

9-27-1932

# Apparatus for Igniting Liquid Fuel

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## Recommended Citation

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Sept. 27, 1932.

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1,879,186

APPARATUS FOR IGNITING LIQUID FUEL

Filed Oct. 30, 1930

2 Sheets-Sheet 1

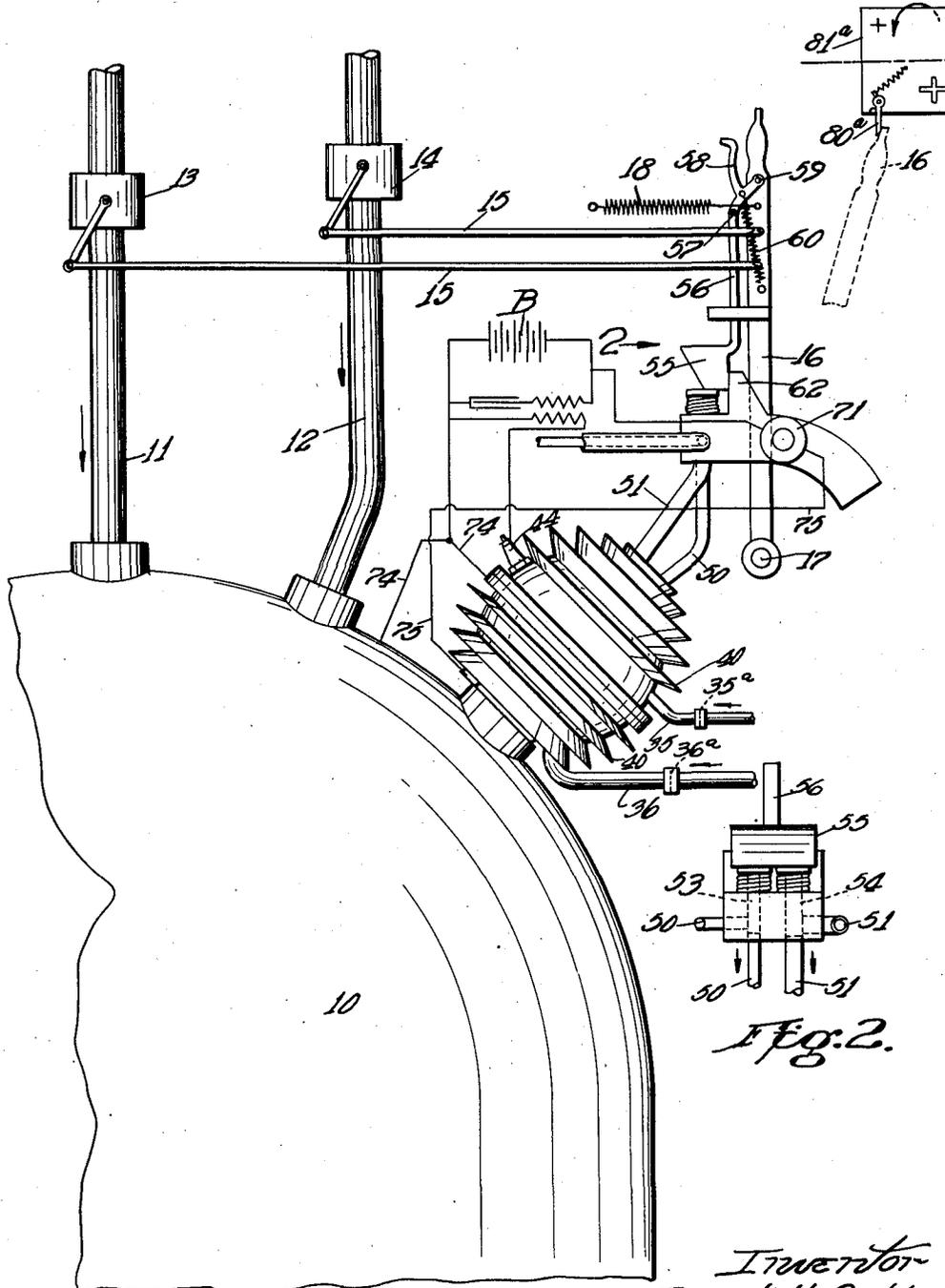


Fig. 1.

