C. E. BROAD.

APPARATUS FOR UTILIZING LIQUID FUELS.

APPLICATION FILED SEPT. 1, 1917.

1,302,505.

Patented May 6, 1919.

2 SHEETS—SHEET 1.

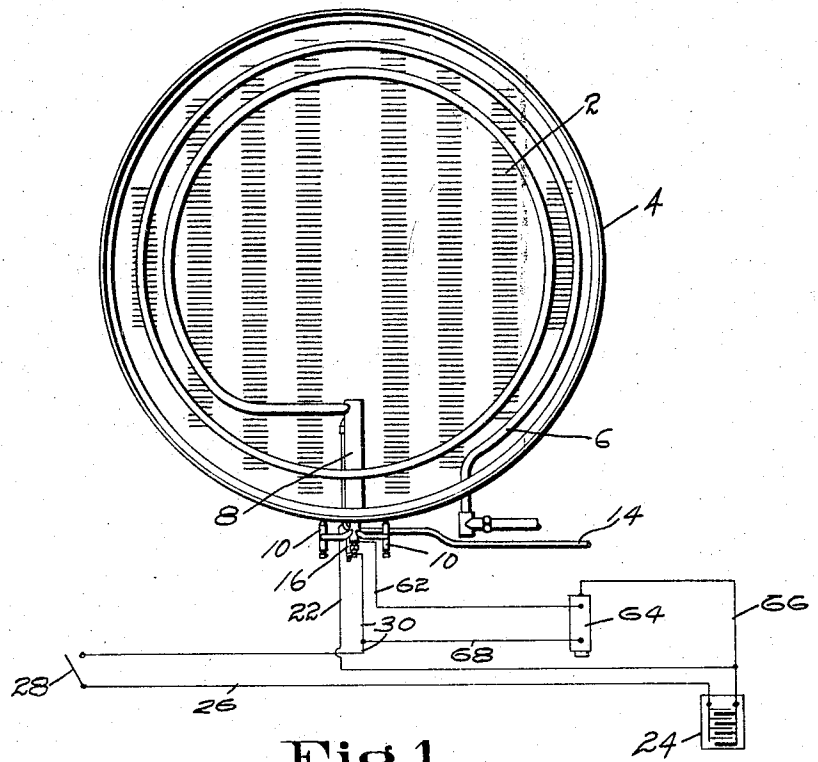

Fig 1

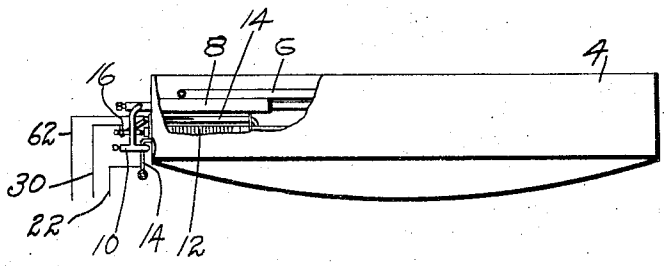

Fig 2

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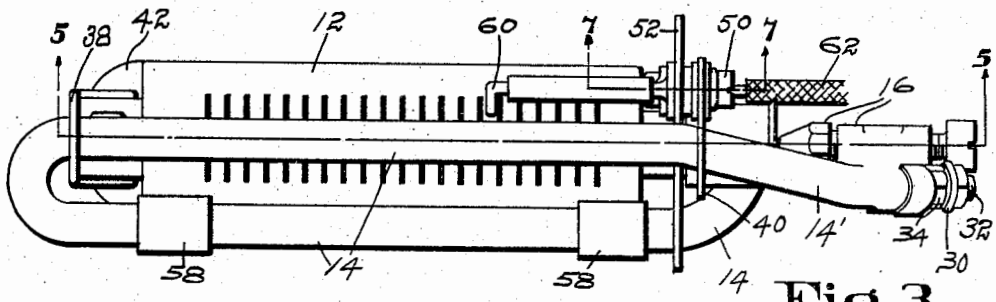

