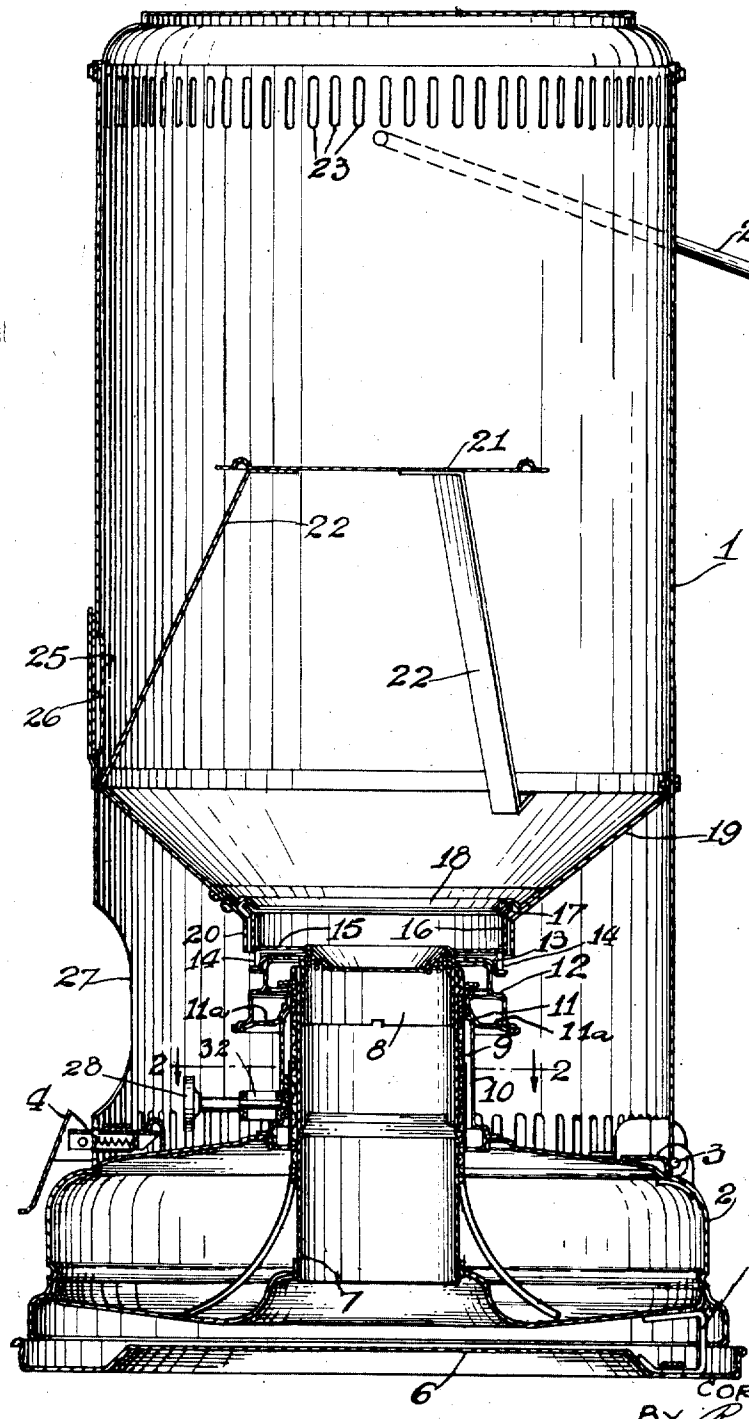
Feb. 6, 1951 W. B. ENGH ET AL 2,540,719

WICK TYPE LIQUID FUEL BURNER

Original Filed Dec. 21, 1945 3 Sheets-Sheet 1

Fig. 1.



