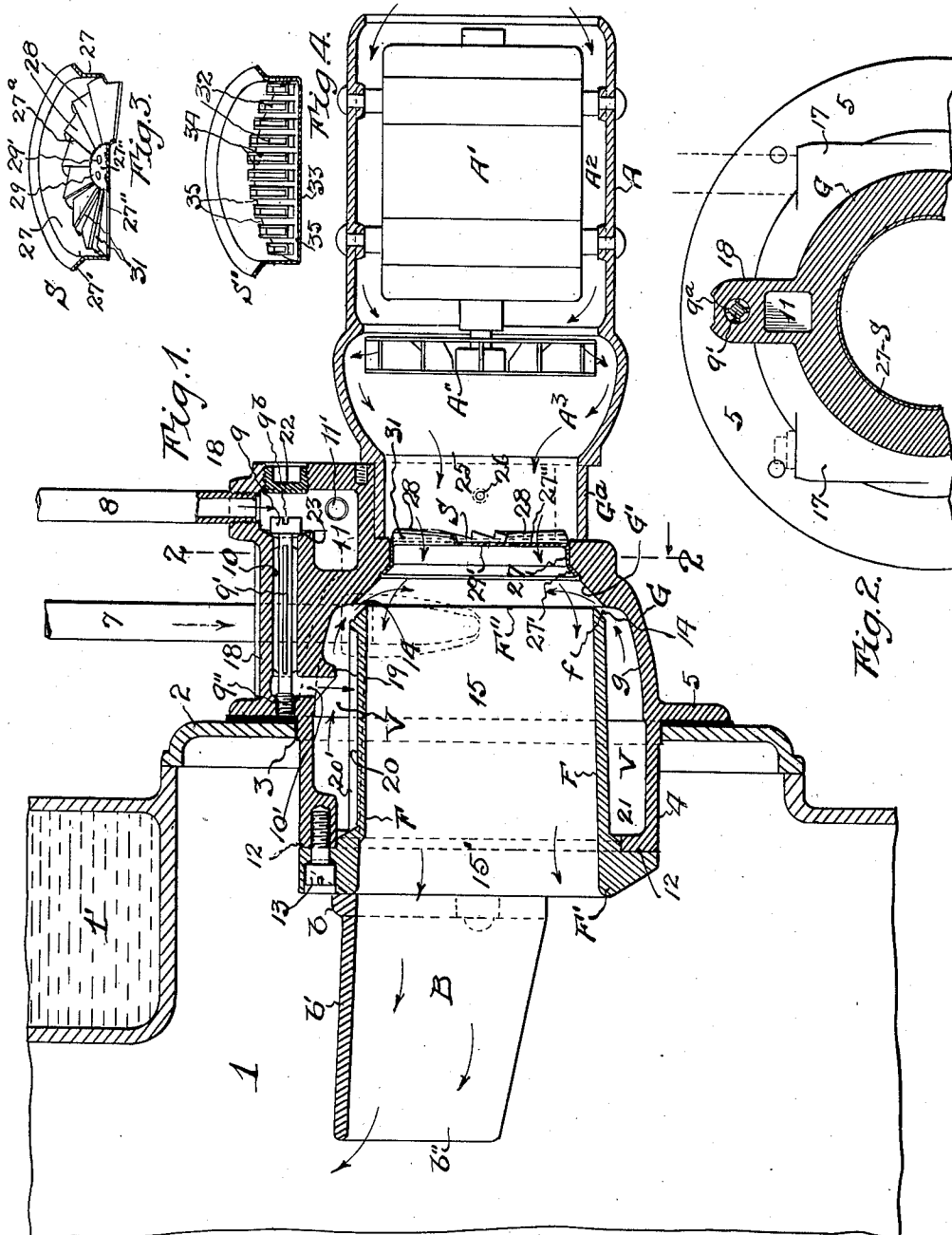
C. G. HAWLEY

1,977,478

BURNER OF THE HORIZONTAL TYPE

Original Filed June 28, 1929

3 Sheets-Sheet 1



INVENTOR

Paul J. H. [Signature]

