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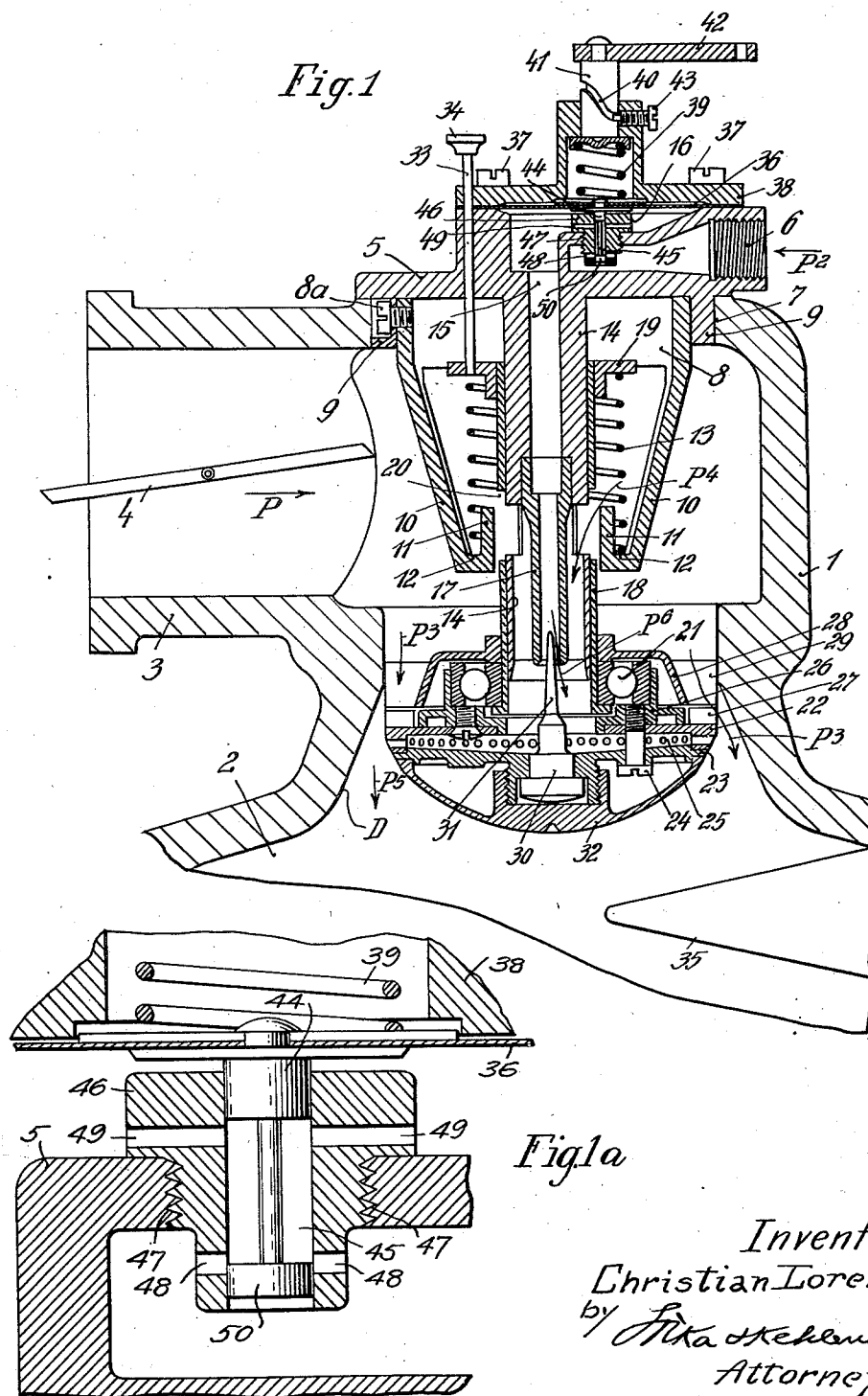
C. LORENZEN

