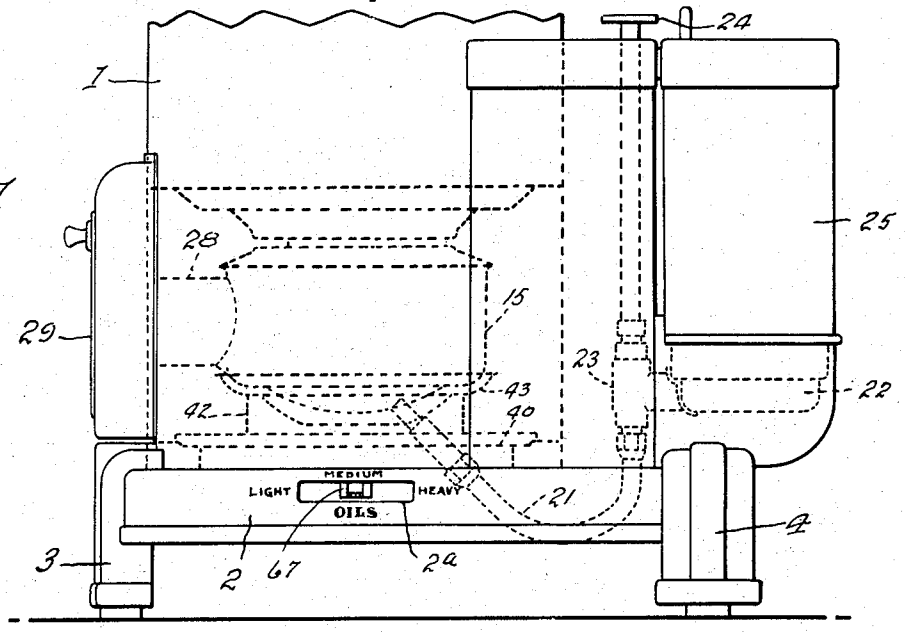
Sept. 10, 1940. L. S. CHADWICK ET AL 2,214,403