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3 Sheets-Sheet 2

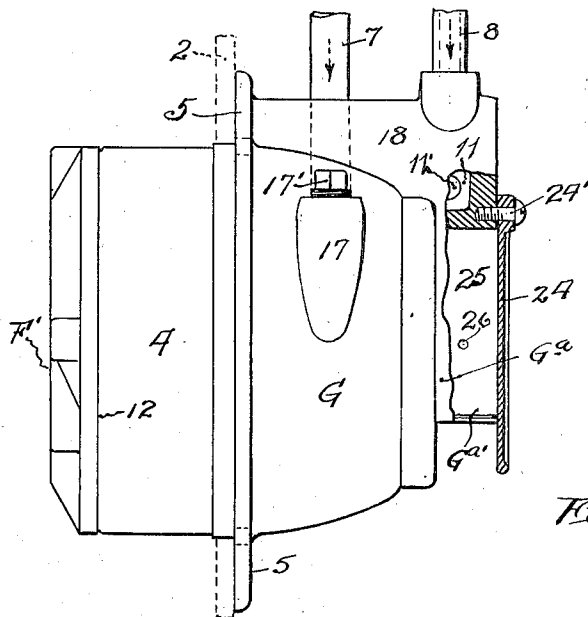
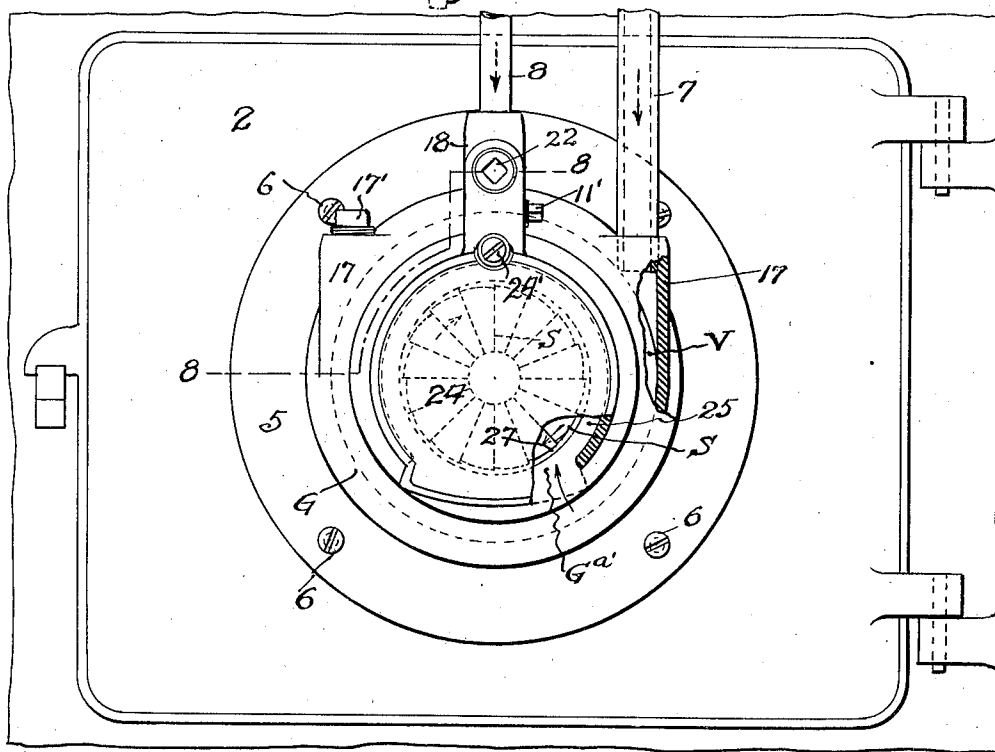


Fig. 5.



Oct. 16, 1934.

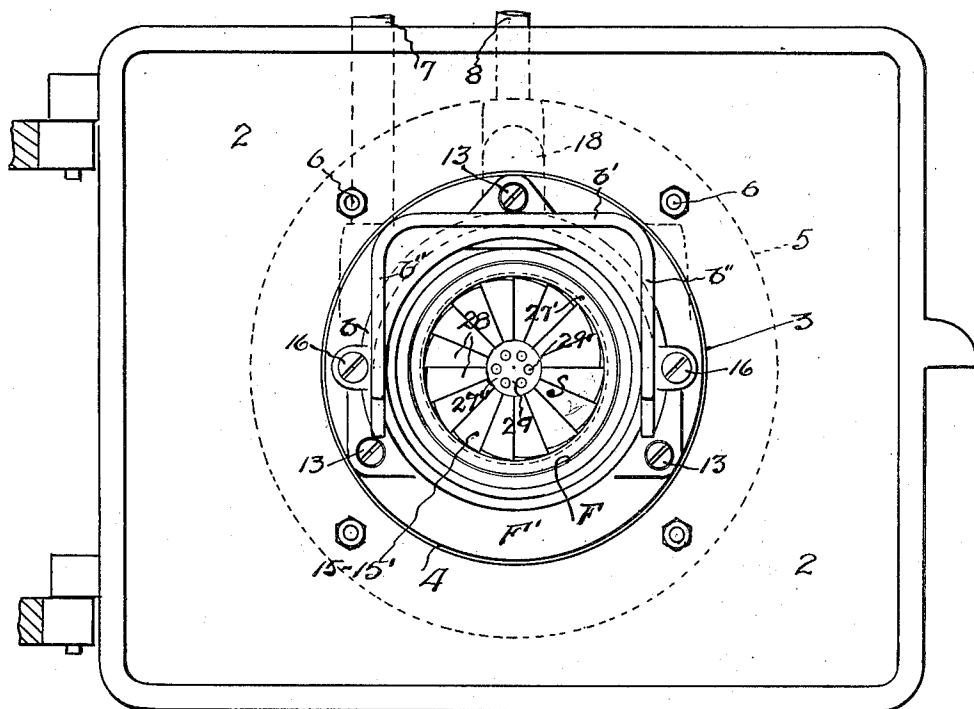
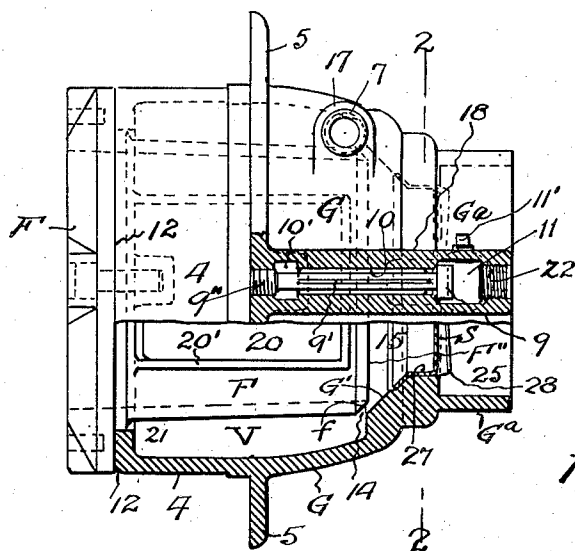
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3 Sheets-Sheet 3



INVENTOR

Chambersburg

UNITED STATES PATENT OFFICE

1,977,478

BURNER OF THE HORIZONTAL TYPE

Charles Gilbert Hawley, Chicago, Ill.

