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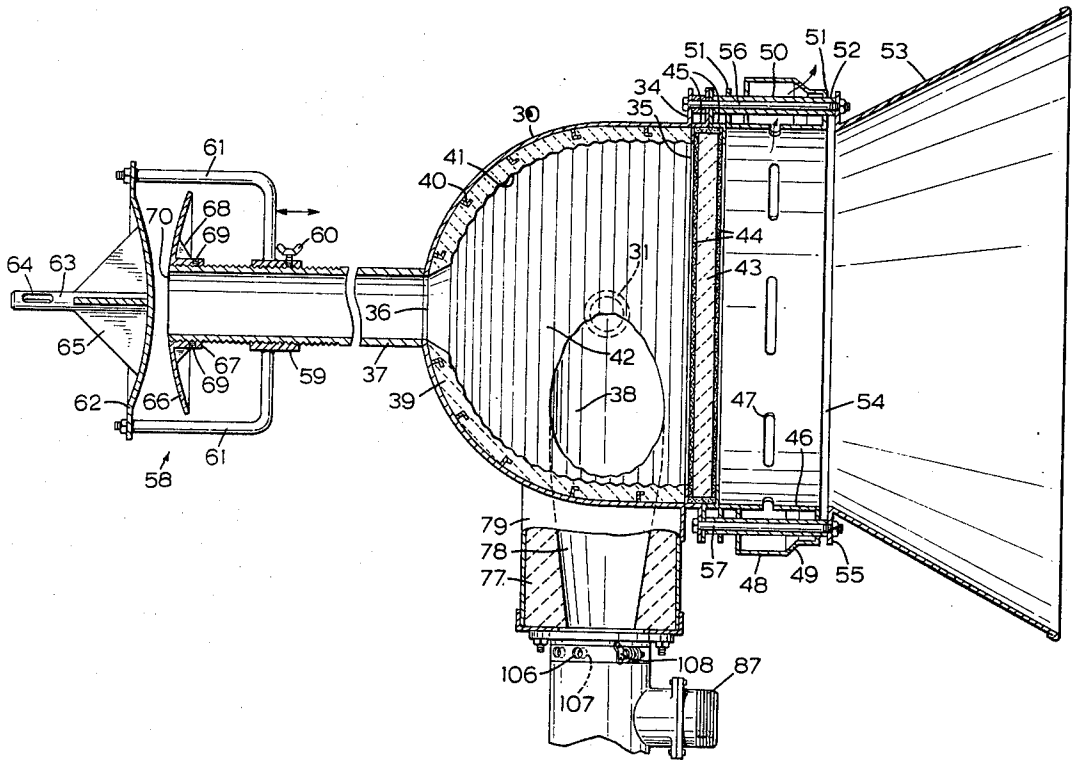
[54] **INFRARED RADIATION GENERATOR**
6 Claims, 6 Drawing Figs.