Fig 3

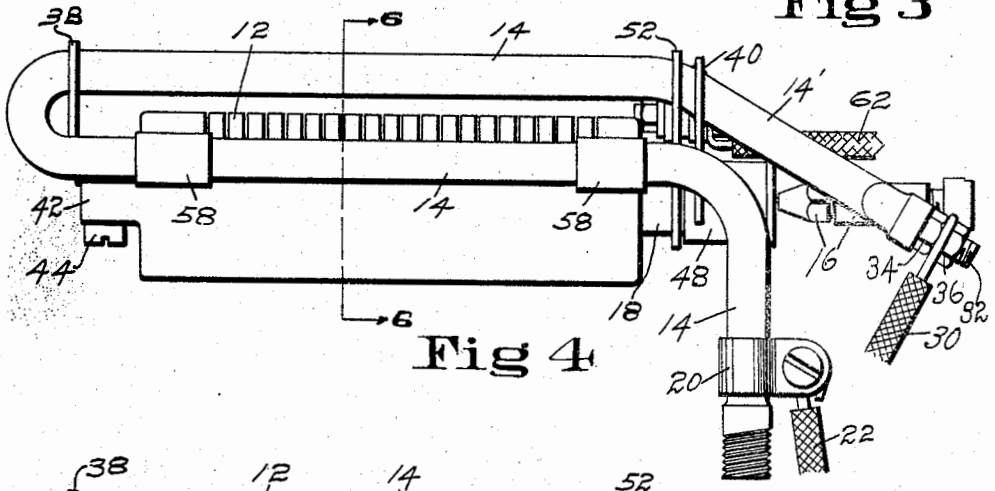

Fig 4

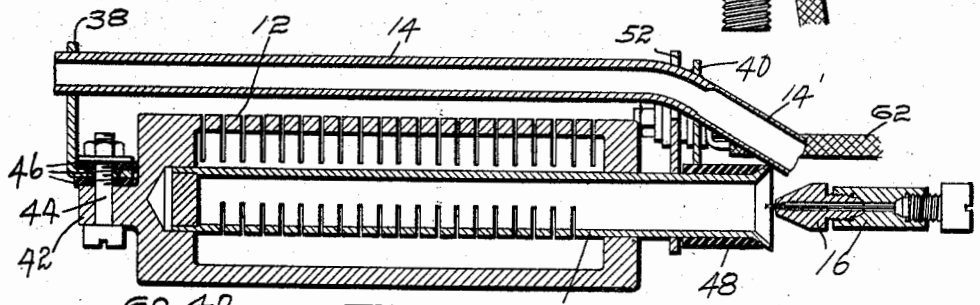

Fig 5

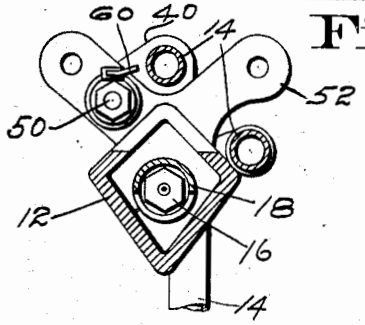

Fig 6

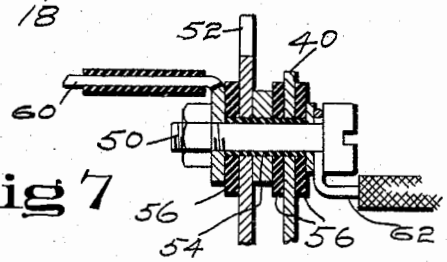

Fig 7

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR UTILIZING LIQUID FUELS.

1,302,505. Specification of Letters Patent. Patented May 6, 1919.

Application filed September 1, 1917. Serial No. 189,373.

To all whom it may concern:

Be it known that I, CHARLES E. BROAD, a citizen of the United States, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Apparatus for Utilizing Liquid Fuels, of which the following description, in connection with the accompanying drawings, is a specification, like reference characters on the drawings indicating like parts in the several figures.

This invention relates to apparatus for utilizing liquid fuel and particularly to means for vaporizing fuel of this character to render it suitable for use in such apparatus. The invention is particularly concerned with the starting of vapor burners for steam driven automobiles in which hydrocarbon oils are used for fuel.

The vapor burners of the type now in common use on steam driven automobiles consist of a main burner and a pilot burner. The latter serves both to light the main burner and also to supply sufficient heat when the main burner is not lighted to maintain a suitable head of steam. In order to light the pilot burner it is necessary to heat it in some manner, usually by means of a hand torch, sufficiently to initiate the generation of such a supply of vapor that the burner when lighted will become self-sustaining. This method of lighting the burner obviously is slow and troublesome, particularly since the burner usually is so located that it can only be reached with some inconvenience.

