May 26, 1942. R. B. EVANS ET AL 2,284,138

SPACE HEATER

Filed Sept. 30, 1938 5 Sheets-Sheet 1

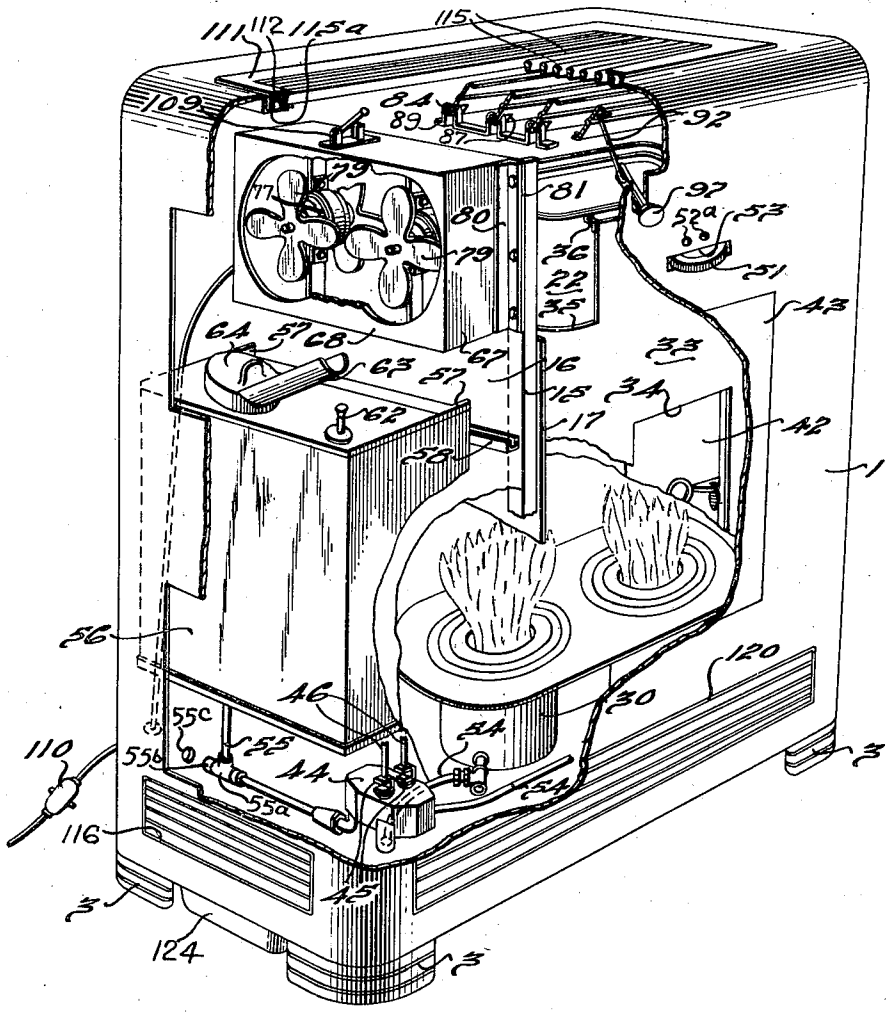


Fig. 1.

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SPACE HEATER

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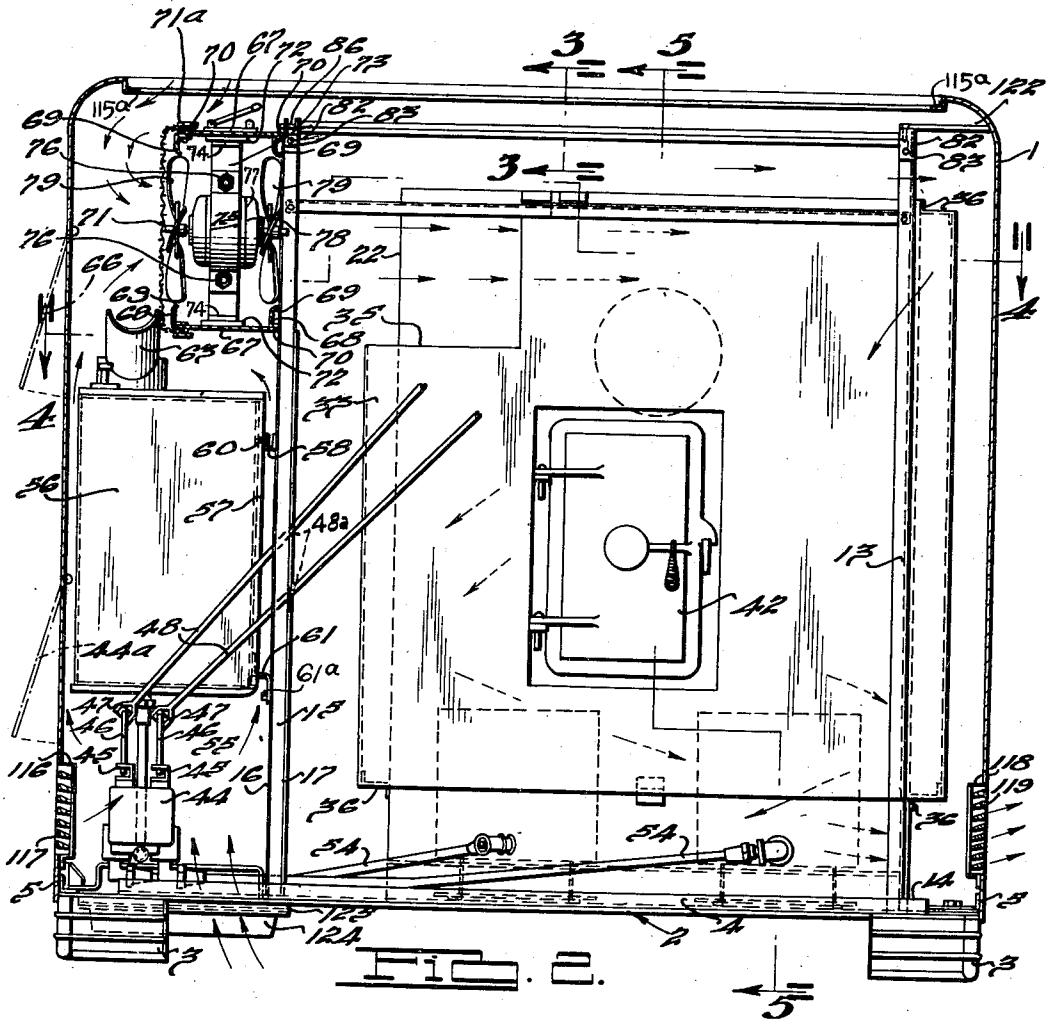


Fig. 2.

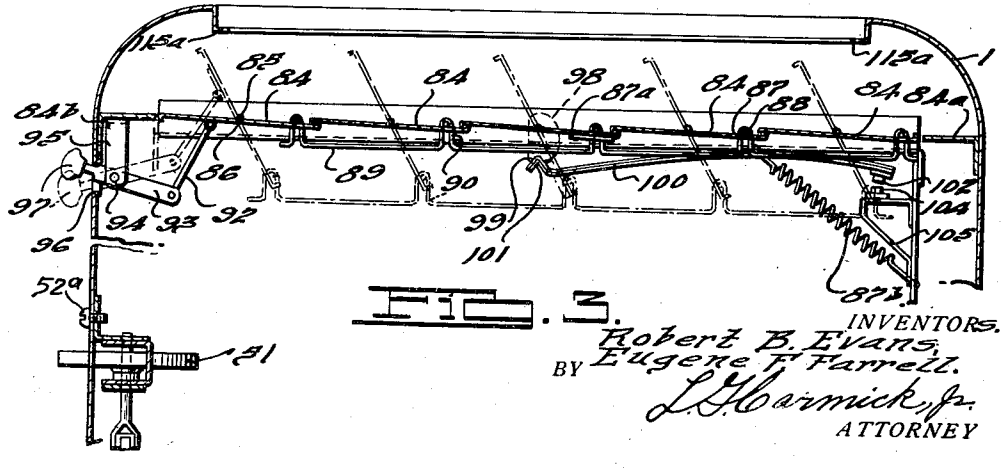


Fig. 3.

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SPACE HEATER

Filed Sept. 30, 1938 5 Sheets-Sheet 3

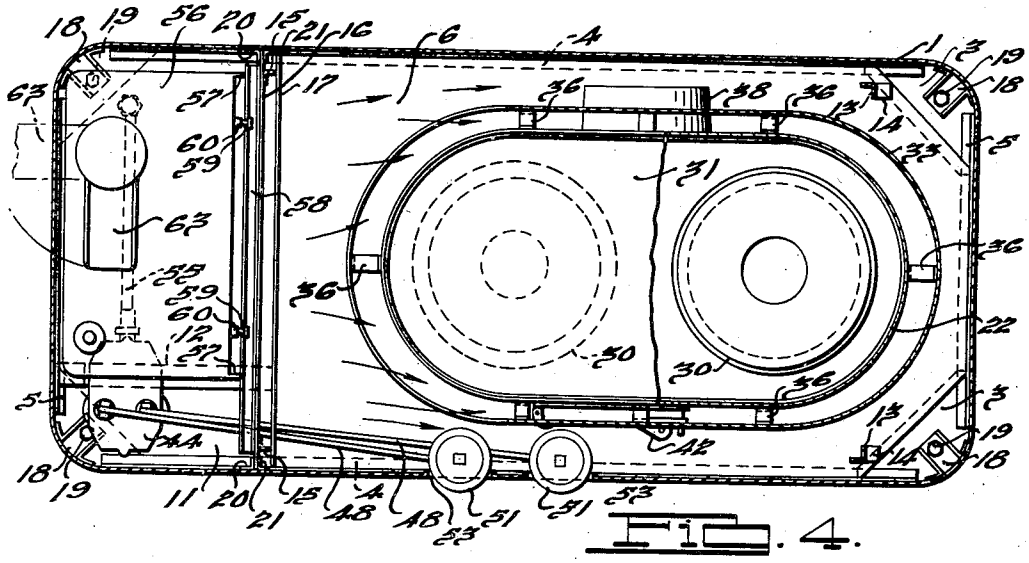


FIG. 4.