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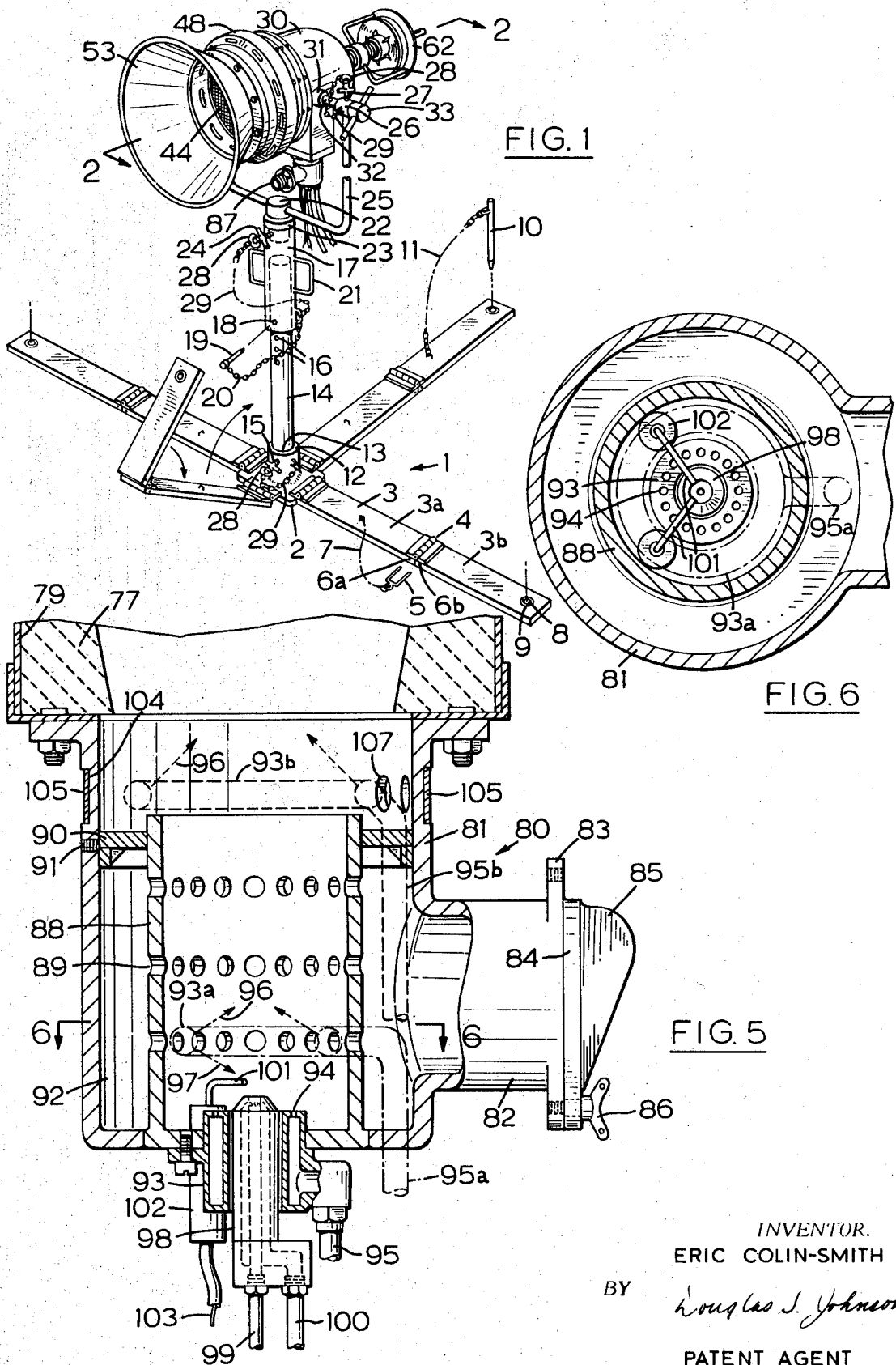
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ABSTRACT: A portable infrared heater comprises a burner capable of burning a plurality of fluid fuels individually or simultaneously and a combustion chamber lined with refractory material. Means are provided to create a vortex of heated gases in a combustion chamber for even heating. A flue mounted wind cap permits variations of draft pressure from negative to positive values to cutoff. The combustion chamber may be open to the atmosphere for direct radiation or closed with a silicon carbide plate in which case secondary radiation is emitted from the outer face of such plate. The surfaces of the lining and the plate are textured to increase their area and radiation intensity. A stand permits radiation to be beamed in any desired direction.



