Sept. 1, 1959 R. W. JOHNSON ET AL 2,902,578

IGNITER AND IGNITER ASSEMBLY FOR POT BURNERS

Filed Nov. 4, 1955

3 Sheets-Sheet 1

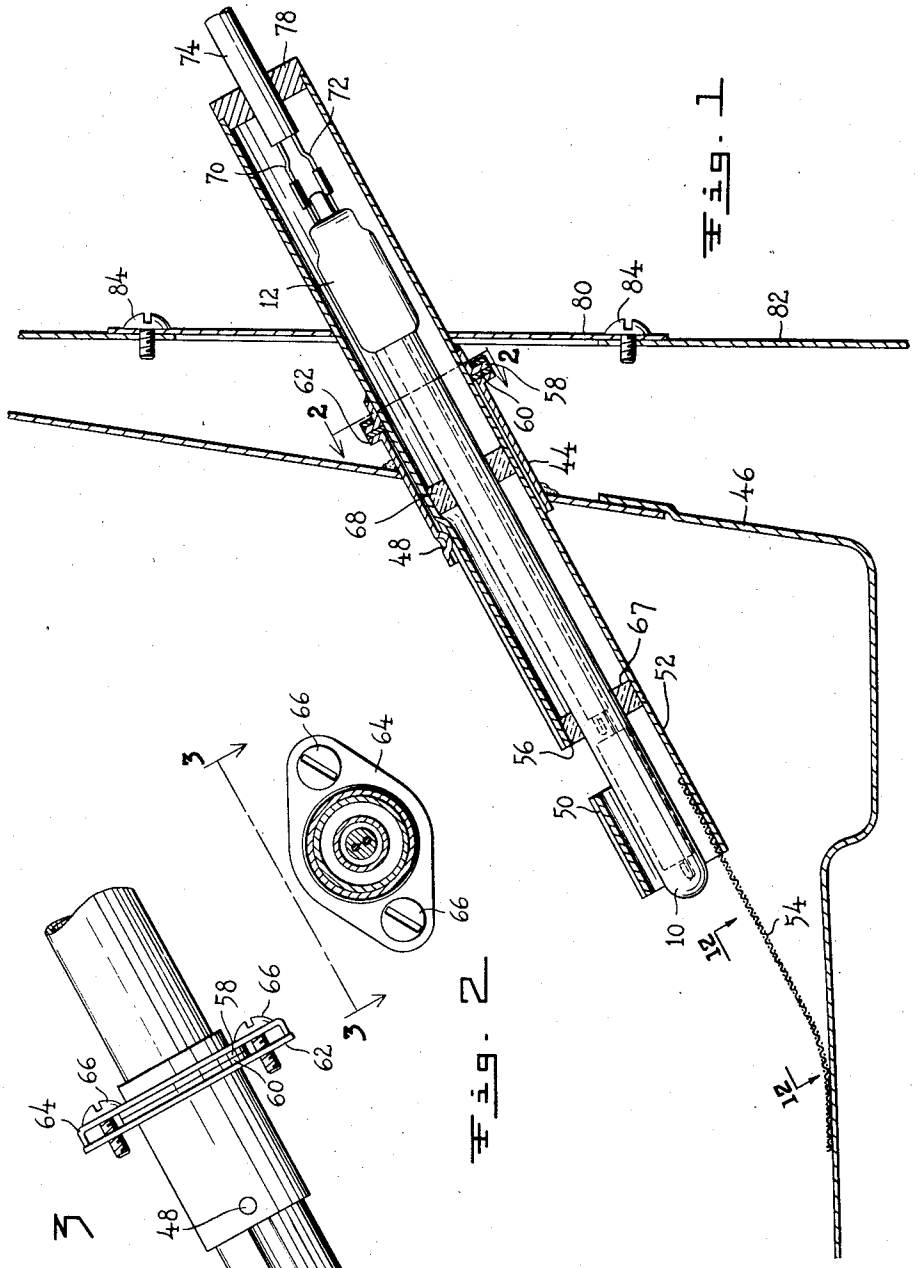

Fig. 1

Fig. 2

Fig. 3

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Filed Nov. 4, 1955 3 Sheets-Sheet 2