VAPORIZATION CONTROL FOR LIQUID FUEL BURNERS

Filed April 21, 1937 2 Sheets-Sheet 1

Fig. 1



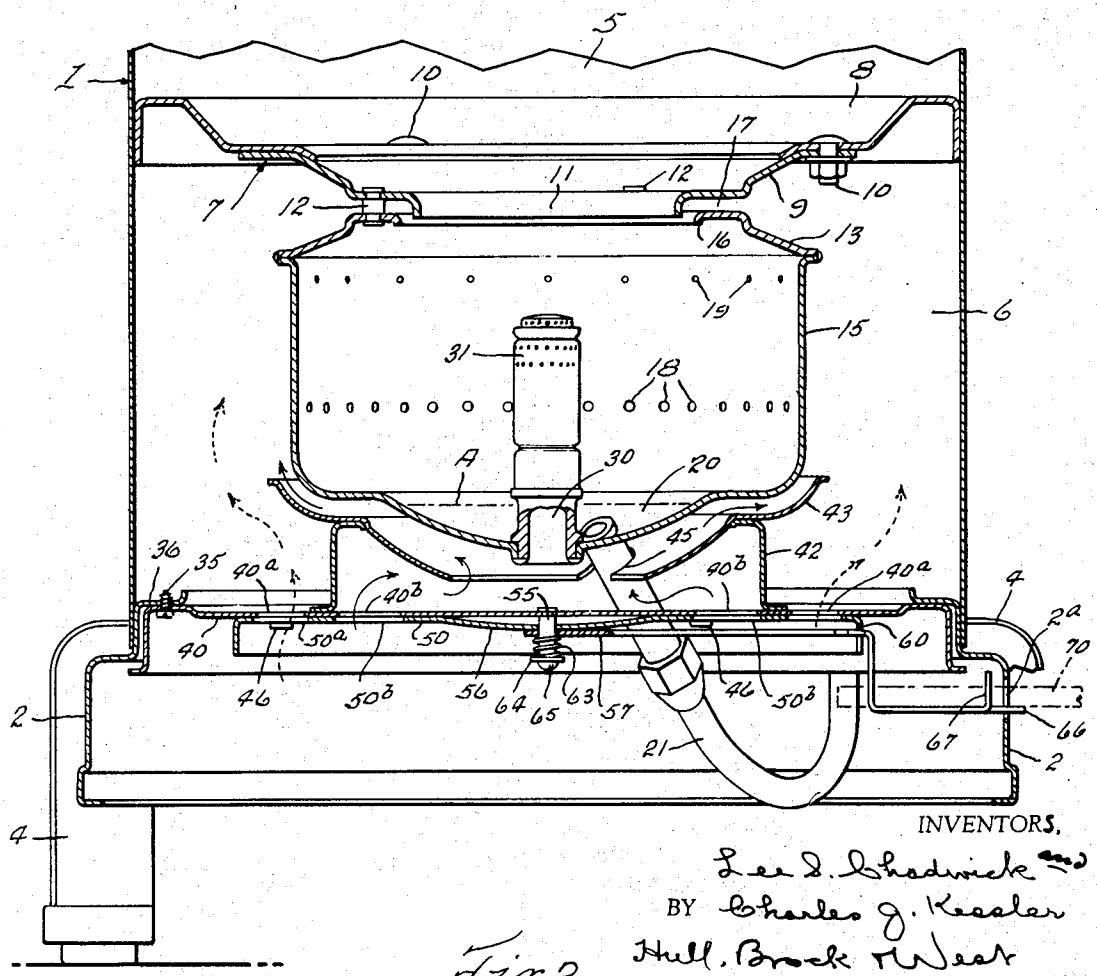


Fig. 2

INVENTORS,
Lee S. Chadwick
BY Charles J. Kessler
Hull, Brock & West
ATTORNEYS.

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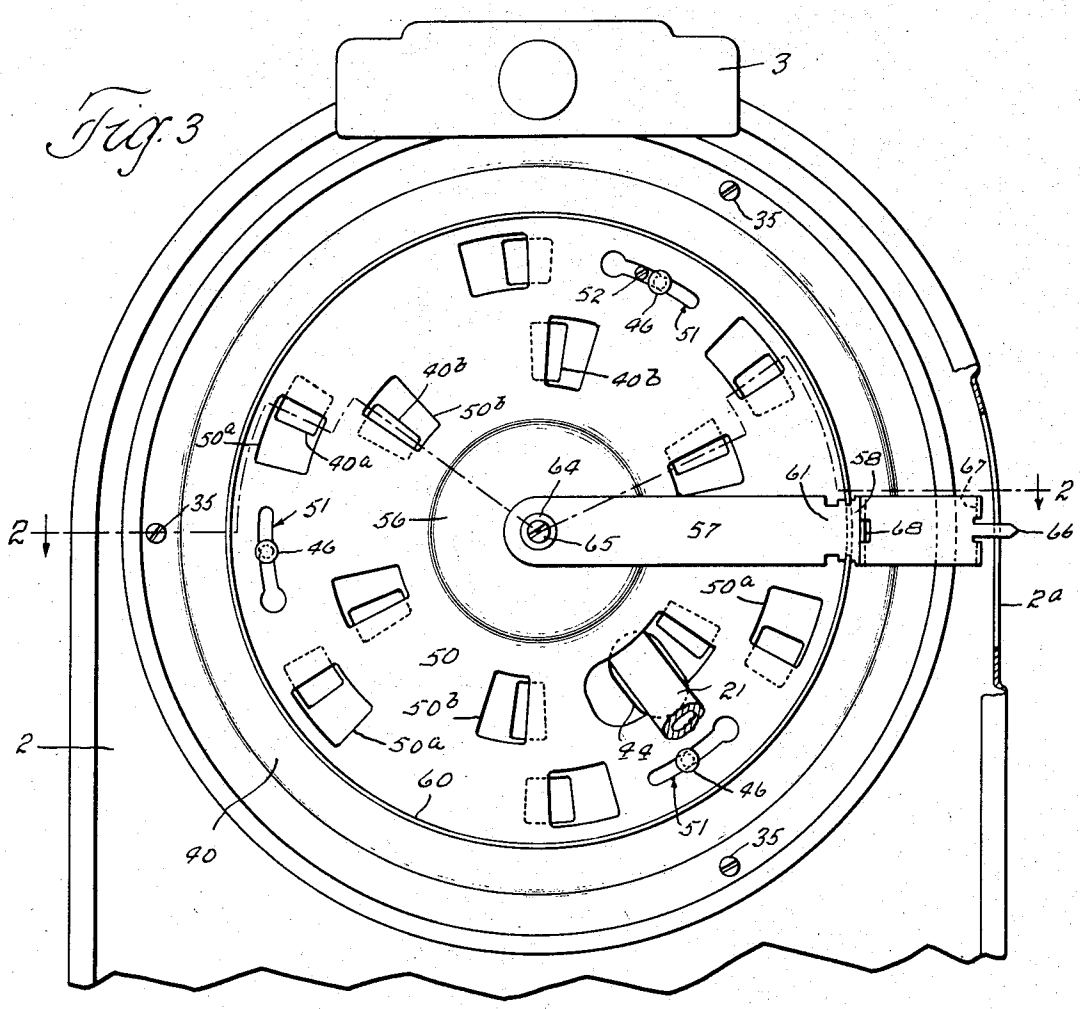
Fig. 3



