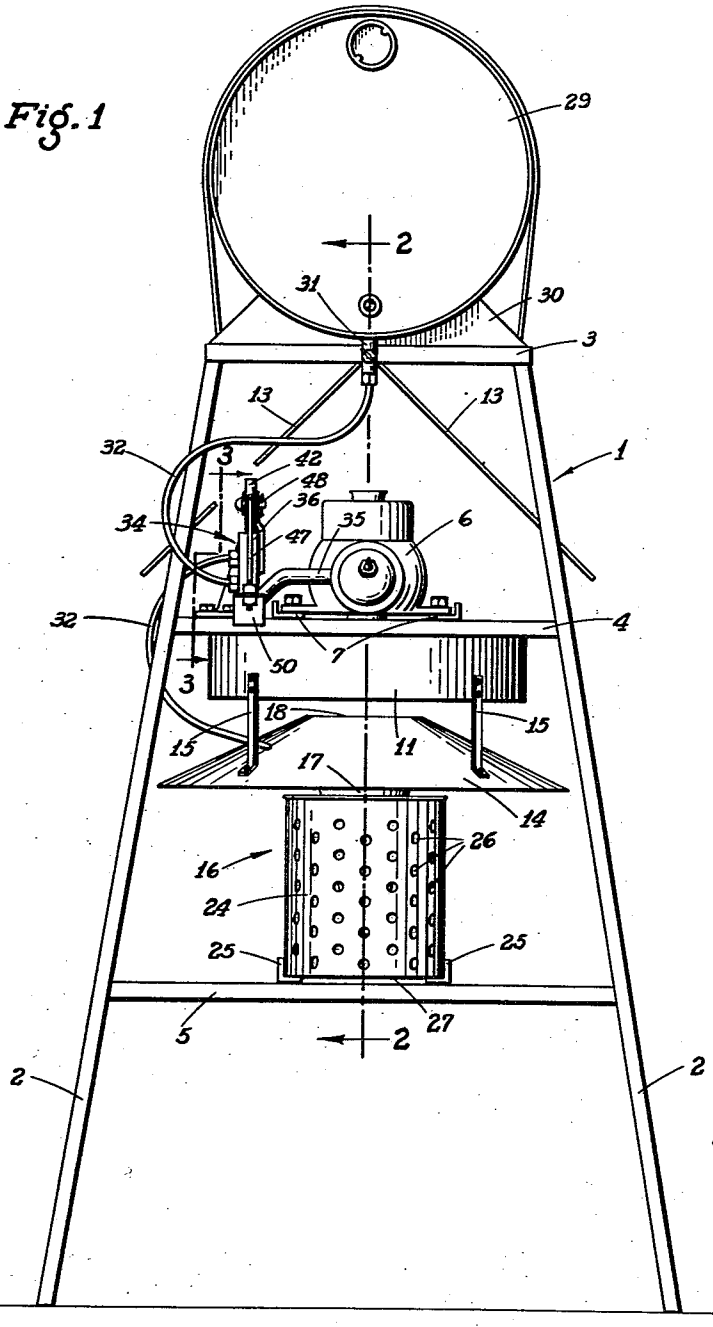
June 25, 1957 J. M. STINSON 2,796,699

FROST CONTROL DEVICE

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Fig. 1



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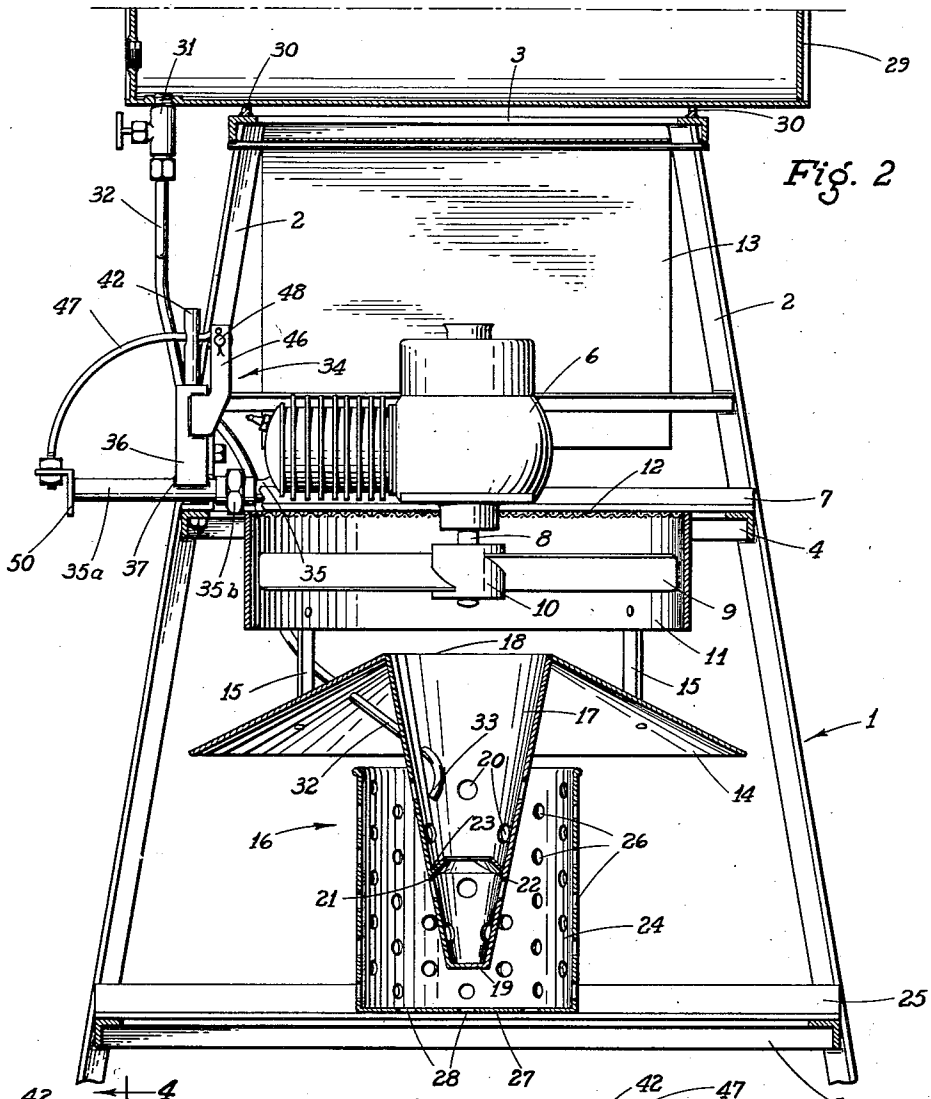


Fig. 2

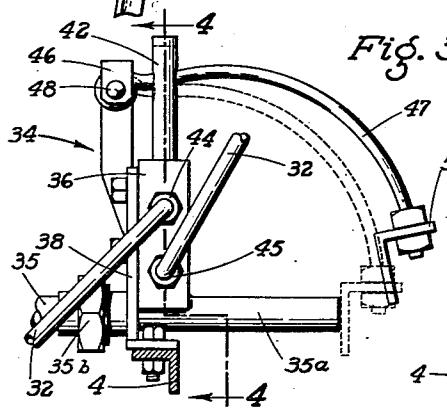


Fig. 3

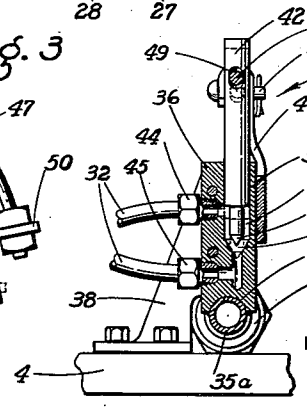


Fig. 4

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FROST CONTROL DEVICE

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7 Claims. (Cl. 47—2)

This invention relates to orchard heaters, which at present are of two distinct types, namely open-pot heaters and stack heaters.

Open-pot heaters do not burn their fuel economically and generate a great amount of objectionable smoke. However, they are small, very inexpensive, and large numbers can be used to good effect, but the objectionable smoke, and the labor involved in tending the same tends to nullify these advantages.

The stack heaters burn their fuel with greater efficiency, but the heat generated thereby rises to such a height before being dissipated that enormous amounts of heat are needed to protect the crops, which are in a zone below such height.

The fuel and labor expenses involved with such heaters under present conditions therefore renders the use of the same so expensive or ineffective that many orchardists have discontinued their use, deeming it a lesser evil to absorb the frost losses.