Fig. 2.

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2 Sheets-Sheet 2

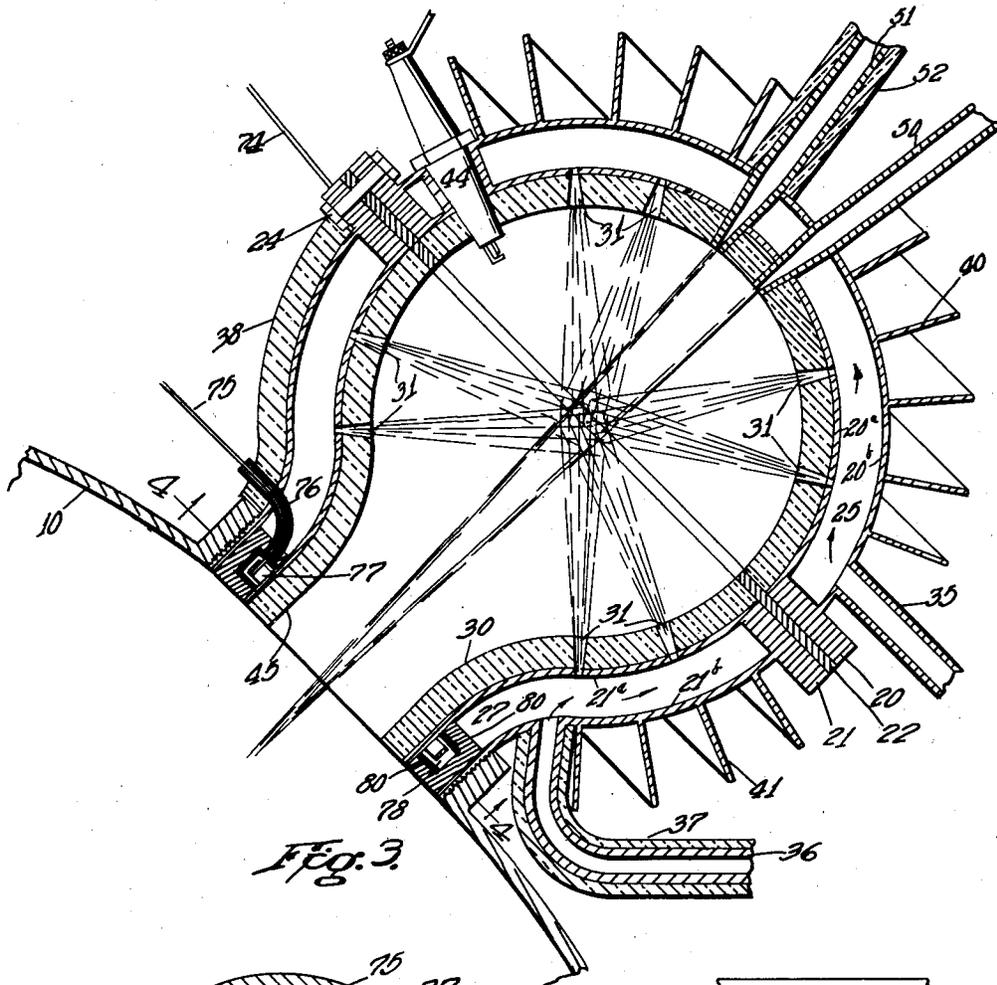


Fig. 3.

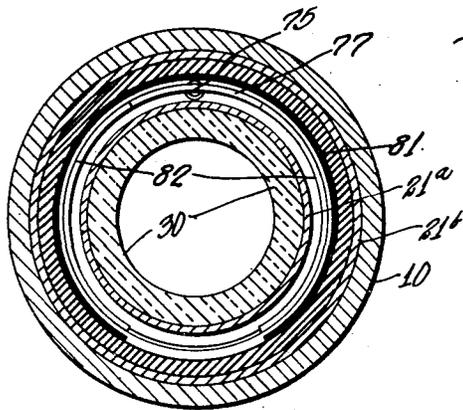


Fig. 4.