2,197,647

BURNER

Filed April 3, 1936

2 Sheets-Sheet 1



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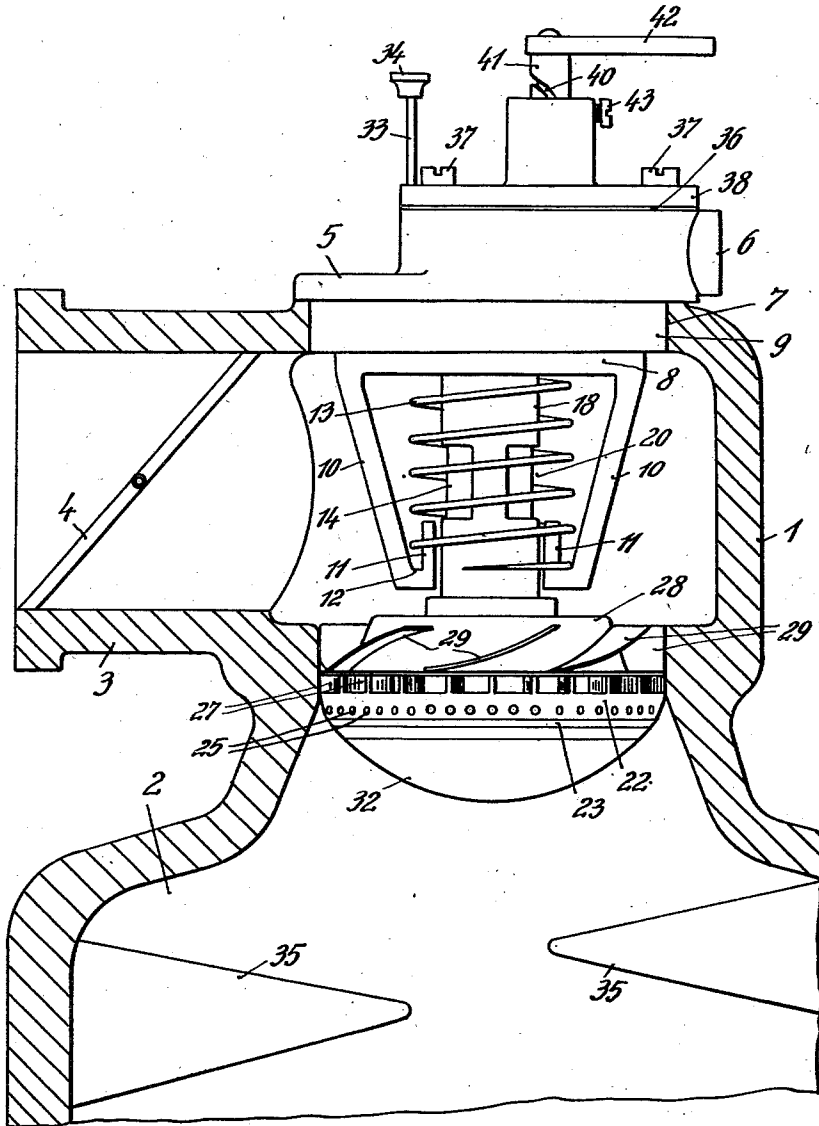
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*Fig. 2*



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## UNITED STATES PATENT OFFICE

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BURNER

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In Germany March 13, 1936

9 Claims. (Cl. 110-104)

This invention relates to a burner, which may be employed for liquid as well as for pulverulent fuels. The term "liquid fuels" includes in the present case also viscous fuels, such as tar and other oils of an equivalent nature.

It is the object of the invention to provide a burner in which the fuel and air making up the mixture are always in such a definite ratio to each other within the entire working range that the combustion is smokeless and complete. Heretofore it has not been possible upon variations in load in the case of furnace systems or the like to regulate the component parts of the mixture, viz., air and fuel, in such fashion perfectly automatically that the mixture results theoretically in a combustion proper in all respects for every load.