Fig. 4

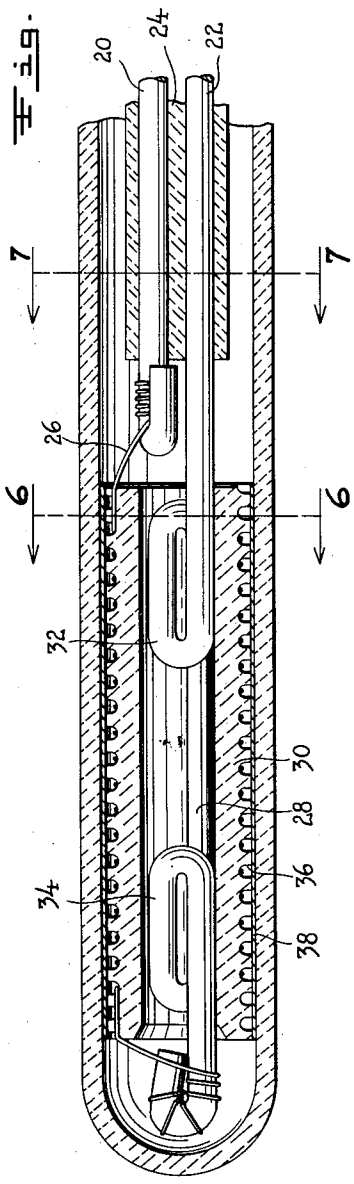


Fig. 7

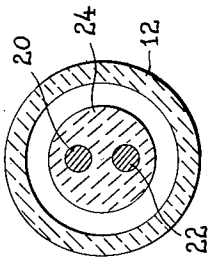


Fig. 6

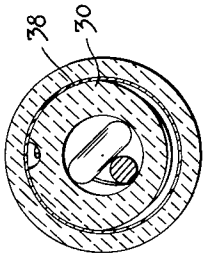


Fig. 5

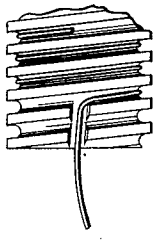
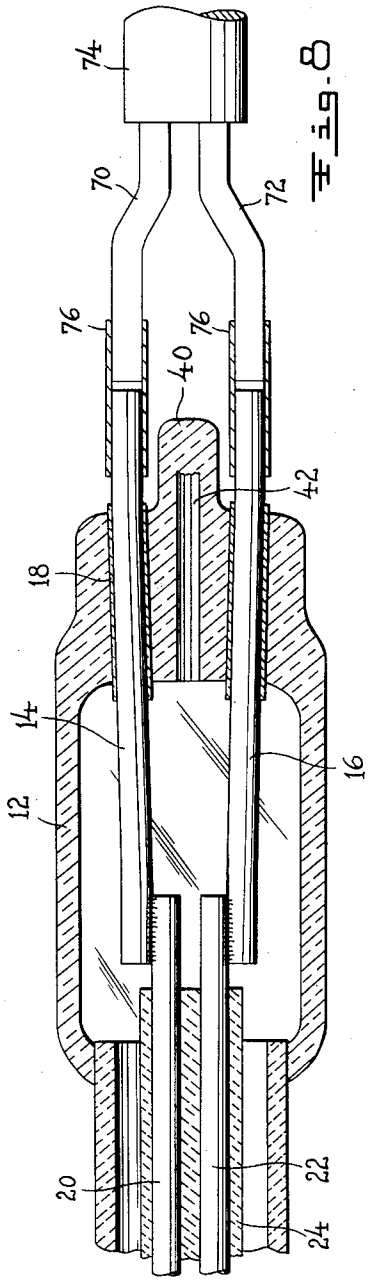