It has been proposed heretofore to use some form of electric heating apparatus to produce the initial supply of vapor required for the lighting of the pilot burner. For instance, it has been proposed to place an electric conductor arranged as a coil, filament, or in some other form inside the fuel supply pipe at a point close to the pilot burner, or to inclose this pipe in a coil designed to be electrically heated. These expedients, however, have not proved successful due to a variety of causes, among which may be mentioned the difficulty of supplying the required degree of heat by any of these forms of apparatus, the fact that coils or other electric conductors inside the fuel supply pipe interfere with the cleaning of the pipe and retard the free flow of fuel through it, and especially the difficulty of insulating such conductors and coils whether placed inside or outside the supply pipe. This last mentioned difficulty has proved particularly serious since the constant jar and vibration to which the parts are subjected seems to have a disintegrating action on both the insulating material and also on the relatively frail electric conductors required in such apparatus. In any event, these constructions have been found to break down so quickly that their use has not proved practicable. Furthermore, it has been found that if such heating apparatus is located outside of the main burner it cools the vapor to such an extent that the burner is not self-sustaining after it has been lighted and the source of electrical energy cut off; while if it is located inside the main burner the high temperature to which it is subjected soon breaks down the insulation or the conductors themselves and renders the apparatus useless.

The present invention aims particularly to overcome the difficulties heretofore experienced in starting burners of the type mentioned and to devise a simple, reliable and efficient means for performing this function. Certain features of the invention are applicable also to apparatus for vaporizing liquid fuels for other purposes.

Referring now to the drawings,

Figure 1 is a plan view of a burner equipped with an apparatus embodying this invention;

Fig. 2 is a side elevation of the burner shown in Fig. 1, certain parts of the apparatus being broken away to illustrate the construction more clearly;

Fig. 3 is a plan view of a pilot burner for the apparatus shown in Fig. 1, equipped with fuel supply and igniting apparatus constructed in accordance with this invention;

Fig. 4 is a side elevation of the apparatus shown in Fig. 3;

Fig. 5 is a vertical transverse cross-sectional view of the apparatus shown in Fig. 3 taken substantially on the line 5—5, Fig. 3;

Fig. 6 is a vertical transverse cross sectional view on the line 6—6, Fig. 4; and

Fig. 7 is a vertical cross sectional view on the line 7—7, Fig. 3.

The vapor burning apparatus shown in the drawings includes a main burner 2 of the construction commonly used in steam driven automobiles and a casing 4 in which

the burner is located. Hydrocarbon oils, particularly gasolene and kerosene, are commonly used for fuel in these burners and this fuel is supplied to the burner by a pipe 6 which enters the casing 4 and makes a plurality of turns inside the casing and above the burner so that the fuel flowing through this pipe will become vaporized before it is delivered to the burner. This pipe leads into a somewhat larger pipe section 8, Figs. 1 and 2, which projects through the casing 4, and two branches from this enlargement lead to nozzles 10 which direct the vaporized fuel into the main burner 2.

Located immediately below the enlargement 8 and inside the casing 4 is a pilot burner 12 which, as above stated, serves not only to light the main burner but also to supply sufficient heat to maintain a considerable head of steam when the car is not running. Fuel is delivered to the pilot burner 12 by a pipe 14 leading from a suitable supply and entering the casing 4 at a point beside the pilot burner. As clearly shown in Figs. 3 and 4, this pipe is bent into a U-shape, one leg of the U lying beside the burner 12 and the other leg lying immediately over the burner where it will be heated by the flame from this burner. The latter leg then passes through the casing and is connected to a nozzle 16, of a common type, which directs the vaporized fuel into the pilot burner. This burner, in the form shown, consists of a hollow body, diamond shaped in cross section, having a series of transverse slots cut through its upper side through which the vapor or mixture of vapor and air escape. The vapor is conducted into this body from the nozzle 16 by a tube 18 positioned longitudinally in the hollow body 12 and provided on its lower side with a series of transverse slots through which the vapor passes into the chamber in the body 12.