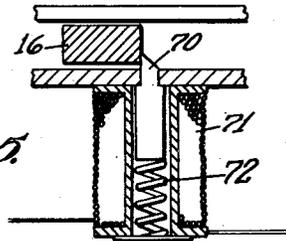


Fig. 5.

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# UNITED STATES PATENT OFFICE

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## APPARATUS FOR IGNITING LIQUID FUEL

Application filed October 30, 1930. Serial No. 492,268.

This invention relates to combustion apparatus in which liquid fuel is used and more particularly to apparatus in which a liquid oxidizing agent such as liquid air or oxygen is also used. Such combinations of liquid fuel and liquid oxidizing agents are highly explosive and dangerous if not promptly and thoroughly ignited as soon as they are introduced into a combustion chamber. Such ignition is preferably provided in the form of a flame directed into the combustion chamber which contains the mixture of fuel and oxidizing agent.

It is the general object of my invention to provide improved means for supplying an effective igniting flame for a combustion chamber.

A further object is to provide improved means for maintaining an idle flame or hot point for lighting the igniting flame whenever the latter is desired for use.

I also provide for a safe and predetermined order of operation of the several parts of the apparatus, to the end that danger may be effectively avoided.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a side elevation of a portion of a combustion chamber having my improvements applied thereto;

Fig. 2 is a detail view, looking in the direction of the arrow 2 in Fig. 1;

Fig. 3 is an enlarged sectional view of the ignition chamber;

Fig. 4 is a detail sectional view, taken along the line 4—4 in Fig. 3; and

Fig. 5 is a detail view to be described.

Referring to the drawings, I have shown a portion 10 of a combustion chamber in which the combustion may be either continuous or intermittent. The chamber 10 is provided with an inlet pipe 11 for liquid fuel and an inlet pipe 12 for a liquid oxidizing agent such as liquid air or oxygen.

Valves 13 and 14 are provided in the pipes 11 and 12, which valves are connected by

links 15 to a manually operated control lever 16 mounted upon a fixed pivot stud 17. A spring 18 normally holds the lever 16 in the inoperative position shown in full lines in Fig. 1, in which the valves 13 and 14 are closed.

My improved ignition chamber is preferably formed in two parts 20 and 21 (Fig. 3) separated by a suitable packing and secured together by clamping bolts 24. The member 20 comprises inner walls 20<sup>a</sup> and outer walls 20<sup>b</sup> separated by a semi-spherical passage or recess 25. Similarly the member 21 comprises inner and outer walls 21<sup>a</sup> and 21<sup>b</sup> separated by an intervening space or recess 27.

A refractory lining 30 is preferably provided for the casing members 20 and 21 and a plurality of small openings 31 are formed in the inner walls 20<sup>a</sup> and 21<sup>a</sup> and in the refractory lining 30. It will be noted that all of said openings 31 are directed toward a common point, which is substantially at the center of the spherical ignition chamber.

A liquid or gaseous fuel is conducted through a pipe 35 to one of the semi-spherical recesses and preferably to the upper recess 25. An oxidizing agent such as liquid air or liquid oxygen is conducted to the other recess, such as the lower recess 27, through a pipe 36, which may be provided with an insulating coating 37 to reduce the rate of evaporation of the low temperature oxidizing agent. More or less of the outer surface of the wall 21<sup>b</sup> of the chamber member 21 may also be covered with an insulating covering 38 for the same purpose.

The outer wall of the member 20 is preferably provided with flanges 40 through which heat may be dissipated, and more or less of the surface of the member 21 may be similarly provided with flanges 41, these flanges being desirable when a gaseous oxidizing agent is used. Strainers of fine wire gauze, shown dotted at 35<sup>a</sup> and 36<sup>a</sup>, (Fig. 1) are preferably provided in the pipes 35 and 36, to prevent clogging of the small holes 31.

