Oct. 9, 1962 H. WAGNER 3,057,400

GLOW BURNER FOR FUEL-AIR MIXTURE

Filed Nov. 8, 1955

Fig. 1.

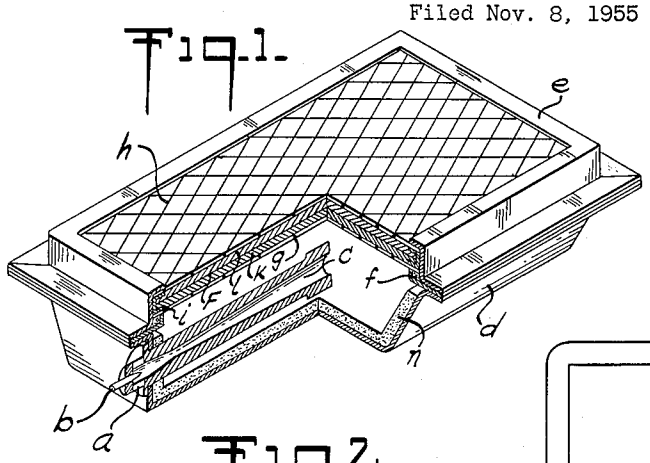


Fig. 2.

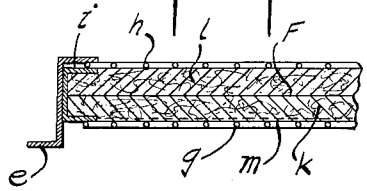


Fig. 3.

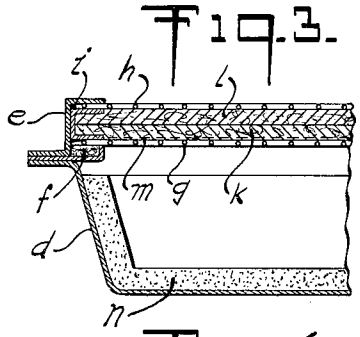


Fig. 4.

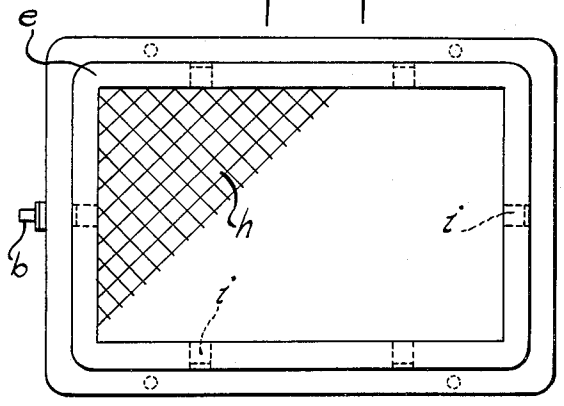


Fig. 5.

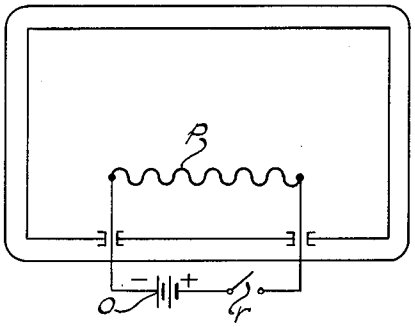


Fig. 6.

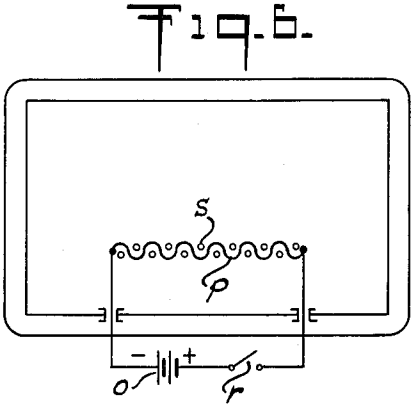
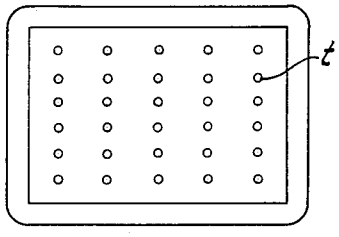


Fig. 7.