According to the present invention, means are provided for regulating the air and fuel in such fashion in rigid dependence on each other that within the load limits the mixture of air and fuel corresponding with a proper and smokeless combustion is brought about automatically.

These means are adapted to produce conditions of such a kind that neither is there supplied an excess of air, which would result in wasteful heating, nor is an excessive quantity of fuel introduced into the mixture, which would result in an incomplete combustion with the development of smoke. It is possible in the burner according to my invention to burn masut, prepared tars and even coal-dust perfectly satisfactorily. The fuel must naturally be converted into a condition in which it will flow more readily. For this purpose viscous tars are pre-heated up to approximately 100° C. As regards the combustion of coal-dust it is a condition that the dust should be absolutely dry.

My invention consists in certain novel features in the construction and arrangement of the burner and its regulating means, as defined in the appended claims. Without desiring to restrict myself to the particular details illustrated, I will now describe a typical embodiment of my invention.

The invention is illustrated by way of example in the accompanying drawings, in which

Fig. 1 is a section through the burner according to the invention, showing a part of the combustion chamber. The disc valve employed in the burner is shown in the open condition, i. e., the burner is in operation. Fig. 1a is a sectional view showing a portion of Fig. 1 upon an enlarged scale.

Fig. 2 is a view of the burner in the position of rest.

In the drawings, 1 is the casing the lower portion of which surrounds the combustion chamber 2. The connection socket 3 of this casing is connected with an air pipe, to which fresh air is supplied under pressure, such pressure amounting to between 100 and 400 millimeters (water column). In the air pipe there is located a manually adjustable throttle 4. The burner casing is designated 5 and forms a flange or top with the fuel supply nipple or socket 6, fuel being applied under pressure, for instance the same pressure as mentioned above in connection with the air supply. As I have stated in the introductory portion of this specification, the fuel employed may be liquid, semi-liquid (viscous), or pulverulent, for instance coal-dust. The casing 1 has at the top an opening 7, into which there is introduced the burner casing 5 with the flange 9. On the flange 9 there is located a spring support 8 held by screws 8a. The spring support is cylindrical at the top and merges downwards into the arms 10, which are bent upwards in hook-like fashion at 11, in such fashion that a seat 12 is formed for a spring 13. At the centre of the spring support 8, extending downwards, there is located in the burner casing 5 the guide socket 14 with the fuel passage 15. Between this fuel passage 15 and the fuel inlet socket 6 there is provided a regulating valve 16 of the diaphragm type, which will be described later.

At the lower end of the guide socket 14 there is situated the fuel nozzle 17. Arranged to be freely reciprocatory on the guide socket 14 is the axially movable hollow valve spindle 18. On this valve spindle there is provided at the upper end a flange 19, against which there bears the spring 13. It will be apparent that in this way the hollow valve spindle is always pressed upwards by the spring.

In the wall of the hollow valve spindle there are provided apertures 20. The actual valve head or disc is mounted to be freely rotatable on the lower end of the valve spindle 18 by the use of a ball bearing 21. The valve disc is made hollow and comprises the two plates 22 and 23, which are connected together by screws 24. In the edge or annular spacing member holding the two plates in certain spacial relation to each other and thus forming the hollow space of the disc there are provided apertures 25. The screws 24 are screwed into the connecting piece 26, which acts as a holding means for the ball bearing.

The valve is movable in the upper portion of the inlet mouth to the combustion chamber 2, with such a fit as to close said inlet when the valve is in the position shown in Fig. 2. Said inlet mouth  
 5 flares or widens towards the combustion chamber, as indicated at D, and forms a guiding means in which the mixture of fuel and air is caused to  
 10 ignite before it can mix with the gases in the combustion chamber proper. In the absence of such guiding means, the jet coming from the  
 15 burner head is liable to such air or gas from the adjacent space, thereby upsetting the proper composition of the mixture required for ignition and practically complete combustion.