The mixture of combustible and oxidizing materials thus produced at the center point of the ignition chamber may be readily ignited in any convenient manner, as by a spark-plug

44. When thus ignited, the mixture provides an intensely hot idle flame which is positioned substantially at the center of the ignition chamber and spaced from the walls thereof.

The gases of combustion pass through the opening 45 at the neck of the ignition chamber and thus enter the combustion chamber 10.

10 It is desirable that the pipes 35 and 36 enter their respective casing sections at the lowest available points, so that any gas which may be produced by evaporation of the liquids therein will not back up in the pipes 35 and 15 36 and thus interfere with the flow of liquids to the ignition chamber.

When it is desired to operate the combustion chamber, streams of fuel and oxidizing agent are admitted to the ignition chamber through pipes 50 and 51, one of which may be heat-insulated as indicated at 52. The streams of liquid or gaseous materials flowing from these pipes converge and pass through the idle flame or hot-point at the middle of the ignition chamber and after being thus ignited are directed in the form of a long and intensely hot flame through the opening 45 into the combustion chamber.

It is necessary for safety in operation that the hot-point or idle flame shall be started before the fuel and oxidizing agent are admitted to the ignition chamber through the pipes 50 and 51 to produce the long ignition flame. It is also necessary that this long flame be produced before any mixture of fuel and oxidizing agent is admitted to the combustion chamber 10.

In order to make certain that these operations be performed in the required order, I have provided safety devices which will now be described.

The delivery of fuel and oxidizing agent to the pipes 50 and 51 which produce the long flame is controlled by spring plungers 53 and 45 54 (Fig. 2) which are normally held down by a cam block 55. The block 55 is mounted at the lower end of a rod 56 and connected at 57 (Fig. 1) to a hand lever 58 pivoted at 59 on the lever 16 previously described. A 50 spring 60 holds the block 55 normally in the lowered position of Figs. 1 and 2.

When the operator wishes to move the lever 16 to open the valves 13 and 14 which control the combustion chamber feed pipes 11 and 12, the handle 58 must be grasped and the block 55 must be raised to clear a shoulder or abutment 62 before the handle can be moved. This raising of the block 55 permits 60 the spring plungers 53 and 54 to rise, admitting fuel and oxidizing agent to the pipes 50 and 51 respectively.

It is thus evident that the necessary materials will be fed to the ignition chamber to 65 start the long flame in operation before any

fuel or oxidizing agent is delivered to the combustion chamber.

In order to further insure that the hot-point or idle flame shall be in operation before the materials for the long flame are admitted to the ignition chamber, I provide a thermostatic device for locking and releasing the lever 16. For this purpose I provide a spring plunger 70 (Fig. 5) mounted in a solenoid coil 71 and yieldingly pressed to locking position by a spring 72.

The solenoid 71 (Fig. 1) is connected on one side through a battery B and ground wire 74 to the casing of the ignition or combustion chambers or both. The other side of the solenoid 71 is connected to a wire 75 which extends through an insulating bushing 76 to a metal ring 77 mounted in a recess 78 surrounding the neck or opening 45 of the ignition chamber.

The ring 77 is insulated at its sides by mica or other suitable insulating material, as indicated at 80 in Fig. 3, and is also insulated around the greater part of its periphery by an insulating layer 81 (Fig. 4), which, however, is interrupted for a substantial distance at a point opposite the point of attachment of the wire 75. Strips 82 of a more expansive metal are secured to the inner faces of the side portions of the ring 77.

When the ignition chamber is cool, the ring 77 and parts 82 assume the circular position indicated in Fig. 4, with the ring 77 out of contact with the casing of the ignition chamber. When the products of combustion of the idle flame flow through the opening 45, the parts 77 and 82 become heated and their unequal expansion elongates the ring 77, causing it to contact with the casing of the ignition chamber, thus completing the circuit and energizing the solenoid coil 71, which in turn withdraws the plunger 70 and permits manual operation of the control lever 16. The beveled outer face of the plunger 70 permits the lever to be restored to inoperative position at any time.