The present invention is directed to, and it is a major object to provide, a method and apparatus for providing heat and distributing the same for frost prevention, which will be more effective, economical, and more readily adjustable to varying conditions than is the case with the present structures. Such structure includes: (1) a burner assembly which generates heat of sufficient intensity, although with comparatively low heat output, to economically consume low grade petroleum fuels; (2) a means to convert this intense heat into heat of very low intensity; (3) a means to distribute this low intensity heat over as wide and low level area as is practicable to use with a portable apparatus; and (4) to incorporated the above features in a portable unitary structure which, together with any desired or necessary number of like structures, may be disposed in an orchard at strategically disposed points in relation thereto and to each other, and where they may remain, ready for use, without attention, for a considerable time.

The above mentioned apparatus, when in operation, functions to forcefully deliver heated air outwardly and downwardly toward the ground all about the device; the heated air having a substantial range, flowing first downwardly to impinge the ground, and then deflecting upwardly with continued outward flow; all whereby the device has a relatively large area of effectiveness in the orchard wherein it is disposed.

An additional object of the invention is to provide a frost control device which embodies a novel burner assembly operative to produce a relatively high and constant heat, adjustable in amount as desired; the burner assembly being adapted to use low cost petroleum fuel, such as diesel oil or the like, and yet produce smokeless combustion, with a maximum of B. t. u. output from the fuel consumed.

A separate object of the invention is to provide a frost control device which includes a novel safety valve unit interposed in the fuel feed pipe leading to the burner assembly; such safety valve unit being operative—automatically—to shut off the fuel flow to the burner assembly whenever the air propeller drive engine stops.

It is also an object of the invention to provide a frost control device of simple construction, designed for ease and economy of manufacture, convenience of operation, and long and efficient service with a minimum of maintenance or repair being required.

Still another object of the invention is to provide a practical and reliable frost control device, and one which will be exceedingly effective for the purpose for which it is designed.

These objects are accomplished by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings:

Fig. 1 is an end elevation of the device.

Fig. 2 is an enlarged fragmentary sectional elevation of the device taken on line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary side elevation showing the safety valve unit; the view being taken on line 3—3 of Fig. 1.

Fig. 4 is an enlarged fragmentary transverse sectional elevation taken on line 4—4 of Fig. 3.

Referring now more particularly to the drawings, and to the characters of reference marked thereon, the improved frost control device or orchard heater comprises a stand, indicated generally at 1, which stand is of open or skeleton construction. The stand 1 is comprised of downwardly divergent corner legs 2 connected together on all sides by top tie bars 3, intermediate tie bars 4, and lower tie bars 5; all of said bars being horizontal. The stand is of welded construction, thus avoiding the need of cross bracing, which would impede the free flow of air from the deflector, later described.

A vertical axis gasoline engine 6 is supported from opposed ones of the intermedite tie bars 4 by cross members 7. The engine 6 includes a depending vertical drive shaft 8, and a relatively large-diameter, horizontally disposed air propeller 9 is secured to the shaft 8 by means of the propeller hub 10.

The propeller 9 runs within the confines of a horizontal imperforate guard ring 11 which is secured to and depends from the cross members 7; the top of said guard ring 11 being fitted with a screen 12.

The engine 6 is protected from the elements by a shed roof 13 disposed thereabove and suitably secured in connection with the top of the stand 1.

A relatively shallow, frusto-conical air deflector plate 14 is disposed adjacent but below the guard ring 11 in concentric relation thereto; the air deflector plate 14 being suspended from said guard ring 11 by a plurality of circumferentially spaced suspension bars 15. The frusto-conical air deflector plate 14 is of somewhat greater diameter than the propeller 9 and guard ring 11, whereby to attain maximum deflection of the air stream from said propeller.

A burner assembly, indicated generally at 16, is disposed below the deflector plate 14 and comprises the following:

An elongated, inverted, frusto-conical burner cone 17 is fixed at its upper end in matching relation within the top opening of the frusto-conical deflector plate 14, and thence depends therefrom to a lower end termination adjacent but short of the horizontal plane of the lower tie bars 5. The burner cone 17 is open at the upper end 18 but closed at the lower end 19, as shown; such cone in at least the lower half thereof being provided with a multiplicity of perforations 20 therethrough.

Within the burner cone 17, and adjacent but short of its lower end, said cone is fitted with an annular, upwardly inclined ring 21 which has fluid-tight connection at its outer edge with said cone; the ring 21 defining

a central opening 22 therein, and also forming an annular catch trough 23 between said ring and the adjacent wall of the cone 17. Such adjacent wall has no perforations therein, whereby fuel fed into the burner cone 17 from above said trough 23, in the manner hereinafter described, will be caught in such trough for vaporization if the fuel does not fully vaporize before reaching such point.