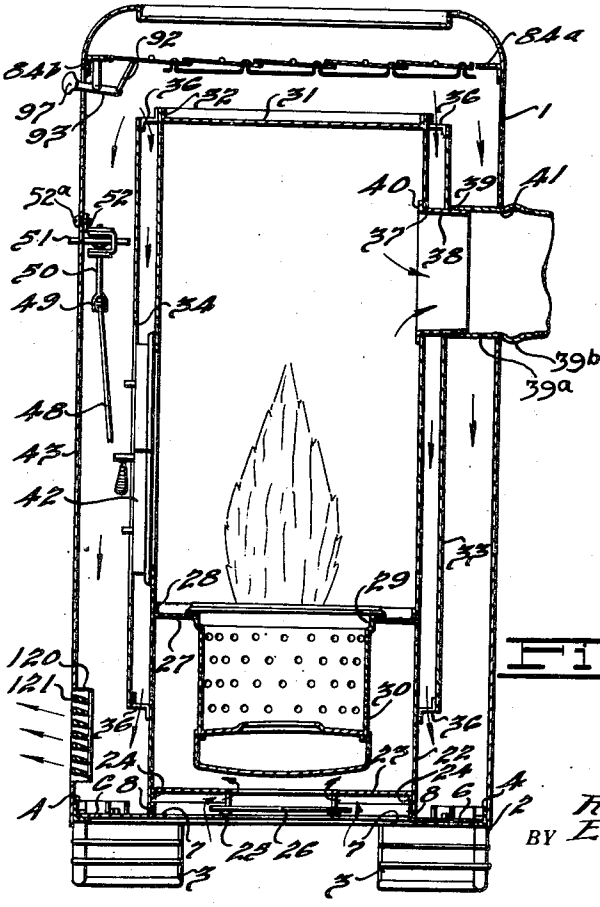


FIG. 5.

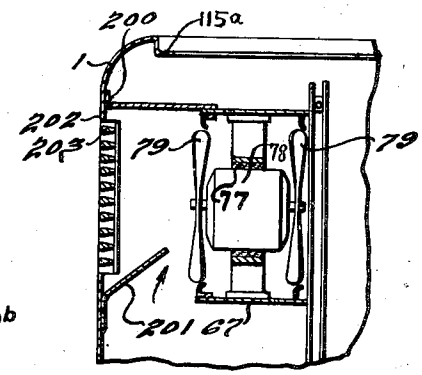


FIG. 6.

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May 26, 1942. R. B. EVANS ET AL 2,284,138

SPACE HEATER

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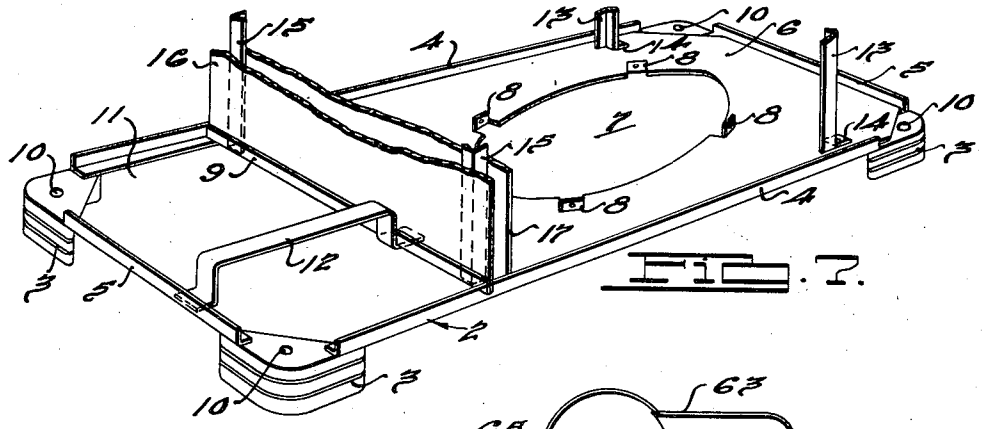


Fig. 7.

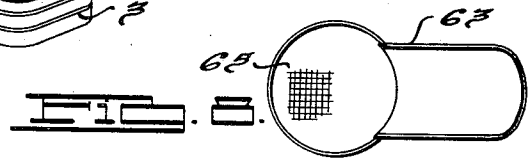


Fig. 8.

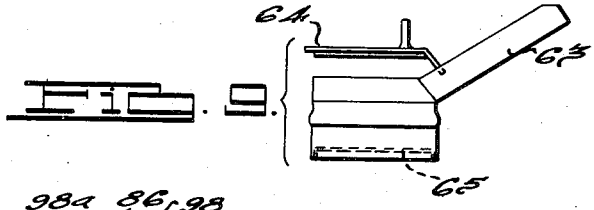


Fig. 9.

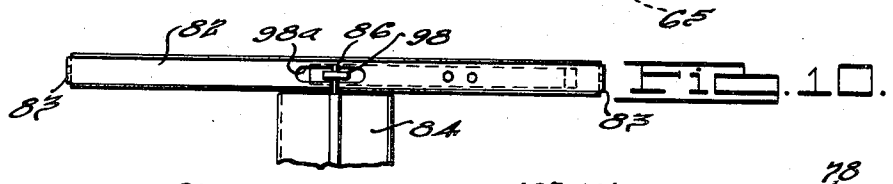


Fig. 10.

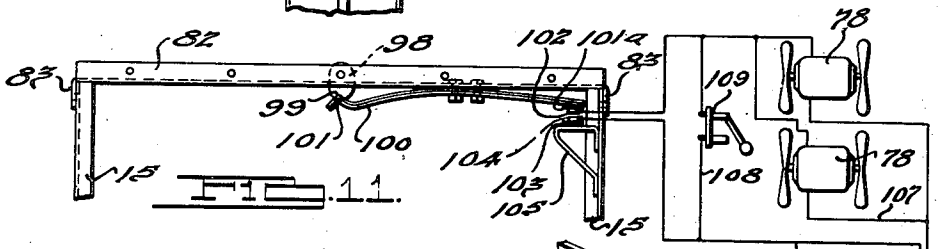


Fig. 11.

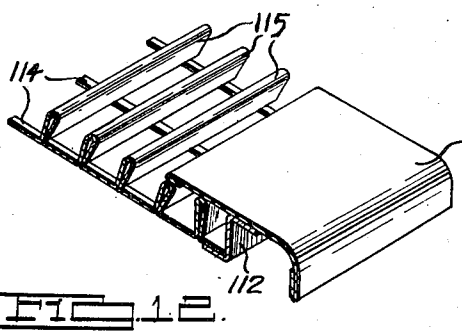


Fig. 12.

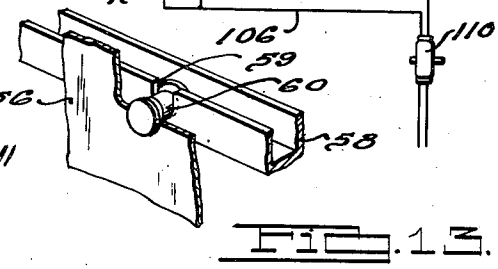


Fig. 13.

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May 26, 1942. R. B. EVANS ET AL 2,284,138

SPACE HEATER

Filed Sept. 30, 1938 5 Sheets-Sheet 5

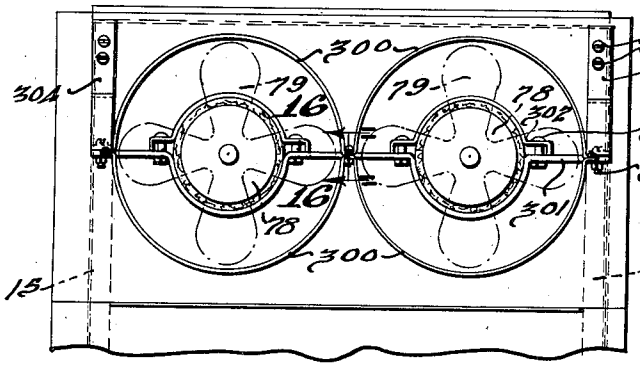


FIG. 14.

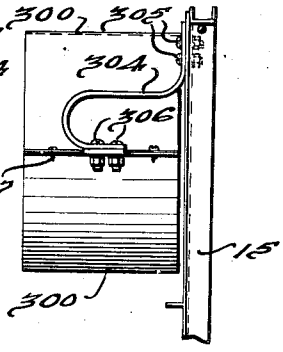


FIG. 15.

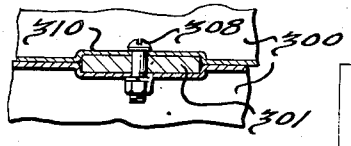


FIG. 16.

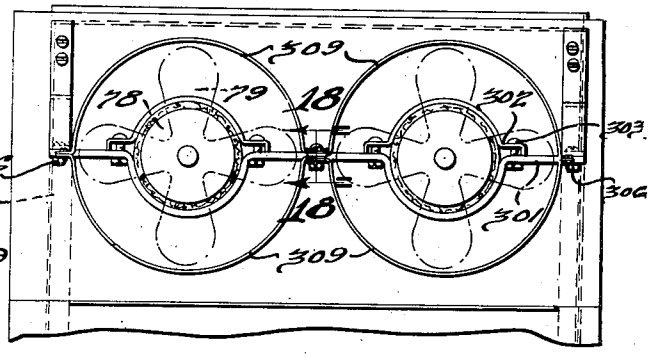


FIG. 17.

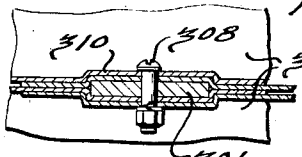


FIG. 18.

FIG. 19.

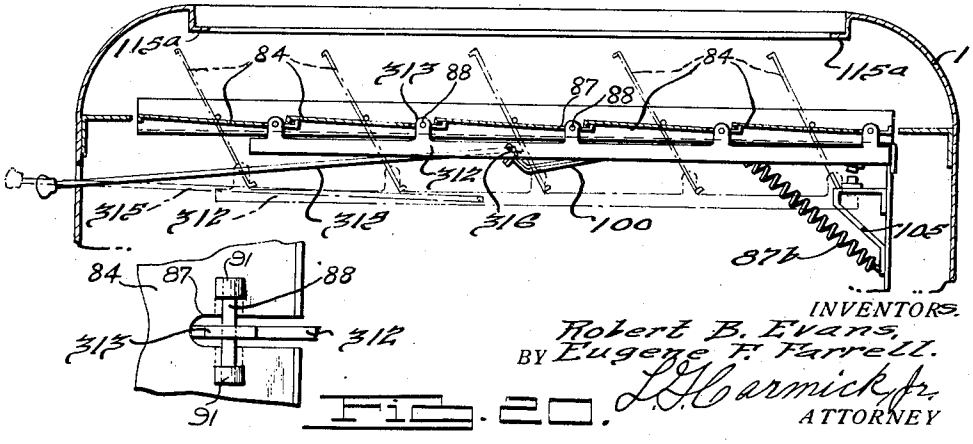


FIG. 20.