Fig. 8



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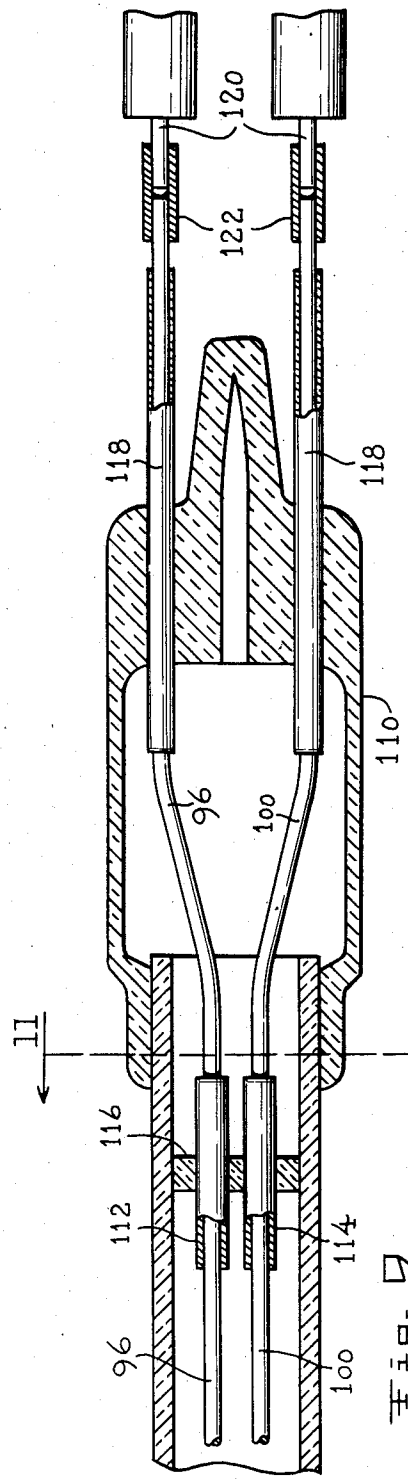

Fig. 9

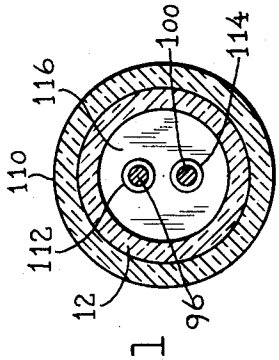

Fig. 11

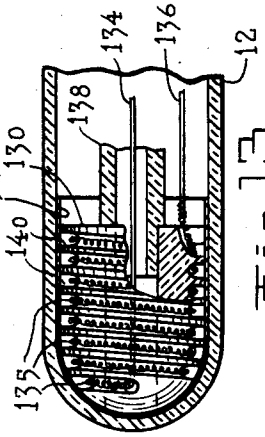

Fig. 13

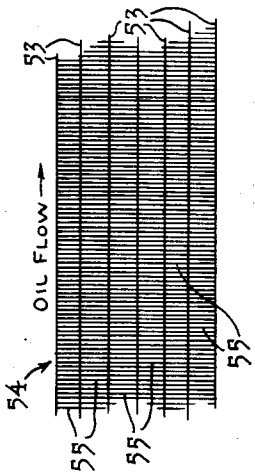

Fig. 12

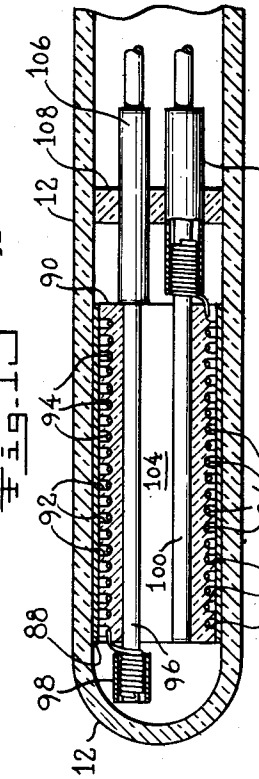

Fig. 10

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IGNITER AND IGNITER ASSEMBLY FOR POT BURNERS

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Application November 4, 1955, Serial No. 545,062

5 Claims. (Cl. 219—32)

This invention relates to a device which may be used to provide heat for ignition of fuels or may be employed as a temperature sensing element which alters a signal for control purposes.