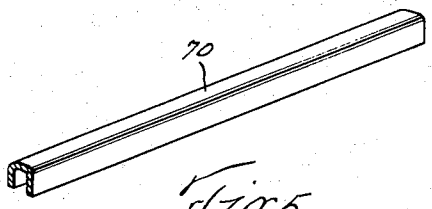


Fig. 5

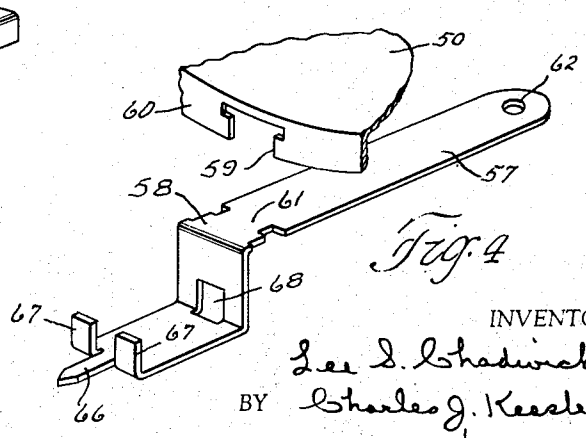


Fig. 4

INVENTORS,
Lee S. Chadwick and
BY Charles J. Keesler
Hull, Brock & West
ATTORNEYS.

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2,214,403

VAPORIZATION CONTROL FOR LIQUID FUEL BURNERS

Lee S. Chadwick, Shaker Heights, and Charles J. Kessler, Cleveland Heights, Ohio, assignors to Perfection Stove Company, Cleveland, Ohio, a corporation of Ohio

Application April 21, 1937, Serial No. 138,168

10 Claims. (Cl. 158—91)

This invention relates to liquid fuel burners, and more particularly to those of the so-called pot or bowl variety wherein vapors are generated from a pool of fuel maintained in the bottom of the bowl, by heat produced by the burner, and mix with air admitted to the bowl to form a combustible gas.

Scientifically developed burners of this variety are designed to consume a predetermined amount of fuel of a given volatility in a definite period of time according to the setting of a metering valve that controls the flow of fuel to the bowl. Further, these burners are intended to operate efficiently and economically under these conditions with practically complete combustion so as to produce a clean fire, relatively free from carbon. These favorable conditions, however, are destroyed if a fuel is used that differs perceptibly in volatility from that wherewith the burner was designed for use.

