Oct. 18, 1949. T. Y. KORSGREN ET AL 2,485,496

ELECTRICAL IGNITER

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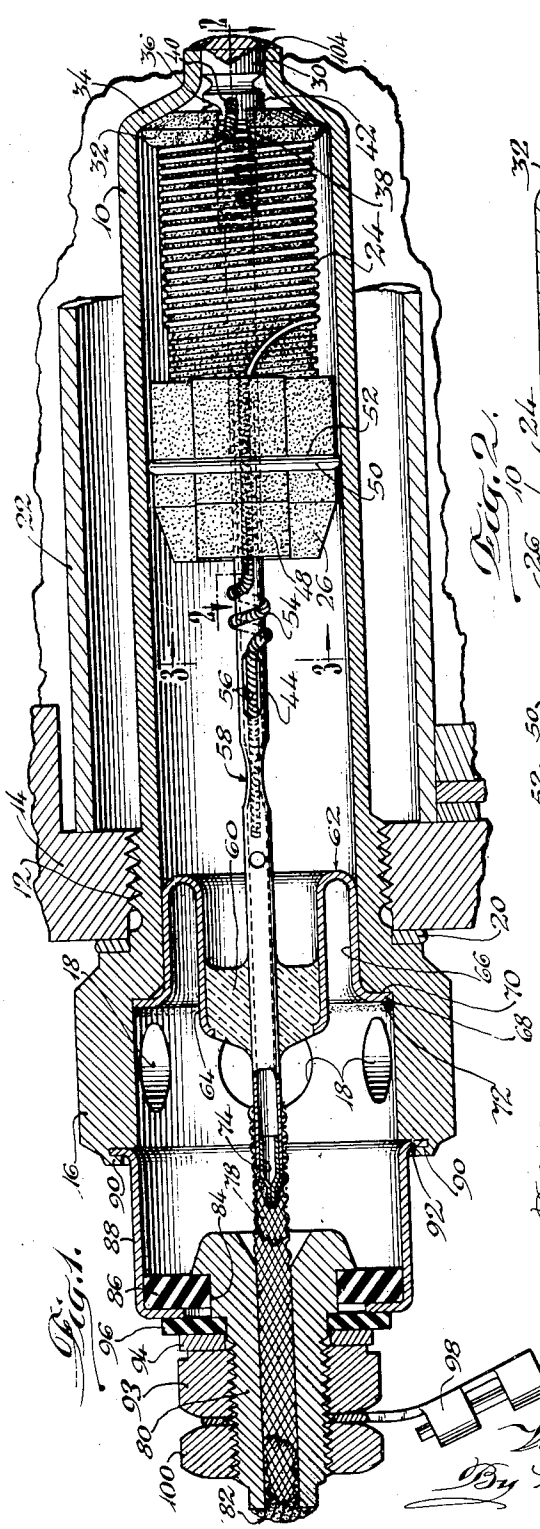


Fig. 1.

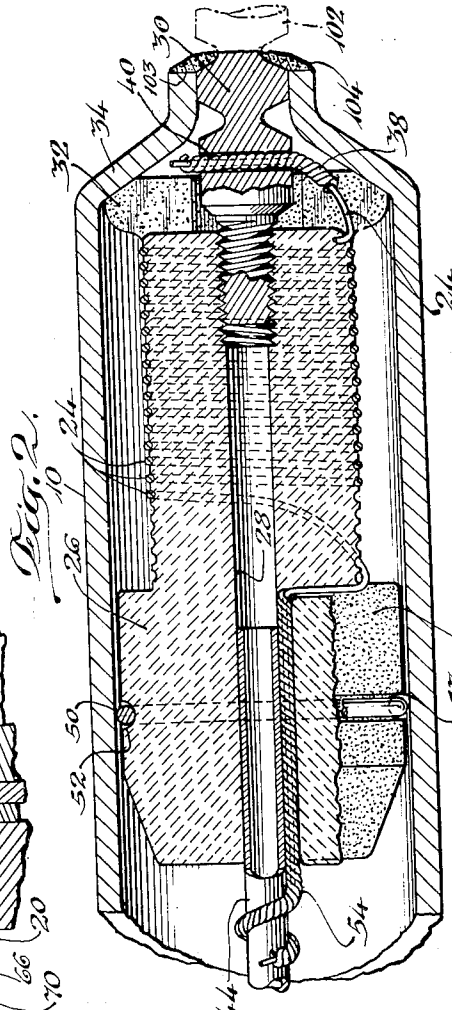


Fig. 2.

