May 26, 1942. A. S. LEONARD 2,284,157

ORCHARD HEATER

Filed Nov. 12, 1937 3 Sheets-Sheet 1

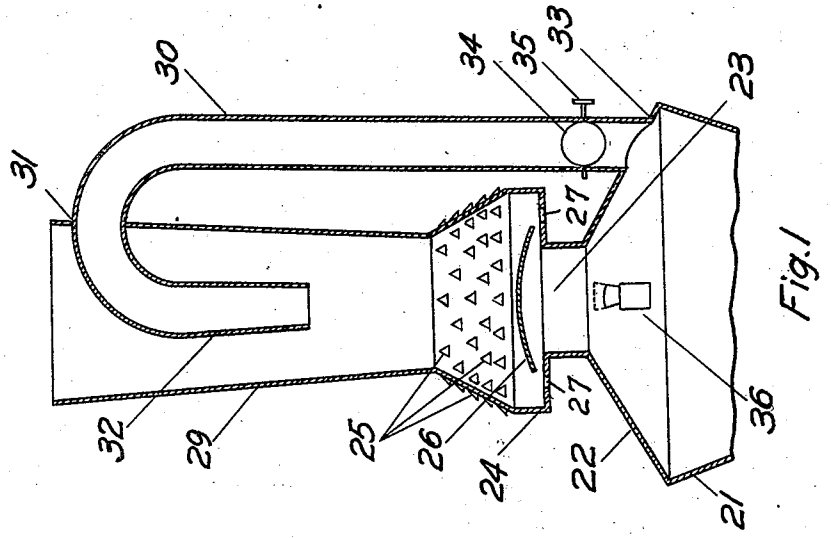


Fig. 1

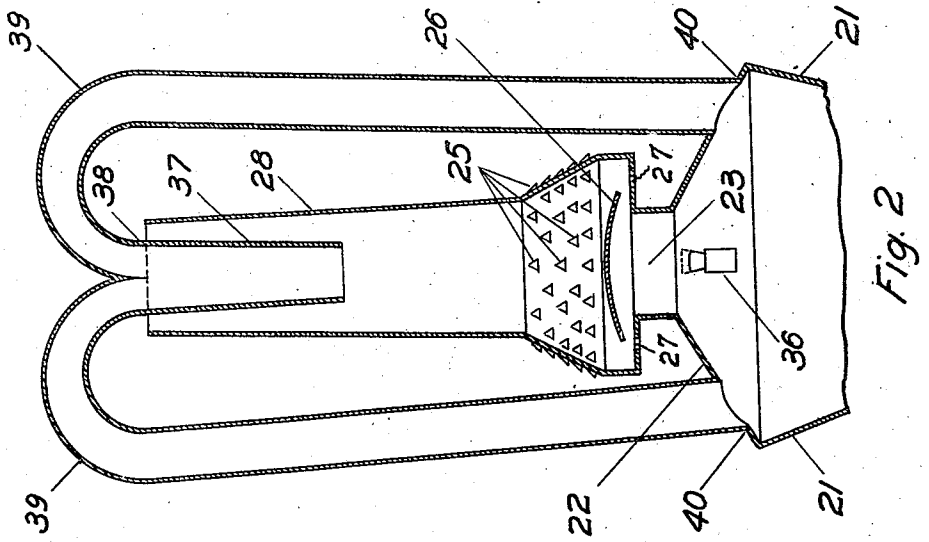


Fig. 2

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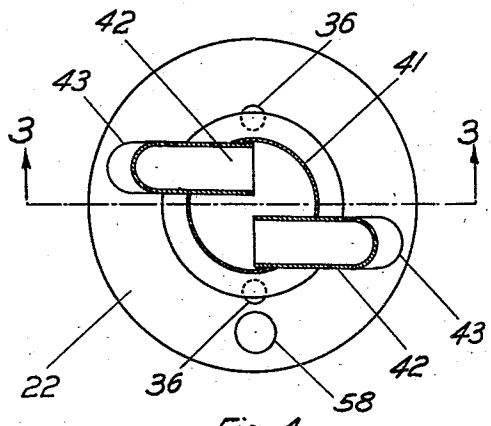