On the plate 22 there are provided radial vanes or blades 27. The ball bearing 21 is covered by a cap 28, which is secured to the lower end of the valve spindle 18. At the extreme periphery of this cap 28 there are provided approximately  
 20 bent vanes 29, in order to conduct the air entering from above to the spaces formed by the blades 27. In the hollow rotary valve disc there is located a valve member 30 having the needle 31. This needle projects into the fuel nozzle 17.

The valve disc carries at its lower portion a cap 32, which at the same time acts as a holding means for the needle valve 30, 31. A pin 33  
 25 furnished with a button 34 is screwed into the flange 19 of the spindle 18 for the purpose of performing by hand a movement of the fuel valve when the burner is to be set into operation, or if during the operation any obstruction  
 30 should be found to exist to the movement of the valve. In the combustion chamber 2 there may be provided baffles 35, which are situated in the heating range of the flame, in order to make the combustion of the fuel as complete as possible.

The regulator referred to above consists of a diaphragm 36, which is clamped between the upper edge of the burner casing 5 and a cover 38  
 40 which is secured by means of screws 37. The diaphragm is acted upon from the outside by a spring 39, the pressure of which may be adjusted by a spindle 41 furnished with a helical groove  
 45 40, such spindle being turned by means of the grip 42. The helical groove 40 is engaged by a pin-like projection on the screw 43. On the diaphragm there is located a piston rod 44, which  
 50 extends into the axial boring 45 of a threaded plug 46. The threaded plug is screwed into the burner casing 5 by means of the thread 47. The threaded plug possesses radial borings 48 and 49. The piston rod 44 is reduced in diameter  
 55 between its two ends, within the axial boring 45, as shown in the drawings. The lower portion of the piston rod is constructed as a piston 50. This piston has the object of regulating the passage of the fuel through the radial passages 48.

The embodiment described enables the piston to be introduced from the fuel outlet end, so that the assembly is facilitated and the space required is considerably reduced. The fuel supplied under pressure and passing through the plug 46 exerts a  
 60 pressure from below on the diaphragm, whilst the opposite side of the diaphragm is acted upon by the spring. If, for example, the pressure of the fuel is greater than the tension of the spring, the diaphragm is lifted together with the control piston 50, so that the passage is reduced and  
 70 throttled down to the pressure of the spring. In order that this thin diaphragm may not expand or be unduly strained by the action of the spring or the pressure of the fuel, the metallic walls or  
 75 counter-bearings for bracing the diaphragm

against the spring pressure are disposed so close to the diaphragm that the latter even when slightly flexed bears against metal, any strain on the thin material thus being avoided.

The pressure regulator described above also  
 5 has the particular advantage that it operates equally well in any position and at the same time requires very little space. Above all, however, it enables the pressure at the nozzle to be regulated in accordance with the viscosity of  
 10 the fuel or the passage to be regulated in accordance with any desired variation in the composition of the mixture.

The operation of the burner is as follows:

After the throttle 4 has been opened air flows  
 15 to the casing 1 in the direction of the arrow P. By opening the fuel pipe fuel is conveyed in the direction of the arrow P<sup>2</sup> into the said casing. The air entering in the direction of the arrow P then flows downwards in the direction of the arrow  
 20 P<sup>3</sup>. The hollow disc valve, however, closes the passage to the combustion chamber 2, i. e., it is situated in the position shown in Fig. 2.