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United States Patent Office

3,057,400
Patented Oct. 9, 1962

3,057,400

GLOW BURNER FOR FUEL-AIR MIXTURE

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Filed Nov. 8, 1955, Ser. No. 545,688
Claims priority, application Germany Nov. 12, 1954
4 Claims. (Cl. 158—99)

The present invention refers to glow burners where a mixture of a combustible gaseous fuel and of air is sucked into the burner by an injector-like nozzle system. Combustible gases, for instance, are lighting gas, natural gas, propane, butane, hydrogen, and carbon monoxide; combustible vapors are various hydrocarbons, among them principally the benzenes. Glow burners operate according to the known principles of Bunsen burners. The air required for the combustion is sucked up at atmospheric pressure by a free gas stream coming from a jet and is mixed with the gas stream in an injector mixing nozzle. The mixture is then driven by the kinetic energy of the gas stream out of the mixing chamber into the actual glow burner.

The burner element in hitherto known glow burners consisted, for example, of a ceramic glow plate with a large number of narrow capillary channels through which the fuel-air mixture flows to the outside. When the outcoming mixture is ignited, a zone of the plate near the outside surface thereof will begin to glow a bright red.

It is the principal object of the present invention to improve glow burners in various directions. Therefore, it is one object to prevent blow-back of the flame as far as possible. It is another object to ensure that combustion is as complete as possible so as to prevent as far as possible the formation of carbon monoxide. It is a further object to reduce fire hazard as much as possible when the burner is in operation.

The resistance encountered by the fuel-air mixture, when flowing through the burner, should be as low as possible, to facilitate the intake of a maximum amount of air required for complete combustion of the mixture, and to prevent the formation of a flame feather above the surface of the glow burner.

It is a further object of the invention to obtain these results with a simple construction which even after prolonged operation at high temperature is neither destroyed nor changed.

These objects are accomplished according to the present invention by effecting the glow combustion in a layer or mat of fine fibers of quartz glass or quartz wool, i.e. fibers consisting essentially of pure silicon dioxide.

Preferably, the quartz wool consists of particularly fine filaments of quartz glass, i.e. filaments with a diameter of 1 to 20 μ. In particular cases filaments with a diameter up to 150 μ, and down to about 0.5 μ may also be used. The shape of the filament can be varied in many ways and it can for example, be straight or crinkled. Preferably, the fibrous mats used in this invention comprise quartz glass filaments of random length intermingled irregularly.

The flow of resistance of the quartz wool fleece or bat towards the flow of the fuel air mixture is so small that it can hardly be measured, which is contrary to known glow burners such as for example, ceramic glow burners. The flow resistance in these known burners is considerable, inhibiting a maximum intake of air as required for complete combustion of the mixture.

Considering that the fine quartz wool forms innumerable fine spaces in the fleece, the shape of which does not alter during continuous operation, an efficient air supply

and good combustion of the fuel-air mixture is ensured even during a very long time of operation. The finest filaments of quartz wool are stable up to temperatures of and exceeding 1,000° C. and maintain their elasticity during long and continuous operation, the quartz wool fleece neither sintering nor collapsing.

Also, glow burners of large surface can be provided without fear of destruction during operation as occurs for example with well-known ceramic burners. For this stability of the shape of the quartz wool fleece the small heat expansion of quartz glass is also relevant.

Even after long interruption in the use of the new glow burners, the gas-air mixture contrary to known glow burners, does not cause any troubles when re-ignited because the quartz glass filaments, when cool, do not adsorb any gas, and do not release any, when hot. They are not hygroscopic and, therefore, after lighting do not generate water vapor at elevated temperature.