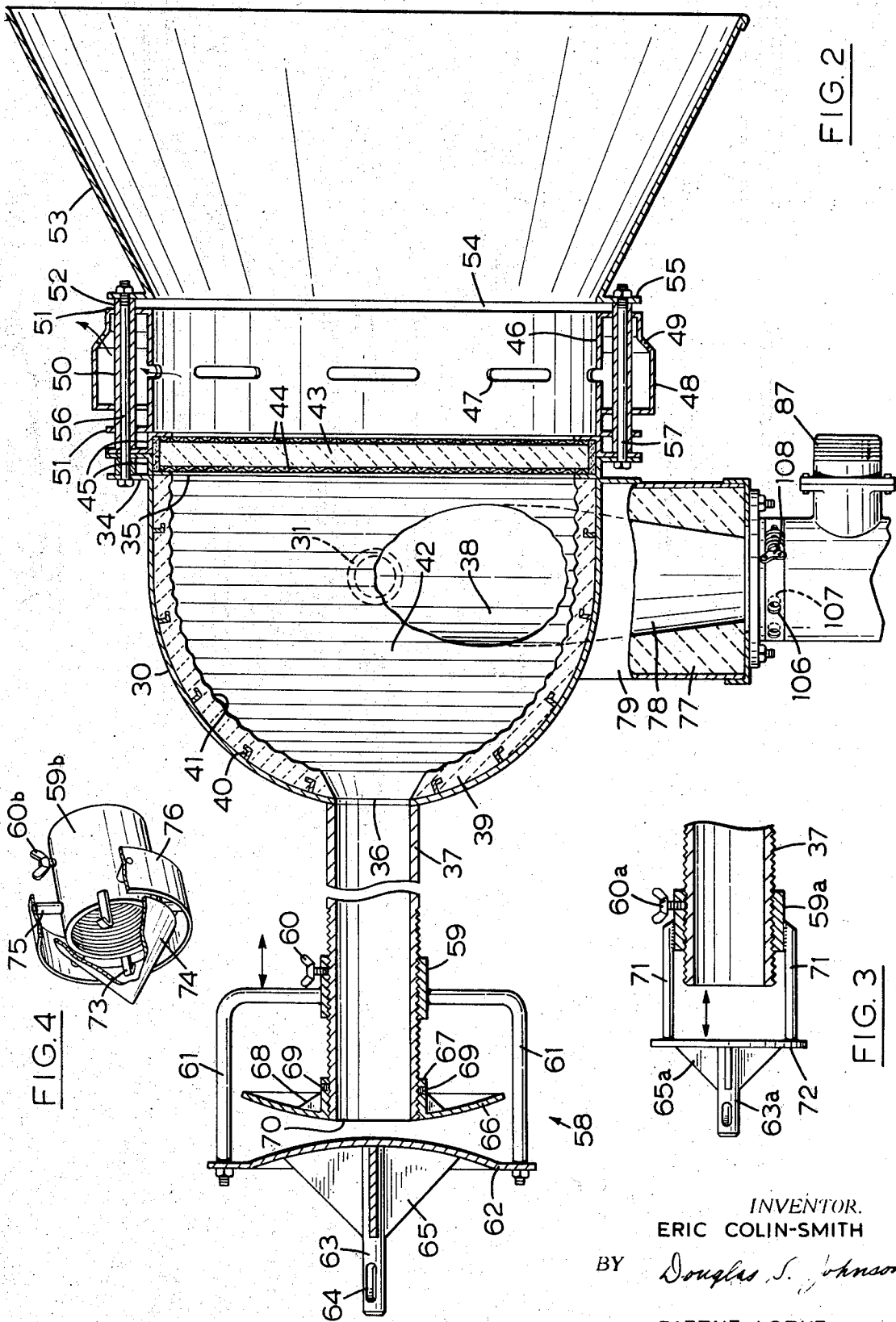
SHEET 1 OF 2



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INFRARED RADIATION GENERATOR

SUMMARY OF THE INVENTION

This invention relates to generators of radiation primarily radiation of such wave lengths as to fall within the infrared portion of the spectrum. Such generators are commonly referred to as infrared heaters.

Infrared radiation possesses the capability of penetrating a transparent medium such as air with little or no loss of energy and of imparting its energy content to more dense objects upon which it impinges. This property can be utilized to maintain humans comfortably warm even though situated outdoors in a cold environment. This invention is directed to a heater primarily intended for such use. However it is also well adapted for cooking, and warming occupants of building or other habitations.

The invention described herein is a reliable, efficient generator of infrared radiation capable of operating with a variety of fluid fuels including diesel oil, kerosene, No. 2 and No. 4 fuel oil, jet fuel, gasoline, natural gas, propane, butane and manufactured gas. This versatility in addition to its ability to serve as a radiant heater either outdoors or indoors or as a food cooker makes it ideally suited for use in remote, frigid areas where the ability to utilize almost any type of fluid fuel is a pronounced asset.

The heater comprises a burner capable of utilizing a variety of fuels. Burning gases issue from the burner and traverse a tuyer from which they are directed tangentially into a combustion chamber comprising a bowl-shaped casing lined with a high temperature refractory material. Means are provided to ensure virtually complete combustion of fuel in the burner and in the combustion chamber. The hot gases revolve cyclone-fashion within the combustion chamber and provide substantially uniform heating of the lining thereof. The surface of the lining is preferably textured by applying a corrugated or wafled design or by roughening to increase the surface area and thereby the intensity of radiation which may emanate therefrom.

The mouth of the combustion chamber may be left open in which case infrared radiation originating on the surface of the chamber lining is beamed directly into the atmosphere.

Alternatively the mouth of the chamber may be closed by a disc of silicon carbide sandwiched between supporting sheets of metallic mesh. In this case infrared radiation emanates from the outer face of the disc which may likewise be textured or roughened to increase its surface area in the same manner as the combustion chamber lining.

A flared, polished horn is mounted in spaced relation to the mouth of the combustion chamber and serves to concentrate and direct the beam of infrared rays in the desired direction and, if used outdoors, to shield the radiation emitting surfaces from the cooling effects of wind.