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WICK TYPE LIQUID FUEL BURNER

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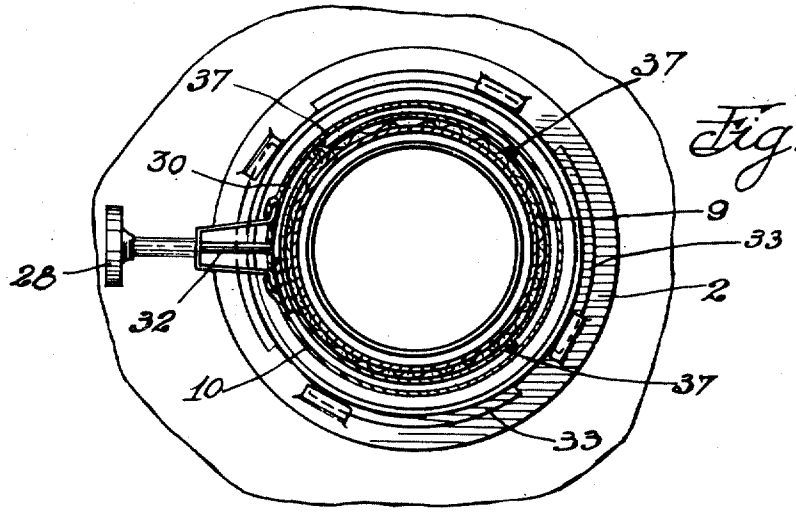

Fig. 2.

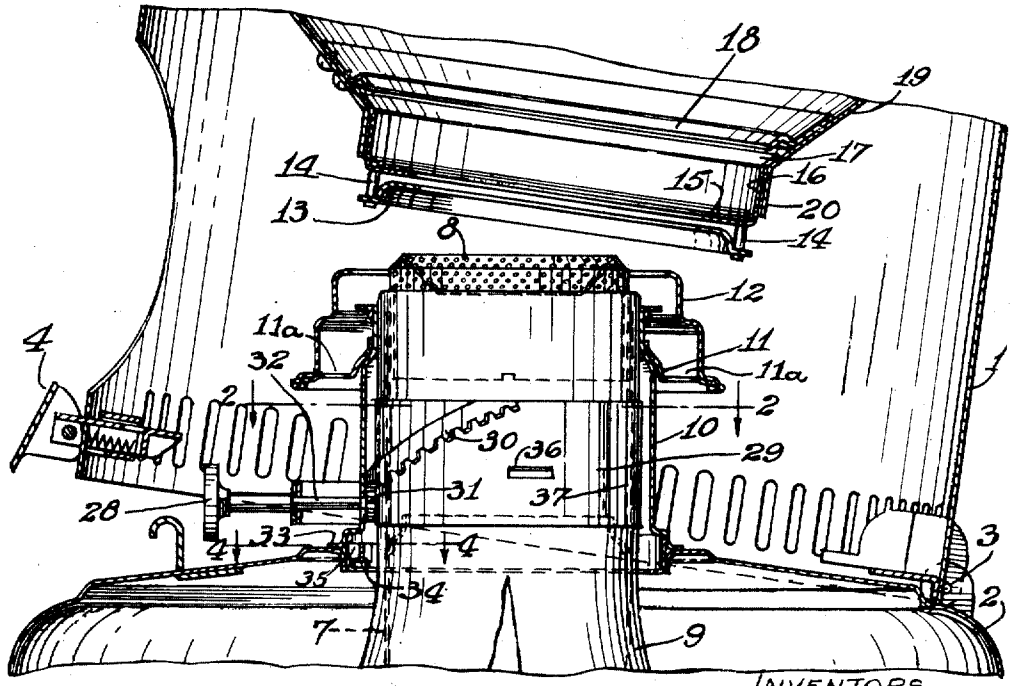

Fig. 3.

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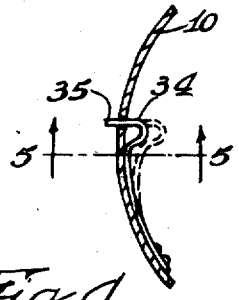

Fig. 4.