A portion of the air, which acts from the outside on the valve disc in the direction of the arrow P<sup>3</sup>, moves such disc axially in the direction  
 25 of the arrow P<sup>5</sup> in opposition to the action of the spring 13. Another portion of the inflowing air penetrates in the direction of the arrow P<sup>4</sup> through the apertures 20 into the hollow valve spindle 18. This primary air flows downwards into the hollow space of the valve disc. In the  
 30 meantime the fuel has reached the nozzle 17 through the passage 15. By this movement, however, the fuel needle 30, 31 on the valve disc has been moved downwards in relation to the nozzle 17, so that fuel will now pass in the direction of the arrow P<sup>6</sup> into the hollow space of  
 35 the valve disc and intimately mix with the primary air entering in the direction of the arrow P<sup>4</sup>. The air in the direction of the arrow P<sup>3</sup>, however, has also been conducted by the helical or bent vanes 29 to the blades 27 on the valve disc. The valve disc commences to rotate, and the mixture inside of the valve disc consisting  
 40 of primary air and fuel, acted upon by the pressure of the air and the pressure of the fuel and also by the centrifugal force owing to the rotation of the valve disc, passes outwards through the apertures 25. The mixture, flowing out rapidly, impinges against the secondary air flowing in axially in the direction of the arrow P<sup>3</sup>, and there now occurs at this point a further intimate  
 45 mixing of the previously finely divided fuel already forming a preliminary mixture with the primary air.

Fig. 1 shows clearly that upon each adjusted load the cross-section of the passage for the air, owing to the enlarged or flaring outlet portion of the burner nozzle, which is designated D in the  
 60 drawings, varies between valve disc 22, 23 and the wall D of the nozzle. At the same time, however, there is also varied the cross-section of the passage for the fuel, which flows in the direction of the arrow P<sup>6</sup> out of the nozzle 17 into the  
 65 hollow space of the valve disc, as the conical needle 31 participates in the reciprocatory movements of the hollow valve disc. The conical form of the nozzle outlet D is so designed in relation to the conical form of the needle 31 in  
 70 co-operation with the fuel nozzle 17 that the ratio between fuel and air remains constant under all loads.

The mixture ignites upon entering the combustion chamber 2. Owing to the heat of com-  
 75

bustion the projections 35 are heated, so that particles of fuel, which may possibly not have taken part in the combustion or have not become mixed with the air, are now also caused to burn by the impact against the projections 35. The projections 35 are not absolutely essential and they may also be dispensed with, experiments having shown that the combustion likewise takes place in proper fashion without these projections.

The operation described above shows that the adjustment of the load occurs solely through the agency of the throttle 4. If the pressure of the introduced air is decreased by adjustment of the throttle 4, the spring 13 presses the hollow disc valve upwards, the cross-section of the passage for the air flowing in the direction of the arrow P<sup>3</sup> then being constricted. At the same time there is also obtained in this way a corresponding constriction of the passage for the fuel flowing in the direction of the arrow P<sup>6</sup>.

I desire to call attention to the fact that the air flowing in the direction of the arrow P<sup>3</sup> and striking the vanes 29 and blades 27 rotates the valve disc in turbine-like fashion, and the velocity of rotation increases with the load. By this construction, even large quantities of fuel will be broken up or atomized in proper manner. As has been stated above, a preliminary scattering of the fuel and its mixing with the primary air take place within the hollow valve disc, and the resulting mixture flows at a speed corresponding to the pressure required to overcome the tension of the spring 13 on which the valve is suspended. In view of these circumstances, a low pressure, for instance one of 150 millimeters (water column) will be sufficient to atomize tar oil, which is a rather sluggish substance.

When the burner is operated with coal dust as its fuel, and the needle 31 is firmly connected with the disc valve so as to rotate in unison therewith, the construction illustrated has the advantage of dislodging any particles of solid fuel that may adhere to the needle or to the cooperating wall of the fuel nozzle 17; I thus avoid any accumulation of coal-dust between the needle on one hand and the wall of the fuel passage or nozzle on the other hand.

The constant ratio between fuel and air is also maintained by a burner embodying the present invention if the burner is switched over suddenly from minimum to top load. Experiments have shown that even in this case there is not the least generation of smoke. Owing to the fact that the composition of the mixture is always the correct one the load on the fuel chamber is very high. Experiments have shown that up to 36,000,000 calories per cubic meter per hour have been produced. There is also obtained with a burner embodying my invention a considerably higher temperature than has been possible heretofore with burners of a similar kind. As a result, the boiler output is increased, or in the case of new constructions the heating area of a boiler may be made correspondingly smaller.