I have thus provided means which make it certain that the idle flame shall be lighted before the lever 16 is released, and further insuring a flow of materials to produce the long flame before the mixture is admitted to the combustion chamber 10.

Under some conditions, it is desirable that the admission of materials to the ignition chamber and also to the combustion chamber be permitted only for a predetermined and limited interval. For this purpose I may provide a latch 80<sup>a</sup> (Fig. 1) to hold the handle 16 in operative position and mount the latch 80<sup>a</sup> on a time-controlled element 81<sup>a</sup> having a rotary movement which will carry the latch 80<sup>a</sup> out of engagement with the handle 16 after a predetermined interval, whereupon the handle is removed to inoperative position, closing the valves 13 and 14

and depressing the spring plungers 53 and 54.

During this closing movement, the block 55 rides up over the inclined rear face of the abutment 62 and is then released to depress the plungers 53 and 54.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:—

1. Apparatus for igniting liquid or gaseous fuels in a combustion chamber which comprises a substantially spherical ignition chamber associated with said combustion chamber and connected thereto by a restricted but unobstructed passage, means to introduce jets of combustible and oxidizing gases to said ignition chamber along a plurality of angularly disposed radial paths, whereby a pilot flame is maintained substantially at the center of said spherical chamber, and means to direct gases to form an ignition flame diametrically through said ignition chamber and through said pilot flame and into said combustion chamber through said restricted opening.

2. The combination in ignition apparatus as set forth in claim 1, in which manual means is provided for introducing fuel to said ignition chamber and to said combustion chamber in predetermined order.

3. In a combustion apparatus, an ignition chamber comprising a two part casing, each part being formed with a recess, means to deliver fuel to one of said recesses, means to deliver an oxidizing agent to the other recess, and means to feed said materials in a plurality of jets from said recesses to a common point within said casing.

4. In a combustion apparatus, a substantially spherical ignition chamber formed of hollow sections having concentric inner and outer walls, each of said sections having also a plurality of circumferential cooling flanges formed on the outer face thereof and the outer edges of said flanges being disposed in parallel planes.

5. The combination in ignition apparatus as set forth in claim 1, in which means is provided which requires the feed to the ignition flame to be opened before the feed to the combustion chamber is opened.

6. The combination in ignition apparatus as set forth in claim 1, in which a thermostatic device at the opening between the ignition and combustion chambers controls the admission of fuel and oxidizing agent to produce the ignition flame, and in which means is provided for preventing the admission of fuel and oxidizing agent to the combustion chamber until after said gases are admitted to the ignition chamber.

7. In a combustion apparatus, an ignition chamber comprising a casing, formed with a plurality of recesses, means to deliver fuel to

one of said recesses, means to deliver an oxidizing agent to the other recess, and means to feed said materials in a plurality of jets from said recesses to a common point within said casing.

8. The combination in combustion apparatus as set forth in claim 7, in which said delivery means is provided with fine strainers to prevent clogging.

9. The combination in combustion apparatus as set forth in claim 7, in which said common point is substantially spaced from the walls of the casing in all directions.

10. The combination in combustion apparatus as set forth in claim 7, in which the casing is substantially spherical, with a restricted outlet at one side thereof.

11. The combination in combustion apparatus as set forth in claim 7, in which feed pipes for fuel and an oxidizing agent enters said recesses at the lowermost points thereof.

12. In a combustion apparatus, a combustion chamber, an ignition chamber having a restricted communication with said combustion chamber, a thermostatic ring surrounding said restricted communication, and means controlling the feed of fuel and oxidizing agent to said ignition chamber, said means being controlled by said thermostatic ring.

In testimony whereof I have hereunto affixed my signature.

ROBERT H. GODDARD.

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