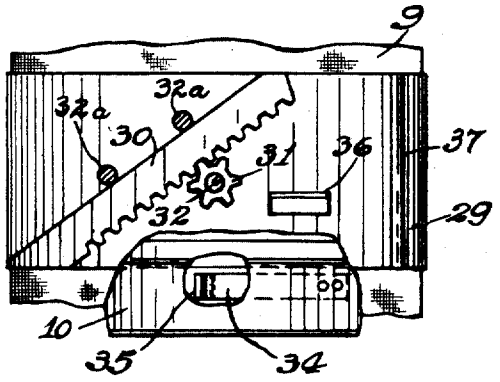

Fig. 7.

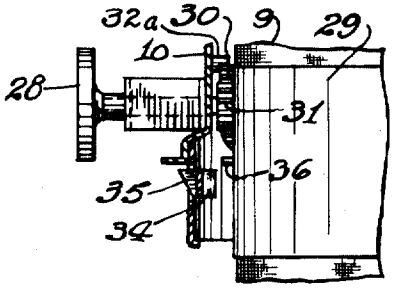

Fig. 5.

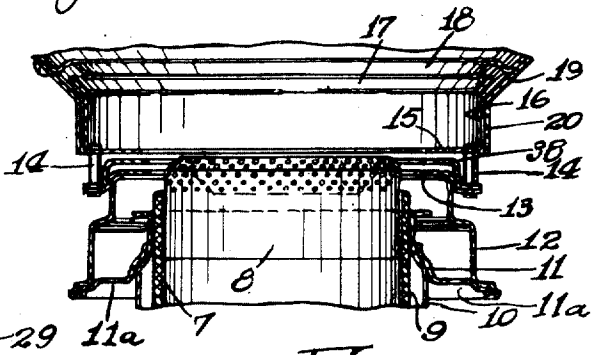

Fig. 8

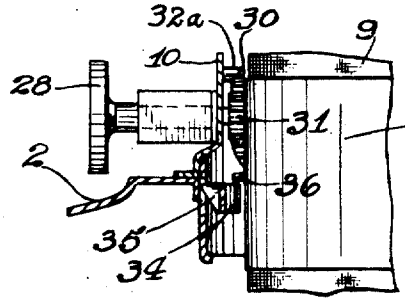

Fig. 6.

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UNITED STATES PATENT OFFICE

2,540,719

WICK TYPE LIQUID FUEL BURNER

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Original application December 21, 1945, Serial No. 636,537. Divided and this application September 8, 1947, Serial No. 772,608

2 Claims. (Cl. 158—94)

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This is a divisional application of parent application Serial No. 636,537, filed December 21, 1945, disclosing an improved stove structure adapted to space heating and also an improved burner structure for effectively burning heavy liquid fuel such as kerosene and the like, to heat said stove. The claims of said parent application are now restricted to said stove structure and the parts required to effectively operate it, and the claims of the present application are limited to said burner structure and the parts required to secure its effective operation.

The stove structure of said parent application includes a tubular casing of sheet metal which is in a vertical position when in use, which casing is mounted above a fuel reservoir provided with a burner of the tubular wick type for effectively burning the liquid fuel used. The casing is preferably connected with the reservoir by means of a horizontal pivot or hinge, at one edge of the lower end of the casing, so that the casing may be moved to a horizontal position to clean the burner and wick and to facilitate lighting the stove. This position of the casing also facilitates replacement of the wick when necessary.

The burner construction of the present application is provided with a central air passage extending vertically through the fuel reservoir to supply the inner air to the vaporized fuel that is required for the burning of the fuel, and a burner cone is provided for directing outer air against the vaporized fuel arising from the wick with sufficient velocity and in proper amount to penetrate and mix with the vaporized fuel and supply the air required in conjunction with the inner air, to completely burn all of the carbonaceous matter in the liquid fuel, so that the flame produced by the burner will not be a yellow flame indicating the presence of unburned carbonaceous matter, but will, on the other hand, be a purple or bluish flame showing complete combustion as far as the carbonaceous matter is concerned. The burner cone is in two parts, the lower part being supported by the main structure of the burner and having an inner opening above the wick which is much too large for purposes of proper combustion. This lower cone portion permits access to the wick for cleaning and lighting purposes in a manner that is not possible where the burner cone is in a single piece. The burner cone also includes an upper part carried by the stove casing which constitutes the chimney of the burner, so that when the casing is in a vertical position for use, the upper part of the burner cone rests upon the lower part