Fig. 4

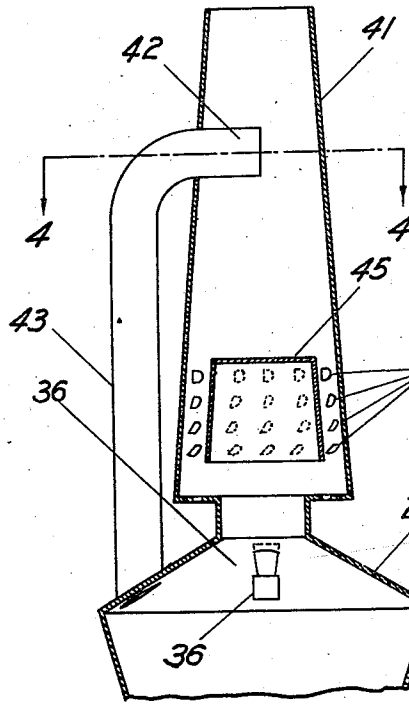


Fig. 3

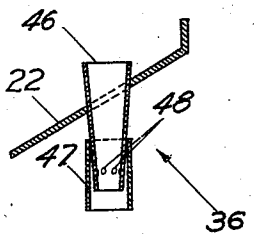


Fig. 5

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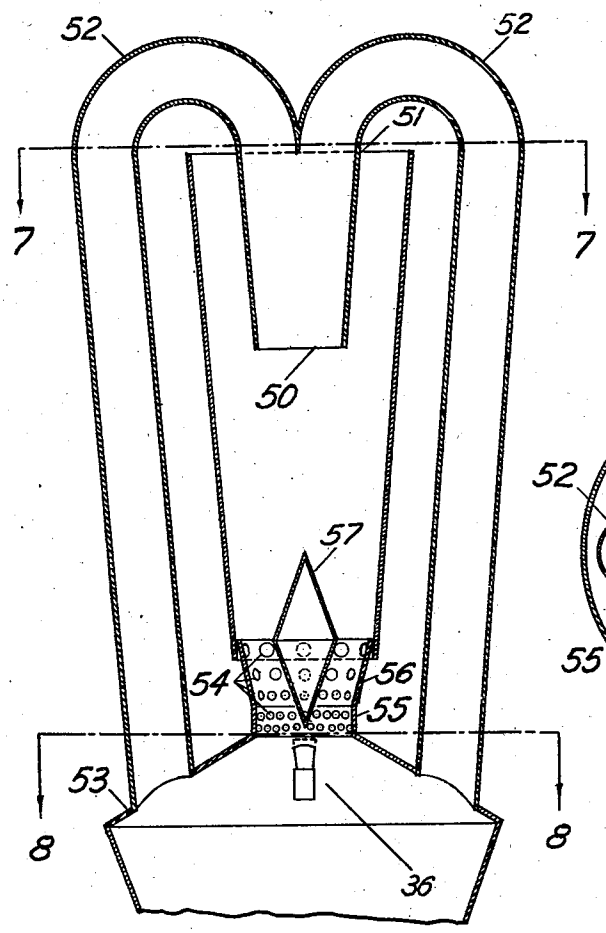


Fig. 6

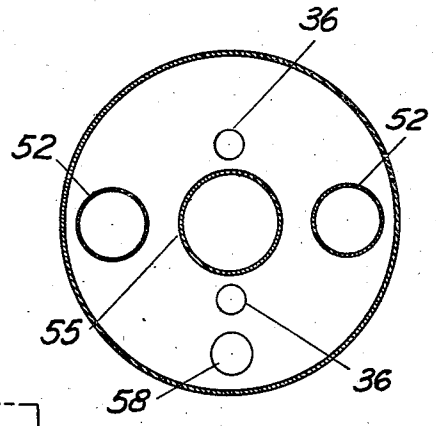


Fig. 8

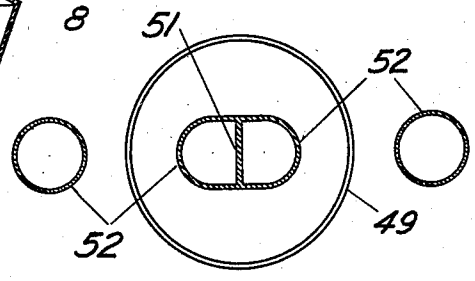


Fig. 7

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UNITED STATES PATENT OFFICE

2,284,157

ORCHARD HEATER

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Application November 12, 1937, Serial No. 174,170