Application June 28, 1929, Serial No. 374,418
Renewed March 7, 1934

22 Claims. (Cl. 158—11)

This invention relates to devices for the combustion of gas and oil; and as herein exemplified, has special reference to improvements in so-called domestic burners; being adapted for attachment and use in stoves, ovens and heaters, hereinafter called furnaces, but peculiarly suited to the requirements of dwellings, which demand a burner that is self-contained, self-guarded and largely automatic in operation.

The object of the invention is to provide a gas and oil burner, which though not limited thereto, shall be adapted for use under natural draft conditions or even in the open without a stack; which shall be dependably safe, efficient, of variable capacity and noiseless; which shall be adapted for operation continuously and yet be efficient at all rates incident to seasonal changes; which shall be compact and simple in construction; clean and ornamental; and, easy to install and maintain.

Special objects are to provide a burner that shall be standardized as to parts, which shall require little attention and no service whatever, which shall be flexible in its ability to meet extremely variable seasonal changes, and at the same time be adequate for use with such gases and furnace oils as its location best offers. This application is a continuation in part of my co-pending application Serial No. 281,864, filed May 31, 1928.

The invention will be readily understood upon reference to the drawings that form part of this specification. As a whole and as to its important elements, it is to be observed that the invention is adapted for embodiment in many different forms and is applicable to many different furnaces and uses, all of which will be hereby suggested to those who are skilled in the art of combustion, including gas burners and oil burners. Nevertheless the invention is operatively plain and structurally so simple that the form and capabilities of the whole and of the individual parts and combinations may be exemplified or expressed in a single burner structure that is suitable for the performance of the most exacting and difficult duties, to wit, the duties of domestic heating.

In said drawings:—Fig. 1 is a vertical and longitudinal section of a burner embodying the invention and of the horizontal type adapted for attachment to the outer wall or door of any furnace. One component of the burner shown in this figure, comprises a blower, A, that may be used to assist the natural draft or omitted as seen fit; and, another optional component comprises a flame duct or extension B upon the inner end of the burner. Fig. 2 is a cross-section on

the line 2—2 of Fig. 1. Fig. 3 is a sectional and perspective view of the rotation imparting draft balance screen, S, shown in Fig. 1; Fig. 4 is a like view of a substitute screen, which latter works without imparting rotation to the air passing therethrough. Fig. 5 is a side elevation of the burner as it appears when removed from the door and deprived of the blower A and flame duct B just mentioned. Fig. 6 is a front view or outer end elevation thereof as it appears upon a furnace door. Fig. 7 is a rear or inner end elevation of the burner upon the same door; and Fig. 8 is a plan view of the burner of Fig. 5, and is horizontally sectioned to disclose internal parts, as upon the irregular section line 8—8 of Fig. 6.

While this burner or heating unit may be placed wholly within the furnace; that is, upon the grate or upon the floor of a furnace chamber 1, it is better when attached to the furnace door 2, as here shown. The only change required in the furnace is to make in the door a hole 3 which is large enough to receive the nose or fire-emergence end 4 of the burner. Attachment is accomplished by means of the circumferential flange 5, which is integral with the body of the burner. The burner becomes a rigid or substantially integral part of the furnace door, being secured thereto by a number of bolts 6.

Though primarily a gas combustion unit, this device is also a gravity-feed oil burner; having the ability to burn both gas and oil in varying quantities and under any conditions that provide a draft or offtake for scavenging or removing the products of combustion. The unit or burner here illustrated is adapted to burn natural and manufactured commercial gases having heat values ranging from 400 to 1000 B. t. u. per cubic foot and in the volumes required for house heating; and, is designed to burn oil distillates ranging from 24 to 42 Baumé, known as furnace oils.

It is usual to operate this burner under natural draft conditions and through the interposition of the so-called draft balance screen, marked S, the thermal operation of this unit in itself is made to accomplish an indraft of combustion supporting air in substantially correct proportion to the varying quantities of gas and oil that are supplied for combustion. This normal or plain use of the burner should be understood before the operation is in any way confused by consideration of the action which follows upon the use of the blower or forced-draft element, A. Disregarding the motor armature and centrifugal fan of the latter, the burner has no moving parts, that is no driven parts, and yet it is automatically

responsive to the naturally changing and arbitrarily modified conditions encountered in actual service. And being composed of only a few parts all of which are substantial and stationary, the whole device is strong and long-lived.

As shown in Fig. 1 the burner extends through the door and somewhat into the furnace chamber but in the main is exposed upon the outside of the furnace, where the structure is sure to be reasonably cool and is both visible and accessible at all times. It is made ready for use by the mere connection to it of a valved gas pipe 7 and a valved oil pipe 8. Obviously, the unit is rigidly foundationed upon the furnace and similarly the gas and oil pipes are firmly foundationed upon the external part of the unit. No special supports are required.

The unit operates substantially at atmospheric pressure; and, accepts gas at the pressure incident to municipal or commercial distribution and accepts oil at any elevation or head that will cause its flow into the substantially unresisting burner. Heat generated within the burner is employed to vaporize the oil before combustion is attempted and no "atomization" of oil is attempted or necessary. Obviously, internal pressure is avoided. The pressure of the gas which is mixed with the oil vapor is in fact the highest pressure that could obtain within the burner. In most cases the pressure will not be higher than atmospheric pressure and frequently less, due to the stack draft. The oil is heated from within the burner but under these conditions carbonization, due to cracking of the oil, is avoided. The gas is supplied under the pressure derived from the gas main, and, the oil may be supplied by any convenient gravity arrangement affording a head of a few inches or a few feet. The entrance of the gas and oil being unopposed, they may be supplied without the interposition of pumps or boosters of any sort. Very simple regulating valves (not shown) belonging to the pipes 7 and 8 suffice to control the flow or delivery of the fuels to the burner.