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thereof to complete the cone and provide an inner opening above the wick having a diameter of the size required to properly supply outer air to the vaporized fuel with a velocity to penetrate the vaporized fuel and mix therewith and to at the same time provide the proper quantity of outer air in conjunction with the inner air supplied to the vaporized fuel, to completely burn the carbonaceous matter in the liquid fuel. The upper portion of the burner cone is loosely carried by the stove casing, and is provided with an annular offset portion registering with and fitting a similar portion on the lower part of the burner cone, so that when the casing is moved to its vertical position, said registering portions will center and accurately place the upper cone portion relatively to the wick so that outer air is uniformly supplied circumferentially to the vaporized fuel.

In many instances of use of burners of the class described, it is of the utmost importance that no disagreeable odors or noxious gases shall be delivered by the burner. With the burner construction thus far described, it has been found that although the carbonaceous matter in the fuel is apparently completely consumed or burned because of the flame being of a purple or bluish color, products of combustion are apparently formed which are themselves combustible and which if delivered to atmosphere, impart disagreeable odors and possibly noxious effects thereto. The present burner provides means for eliminating these undesirable odors and effects, as below described, including an annular passageway for auxiliary air, secured to the upper burner cone portion in a horizontal plane, near said upper burner cone portion, which passageway includes an annular member provided with a central aperture somewhat larger in diameter than the diameter of the opening in the upper burner cone portion, said passageway being in free communication at its outer edge with the surrounding atmosphere, so that the action of the stove casing as a chimney will draw secondary air through said passageway, determined in amount by the vertical extent of said passageway, said secondary air being delivered around the annular flame and in such close proximity to the flame that the inner portion of the resulting annular column of said secondary or auxiliary air commingles with the outermost portion of the annular flame. The result of this construction and operation is that the fumes and the still combustible gaseous products resulting from the burning of the fuel, are completely surrounded by said column of auxiliary air and cannot escape into the interior of the

stove casing without passing through the auxiliary air which is highly heated by the action of the flame, which produces the burning of said fumes and said still combustible gaseous products, so that disagreeable odors and noxious effects are eliminated from the gases discharged to the atmosphere.

The construction of said parent application includes an imperforate baffle of sheet metal horizontally disposed in the stove casing about mid-way between the burner and the openings provided in the upper portion of the casing for the discharge of the gases of combustion, said baffle having a diameter substantially larger than the diameter of the flame produced by the burner and being coaxially disposed with regard to the burner, a sufficient annular spacing being provided around the baffle inside of the stove casing to permit the free flow of gases of combustion in the casing and around the edge of the baffle. The baffle functions both with the stove structure and the burner and performs two functions: first, it directs all of the gases of combustion outwardly so that they impinge forcibly against the side wall of the stove casing mid-way between the lower and upper portions of the casing, so that a highly heated band of the casing is provided around the baffle, which highly heated band in turn radiates heat to a corresponding degree into the air around the stove, thus discharging a large part of the heat developed by the stove, laterally from the stove into the space heated by it; second, the annular column of highly heated gases of combustion flowing upwardly from the flame, surrounded by the annular envelope of auxiliary air, strikes the lower surface of the baffle with considerable velocity, which results in a burner action thoroughly commingling the gases of combustion produced by the annular flame, with the auxiliary air. The baffle, being directly over the flame, is highly heated thereby and a temperature is maintained in the zone below the baffle which is sufficient to complete the burning of any fumes and still combustible gaseous products that may not have been previously burned, and this insures the delivery from the upper portion of the chimney or casing of the stove, of products of combustion free from odor and having no noxious properties. The results described are secured without unduly cooling the fuel vapor and without appreciably decreasing the efficiency of the stove and burner, by providing the said passageway for auxiliary air, with a vertical spacing or extent and with an internal opening no larger than required to supply an amount of auxiliary air slightly in excess of that required to effect the complete combustion of the fumes and still combustible products delivered from the flame of the burner. The baffle described and the structure of said auxiliary air passageway thus constitute important parts of the present burner structure in cooperation with the chimney of the burner.

