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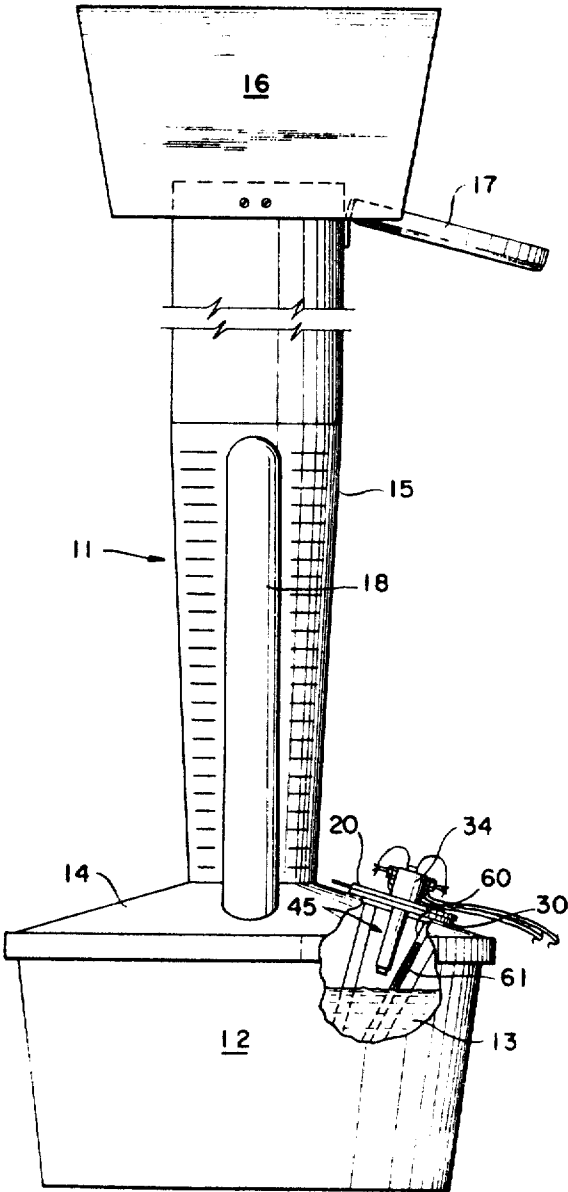
[54] **IGNITER FOR SMUDGE POTS**
10 Claims, 5 Drawing Figs.

[52] U.S. CL. 126/59.5,
44/36, 431/270
[51] Int. Cl. A01g 13/06
[50] Field of Search 431/269,
270, 91; 126/59.5; 44/36; 52/23

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ABSTRACT: An electrically controlled igniter assembly for lighting the fuel in an orchard heater or smudge pot. The assembly includes an igniter cartridge loaded with a large main pyrotechnic charge and with a small ignition charge fired by an electric heating element to ignite the main pyrotechnic charge. The assembly further includes a cartridge holder comprising an open ended tube adapted to be secured to a smudge pot and project into the fuel chamber thereof, and a connector for electrically connecting an igniter cartridge inserted into the holder tube to an energizing and control circuit by means of which the heating element of the cartridge is energized.