It is common knowledge that burners which consume oil are likely to be mishandled and to become flooded and dangerous without giving notice. Being a combined gas and oil burner and subject to the dangers of oil usage this device incorporates and is protected by a heat actuated or thermostatic element or valve 9, the same being included in the burner's oil passage 10. This device, called the safety element, performs many important offices—as follows: It determines the maximum of oil feed during operation. It closes the oil passage and excludes oil from the burner while the burner is cold and until the same has become hot enough to vaporize the oil as fast as it enters the burner. And if during operation the heat of the burner, for any reason falls below the vaporizing temperature, this thermostatic valve automatically closes the oil passage, and flooding is thus prevented. Further the valve is operated by relatively small ranges of temperature and has so slight a movement that in conjunction with an underlying dirt pocket, 11, it serves as a final and practically self-cleaning fine strainer which excludes dirt particles from the vapor chamber.

The chief member of the combustion portion of the burner unit comprises an outer tubular metal casting or shell G called the generator. The before mentioned part 4 is the inner or rear end of said generator casting. The second member of the combustion unit comprises an inner

tubular metal casting or sleeve, F, called the fire tube. The member F has a flange F' which tightly joins the rear end of the generator, upon the transverse plane 12, and is secured thereto by the bolts 13. The tubular parts described are co-axial but of different diameters and by their differing shapes and sizes provide an internal annular chamber V which is called the vaporizing chamber. The outer end of the generator casting contains a large opening which is co-axial with the fire tube F but of considerably less diameter. In this opening is situated the third chief member or element of the combustion unit, to wit, the many ported member S, which comprises and is called the draft balance screen.

The free end of the fire tube is marked F'' and is separated from the screen S by a space of sufficient width to accommodate the intervening internal shoulder G' of the generator. Preferably that shoulder has the form of a truncated cone converging toward the screen. Preferably also, the end F'' of the fire tube is truncated or beveled outwardly to correspond therewith, as well shown at f. The conical surfaces f and G' are separated; and, together form a narrow fuel supply slot 14 which is endless or annular. This narrow slot or opening, which is directed toward the screen S, forms an avenue of communication between the vaporizing chamber V and the combustion space 15 within the burner. The combustible substances, to wit, gas and oil vapor, are mixed in the chamber V; at negligible pressure but nevertheless at a pressure which always exceeds the pressure within the fire space 15. The restricted and yet in the total, very ample, communication between those chambers, accomplished by the employment of a narrow fuel slot 14, results in the exclusion of air from the chamber V. Therefore combustion does not take place in the chamber V but only in the fire space 15. Further, the annular completeness and regularity of the slot 14 ensures the substantially uniform feed or supply of the fuel from the chamber V to the enclosed or contained space immediately adjacent the air admission screen S.

The screen S, as will be further explained, subdivides the entering air into many thin streams or layers which intercept and traverse the annular and inwardly directed converging cone, layer or film of gaseous fuel expelled from the chamber V and emerging from the slot 14. Thus an immediate and extremely intimate mixture of air and fuel is brought about at the instant of entrance to the chamber 15. Ignition is initiated and maintained at that point, and obviously a combustion of great intensity is supported and accomplished within the relatively commodious chamber 15. The flames issue from the open inner end 15' of the fire tube and thus enter the furnace chamber 1.

At this point it may be explained that in most cases the flange F' of the fire tube marks the inner end of the burner but when the furnace 1 is a water heater or a steam boiler, as indicated by the water leg 1' in Fig. 1, it is desirable to prevent the impingement of the flames upon the water cooled surfaces lest combustion be suppressed and soot formed; and, in such cases the inner end of the burner is provided with the extension B, before mentioned. The same is a short inverted channel comprising a base portion b, a preferably inclined top b' and the partial sides b''. The device does not require a bottom and is attached to the flange F' of the fire

tube by two bolts 16. By this simple device the flames from the burner are directed into the open part of the furnace chamber, away from the water walls; and ample opportunity is afforded for the flames to mature before any cool surfaces are encountered thereby.

The gas pipe 7 joins the burner through one or the other of the integral tangential leads or protuberances 17 of the part G, as best shown in Fig. 6. Both are tapped to receive the pipe. Connections from the right or the left are thus permitted. The connection that is not used is closed by a plug 17'. In addition, this construction permits inspection of the interior of the generator when the plug 17' is removed, and also permits the charging of the burner with a starting fuel when gas is not available for that purpose and the oil not sufficiently volatile to enable a fire to be started in the cold burner.

The oil duct 10 and the dirt pocket 11 are contained by a lug 18 which is preferably integral with the casing G so that the heat of the latter may be most advantageously employed in the thermostatic control of the oil flow. As shown the lug stands upright upon the top of the part G, and its outer top end 18' receives the oil pipe 8 which is thus placed in communication with the pocket 11 and the duct 10. The inner or rear end of the duct opens downward into the top of the vaporizing chamber V as shown by the angular duct extension 10' and as marked by the depending lip or dripping edge 19. The latter is positioned to deliver the oil upon the top of the fire tube F and it is there received in a shallow pan 20, see Figs. 1 and 8, which is formed in or on the top of fire tube casting. The pan has raised edges 20' and is of sufficient capacity to momentarily retain a small depth or film of oil. During operation the chamber 15 is filled with flame and the fire tube F is extremely hot. Therefore the oil which drops upon the top of the fire tube, that is into the pan 20, is almost instantly heated and most effectively vaporized. Further the oil is preheated by the preheating to which it is subjected within the lug 18, which being in close or integral relation to the main casting G is also kept at fairly high temperature. The temperature actually attained in the lug 18 is rarely, if ever, high enough to itself vaporize the stream of oil, but is ample to preheat the oil so that it quickly vaporizes upon contacting the red hot plate or pan portion 20 of the fire tube F.