The effective operation of the burner in the manner described, requires proper wick adjustment, which is insured by the particular wick and wick operating mechanism employed as a part of the burner construction. The tubular wick is provided, below its burning portion, with a thin sheet metal tubular carrier which is rigidly secured to the wick, said carrier having secured thereto a rack bar extending angularly and also axially of the carrier tube, the rack bar having a helical conformation and disposition when mounted on the tubular carrier. The outer wick

tube of the burner is enlarged around the wick operating mechanism and supports internally a spur gear meshing with the rack bar, said spur gear being substantially in a vertical plane and being rigidly secured to the inner end of a short horizontal shaft extending radially through the outer wick tube and rigidly carrying at its outer end an operating handle or disc. The outer wick tube has projecting inwardly therefrom suitable guide members to hold the rack bar in mesh with the spur gear. In this manner the raising and lowering of the wick is effected by both an angular movement and an axial movement, which operating arrangement is found to be much more effective and accurate than where it is attempted to operate the wick by axial movement only. To limit the movement of the wick, a stop is provided on the lower end of the rack bar, to prevent moving the wick upwardly relatively to the burner beyond a desired extent, for example, the lower part of the rack bar may be suitably enlarged to prevent further relative movement between the rack bar and the spur gear. To prevent downward movement of the wick substantially below the position required to extinguish the flame, and low enough so that the wick might drop into the reservoir, the outer wick tube is provided with a lower stop member in the path of a lug carried by the carrier tube of the wick, so that when the wick is moved downwardly until the lug engages the stop member, further downward movement of the wick is prevented. This takes care of the requirements for operating the wick and the burner in place on the reservoir, and to facilitate renewing the wick, the present invention provides a construction of lower stop member such that it does not function as a stop member when the burner is removed from the reservoir, or in other words, with the burner removed from the reservoir, the wick may be moved downwardly relatively to the burner, until it is entirely free from the burner and drops out, which greatly facilitates the operation of renewing the wick. To accomplish this result, the lower stop member is mounted on a spring band secured to and extending partly around the inner surface of the outer wick tube, and said stop member is provided with an outwardly extending cam for engagement with the opening in the top of the reservoir made to receive the burner. The parts are so arranged that when the burner is removed from the reservoir, the spring action of the spring band moves the stop member outwardly from the path of movement of the stop lug carried by the carrier tube of the wick, and when the burner is placed in operating position on the reservoir, the cam referred to presses the lower stop member inwardly against the spring action of the spring band and into the path of said stop lug, to limit downward movement of the wick. In this manner the burner construction is made highly effective for operation to accurately secure the best results, without introducing any objectionable features in connection with its operation.

The heating stove described constitutes an illustrative use of the described burner which may be effectively used for other purposes, and the burner described constitutes an illustrative source of heat for said stove which may be supplied with heat, if desired, by other types of burners.

The invention will be best understood by reference to the accompanying drawings showing a preferred embodiment thereof. in which:

Fig. 1 is a vertical, central, sectional view through the stove,

Fig. 2 is a horizontal, sectional view of the burner of the stove taken along the line 2—2 in Figs. 1 and 3,

Fig. 3 shows in a view similar to that shown in Fig. 1 and to an enlarged scale, the burner construction employed, excepting that in this view the wick and parts carried thereby are shown in front elevation, and the parts controlling the auxiliary air flow are shown raised from engagement with the burner,

Fig. 4 is a horizontal, sectional view of a part of the structure shown in Fig. 3, taken along the line 4—4 in Fig. 3,

Fig. 5 shows in a view similar to Fig. 3 and to an enlarged scale, the position of the stop mechanism for the wick when the burner is removed from the reservoir,

Fig. 6 shows in a view similar to Fig. 5, the stop mechanism for the wick in the position given it by mounting the burner on the reservoir,

Fig. 7 shows in side elevation and to an enlarged scale, with most of the outer wick tube removed, the wick and the parts carried thereby, as well as the stop for limiting downward movement of the wick, and

Fig. 8 shows in a view similar to Fig. 3, a modified form of auxiliary air passageway.