An exhaust flue is provided through which burned gases are expelled to the atmosphere. An adjustable cap is mounted upon the outer end of the flue. Three variations of this cap are depicted. All possess means for altering the back pressure upon the escaping gases and for reducing the detrimental effects of wind upon such back pressure. One variation utilizes the Venturi principle to achieve a hyperdraft within said flue.

The burner, combustion chamber and associated elements are mounted upon a highly versatile stand. This stand is capable of being secured to the ground by means of pegs anchored thereto by light chains. It permits infrared radiation emanating from the unit to be beamed in any desired direction. Means are provided to lock the combustion chamber casing in the desired attitude. When using the heater for cooking purposes the upwardly directed mouth of the chamber can be lowered to a convenient height.

All adjustments of the stand and flue caps are designed to be easily managed by an operator wearing heavy mitts or gloves—normal apparel for outdoor workers in frigid environments.

DESCRIPTION OF DRAWINGS

FIG. 1 is a pictorial view of the infrared radiation generator equipped with a flue cap as detailed in FIG. 2.

FIG. 2 is a vertical section of the combustion chamber and flue cap taken on the line 2-2 of FIG. 1.

FIGS. 3 and 4 disclose alternative flue caps.

FIG. 5 is a central sectional view of the burner mechanism.

FIG. 6 is a sectional view taken on the line 6-6 of FIG. 5.

DESCRIPTION OF INVENTION

The invention comprises a stand 1 consisting of a square base plate 2 to which is hinged adjacent each of the four edges thereof an articulated foot 3 composed of inner and outer elements 3a and 3b respectively pivotally connected by a hinge 4. When aligned, elements 3a and 3b may be locked in position by a U-shaped clevis 5 inserted into mating apertures 6a and 6b in such elements. The clevis is anchored to the element 3a by a light chain 7. An opening 8 bushed with a hardened steel liner 9 is provided adjacent the outer end of each of the elements 3b. Pegs 10 anchored by light chains 11 to elements 3b may be inserted through the liners 9 to secure the feet to the ground. If used indoors appropriate fastening means such as bolts or screws may be substituted for the pegs 10.

A collar 12 cast integral with the plate 2 or welded thereto forms, in conjunction with such plate, a socket 13. A post 14 seated in such socket may be locked in position by a hand screw 15. The post 14 is provided with a vertical row of openings 16 each extending diametrically therethrough.

A sleeve 17 slidably mounted upon the upper portion of the post 14 has a hole 18 drilled diametrically therethrough which may be brought into register with any one of the openings 16. A pin 19 attached to the sleeve by a light chain 20 may be inserted through the hole 18 into any one of such openings. By choosing different openings the elevation of the sleeve 17 upon the post 14 may be adjusted. Handles 21 attached to opposite sides of the sleeve 17 facilitate such adjustment.

A short cylindrical member 22 having an integral collar 23 is rotatably seated within the upper end of the sleeve 17. A hand screw 24 permits such member to be locked in any desired position in the plane of rotation thereof. Arms 25 project outwardly and upwardly from the member 22 and carry aligned bearings 26 at the extremities thereof. Each such bearing is equipped with a locking screw 27. The hand and locking screws 15, 24 and 27 are anchored through swivels 28 and light chains 29 to adjacent members respectively.

The base plate 2, feet 3, collar 12, post 14 and sleeve 17 are preferably composed of a lightweight material such as aluminum or aluminum alloy to render the unit more easily portable.

A generally bowl-shaped shell 30 composed of metal capable of withstanding high temperatures without deformation is located between the bearings 26. While this configuration is to be preferred the shell 30 may be otherwise shaped. For example it may be cylindrical or conical or rectilinear while maintaining roughly the same mouth area to linear depth relationship. Any such form will yield generally satisfactory results. Trunnions 31 secured to either side of the shell 30 threadably receive shafts 32 journaled within the bearings 26. Each such shaft has a handle 33 affixed to the outer end thereof. It will be apparent that by loosening the screws 27 and turning handle 33 the shell 30 may be rotated in a plane normal to that of the base plate 2. With reference to FIG. 2 of the drawings it will be noted that a flange 34 encircles the mouth 35 of the shell 30. At the opposite end of the shell a vent 36 is provided around which is attached by welding or other suitable means a flue 37 which serves to connect the interior of the shell 30 with the outer atmosphere. A further opening 38 of ovoid shape is provided in the wall of the shell 30 through which heated gases emerge tangentially into such shell in a manner to be described more fully hereinafter.