At the outset the principal object of this invention was to provide a satisfactory igniter for use in a pot-type oil burner. This object has been achieved and the device which has resulted from the invention now appears to have considerably wider application. The device also serves to ignite gun-type oil burners and gas burners. Various characteristics make it quite useful as a temperature sensing unit in place of a stack switch, for example. Another use which appears likely is as an igniter or glow plug in diesel engines. Other uses will no doubt suggest themselves and for this reason the uses mentioned herein should not be taken as limiting the invention.

Another object of this invention is to provide a device of the type described which has a long, trouble-free service life.

Another object of the invention is to provide a device of the type described which consumes little power and is completely reliable in service.

Another object of this invention is to provide a novel igniter installation for pot-type burners.

A further object is to provide a novel wicking arrangement for lifting oil to an igniter.

Without intending to limit the invention, much of the following description will be directed to the device when serving as an igniter for burners of various types. This use is about the most rigorous presently visualized and the remarks should, therefore, illuminate the scope of the invention.

There have been efforts in the past to provide a satisfactory igniter for fuel burners but in no case have the proposals been wholly satisfactory. Spark igniters are notoriously poor so far as long service is concerned. Intermittently or continuously energized heater-type igniters have been proposed but have not been used commercially due to inability to provide a reasonable service period. Various heater constructions have been suggested but all broke down rapidly in the high heat and corrosive atmosphere encountered in service. Probably the most promising of this type was the metal clad heater element but even these became brittle and porous within a comparatively short time. Frequently, the energy requirement was great and in order to reduce the operating costs intermittent operation of the heater was dictated. This, however, requires expensive control circuits and necessitates a delay period (after the call for heat) for the igniter to reach operating temperature. Even with such controls the igniter life was too short for commercial use. Ideally the igniter should be hot at all times, ready for instant service. Past efforts in this direction have met with consistent failure which is rather understandable when it is realized the igniter must then operate continuously in corrosive conditions at temperatures upwards of 1500° F. for a number of heating seasons.

The present invention provides an igniter adapted for continuous service. This igniter has a service life well above minimum commercial requirements and is apparently unaffected by the continuous high operating temperatures or by the combustion gases. The outward appearance remains the same with no destruction of the exterior of the igniter which, in service, is constantly incandescent.

The igniter has an exterior sheath of high alumina to which glass is sealed at one end. Leads to the heater element are brought in through the glass and the heater wire (tungsten) is wound on a high alumina support. Between the support and the inside of the sheath is a nickel sleeve which will be described more fully hereinafter. The interior of the sleeve is charged with dried hydrogen. It is thought that the inside temperature runs in the neighborhood of 2000° F. while the outside temperature is about 1700° F. When the igniter is constructed as hereinafter explained in detail it has an exceptional service life with low power consumption. Since the operating cost is, therefore, low it becomes desirable to have the unit continuously energized which permits a great simplification in the allied burner controls with a resulting reduction in cost to the purchaser.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the three embodiments shown in the drawings in which:

Fig. 1 is a side elevation partly in section of an igniter incorporating the present invention and serving as an igniter showing the manner in which it is mounted in a pot-type burner;

Fig. 2 is a section taken as indicated by line **2—2** in Fig. 1;

Fig. 3 is a section taken as indicated by line **3—3** on Fig. 2;

Fig. 4 is an enlarged section of the tip portion of the igniter;

Fig. 5 is an enlarged fragmentary view showing the manner of winding the resistance wire on the spool;

Fig. 6 is a section taken as indicated by line **6—6** on Fig. 4;

Fig. 7 is a section taken as indicated by line **7—7** on Fig. 4;

Fig. 8 is an enlarged fragmentary section showing the seal end of the igniter;

Fig. 9 is an enlarged section of a modified form of construction for the lead-in;

Fig. 10 is an enlarged section of a modified tip construction;

Fig. 11 is a section taken as indicated by line **11—11** on Fig. 9;

Fig. 12 is a view of the wire screen used as a wick in Fig. 1; and

Fig. 13 is a section of a third modification of the tip construction.