Similar numerals refer to similar parts throughout the several views.

As shown in Fig. 1, the stove consists of a tubular casing 1 mounted at its lower end on a fuel reservoir 2 to which it is hinged at 3 at one edge of the lower end of the casing so that the casing may assume the vertical position for use indicated in Fig. 1, or be moved to a horizontal position when it is desired to light the burner or clean the same or to remove the wick. A spring catch 4 is employed to hold the casing 1 in vertical position against accidental movement away from that position. The reservoir 2 is provided with downwardly extending feet 5 resting in a drip pan 6 to which they are secured by suitable bayonet joint connections, the drip pan being spaced from the reservoir to permit the free flow of air around the lower edge of the reservoir and between the reservoir and the drip pan 6, to supply the inner wick tube 7 extending vertically through the reservoir, with the inner air required to in part support combustion of the fuel vapor. The wick tube 7 carries at its upper end a perforated flame spreader 8 for directing the inner air outwardly into the fuel vapor delivered from the wick 9 surrounding the tube 7. The burner includes an outer wick tube 10 supporting at its upper portion an annular member 11 extending outwardly and supporting the lower portion 12 of the burner cone of the burner. The member 11 is provided with an annular row of perforations 11a as indicated in the drawings, to supply the requisite outer air to the burner cone. The upper portion 13 of the burner cone rests upon the portion 12 when the stove is in operation, and said upper portion is rigidly secured by studs 14 to a horizontally disposed annular member 15 which at its outer edge is provided with a tubular extension 16 terminating at its upper edge in an outwardly flanged portion 17 contained in an annular groove formed by an annular angle member 18 rigidly secured to a cone shaped partition 19 diverging upwardly and rigidly and tightly secured at its upper edge to the casing 1. The lower edge of the partition 19 that extends around the tubular portion 16, is tubular in form as shown at 20, and is slightly spaced from the tubular portion 16 to limit movement of the annular member 15 and upper burner cone portion 13, relatively to the partition 19. The parts are so proportioned that when the casing 1 is in vertical position, the upper burner cone portion 13 rests on the lower cone portion 12, with the flanged member 17 raised above the lower portion of the partition 19, the described structure preventing accidental displacement of the annular member 15 and attached parts relatively to the partition 19, when the casing 1 is moved to its horizontal position.

Just above the mid-portion vertically of the casing 1, an imperforate baffle 21 of sheet metal is mounted in horizontal position by a plurality of supporting bars 22 secured at their lower ends to the partition 19 and at the upper ends to said baffle, the baffle being preferably circular and of sufficiently smaller diameter than the casing 1 to permit the free passage of gases of combustion around the baffle to the outlet openings 23 formed through the upper portion of the casing 1. A handle 24 is provided for conveniently moving the stove from one location to another.

The casing 1 is provided just above the partition 19 with a slight opening 25 having a transparent covering 26 by which the condition of the flame may be observed during the operation of the stove, and below the partition 19 the casing 1 is provided with a hand opening 27 permitting convenient access to the operating handle 28 of the wick raising mechanism.

As shown in Fig. 3, the wick 9 is provided with a carrier tube 29 of thin sheet metal which is secured to said wick, and said tube has rigidly secured thereto a rack bar 30 extending circumferentially and axially of said tube so that the rack bar has a helical formation, said rack bar meshing with a spur gear 31 substantially in a vertical plane and secured to the inner end of a short shaft 32 supported in horizontal and radial position by the outer wick tube 10, and having the operating handle or disc 28 rigidly secured to its outer end. Suitable guide pins or members 32a extend inwardly from the outer wick tube, to engage the rack bar 30 and hold it in mesh with the spur gear 31, (see Figs. 5, 6 and 7). When the burner is mounted on the reservoir 2, an outwardly extending flange 33 rests upon the reservoir and has bayonet joint engagement with said reservoir as shown in Fig. 2, to hold the burner in place, at which time a spring stop member 34 is held inwardly by a cam member 35 engaging the opening in the top of the reservoir 2, so that said stop member is in the path of a lug 36 carried by the carrier tube 29, to limit downward movement of the wick 9 by operation of the handle 28. This condition of the wick is more clearly illustrated in Fig. 6, and as illustrated in Fig. 5, when the burner is removed from the reservoir 2, the spring action of the stop member 34 moves said stop member from the path of the lug 36 so that the wick may move freely downwardly until it is entirely released from the burner.