Owing to the proper and intimate mixing of the air and the fuel, a burner constructed according to the present invention will operate successfully with a relatively small combustion chamber.

What I claim as new and desire to secure by Letters Patent is:

1. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle having an outlet mouth which flares towards the said combustion chamber and serves to conduct primary

and secondary air to said chamber, a hollow axially movable valve located in the said mouth and having radial outlets for the primary air, a hollow valve spindle through which the fuel and the primary air are conducted to the said hollow valve, and a seat in relation to which the said valve is movable under the action of the primary air for the purpose of regulating the passage of the secondary air moving past the said outlets in a fixed ratio to the mixture of fuel and primary air emerging radially through the said outlets.

2. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle having an outlet mouth which flares towards the said combustion chamber and serves to conduct primary and secondary air to said chamber, a hollow axially movable valve located in the said mouth and having radial outlets for the primary air, a hollow valve spindle through which the fuel and the primary air are conducted to the said hollow valve and on which the said hollow valve is rotatably mounted, vanes connected with the said spindle for deflecting the secondary air, and blades on the said valve adapted to cause rotation of the said valve under the action of the secondary air deflected by the said vanes.

3. In a burner for a mixture of air and fuel, a stationary member having a fuel supply conduit provided with a tubular outlet, and also having an air supply passage, a rotary hollow valve member having a chamber with a central inlet and peripheral outlets, said valve member being movable axially to control said air supply passage, means associated with said valve member for causing it to rotate during the operation of the burner, and a needle valve held to move axially in unison with said rotary valve member and cooperating with the said tubular outlet of the fuel supply conduit.

4. A burner according to claim 3, in which the needle valve is held to rotate with the valve member.

5. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle provided with an outlet mouth forming an inlet to said chamber, a valve located in said mouth and movable axially under the action of air flowing through said inlet, and a spindle movable axially in unison with said valve, the valve being mounted to rotate on said spindle under the action of air flowing through said inlet.

6. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle provided with an outlet mouth forming an inlet to said chamber, a valve located in said mouth and movable axially under the action of air flowing through said inlet, and provided with an interior chamber having peripheral outlets, a hollow spindle movable axially in unison with said valve and channeled for conducting air and fuel into said chamber, said valve being rotatable on said spindle, and means associated with said valve for causing it to be rotated by the flow of air.

7. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle provided with an outlet mouth forming an inlet to said chamber, a valve located in said mouth and movable axially under the action of the current of air flowing through said inlet, and provided with an interior chamber having peripheral outlets, a hollow spindle movable axially in unison with said valve and channeled for conducting air and fuel into said interior chamber, said valve being rotatable on said spindle, vanes connected with said spindle to deflect the said current of air, and

blades on said valve, in the path of the air thus deflected, to produce a rotation of said valve.

8. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle provided  
5 with an outlet mouth forming an inlet to said chamber, a valve located in said mouth and movable axially under the action of air flowing through said inlet, and provided with an interior chamber having peripheral outlets, a hollow  
10 spindle movable axially in unison with said valve and channeled for conducting air and fuel into said interior chamber, said valve being rotatable on said spindle, a ball bearing interposed between said valve and said spindle, a cap on said spindle  
15 covering said ball bearing, vanes on said cap to

deflect the current of air, and blades on said valve, in the path of the air thus deflected, to produce a rotation of said valve.

9. In a burner for a mixture of air and fuel, a combustion chamber, a burner nozzle provided  
5 with an outlet mouth forming an inlet to said chamber and widening gradually toward said chamber, means for supplying air and fuel to said chamber, a valve located in said mouth and controlling the flow of air and fuel, said valve being  
10 movable toward the said chamber under the action of the air flowing through said inlet, and resilient means for moving said valve in the opposite direction.

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