There is further the considerable advantage that the danger of blow-back of the flame is considerably reduced compared with hitherto known glow burners. According to experiments, this can be ascribed to the very small heat conductivity of quartz glass.

In view of these improvements, the burners according to the invention open many new ways for the application of glow burners. This glow burner with a filling of quartz wool also has a fraction of the weight of a glow burner from ceramic material.

To obtain certain effects, for example, to obtain a desired spectral distribution of radiation, substances of corresponding characteristics, e.g. oxides or silicates, may be added to the quartz wool, preferably in small quantities.

To facilitate the ignition of the fuel-air mixture and to ensure a complete and regular combustion, catalytic masses in small quanties can be introduced at different points, and in various ways, on or into the quartz glass fleece. Quartz wool itself can be the carrier of the catalyst layers. Catalysts are preferably provided as outside coatings but they can also be arranged within the quartz glass fleece. The outside surface of fleece 1 may be covered with a layer of catalytic material. Metals from the platinum group such as platinum, palladium or rhodium and substances containing some non-precious metals, such as cobalt, can be applied as catalyst in a manner known in the art. The substances with catalytic action need not form a continuous layer, but may be distributed discontinuously at various point s. In this case it will be advantageous to make use of the quartz glass filaments themselves as carriers for the catalysts. But the catalysts may also be embedded in the quartz glass fleece in a different form, for example as scattered granules.

According to a preferred embodiment, the fuel-air mixture produced in the injector nozzle system is passed in succession through two fleece layers of very fine quartz wool filaments which touch each other along one surface. The two quartz wool fleeces cover the mixing chamber instead of the hitherto known ceramic plates.

To initiate the glowing of the outer quartz wool fleece, its filaments are covered with a small amount of a stimulating catalyst. As soon as this catalyst is stimulated to put the burner into operation by heating, a slight glowing of the quartz wool filaments is initiated by the passing mixture. Immediately afterwards the glow combustion of the passing mixture raises the temperature of all the quartz glass filaments of the external fleece rapidly up to a bright red glow, a process which has nothing more to do with the catalytic stimulation itself.

As a consequence of the complete glow combustion of the mixture in the mass of the external fleece, no flame feather is formed.

Surprisingly, I have found experimentally that some gaseous fuels are not inflamed when they touch the out-

side of the external fleece even when it is in a state of brightest red glow.

It also has become possible for the first time to operate glow burners without assistance of any additional flame. Simultaneously, security against escape of unburnt fuel-air mixtures into the open air has been achieved with burners of this invention.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings which show by way of example, and in which:

FIGURES 1 to 4 show the essential parts of a glow burner according to the invention, FIGURE 1 being a perspective view of the arrangement (partially broken away); FIGURES 2 and 3 are longitudinal and transverse sections of parts of the arrangement; FIGURE 4 is a plan view, and

FIGURES 5 to 7 show various schematic arrangements for putting the burner into operation, and also to safeguard against escape of unburnt fuel-air mixtures.

A fuel-air mixture injector *c* which in known manner is provided with air inlets *a* and gas nozzles or jets *b* projects into the mixing housing *d* which, to reduce weight, is punched out from deep drawn sheet metal. A sheet metal frame comprising two parts *e* and *f* is removably mounted on housing *d*. The frame holds two strong, preferably flat protective gauze wires or screens *g* and *h* of great heat resistance. To prevent warping as a consequence of the high temperature, the wire screens are held loosely movable in the frame by profiles *i* which are mounted on the framework *e*, as by brazing or other suitabble means, so that the gauze wires are free to expand. The quartz wool bats or fleeces *k*, *l* forming interface F completely fill the space formed by the frame and the gauze wires and are arranged in such a manner that the elasticity of the quartz wool fleece cannot be impaired by the pressure of the protective gauze wire. Both fleeces are relatively thin compared with their surface areas. The quartz wool fleece *k*, through which the fuel-air mixture first flows, prevents the glow combustion from wandering back from the outside fleece *I*, the filaments of which are covered with any stimulating catalyst, for example, platinum or cobalt. A gauze wire *m* of small gauge and small mesh size can be provided at the inside protective gauze wire as additional safeguard against wandering back of the glow combustion into the mixing housing.