As shown in Fig. 4, the spring stop 34 comprises a strip of spring metal carrying at its free end and projecting through and outside of the tube 10, the cam member 35, said stop member being rigidly secured at its other end to the inner surface of the lower portion of the tube 10, so that the stop member may move freely inwardly to the position indicated in dotted lines in Fig. 4 to its wick stopping position, when the

burner is mounted on the reservoir. The relation of the wick and the parts carried thereby, as well as the relation of the stop member to the lug on the carrier tube of the wick, are more clearly shown in Fig. 7 which also illustrates the manner of preventing extreme upward movement of the wick by the enlargement on the lower end of the rack bar **30** to prevent further relative movement between the rack bar and the spur gear **31**.

As shown in Figs. 2 and 3, the carrier tube **29** is provided at spaced intervals around its circumference with axially disposed spacing bars **37** to maintain uniform spacing between the carrier tube **29** and the outer wick tube **10**, to insure proper meshing of the spur gear **31** with the rack bar **30**.

In Fig. 3, the casing **1** is shown in part, together with the cone member **13** and the member **15** controlling the flow of auxiliary air to the exterior of the annular flame for the purposes referred to, the casing and attached parts being shown in this figure at the beginning in their movement from the vertical position of the casing to its horizontal position, to more clearly illustrate the clearance opening inside of the lower burner cone portion **12** for cleaning and lighting purposes, when the casing is moved to its horizontal position. This figure also illustrates the manner of supporting the said members **13** and **15** from the partition **19** against the possibility of displacement from proper aligning position with the lower burner cone portion **12**, when the casing **1** is moved to its horizontal position.

The auxiliary air supply provided for by the members **13** and **15** in addition to securing the advantages above described, serves to a substantial extent to cool the parts of the burner and stove construction without appreciably interfering with the heating efficiency of the stove.

In constructing the stove, the height of the casing from the burner and above the partition **19** to the outlet openings **23** is important, to the end that a proper chimney or draft effect may be exerted upon the burner, in addition to producing the influx of auxiliary air between the parts **13** and **15**. In other words, with the construction described, the check draft effect of the inflowing air between the parts **13** and **15**, does not reduce the chimney draft on the flame below its optimum value.

Where the draft on the flame is too great, the effect is to produce a relatively small visible flame of a steel blue color, and the combustion is frequently so vigorous as to produce a noisy effect similar to that produced by a blast lamp; so this condition, although it produces complete combustion of the fuel, is undesirable on account of the noisy burning that is apt to be produced, and what is even more important, on account of the excess air cooling the products of combustion and resulting in inefficient heating by means of the stove. On the other hand, where the draft on the flame is too small, the flame is relatively high and contains more or less yellow spots indicating incomplete combustion of the carbonaceous matter in the fuel, so that, although the burning is relatively slow and noiseless, this condition also produces inefficient heating by the stove. When the draft on the flame is correct in amount, both of the conditions referred to are avoided, the flame is of medium height and of a purplish or bluish color and free from yellow spots, indicating complete combustion of the carbonaceous matter in the fuel without the use of excess air, and efficient heating by the stove is the result. This illustrates the importance of producing a definite total draft by the casing of the stove, that will secure the correct amount of draft on the flame and that will at the same time induce the correct amount of air flow through the auxiliary air passage, to operate in the manner described to free the gases delivered from the stove, from disagreeable odors and noxious effects. In the practical operation of the stove, the burner flame may in some cases be increased in size to such an extent, by raising the wick too high, that small streamers of yellow flame develop, indicating that a small amount of carbonaceous matter is unburned by the combined air introduced to the flame from the flame spreader **8** and under the cone portions **12** and **13**. In such cases it is found that the continuous envelope of air that is produced around the flame by the auxiliary air from under the annular member **15**, effects the complete burning of said small streamers of carbonaceous matter, and avoids the discharge of undesirable odors through the openings **23** at the top of the casing **1**, whereby the invention protects the user of the stove from undesirable effects, even in such cases of improper operation of the stove.