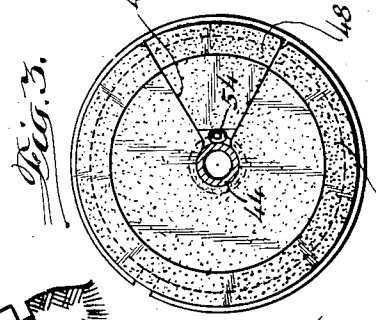


Fig. 3.

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Fig. 5.

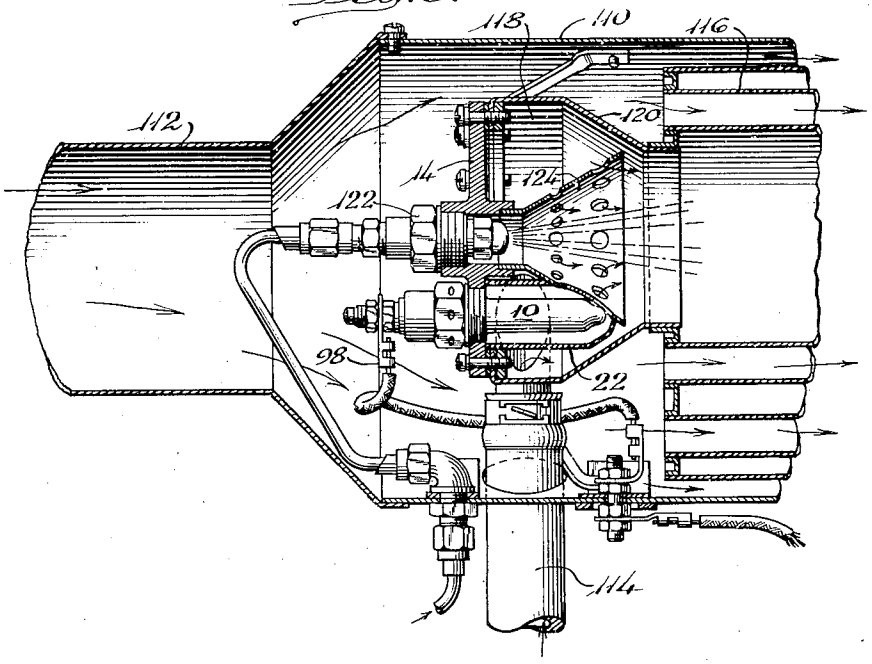
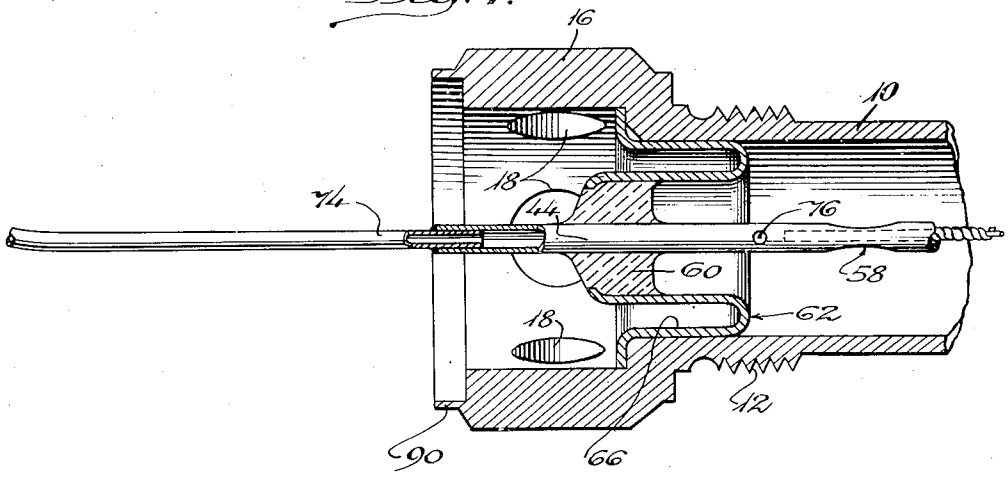