Referring now to the drawings in detail, Fig. 1 shows a device according to this invention serving as an igniter in a pot-type burner. The details of the igniter installation will be discussed more fully hereinafter, the present reference to Fig. 1 being for the principal purpose of showing the exterior shape of the igniter element. It will be noted the igniter includes a sheath **10** having a generally tubular glass seal **12** fused thereto at one end. The sheath **10** is made of high alumina which is a dense refractory ceramic capable of withstanding very high temperatures and pressures without deterioration. The glass seal is fused to the sheath and is selected to have a coefficient of expansion substantially equal to that of the ceramic and to that of the Kovar (42% nickel steel) leads **14**, **16** passing through the seal. The glass is heated

and carefully pinched onto the leads to hermetically seal the glass to the leads. Prior to sealing the leads the leads are coated with beading glass 18 to improve the quality of the seal. It should be noted that one type of glass available today can be used for the entire seal but the seal can be made of two types of glass—one which matches the sheath and the other selected to match the Kovar.

Inside the seal the Kovar leads are welded to molybdenum (hereinafter referred to as "moly") leads 20, 22 which pass through a high alumina insulator 24 having spaced holes therein. Moly leads may be substituted for the Kovar leads without adversely affecting the seal. At the inner end of the insulator one moly lead 20 is terminated in a sharp bend upon itself to securely engage one end of tungsten resistance wire 26 wrapped on the lead. The longer moly lead 22 passes through the hole 28 in spool or conductor support 30. The long lead is bent as shown at 32, 34 in Fig. 8 at spaced locations to snugly engage the hole 28 to position the spool on the lead. The innermost end of the long lead 22 has the other end of wire 26 wound thereon and is bent sharply to make a secure connection with the wire. The spool 30 has a helical groove in its outer surface and the resistance wire 26 is wound in the groove. When an electric potential is impressed across the moly leads the tungsten wire will heat. The support material (in this case high alumina) must have good electrical resistance at high temperatures to avoid shorting the resistance wire. Many resistors at normal temperatures become quite conductive at high temperatures and are not suitable. The support must also withstand continuous high temperatures.

The interior of the sheath is charged with a gas which is inert with respect to the leads, sheath and spool. Hydrogen is an excellent gas for the charge since it will combine with any free oxygen during the flushing process and prevent the oxygen later attacking the resistance wire. Furthermore, the hydrogen has good thermal conductivity and is inert with respect to the resistance wire and the sheath and spool. The true inert gases can be used but they do not have the high thermal conductivity found in hydrogen. The principal feature required of the gas charge is that it is inert with respect to the wire, spool and sheath.

A nickel sleeve 38 is fitted snugly over the spool and fits snugly inside the sheath 10. This sleeve distributes the heat uniformly to avoid hot spots and in some cases it additionally acts as a getter in taking up impurities. At present the sleeve is considered necessary to achieving uniform quality but further advances in impurity removal may eliminate the need.

Clearance between the resistance wire and the groove in which it is mounted, the clearance between the spool and sleeve and the clearance between the sleeve and inside of the sheath are all quite critical. These clearances must be held as low as possible in order to keep the current consumption within proper limits. If the clearance is increased, the current consumption goes up rapidly and the wire is reduced and fails.

As noted above, the outside of the tip portion of the igniter operates around 950° C. (1700°–1750° F.). This can be done without damage to the glass seal since the rather considerable length of the sheath prevents the glass from reaching temperatures approaching this. Referring back to Fig. 1 now, the manner of mounting the igniter in a pot-type burner is illustrated. The mounting tube 44 is welded in the wall of pot 46 at a downwardly inclined angle. The detent 48 cooperates with groove 50 in guard 52 to properly register the guard to position the stainless steel wire gauze wick 54 at the bottom of the guard with the hole 56 at the top of the guard. The guard is inserted into the tube 44 until the guard flange 58 compresses gasket 60 against flange 62 on tube 44. The mounting plate 64 is now secured to tube flange 62 by screws 66, 66. Asbestos ring 67 is positioned as shown between the hole 56 and the outside end of the guard. Asbestos ring 68 is inserted into guard 52 to the outer end of the groove 50 as shown and the igniter is passed through the ring until the tip just barely projects from the end of the guard. Wires 70, 72 from cable 74 are connected to the Kovar leads 14, 16 by crimping the connectors 76, 76 over the wires and leads as shown in Fig. 8. The cable 74 is pulled through washer 78 at the outer end of the guard. The access plate 80 is passed over the guard and connected to the furnace wall 82 by screws 84, 84.