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Patented May 26, 1942

2,284,138

UNITED STATES PATENT OFFICE

2,284,138

SPACE HEATER

Robert B. Evans, Grosse Pointe, and Eugene F. Farrell, Detroit, Mich., assignors to Evans Products Company, Detroit, Mich., a corporation of Delaware

Application September 30, 1938, Serial No. 232,502

36 Claims. (Cl. 126—93)

This invention relates to air circulating unit heaters, and particularly to room or space heaters of the forced air circulating, portable, self-contained unit, cabinet type, burning oil, gas, or the like, and preferably arranged for a blower-forced discharge of high temperature (up to about 250° F.) air directly into the room close above its floor but not immediately striking the floor or, selectively, for operation by natural upward thermal circulation.

Objects of this invention are, in general, to provide improved and simplified features and arrangements for an air circulating heater including a high temperature combustion unit of this portable unit or self-contained cabinet type which preferably has blower-forced downward air circulation therethrough; to provide a heater of this type constructed to give a particularly efficient and safe forced distribution of the high temperature air in a low level, wide, thin stream directly from the heater cabinet into and throughout the room or rooms to be heated, particularly by discharging this flat stream of high temperature air across and close to but slightly above the room floor so as not to over-heat or injure the floor or its covering; and to provide a simple arrangement of the blower, shutter unit, and other parts for such a heater whereby it can be operated safely and without danger of overheating the blower motors, the shutters, the cabinet, and other parts with blower-forced down flow of the air being heated.

Other objects of this invention are to provide a space heater of this type having improved means for filling of its fuel or oil tank which is positioned inside of its cabinet; to provide connections whereby an outside fuel tank may be used if desired; to provide accessible controls mounted on the front of the cabinet of such a unit space heater, and particularly to provide such accessible controls upon the front of the removable shell type cabinet; and to provide a forced air circulating space heater in which the blower unit not only forces heated air into the room but also provides a cooling current of air over the oil tank, the shutter unit, and other parts to prevent overheating thereof.

Other objects of this invention are to provide a unit space heater of this type formed almost entirely of sheet metal which can be cheaply manufactured and assembled by modern production line methods; to provide such a heater, composed of removable and replaceable units, which can be readily and easily serviced in the field; and to provide a heater of this type in which the units for forced downward air flow can be omitted in original assembly without other changes or easily removed by the dealers to provide a unit of smaller capacity or of lower cost, these units being the complete blower unit and the complete shutter unit.

Other objects of this invention are to provide a cheaply manufactured and readily serviced space heater of the aforesaid type comprising a base unit including feet, said base unit carrying and forming part of a complete and rigid chassis assembly unit which includes suitable frame members carrying practically all parts, i. e. the blower unit, the oil tank, the combustion unit, the top damper unit and substantially all of the several operating parts; and to provide, in a space heater having such a chassis, a rigidly connected or "one-piece" open bottom outer shell cabinet member having suitable openings and grilles therein, which open bottom cabinet shell is removably and slidably fitted down over the complete upright chassis unit and yet is rigidly braced by this chassis unit.

Other objects of this invention are to provide in such a forced air circulating unit cabinet heater an arrangement of the blower unit, the oil tank, the combustion and heating unit, and the other operating units in an outer cabinet shell to give an efficient heat transfer and air circulation, a cooled oil tank, and a comparatively cool or non-burning outer cabinet shell, and particularly to make possible such a blower forced air circulating heater of very large heating and air flow capacity but which has all of its parts completely enclosed in a compact, shallow depth, limited height cabinet of the so-called "low boy" type having an attractive appearance and space conserving proportions for home use; and to provide an efficient and attractive type of grille for the air openings of such an air circulating heater.

Other objects of this invention are to provide, for use in a space heater or the like, a cheap blower unit of the duo-tandem fan type which is quite compact and readily removable, this unit comprising a compact housing containing two small electric motors arranged side by side and each having a fan at each end; to provide a simple vibration and noise absorbing mounting for a blower unit of this type; to provide a heater unit of this type in which the blower may also be employed for summer ventilation or air circulation when heat is not used; to provide a single unitary damper or closure means comprising a plurality of shutters selectively permitting or pre-

venting hot air from rising through the top of the heater during blower-forced air circulation, this damper means being compact and not materially increasing the over-all height of the heater cabinet; and to provide a simple combined manual and automatic or automatic thermostatic control for such a damper or closure means and for the blower motors.

Other objects and advantages of the present invention will become apparent from the following specification, the drawings relating thereto, and from the claims hereinafter set forth.

In the drawings, in which like numerals are used to designate like parts in the several views throughout:

Fig. 1 is a perspective view of the front and side of the complete space heater unit with portions broken away to show the interior construction;

Fig. 2 is a front elevation of the front of the heater unit with the front of the shell cut away to show the interior and with the top grille omitted;

Fig. 3 is a transverse vertical section taken on the line 3—3 of Fig. 2;

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 2;

Fig. 5 is a transverse vertical section taken on the line 5—5 of Fig. 2;

Fig. 6 shows a part of a similar heater having a modified form of air intake for the blower unit. This figure is otherwise similar to the upper left-hand portion of Fig. 2;

Fig. 7 is a perspective view showing the details of the base or the lower portion of the chassis assembly unit;

Fig. 8 is a plan view showing the oil filler spout unit with its cover removed;

Fig. 9 is an elevational view showing the oil filler spout unit with its cover;

Fig. 10 is a plan view showing details of the shutter unit and its thermostatic control;

Fig. 11 is an elevational view showing details of the shutter unit and its thermostatic control together with a schematic showing of the wiring diagram or motor control circuit and switches;

Fig. 12 is a perspective view showing the details of the upper removable grille;

Fig. 13 is a perspective view showing details of the upper removable mounting for the oil tank;

Fig. 14 is an end view showing a modified form of blower unit;

Fig. 15 is a front elevation of this modified form of blower unit;

Fig. 16 is a section taken on the line 16—16 of Fig. 14;

Fig. 17 is an end view showing another modified form of blower unit;

Fig. 18 is a section taken on the line 18—18 of Fig. 17;

Fig. 19 is a transverse sectional view similar to Fig. 3 showing a modified form of linkage for manual operation of the shutter; and

Fig. 20 is a plan view showing the details of the connection of this manual operating mechanism to a shutter.

While the several features and arrangements of the present invention relate primarily to a blower forced air circulating, portable unit, cabinet type, space heater, and accordingly have been illustrated and described in connection with this type of heater, from the following description it will be apparent to those skilled in the art that the use of certain aspects and features of the present invention is not necessarily limited to this particular type of heater, but may extend to different devices including other types of heaters, ventilating or air conditioning apparatus, or the like, all within the purview and scope of the present invention as set forth in the subjoined claims.

In unit space heaters of the general type of the present invention, there are a number of rather different but interrelated considerations and conditions which it is necessary or desirable to satisfy by suitable features and compromise arrangements in such heaters. Among them are the highly competitive market for such devices and the consequent necessity for a heater which can be manufactured from a small weight of sheet metal and assembled at low cost in large scale production; the desirability, for similar reasons, for standardized parts production and removable units, giving cheaper and smaller capacity models by omission or removal of certain units; the necessity for low cost of operation, including low fuel cost, from high efficiency and ease and low cost of repairs and servicing; the requirement, from its widespread use in homes or the like, that the parts of such unit be formed and arranged to give the unit a large heating and air circulating capacity with a limited cabinet size and an exterior shape or proportions such that the heater cabinet will not take up much floor space when positioned against the room wall and will have an attractive appearance as an article of furniture; the desirability for such a cheap and compact heater to have means, including a cheap, compact blower unit, to give an efficient and safe blower forced circulation of heated air and to have safety features for avoiding the danger of overheating the blower electric motors or other parts by the heated air, eliminating the danger of burning or overheating the floor from a low level discharge, keeping the outer shell temperature relatively low to prevent burns, and keeping the inside oil tank and associated parts sufficiently cool.

It is desirable, particularly when the heater is running at a high or full fuel setting, to force the heated air out adjacent the room floor. The blower-forced circulation of hot air through the heater will, of course, materially increase the air heating capacity of the heater unit over that obtainable by natural or convection type of air circulation, and cause a desirable circulation within the room or space to be heated. The discharge of hot air close to the floor, and particularly a blower-forced, wide, thin stream of hot air discharged along the floor, will prevent cold floors and stratification of the air, which is one of the objections to a convection circulation space heater or to a space heater using a blower to force the air upwardly or out into the room at a high level. The more uniform distribution of warm air throughout the height of the room increases comfort and decreases the amount of heat, and consequently fuel, necessary to maintain a comfort level in the more critical portion of the room, which is close to the floor.

In connection with the above mentioned danger of burning or injuring by over-heating the room floor or its covering by a direct blower-forced discharge thereon of the high temperature air from a combustion type space heater, it should be noted that a combustion type space heater of the type disclosed herein, when operating at full capacity, may discharge the air from its lower open-

ing at temperatures as high as or more than 215° F. Air at such temperatures, or even at considerably lower temperatures, will injure the floor or common floor coverings such as linoleum. The Underwriters will not permit unit space heaters to raise the floor temperature more than about 90° F. above ordinary room temperatures. Although it has been proposed heretofore to use a blower with a combustion unit type of space heater to force the hot air out the blower end, such proposals are believed impractical since the high temperature air impinges directly on the floor and will dangerously over-heat the same.

Therefore, a particularly important feature of the present invention is the provision of a combustion unit space heater in which the air is heated to high temperature and which is constructed so that the blower-forced high temperature air is discharged directly into the room close to but slightly above the floor in a substantially horizontal direction so that it will not strike the floor in any appreciable degree until it has moved out far enough from the heater to become sufficiently cooled. It has been found in connection with a heater of the type disclosed that after the discharged air has moved out about one and one-half feet from the heater the widening stream does strike the floor to some extent, but its temperature is reduced sufficiently so that it is quite safe and not injurious to the floor or its covering.

It is believed that the problems arising from these several considerations and conditions, which have not been entirely realized or satisfactorily solved by the space heaters of the prior art, have been advantageously met by the teachings of the present invention.

For a better understanding of the details of the invention, reference may be had to the drawings in which:

Reference numeral 1 represents the unitary and removable outer shell of the cabinet. This shell unit 1 is formed of suitably stamped and connected pieces of sheet metal reinforced and having openings therein for the several grilles hereinafter described. Since the present heater unit is intended to be placed up against a wall for circulating heated air throughout the room or rooms of homes, offices, cottages or the like, it is important that the heater as a whole, and particularly the outer shell, be of desirable size and shape and of pleasing exterior appearance. The heater cabinet illustrated is of the so-called "low boy" type. It will be noted that it is comparatively shallow from front to back so as not to protrude too far into the room. The over-all height is limited by considerations of appearance. It will be apparent that this stamped one-piece outer shell construction lends itself to the manufacture of the illustrated type of cabinet having all its corners rounded and suitably enameled and otherwise decorated.