Fig. 4.



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ELECTRICAL IGNITER

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3 Claims. (Cl. 219—32)

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Our invention relates generally to igniters, and more particularly to igniters of the hot wire type used for the ignition of liquid and vapor fuel burning heaters and the like.

It has been customary in many types of heaters to ignite the fuel mixture by means of a coiled wire of nichrome or similar high resistance material electrically heated to incandescence. Such igniters have usually had a relatively short useful life due to various factors. For example, the corrosive action of the hot products of combustion resulted in increasing the resistance of the wire so that it became heated to an excessively high temperature and rapidly burned out. Deposits of soot and carbon upon the resistance wire likewise caused rapid deterioration of the wire.

In addition, there were certain dimensional and quantitative relationships which had to be maintained in order to assure usefulness of the igniter for a reasonable length of time, and these necessary relationships did not permit ready utilization of igniters of this type with sources of different voltage. The design of the coiled resistance wire had to accord with the voltage at which it was to be operated, and since it was not feasible to reduce the diameter of the wire beyond a certain limit, it was found more practical to incur the additional expense of a transformer whenever an igniter was to be operated from a source at a relatively high voltage, such as 110 volts A. C. For example, if it were endeavored to design an igniter of this type, of reasonable overall dimensions, for operation at 110 volts, it would be found necessary that the resistance wire be either of impractically small diameter, or of impractical length in order to provide for the required resistance, temperature rise, and heat output at the given voltage.

Furthermore, many resistance wire igniters of the type commonly used in the past were inefficient in the utilization of the electrical energy supplied thereto, since the heat produced thereby was not effectively concentrated, but instead, was in part ineffectively radiated.

In accordance with the underlying principles and objects of our invention, the electrical resistance wire is sealed in a suitable envelope containing inert gases, and the envelope heated by radiation from the resistance wire heating element to a temperature sufficient to cause ignition of the fuel. By virtue of this arrangement, the heating element is protected from corrosion while the envelope may be made of a material resistant to corrosion irrespective of its electrical conductive properties. Thus the materials of which the resistance wire and envelope are made may be independently selected for the most efficient performance of their respective functions. Thus the resistance wire may be made of tungsten, and safely be heated to higher temperatures than were feasible with nichrome and similar alloys. Since the resistance wire heating element is entirely enclosed, it is not subject to having turns thereof short-circuited by deposits of foreign matter, such as carbon from partially burned fuel, or lead residue from fuels treated with lead compounds, and thus its useful life is greatly extended.

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By virtue of the fact that the resistance wire is separate from and enclosed in an envelope, with only the latter coming into contact with the hot gases and products of combustion, the amount of heat generated may be readily predetermined in the design of the heating element, with consequent efficient utilization of the electrical energy and accurate control of the temperature to which the envelope is heated. In addition, the life of the igniter may be controlled by the thickness of the envelope wall.

Other objects of the invention are to provide an improved electrical igniter in which the resistance wire heating element is fully protected against damage in handling and in use, in which provision is made for the effects of differential thermal expansion of the various parts, and in which a gas-tight seal of the envelope is effected to prevent escape of the inert gases and so that pressure variations of the gas within the envelope, due to variations in temperature, may be utilized for control purposes.