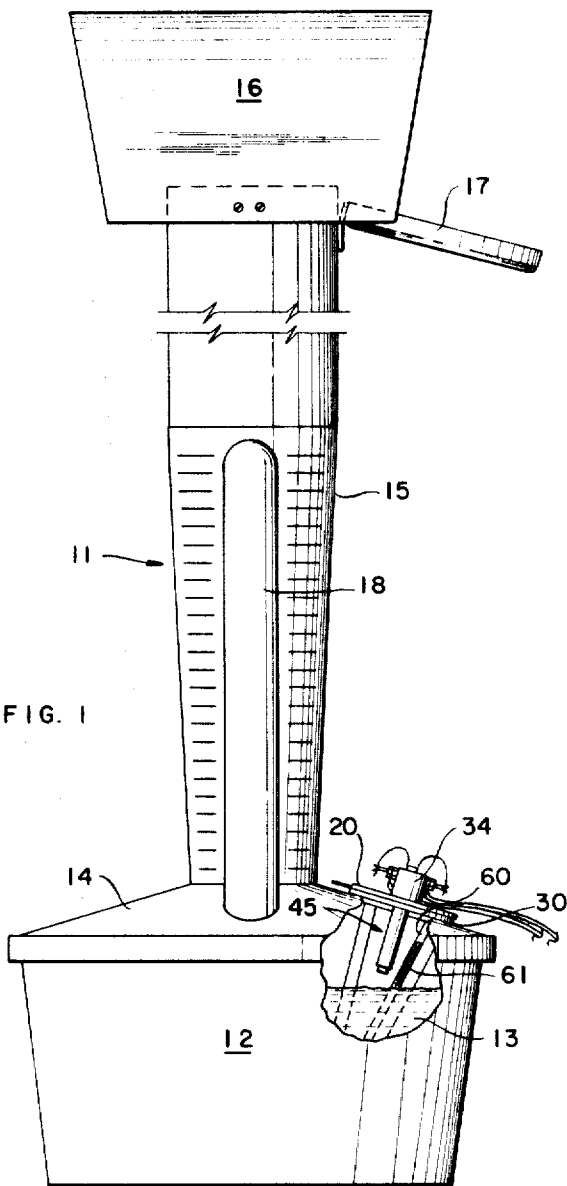


FIG. 1

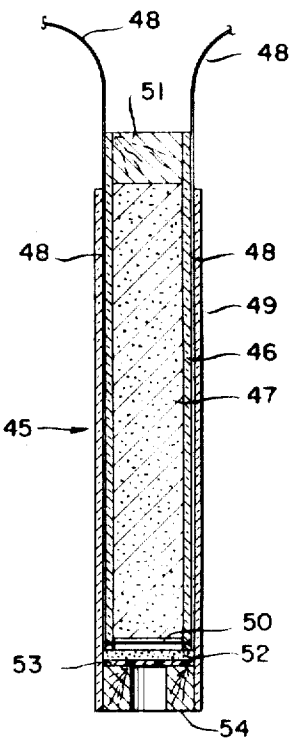


FIG. 5

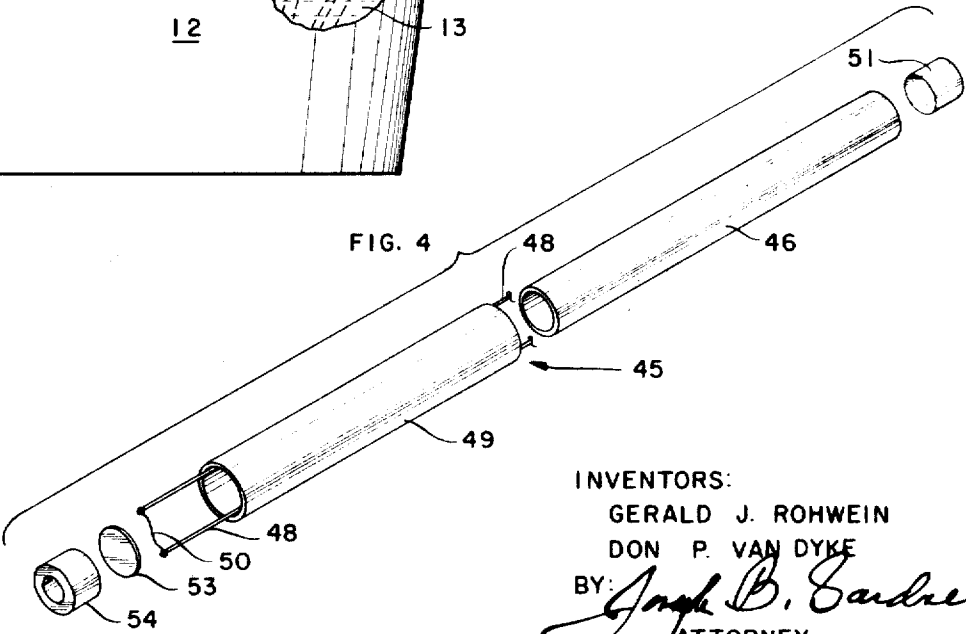


FIG. 4

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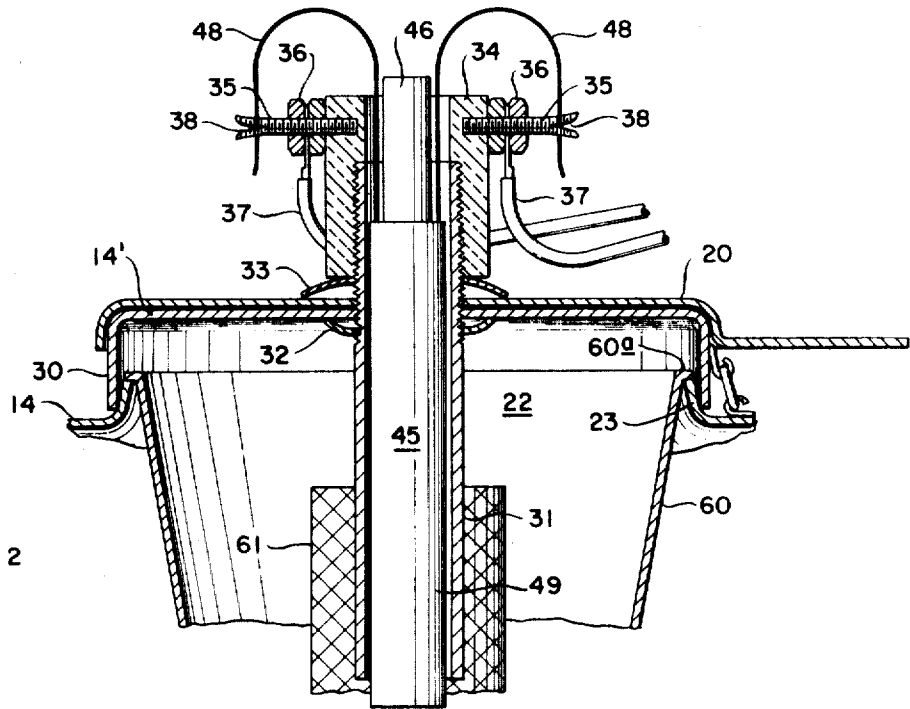


FIG. 2

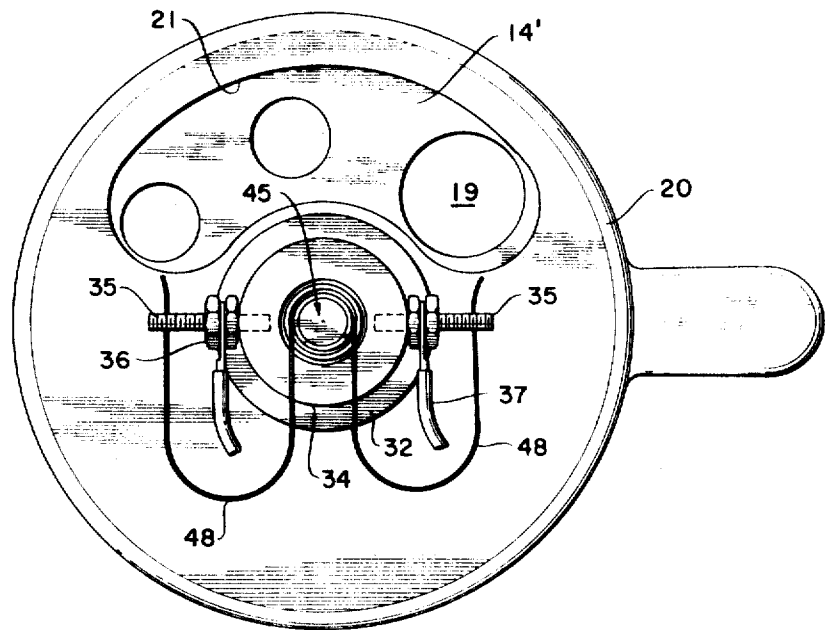


FIG. 3

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IGNITER FOR SMUDGE POTS

This invention relates to an igniter assembly for electrically igniting the fuel in one or more orchard smudge pots of conventional construction which may burn an inexpensive fuel of relatively low flashpoint, such as diesel fuel or used motor oil, but may also burn a high flashpoint fuel. More specifically, the invention relates to an electrically operated igniter cartridge and to a holder assembly therefor for use with orchard smudge pots and the like.