A cylindrical open top burner pot 24 of greater diameter than the burner cone 17 is supported by cross members 25 which span between opposed ones of the lower tie bars 5; said burner pot 24 extending upwardly in substantially spaced concentric relation about at least the lower half of the burner cone 17. The upper edge of the burner pot 24 is preferably disposed in a horizontal plane approximately adjacent the corresponding plane of the lower edge of the air deflector plate 14; said burner pot 24 having a multiplicity of perforations 26 therethrough.

The bottom 27 of the burner pot 24 has perforations 28 which preclude the undesirable accumulation of any unburned fuel which may drip into said burner pot.

A fuel tank 29 of drum type is suitably supported on top of the stand 1 as by cradles 30; fuel from such tank delivering first through a needle valve and strainer unit 31, and thence passing into a fuel feed pipe 32. The fuel feed pipe 32 extends downwardly and passes diagonally through the air deflector plate 14 and burner cone 17, terminating in a discharge end 33 disposed to deliver the fuel against the inner face of said burner cone 17 clear of the perforations and at a point some distance above the annular catch trough 23.

A safety valve unit, indicated generally at 34, is interposed in the fuel feed pipe 32 intermediate its ends; said safety valve unit being operative to permit of fuel flow in pipe 32 to the burner assembly 16 only when the engine 6 is in operation. The construction and function of the safety valve unit 34 are, in detail, as follows:

The gas engine 6 includes an exhaust pipe 35 having a relatively short extension 35*a* which projects horizontally outwardly to a termination laterally out from the stand 1, and an upstanding valve block 36 is disposed directly above said exhaust; the valve block 36 having a saddle 37 on its lower end which engages and is welded to said extension 35*a*. The valve block 36 may be removably supported from the adjacent tie bar 4 by a bracket 38.

Pipe extension 35*a* is removably secured to the main exhaust pipe 35 by a union 35*b*, so that said extension, together with the valve block, may be readily removed for replacement, repairs, or servicing, if needed.

The valve block 36 is formed, from its upper end, with a vertical bore 39, the lower portion of which forms a valve chamber 40. Intermediate the ends of the valve chamber 40 it reduces in diameter and is there shaped as an upwardly facing, tapered valve seat 41. A vertical plunger 42 slidably engages in the bore 39, and said plunger is formed at its lower end with a taper valve 43 adapted for cooperative engagement with the valve seat 41 when the plunger 42 is lowered.

The fuel feed pipe 32 is cut or divided intermediate its ends, with the adjacent end portions secured by couplings 44 and 45 in communication with the upper and lower ends, respectively, of the valve chamber 40. Thus, when the plunger 42 is lowered, with the taper valve 43 closed against the valve seat 41, fuel cannot feed in the pipe 32 below the safety valve unit 34.

A post 46 is secured to, and upstands from, the valve block 36 inwardly of the upwardly projecting portion of the plunger 42, and an arcuate arm 47 is pivoted at its inner or rear end, as at 48, to the upper end of the post 46. The arcuate arm 47 extends in vertically swingable relation outwardly from the pivot 48 in a downward direction; such arm passing in relatively free-play relation through a bore 49 in the plunger 42.

At its outer end the arcuate arm 47 is fitted with a baffle plate 50 which faces and lies in abutment with the outer end of the exhaust pipe 35 when the engine 6 is not in operation. The arcuate arm 47 is then in a lowered position, as shown in dotted lines in Fig. 3, and at such time the plunger 42 is likewise lowered, with the taper valve 43 closed against the seat 41. Consequently, when the engine 6 is not in operation no fuel can flow in the feed pipe 32 below the safety valve unit 34.

However, when the engine 6 is in operation, with an exhaust blast eminating from the exhaust pipe 35, such blast forces the baffle plate 50 outwardly, swinging the arcuate arm 47 upwardly to the full-line position of Fig. 3. When this occurs the plunger 42 is shifted upwardly, opening the taper valve 43 to a position above the seat 41 so that fuel may flow through the safety valve unit 34; i. e., through the valve chamber 40 and thence downwardly through the lower portion of the feed pipe 32 into the burner assembly 16.

The cone, being closed at the bottom, provides a receptacle below the lowest row of perforations 20 of a size to hold a small quantity of fuel, sufficient for ready starting of the fire, which must be done before the motor is started, since the blast of air from the fan would extinguish any small flame.