A further object is to provide an improved electrical igniter in which the parts are united in a durable assembly, not readily damaged by handling or use.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a central longitudinal sectional view of our improved igniter shown secured in a portion of a heater;

Fig. 2 is a slightly enlarged central longitudinal sectional view of the resistance wire heating element, illustrating also the manner in which the parts are assembled, and taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional view of the

stem seal showing the parts prior to complete assembly; and

Fig. 5 is a fragmentary central vertical sectional view of a sealed combustion heater, illustrating the manner in which the improved igniter may be used.

Referring to Fig. 1, the igniter comprises an envelope or body 10 which is generally tubular in shape and may be provided with threads 12 for securing it in a tapped opening in a combustion chamber wall 14. In lieu of the threaded connection a press fit may be employed. The envelope 10 is provided with a hexagonal portion 16 having ventilating openings 18 therein. A gasket 20, preferably of copper or similar metal, is provided to assure a good grounding connection between the envelope and the combustion chamber wall 14.

The envelope 10 is preferably surrounded in part by a heat retaining shield 22 forming part of the combustion apparatus of the heater in which the igniter is installed.

The envelope 10 is preferably made of stainless steel or other metal or alloy which is highly resistant to corrosion by the products of combustion at high temperatures, and which will not materially change its shape when subjected to high temperatures. Stainless steel is also of advantage as the metal of which the envelope is made, because of its fairly low thermal conductivity which makes it possible for the heat to be concentrated at the end of the envelope, with relatively small losses due to conduction of heat to the combustion chamber wall 14.

The heating element comprises a wire 24 of tungsten, tungsten alloy, or the like, wound on a suitable helically grooved form 26. The latter is preferably made of thorium oxide, aluminum silicate, or other suitable electrically insulating ceramic material capable of withstanding high temperatures without deterioration, fracture, or distortion. The form 26 has an axial bore 28, one end of which is threaded to receive a terminal stud 30. The inner end 32 of the form 26 is of increased diameter and shaped to engage the tapering end 34 of the envelope 10. The end portion 32 is also provided with a diametral slot 36 through which the end of the wire 24 is passed. This end of the wire has a pad coil 38 of tungsten wire surrounding it, and extends through a diametrical hole 40 formed in the terminal stud 30, the latter being deformed by swedging, as indicated at 42 in Fig. 1, to clamp the wire 24 with its pad coil 38 firmly in place to secure a reliable mechanical and electrical connection between the wire and the terminal stud.

A tube 44 made of Kovar or similar alloy, having a coefficient of thermal expansion similar to that of a suitable vitreous seal, extends into the bore 28. The form 26 has a sector-shaped slot 46 formed at its enlarged end and this slot is substantially filled by a sector-shaped plug 48, the latter being held in position by a split ring spring 50, of stainless steel or the like, which fits in a groove 52 formed around the enlarged end portion of the form 26 and a registering groove 53 formed in the plug 48.

The plug 48 does not entirely fill the segmental slot 46, but leaves space for the passage of the end of the wire 24 and its pad coil 54. As best shown in Fig. 1, the pad coil 54 and the embraced end of the wire 24 have several turns around the tube 44 and pass into this tube through an elongated slot 56. Beyond the slot 56 the pad coil 54 and the end of the wire 24 are clamped to the tube 44 by necking the latter, as indicated at 58 in Fig. 1, so as to secure a reliable mechanical and electrical connection between the end of the wire 24 and the tube 44.

The tube 44 extends through and is bonded to a vitreous sealing bead 60 which is supported by a seal element 62. The latter has an inner cylindrical portion 64 for the reception and adhesion thereto of the vitreous sealing bead 60 and an outer cylindrical portion 66 terminating in a flange 68. The re-entrant cup shape of this sealing element 62 provides for some flexibility and prevents the application of excessive strains to the seal due to thermal expansion and contraction. The sealing element 62 is preferably made of Kovar or similar alloy having a coefficient of thermal expansion substantially equal to that of the vitreous bead seal 60. The latter may be of a type known commercially as "Corning G-705 AJ." The flange 68 of the seal element 62 rests against a shoulder 70 formed in the envelope 10, and is sealed therein, preferably by silver brazing at the edge 72.