The igniter assembly is intended for use with or as an attachment for conventional orchard smudge pots which may use a heavy oil, of low flashpoint, such as used engine oil or diesel oil as fuel. The igniter assembly includes an igniter cartridge loaded with a pyrotechnic charge and provided with a pair of electric lead wires terminating in a resistance bridge wire (heater wire) which will become sufficiently hot to fire an ignition charge located thereabout upon the flow of a low value current through the bridge wire of about 350 to 400 milliamps. The lead wires extend through the back and closed end of the cartridge and are adapted to be connected to a suitable source of electrical power. A plug having an orifice therein is used to direct the flame from the charge for impingement on the fuel; and by way of example, a typical cartridge may be about nine-sixteenths of an inch in diameter, 3½ inches in length, it will burn for about 25 seconds, and the jet issuing through the orifice may be about 6 inches long.

The igniter assembly further includes a suitable holder device for such a cartridge. The holder device is supported on the smudge pot and comprises a hollow tube extending downwardly into the reservoir of the pot to a point adjacent the liquid level therein. The cartridge is supported within the tube and when ignited, a long jet of flame issues from the tube toward the upper surface of the fuel, thereby causing local vaporization and ignition thereof. Within seconds, the burning fuel vapor envelops the interior of the burner space and thereby efficiently ignites the surface of the fuel in the smudge pot. The heat generated by the ignited fuel is sufficient to stimulate a draft through the smudge pot stack. It has been found that from a cold start, the smudge pot can typically be brought into full operation in less than 60 seconds after the application of the electrical charge to the cartridge, so that a cartridge of the size and character mentioned is amply sufficient to ignite the heavy oil fuel of such a pot.

One of the primary objects of the present invention is to provide an improved electrically activated pyrotechnic cartridge suitable for igniting the fuel of orchard smudge pots and the like, and especially those utilizing a heavy oil such as used motor oil, diesel fuel, or ordinary fuel oil, as the fuel therefor.

Another of the primary objects of the present invention is in the provision of an improved holder assembly for a pyrotechnic cartridge operative to direct the flame thereof either directly against the surface of the fuel to be burned or against a wick located in the throat of a smudge pot.

Still another object of the invention is that of providing a cartridge and holder assembly therefor suitable for use in simultaneously igniting a battery of orchard smudge pots so that a relatively large orchard can have the smudge pots thereof prearranged and quickly and efficiently ignited when conditions demand.

A further object of the invention is to provide an electrically operated igniter for smudge pots which can be activated by the use of low voltage, low current source of electrical energy such as that generated by the usual 12-volt automobile system or, for large installations, a 24-volt source of electrical energy, but of course a high voltage source can be used.

Additional objects and advantages will be apparent to those skilled in the art, and a fuller understanding of the invention will be had, by referring to the following specification and accompanying drawings in which:

FIG. 1 is a side view in elevation of a common form of smudge pot with a portion of the fuel chamber broken away to show the location of the cartridge holder;

FIG. 2 is a vertical sectional view, on an enlarged scale, of the cartridge holder and cartridge therein;

FIG. 3 is a top plan view of the holder shown in FIG. 2;

FIG. 4 is an exploded perspective view of the cartridge shown in cross section in FIG. 2; and

FIG. 5 is a longitudinal sectional view in its assembled condition of the cartridge.

The cartridge holder of the present invention is adapted to be used in association with any of the many types of smudge pots now in common use. For example, and by way of illustration only, FIG. 1 shows one of the smudge pot models manufactured by the Scheu Products Company and which is particularly adapted to burning a heavy oil such as heating oil, diesel fuel, or even used motor oil. However, the igniter of the present invention can be applied equally well to smudge pots burning solid fuel. The exemplary smudge pot illustrated in FIG. 1 is denoted with the numeral 11, and it comprises a pot or container 12 adapted to be filled to a predetermined level with a suitable fuel 13 such as fuel oil, diesel fuel oil, used motor oil, or any flammable material, but preferably one with a relatively low flashpoint. Associated with the pot 12 is a cover 14 which normally includes an integral chimney 15 terminating in a rain hood or bonnet 16 (which can be omitted) and a tight-fitting, but hinged, cover 17.

Many such smudge pots also have a bypass conduit or flue 18 leading from the top of the cover 14 to an intermediate level of the chimney 15 for reentrance thereto, as shown. Such smudge pots conventionally are provided with damper structure (see FIG. 3) which includes a plurality of apertures 19 in a cover plate 14' with which is associated a rotatable damper plate 20 provided with a long arcuate slot 21 adapted to register with one or more of the apertures 19 upon angular displacement of the damper 20 relative thereto for the purpose of regulating the amount of air admitted into the interior of the container 12 for fuel combustion. It is believed that a smudge pot of the kind described and operation thereof are well known and readily understood by those skilled in the art; and since the smudge pot per se is not a part of the present invention, no further description of the smudge pot will be included.