After the fuel has been burning, with a continued inflow of fuel through pipe 32, until a brisk fire is obtained, the motor is started to operate the fan. The fire is then adjusted to provide the desired heat according to experience or reading of temperature and humidity instruments, suitably placed so that a temperature reading at the outermost range of effectiveness of the device, will be 1° or 2° above the critical temperature of the crops to be protected.

When the described frost control device is in use the engine 6 is in operation, driving the propeller 9 at relatively high speed and creating a forceful stream of air downwardly out of the guard ring 11 which also forms an air deflector; the major portion of such air stream striking the deflector plate 14, but another portion of such air delivering spirally downward into the burner cone 17.

The fuel, after passing the safety valve unit 34, delivers downwardly through the lower portion of the pipe 32 and feeds from the discharge end 33 directly into the burner cone 17.

The entire burner assembly 16 operates under relatively high temperature, so that the fuel as it feeds from the discharge end 33 is, in the major portion, immediately vaporized within the burner cone 17. The ignited vaporized fuel burns in part within the cone 17, and in part exteriorly thereof; this for the reason that the air stream, whirling spirally downward in said cone, carries part of the combustible mixture through the perforations 20. Thus, there is a complete combustion of the fuel after it is vaporized, either within the cone 17, between the latter and the burner pot 24, or outside the pot by reason of the fuel being forced out through perforations 26; all to the end that the burner assembly 16 functions to produce a maximum of B. t. u.'s with a smokeless fire, if proper control of the flow of fuel is exercised.

Any fuel which may not fully vaporize when discharged from the pipe 33, and when it strikes the inner face of the cone 17 drops into the trough 23, where vaporization is completed; the trough being directly in the major area of combustion.

The relatively high heat created by the burner assembly 16 rises against the under side of the air deflector plate 14, heating such plate and thence rolling downwardly and outwardly to discharge from the periphery thereof. The downward air blast or stream from the propeller 9, striking the top of the deflector plate 14, is warmed by heat exchange therefrom, and then delivers laterally in an outward and downward direction. As the warmed air leaves the periphery of the deflector plate 14, it also picks up and carries with it the heat flow which is escap-

ing laterally outwardly from beneath said deflector plate **14** at said periphery. Thus, the heat from the burner assembly **16** is employed in a most effective manner to raise the temperature of the air stream, from the propeller **9**, as deflected by the plate **14**.

From the plate **14** the heated air is discharged with an initially relatively high velocity, in a downward and outward direction over a continuous circular path. This air stream passes through the surrounding static air, its velocity gradually decreasing by reason of the resistance offered by such static air. The heated air stream finally impinges gently against the ground at a flat angle some distance from the stand **1**, and rebounds and rises. The heated air, during its downward and upward movement, imparts its heat to the surrounding air to raise the temperature thereof to the desired extent, depending on the initial heat of the fire.

With the aforesaid directional control of the warmed air stream, together with the fact that such stream has considerable range, the device is effective—for frost control—over a relatively wide area within the orchard wherein such device is disposed; the fire being regulated so that the air adjacent the limits of the range of the device will be heated only slightly above the temperature of the air outside this range.

Fuel feed to the burner assembly **16** is controlled, within accurate limits, by manual adjustment of the needle valve and strainer unit **31** over a wide range of heat output; the operator, by visual attention to the flame within the burner assembly **16**, being thus able to regulate fuel combustion so that good combustion and economy over said range is obtainable, with adequate heat output.

By reason of the inclusion of the safety valve unit **34**, together with the fact that the gasoline engine **6** and fuel supply in the tank **29** will run for a number of hours, the device when started can thereafter be left unattended for a considerable period of time. Upon the engine **6** stopping for any reason, the safety valve unit **34** will function to shut off the fuel supply to the burner assembly **6** so that damage, by overheating, to the parts of the device cannot accidentally occur.

With a suitable number of the above described frost control devices strategically disposed, the prevention of frost damage to an entire orchard crop can be accomplished in an effective and practical manner; the devices—by reason of their portability—being capable of being disposed at the most advantageous points within an orchard area.

From the foregoing description it will be readily seen that there has been produced such a device as will substantially fulfill the objects of the invention, as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as set forth herein.

Having thus described the invention, the following is claimed as new and useful, and upon which Letters Patent are desired.