With prevailing burners of the class described, if fuel that is more volatile than that prescribed for use with the burner is employed there is an excess of vapors, resulting in incomplete combustion, lower efficiency, smoky fire and consequently an undue accumulation of carbon in the burner; and if a heavier and less volatile fuel than that prescribed is used there is an insufficiency of vapor, resulting in a slower rate of combustion or fuel consumption, although there will be relatively complete combustion and clean fire. In both of these instances of abnormal conditions, however, the thermal efficiency is less than would be the case if the burner were operating under normal conditions with the grade of fuel intended.

A broad purpose of our invention is to provide, in a liquid fuel burner, means for administering a cooling medium to a part of the burner that is in heat exchanging relation to the fuel thereby to control the temperature and consequently the vaporization of the fuel. By virtue thereof, fuels of different volatility may be burned efficiently, economically and satisfactorily, and at the desired rate of combustion or fuel consumption.

A more specific object of our invention is to provide a burner of the pot or bowl variety with means for varying the temperature of a part of the burner that is in intimate heat exchanging relation to the fuel (such part, in the embodiment herein disclosed, being the bottom portion of the pot or bowl) according to the grade of fuel employed, so as to maintain the intended rate of vaporization.

A still more limited object of our invention is to combine with a pot or bowl type burner, means for distributing the air supplied thereto for combustion purposes in various relations to the pot or bowl so as to alter its cooling influence thereon and thereby control the temperature of the pot or bowl and consequently the temperature and vaporization of the fuel.

A further object is to provide a simple damper arrangement, that is practically immune from disorder, for controlling the passage of air through different courses to the burner, the vapor generating function of the burner depending upon the apportionment of the air to said different courses.

A further object is to provide a construction for such a damper that is adapted to standard stove construction and may be simply and economically incorporated therein.

A still further object of the invention is to provide an adjusting lever for the damper that is convenient of installation and manipulation and that desirably includes an indicator which, in association with a suitable scale or the like, designates the setting of the damper for the different grades of fuel.

The foregoing objects, with others hereinafter appearing, are attained in the embodiment of the invention illustrated in the accompanying drawings, wherein like reference characters designate corresponding parts throughout the several views.

In the drawings, Fig. 1 is a fragmentary side elevation of a liquid fuel heating stove incorporating our invention; Fig. 2 is a transverse vertical section through the lower portion of the stove, the plane of section being staggered as indicated by the line 2—2 of Fig. 3; Fig. 3 is a fragmentary bottom plan view of the stove; Fig. 4 is a perspective view of the damper operating lever with a fragment of the damper plate associated therewith, and Fig. 5 is a fragmentary perspective view of the detached lever operating member.

The stove structure with which we have shown our improvements associated includes a cylindrical drum 1 that is mounted on a base 2 supported a suitable distance from the floor by a front leg 3 and rear legs 4. These parts are constructed of sheet metal of suitable gauge and are fastened together by welding or any other approved means. The interior of the drum 1 is separated into a combustion chamber 5 and an air chamber 6 by a horizontally disposed partition designated generally by the numeral 7. This partition consists of an annulus 8, having a peripheral flange that is welded or otherwise fastened to the drum,

and a ring-like member 9 that is attached by bolts 10 to said annulus, and whose inner edge is flanged downwardly to form a neck 11. The member 9 is permanently secured, by rivets 12, to the annular top wall 13 of a burner pot or bowl 15. The body portions of the rivets 12 space the member 9 from the top wall 13 of the burner bowl, and the inner edge of said top wall is turned downwardly slightly to form a lip 16 that is in spaced relation to the neck 11. A passage 17 is thus provided between the member 9 and the top wall of the burner bowl through which secondary air may enter the bowl from the surrounding air chamber 6, such air being deflected downwardly into the bowl by the neck 11. So-called primary air is admitted to the interior of the bowl from said chamber through perforations 18 and 19 in the peripheral wall of the bowl.