The numeral 2 represents the base or chassis assembly as a whole, as shown in Fig. 7. The base and complete chassis assembly are supported by feet 3 which are one-piece sheet metal stampings decoratively embossed, as shown. Angles 4 are welded or otherwise suitably secured to the feet 3 to form the front and back rails of the base, and angles 5, similarly secured, form the end rails. Base plate 6 rests in rail channels 4 and one end channel 5, and is welded or otherwise secured to them and to feet 3 to form a rigid base unit. Base plate 6 has a simple elongated or oval opening 7 (as shown in Figs. 4, 5 and 7) and integral tangs or lugs 8 are struck up from the metal of the plate around this opening.

The left-hand end of plate 6, as seen in Fig. 7, rests in and is welded or otherwise suitably secured to angle iron 9 which is similarly secured to the front and back rails 4.

Feet 3 have bolt holes 10 on their top portions to receive the outer shell holddown bolts, as later described.

The left-hand portion of the base 2 is open, as shown by 11 in Fig. 7. This opening is bridged by a sheet metal member 12 suitably secured to transverse channels 9 and 5.

Upright angle irons 13 are welded to the base 2 by integral turned-over feet 14. Upright angle irons 15 are mounted on the front and back of the blower end of plate 6. Solid partition plate 16 is welded to channel 9 and extends from the base plate 6 to the base of the blower unit.

An additional partition plate 17 may be welded or otherwise secured to channels 15 to increase the heat insulation.

As seen in Figs. 2 and 4, the lower corners of the shell 1 carry retaining lugs 18 having suitable holes to receive bolts 19, to be received in holes 10 in the base feet, to thus removably secure the shell to the base.

Angle irons 20 and 21 are welded to the front and back of the shell to provide between them a channel to receive the whole length of the front and back edges of partition plate 16 to brace the rather light sheet metal shell 1 against weave or deformation with respect to the chassis assembly.

The oil burning combustion units are enclosed in upright oval expansion chamber 22, the lower edges of which are secured to plate 6 by screws through its up-turned tangs 8, as best seen in Fig. 5. As shown in Fig. 5, the lower end of chamber 22 is partially closed by a bed plate 23 screwed or otherwise suitably secured to chamber 22 by integral down-turned flanges 24. Bed plate 23 has small circular air intake openings positioned under each burner unit. Each of these openings has integral down-turned lugs 25 about its periphery to support circular plate baffles 26 with these air intake openings.

Burner retaining and partition plate 27 is suitably secured by an integral up-turned flange 28 in the chamber 22. Two circular holes 29 in plate 27 support two conventional pot-type burner units, the details of which are not described here since they may be of any desired type and since they form no part of the present invention.

The upper end of the expansion chamber 22 is closed by a top plate 31 having its up-turned flange 32 welded or otherwise suitably secured to chamber 22.

The expansion chamber 22 is surrounded by a spaced shroud or cowl member 33 having door opening 34 and a cut-out portion at 35, as seen in Figs. 1, 2 and 4, to permit the blast of air from the fans of the blower unit to enter shroud 33 and to be confined by it to close proximity to the hot metal surface of the expansion chamber 22. Shroud 33 is secured on the expansion chamber 22 by suitably welded-on brackets 36.

The expansion chamber 22 has a suitable circular opening 37 for a section of the flue connection 38 which passes through a corresponding circular opening 39 in shroud 33. Flue connection 38 is secured to member 22 by an out-turned flange 40. A short section of flue connection pipe 39a is tightly fitted over the slightly tapered

end of section 38 and has an outwardly rolled portion 39b to present a tapered surface which is shoved into and thus tightly fitted in circular opening 41 of the cabinet shell 1. The conventional flue pipe may be fitted over the slightly tapered end of 39a.

Conventional door opening 42 in the expansion chamber 22 matches opening 34 in the shroud 33, and there is a corresponding door 43 in the outer shell 1.

Any desired or conventional form of oil supply float chamber and control valve for each pot burner are enclosed in a common housing 44 which is suitably mounted on member 12 above the opening 11. Door 44a in the end of cabinet 1 permits access to the valve unit.

The unillustrated rotary valves for regulating the supply of oil to each pot burner may be of any conventional or desired type, as will be apparent to those skilled in the art, and their details form no part of the present invention.

Each of these valves is suitably connected to rotatable clips 45 on the top of the housing 44 (see Figs. 1, 2 and 4). These valves may be individually manually adjusted to regulate the oil flow to, and hence the height of, the flame in each burner unit by means of any desired linkage. The preferred linkage comprises the aforesaid clips 45, short vertical rods 46, universal joints of the Hookes type 47, long inclined rods 48, universal joints of the Hookes type 49, short vertical rods 50 (see Fig. 5), and horizontal regulating wheels 51 carried by brackets 52 and extending to the outside of the cabinet through suitable openings 53 in the cabinet shell. The two Hookes joints 47 and 49 are arranged with their pivots at right angles to each other so that movements of the control wheels 51 give corresponding equal angular movements of clips 45, as is well understood in the art concerning the use of universal joints. The inclined rods 48 pass through suitable closely fitting holes 48a in partition plates 16 and 17. Regulating wheels 51 carry suitable indicia to indicate the valve settings.

As shown in Figs. 3 and 5, bracket 52 is removably secured to the inner surface of the shell 1 by screws 52a. Note that this linkage for manual control of the oil valves is simple and compact and offers no possibilities of getting out of adjustment. The downwardly extending rods 50, as used in this linkage, permit the use of spaced rotatable controls having vertical axes. For removal of the shell for repairs or the like, the screws 52a are removed so that the controls 51 may be pushed in to disconnect the valve control linkage from the cabinet shell.

As shown in Figs. 1, 2 and 4, oil supply pipes 54 are provided with suitable or conventional fittings at either end and lead from the valve and float chamber housing 44 to each of the burner units 30. A similar oil supply pipe line 55 leads from the oil tank 56 to the housing 44 and has a T fitting 55a with an end plug 55b intermediate its length to permit the connection of an oil supply pipe from an outside large tank through hole 55c in the back of the cabinet shell 1 to the T fitting 55a in place of its plug 55b. Where such an outside large tank is connected in this fashion, the oil tank 56 may be removed, if desired, and plug 55b used to close off the top of the T fitting 55a.

It is desirable that the oil tank 56 be firmly and yet removably secured on the upright frame or upright portions of the chassis base assembly to facilitate repairs and the like. As shown in Figs. 1, 2 and 4, tank 56 has integral flanges 57 along its upright back edges. Upwardly facing channel 58 extends all the way across partition plate 16 adjacent the top of the oil tank and is suitably and rigidly secured to this plate 16. As shown in Fig. 4 and in detail in Fig. 13, the upper portion of tank 56 is hung on or removably secured to this channel 58 by two spaced pins or buttons 60 which are suitably fixed on the back of tank 56 and are received in open topped slots 59 in the outer flange of channel 58. Note that pins or buttons 60 have enlarged outer ends to engage the inner side of the outer flange of channel 58. As shown in Fig. 2, the lower end of tank 56 is removably secured to the frame by having the downwardly extending bracket or strap 61 rigidly secured to the lower portion of tank 56 and removably secured to plate 16 by screw 61a which is accessible from under the oil tank 56.

It will be apparent that when the outer shell 1 is removed, the oil tank 56 can be readily removed by unscrewing screw 61a and simply lifting the oil tank out of place. Assembly, which is the reverse of this operation, is equally simple.

Reference numeral 62 represents the indicator member for a conventional float type oil lever indicator which is well-known in the art and the details of which are not described herein.

The arrangement for filling the oil tank is shown in Figs. 1, 2, 4 and in detail in Figs. 8 and 9, wherein the removable filler spout unit 63 is shown as having the removable cover fitting into its top and a suitable straining screen 65 mounted in the bottom of the cylindrical portion of unit 63. Unit 63 has the lower end of its cylindrical portion removably and rotatably mounted in the equivalent diameter filler opening of the oil tank 56 and is supported thereon by its outwardly projecting portion above the lower end. Cover 64 is down-turned at one end so that it fits into and closes not only the cylindrical portion of unit 63 but its curved filler spout portion.

Note that as shown in Figs. 1, 2 and 4 filler spout unit 63 is rotatably mounted to one side of the oil tank and to one side of door 66, which door is suitably pivoted at its top to be swung open for filling and also for inspection of the oil level indicator 62. The positioning of the rotatable mounting of filler unit 63 at one side of this door opening permits its long filler spout to be readily swung out through the door opening to receive oil poured into it by the user.

As shown in Figs. 1 and 2, the compact blower unit 67 is removably mounted upon the upper portions of the upright frame members of the chassis base assembly unit in the upper end portion of the housing shell, but is entirely unconnected to and independent of the removable housing shell 1.

In the form shown in Figs. 1, 2, etc., the blower unit comprises a four-sided, rectangular housing or box 67 having its otherwise open ends partially closed and stiffened by similar end plates 68 which have integral, in-turned flanges 69 defining circular openings for the fan blades and forming air deflecting cowlings for each fan. Plates 68 have integral, similarly in-turned, outer flanges 70 stiffening them and providing for their being screwed or otherwise removably secured in box 67. As shown in Fig. 2, a suitable screen 71 may be held in place over the outer end of the blower unit by a clamping strap 71a to provide

a protection against a user getting his fingers into the fan blades.

The motor fan units are removably mounted in the blower housing by the following structure. As shown in Figs. 1 and 2, heavy metal straps 72 are welded to and extend from front to back of the top and bottom of the housing 67 to stiffen the same and to carry upright metal straps 73 having integral, turned-over ends 74 which are welded to straps 72. The central portions of straps 73 are curved to conform to and hold the electric motors. It will be noted that upright straps 73 stiffen and serve as braces for box 67. Strap members 75, having their central portions similarly curved to fit the electric motors, are removably secured to straps 73 by bolts and nuts 76 to clamp tightly a band of vibration and noise absorbing or insulating material 77 surrounding the small, conventional, electric motors 78 which carry multiple-blade conventional, propeller-type fans 79 upon the armature shaft at each end thereof.

It will be noted that the blower unit in its housing 67 extends substantially from front to back of cabinet shell 1 and is of a very limited height for a large volume capacity unit. The adjacent side-by-side fans are close to each other and extend substantially from front to back of housing 67 and the cabinet 1. Since there are two sets of fans operating in series upon the air streams, the blade pitch of the second or innermost fans may be made greater and otherwise modified to compensate for the faster-moving air it receives, as is well understood in the art relating to tandem propellers.

This arrangement of two sets of tandem fans side by side may be termed, for the sake of convenience, a "duo tandem" arrangement, and it will be apparent that such an arrangement is particularly advantageous in the blower unit for use in a "low boy" type, cabinet, space heater or in other installations in a compact housing wherein it is important that all space be efficiently used and the over-all height of the cabinet or housing is limited. This form of blower unit is cheap to manufacture because small size, and cheap, standard, electric motors and fan blades may be used in lieu of the specialized and more expensive larger motors and fans. In addition, this blower unit makes use of two sets of standard parts which may be used in building smaller, forced-air heaters with one tandem set, or the like.