A copper tube 74 is brazed in the end of the tube 44 and has its outer end collapsed and brazed so as to form a plug for the end of the tube 44. As best illustrated in Fig. 4, during the process of assembling the igniter, the tube 74 is connected to a suitable vacuum pump and the air within the envelope 10 is exhausted through an opening 76 formed in the tube 44. After being exhausted, a suitable inert gas, or gas mixture, such, for example, as a mixture of 87% argon and 13% nitrogen, is supplied to the envelope at substantially atmospheric pressure. When the envelope has thus been refilled, the tube 74 is collapsed and severed close to the end of tube 44, and sealed by brazing with silver. Thereafter a tubular conducting wire mesh 78 is silver soldered or brazed to the tubes 44 and 74 so as to make a reliable, durable, electrical connection therewith. The wire mesh 78 is then passed through the central bore of a binding post 80 and the extremity of the former is soldered to the latter as indicated at 82.

The binding post 80 has a square or other non-circular portion 84 over which is fitted a heat and electrical insulating washer 86 which has an opening conforming to the shape of the portion 84 and the outline of which is preferably square. A thimble 88 having its outer end portion deformed to form a square recess for the washer 86 is then secured to the hexagonal portion 16 of the envelope 10 by swedging a lip 90 of the latter over the base flange 92 of the thimble. The binding post 80 is secured to the thimble 88 by a nut 93, lock washer 94, and insulating washer 96. The electrical connection to the binding post 80 may be made in in any suitable manner, as by a terminal soldering lug 98 secured by means of a nut 100. The tubular wire mesh 78 is sufficiently flexible and extensible that any relative movement of the tube 44 with respect to the binding post 80, due to the differential thermal expansion or mechanically applied forces during handling, does not apply strains to the vitreous bead seal 60.

In assembling the stud 30 in the envelope 10, the stud is initially formed with a rod-like extension 102 (Fig. 2) connected to the stud proper by a reduced diameter section. When the stud has been threaded in the form 26, a seal with neck portion 103 of the envelope 10 is effected by a weld 104. Thereafter the extending portion 102 of the stud may be broken or cut off

so as to leave a hermetically sealed assembly as shown in Fig. 1.

It will be appreciated that Figs. 1 to 4 are to enlarged scales, and that the major portion of the envelope 10 is in the order of one-half inch in diameter. From this it will appear that the igniter forms a very compact small unit which may be used in small sealed combustion type heaters as well as in other forms of combustion apparatus.

Fig. 5 illustrates the use of the igniter as a part of a sealed combustion type heater. The heater comprises an external casing 110 having an inlet duct 112 for the ventilating air and an inlet pipe 114 for the air for combustion. Within the casing 110 is a suitable heat exchanger 116. A combustion chamber 118 is formed by a stamping 120 secured to an end plate 14. A fuel supply nozzle 122 is suitably secured in the end plate 14 in axial alignment with a perforated conical baffle 124 likewise secured to the end plate 14. The igniter shield 22 surrounds the igniter envelope 10 and serves as a reflector and retainer of heat radiated from the igniter, and as a means to prevent the stream of combustion air supplied through the pipe 114 from impinging directly upon the igniter envelope. Droplets of the fuel supplied through the nozzle 122 drain into the shield 22 and are there vaporized and ignited, thereby igniting the fuel and air mixture in the combustion chamber.

In the construction of the igniter, the size of the tungsten or other high resistance wire 24 used may be determined by the voltage to be applied to the igniter, since it will be apparent that the useful life of the wire will not depend upon it being of relatively large diameter, but rather that the wire may be of any practical diameter and length providing the required resistance. The pad coils 38 and 54 not only serve as a means for facilitating the electrical connections between the ends of the wire 24 and the stud 30 and tube 44, respectively, but also serve, in effect, to reduce the resistance of those portions of the wire 24 which are enclosed thereby, and thus prevent such portions from becoming overheated. Since the radiation from the portion of the wire embraced by the pad coil 54 is greatly limited, it is desirable in this manner to reduce the I^2R loss in this portion of the wire.