The quantity of oil admitted is volumetrically small but the volume of the vapor generated therefrom is much larger and emergence through the annular exit slot 14 is so free that any unvaporized residues expelled from the hot pan 20 are immediately swept into the combustion space and are consumed, instead of being left within the vaporizing chamber V. It is to be further observed that the inner wall *g* of the member G is curved or conical and therefore slants downward at the bottom so that liquid residues are compelled to accumulate at the bottom and inner end 21 of the vapor chamber V. Clearly that end of the vaporizing chamber is not only heated through the hot wall of the fire tube F but is also heated externally because of the exposure of the part 4 within the fire space of the furnace. In consequence, such liquid residues as may escape immediate discharge through the slot 14 are successfully vaporized in the lower part of the chamber V and then pass out through said slot 14. These self-cleaning actions are so pro-

nounced that these burners have been operated for long periods without becoming internally clogged.

The lug 18 and the duct 10, 10' become convenient parts of the before mentioned automatic or thermostatic control valve or safety element. The outer face of the lug contains a hole which is in alignment with the duct 10 and is normally closed by a tight threaded plug 22. Through that opening the metal at the outer end of the duct 10 is machined to provide a seat 23 for the movable member of the valve. The valve is introduced through the plug opening and in itself comprises the head marked 9 and its shank 9'. The inner or rear end of the shank threads into a coaxial hole in the member G as shown at 9''. Preferably the duct 10 is formed by drilling the lug 18 and it is therefore internally smooth, and the valve is held centrally, though freely, in the duct by means of the radiating fins 9^a, see Figs. 1 and 2. The head 9 contains a screw driver slot 9^b and by such means the valve is easily inserted and turned in its thread 9'' until the head 9 contacts the seat 23. The valve proper (comprising the parts 9 and 9') is made of a metal which has a higher co-efficient of expansion than the metal composing the casting G, 18. Therefore when the casting is heated the valve expands and opens; to permit the flow of oil from the pipe 8 through the pocket 11 and the duct 10, 10'. Should the burner become sufficiently cool, the valve automatically contracts, closes, and shuts off the flow of oil. The circumferential dimension of the valve 9 is large in proportion to the maximum flow to be accommodated. And obviously very slight expansion of the valve serves to unseat the head or valve proper 9 very slightly and yet far enough to accommodate such flow. The actual opening rarely exceeds two thousandths of an inch, which is so minute that the valve crack becomes a substitute for the less efficient oil straining devices usually employed with oil burners. Intercepted solids remain in the pocket 11; which latter is provided with a clean-out plug 22 and may be readily cleaned at any time.

An outward extension G^a of the member G forms the passage through which the combustion supporting air enters the burner. By preference the part G^a is not completely circumferential but is open at the bottom as shown at G^a'; and for most burners a swinging door plate 24 serves to close the outer end of the extension G^a. Therefore the air enters the space 25 from beneath, while the door 24 serves as a baffle to downwardly deflect a back-flash that might come from the burner due to down-draft in the furnace chamber 1. Conveniently, the door takes the form best shown in Figs. 5 and 6 and hangs from a stud 24' projecting from the face of the lug 18. Thus positioned the door performs the function of a plumb-bob which may swing from side to side; and initially ensures the correct positioning of the burner upon the furnace door 2. It is important that it be correctly positioned; otherwise the oil pan 20 would be pitched to one side or the other and would not so effectively retain the oil which it receives from the oil feeding duct 10.

The cylindrical shape of the interior of the part G^a permits the blower A to be substituted for the door 24. That blower is characterized by a reduced end *a* which snugly fits within the extension G^a and friction may be relied upon to hold the blower in place. Better still, the blower is fastened therein by means of a removable cross-

pin 26, entering through the side of the part G^a. The function of the blower is to furnish an increased supply of air at times when it is desired to burn a larger quantity of oil than can be burned under purely natural draft conditions, and its further function and reason for use is to afford a constant supply of air to burners that are used under conditions which do not afford a sufficiently uniform single direction natural draft. As well known some chimneys are intermittent in action due to their location near wind-breaks and walls, and burners so used may well require the steadying of the draft conditions by the use of this blower. As stated hereinafter, the blower is defined in a companion application. Briefly it comprises a substantially cylindrical shell of greater diameter than and which contains an electric motor A'. The part A'' is a centrifugal blower element or fan that is attached to the shaft of the motor. By the rotation thereof, air is drawn through the open end of the shell and passing through the annular space A² keeps the motor cool and enters the central portion of the fan or motor A''. The action of the latter expels the air centrifugally into the chamber A³, whence it passes through the part G^a and enters the burner through the limited avenue afforded by the screen S. Importantly, the latter effectively protects the motor from the heat within the burner.

Further characteristics and functions of the screen S remain to be stated. A variety of designs are open for employment, but essentially the screen S is a thin metal part or plate which contains many small openings whereby the entering air is broken up into a number of minute streams. The aggregate area of these openings is very small in proportion to the cross-sectional area of the fire chamber 15. It is rare that the aggregate area of the screen can or should exceed one fourth of the said area of the chamber 15. Desirably it is as little as one fifth thereof. The reason for this will presently appear to reside in that function of the screen which causes it to become an automatic regulator of the air supply, quite accurately proportioning the supply of air to the supply of fuel throughout a fuel range which is so considerable as to cause this feature of the invention to assume much practical importance.