The interior of the shell 30 is heavily lined with an insulating refractory material 39 held in place by a multiplicity of metal-

lic hooks 40 welded to the inner wall of the shell. The refractory material 39 should be castable, light in weight, mechanically strong and low in heat conductivity. Such a material is commercially marketed under the trademark "Kast-o-lite" although other materials possessing the properties mentioned will be equally satisfactory.

The surface of the coating is preferably textured as at 41 by applying a corrugated or waffle design or by otherwise roughening to increase the area thereof. The shell 30 contains the combustion chamber 42.

The mouth 35 of the shell may be closed by a plate composed of material of high heat permeability preferably a silicon carbide disc 43 sandwiched between sheets 44 of metallic mesh. These elements are clamped between encircling rims 45. The faces of the disc are preferably textured in a manner similar to that of the surface of the lining 39.

A cylindrical spacing member 46 provided with slots 47 is mounted outwardly of the silicon carbide disc 43 and is encircled by an integral wind screen 48 likewise slotted as at 49.

A plurality of sleeves 50 are equispaced around the member 46 and extend through and are affixed to annular flanges 51 encircling such member. It will be noted that the sleeves project a short distance forwardly of the outermost flange as at 52.

A flared, internally polished horn 53 is mounted forwardly of the member 46. Because of the sleeve projections 52 a gap 54 exists between the projecting rim 55 forming part of the horn 53 and the outermost flange 51. The horn 53, spacing member 46 and rims 45 are secured to the flange 34 by bolts 56 extending through the sleeves 50. Shorter bolts 57 used in the vicinity of housing 79 fail to extend through the flange 34 but serve to secure the remaining elements. The purpose of the spacing member 46, the horn 53 and the gap 54 therebetween will be explained hereinafter.

As illustrated in FIGS. 1 and 2 the horn 53 is straight sided with a medium flare. This flare may be increased or decreased to disperse or concentrate the infrared beam or the horn sides may be curved outwardly or inwardly to achieve the same objectives.

The flue 37 is illustrated as a straight cylindrical member externally threaded for the major portion of its length. It should be noted however that the unthreaded section may be elongated and arranged in the form of a rigid or semirigid elbow if desired for reasons to be later explained.

An adjustable cap 58 comprises a collar 59 threadably mounted upon the flue 37 and equipped with a locking screw 60 for the purpose of clamping the collar at any desired location along the threaded portion of such flue.

Angular brackets 61 are attached to the collar 59 to the outer extremities of which is bolted or otherwise affixed a plate 62 the inner face of which is of convex configuration. An upright post 63 having a slot 64 therein projects from the center of the outer face of such plate. Web members 65 support the post 63 and serve to stiffen the plate.

A second convex plate 66 integral with an internally threaded collar 67 and provided with stiffening gussets 68 is threadably mounted upon the outer end of the flue 37 in opposed relation to the plate 62. The collar 67 is threaded onto the flue 32 until the outer surface thereof is flush with the end of the flue. It is then locked in position by set screws 69. It will be apparent that by rotating the outer plate 62 and associated brackets 61 and collar 59 such plate can be caused to advance toward or retract from opposing plate 66. This adjustment is facilitated when cap 58 is not by turning the post 63 with a bar or any similar tool inserted into the slot 64.

Due to the configuration of plates 62 and 66 air moving therebetween creates a negative pressure at the mouth 70 of the flue in accordance with the well-known Venturi principle. This pressure will vary depending upon the velocity of the air passing between the plates and the spacing thereof. By narrowing the gap a positive pressure can be achieved at the mouth 70 and by closing the gap the purpose of the flue can be defeated. This may be desirable in certain circumstances to be later described.

A first alternative flue cap of somewhat simpler construction is illustrated in FIG. 3. The collar 59a is threadably mounted upon the flue 37 in the same manner as the collar 59 and carries a similar locking screw 60a. A plurality of parallel spaced bars 71 support a flat circular disc 72 carrying on its outer face a slotted post 63a and web members 65a similar to the post 63 and web members 65 of FIG. 2. It will be apparent that by axially rotating the disc 72 and associated elements 59a and 71 the inner face of the disc will advance toward or retract from the mouth of the flue. By this means back pressure upon gases issuing from the flue can be adjusted.

A second alternative flue cap is illustrated in FIG. 4. In this instance the internally threaded collar 59b and clamping screw 60b are identical to the corresponding elements in FIGS. 2 and 3.