When installed as described, the lowest point on guard 52 should be at about the maximum possible oil level in the pot. This prevents immersion of the igniter in oil if the pot should be flooded. Normally the floor of the pot is dry and when oil flows into the pot it is drawn up the wick 54. Since the exterior of the igniter is incandescent over an area generally corresponding to the location of the spool (shown in dotted lines) the guard and upper portion of the wick are hot enough to vaporize oil. The vapors rise and are ignited by the igniter to start combustion. As the combustion proceeds the flames rise in the pot and the igniter is not heated by the flames except by radiant heating. The radiant heating of the igniter is held down by the protection afforded by guard 52. Any increase in heat of the igniter will reduce the electrical resistance of the resistance wire which in turn reduces the heating effect. This ballast action insures against overheating the resistance wire which would cause failure. It will be noted that the length of the igniter plus the presence of the asbestos rings 67, 68 prevents overheating the seal.

As mentioned above the upper part of wick 54 and the lower part of guard 52 get quite hot and serve to vaporize oil coming up the wick. Hole 56 in guard 52 is important since it develops a chimney effect drawing the hot vapors up over the igniter tip. The spacing between the igniter sheath and the guard is very important—present use calls for a ⅛" space. If this space is reduced as much as 1/32", the igniter will not operate since the vapors are like a fog and are not a combustible mixture. If the clearance is increased as much as 1/32", a greatly increased current requirement is encountered—so much current, in fact, that the igniter becomes unusable. Therefore, the spacing has to be almost the minimum which will produce a combustible mixture.

The wick 54 should be noted specially. In order to operate successfully the wick must work fast and must be able to stand up for long periods in this corrosive atmosphere. Various conventional wicks have been tried with some success. Conventionally woven screen or mesh was tried but did not have sufficient wicking action. Most successful has been the illustrated Twilled Dutch Weave which is 30 x 250 mesh and has excellent wicking action and can be made of stainless steel to insure long service life. The widely spaced 30 mesh wires 53 are positioned to run vertically while the closely spaced 250 mesh wires 55 run horizontally. When the bottom of the wick is touched by oil the oil seems to "climb" up the wick. The wick is quite important to operation of the igniter in a pot burner and while the illustrated weave is preferred, the invention in its broader aspect is not limited to that form.

The structure in Figs. 9 to 11 includes the sheath 12 fitting over the nickel sleeve 38 and the spool 90 which has the grooves 92 in which the resistance wire 94 is wound. The left or outer end of wire 94 is wrapped around moly lead 96 and held thereon by connector sleeve 98. The inner end of wire 94 is wrapped on lead 100 and connected by sleeve 102. Both leads 96 and 100 pass through the central bore 104 inside the spool to position the spool properly. An extra sleeve 106 is mounted on lead 96 to abut the spool and reduce the chance of relative movement between the leads and the wire 94. The spaces fit in cooperating holes in the ceramic washer 108 which

supports the lead wires and reduces gas circulation within the igniter as well as serving to insulate the glass seal **110** at the other end of the sheath. At this cool end the leads **96** and **100** are provided with additional sleeves **112** and **114** which support the leads from each other at washer **116**. At the glass seal **110** the leads are spread and pass through the seal which actually contacts the beading glass **118** on the leads. The leads are then connected to other wires **120** by connectors **122**. This modification uses less expensive construction and still runs cooler than the first modification. Furthermore, by reducing the possibility of gas and impurity movement from one portion of the element to another by reason of the washers **108**, **116**, there is less chance of failure.