As briefly indicated by Figs. 3 and 4 and as aforesaid the screens may partake of several designs; and it has even been thought unnecessary to illustrate an obvious design in which the screen is marked by a large number of small holes uniformly spaced. In all cases the openings are small and their aggregate area likewise small in relation to the area of the fire tube.

The screen S is of a preferred construction that not only limits and subdivides the air entering the burner but also imparts thereto a gentle whirling motion which in addition to the above described crossing of the air and fuel streams results in an admixture which is so intimate that combustion begins promptly upon the inner face of the screen; and, when desired, may be substantially completed within the chamber 15. Thus though the quantity of heat generated may be great, only a short flame emerges from the burner and into the furnace chamber 1.

Specifically the screen S comprises a thin metal cup 27 which fits the opening in the outer end of the member G. Most conveniently it is tightly held therein by friction, but it may be positively secured if desired. It is best provided

with a flange 27' upon its inner edge so that it can only be removed through the fire end of the burner, that is, by intention and not through being meddled with. The bottom 27'' of the cup is sheared upon the lines 27* and is pressed to form the inclined blades 28, all radiating from the center 29 and joining the peripheral wall of the cup. Between these blades are many narrow openings 31 which are the small or restricted air entrance openings before described. The central portion 29 may be provided with a number of additional openings 29'. The device being in place as shown in Fig. 1, and the atmospheric pressure upon the outer or room side of the screen being higher than that existing in the furnace chamber 1, it is obvious that air will enter the openings 31, and because of the angularity of the blades 28 will enter the chamber 15 in the form of many thin streams and whirlingly. The mixing results need not be repeated.

The screen S' shown in Fig. 4 resembles the other but is characterized by cross-slots 32 which are formed by shearing and pressing the bottom 33. In that pressing operation edges 34 are struck up at the margins of the slots 32, still leaving effective voids 35 between them. As before, the screen S' is a device for subdividing the combustion supporting air into minute streams which being of small bulk and quickly heated readily admix with the vapor and gas from the slot 14 which have a strong affinity therefor, particularly the oil vapor.

The localization or intensification of the stream through the minute openings in the screen results in regions of lower pressure, voids, upon the inner face thereof, and naturally these voids are supplied from within, that is, by the gaseous fuel (gas and vapor) drawn toward the same from the slot 14. That slot 14 is situated immediately (between the screen and the exit end of the fire tube) and yet this peculiar formation of voids between the entering streams of air is so pronounced that in actual performance substantially the whole inner face of the screen may be seen to be covered with flame, showing that both admixture and ignition have taken place thereon.

As should now be apparent the promptness and thoroughness with which the air and combustibles are admixed are of primary importance both from the standpoint of the generation of smokeless flames and from the standpoint of ensuring flame maturity within a short distance from the burner and therefore well remote from the relatively cold furnace surfaces which are to be heated and which if contacted by the flames would become sooted.

A further characteristic of the screen is that being exposed to relatively cold air upon its outer side and parting with the heat readily, it is always relatively cool although in the immediate presence of great heat upon its inner or fire side. One consequence is that in case of a down draft which would otherwise force flame out into the room, the flaming gases are extinguished as they seek escape through the minute openings in the relatively cold screen; and thus dangerous back flashes are avoided.

Still another important characteristic is that the air and combustibles are not permitted to mix until in the presence of enough heat to ensure the ignition of the mixture. Were the contrary the case the effect would be immediately perceptible in the cooling and condensation of oil vapors, which would either escape in the form

of liquid or render the combustion smoky, uncertain, and of low temperature.

These matters being understood it remains to make plain the automatic action of the screen as a draft promotor and draft regulator. Obviously the promptness with which burning and combusted gases leave the chamber 15 is determined by the force of the air entering through the screen and tending to displace them, and second, by the temperature of such gases; which, as will be apparent, determines their weight and hence relation to the entering air and to gases occupying the larger furnace chamber 1. While temperatures of gases which are in combustion are generally regarded as fixed by the nature of the gases themselves, in practice such characteristic temperatures are not attained and the lower flame temperatures within a restricted space such as the fire chamber 15 vary markedly with the varying of the quantities of combustion therein. The higher the temperature the more promptly are the gases evacuated from the fire tube. Importantly these differences of temperature within the fire tube are reduced or amplified by the varying extent to which the fire tube is filled with gases and the average temperature within that tube establishes its relation to the restricted air entrance afforded by the screen. These conditions coupled with the described combustion immediately at the inner side or face of the screen result in pressure differences upon the two sides of the screen which inaugurate air flow through the screen in proportion to such pressure difference. This is made possible by the restriction of the air admission passage and by the ample provision in the chamber 15 of capacity which permits the expansion of the burning mixture to from three to five times the volume of the cooler entering air. Without such provision for expansion and the free scavenging of the gases it would be fruitless to merely slow down the entrance of air for combustion, and in this case instead of slowing down the entrance the free attainment of a higher temperature in the chamber 15 is accompanied by the more rapid entrance of air through the fixed air admission openings of the screen. Thus the screen may be said to provide combustion supporting air in the amount demanded by the quantity of combustion effected in the fire chamber, the temperature therein varying with the fuel stream and the indraft or inflow of air varying with the difference between the temperature in the chambers 15 and 25, upon opposite sides of the screen. Obviously the differing weights of the air and gases are here utilized to promote the supply of the air requisite for combustion and the admixture thereof with the fuel; which, in turn, results in the generation of corresponding quantities of heat in the fire chamber 15.