5 Claims. (Cl. 158—91)

In the operation of orchard heaters many serious problems are met with. At least two of these arise from the formation of smoke or other more or less solid substances during the combustion of the fuel. These are the formation of clouds of smoke in the atmosphere and the filling up of the heater or parts thereof with soot and coky and resinous residues. Many attempts have been made to reduce the amount of smoke discharged into the atmosphere by orchard heaters for the sake of convenience of neighboring residents. Moreover, it seems desirable to burn the fuel as completely as possible so as to obtain more heat from a given amount. It is imperative to reduce the amount of soot and other residues deposited in the interior of the heater. Otherwise, during the cold season the capacity of heaters of the bowl type may be materially reduced. Obviously during the winter such heaters must always be refilled promptly after burning so as to be ready for any further cold spells. It is manifestly impossible, then, to clean out the heaters, and so the soot or carbon or other residues accumulate from one burning to the next. This accumulation may become very substantial and may not only seriously impair the capacity of the heater to hold the customary charge of oil, but also may interfere with the proper operation of the heater.

I have now discovered that the deposition of soot and other residues within the heater and the discharge of soot and smoke into the air may be very materially reduced if not eliminated altogether. I accomplish this and other important results by the apparatus more fully described hereinafter. Accordingly an object of my invention is to provide and disclose means for operating orchard heaters in which the deposition and discharge of soot and the like is very greatly reduced or substantially eliminated.

Another object of my invention is to provide and disclose means for burning carbonaceous materials in orchard heaters so as to reduce the size of carbon particles formed during combustion.

A still further object of my invention is to provide and disclose means for burning carbon-containing fuels in orchard heaters by re-circulating at least a portion of the products of combustion and diluting the fuel gases and/or vapors therewith prior to the combustion of said fuel.

More specifically, an object of my invention is to provide and disclose orchard heaters in which products of combustion are mixed with fuel gases and/or vapors prior to combustion of the same.

A more limited object of my invention is to provide and disclose means for operating orchard heaters by diluting fuel vapors and/or gases with products of combustion before admixing any substantial quantity of air.

A further object of my invention is the provision of a new and improved type of burner for orchard heaters.

Other objects and advantages including more specific objects and advantages embraced within the scope of those broadly stated above will appear more fully and at large hereinafter and others will be obvious to those skilled in the art, appearing in part at least from contemplation and use of the inventions described and claimed.

I obtain these and other objects and advantages by means of apparatus embodying the broad principles of my invention, these apparatus being illustrated in the accompanying drawings in which:

Figure 1 is a vertical section of one form of my improved heater.

Figure 2 is a vertical section of a known type of heater modified to employ my new method of operation.

Figure 3 is a vertical, sectional view taken at the line 3—3 of Figure 4 and showing the modification of another known type of orchard heater to adapt it to my new method of operation.

Figure 4 is a horizontal section and plan view taken along the line 4—4 of Figure 3.

Figure 5 is a detail view showing the construction of my preferred form of air jet.

Figure 6 is a vertical section of another form of my improved heater and likewise illustrates my new and improved burner.

Figure 7 is a horizontal section taken along the line 7—7 of Figure 6.

Figure 8 is a horizontal section and plan view taken along the line 8—8 of Figure 6.

Similar numerals refer to similar parts throughout the several views.

In the burning of carbon-containing fuels, which may be broadly referred to as carbonaceous materials, the constituents of the fuel that are volatile at the temperatures attained will be in vapor or gaseous form. It is generally understood that in the combustion of the materials in this form the chemical compounds are broken down to liberate free carbon and other elements. Incandescent carbon particles create a luminous flame. When the particles of the carbon cool below incandescence before they are completely burned, smoke and soot result.

In dealing with the problems of smoke and soot in connection with orchard heating some

very definite limitations are met with and must be taken into account in any successful handling of these problems.

For example, it is well known that under conditions requiring orchard heating the layers of air nearest the ground are colder than those next above. The need then is to heat the layers near the ground and to avoid loss of the heat into the upper air. This makes desirable the use of a larger number of heating units with relatively lower heat output per unit, rather than a smaller number with relatively large heat output per unit. This avoids the tendency of a large unit to create a strong updraft and thus to carry away the heat into the upper air. Likewise the smaller heating unit will be less likely to overheat the foliage and other parts of the plants near the heater.