Short turned straps 73 are attached to the outer wall of collar 59b and project beyond the end thereof. These straps support a conical hood 74 in spaced relation to the end of the collar enabling gases issuing from the mouth of the flue 37 to escape between the outer edge of the collar 59b and the inner surface of the hood 74.

A plurality of studs 75 project radially from the outer surface of the collar 59b and carry a circular metallic band 76. The band is so located that it overlaps the edge of the hood 74. The combination operates to prevent wind from blowing into the collar and creating unwanted and spasmodic back pressure. However desirable back pressure may be achieved by rotating the cap embodiment upon the flue 37 thereby causing the hood to advance toward or retract from the mouth of such flue.

A firebrick tuyer 77, rectangular in cross section, is snugly fitted against the outer surface of the shell 30. A flared throat 78 extends axially through the tuyer and connects at its larger end with the opening 38 in the wall of the shell 30. The tuyer is fixed in position by a closely fitting metal housing 79 preferentially bolted to the shell and so positioned that gases flowing through it enter the shell tangentially.

A burner 80 illustrated most clearly in FIGS. 5 and 6 is bolted to the housing 79 in axial alignment with the tuyer 77.

The burner consists of a substantially cylindrical casing 81 to which is integrally attached an air inlet conduit 82 equipped with a flange 83. A damper plate 84 provided with an integral upstanding lug 85 is frictionally held against the face of the flange 83 by a single wing headed bolt 86. The position of the damper plate upon the flange may be adjusted to variably control the volume of air entering the conduit 82. The lug 85 facilitates such adjustment by an operator wearing heavy gloves or mitts. Under certain circumstances it may be desirable to force air into the conduit 82. For this purpose a flanged air hose 87 is shown in FIGS. 1 and 2 is bolted to the flange 83 in place of the damper plate 84.

A cylindrical inner wall 88 terminating short of the open end of the casing 81 is provided with rows of air vents 89. The free end of the wall 88 is surrounded by a removable metallic ring 90 maintained in position by grub screws 91. This ring, the casing 81 and the wall 88 bound a substantially annular chamber 92.

Due to this construction air entering the conduit 82 must necessarily pass through the vents 89 in order to reach the interior of the cylindrical wall for combustion purposes. Ring 90 is intended for use primarily when pressurized air is introduced through conduit 82. With this exception the ring may be dispensed with if desired.

A circular gas ring 93 provided with a series of jets 94 is centrally mounted within the end wall of the casing 81. Gas may be supplied to the ring through conduit 95.

Alternate gas rings are shown at 93a and 93b with gas supply conduits 95a and 95b respectively. In the case of the alternate gas rings openings (not shown) are provided in the end wall of the casing 81 to admit the gas supply conduits 95a and 95b. Further openings (not shown) are located in the wall 88 for the passage of conduit 95a and in the ring 90 (if used) to accommodate conduit 95b.

Both gas rings 93a and 93b are provided with a multiplicity of jets aimed partially toward the axis of the casing 81 and partially toward the open end thereof as illustrated at 96. The ring 93a is also provided with a less number of rearwardly directed jets as shown at 97.

An oil burner nozzle 98 is concentrically mounted within the gas ring 93. An oil supply line 99 and an air line 100 are connected to the nozzle in the usual manner.

Igniting electrodes 101 passing through cylindrical insulators 102 are supplied with current at high voltage through the conductors 103. The electrodes are gapped immediately in front of the oil burner nozzle as shown in FIGS. 5 and 6.

An annular recess 104 is formed in the outer wall of the casing adjacent the open end thereof. A flexible band 105 provided with a series of equispaced openings 106 is slidably mounted within such recess. Matched openings 107 are located in the casing. By adjusting the band the openings may be continuously varied from fully open to fully closed. When the desired adjustment has been achieved the band may be locked in position by tightening the winged clamping screw 108 as shown in FIG. 2.

Gas may be supplied to the burner 80 from any available supply such as gas mains or pressure bottles. Appropriate connections are made to the gas supply conduits 95, 95a and 95b.

Oil under pressure is applied to the oil burner nozzle 98 through the supply line 99. The oil may be contained in a tank (not shown) with pressure generated by a motor driven pump (not shown). Forced air is supplied to the hose 87 and air line 100 from blowers or air pumps (not shown). The flow in all fluid lines is controlled by valves in the usual manner.

The electrodes 101 are excited by a source of high voltage current such as a transformer capable of generating a voltage of sufficient magnitude to breach the gap between such electrodes.

The invention operates in the following manner:

When being transported the feet 3 are compactly folded against the post 14 and sleeve 17. When it is desired to mount the unit in the open the feet are unfolded as shown and spiked to the ground by pegs 10. When used indoors bolts or screws may be substituted for the pegs.