The tip construction of Fig. 13 has spool **130** with a curved end so it can fit snugly inside the similarly shaped nickel cap **132** which in turn fits inside the sheath **12**. Here the lead wires **134**, **136** are quite thin and flexible. The central lead **134** is brought in through a ceramic tube **138** which acts as an insulator and fits into the opening in the spool **130**. This lead **134** goes to the tip of the spool and is there connected to a very fine coiled tungsten resistance wire **135**. By "very fine" we mean .0017" diameter as opposed to the .010" diameter used in the other modifications. This coiled, spring-like wire is wound on the spool in the grooves **140** and its other end is connected to lead **136**. Both leads are then brought out through a seal etc.

While construction of the three modifications differs, they all have several features in common. Thus, all have the resistance wire wound on a spool which is covered by a close fitting nickel sleeve or cap and this assembly fits snugly within the high alumina sheath which is charged with a gas. As used in the claims "sleeve" is used as including "cap." The basic features of the igniter are the sheath, the gas charge and the resistance wire. Additionally, the spool support is found quite important in that it positions the resistance wire close to the sheath and also prevents movement of the wire. The spool need not take the form shown but should provide support for the resistance wire and position the wire close to the sleeve.

Another use of the igniter is to ignite gun type oil burners. In such a case the igniter would be placed in the spray from the gun but would be protected from the spray by wire mesh or the like which would be heated by the igniter and serve to vaporize the oil spray for ignition. Another use would be as an igniter for a gas burner which appears to raise no special problems. Still another use is as a control element wherein a small current would be passed through the resistance wire without appreciable heating thereof. When the element is heated by an external source the change in resistance will affect the signal current flow and the change can be used for control purposes. This use could substitute for a conventional stack switch arrangement. Finally, the element may be usable as a glow plug in a diesel engine.

A few additional comments are in order. The sheath, spool and insulator are made of high purity high alumina. The sheath and spool at least should be of the same material to avoid a condition similar to electrolysis. High alumina is a dense, hard, refractory material which will withstand high vacuum and high heat. Other materials may now or later be found suitable. The material should be able to withstand high temperatures for long periods and should not be conductive at high temperatures (which pretty well rules out metals). The logical choice is ceramics although "cermets" may prove satisfactory. The high alumina is fired at about 3000–3200° F. which is necessary to avoid vitrification. Whatever material is used it appears the firing temperature thereof should be in excess of 2700° F. The leads and resistance wire have been described as moly and tungsten but other materials may be satisfactory.

Although but three embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. A device of the class described comprising, a sheath of dense refractory material open at one end, a conductor support within the sheath, a resistance wire wound on the conductor support, lead wires connected to the ends of the resistance wire and projecting through the open end of the sheath, a metal sleeve of good heat conducting properties fitting snugly over the conductor support out of contact with the resistance wire and fitting snugly within the sheath, hermetic sealing means sealed to the sheath and the lead wires, and a gas charge within the sheath, the gas being inert with respect to the resistance wire and sheath.

2. A device according to claim 1 in which the metal sleeve is nickel.

3. A device according to claim 1 in which the conductor support is made of the same material used in the sheath.

4. A device according to claim 1 in which the sheath is and conductor support are both made of a ceramic material having a firing temperature in excess of 2600° F.

5. A device of the type described comprising, a sheath of dense refractory material capable of withstanding high temperatures and high vacuum and being non-corrosive, a conductor support inside the sheath, said conductor support being formed with grooves therein for the reception of a resistance wire whereby the turns of the wire are kept from contacting each other, a resistance wire wound on the support and disposed within said grooves, electric leads connected to the ends of the wire and projecting from the sheath, and a sleeve of nickel disposed within the sheath in contact with both the inner wall of the sheath and with the outer surface of the grooved conductor support, means hermetically sealing the sheath with the leads projecting therefrom, and a gas inside the sheath which will not react with the sheath, support, wire or leads.

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