The cover 14 of the smudge pot 11 is provided with an enlarged opening 22 (see FIG. 2) defined by an upwardly extending annular collar 23 that cooperates with the damper structure and to hold the same against lateral displacement. In this respect, the cover plate 14 is adapted to fit fairly snugly about the collar 23, and the cover plate has a depending perimetric flange 30 that telescopes over the collar 23. The cover plate 14' rigidly supports the cartridge holder 31 which is a cylindrical tube and, by way of example, can be a common half-inch steel water pipe. The holder 31 is held rigidly on the cover plate 14' by any suitable means, such as a locknut 32 below the plate and a wave washer 33 above the plate in association with an upper nut in the form of an internally threaded collar 34.

The damper plate 20 bears against the upper face of the cover plate 14', being rotatably mounted on the holder 31 between the cover plate and the washer 33. The cartridge holder is completed by the collar 34 which is formed of a suitable high temperature electrical insulating material, such as a high grade electrical ceramic or plastic. The holder 31 is threaded into the insulating collar 34, as shown particularly in FIG. 2. The insulating collar 34 carries a pair of diametrically opposed binding posts or terminals 35 formed of a suitable electrical conductor, such as copper, and which are threaded into openings therefor in the collar 34. The posts 35 preferably each carry a pair of nuts 36 between which can be rigidly held and electrically connected to the post an uninsulated end of one of a pair of insulated lead-in wires 37. Preferably, the outer ends of the binding posts 35 are split, as shown in FIG. 2, so that a lead wire to the cartridge can be quickly pressed therein and will be held firmly in electrical contact with the binding post without the necessity of tightening nuts to hold the same. It is obvious that with the construc-

tion of the holder as above-described, the flame from a cartridge 45 (to be described shortly) is directly downwardly against the surface of the body of fuel 13 within the container 12.

It will readily be understood from the foregoing description that the cartridge holder assembly comprising the cover plate 14, damper plate 20, the cartridge holder 31 and the insulating collar 34, can be readily positioned relative to the enlarged opening 22 of the smudge pot, and may be hingedly related to the cover 14, as shown in FIG. 2. The lead wires 37, which may be connected in parallel to a number of smudge pots, are movable with the holder assembly clamped between the respective nuts 36. When the cartridge 45 is inserted into the holder 31 and its lead wires are connected to the binding posts, as by inserting the same into the slots 38, a complete electric circuit is formed which is under control of an external switch (not shown). It can be mentioned that it is common in this art to wire as many as 25 smudge pots in parallel to a string of up to 2,000 feet of wire. Commonly, the wire used in No. 16 A.W.G. stranded cooper, and for such a string of smudge pots, it is suggested that the power source be a 24-volt system. A lower voltage, say of 6 or 12 volts, could be used on similar runs if the wire size were increased or if the number of pots on the string were decreased. What is important is to note that the combination of wire size, length of cable, number of igniters per string, type of energy source, and magnitude of the control voltage are determined by operator preferences which are understood by those familiar with this art.

The preferred form of construction of the cartridge 45 is shown in FIGS. 4 and 5, and it is seen to comprise an inner cardboard or plastic tube 46, the upper end of which is sealed such as by a wooden plug 51. The inner tube 46 is filled with a suitable pyrotechnic charge 47. A pair of wire leads 48 are placed exteriorly of the tube 46 such as on diametrically opposite sides thereof, and the inner tube and wires are inserted into an outer cardboard or plastic tube 49, the lower end of which extends below the end of the inner tube. The two lead wires 48 terminate at the lower end of the inner tube 46 and are interconnected by a fine, high resistance heater wire 50 which forms a bridge between the two leads 48 across the open end of the inner tube 46. The heater wire 50 may be soldered or swaged to the wire leads 48 prior to assembly as it is necessary that there be a good electrical connection between both of the leads 48 and the bridge wire 50, and obviously the wires are not best soldered after the inner cartridge is loaded with a pyrotechnic charge. As shown most clearly in FIG. 5, the lead wires 48 extend for a considerable distance beyond the outer end of the assembled tubes 46 and 49.