If the burner is to be gas operated this fuel is introduced through conduits 95, 95a or 95b depending on whether gas rings 93, 93a or 93b are to be used. The ring 93 is preferred but either of the two alternatives yield highly satisfactory results. The backward directed jets 97 of rings 93a facilitate ignition by electrical means. Ring 93b lends itself to ignition by manual means such as by the insertion of a lighted match or taper through one of the sets of like openings 106 and 107.

With ring 90 in the position illustrated in FIG. 5 combustion supporting air flowing through the conduit 82 must necessarily traverse the vents 89 to reach the interior of the cylindrical wall 88 wherein combustion occurs. During operation the temperature of the wall will be raised with consequent preheating of air passing through the vents thereby enhancing the efficiency of the burner. When using ring 93b little or no combustion will occur within the confines of the cylindrical wall 88 and consequently no marked preheating of combustion supporting air will take place. However use of this ring is desirable where manual ignition is necessary.

Air may be permitted to flow into the conduit 82 under atmospheric pressure alone and the volume of such flow may be varied by adjusting the damper 84. Alternatively air may be directed into the conduit under positive pressure through the hose 87.

When it is desired to burn oil this fuel is admitted under pressure through supply line 99 and air is likewise forced through line 100. An atomized oil and air mixture emerges from the nozzle 98 and is electrically ignited by a voltage discharge across electrodes 101 in the usual manner. If required, preheated air for combination with the mixture is obtained in the same manner as with the use of gas and gas rings 93 and 93a.

Under certain circumstances when both gaseous and liquid fuels are available and when maximum infrared radiation is desired, gas may be supplied to one or more of the gas rings and oil to the nozzle 98 and both fuels may be burned simultaneously.

Under other circumstances if a gaseous fuel and a source of pressurized air is available the burner will perform satisfactorily with gas supplied to one of the gas rings and air introduced through the oil nozzle air line 100. In this instance it may be unnecessary to supply air through the conduit 82 or air supplied through the nozzle may be auxiliary to that admitted by such conduit.

Improved burner performance may be achieved by admitting additional air through the matched openings 106 and 107. The volume of air so admitted may be varied by sliding the flexible band 105 in its recess and locking it in position by the winged clamping screw 108 when the desired adjustment has been achieved.

By providing a variety of gas rings and multiple air admission means in addition to a fluid fuel nozzle the burner is capable of highly satisfactory operation with a variety of fuels ranging from gasoline, natural gas, propane, butane and manufactured gas on the one hand to No. 2 and No. 4 fuel oil, diesel oil, jet fuel and kerosene on the other. Even crankcase oil from internal combustion engines will yield tolerable results.

Following ignition flaming fuel issues from the burner into the flared tuyer throat 78 from which it emerges into the combustion chamber wherein the final stages of combustion occur. The variety of fuel inlet and air inlet means in addition to draft regulation later described permits a multiplicity of variations of fuels and fuel mixtures and combustion chamber pressures ensuring that the right combination for complete combustion can be achieved.

Assuming that the combustion chamber is closed by the disc 43 the flaming products issuing from the tuyer will create a vortex whirling cyclonelike against the coating 39 while spiralling toward the flue 37 through which they will discharge to the atmosphere. This results in uniform heating of the interior surfaces of the lining 39 and of the disc 43.

The combination of radiation impinging against the inner face of the disc and heated gases whirling thereacross quickly brings and maintains the disc at a temperature most favourable for producing infrared radiation from its outer face in copious quantities. This temperature has been determined as between 1,625° F. and 1,750° F. although a wide temperature variation will yield satisfactory results.

The spacing member 46 and the horn 53 perform a dual function. They prevent wind from cooling the face of the disc and also serve to direct the rays emanating from the disc in the desired direction. In addition the member 46 and gap 54 reduce heating and consequent discoloration of the internally polished horn by conduction from the shell 30.

The heater may be used without the disc 43. The mesh 44 will then incandesce and emit infrared radiation and in addition radiation generated within the combustion chamber will escape through the interstices in the mesh. Under these circumstances the mesh serves as an effective wind barrier.

When it is desired to use the heater for cooking the post 14 and sleeve 17 may be removed and the member 22 seated within the socket 13 to reduce the height of the unit. The casing 30 will then be positioned with its mouth directed upwardly. The disc 43, mesh 44, spacing member 46 and horn 53 may be removed and replaced with a stout grill (not shown) to support cooking vessels. When so used the flue 37 may be closed in a manner to be later described.