Blower unit 67 is removably secured to uprights or frame angles 80 which are welded to the sides of housing 67 and are removably bolted to said uprights 15 with a noise and vibration-deadening backing 81 between angles 15 and 80.

As shown in Figs. 2, 3, 10 and 11, the top closure damper or shutter unit is removably secured across the top of the frame uprights of the chassis base assembly unit. This flat, rectangular shutter unit comprises upwardly extending channels 82 having integral, down-turned ends 83 on their webs which are screwed or otherwise removably secured to the top of upright frame members 15. A plurality of sheet metal shutters 84, having alternately up-turned and down-turned longitudinal edges to interlock when they are closed to provide a better closure, extend substantially from front to back of the housing shell 1 between suitable shelves or bracket plates 84a and 84b welded or otherwise secured on the inner back surface and front surface of shell 1, respectively, to match the outer edges of the shutter unit. It will be apparent that this unit is simple and compact, occupying little vertical space even when open, which is an advantage when the closure is positioned underneath a top grille such as grille 115. A closure unit occupying considerable height could not be positioned under a top grille without increasing the over-all height of the heater or modifying the design of the expansion chamber or the like.

As will be apparent to those skilled in this art, other types of closure units which are compact, and occupy little vertical space or height may be used within the purview of this invention.

As shown in Figs. 1 and 3, each shutter 84 is bent or crimped along its central portion to provide a recess 85 to carry suitably welded-in pivot rods 86 which are mounted in suitable aligned pivot holes in end channels 82.

As shown in Fig. 3, and, in part, in Figs. 19 and 20, each shutter has a slot 87 extending in from one edge thereof, and one or more of said shutters carry suitable counterweights 87a. If desired, spring 87b is also connected to pull said shutters open. Suitable pivot rods 88 extend across each slot 87 and are connected to a bent wire or strip interconnecting-member 89 by its integral bends or loops 90 which enter slots 87 and extend around each pivot 88, which pivots are held on each shutter by suitably welded-on or up-struck strips 91. The front shutter is pivotally connected to the over-turned end of a metal wire or rod link 92, the other bent-over end of which is removably sprung into a pivot hole in the outer end of handle lever 93 which is pivotally mounted on the lower end of strap or bracket 95 carried by and depending from bracket 84b. The other end of handle lever 93 extends through a suitable opening 96 in the cabinet shell 1 and carries a removable knob 97 at its outer end.

One of the shutters, preferably the central shutter, has a holding member or cam 98 of metal or suitable fibrous material fixedly secured on its pivot 86 intermediate the flanges of channel 82 and extending down through an opening 98a in the web of channel 82. Member 98 has a pre-determined, oval, cam shape. This shutter has a locking recess 99 at one end thereof. Bimetallic spring strip 100 is riveted intermediate its ends to the under side of the web of channel 82 and is formed so that each end thereof will move downwardly upon increasing temperature, as is well understood in the art relating to bimetallic spring members. This thermostatic strip 100 carries a suitable projection or bent-up member 101 at its inner end which may engage in and hold rotary locking plate 98.

It will be apparent that the above provides a very simple, fool-proof, and cheap mechanism for holding the interconnected shutters (which are spring and/or gravity biased towards open position) closed when they are closed by the manually operated handle 93—97. It is, in effect, a spring or snap detent to hold the shutters closed but permitting them to be manually operated when desired since the projection 101 of spring 100 will be pushed out of recess 99 of the rotary plate 98 when it is desired to manually open the shutters.

The bimetallic spring strip 100 and its associated parts are suitably calibrated and arranged so that member 98 will be released—permitting the shutters to open—at a desired pre-determined temperature which will be somewhat in

excess of any temperature which would be encountered in this part of the heater unit during normal, forced-air circulation operation at full fuel setting.

As shown in Figs. 2, 3, and 20, the bimetallic spring strip 100 (which serves as a temperature responsive retaining latch and releasing member for the biased top closure or shutters) is secured on the under side of channel 82 just in front of and just above the blades 79 of the innermost fan on the front side. These blades 79 extend into and partly through the cowling formed by the flanges 69 and will throw some of the discharged air out in a more or less radial direction (a well-known characteristic of this type of fan). Some of this air stream will necessarily strike strip 100 and this air stream will be relatively cool since the fans draw a part of their air supply down through grille 115 and a part up around oil tank 56 and past partition 16. This stream of relatively cool air acting as long as the fans are running will keep the simple and small bimetallic strip 100 sufficiently cool so that it will definitely latch or hold the biased shutters closed even though the whole upper part of the cabinet and heater unit may be quite hot in normal blower-heating operation.

Thus the temperature responsive element 100 is located in a relatively high velocity stream or is struck by a substantial amount of relatively cool air coming into the air heating passage. It will be apparent to those skilled in this art that various designs or expedients may be used to get this relatively high velocity stream of incoming or substantially unheated air acting directly on the temperature responsive element. Preferably, as specifically disclosed herein, but not necessarily, the temperature responsive element is quite close to the fans or blower and is located on the discharge side since the velocity is greater there.

Due to the rapid removal of heat from strip 100 by the portion of the relatively cool fan blast which strikes it when the fans are running, and since it will heat up rapidly when the fans stop, it will be apparent that the temperature responsive unit operates between two widely separated temperatures for its holding and its releasing positions so that a small simple unit can directly exert a greater force or have a greater travel (as is required for the latch organization herein) than in the case of a temperature responsive element acting on small temperature differences, as is true of most thermostatic regulators. Its operation is, in effect, dependent upon whether or not the fans are running so that there is a definite combination relationship.

This feature is quite important. It makes possible the use of a cheap, simple temperature responsive unit. It eliminates the necessity for a delicate, sensitive, or accurate temperature responsive system or for relays or the like in order to have sufficient force exerted on the latch to hold it firmly against accidental release and to release it quickly and definitely when the fans stop. It would be difficult to design a cheap, simple, and durable temperature responsive holding and releasing system for the top closure without employing this feature. For example, if the temperature responsive element were not struck and cooled by an appreciable amount of substantially unheated incoming air, or if it were simply positioned remote from the fan unit, such as at the other end of the shutters, a simple unit of this type would not be possible.

It will be apparent that when the shutters are closed for blower-forced downward air circulation, the blower unit should be running. Otherwise the hot air and heat trapped by the closed shutters—some of which would escape through the blower unit—would injure the motors 78 and possibly warp or otherwise injure the shutter unit itself and the enamel and finish of the cabinet unit.

The present, automatically-openable, top closure unit avoids these dangers since, upon reaching this predetermined excess temperature, the inner end of bimetallic spring strip 100 has moved down sufficiently to release plate 98 and permit the shutters to open, thus permitting release of the entrapped air and heat by normal, upward, gravity or thermal circulation.

If desired, means may be provided in the electric circuit for the blower motors so that, in normal heating operation with the fans running, they may be initially turned on but will not be energized to start until the temperature of the air inside the space heater has been raised to a pre-determined point to thus prevent circulating cold or unwarmed air throughout the room.

For this purpose, a bimetallic, spring-strip controlled switch is used and, if desired, and as shown in Fig. 11, it may be the other end of the bimetallic spring strip 100 carrying an insulating pad 101*a* which, in turn carries contact 102. Another insulating pad 103 carries co-acting contact 104 and is mounted on bracket 105 which is suitably secured on the inside of frame upright or angle 15. Contacts 102 and 104 are in one side 106 of the circuit 106—107 supplying current to the parallel-connected fan motors 78. Contacts 101 and 102 are bridged by a wire 108 having therein a simple, manually operable switch 109, which switch is preferably mounted in a concealed and yet moderately accessible place, such as on top of the blower housing 67, as shown in Fig. 1, so that it can be reached by removing the top grille of the cabinet when it is desired to render thermostatic control switch 101—102 inoperative so that the blower unit may be used to circulate air without any heating. This will be desirable for summer use of the heater blower unit for ventilation, and hence switch 109 will be rarely used.

As shown in Fig. 1 and in detail in Fig. 12, a decorative and protecting grille is removably mounted in a suitable opening in the top of the cabinet shell 1. This rectangular grille consists of a retaining rim formed of an open, rectangular, rim plate 111 having its outer edge downturned and having both its inner and outer edges turned over to stiffen it. A corresponding, open, rectangular plate 112, having its edges bent in reverse directions, as shown, is welded or suitably secured to plate 111 to form a channel to receive the ends and sides of the louver unit.

It is desired that the louvers, which run across the width of the grille, be attractive and sturdy, and yet offer small resistance to air flow. Accordingly, they are narrow from side to side, of an appreciably greater depth, and have a "streamline" cross section to give low resistance to downward air flow and also a small resistance to upward air flow. At the same time, they have an attractive appearance with smooth, rounded, upper surfaces. Although they may be made in any conventional way, the preferred form is shown in detail in Fig. 12, wherein the "streamline" louvers 115 and their connecting members

114 are integral and are formed from one large, flat piece of sheet metal which has suitable openings cut therein and then has a rounded or curved bent made along the centerline of each louver portion, leaving the horizontal, integral, connecting pieces 114 to hold them in place, as will be apparent from an inspection of Fig. 12.

There is an elongated air intake opening 116 opposite the float chamber 44. Grille 117 is secured in this opening. The grille 117 is preferably formed as shown in detail in Fig. 12.

Air discharge opening 118 extends along the bottom portion of the other end of the cabinet shell and carries grille 119, the louvers of which may, if desired, provide air deflecting vanes or fins which are of sufficient width to aid in deflecting the blower-forced downward flow of hot air from its downward path into a substantially horizontal path so that this very hot air will not impinge upon and burn the floor or floor covering close to the heater.

As illustrated, it may be desirable to have these louvers 119 slightly up-turned to deflect this air stream slightly upward from the horizontal, as is shown in exaggerated fashion by the louvers and the arrows in Fig. 2. It will, however, be apparent that this feature may be omitted if desired.

Similarly, long narrow opening 120 extends across the bottom portion of the front of the heater close above the bottom plate 6 and a grille 121 similar to that described above for opening 118 is mounted therein, the louvers of which grille 121 provide air deflecting vanes or fins, as described above.

Preferably, louvers 119 and 121 are formed as shown in detail in Fig. 12.

As shown in Fig. 2, upright frame angles 13 carry at their tops plate 122 which is suitably screwed across the open top of channel 122 which, in turn, is secured to angles 13 and forms the end of the shutter unit. This closure plate 122 is shaped to fit the end and curved corners of the outer shell 1 so that with the shutter unit closed it prevents any air from arising through the top of the heater during blower heating operation.