A small amount of ignition charge 52 is placed against the bridge wire 50 at the outer end of the inner tube 46 and within the outer tube 49, and is held in close contact with the bridge wire by a burnout diaphragm 53 which may be a thin vinyl material held in place by an orifice plug 54 inserted in the open lower end of the outer tube 48. The orifice plug 54 serves not only to hold the ignition charge against the bridge wire 50, but because of the central orifice therethrough (originally closed by the thin diaphragm 53) it also directs the flame from the burning of the pyrotechnic charge as a jet projecting axially downwardly from the cartridge 45.

It will readily be understood that smudge pots can be located at strategic locations before any expected need therefor, and filled to the desired level with a suitable fuel. Lead wires can also be connected to the various pots, usually in parallel, by attaching the uninsulated ends of the leads 37 between the locknuts 36 in engagement with each of the binding posts 35. The pots are then each charged for ignition by placing a cartridge 45 in the holder 31, and the free ends of the lead wires 48 from such cartridge are forced into the slots 38 in the ends of the binding posts. When the master control switch is closed at the proper time, an electrical current flows through the power leads 37 to one of the binding posts 35, thence through the associated lead 48, bridge wire 50, the other lead 48, opposite binding post 35, and finally to the other power lead 37.

The flow of current through the bridge wire 50 rapidly heats the same, thereby igniting the ignition charge 52 which burns through the diaphragm 53 and at the same time ignites the pyrotechnic charge 47. The pyrotechnic charge will thereupon burn with an exceedingly hot jet flame directed downwardly through the plug 54 toward impingement against the surface of the fuel body 13 in the chamber 12 of the smudge pot 11, thereby causing the fuel to be ignited within a matter of seconds. It has been found that the high temperature jet flame from the cartridge 45 projected against the fuel surface in the chamber of the smudge pot causes rapid vaporization of the fuel and immediate ignition thereof, so that within a few seconds the whole chamber pot is a mass of flames, thereby effecting a pronounced upward draft of hot air through the chimney 15 (the lid structure or closure 17 being opened prior to ignition) which permits the emission of hot combustion gases therefrom.

A standard smudge pot is ordinarily equipped with a wick and holder therefor, and an exemplary arrangement is shown best in FIG. 2. The wick holder 60 illustrated tapers inwardly and downwardly, and at its upper end it is provided with an outwardly flared lip 60a that rests upon and is supported by the collar 23 so that the holder (or throat) projects downwardly through the opening 22 into the fuel chamber. The wick 61 is supported within the holder 60 in a position to have a jet of flame from the cartridge 45 impinge thereon when the cartridge is ignited.

The present invention has been used in orchard installations with both solid and liquid pyrotechnic charges. In both cases, the igniters emitted an intense high temperature flame (over 2,000° F. in the case of the liquid charge and over 2,700° F. in the case of a solid charge) for a period of approximately 25 seconds. While the pyrotechnic charge can be either fluid or solid, the solid charge is preferred for at least two reasons: (1) it burns with a hotter flame, and (2) storage is less of a problem.

An exemplary solid pyrotechnic material used successfully was composed of (by weight):

Potassium nitrate	50%
sulfur	20%
Aluminum powder	20%
Wood sawdust	10%

These ingredients were mixed, followed by grinding in a rod mill until the mixture was fully blended and in the form of a fine homogeneous powder. The ignition temperature of such a pyrotechnic charge is approximately 650° F., and it burns at a temperature in excess of 2,700° F. (probably closer to 3,500° F. as it will melt light gage sheet steel).

A very satisfactory ignition charge, or primer, is a common double base smokeless shotgun powder (nitrocellulose-nitroglycerin). Preferably this powder is glazed with finely divided black powder to enhance ignition properties. Such a mixture has an ignition temperature of about 392° F. which is readily reached by a short flow of current through the bridgewire 50.

In both instances, it was found that the igniters were very reliable and capable of quickly igniting cold, low volatile, heavy oils, such as engine grade diesel oil, used motor oil, and ordinary fuel oil. Such oil may have a fire point of about 300° F., but commonly is as high as 400° F. as obviously, cheaper, less volatile fuel is preferred. However, the intense igniter flame generates a fuel vapor cloud that rapidly becomes a fireball enveloping the entire interior of the heater space in a matter of a very few seconds.