These considerations as well as others make it imperative that individual heating units be relatively inexpensive, which means that one cannot resort to elaborate constructions to be sure that the fuel is all subjected to conditions of temperature, air-mixing, and draft that will result in burning of the fuel without formation of soot, smoke, residues, etc. Moreover, if new developments are to come into use promptly, they should preferably be of such a nature that, to a very large extent at least, present equipment can be utilized. One of the important advantages of my new development resides in the fact that it can be adapted to present equipment, thus protecting the investment in present orchard heating equipment which in the citrus industry alone amounts to a tremendous amount of money.

With the above and other considerations in mind I may apply my present invention to the problems of orchard heating by means of specific equipment such as that hereinafter described in detail and illustrated in the accompanying drawings.

Figure 1 and Figure 2 show modifications of the construction of a known type of heater, known commonly as the jumbo cone heater. This is formed of a bowl **21**, not completely shown, a cover schematically indicated at **22**, with a throat or opening **23**, a combustion chamber indicated generally at **24**, and a plurality of openings or louvres indicated at **25**. Within the combustion chamber is a baffle or flame spreader **26**. The lower part of the burner is provided with a plurality of air-admitting apertures **27**. This is a standard type of construction well known in the art.

The type of stack at present regarded as standard for this known type of heater is indicated at **28**, in Figure 2.

In the embodiment illustrated in Figure 1, I employ a modified type of stack **29**, which, as indicated, is of inverted frusto-conical construction.

In the combustion of carbon-containing fuels in vapor or gaseous form the tendency toward the formation of soot, smoke, etc., may be reduced or altogether eliminated by modifying the combustion by adding to the combustion mixture some gaseous material that will not itself take part in the combustion to any substantial degree. Combustion products derived from the burning of carbonaceous materials will be of such a nature that, when added to a mixture for subsequent combustion, they will not take part to any substantial degree in the later combustion. A satisfactory means for accomplishing this result is the recirculation of at least a portion of the products of a continuing combustion and adding these to the combustion mixture before it is burned.

I apply this principle in a practical way to the operation of orchard heaters by providing means for the recirculation of at least a portion of the combustion products. In the constructions herein described and shown in the accompanying drawings several embodiments of such means are illustrated.

As shown in Figure 1 the recirculating means is comprised of a return pipe **30**. This may preferably be introduced through the side of the stack **29** as at **31** and may be provided with an intake portion **32** which, as illustrated, may be of frusto-conical form. This gives a general correspondence between the shape of the intake portion **32** and the stack **29** so as to provide throughout that portion of the stack an opening of at least roughly uniform cross section for the outgoing gases. The pipe **30** is preferably introduced through the cover **22** as at **33**. It may preferably be provided with a suitable damper **34** which may be moved to different positions by the handle **35**.

I also preferably provide in the cover **21** one or more air jets **36** preferably of the type shown in detail in Figure 5.

In the operation of this heater the bowl may be filled with a suitable fuel such as the marine Diesel, bunker grade, fuel oil commonly used for orchard heating. The filling may be done through the usual filler opening in the cover. The heater may be lighted in the usual way. I may preferably provide that the heater is tightly covered so that no air is admitted except through a jet or jets **36**. When the heater is burning a flame may be maintained at the jet or jets **36**. This flame will consume to a substantial extent the combustible portion of the air admitted through the jet. Due to the vertical positioning of the jet the flame will go directly downwardly against the surface of the oil and will be deflected back up and the deflected portion of the flame will tend to come back up around the flame on all sides. It is found that when so controlled and operated the burning of this flame within the bowl of the heater does not result in troublesome deposition of carbon, etc., within the bowl of the heater or upon the cover thereof.

The flame about the jet or air vent **36** serves to heat the surface of the oil and assist in vaporizing the same so as to keep the heater as a whole in operation at the higher burning rates. The jet flame is not essential. At present I prefer not to use it at low burning rates.

The fuel vapors pass through the throat **23** and into the combustion chamber **24** where they will burn in the usual way in admixture with and in the presence of added air entering through the openings **27** and louvres **25**. By means of a suitable recirculating device such as the return pipes **30** shown in Figure 1 a portion of the combustion products is recirculated into the bowl and admixed with the fuel vapors prior to the combustion thereof.

