

Aug. 8, 1944.

J. N. JUNKINS

2,355,080

BURNER

Filed Aug. 4, 1940

2 Sheets-Sheet 1

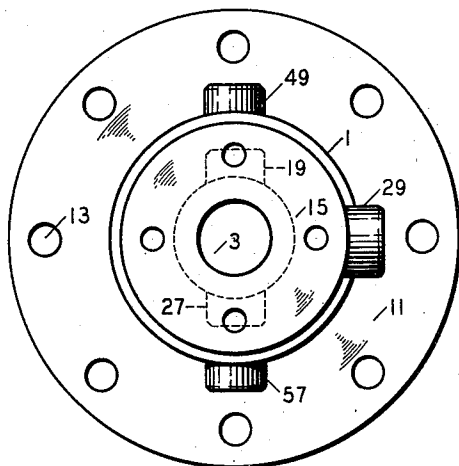


FIG. 1

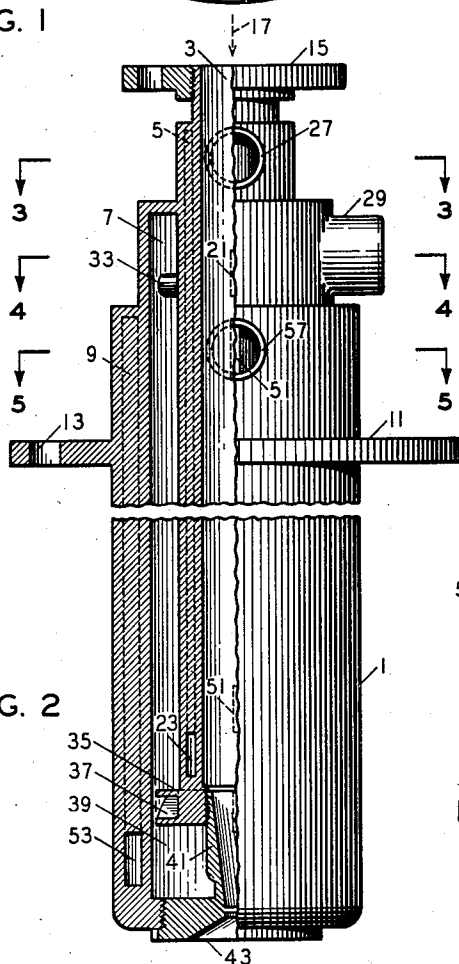


FIG. 2

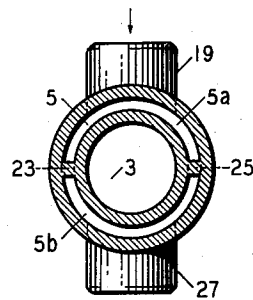


FIG. 3

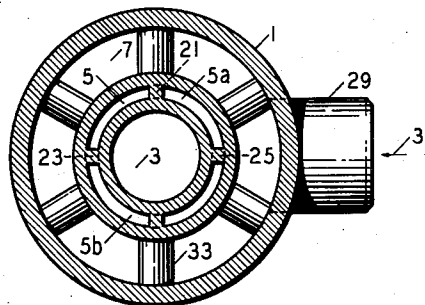


FIG. 4

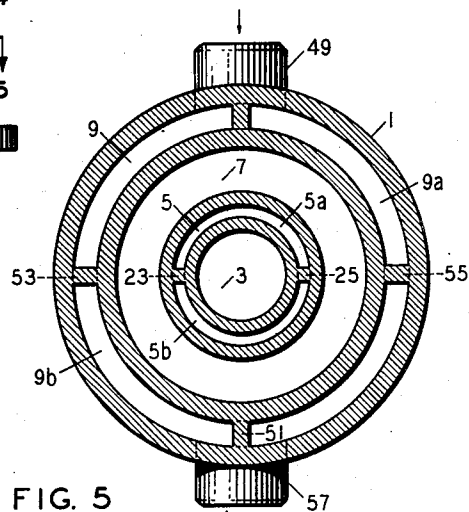


FIG. 5

John N. Junkins

INVENTOR

BY *Arthur L. Davis*
ATTORNEY

Aug. 8, 1944.