Any heat rays which pass through the inside quartz fleece *k* from the glowing quartz wool fleece *l* into the inside of the mixing housing *d* are retained by lining the inside walls of the mixing housing with reflecting layers *n* which also check the heat flow, such as, preferably, layers of creased aluminum foil.

If desired, the fuel-air mixture may be conducted from a single mixing chamber to a number of burners provided with quartz wool burner elements.

When liquid combustible material fuel is used, it is possible, in a manner known per se, to transfer the operating heat of the glow burner onto the liquid which has been sucked from a container by cotton wool or wicks. The vaporized liquid is admitted to the burner nozzle *b* under the required pressure. The air-vapor mixture thereafter passes to the mixing housing and to the glow burner. For the purpose of putting the burner into operation, a fuel-air mixture is forced in a known manner through the injector and quartz fleece by an air pump and is ignited above the latter.

The burner can be put into operation in a manner known per se for ceramic platen glow burners by ignition of the outgoing fuel-air mixture.

It is however much more advantageous to put the burner into operation without any flame, and this also safeguards against the escape of unburnt fuel-air mixtures.

Three different arrangements of this type are given schematically by way of example in FIGS. 5–7.

It is common to all three embodiments, to initiate the flameless ignition at the interface F of quartz wool fleeces *k* and *l*. According to the arrangement of FIGURE 5, one or more heating elements *p* are placed in the interface F and are connected to a low voltage D.C. battery or to a D.C. battery of smallest possible voltage, a switch *r* being arranged in circuit.

Intensive experiments have shown that the quartz wool filaments covered with the initiating catalyst, adjacent to the heated resistance wire *p* start to react catalytically and initiate the glow combustion of the fuel-air mixture at a heat energy amounting to only two watts. Within a few seconds, the combustion is fully effective. This property of the quartz wool can probably be ascribed to the fact that the filaments are moisture repellant and that no heater energy is required for evaporation of water.

As a safety device the battery current is connected before or during the start of the operation, and remains connected during the whole time of operation as a pilot current. If the admission of fuel to the glow combustion system is stopped, the glow burners are extinguished. The heater current however, remains connected. As soon as fuel is introduced again, the mixture is re-admitted to the quartz wool fleece and glow combustion starts again and no unburnt fuel-air mixture can escape into the open air. The heating wire, of course, must be resistant to high temperature and chrome-nickel wire, for example, is suitable for this purpose. Also the quartz wool can be exposed for a practically unlimited time to temperatures of 800–900° C. The capacity of the D.C. battery should be large enough to maintain operation for many weeks. It can be protected by control lamps.

The small energy expended for the continuous heating of the heater element can be further reduced by placing within the spaces between the heater wires, and in interface F, highly active ignition catalysts, for instance, finely-divided platinum in the form of a plurality of granules *s* (FIG. 6). As is known, such platinum catalysts will heat up even at room temperature when an inflammable fuel-air mixture passes them. However, the safe initiation of the catalytic reaction and the subsequent glow combustion of the mixture in the external quartz wool fleece will be assured by warming the granules *s* a little with heating element *p*. This is required more particularly where room and mixture temperature are below zero, in which case the reaction is much more sluggish.