The general arrangement so far described is substantially like that which has been used heretofore. As above stated, it has been customary to light the pilot burner by heating it with a hand torch until the liquid fuel admitted to the pipe 14 vaporizes with sufficient rapidity to create the flow of vapor necessary to enable the burner to be lighted. Inasmuch as the part of the pipe 14 adjacent to its point of delivery to the burner is positioned in the flame of the burner, the burner becomes self-sustaining after the vaporizing action had once been initiated. The problem therefore presented in starting vapor burners of this type has been to produce the initial supply of vapor necessary to enable the pilot to be lighted.

According to the present invention the part of the fuel supply pipe 14 adjacent to the nozzle 16 forms part of an electric circuit which is arranged to conduct a sufficiently heavy flow of current through this portion of the pipe to heat the pipe to such a degree that the flow of vapor required to permit the lighting of the pilot will be produced in a very few seconds. For this purpose a connector 20, Fig. 4, is clamped to the pipe 14 and an electric conductor 22, Figs. 1 and 4, leads from this connector to one terminal of a source of electrical energy, indicated in the drawings as a storage battery 24. Another conductor 26 leads from the opposite terminal of this battery, through a hand operated switch 28 and a conductor 30, to a point on the pipe 14 adjacent to the nozzle 16, as clearly shown in Figs. 3 and 4. Obviously, any suitable type of connector may be used to secure the conductor to the pipe, but the construction shown comprises a threaded stud 32 provided with a head 34 between its ends, the conductor 30 being clamped between the head 34 and a nut 36 threaded on to the stud. This construction provides a removable closure for the end of the pipe 14, by means of which ready access to the interior of the pipe for cleaning or other purposes is provided.

For the purpose of insulating the pipe 14 from the adjacent parts of the burner which otherwise would tend to short-circuit it, the pipe is supported by two insulated brackets indicated, respectively, at 38 and 40. The bracket 38 preferably is L-shaped, as clearly shown in Fig. 5, and the horizontal portion of the bracket is secured to a boss 42 on the back of the burner by means of a bolt 44, suitable insulating washers 46 being interposed between the bolt and the bracket to keep them electrically separated. The insulating washers may be made of some material capable of withstanding high temperatures, such for instance, as mica, asbestos, lava, or compressed compositions made for this purpose. These washers are clamped together in such a manner that practically no mechanical strain is placed on them other than that required to resist the compression due to the clamping action of the bolt and this strain obviously is not severe. The other bracket 40 rests on an insulating sleeve 48 which encircles the tube 18 and it is secured by a bolt 50, Figs. 3 and 7, to another bracket 52 which is bolted to the casing 4 of the main burner, an insulating sleeve 54 and a series of insulating washers 56, Fig. 7, being provided to insulate the bolt 50 from the brackets 40 and 52. Insulating sleeves 58, Figs. 3 and 4, may also be placed on the part of the pipe 14 that lies beside the pilot burner 12 to prevent this portion of the pipe from being sprung against the burner. Preferably the conductors that connect the pipe 14 with the source of electrical energy are made very heavy so that they will conduct a current of heavy amperage without heating excessively.

The pipe 14 may be made of a great variety of materials but I prefer to make it of monel metal since this material successfully withstands high temperatures and its electrical resistance is well suited to the present conditions. I prefer, however, to make the wall of the pipe 14 somewhat thinner at the portion immediately behind its union with the nozzle 16 than at other points, and this object may conveniently be accomplished by reaming or drilling this portion of the pipe, as indicated at 14', Fig. 5. The electrical resistance of the pipe thus is increased at this point and it develops a higher degree of heat in this region due to the flow of electricity therethrough than otherwise would be the case. Consequently vapor generated in the pipe 14 reaches the hottest part of the pipe just before it flows into the nozzle 16, which of course is comparatively cool, and any tendency of the vapor to condense thus is avoided.

Obviously the details of construction of the apparatus will depend upon the requirements of each particular installation. In installations of the character illustrated in which a pilot burner of the usual size is used and in which the pipe 14 consists of a five-sixteenths inch tube made of monel metal, the current being supplied by a storage battery of the type commonly used in automobiles for supplying the starting current for the engine, the pipe will heat up so rapidly on the closing of the switch 28 that the burner will light in from eight to twelve seconds. The rush of current is so great that the pipe becomes red hot when the current is allowed to flow through it a few seconds longer. Inasmuch as a storage battery of this type only develops a pressure of about 6 volts, it is obvious that the voltage drop between the connectors 20 and 32 is very low indeed so that the problem of insulating the pipe from the adjacent parts of the burner is very simple.