In order to humidify the air in the room being heated, and as shown in Figs. 1 and 2, a humidifier pan 124 may be removably mounted by having its opposite edges received in slides 125 so that it is positioned under part of the open space beneath the float chamber control valve unit of the oil tank. Thus it will be apparent that some of the air being drawn up through this open space to go up around the oil tank will sweep across the water of this pan 124.

Fig. 6 is generally similar to the structure shown in Fig. 2 except that it shows a modified arrangement for supplying air to the fans in which partition plate 200, which is welded or otherwise suitably secured by its integral flange to the shell 1, extends out over and rests on the fan housing 67 to close off air supply coming from above or over the shutter unit. It will be apparent that when the shell 1 is lifted up off the chassis assembly, member 200 may be lifted with it from fan housing 67. In order to reduce the resistance to flow and to give a portion of the air being supplied to the fans a straight path, an opening 202 is provided in the shell 1 opposite the intake side of the blower unit and has mounted therein a grille 203, the details of which are preferably formed as in Fig. 12. As in Fig. 2, a portion of the air supplied to the blower unit rises up around the oil tank to cool it and its valve unit, and in order to proportion the relative amounts of air coming up from around the oil tank and coming through the opening 202, there is provided a baffle 201 with a bent end welded or otherwise suitably secured to the shell. The length of member 201 and angle at which it is bent will determine the amount of air coming up from below.

Figs. 14, 15 and 16 disclose a modified and preferred form of blower unit and its mounting, wherein the housing for the complete unit and the shrouds for the two sets of tandem fans are formed by two symmetrical sheet metal stampings 300 each providing two side-by-side and integrally connected semi-cylindrical portions. A piece of comparatively heavy strap iron 301 is received between and extends across these members 300 and has two curved portions formed therein to receive the electric motors, which are horizontally clamped therein by two upper clamping members 302 removably secured to member 301 by bolts and nuts 303. Note that the ends of clamps 302 are formed to be spaced and held above strap 301 so that they can be taken up and sprung by the tightening of the bolts to give a resilient clamping action.

The blower unit is entirely supported by carriage or buggy type springs 304 which absorb noise and vibration. These springs are suitably bolted at 305 to upright frame angles 15 and to the projecting outer ends of member 300 and to member 301 at 306. Screws 307 hold together the projecting end flanges of the two housing members 300. Central bolts 308 clamp together the embossed portions 310 of the housing member 300 about the strap 301 to secure the central portions of the blower unit.

Figs. 17 and 18 disclose a modified form of blower unit which is similar to that of Figs. 14, 15 and 16 except that the semi-cylindrical housing and fan shroud portions are separate so that they will form standard parts which may be used in building blower units having only one set of tandem fans. This modification also may be desirable when it is found disadvantageous to make too large a stamping. In this form, suitable clamping bolts 308 clamp together the four semi-cylindrical members 309 by their overlapping edges or ends 310 about the central strap 301.

Figs. 19 and 20 show a modified and preferred form of the upper shutter unit and controls therefor and, in addition, show certain details of the shutter unit of Figs. 1 and 3, as will be apparent from the equivalent reference numbers.

Fig. 19 illustrates a manner of securing pins 88, which extend across open-ended slots 87, to the shutter 84 by suitable, integral, struck-up straps 91.

In this preferred embodiment, the shutters 84 are interconnected by a single elongated sheet metal stamping 312 having upwardly extending portions 313 extending up into slot 77 and receiving pins 88. An elongated metal handle rod 315 has its inner, bent-over end removably secured by cotter pin 316, or the like, to the interconnecting member 312.

It will be apparent that when the shutters are open the operator can reach down between the open shutters and remove the cotter pin 316 which passes through a hole in the bent-over end of member 315 to thus disconnect this handle rod 315 and permit its withdrawal so that the outer shell unit, having been disconnected at the other

required points, may be freely raised from the chassis assembly unit. The outer end of handle rod 315 extends through a suitable opening in the shell and carries a handle knob, substantially as shown in Fig. 3.

Operation

The pot-type burners 30 are lighted in the conventional fashion through opened door 42, opening 34, and opened door 43, after turning on the oil by control wheels 51. Controls 51 are also used to set the valves in the unit 44 to regulate or turn off the oil flow to each burner.

A detailed description of the operation of the pot-type oil burner units 30 is not given herein since it is well-known in this art. Air to support this combustion is supplied from the space under the bottom plate 6, upward through the oval opening 7, around the baffle or regulating plate 26, and in through the circular air intake openings in plate 23 to the space around the two burner units 30. This air then goes in through the plurality of openings in the sides of burner units 30 and picks up oil or oil vapor so that the flame may burn either at low level from the lower baffle or at a regulated height from the upper plate.

The products of combustion rise and expand in the expansion chamber 22, which extends substantially from top to bottom and through the major part of the width and depth of the entire cabinet shell 1 so that it has ample volume to permit expansion and provides a large area for efficient heat transfer.

The smoke and flue gases discharge through the flue connection 39, 39*a*, and the usual stack. Note that the flue opening 37 is connected to the back of the expansion chamber below its top to cause a swirling of the hot gases, instead of being connected with the less efficient, straight through passage into the stack.

In heater units in which the blower unit and the shutter unit are not included, or in units having the blower, but where it is not turned on, this heater operates by gravity or by natural, upward thermal circulation in which air from adjacent the floor enters the upwardly extending air heating passage through openings 120 and 118. Note that no air can enter the air heating passage through the closed bottom plate 6.

The air heating passage extends from bottom plate 6 to and through the open top of the cabinet 1 between the expansion chamber 22 and the walls of cabinet shell 1. On the left side of the heater (as shown in Fig. 1), this passage is bounded by the partition 16—17, which partition means prevents any of the hot air from getting over into the end chamber which holds the oil tank, etc.

Shroud 33 extends entirely around and throughout most of the height of the expansion chamber 22 to more closely confine the upwardly flowing air stream to the heating walls of chamber 22 to procure more efficient heating. Of course, air flow between shroud 33 and the cabinet shell will also be heated, but to a lesser degree, and will keep cabinet shell 1 at a lower temperature. It will be noted that shroud 33, which is open at its top and bottom, ends about opposite the top of openings 118 and 120 so that air from these openings can readily enter the shroud. The hot air arising from both inside and outside the shroud mixes at the top and flows out through the open shutters of the top grille 115 into the room.

During this non-blower operation, cool air rises from the space under the cabinet through the large area opening 11 and also comes in through the additional opening and grille 116—117 and in through the left-hand end of opening 120 to rise and flow around the float chamber-control valve unit 44, the oil tank 56, and up around the fan unit and out through the top grille 115.

Note that some of this air rises through the space between the back of the oil tank and partition 16—17 so that all sides of the oil tank are cooled to prevent excessive vaporization of the oil or other fuel, thus reducing the smell and fire hazard. Thus the oil tank and the fuel control valves, float bowl, etc., are positioned in a chimney having large area openings at its base and large area openings at its top for free flow to keep the oil tank, etc. cool.

This upward flow of cooling air is partly due to this chimney effect or the upward convection current caused by the certain amount of heat which is transmitted to this end chamber through the partition 16—17 and the walls of shell 1, and is partly induced by the adjacent and more vigorous flow through the upwardly extending air heating passage. Some flow of relatively cool air through the blower unit (and past the fan motors to cool them) into the upwardly extending air heating passage will be induced by the main upward flow of hot air in the air heating passage.

It will be apparent that high temperature air from the main heating passage does not flow through the blower unit, which is offset or positioned to one side out of this main upwardly extending air heating passage to avoid this and the consequent over-heating of its electric motors.

For blower-forced air circulation, the fan motors 78 are turned on by switch 110, and the shutters 84 are closed by pushing handle 97 of Fig. 1, etc., upwardly or pushing handle 315 of Fig. 19 inwardly.

The "duo-tandem" fans discharge a wide stream of air (substantially the width of the cabinet) across the top of the cabinet shell.

It will be apparent that the closed shutter unit, together with plate 122, entirely closes off the whole upper portion of shell 1 except for the blower discharge. Cut-away portion 35 in the shroud 33 provides an opening permitting the major portion of the blast of air from the fans to impinge directly on the hot expansion chamber and to enter the space between the shroud and the expansion chamber. This blast is reflected from the other end of the shroud 33 and the other end wall of the shell 1 and follows a turbulent and generally downwardly extending path, which is roughly indicated by the arrows in Fig. 2. It will be seen that this turbulent flow will give a high heat exchange efficiency and will extend over all of the heating areas through the height and width of the heating passage.

It is desired to discharge this blower-forced, generally downward flow of very hot air directly into the room or rooms to be heated. No distribution ducts, or the like, are used with this portable, unit heater.

It is also desirable that the hot air be forced into the rooms in a wide, thin stream close to and across the floors, so that heat may rise from this low stream to give a more uniform temperature throughout all portions of the rooms. This low, wide stream avoids stratification or heating

only the upper portions of the rooms, which is a disadvantage of ordinary non-blower space heaters or blower space heaters having an upper air discharge.

Accordingly, the blower-forced hot air is discharged through long, narrow, low openings 118 and 120. Note that 120 extends across the entire front of the cabinet. These narrow openings are spaced a desired small distance above the floor and are positioned at the bottom of the cabinet adjacent its bottom or base plate 6. Since, as illustrated, these openings 118 and 120 are narrow and have a relatively small total discharge area, they will inherently direct the discharged air (by their jet or nozzle action since they are, in effect, constricted openings) into a wide thin stream moving out substantially horizontally from the cabinet so that the high temperature air will not immediately strike the floor or its covering to injure or dangerously over-heat the same. The small height or the narrowness of these openings or slots 118 and 120 is important in horizontally directing this air discharge. For example, the directional effect would be much less in the case of a circular, square, or similarly shaped discharge opening having the same total area as openings 118 and 120. In addition, the plurality of horizontal louvers or vanes 119 and 121 extending across each of the long openings 118 and 120 divides them into a number of even narrower openings or slots to increase their directional effect. The width of the vanes 118 and 120 (which, as noted above, may be slightly upturned if desired) also aids in deflecting the downwardly moving stream of high temperature air into a substantially horizontal discharge stream.

During blower-heating operation, the intake air for the fans comes in from two sources. One portion rises up through the left-hand or end chamber (as seen in Fig. 1) through opening 116 and the large opening 11 to cool the oil tank, etc., as described above for non-blower operation. Another portion is drawn down through the low resistance louvers of grille 115, across the closed shutters to cool them, turns, and is drawn into the fans to cool their electric motors. Thus the blower unit air intakes are of relatively large area and consequently offer small resistance to the air flow. As noted above, the lower discharge openings 118 and 120 are relatively small so that the air heating passageways (the spaces between the expansion chamber 22 and the cabinet shell 1 closed at the top by shutters 84 and having their bottoms closed by base plate 6) form, in effect, a plenum chamber in which the fans build up a slight pressure to produce the horizontally directed jet type of discharge stream. Note that this slight pressure aids in insuring discharge of the high temperature air throughout the length of long openings 118 and 120.