Finally, it is possible to work without any electrical auxiliary heating means by evenly distributing contact preparations *t* of highest activity in the interface F of the two contacting quartz wool fleeces (FIG. 7). Such catalytic agents react even at low temperature upon the passage of the fuel-air mixture by being heated up immediately, and causing glowing of the external quartz wool fleece in such short time that during this short period of putting the device into operation, no unburnt fuel-air mixture will escape into the atmosphere. For example, very finely divided platinum group metals, more particularly platinum but also palladium and rhodium can be used as these contact preparations, as is known in the art. They are applied to carriers of large surface, such as kieselguhr, silicic acid gel, asbestos, clay, and other finely distributed oxides more particularly also quartz wool itself. In that way the operation of the quartz wool glow burner is safeguarded in a simple, reliable, and cheap way.

As mentioned above the catalysts also can be located in the quartz wool fleece in a different form and in a different distribution from what has been described in the above examples, where two fleeces are arranged in contact. If it is desired to forego the described advantage of using catalysts, it is possible to use one layer of quartz wool only.

In this connection it may be mentioned that the essence of the invention does not consist in the use of quartz wool as a carrier for catalysts but in the use of quartz wool as glow heater elements, which means its usage to fill in the combustion space through which the prepared fuel-air mixture flows from one side to the other,

causing a combustion temperature of up to 1,000° C., for example. Quartz wool therefore replaces the apertured heater elements which hitherto, for example, were made from high melting ceramic material.

The arrangement consisting of a single fleece of quartz wool may correspond, for example, to the arrangement described above for two fleeces of quartz wool superimposed one on the other, of which one carries a thin layer of a catalyst. In the place of the fleeces *k* and *l* there is utilized a uniform fleece of quartz wool without a covering.

I claim:

1. In combination with a glow burner comprising a mixing housing and an injector nozzle in said housing adapted to produce a mixture of air with gaseous fuel: two fleeces of fine quartz glass filaments with adjacent fleece surfaces, the adjacent fleeces being positioned on the mixing housing in the path of the flow of the mixture, a thin layer of an ignition catalyst carried on the external one of said quartz glass fleeces, electric heating means positioned between said adjacent surfaces, and means for continuously energizing the heating means during operation of the glow burner, said energizing means including a low-voltage battery of high capacity, an electric circuit connecting the battery with the heating means, and a control switch for igniting the fuel-air mixture without a flame and giving protection against escape of unburnt mixture.

2. A glow burner as claimed in claim 1, comprising highly active platinum preparations in the form of a number of small granules distributed between the surfaces of said two fleeces of quartz wool, said preparations acting to further reduce the energy required for the continuous heating of said electrical heating means, said preparations being easily warmed up when the heating apparatus is cold after the continuous-heating current is switched on, whereby said preparations safely react after admission of the mixture and initiate the glow combustion in the external quartz wool fleece.

3. A glow burner for burning a mixture of fuel and air at high temperatures, comprising a housing defining a mixing chamber for said fuel and air, said chamber having an opening, a fuel-air mixing device disposed within said mixing chamber, a frame mounted on said housing and including spaced parts extending along the peripheral edge of said chamber, a pair of spaced wire screens of high heat resistance mounted between said spaced parts and covering said chamber opening, a plurality of members secured to said frame along the periphery thereof and having means to loosely hold said spaced wire screens in said frame to guide said screens during movement thereof, and a pair of superposed layers of non-combustible fibrous material disposed within said spaced wire screens, the outer layer of said fibrous material consisting essentially of substantially pure silicon dioxide filaments, said burner having an operative range of about 800° C. to 1000° C.

4. A glow burner for burning a mixture of fuel and air at high temperatures, comprising a housing defining a mixing chamber for said fuel and air, said chamber having an opening, a fuel-air mixing device disposed within said mixing chamber, superimposed inner and outer layers, respectively, of non-combustible fibrous material covering said opening and positioned in the path of flow of the fuel-air mixture, said layers of material being in surface-to-surface contact with each other along their interface, the outer layer of said fibrous material consisting essentially of substantially pure silicon dioxide filaments, and a layer of catalytic material disposed on the interface of said superimposed layers of fibrous material, said burner having an operative temperature range of about 800° C. to 1000° C.

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