It is found that the recirculation of a portion of the combustion products and admixing thereof with the fuel vapors results in a very substantial reduction in the amount of soot and smoke formed, which, under the best conditions, may amount to a substantially complete elimination of soot and smoke. This result may be due to the dilution of the combustion mixture with non-combustible gases with consequent formation of

relatively smaller carbon particles or aggregates as the fuel vapor undergoes decomposition into its elements in the combustion zone. These smaller carbon particles, as each is burned in the presence of admixed air, will be much more readily consumed and thus be completely burned, or at least more nearly completely burned, before passing from that portion of the combustion zone within the heater in which the burning fuel particles are maintained in a state of incandescence. The practical result is that smoking of the heater to the outside air and deposition of carbon, soot, etc., within the heater are substantially completely eliminated. This achieves the three-fold advantage of avoiding the smudge in the air which is so disagreeable to everybody concerned, of maintaining the full capacity of the heater at all times, and of obtaining the maximum amount of heat from a given amount of fuel by burning the fuel completely.

The upward draft of the combustion products within the stack will cause a desired portion thereof to go into the intake portion 32 and back through the pipe 30 and into the bowl at 33. When it is desired to regulate the rate of return flow, this may be done by means of a damper 34.

The return flow may be accomplished by means of one or more return pipes and, if desired, there may be a damper in each of the return pipes. According to my present understanding the factor which principally limits the number and arrangement of return pipes is the expense of building new heaters or of converting to the employment of my invention known types of heaters at present in use.

In the embodiment shown in Figure 2 the type of stack which is at present standard for this type of heater has been retained. This heater is modified by the introduction of a return flow construction which, as illustrated, consists of entrance pipe or portion 37 which, at 38, is connected to return pipe 39 which enters the cover as at 40. The method of operation of the various embodiments is substantially the same and will not be repeated in detail.

Figures 3 and 4 illustrate the adaptation of a known type of heater known commonly as the Lemora heater to the employment of my invention. This known type of heater, due to its construction, gives to the combustion products as they rise through the stack 41, a strong swirling action which, in the common form of this heater and in the embodiment shown in the drawings, is counterclockwise in direction when viewed from the top of the heater. I introduce through the sides of the stack 41 one or more entrance pipes 42, two such pipes being illustrated in Figures 3 and 4, as more clearly appears from Figure 4. These entrance portions 42 lead back through pipes 43 through the cover and into the interior of the bowl.

The swirling action of the combustion mixture arises from the particular arrangement of a plurality of openings or louvres 44 about the flame spreader 45, all in a manner well understood in this art. In adapting this type of heater to the use of my invention, return mechanism such as illustrated in Figure 1 might be employed. However, the mechanism illustrated in Figures 3 and 4 is adapted to take advantage of the swirling action of the combustion products. Otherwise the operation of the heater is substantially the same as previously described. If desired suitable dampers may be inserted in the pipes 43.

The embodiments shown in Figure 1 and in Figures 3 and 4 have the advantage that they can readily be provided with a cap or cover over the stack to exclude rain.

The air jet 36 illustrated in detail in Figure 5 consists of a frusto-conical portion 46 provided near its smaller inner end with a cylindrical collar 47, the lower end of which projects below the lower end of the tube 46. Within the collar 47 the tube 46 is provided with a plurality (for example, four) of perforations 48. It is found that a jet of this type will retain the flame at the jet and that rapid passage of air through the tube 46 will not ordinarily cause the flame to blow off the end of the jet.

In the embodiment illustrated in Figures 6, 7, and 8 the heater is provided with a stack 49, preferably of inverted frusto-conical shape as shown. Within the upper end of this stack is positioned an entrance portion 50 which at 51 is joined to the return flow pipes 52. These pass through the cover as at 53. If desired the pipes 52 may be supplied with suitable dampers. The operation of this heater is substantially the same as that previously described.

In Figure 6 there is also illustrated a new and improved type of burner indicated generally at 54. This burner is comprised of a cylindrical portion 55 and a frusto-conical portion 56 and, in one preferred embodiment, is approximately 6 inches high, being approximately 6 inches in diameter at the lower end and 8 inches at the upper end. It is provided with 5 rows of holes, the holes in each row being approximately equally spaced around the burner. In the preferred embodiment mentioned the top row consists of 5 holes ¾ inch in diameter, the second row of 10 holes ½ inch in diameter, the third row of 20 holes 23/64 inch in diameter, the fourth row of 40 holes ¼ inch in diameter, and the bottom row of 80 holes drilled with a No. 20 drill (0.161 inch in diameter).

Within this burner and centrally thereof there is suitably supported a flame spreader 57 which may be said to be formed of two hollow cones joined together at their bases, with one apex extending downwardly into the burner and the other up into the stack. In an embodiment corresponding in dimensions to the dimensions given for the exterior portion of the burner, the flame spreader would be approximately 4 inches in diameter and 10 inches from apex to apex.