As this substantially horizontally directed stream of high temperature air goes out from the heater cabinet, it is cooled in various ways, including mixing with the room air and by hot air rising from the stream. Of course, this thin stream also "fans out" so that its lower portion will strike the floor at a certain distance out from the heater cabinet. However, openings 118 and 120 are spaced just high enough above the floor and the stream is directed substantially horizontally so that when this air does impinge against the floor it is at a sufficiently low temperature to be non-objectionable and safe.

It will be apparent that the similarly mounted fan units of Figs. 14 through 18, inclusive, operate in the same way as described above.

In the modified form of blower air intake shown in Fig. 6, the second portion of this intake air has a low resistance path straight across from opening 202 into the fans.

In the forms of both Fig. 1 and Fig. 6, and during heating with or without blower operation, it will be apparent that part of the intake air is always humidified by sweeping across the water in removable pan 114.

If the operator should fail to open the shutters, or if the fans should stop or fail to go on when the shutters have been closed for blower-heating operation, the shutters will be automatically opened to release the entrapped hot air which would otherwise pass by and over-heat the fan motors and injure the shutters or the like.

The shutters are biased towards open position by weight 87*a* and spring 87*b* and are held closed by thermostatic spring 100 engaging the cam plate 98 which moves with the shutters 84. At a pre-determined temperature, spring 100 moves down to permit the shutters to open. The importance and the advantages of positioning this temperature responsive element in the fan blast of incoming air are discussed above.

In blower-heating operation, it may be desirable to prevent the blower from circulating non-heated air by delaying its starting, after it has been turned on by the usual outside switch 110, until the heater has come up to the proper temperature. As shown in Fig. 11, thermostatic switch 101—102 keeps the blower motor circuit open until a pre-determined temperature in the cabinet has been reached.

With the shutters 84 open, the blower may be used for summer air circulation without heating. Its discharge stream will go across and rise through ths upper grille 115 and thence into the room, rather than going down through the longer heating passage. To cut out the above-described delay switch 101—102, manual switch 109 bridges it so that the operator can make it ineffective. Manual switch 109 is concealed, but accessible through the removable upper grille 115.

The base-chassis assembly carries all of the operating parts of this heater independently of and unconnected to the cabinet shell 1. The only parts not carried by the chassis assembly are the fuel controls 51, the shutter control handle 97 or 315, and the conventional outside blower switch 110.

For repairs or service, it is not necessary to work through doors, or the like, since the entire outer cabinet shell 1 can be readily lifted off the chassis. It will also be apparent that this complete chassis can be efficiently assembled in a factory production line.

For removal of shell 1, the fuel controls 51 are disconnected by screws 52*a*, the shutter handles 97 and 315 are disconnected from the shell as described in the foregoing specification, the wiring is suitably disconnected, and flue connection 39*a* is disconnected from the stack and is pulled out of opening 41. Then the cabinet may be turned over and bolts 19 removed from the bottom to thus entirely disconnect the shell from the chassis assembly.

It will be noted that the entire blower unit and the entire shutter unit, and also the oil tank 56 and the valve-float chamber unit 44 are also removable for replacement or repairs.

It is to be understood that the specific embodiments of the invention described herein are to be taken as preferred examples of the same and that various modifications and changes in the size, shape, arrangement, and uses of the several parts, features, and sub-combinations may be resorted to without departing from the teaching or the spirit and substance of the present invention, the scope of which is commensurate with the appended claims.

We claim:

1. A unit, cabinet type, space heater circulating heated air by natural, upward, thermal convection or by downward, blower-induced, contra thermal flow and having an upright combustion unit, an upright, open-top cabinet enclosing and laterally spaced from said upright combustion unit to provide an upwardly extending air heating passage having an open upper end and a lower opening, blower means associated with said passage to induce said downward flow, a grille across the open top of the cabinet, and a substantially horizontal openable closure unit extending across the upper end of said passage above said combustion unit and below said grille and comprising a series of interconnected pivoted shutter vanes which, when open, permit free upward rise of said thermal convection flow but occupy a small height.

2. A unit, forced-air circulation, space heater comprising an upright cabinet type housing having a relatively small depth from back to front and a substantially flat back to go up against a room wall, liquid fuel burning heating means and means forming an associated contiguous air heating passage in said housing, means defining a separate upright narrow chamber in said housing to one side of said heating means and passage, said chamber containing fuel supply float valve and control means, an upright fuel tank, and blower means associated with said passage one above the other in the order given.

3. A forced-air circulating, unit space heater comprising an upright, cabinet type housing having a relatively small depth from its front to its back, which is flat to go up against a room wall, and having a limited height and a greater width from side to side, a liquid fuel burning heating unit and means forming an associated contiguous air heating passage extending across the depth and most of the width of said housing, a fuel supply tank and a blower unit mounted above said tank and operatively associated with said passage, said tank and said blower unit being mounted at one side of said housing, and partition means to separate the tank from said heating unit and passage.

4. A forced-air circulating, unit space heater comprising an upright, cabinet type housing having a relatively small depth from its front to its back, which is flat to go up against a room wall, and having a limited height and a greater width from side to side, a liquid fuel burning heating unit and means forming an associated contiguous air heating passage extending across the depth and most of the width of said housing, a fuel supply tank and a blower unit mounted above said tank, said blower unit forcing air across said passage and heating unit and comprising a mounting holding two small parallel electric motors each having tandem propeller type fans, one at each motor end and with said fans at each end of the unit arranged adjacent, side by side, and extending from front to back of said cabinet type housing, said tank and said blower unit being mounted at one side of said housing, and partition means to separate the tank from said heating unit and passage.

5. A unit space heater comprising an upright, cabinet type housing having a front, back and sides, heating means therein, means forming an upwardly extending heating passage of appreciable width from side to side contiguous to and associated with said heating means, means closing the top part of said passage, a front discharge opening adjacent the bottom of said passage, and blower means in the upper part of said housing to one side of said passage, the blower discharge being directed across the width of said passage to give a long turbulent path of forced downward reversed thermal air flow.

6. A unit space heater comprising an upright, cabinet type housing having a front, back and sides, an upright combustion heating unit in and extending across said housing and spaced therefrom to provide an air heating passage, means closing the top part of said passage, a discharge opening adjacent the bottom of said passage, blower means in the upper end side of the cabinet discharging across the width of said passage from side to side, and an air confining shroud extending about and spaced from said heating unit and spaced from said housing and having an air intake opening opposite said blower discharge for entry of the blower stream.

7. A cabinet, unit, air circulating space heater comprising a floor supported, upright cabinet the depth of which from front to back is considerably less than its width or its height, an upright partition in and extending from front to back of said cabinet to separate it into two chambers, an upright liquid fuel burning combustion unit in one chamber and spaced from said partition and said cabinet side walls to form a passage for circulation of air to be heated, means forming a lower discharge opening from said passage, a liquid fuel tank in said other chamber carried by but insulatingly laterally spaced from said partition to permit an upward flow of cooling air against said tank, means forming a lower air inlet to said other chamber, said partition having an opening communicating between the upper portions of said chambers and blower means to circulate air up through said first chamber and down through said other chamber and out its lower opening.

8. A cabinet, self-contained unit, air circulating space heater comprising a floor supported, upright, rectangular cabinet having substantially flat sides and top and having a narrow depth from front to back less than its width or height, an upright partition means secured to and extending from the front to the back walls of said cabinet to brace and stiffen it and to separate it into unequal width chambers, an upright oil burning combustion unit spaced from said partition means and the cabinet side walls in said larger chamber to provide an upwardly extending air heating passage, an upright oil tank in said smaller chamber mounted on and extending along said partition means but laterally spaced therefrom to provide an upwardly extending path for tank cooling air flow, and blower means in said smaller chamber discharging into and across the upper portion of said passage and mounted on the upper portion of said partition means.

9. A cabinet, self-contained unit, air circulating space heater comprising a floor supported,

upright, rectangular cabinet having substantially flat sides and top and having a narrow depth from front to back less than its width or height, and upright partition means secured to and extending from the front to the back walls of said cabinet to brace and stiffen it and to separate it into unequal width chambers, an upright, oil burning combustion unit spaced from said partition means and the cabinet side walls in said larger chamber to provide an upwardly extending air heating passage, an upright oil tank in said smaller chamber mounted on and extending along said partition means but laterally spaced therefrom to provide an upwardly extending path for tank cooling air flow, and a blower unit in and extending from front to back of said tank, said unit comprising a frame mounted on the upper part of said partition and carrying therein two small electric motors each having a fan on its motor shaft to blow air axially of said motors and fans across the upper portion of said passage and mounted on the upper portion of said partition means.

10. An air circulating, unit space heater comprising a base, an upright, liquid fuel burning, combustion unit mounted on said base, a contiguous air heating passage associated with said combustion unit, an upright partition means rigidly mounted on said base alongside of but spaced from said combustion unit, a fuel tank mounted on but spaced for insulation from the other side of said partition, an open bottom outer cabinet shell slidably fitting down over and removably secured to said base and having means on its front and rear walls to removably and slidably secure them to the edges of said partition means to brace and stiffen said walls.

11. In an air heater of the type described having means forming an upwardly extending air heating passage and blower means operatively associated therewith to circulate air downwardly therethrough, means forming an air inlet for said blower means, an openable closure associated with the upper portion of said passage, and means responsive to an excessive temperature to automatically open said closure to permit upward flow of the heated air past said closure upon stopping of said blower during heating.

12. A unit space heater circulating heated air by natural, thermal circulation or by downward, blower-induced, reversed thermal flow and having means forming an upwardly extending air heating passage having a lower opening, blower means operatively associated with said passage, to induce downward flow therethrough, means forming an air inlet for said blower means, adjustable damper means at the upper end of said passage permitting said upward flow when open and preventing upward flow when closed for said downward flow, means to bias said damper toward open position, and means to positively hold it in closed position, and to automatically release it upon stopping or failure of said blower means in normal heating operation to prevent overheating and to continue heating by gravity air circulation.

13. In an air circulating space heater of the type described, a top closure unit including a closure member movable from open to closed position, means to bias it toward one position, and a single unitary means to both positively hold said member in the other position against said biasing means and to automatically release it at a predetermined temperature.

14. A top closure unit for an air circulating space heater comprising a frame pivotally carrying a row of interconnected, swingable shutters, means to bias said shutters toward open position, a member carried by and swingable with one of said shutters and having a portion to be engaged, a bimetallic spring strip mounted on said frame and having means thereon to engage said portion to hold said shutters closed against said biasing means and to release them at a predetermined temperature.