In Fig. 8 we illustrate a modified construction of auxiliary air passageway, in which the lower wall of said passageway is formed by an annular member **38** spaced below the member **15** and above the upper cone portion **13**, the members **38** and **13** being secured to the member **15** by studs **14** as indicated. The spacing of the members **15** and **38** from each other, is such as to impart to the auxiliary air passageway the optimum vertical extent required for most effective operation of the stove, said passageway being open to atmosphere at its outer edge. This construction may be used where it is desirable to have the auxiliary air passageway independent of the burner cone, and where it is desired to deliver the auxiliary air to the flame of the burner or to the gases of combustion, a small distance above the burner cone. In other respects, the stove and burner construction may be the same as above described.

In a practical embodiment of the invention described, the following approximate dimensions were employed: The casing had a diameter of 10⅜", the vertical distance from the top of the burner to the bottom of the outlet openings **23** was 15½", and the diameter of the baffle **21** was 6", said baffle being located 9¼" above the top of the burner. The wick had an outside diameter of 3⅛", the diameter of the opening in the lower portion **12** of the burner cone was substantially 3¾", the diameter of the opening in the upper portion **13** of the burner cone was substantially 3¼", and the diameter of the opening in the annular member **15** was substantially 3⅜". With these dimensions and using kerosene as fuel, a highly heated band was produced on the casing around the baffle **21** having a height of about 3 or 4" and a temperature of about 600° F., the temperature of the casing at its upper end portion being at the same time from 350° to 400° F., and the gases delivered from the outlet openings **23** were not hot enough for cooking purposes. The effect of the highly heated band of the casing around the baffle **21** was to radiate a substantial amount of heat laterally from the stove to give a feeling of warmth to the space around the stove considerably before the entire space was heated by the stove.

While we have shown our invention in the particular embodiment above described, we do not limit ourselves thereto as we may employ equivalents thereof without departing from the scope of the appended claims.

What we claim is:

1. As a means for completely burning liquid fuel, the combination in a burner of the annular flame type of means for producing an annular flame including inner air supply means, a burner frame, a burner cone having in use a stationary support from said frame and being independent of said flame producing means and defining a passage for supplying a predetermined main quantity of outer air to said flame, an annular member parallel with and spaced above said burner cone and in cooperation with said burner cone defining an annular auxiliary air passage means materially smaller than said first passage around and adjacent to the inner air supply means of the burner and terminating outwardly of said flame producing means for discharging auxiliary air in materially smaller quantity than said main quantity inwardly and around said inner air supply means, and means rigidly connecting said burner cone and said annular member and maintaining said annular member a fixed distance from said burner cone.

2. As a means for completely burning liquid fuel, the combination in a burner of the annular flame type of means for producing an annular flame including inner air supply means, a burner frame, a burner cone having in use a stationary support from said frame and being independent of said flame producing means and defining a passage for supplying a predetermined main quantity of outer air to said flame, an annular member parallel with and spaced above said burner cone and in cooperation with said burner cone defining an annular auxiliary air passage means materially smaller than said first passage around and adjacent to the inner air supply means of the burner and terminating outwardly of said flame producing means for discharging auxiliary air in materially smaller quantity than said main quantity inwardly and around said inner air supply means, means rigidly connecting said burner cone and said annular member and maintaining said annular member a fixed distance from said burner cone, said burner cone having a central opening of substantially larger diameter than said inner air supply means, and said annular member having a central opening coaxial with and of substantially larger diameter than the central opening in said burner cone.

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