It will be understood that after each use, the cartridge 45 is completely burned out or destroyed and will have to be replaced for a subsequent firing of the smudge pot. This is no handicap as a prolonged use of a smudge pot requires that the fuel therefor be replenished from time to time, and in any event after such usage, the operator will check each pot to en-

sure that the fuel supply is adequate for the next use. At that time it is a simple matter to pull the cartridge leads 48 out of the slots 38 in the binding posts, pull the cartridge out of the holder 31 and replace the expended cartridge with a fresh one.

It has been found that a suitable power supply can be an automotive 12-volt power source for a short string of smudge pots comprising but a few pots, for example, 20 smudge pots on a 2,000-foot string. A 24-volt source is adequate for as many as 25 smudge pots on a string of approximately 2,000 feet. One additional feature that can be easily and inexpensively incorporated in the control system of the present invention is a voltage threshold detector installed on each smudge pot or heater which will permit sequential or selective ignition of the heaters. That is, at one particular voltage value only certain of the smudge pots will be activated, but when the voltage is increased slightly to a higher value, additional pots will be activated, etc. Thus, by applying the voltage to parallel-connected heaters in discrete steps with simple switching techniques, which are now available, at the control station, only the heaters that detect the threshold at or below the applied voltage would respond. Therefore, one could, for example, light alternate heaters in one stage and additional heaters at a later stage or, perhaps first light heaters in the coldest part of an orchard and others later, etc. It has been found that with a 24-volt power source as many as nine or 10 lighting steps are possible; and the threshold detectors can be solid state devices ruggedly packaged and numbered or color-coded according to their operating points. Such devices are inexpensive and readily installed in the power supply lines to the heaters.

It should be understood that the cartridge configuration can be of any desired shape or size, and for purposes of example, cartridges embodying the present invention have been as small as three-eighths inch in diameter and as large as about three-fourth inch, and they have inch, lengths of about 3½ inches to 4 inches. Such cartridge can comprise waterproof cardboard or plastic tubing as the case material, but other materials can be used which advantageously are both waterproof and dielectric.

It may be desirable in many installations to place a rain cover (not shown) over the insulating collar and wiring illustrated in FIG. 2. Such a rain cover has not been shown or described in detail as its function is obvious and it may take any form effective to protect the installation from short circuits which might occur if the assembly is unprotected and moisture allowed to accumulate on the top of the cartridge.

It will be evident to those skilled in the art that the igniter cartridge 45 can be designed to burn for various periods of time by changing the length of the pyrotechnic column, or by including a reaction inhibitor in selected proportions within the mixture. Generally, however, the cartridge is intended to burn for approximately 25 seconds and to emit a jet flame of approximately 2,700° F. to 3,500° F. having a length of approximately 5 inches long. Likewise, the ignition sensitivity of the cartridge may be adjusted by varying the composition of the pyrotechnic mixture, by using bridge wires of various sizes, or by the addition of highly sensitive ignition mixtures to the initiation region of the cartridge. Typically, the cartridges have been designed to operate at a current level of the order of 400 milliamperes and to fail to operate at a level of about 360 milliamperes.

It will be apparent to those skilled in the art that the smudge pot igniters can be operated by means of radio-controlled equipment with the consequent elimination of the wiring which interconnects the various smudge pots. Instead of wiring, the smudge pots in such event can be equipped with radio receivers and battery power sources, and a coded signal would be transmitted by mobile or stationary transmitter which would trigger the ignition circuit of the receivers. In that case, the receivers should be equipped with an encoder to prevent spurious radio signals from energizing them, and the coding system could be any one of three basic types: (1) a tone code system; (2) a digital code system; or (3) a pulse time code system.

It has been stated heretofore that the number of smudge pots which can be operated from a single line depends, among other factors, upon the length of the wire in the system and the number of pots to be ignited therealong. It is apparent that the line resistance of a string of interconnected pots is an important factor in the installation, and in most instances the length of the line and the number of pots will be calculated to fit a particular power source. Most of the problem concerning power requirements can be handled by increasing the wire size to reduce resistance and consequent power loss over longer runs, as well as by increasing the potential of the power source. Another possibility is to increase the sensitivity of the igniters, but this can be objectionable from a safety standpoint in certain installations. (Igniters or cartridges of the type herein described can be stored with a safety factor comparable to that of the storage of ordinary shotgun shells; however, if the sensitivity of the device is increased, the danger of accidental igniting increases correspondingly.) A further possibility is to install an inexpensive voltage level detector at each heater which will prevent the cartridge from drawing current until the voltage reaches a level sufficient to fire the unit. If this is done, the cartridge close to the source of power will draw a greater amount of current as there is less wire resistance to that point. When the first cartridge fires, the bridge wire is immediately burned out and the next one in the system can fire, etc.