The objective sought in my burner is to provide a comparatively narrow space through which the combustion mixture must pass, first introducing the air through a large number of very small openings and then progressively through a smaller number of larger openings. This results in the thorough admixture of the fuel vapors with an amount of air adequate to support complete combustion and thus assist in reducing the formation of soot and smoke. This effect is particularly pronounced when the burner is used in conjunction with a suitable means for mixing non-combustible gases with the fuel vapors before combustion.

In Figure 8 there is conventionally indicated a filler opening 58.

I am aware that this principle of combustion may be adapted to other applications with desirable results. I am also aware that numerous changes and modifications may be made in the details of procedures described and in the details of the apparatus described and shown. I therefore do not propose to limit myself to the

exact details of construction and procedure described, but only as necessitated by the prior art and as indicated in the appended claims.

Having thus described my invention in such full, clear, concise and exact language as to enable others skilled in the art to make and use the same, I claim as my invention and desire to secure by Letters Patent the following.

I claim:

1. In a unitary, portable orchard heater, a fuel receptacle having bottom and side walls and adapted to hold as a body a charge of oil to be burned, said receptacle being provided with a cover having vents therein, a combustion chamber centrally positioned over said cover and connected therewith, a main stack centrally positioned above said combustion chamber, one or more auxiliary stacks having an entrance portion disposed within the main stack and above the combustion zone, and communicating with the receptacle for the body of oil at a point ahead of the combustion chamber, said auxiliary stack being positioned outside of the main stack and adapted to provide for the return of a portion of the products of combustion from the main stack to the fuel receptacle and over the body of oil, whereby there is obtained a mixture of the returned products of combustion with the vapors from said body of oil prior to the entry of said vapors into the combustion chamber.

2. In a unitary, portable orchard heater, a fuel receptacle having bottom and side walls and adapted to hold as a body a charge of oil to be burned, said receptacle being provided with a cover having air vents therein, a combustion chamber centrally positioned over said cover and connected therewith by means of a throat, a main stack centrally positioned above said combustion chamber, one or more auxiliary stacks having an entrance portion disposed within the main stack and above the combustion zone and communicating with the receptacle for the body of oil at a point ahead of the combustion chamber, said auxiliary stack being positioned outside of the main stack and adapted to provide for the return of a portion of the products of combustion from the main stack to the fuel receptacle and over the body of oil, whereby there is obtained a mixture of the returned products of combustion with the vapors from said body of oil prior to the entry of said vapors into the combustion chamber.

3. In a unitary, portable orchard heater, a fuel receptacle having bottom and side walls and adapted to hold as a body a charge of oil to be burned, said receptacle being provided with a cover having air vents therein, a combustion chamber having a plurality of openings or louvers centrally positioned over said cover and connected therewith by means of a throat, a baffle plate within said combustion chamber, a main stack centrally positioned above said combustion chamber, one or more auxiliary stacks having an entrance portion disposed within the main stack and above the combustion zone and communicating with the receptacle for the body of oil at a point ahead of the combustion chamber, said auxiliary stack being positioned outside of the main stack and adapted to provide for the return of a portion of the products of combustion from the main stack to the fuel receptacle and over the body of oil, whereby there is obtained a mixture of the returned products of combustion with the vapors from said body of oil prior to the entry of said vapors into the combustion chamber.

4. An orchard heater having an oil fuel receptacle, a combustion chamber supported thereon and in communication therewith, a main stack positioned above the combustion chamber, and one or more auxiliary stacks exterior of said main stack and having an entrance portion disposed within the main stack and communicating with the oil fuel receptacle and adapted to return a portion of the products of combustion from the main stack to the fuel receptacle over the oil therein.

5. In a unitary, portable orchard heater, a fuel receptacle adapted to hold as a body a charge of oil to be burned, said receptacle provided with a cover, a combustion chamber positioned over said cover and connected therewith, a main stack positioned above said combustion chamber, one or more auxiliary stacks having an entrance portion disposed within the main stack and communicating with the receptacle for the body of oil at a point ahead of the combustion chamber, and adapted to provide for the return of a portion of the products of combustion from the main stack to the fuel receptacle and over the body of oil, whereby there is obtained a mixture of the returned products of combustion with the vapors from said body of oil prior to the entry of said vapors into the combustion chamber.

ARTHUR STEPHEN LEONARD.