1. A frost control device comprising, in connection with a stand, a relatively exposed deflector plate having a downwardly and outwardly inclined top surface, a burner assembly below the deflector plate in heating relation thereto, a propeller journaled above the deflector plate operative to direct a forceful air stream downwardly against said plate, an internal combustion engine connected in driving relation to the propeller, said engine having an exhaust pipe with an exposed end, a fuel tank, a fuel feed conduit leading from the tank to the burner assembly, a valve unit arranged to control fuel feed through the conduit, the valve unit including a part movable between one position with said valve unit closed and another position with the same open, a movable baffle disposed in the path of the exhaust blast from the exhaust pipe, and mechanism connecting the baffle and part operative to translate movement of the baffle by said exhaust blast into motion of said part to said other position, the baffle moving the part to said one position when the engine is off and the exhaust blast ceases.

2. A frost control device, as in claim 1, in which the valve unit includes a valve body, a plunger slidable in the body, a portion of said plunger projecting from the body and comprising said part, said mechanism embodying a swing arm pivoted at one end in connection with the body and connected intermediate the ends with said portion of the plunger in a manner to reciprocate the same between said positions upon to and fro swinging of the arm, and the baffle being mounted on the other end of the arm.

3. A frost control device comprising, in connection with a stand, a relatively exposed substantially horizontal deflector plate of generally conical form whereby the upper surface of the deflector plate slopes outwardly and downwardly, a burner assembly below the deflector plate in heating relation thereto, and a driven propeller journaled above the deflector plate operative to direct a forceful air stream downwardly against said plate, the plate being formed with a central opening; the burner assembly including a depending tubular burner member secured at its upper end to the deflector plate in communication with said central opening therein, said tubular burner member being perforate, and a cylindrical burner pot into which said burner member depends.

4. A frost control device comprising, in connection with a stand, a relatively exposed substantially horizontal deflector plate of generally conical form whereby the upper surface of the deflector plate slops outwardly and downwardly, a burner assembly below the deflector plate in heating relation thereto, a driven propeller journaled above the deflector plate operative to direct a forceful air stream downwardly against said plate, the deflector plate being formed with a central opening; the burner assembly including a depending tubular burner member secured at its upper end to the deflector plate in communication with said central opening therein, and an annular upwardly opening trough-forming ring secured internally in the tubular member intermediate its ends; there being a fuel feed pipe disposed to discharge in said member against the inner surface thereof and at a point above the trough.

5. A frost control device comprising, in connection with a stand, a relatively exposed, horizontal deflector plate of frusto-conical configuration whereby the upper surface of said deflector plate slopes outwardly and downwardly, a vertical axis propeller journaled above but adjacent the deflector plate operative to direct a forceful air stream downwardly against said plate, means to drive the propeller, a burner assembly below but adjacent the deflector plate in heating relation thereto, and means to feed fuel to said burner assembly; the frustoconical deflector plate being formed with a central opening of substantial diameter, the burner assembly including a depending tubular member fixed in connection with said deflector plate in communication with said opening; said depending tubular member being elongated and of inverted frusto-conical configuration, at least the lower portion of said tubular member being perforate, and a cylindrical burner pot of greater diameter than the tubular member surrounding at least the lower portion thereof in spaced symmetrical relation; the fuel feed means being a pipe disposed to discharge at one end into the tubular member intermediate the ends of the latter.

6. A frost control device comprising an upstanding frame of open construction, an engine mounted in the frame a substantial distance above its lowermost end, the engine having a depending vertical shaft, a vertical axis propeller secured on the shaft, a horizontal guard ring secured to the frame extending about the propeller, a frusto-conical deflector plate disposed in coaxial relation below the guard ring, said plate having a central opening,

means suspending the deflector plate from the guard ring, an elongated inverted frusto-conical burner member secured to the deflector plate in communication with said central opening and depending therefrom, and an open top burner pot secured to the frame below the deflector plate in position with said member projecting into said pot from above, both said member and pot having perforations therein.

7. A frost control device comprising an upstanding frame of open construction, an engine mounted in the frame a substantial distance above its lowermost end, the engine having a depending vertical shaft, a vertical axis propeller secured on the shaft, a horizontal guard ring secured to the frame extending about the propeller, a frusto-conical deflector plate disposed in coaxial relation below the guard ring, said plate having a central opening, means suspending the deflector plate from the guard ring, an elongated inverted frusto-conical burner member secured to the deflector plate in communication with said central opening and depending therefrom, an open top burner pot secured to the frame below the deflector plate in position with said member projecting into said pot from above, both said member and pot having perforations therein, a fuel tank mounted on the frame above the engine, and a fuel feed conduit leading from the tank to a discharge end within said member.

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