In order to achieve optimum performance from the invention, irrespective of the type of fuel or fuels used, the fuel pressure and combustion supporting air pressure it is necessary to regulate the flue draft. The cap 58 permits a wide variation in flue draft pressure.

The axis of the threaded portion of the flue 37 is vertically disposed. This may be achieved, after directing the casing 30 in the desired direction, by inserting a rigid elbow or adjusting

a semirigid elbow in the unthreaded portion of the flue 37. When the opposed convex plates 62 and 66 are spaced as illustrated in FIG. 2 a distinct negative pressure will be developed at the mouth 70 of the flue by wind blowing between such plates from any compass direction. Negative pressure can be developed at the mouth of any conduit by the action of a stream of air blowing thereacross. In the present instance however the effect is greatly enhanced by the employment of oppositely convex plates 62 and 66 which utilize the Venturi principle to increase the air velocity across the mouth 70 in relation to its normal velocity. A hyperdraft is thereby achieved. If maximum draft is required the upper plate 62 is rotated thereby varying the spacing between the plates until the desired result is attained. The collar 59 may be then locked in position by screw 60.

In order to reduce the draft the spacing between the plates is gradually decreased. A point will then be reached at which a positive pressure will be exerted against the gases issuing from the flue. This condition may be necessary for maximum burner efficiency with certain types of fuels and certain combustion air pressures.

The gap between the plates may be further reduced until contact thereof occurs. The plate 62 will then act as a closed valve to block the flue. This arrangement would be adopted for instance, when the heater is used for cooking purposes as previously described.

Back pressure and valve action can be similarly controlled by the caps illustrated in FIGS. 3 and 4. Some negative pressure will be developed at the mouth of the flue in FIG. 3 due to air moving thereacross. This negative pressure will not reach the level achieved by the cap shown in FIG. 2 due to the absence of any Venturi action. However the cap of FIG. 3 is simpler and more economical to construct.

The cap illustrated in FIG. 4 possesses means for adjusting the back pressure in the flue 37. This cap however, is particularly useful, due to its sheltering elements, in preventing downdrafts within the flue in gusty environments.

The invention described herein is a portable, efficient generator of infrared radiation adapted to burn a variety of fuels. It may be used to direct a beam of radiation in any desired direction, utilizes wind to increase flue draft, may be adjusted by an operator wearing heavy gloves or mitts and may be used for cooking purposes. Because of these properties it is particularly fitted for use outdoors in frigid, remote regions. However it is not restricted to such use since it can be effectively used indoors with the flue 37 extended, as

required, to the outer atmosphere.

I claim:

1. An infrared radiation generator comprising a fluid fuel burner, means for admitting fuel into said burner, means for admitting air into said burner, a combustion chamber provided with a radiation emitting opening, refractory material lining said chamber, said material being adapted when heated to a predetermined temperature by combustion products issuing from said burner to emit abundant radiation in the infrared portion of the spectrum; an exhaust flue connecting said combustion chamber with the outer atmosphere and high heat permeability means closing said radiation emitting opening and means for varying the draft pressure in said flue to create, in combination with air moving externally of said flue, a hyper-draft therein.

2. An infrared radiation generator as claimed in claim 1 in which said high heat permeability means is composed of silicon carbide.

3. An infrared radiation generator comprising a fluid fuel burner capable of burning a plurality of fuels, means for admitting fluid fuel into said burner, means for admitting air into said burner, a combustion chamber provided with a radiation emitting opening, means for causing combustion products issued from said burner to form a vortex within said chamber, refractory material lining said chamber adapted, when heated to a predetermined temperature, to emit abundant radiation in the infrared portion of the spectrum, the surface of said refractory material being textured, an exhaust flue connecting said combustion chamber with the outer atmosphere and high heat permeability means closing said radiation emitting opening; said high heat permeability means being composed of silicon carbide and the outer face of said high heat permeability means being textured and means for adjusting the draft pressure in said flue to create, in cooperation with air movement external to said flue, a hyper-draft in said flue.

4. An infrared radiation generator as claimed in claim 3 in which said means for adjusting the draft pressure in said flue, when substantially vertically disposed, will respond to air movement from any compass direction.

5. An infrared radiation generator as claimed in claim 4 provided with support means permitting radiation emanating from said generator to be beamed in any desired direction and further means for locking said generator in the position so chosen.

6. An infrared radiation generator as claimed in claim 4 in which said plurality of fuels may be burned simultaneously.

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