It will be appreciated that the cartridge structure can be varied from the preferred form shown and, for example, the tubes 46 and 49 could be formed of wrapped paper with the lead wires 48 embedded therein, and they could be extruded plastic with the lead wires integrally embedded within the walls of the tube. In either of the latter cases, the two tubes 46 and 49 would be integrated so that only one tube would result.

It will be understood that the drawings and foregoing description disclose a preferred embodiment of the invention and that many modifications may occur to those skilled in the art with which this invention is associated in addition to the variants suggested heretofore. Accordingly, it is intended that the appended claims cover such modifications as fall within the true spirit and concept of the invention.

What we claim is:

1. An igniter cartridge for igniting the fuel in orchard smudge pots and the like, comprising longitudinally extending tube structure closed at its outer end and being adapted at its inner end to project into the fuel chamber of such smudge pot, said tube structure having a main pyrotechnic charge therein and having also an ignition charge adjacent said inner end for firing said main charge, an electric igniter element in thermal proximity with said ignition charge for energizing the same and having conductors leading to the exterior of said tube structure for connecting said igniter element with a control circuit, and an orifice plug carried by said tube structure adjacent the inner end thereof and having an orifice therethrough for directing the jet flame resulting from combustion of said main charge toward a selected location.

2. The igniter cartridge of claim 1 and further comprising a burnout diaphragm extending across said orifice to close the interior of said tube structure.

3. The igniter cartridge of claim 1 in which said tube structure includes a pair of telescopically related inner and outer tubes, said inner tube at one end thereof defining the aforesaid closed outer end and said outer tube at one end thereof defining the aforesaid inner end carrying said orifice plug.

4. The igniter cartridge of claim 3 in which said igniter element is disposed at the interior end of said inner tube intermediate the ends of said outer tube, and further comprising a burnout diaphragm extending across said orifice to close the interior of said tubes.

5. The igniter cartridge of claim 4 in which said ignition charge is confined between said orifice plug and the interior end of said inner tube, and in which said conductors extend longitudinally intermediate said tubes.

6. An igniter cartridge of claim 5 wherein the pyrotechnic charge comprises (by weight):

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potassium nitrate	50%.
sulfur	20%.
aluminum powder	20%.
wood sawdust	10%.

and wherein the ignition charge comprises a shotgun powder and finely divided black powder.

7. An igniter assembly for igniting the fuel in orchard smudge pots and the like having a casing defining a chamber adapted to hold a combustible material and providing an opening for receipt of said assembly therein, comprising a longitudinally extending cartridge holder adapted to extend through such opening and be secured to such casing for communication with the chamber defined thereby, and electric insulator member affixed to said holder adjacent the outer end portion thereof and being equipped with terminals for connection to an electric control circuit and to the conductors from an ignition cartridge, and fastener means for securing said holder to such casing, said holder being provided with a longitudinally extending passage therein open at its inner end and through which a jet flame from an ignition cartridge mounted within said passage can issue toward such combustible material.

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8. The igniter assembly of claim 7 and further comprising an ignition cartridge including longitudinally extending tube structure mounted within said holder and containing a main pyrotechnic charge and also an ignition charge adjacent its inner end for firing said main charge, and an electric igniter element in thermal proximity with said ignition charge for energizing the same and having conductors leading to the exterior of said tube structure and being connected with said terminals.

9. The igniter assembly of claim 8 in which said ignition cartridge further includes an orifice plug carried by said tube structure adjacent the inner end thereof and having an orifice therethrough for directing the jet flame resulting from combustion of said main charge, means closing the outer end of said tube structure, and a burnout diaphragm extending across said orifice to close the interior of said tube structure.

10. The igniter assembly of claim 9 in which said tube structure includes a pair of telescopically related inner and outer tubes, said conductors being lead wires extending intermediate said tubes and supporting said ignition cartridge with said passage by the physical connection with said terminals.

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