Referring again to the body of the burner, several advantages are gained as to heat conduction, good appearance and economy of finish by enameling the surfaces of the members G and F. The enamel is of any desired color and is fired or completed at a high temperature. It affords a pleasing surface which is rustless and which easily may be kept clean.

The use of this fired enamel, ceramic or glazed coating is perhaps chiefly remarkable only because it is here possible or rather practicable to finish this particular burner in this way. This practicability grows out of the fact that the chamber V is occupied by vapor and therefore by a medium of fixed and relatively low tempera-

ture. That temperature is much lower than the temperature which would disrupt the described enamel or glaze upon the surfaces of the metal walls. It will further be noted that because of the longitudinal extent of the chamber V, the presence of the temperature determining vapors persists for the protection of all those parts of the burner which are exposed upon the outside of the furnace. They never attain an uncomfortably high or dangerous temperature; which is remarkable, in view of the fact that the interior of the burner is filled with flames having temperatures that range from 1800° to 3000° F.

Heat developed within the burner, that is internally, is depended upon to prepare both the gas and the oil for quick internal admixture and combustion. The heat, as employed, both dries and preheats the gas, ideally conditioning it for combustion; and the developed heat is also utilized to both preheat and vaporize the oil as rapidly as it enters the vaporizing chamber where it joins and mixes with the hot gas, prior to meeting the air volumes and the ignition flames and temperatures required for the combustion of the products. Likewise heat, as explained, is depended upon to both enforce the supply of air and to compel its admixture with the combustibles in the volumes required for combustion of the quality desired.

The prevention of high pressures within the burner and the uniform and free release of the hot gas and vapor into the internal combustion space find accomplishment in passages of very generous and non-clogging sizes which however are so arranged or related to the air admission that air is excluded, and premature combustion which would clog the gas and vapor passages is avoided.

The combustion is initiated and to a large extent completed within the interior of the burner thereby ensuring, without waste, ample heat for the preparation of the gas and vapor and causing the needed supply of air and inducing motions which result in the quick mixing of the entering air and combustibles; and yet the conditions induced by varying of fuel feeds automatically vary the corresponding supply of air for combustion.

Though not precluded, it should now be clear that air blast and suction fans are usually unnecessary, but as indicated may be combined with this burner where special duties are to be performed.

The operation of the burner is started by admitting gas through the passages V and 14 and igniting it within the fire chamber 15 and the necessary air being automatically supplied, the operation may be continued with any volume of gas required to furnish the heat and temperatures desired. At any given gas consumption, increased heat is obtained by admitting oil to the burner. The first oil is vaporized by the residual heat of the previous combustion therein, and naturally the vapor joins the gas in its flow toward the interior of the burner, that is, toward the point or place of mixture with air. As long as the burner is kept hot, and hence able to vaporize the incoming oil, the rate of oil feed and the rate of gas feed may be varied, each from zero to maximum; and the volume of flame and the quantity of heat delivered by the burner responds almost instantly to each variation of the fuel supply.

Obviously, by varying the feeds frequently, as through the control of distant thermostatic de-

vices, the operation of the burner may be rendered "intermittent", but from the stand-point of heat conservation the continuous operation of this burner is recommended; and, by reason of its characteristics, such continuous operation now becomes practicable.

In this burner combustion which is both smokeless and silent is attained by carefully heating and preparing the combustibles in advance of their admixture with air and by thoroughly and uniformly admixing the combustibles with air at ignition temperatures, followed by the uninterrupted combustion of the mixture and the immediate freeing of the resulting flames and combusted gases.

Heat, gravity, water and time are not mechanical elements but by the mechanical or physical employment thereof in this simple structure it becomes possible to secure the entirely satisfactory combustion of either gas or oil, or both, without using the many mechanical elements and power driven parts ordinarily required to feed and prepare gases and oils for combustion and to supply air in the volumes required for such combustion. And further these forces and factors working with very simple stationary parts are made to automatically proportion the fuel and air feeds.

This statement may serve to classify and define the invention better than could be accomplished by mere structural definition and the facts and characteristics mentioned largely qualify and determine the structural entity of the device as a whole.

It will be found that a burner of this construction is capable of reliably operating continuously, as well as efficiently, and with little attention on the part of the user and yet at rates of gas and oil consumption, one or both, which he may establish definitely and easily. In this the user should be aided by the inclusion in the oil line of a sight feed hydrolator, really a true part of this burner, but which of necessity is the subject of a separate patent application, to wit, my companion application, Serial No. 374,420, filed of even date herewith. Similarly, the forced draft device or blower A which is an optioned part of this burner, is presented in a companion application; to wit, Serial No. 374,421 also filed of even date herewith, and that form of my invention which comprises a burner of the vertical type is described and specifically claimed in a companion application: to wit, Serial No. 374,419 filed of even date herewith.

Having thus described my invention I claim as new and desire to secure by Letters Patent:—

1. A fuel burner comprising a fire chamber which has open ends in combination with an air admission screen transversely located occupying one of said ends and means adapted to direct fuel into said chamber and toward the inner face of said screen.

2. A fuel burner comprising a fire chamber which has open ends in combination with an air admission screen transversely positioned in one of said ends, means adapted to direct fuel into said chamber between said screen and the other end of the chamber, and thermostatic means controlling the movement of fuel thereto.

3. A fuel burner comprising an elongated fire chamber which has open ends in combination with an air admission screen occupying one of said ends, means for directing air against the outer face of said screen, and means adapted to

direct fuel into and toward said chamber, near the inner face of said screen.