For the purpose of igniting the vapor as it begins to flow through the slots in the pilot burner 12 I have provided an electrical ignition system preferably of the high tension jump spark type, which may also be supplied with energy from the battery 24. Referring to Figs. 3, 6 and 7, it will be seen that a spark terminal or "point" 60 is located close beside the pipe 14 where it overlies the burner and is clamped in place by the bolt 50. A conductor 62, clamped under the head of this bolt, leads to one high tension terminal of the spark coil 64, Fig. 1, provided with the usual vibrator. The terminals of the primary or low tension side of this coil are connected by conductors 66 and 68, respectively, to the opposite terminals of the battery 24, one of these connections being made through the switch 28. The conductor 68 also connects the terminal of the high tension side of the coil to the conductor 30 which is connected to the pipe 14. The conductor 68 is a common connection for the high pressure and low pressure sides of the coil. This is a common type of spark coil used in ignition systems for internal combustion engines but any other suitable apparatus may be substituted for it. When the switch 28 is closed to create a flow of current through the pipe 14 to start the pilot burner 12, it also closes the circuit through the primary of the coil 64, thus causing a rapid succession of sparks to jump from the terminal 60 to the pipe 14 where they will ignite the vapor emerging from the burner 12 as soon as it begins to flow in sufficient volume.

It is obvious that this arrangement completely avoids the annoyance and inconvenience which is necessary in order to start the burner by the methods heretofore practised. With this apparatus it is merely necessary for the operator to close the switch 28 for a few seconds to allow the flow of current from the battery to create the initial flow of vapor required to start the burner and also to ignite this vapor automatically and then to open the switch again. Obviously the switch may be located in any position for convenient operation. The burner when once started immediately becomes self-sustaining and when it is desired to light the main burner it is merely necessary to turn on the fuel through the pipe 6 in the usual manner. Since the enlargement 8 into which this pipe 6 leads lies immediately over the pilot burner 12, it will be heated as long as the pilot is allowed to burn and will supply the initial flow of vapor required to light the main burner. It is obvious that the starting arrangement provided by this invention might be applied to the main burner instead of to the pilot burner if it were found desirable for any reason to dispense with the pilot burner.

It will also be understood that by directing the flow of current through the fuel supply pipe for the burner and thus heating this pipe directly, as distinguished from heating it indirectly through the use of heating coils or the like, I am able to provide a much sturdier and more substantial construction than has been possible by the means heretofore proposed. Furthermore, this arrangement enables me to overcome the difficulty of obtaining the required degree of heat to start the burner in a reasonably short length of time, and to accomplish this result by using the source of electrical power with which automobiles ordinarily are equipped, thus avoiding the necessity for a separate source of current. At the same time, by using a low voltage source of current and utilizing the fuel supply pipe itself as the electrical heating unit, I am enabled

to use insulating devices which successfully withstand the disintegrating action to which they are subjected in actual use and which has proved the undoing of many of the expedients heretofore proposed. A further advantage of the construction of the pilot vaporizer whereby it leads the fuel out of the casing at a point closely adjacent to that at which it enters the casing is that it provides a very compact construction convenient to remove for purposes of inspection, cleaning or repair, and which may be easily replaced again. It also facilitates the support and insulation of the parts that carry current.

While I have herein dealt with the specific problem of starting a vapor burner designed primarily for use in steam driven automobiles, it will readily be understood by those skilled in this art that certain features of this invention are also applicable to vaporizing liquid fuels in other situations.

What is claimed as new is:

1. A vapor generating apparatus, having, in combination, a supply pipe for liquid fuel, an apparatus to which said pipe delivers fuel, and an electric circuit including the portion of said pipe adjacent to its delivery end, whereby the flow of electricity through said pipe will heat the fuel therein sufficiently to vaporize it and thereby supply vaporized fuel to said apparatus, the portion of said pipe immediately behind its delivery end being of a greater electrical resistance than the other portions of the pipe in said circuit.

2. A vapor burning apparatus, having, in combination, a burner, a pipe for conducting liquid fuel to said burner, and an electric circuit including a portion of said pipe adjacent to the point at which it delivers fuel to said burner, whereby the flow of electricity through said pipe will heat the fuel therein sufficiently to vaporize it and thereby supply vapor to said burner, the part of said pipe immediately behind its delivery end being constructed and arranged to be heated to a higher temperature by the flow of electricity therethrough than the other portions of the pipe in said electric circuit.