The bottom wall of the bowl is shown as formed with a sump 20 to which liquid fuel is conveyed by a pipe 21 from a receptacle 22 with which the pipe communicates through a metering valve 23, adapted to be operated by a handle 24. A reservoir 25 is suitably supported in an inverted position over the receptacle 25 and the outlet thereof is liquid sealed in said receptacle in accordance with common practice. By this well known expedient a maximum liquid level is established in the burner bowl or sump, the same being indicated by the line A. Access is had to the interior of the burner bowl 15 for lighting and clean-out purposes through a forwardly projecting sleeve 28. A plug (not shown) fits within the sleeve 28 and forms a closure therefor, and the same is adapted to be reached through an opening in the front of the stove structure normally closed by a door 29. Air is also supplied to the central interior of the burner bowl through an air tube 30 that opens through the bottom of the bowl and has a perforated cap 31 applied to its upper end.

The structure thus far described is, generally speaking, that of a standard type of liquid fuel heating stove and constitutes no part of the present invention except as it enters into the combination; and its operation, briefly, is as follows: With the metering valve 23 set, by means of the handle 24, to maintain a fire of the desired intensity, fuel will flow from the receptacle 22 through the valve 23 and pipe 21 to the burner bowl, attaining a level therein indicated by the line A. To light the burner, the door 29 is opened and the previously mentioned plug (not shown) is removed from the sleeve 28 and a lighted match, taper or other igniting means is entered through the sleeve to ignite the fuel in the sump 20, after which the plug is replaced and the door 29 closed. As combustion progresses, the fuel is more rapidly vaporized and the vapors commingle with primary air entering through the perforations 18 and 19 to form a rich mixture which, when joined by the secondary air entering through the passage 17, burns with a clean flame that rises through the neck 11 into the combustion chamber 5. Very soon after the burner is lighted, the oil level recedes to a very low point on account of the increased rate of evaporation due, in part, to the relatively high temperature of the bottom of the burner bowl or pot, and operation proceeds in a normal fashion.

If liquid fuel is employed having a volatility suited to the operating temperature of the burner, practically complete combustion is obtained resulting in a clean and efficient fire. As previously pointed out, however, if a lighter or more volatile fuel is used, there is an excess of vapors, resulting in incomplete combustion, lower efficiency, smoky fire, etc.; and if a heavier or less volatile fuel is used, there is an insufficiency of vapor, resulting in a slow rate of combustion or fuel consumption, although the combustion will be practically complete and the fire clean. In both instances, however, the thermal efficiency will be less than when fuel of the prescribed grade is employed, whose volatility is suited to the temperature of the burner.

From the foregoing description of the operation of the burner it will be evident that vaporization of the fuel may be controlled or, in other words, differences in the volatility of various grades of fuel may be compensated for, by changing the temperature of the burner, or, more specifically, by altering the temperature of the bottom wall of the burner bowl. Our present invention provides means for attaining this result, and such means, as herein disclosed for illustrative purposes, will now be described.

Secured, as by screws 35, to the inturned upper end 36 of a cylindrical portion of the base, over which the bottom of the drum 1 is engaged, is a stationary damper plate 40, the edge portion of which is turned downwardly and then flanged outwardly to correspond in cross section generally with the adjacent portion of the base 2. This stationary burner plate has an outer series of segmental openings 40^a, and an inner series of similar openings 40^b, and mounted upon said plate between said series of openings is an annular partition 42 that sustains a dish-shaped baffle 43 is provided with a notch 45 for the acly, the shape of the bottom wall of the burner bowl 15. The plate 40 has a slot 44 and the baffle 43 is provided with a notch 45 for th accommodation of that section of the pipe 21 that is welded or otherwise permanently connected to the burner bowl. Buttons 46, that may be riveted or otherwise secured to the plate 40, depend from said plate and support a movable damper plate 50, having arcuate keyhole slots 51 through which the buttons 46 are engaged. Obviously, the movable damper plate may be attached to the stationary damper plate by engaging the enlarged ends of its slots 51 over the buttons 46 and turning the plate 50 to dispose the buttons out of register with the enlarged ends of the slots; and to prevent the plate 50 from being turned to a position to align the buttons with the enlarged ends of the slots, a stop 52 depends from the stationary burner plate and occupies one of the slots between the enlarged end thereof and the corresponding button 46.