It will be noted that the form 26 is secured at but one end thereof, so that differential thermal expansion of the form relative to the envelope 10 will not impart strains to the form. Similarly, since the tube 44 is freely slidable in the bore 28, such differential expansion cannot apply any strains to the vitreous sealing bead 60. Because the tube 44 and the seal element 66 are made of an alloy having a coefficient of thermal expansion substantially the same as that of the vitreous bead 60, the latter will not be subjected to any appreciable strains and will be effective to maintain a gas-tight seal. A certain amount of air will circulate through the holes 18 to prevent an undue rise in temperature of the vitreous seal.

Under some conditions, it may be desirable to utilize the thermal expansion of the inert gases within the envelope 10 as a means for operating control bellows. In such instances the tube 74, as shown in Fig. 4, will be connected directly to the bellows. For example, in a heater of the type illustrated in Fig. 5, a switch operated by the bellows when the latter is expanded may be utilized to control the energization of a solenoid in the fuel supply line for the nozzle 122, and may, in addition, control the operation of a valve in the combustion air supply pipe 114. In this type of control the closure of the main operating switch would result in supplying current to the igniter and after the latter had been heated sufficiently to expand the inert gases contained in its envelope, the bellows would be expanded, as against spring pressure, to close the switch or switches, whereby the valves in the fuel and combustion air lines would be opened. Thus ignition of the fuel and combustion air lines would be opened. Thus ignition of the fuel would be facilitated, since the igniter envelope 10 would be raised to a high temperature before it would be subjected to any cooling effect of the combustion air supplied.

Since the heating element is surrounded by an inert gas, corrosion thereof is prevented. Likewise, the heating element is protected against deposits of carbon, lead, and against damage by rough handling. It will be clear that the maximum temperature attained by the wire, and the duration of its useful life, will depend, among other factors, upon the thickness of the wall of the envelope 10. The envelope 10, being made of stainless steel will be highly resistive to corrosion and will cause substantial localization of the heating effect adjacent the heating element, thereby decreasing the current consumption necessary to obtain ignition. The igniter is therefore very efficient not only with respect to the maximum current which it draws, but also with respect to the rapidity with which it is heated to ignition temperature.

While we have shown and described a preferred embodiment of our invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles of the invention. We therefore desire, by the following claims, to include within the scope of our invention all such variations and modifications by which substantially the results of our invention may be obtained through the use of substantially the same or equivalent means.

We claim:

1. In an electrical igniter, the combination of a metallic envelope, an insulating heat resistant form within said envelope, a stud extending through the end of said envelope and securing one end of said form to said envelope, said stud being welded to said envelope to seal the end of the latter, a tungsten wire wound on said form to provide a heating element, one end of said wire being mechanically and electrically secured to said stud, a tube held in position by said form and having the other end of said wire mechanically and electrically secured thereto, an electrically insulating vitreous seal between said tube and said envelope, a binding post rigidly secured to said envelope, and a flexible extensible conductor connecting said tube to said binding post.

2. In an electrical igniter of the resistance wire type, the combination of a relatively long tubular envelope of heat and corrosion resisant metal, a ceramic form having a heating element wire wound thereon, a stud secured to said form and having one end of said wire electrically and mechanically secured thereto, said stud projecting through an opening in the end of said envelope and having a weld to seal it to said envelope, a vitreous press at the other end of said envelope, and a conductor extending through said press and connected to the other end of said wire.

3. In an electrical igniter, the combination of a generally cylindrical stainless steel envelope, an insulating heat resistant form within said en-

velope, means securing one end of said form to said envelope, a wire wound on said form to provide a heating element, one end of said wire being electrically connected to said envelope, a tube extending through said envelope, said tube being held in position by said form and having the other end of said wire electrically connected thereto, and an electrically insulating vitreous seal between said tube and said envelope.

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