15. A unit, air circulating space heater comprising a cabinet, a combustion unit and means forming a contiguous associated, upwardly-extending, air heating passage therein having an open upper end, a lower discharge for said passage, blower means in said cabinet located to the side of, but discharging into the upper portion of, said passage to force air downwardly therethrough, means closing the open upper end of said passage and means automatically opening said closing means upon non-operation of said blower means to permit the trapped, heated air to rise from said passage without passing through said blower means.

16. A unit space heater comprising a cabinet, a combustion heating unit therein, means forming an upwardly extending air heating passage therein containing said heating unit, a lower discharge opening therefor, a blower discharging into and across the upper portion of said passage, means to close the upper portion of said passage for blower-forced discharge of heated air from its lower opening and to open it for upward discharge of unheated air for summer air circulation.

17. In combination, a room space heater having means forming an upwardly extending air heating passage having an upper and a lower opening, an associated, contiguous, high temperature, combustion, air-heating unit, means including a blower to circulate outside air downwardly through said passage to be heated and out its lower opening, means forming an inlet for unheated air to said blower, an openable closure closing said upper opening for said downward blower air circulation and, when open, permitting upward convection air circulation out through said upper opening, and means to open said closure including a temperature responsive element positioned to be heated by said heating unit and close to and in the path of said blower's discharge to be swept by and cooled by air moved by said blower before this air has been heated sufficiently to actuate said element to open said closure.

18. A cabinet-type unit space heater adapted to be supported on a room floor and circulating heated air by natural, upward, thermal convection or by downward, blower-induced, contrathermal flow, and comprising an upright open-topped cabinet having a front and back, an upright partition extending from front to back and dividing said cabinet into two upright passages opening through said open top, a liquid fuel tank mounted in one of said passages spaced from its side walls, means to provide cooling air flow past said tank, an upright combustion unit connected to said fuel tank, an upright heat shield wall spaced around said unit, said unit and said wall being enclosed in and laterally spaced from the walls of said other passage to provide upwardly-extending air-heating passageways in said other passage, said cabinet and said other passage having openings in their lower fronts discharging directly into the room, and operative or inopera-

tive means, including a blower in said cabinet, operative to circulate air downwardly through said other heating passage and to force the high temperature heated air directly out into the room in a stream directed across the room floor, said means, when inoperative, permitting said upward thermal flow out through said open top.

19. A cabinet-type unit space heater adapted to be supported on a room floor and circulating heated air by natural, upward, thermal convection or by downward, blower-induced, contra-thermal flow, and having an upright open-topped rectangular cabinet having a top and a substantially coextensive top opening and a wide front and being relatively narrow from front to back, an upright combustion drum, an upright heat shield wall spaced around said drum, said wall and said drum being inclosed in and laterally spaced from the walls of said cabinet to provide two upwardly-extending air-heating passageways, said cabinet having an opening in its lower front communicating with said two air-heating passageways and discharging directly into the room, and means, manually adjustable to operative or inoperative condition and including a blower, to circulate air down through said two passageways and force it directly into the room in its operative condition, and to permit said upward thermal flow out through said open top in its inoperative condition.

20. An air circulating space heater having a cabinet casing with a front and sides, a combustion heating unit in said casing, means forming, a contiguous, associated, air-heating passage extending downwardly, means forming a separate and communicating passage to one side of said combustion unit and having an air inlet, an adjacent fluid fuel supply tank for said heating unit in said separate passage and spaced from it on all sides, and a blower drawing air through said separate passage past said fuel tank to cool it on all sides and then causing the same air to flow down through said air-heating passage.

21. An air circulating heater comprising an upright casing, a combustion heating unit therein, means for forcing outside air into the upper portion of said casing and downwardly therethrough, and means permitting upward gravity air circulation through said casing responsive to a predetermined temperature rise therein upon stopping of said air forcing means to thus prevent excessive temperatures in said casing, said last means including, and operating in response to, a temperature responsive element positioned to be heated by said heating unit and to be cooled by said forced outside air.

22. An air circulating unit space heater comprising an upright casing, a combustion heating unit spaced therein to form an air-heating passageway, said casing having a lower opening and a large top opening at least substantially equal in area to the cross-sectional area of said passageway to prevent restriction of the upward gravity air flow therethrough, means to force air into the upper portion of said passageway, downwardly therethrough, and out said lower opening, a movably mounted closure for said top opening, means biasing said closure to open position to permit operation by upward gravity circulation, latch means holding said closure in closed position against said biasing means to prevent upward circulation through said top opening during said downward forced air circulation operation, said latch means including and being operated by a temperature responsive element, and means to hold said closure in open or in closed position to permit operation by said upward gravity circulation or by said downward forced air circulation respectively.

23. An air circulating unit space heater comprising an upright, floor-supported casing having a top, a combustion heating unit spaced therein to provide an upwardly extending air-heating passageway, said casing having a lower opening and an open top communicating with said passageway, means forming a lateral opening into the upper portion of said passageway below said open top, fan means forcing outside air substantially horizontally through said lateral opening into the upper portion of said passageway below its upper opening, downwardly through said passageway and out its lower opening directly into the room to be heated, movable means having a closed position or an open position to close said open top to prevent major upward air flow therethrough during said forced downward air circulation or to open said top to permit free upward gravity air circulation up past said lateral opening and up through said open top upon stopping of said fan means, and means to hold said movable means in open position.

24. An air circulating unit space heater comprising an upright, floor-supported casing, a combustion heating unit spaced therein to provide an upwardly extending air-heating passageway, said casing having a lower opening and an open top communicating with said passageway, means forming a lateral opening into the upper portion of said passageway below said open top, a fan in said casing forcing outside air substantially horizontally through said lateral opening against and around said heating unit and into the upper portion of said passageway below its upper opening, downwardly through said passageway and out its lower opening directly into the room to be heated, a closure for said open top movable between closed and open positions, respectively, to prevent major upward air flow therethrough during said forced downward air circulation or to permit free upward gravity air circulation past said lateral opening and up through said open top upon stopping of said fan means, and means to hold said closure in open position.

25. In a space heater circulating heated air by natural, upward, thermal flow or by blower-forced, downward, contra thermal flow; means forming an upwardly extending air heating path having a lower opening communicating directly with the room to be heated, blower means discharging into the upper part of, but located to one side of, said upwardly extending path so that it will not impede the upward flow of hot air and be heated thereby, means to close or to open said path above the discharge of said blower means for said downward flow or said upward flow respectively, and means to hold said last means in open position.

26. In a room heating unit space heater circulating heated air by natural, upward, thermal flow or by blower-forced, downward, reversed thermal flow directly into the room and having heating means and associated means forming a contiguous, upwardly extending, air heating passage having a lower opening and an open top portion both opening directly into the room, openable means for closing off its open top portion for said blower-forced downward flow, means to operate said openable means, and

blower means discharging into the upper portion of said passage below said closing means but positioned laterally out of said upwardly extending passage to be out of the path of the upward flow.

27. An air heater unit selectively circulating heated air by natural, upward, thermal convection or by forced, downward, reversed thermal flow and having blower means, heating means, means forming an associated, contiguous, upwardly-extending air-heating passage having an upper opening, said blower means opening into said passage below its upper opening, and means to selectively and automatically open or to close only the upper opening of said passage for said upward flow or said downward flow respectively.

28. An air heater unit circulating heated air by natural, upward, thermal convection or by downward, blower-induced, reversed thermal flow, having blower means to cause said downward flow and heating means, means forming an upwardly-extending air-heating passage contiguous to and associated with said heating means and blower and having a lower opening and its upper end having an opening substantially coextensive therewith, openable closure means extending across said upper end opening, and means to operate said closure means.

29. A unit cabinet-type space heater having a cabinet housing, a combustion heating unit, means forming an upwardly-extending air-heating passage therein containing said heating unit, said passage having an opening through and substantially co-extensive with the top of said cabinet housing and having an opening adjacent the base of said cabinet housing, blower means in said housing to cause downward circulation of air through said passage and out said lower opening, means to close said top opening, and manually operable means actuating said closure means to selectively open or close the upper opening of said passage for normal, upward, thermal convection or said downward flow respectively.

30. A unit, forced air circulation, space heater comprising an upright cabinet-type housing having a relatively small depth from back to front and a substantially flat back to go up against a room wall, liquid fuel burning heating means and means forming a contiguous, associated, air heating passage in said housing, and air circulating blower means associated with said passage, a fuel tank and fuel supply control valve means, all of said last three being within the housing, to the side thereof, alongside of the heating means and passage to achieve the small depth and the flat back, said housing having an inlet opening and a low-level discharge opening communicating with said blower and said passage to provide a blower-induced, low-level discharge of heated air.

31. A unit space heater comprising an upright cabinet-type housing having a front, back, and sides, a combustion heating unit therein, means forming an upwardly-extending air-heating passage contiguous to and associated with said combustion unit and having a width from side to side greater than its depth from front to back, means closing the top part of said passage, a front discharge opening adjacent the bottom of said passage, and blower means in the upper part of said housing to one side of said passage, the blower discharge being directed across the width of said passage to give a long turbulent path of forced downward, reversed thermal air flow.

32. A cabinet-type unit space heater adapted to be supported on a room floor to circulate heated air by natural, upward, thermal convection or by downward, blower-induced, contra thermal flow, and having an upright air-heating combustion unit, an upright cabinet enclosing and laterally spaced from said upright combustion unit to provide an upwardly-extending air-heating passage, said cabinet having a top and a top opening substantially co-extensive with said top and having a lower opening discharging directly into the room, and operative or inoperative means, including a blower below said top and operatively communicating with said passage, operative to circulate heated air downwardly through said heating passage and to force it out said lower opening directly into the room, said means, when inoperative, permitting said upward thermal convection flow out through said open top.

33. In combination, a heater, a blower, a movable blower-air-flow-controlling member, a latch holding said member in one position, means to bias said member toward another position, and a latch-controlling means including a temperature responsive element to be heated by said heater and to be positioned in and cooled by a relatively high velocity stream moved by said blower, whereby said latch-controlling means is operated in response to heat from said heater in the absence of said cooling high velocity air stream.

34. In combination, a heat exchanger, an associated blower, a movable air-flow-controlling closure member, and means to move said member including a temperature responsive element to be heated by said heat exchanger and positioned in and close to the blower discharge to be struck and cooled by the relatively high velocity stream moved by said blower while said closure member is in closed position.

35. In an air circulating heating device for heating a room and having a control element operative in response to temperature changes, a combustion chamber heating said element, means including a blower to circulate cooling air past said element to cool it during combustion and then in heat exchange relation with said combustion chamber to heat the air so that only during combustion said element is also operative in response to said air circulation due to the operation or non-operation of said blower.

36. The organization of claim 35 including an air flow controlling means and in which said control element controls said air flow controlling means.

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