The movable damper plate 50 has an outer series of segmental openings 50^a and an inner series of similar openings 50^b that are spaced radially from the center of the damper plates like distances, respectively, with the series of openings 40^a and 40^b of the stationary damper plate 40. The openings of the two plates are so related that when the corresponding ones of the outer series of both plates are in register with each other, the corresponding ones of the inner series of the two plates are out of register, and vice versa, these conditions being attained when the movable damper plate is at the extreme limits of its movement; and when in any position intermediate said limits, the openings of both series of the two plates are in overlapping relation, the extent to which they overlap being determined by the adjustment of the movable

damper plate. If the combined area or capacity of the openings of the respective inner and outer series be equal, the total amount of air passing through the damper will remain constant regardless of the damper adjustment; but if it were found advantageous to vary the amount of combustion air for different grades of fuel, this may be accomplished by making the area or capacity of the openings of the two series different and of the proper ratio.

A stud 55 is secured to and depends from the center of the stationary damper plate 40 and passes through an aperture in the depressed central portion 56 of the damper plate 50 and has journaled on its therebelow the inner end of an operating lever 57, shown in perspective in Fig. 4. A portion 58 of the lever 57 accurately fits within the enlarged end of a T-shaped notch 59 that is formed in the downturned peripheral flange 60 of the damper plate 50, and to facilitate the insertion of the lever within the notch, the former is reduced in width adjacent the portion 58 to form a neck 61, the neck being sufficiently less in width than the narrower part of the notch 59 to permit it to be readily engaged through said narrow part so as to register the portion 58 of the lever with the wider portion of the notch thereby permitting the lever to be moved radially inwardly with respect to the plate until the opening 62 at its inner end is in a position to be engaged over the stud 55. The inner end of the lever is held tightly against the adjacent portion 56 of the movable damper plate, and the portion of said plate outwardly beyond its depressed portion 56 is held in firm frictional engagement with the damper plate 40, by a spring 63 that surrounds the stud 55 and is compressed between the lever 57 and an abutment 64 which may consist of a washer that is held to the end of the stud by a screw 65. The outer end portion of the lever is turned downwardly and thence outwardly and terminates in a central index pointer 66 and laterally spaced upturned lugs 67, the former projecting through a slot 2^a in the side of the base 2 for association with certain indicia that is carried by the base adjacent the slot and consisting, in the present instance, of the words "Light—Medium—Heavy—Oils." The space between the aforesaid lugs 67 is in axial alignment with an opening 68 in the downturned portion of the lever. By inserting the end of a channel bar 70 (Figs. 2 and 5) through the slot 2^a and between the lugs 67 and into the slot 68 of the lever, the lever may be operated to adjust the movable damper plate 50 with respect to the stationary damper plate 40 so as to effect the desired relation of the openings of the two plates.