4. A fuel burner comprising a fire chamber which has open ends in combination with an air admission screen occupying one of said ends, a second chamber imposed upon said fire chamber and separated therefrom by a wall which is common to both chambers, means for feeding fuel into said second chamber, and said chambers being in limited communication adjacent the opposed inner face of said screen.

5. A fuel burner comprising a fire chamber having a large open end for the discharge of flame and a restricted end for the reception of air, in combination with a second chamber imposed upon said fire chamber and deriving heat therefrom, said second chamber opening into said fire chamber and toward the restricted end thereof, and fuel feeding means opening into said second chamber.

6. A fuel burner comprising a fire chamber having open ends in combination with an air admission screen occupying one of said ends, a second chamber imposed upon said fire chamber, said chambers having a common wall through which the second derives heat from the first, means for feeding oil into said second chamber and upon said wall, and means adapted to direct vapor generated in the second chamber into said fire chamber intermediate the ends of the latter.

7. A fuel burner comprising a fire chamber having open ends, and which contains an oil pan or sink in combination with a whirl promoting air admission screen occupying one of said ends, a second chamber imposed upon said fire chamber, enclosing said oil sink and opening into the fire chamber adjacent said screen, and means for feeding oil into said sink.

8. A fuel burner comprising a fire chamber which has open ends in combination with an air admission screen occupying one of said ends, a second chamber imposed upon said fire chamber and deriving heat therefrom, said chambers being in limited communication adjacent the inner face of said screen, an oil duct leading to said second chamber and also deriving heat from said fire chamber, and a thermostatic valve positioned in and controlling said duct in response to variations of temperature therein.

9. A fuel burner comprising a fire chamber which has a virtually unrestricted flame discharge opening and, in contrast, a restricted air admission end characterized by a plurality of relatively minute air passages, and means adapted to direct fuel into said fire chamber adjacent to its restricted end.

10. A fuel burner comprising a fire chamber having an open flame discharge end and a restricted air admission end opposed thereto, in combination with a second chamber imposed upon said fire chamber and which is in limited communication therewith adjacent to said air admission end, said communication being directed against said air admission end, and means for supplying the fuel to said second chamber.

11. A fuel burner comprising a fire chamber which has open ends in combination with air subdividing means positioned in one of said ends, a fuel preparing chamber imposed upon said fire chamber, deriving heat therefrom and opening into the fire chamber between the ends thereof toward said air subdividing means, and means for supplying fuel to said fuel preparing chamber.

12. A fuel burner comprising a fire chamber in combination with means for feeding fuel into said fire chamber, an air feeding chamber in advance of said fire chamber, and a draft balancing, air admission screen interposed between said chambers and having a plurality of angularly disposed blades whereby rotation is imparted to the combustible mixture within said fire chamber.

13. A gas and oil burner comprising an annular fuel preparing chamber, the central portion of which is the fire space, in combination with means for directing prepared fuel from said chamber and into said space near and toward one end thereof, and, an air admission screen positioned at that end of the fire space.

14. A gas and oil burner comprising an annular fuel preparing chamber, the central portion of which is the fire space, in combination with means for feeding gas and oil into said chamber, means directing the products from said chamber into and toward one end of said fire space, air admission means restricting that end of the fire space, and the surfaces of said chamber being coated with an enamel adapted to withstand the temperatures determined by the vaporization of oil therein.

15. A fuel burner comprising a generator shell and means for feeding fuel thereto, in combination with a fire tube occupying said shell and therewith forming a fuel preparing chamber which surrounds said fire tube, means adapted to direct fuel from said chamber into said tube toward one end thereof, and air admission means provided in said shell at that end of the fire tube.

16. A fuel burner comprising a fire tube having a flanged end which is open for the discharge of flame, in combination with a generator shell enclosing and supporting said fire tube through the medium of its flanged end, said tube and shell together forming a fuel preparing chamber, means for feeding gas and oil into said chamber, and said shell having a plurality of air admission openings adjacent the free end of said fire tube.

17. A fuel burner comprising a horizontally elongated fire chamber which has open ends, one adapted to be positioned within the furnace and

the other for exposure upon the exterior thereof, in combination with an air admission screen occupying the exposed end of the fire chamber, a flame retaining part extending from the other end of the fire chamber, and means adjacent said screen and adapted to direct fuel into said fire chamber.

18. A fuel burner comprising a generator shell adapted for attachment to the exterior of a furnace and presenting an air admission end for exposure upon the exterior thereof and having a flame discharge end for exposure within such furnace, in combination with means for feeding fuel into said shell toward said air admission end, and an air admission screen occupying the air admission end of said shell.

19. A fuel burner comprising a generator shell which is open at its ends and which has an integral lug upon its top, said lug forming an oil supply duct, in combination with a thermostatic valve adapted to control the flow of oil through said duct.

20. A fuel burner comprising a generator shell having open ends in combination with an air admission screen occupying one of said ends, a fire tube closing the other of said ends and extending nearly to said screen, said fire tube bearing an oil sink or pan, and means for feeding oil to said sink.

21. A fuel burner comprising a generator shell having open ends in combination with an air admission screen occupying one of said ends, a fire tube closing the other of said ends and extending nearly to said screen, said fire tube bearing an oil sink or pan, means for feeding oil to said sink, and means for simultaneously feeding gas into said shell.

22. A fuel burner having fuel preparation and combustion spaces, an air admission and fuel supply means directed toward said admission end, in combination with a thin walled back-flash preventing air admission screen, the aggregate area of the openings in which is small in relation to the cross-sectional area of said combustion space.

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