3. A vapor burning apparatus, having, in combination, a main burner, a casing therefor, a pilot burner in said casing, a supply pipe for liquid fuel leading to said pilot burner and having a portion thereof located in said casing in position to be heated by the pilot burner, and an electric circuit including said portion of said pipe and constructed and arranged to conduct a heavy flow of current through said pipe, whereby said flow of current will heat said pipe sufficiently to vaporize the fuel therein and thereby supply vapor to said pilot burner, electrical means for lighting said pilot burner after said flow of vapor has been produced, and controlling means for said electric circuit and said lighting means.

4. A vapor burning apparatus, having, in combination, a burner, liquid fuel supplying means for said burner, an electric heating means constructed and arranged to carry a heavy continuous flow of current to vaporize the liquid fuel before it reaches said burner and thereby supply fuel to said burner in vaporized form, a high tension ignition system for lighting said burner, the circuit for said ignition system having a portion in common with the circuit of said heating means, and a single controlling switch in said common portion for controlling both said heating and igniting means whereby the igniting means will light the burner as soon as the vapor is delivered to said burner in sufficient volume to be ignited.

5. A vapor burning apparatus, having, in combination, a supply pipe for liquid fuel, a burner to which said pipe delivers fuel, an electric circuit including a portion of said pipe and constructed to carry a heavy continuous flow of current whereby the flow of electricity through said pipe will heat the fuel therein sufficiently to vaporize it and supply it to said burner in vaporized form, a jump spark ignition system coöperating with said burner to ignite the vapor so supplied to the burner, the circuit for said ignition system having a portion in common with said heating circuit, and a switch located in said common portion and operative to control both said heating circuit and said ignition system whereby the burner will be lighted as soon as vaporized fuel is delivered thereto in sufficient quantity to be ignited.

6. A vapor burning apparatus, having, in combination, a burner, a casing for said burner, a supply pipe for liquid fuel having a portion thereof located in said casing in the heat of said burner and constituting a fuel vaporizer for said burner, said vaporizer being constructed to conduct the vaporized fuel out of said casing at a point closely adjacent to that at which it enters the casing, a nozzle connected to said vaporizer and serving to direct the vaporized fuel into said burner, and an electric circuit including said vaporizer and including current controlling means whereby the flow of electricity through said pipe may be utilized to heat the vaporizer sufficiently to vaporize the fuel for the purpose of starting the burner into operation.

7. A vapor burning apparatus, having, in combination, a main burner, a casing for said burner, a pilot burner located in said casing, a supply pipe for liquid fuel leading to said pilot burner and including a U-shaped portion, the legs of which project through said casing and the bent portion of

which lies within said casing in position to be heated by said pilot burner to vaporize the fuel in said pipe, and an electric circuit including the portion of said pipe located in said casing, whereby the flow of electricity through said pipe can be utilized to heat the fuel therein sufficiently to vaporize it and thereby start said burner into operation.

8. A vapor burning apparatus, having, in combination, a main burner, a casing inclosing said burner, a pilot burner for said main burner located in said casing, a supply pipe for liquid fuel entering said casing at a point adjacent to said pilot burner and leaving said casing close to its point of entrance, a bracket supporting said pipe near the points at which it passes through said casing, said pipe having a portion thereof within said casing located immediately above said pilot burner and constituting a vaporizer for said pilot burner, a nozzle connected to the end of said pipe closely adjacent to the point at which it leaves said casing and directing the vaporized fuel into said pilot burner, and an electric circuit including the portion of said pipe in said casing and including current controlling means whereby the flow of electricity through said pipe may be utilized to effect a preliminary heating of said vaporizer to start said pilot burner into operation.

9. A vapor burning apparatus, having, in combination, a main burner, a casing for said burner, a pilot burner located in said casing, a supply pipe for liquid fuel leading to said pilot burner and including a U-shaped portion, the legs of which project through said casing and the bent portion of which lies within said casing in position to be heated by said pilot burner to vaporize the fuel in said pipe, a source of electric current, and conductors leading from said source and connected to the legs of said U-shaped portion at points outside of said casing.

In testimony whereof I have signed my name to this specification.

CHARLES E. BROAD.