When the lever is swung to the left, as the parts are viewed in Fig. 1, or toward the marking on the base that indicates an adjustment of the damper that renders the stove suitable for use with light fuels, the openings 40^a and 50^a are out of register with one another and the openings 40^b and 50^b are in complete registration. Consequently the air that is supplied to the chamber 6 for combustion purposes is required to take the course indicated by the full line arrows in Fig. 2, a small part of said air incidentally entering the burner bowl through the tube 30 while the major portion of it sweeps outwardly between the baffle 43 and the botom wall of the burner bowl, thus keeping the lower portion of the bowl at a relatively low temperature which is desirable for the light and more volatile fuel. By moving the lever to the opposite end of the slot adjacent the marking indicating heavy oil, the openings 40^b and 50^b are closed, and the openings 40^a and 50^a are brought into complete registration which causes all air entering the chamber 6 to take the course of the dotted line arrows. In this case only an insignificant portion of the air that enters the chamber 6 will find its way between the baffle 43 and the bottom wall of the burner bowl to satisfy the demands of the air tube 30, wherefore the bottom wall of the burner may attain its highest temperature which is required in the vaporization of the heavier fuel. When the adjusting lever is in intermediate position, as illustrated in the drawings, the openings of the two series of both plates are in partial registration, as indicated in Fig. 3, so that the air is divided substantially equally between the two courses indicated by the full and dotted line arrows, thus causing the bottom of the burner bowl to be kept at a moderate temperature such as is suitable for the proper vaporization of a medium grade oil.

Having thus described our invention, what we claim is:

1. In a liquid fuel burner, a burner bowl having means for admitting air thereto, means for delivering fuel to the bowl, means defining two passages for the air supplied to the bowl, one of said passages conducting the air in more intimate heat exchanging relation than the other to a part of the bowl whose temperature influences the vaporization of the fuel, and an adjustable means for variably apportioning the air to the two passages.

2. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; means defining two passages for the air admitted to said chamber, one of said passages conducting the air in more intimate heat exchanging relation than the other to a part of the bowl whose temperature influences the vaporization of the fuel, and damper means common to both passages for simultaneously controlling the admission of air thereto.

3. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting a wall of said chamber, a movable damper plate sustained in operative relation to the former damper plate, the damper plates having two series of cooperating air openings so related that when the movable damper plate is shifted to close the openings of either series those of the other series will be opened, and means defining two passages arranged to receive air, respectively, from the two series of openings, one of said passages conducting the air in more intimate heat exchanging relation than the other to a part of the burner bowl whose temperature influences the vaporization of the fuel.

4. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting a wall of said chamber, a movable damper plate sustained in operative relation to the former damper plate, the damper plates having two series of cooperating air openings so related that when the mov-

able damper plate is shifted to close the openings of either series those of the other series will be opened, means defining two passages arranged to receive air, respectively, from the two series of openings, one of said passages conducting the air in more intimate heat exchanging relation than the other to a part of the burner bowl whose temperature influences the vaporization of the fuel, means for adjusting the movable damper plate, and an indicator associated therewith for designating the different positions of damper adjustment.

5. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting the bottom wall of the air chamber and having an outer series of openings and an inner series of openings, a movable damper plate connected to the stationary damper plate for rotary movement and having corresponding series of openings for cooperation with the openings of the stationary damper plate, all series of openings being substantially concentric to the axis of rotation of the movable damper plate, the openings being so arranged and related that those of one series are closed when those of the other series are open, and vice versa, whereby the openings of both plates of the two series are in overlapped relation when the movable damper plate occupies any position between its two extreme positions, an annular partition rising from the stationary damper plate between the inner and outer series of openings, a baffle supported by said partition in spaced relation to the bottom wall of the burner bowl, said baffle having an opening inside the confines of said partition, and means for adjusting the movable damper plate.

6. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting the bottom wall of the air chamber and having an outer series of openings and an inner series of openings, a movable damper plate connected to the stationary damper plate for rotary motion with respect thereto and having corresponding series of openings for cooperation with the openings of the stationary damper plate, all series of openings being substantially concentric to the axis of rotation of the movable damper plate, the openings being so arranged and related that when those of either series are closed those of the other series are open and so that the openings of both plates of the two series are in overlapped relation when the movable damper plate occupies any position between its two extreme positions, an annular partition rising from the stationary damper plate between the inner and outer series of openings, a baffle supported by said partition in spaced relation to the bottom wall of the burner bowl and having an opening within the confines of said partition, and a lever arranged to swing on the axis of rotation of the movable damper plate and having connection with said plate for adjusting it.

7. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting the bottom wall of the air chamber and having an outer series of openings and an inner series of openings, a movable damper plate connected to the stationary damper plate for rotary motion and having corresponding series of openings for cooperation with the openings of the stationary damper plate, all series of openings being substantially concentric to the axis of rotation of the movable damper plate, the openings being so arranged and related that when those of either series are closed those of the other series will be open and so that the openings of both plates of the two series are in overlapped relation when the movable damper plate occupies any position between its two extreme positions, an annular partition rising from the stationary damper plate between the inner and outer series of openings, a baffle supported by said partition in spaced relation to the bottom wall of the burner bowl and having an opening inside the confines of said partition, an adjusting lever supported to swing on the axis of rotation of the movable damper plate, a part of the movable damper plate adjacent its periphery being turned downwardly and having a T-shaped notch, the adjusting lever being reduced in width to form a neck adapted to be engaged through the narrow portion of said notch, which neck is out of register with the notch when the pivotal axis of the lever is coincident with the axis of rotation of the movable damper plate, the outer end of the lever being designed to receive a detached operating member.

8. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting the bottom wall of the air chamber and having an outer series of openings and an inner series of openings, a movable damper plate connected to the stationary damper plate for rotary movement and having corresponding series of openings for cooperation with the openings of the stationary damper plate, all series of openings being substantially concentric to the rotational axis of the movable damper plate, the openings being so arranged and related that when those of either series are closed those of the other series will be open and so that the openings of both plates of the two series are in overlapped relation when the movable damper plate occupies any position between its two extreme positions, an annular partition rising from the stationary damper plate between the inner and outer series of openings, a baffle supported by said partition in spaced relation to the bottom wall of the burner bowl and having an opening within the confines of said partition, an adjusting lever supported to swing on the rotational axis of the movable damper plate and connected to said plate, the outer end of the lever being provided with a pointer, and indicating means on the stove structure wherewith said pointer cooperates to designate the different positions of damper adjustment.

9. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting a wall of the air chamber and having two series of openings, a movable damper plate associated with the stationary damper plate and having corresponding series of openings for cooperation with the openings of the stationary damper plate, the openings being so arranged and related that those of one series are closed when those of the other series are open, and vice versa, whereby the openings of both plates of the two series are in overlapped relation when the movable damper plate

occupies any position between its two extreme positions, air directing means defining two passages wherewith the openings of the respective series communicate, the movable damper plate having keyhole slots, and buttons carried by the stationary damper plate occupying said slots, the enlarged ends of the slots being ample to permit the passage of the buttons therethrough while the body portions of said slots are of less width than the buttons, and stop means for preventing the movable damper plate from assuming a position wherein the buttons register with the enlarged ends of the slots.

10. In a liquid fuel stove including an air chamber, a burner bowl situated therein and arranged to receive combustion air therefrom, and means for delivering liquid fuel to the bowl; a stationary damper plate constituting the bottom wall of the air chamber and having an outer series of openings and an inner series of openings, a movable damper plate connected to the stationary damper plate for rotary movement and having corresponding series of openings for cooperation with the openings of the stationary damper plate, all series of openings being substantially concentric to the rotational axis of the movable damper plate, the openings being so arranged and related that those of one series are closed when those of the other series are open, and vice versa, whereby the openings of both plates of the two series are in overlapped relation when the movable damper plate occupies any position between its two extreme positions, air directing means rising from the stationary damper plate between the inner and outer series of openings and having its upper portion in spaced relation to the bottom wall of the burner bowl, the movable damper plate having arcuate keyhole slots, buttons carried by the stationary damper plate occupying said slots, the enlarged ends of the slots being ample to permit the passage of the buttons therethrough while the body portions of said slots are of less width than the buttons, and stop means depending from the stationary damper plate and occupying one of the slots intermediate the enlarged end thereof and the corresponding button.

LEE S. CHADWICK.
CHARLES J. KESSLER.