J. N. JUNKINS

2,355,080

BURNER

Filed Aug. 4, 1940

2 Sheets-Sheet 2

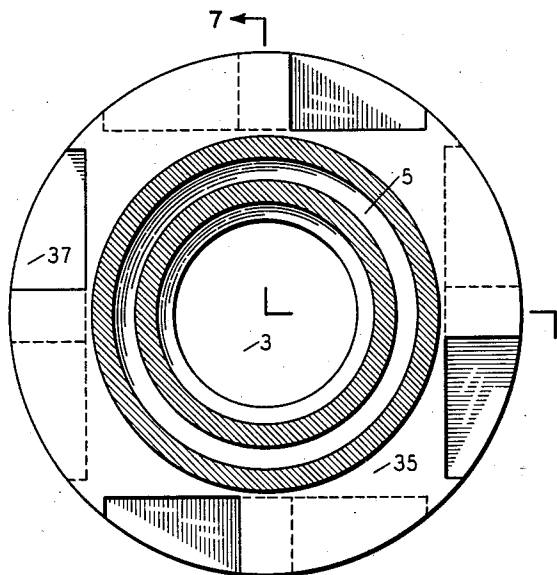


FIG. 6

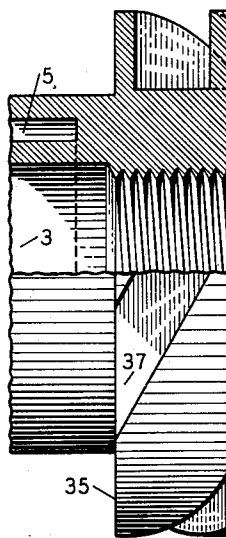


FIG. 7

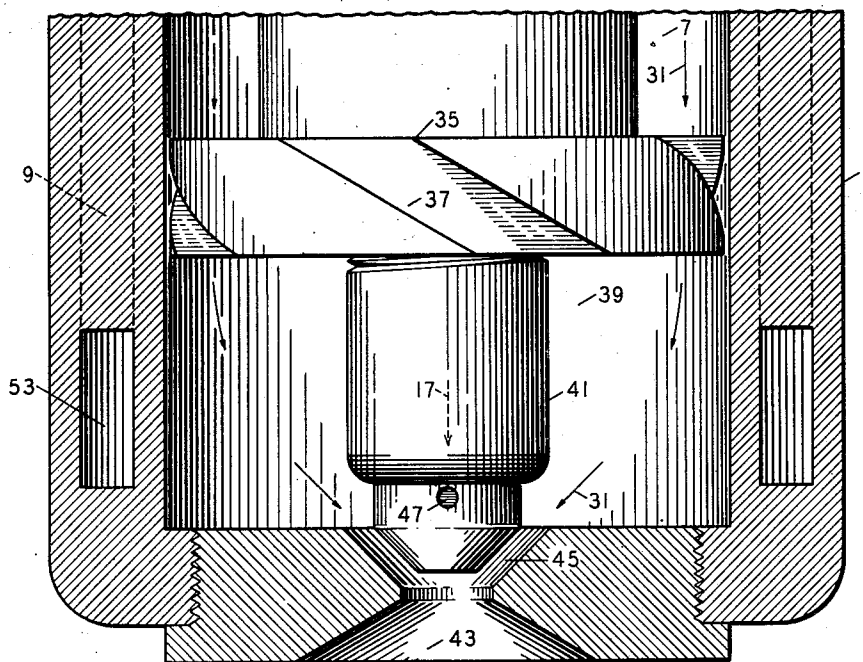


FIG. 8

John N. Junkins

INVENTOR

BY *Arthur L. Davis*

ATTORNEY

UNITED STATES PATENT OFFICE

2,355,080

BURNER

John N. Junkins, near Sheffield, Ala., assignor to
Tennessee Valley Authority, a corporation of
the United States of America

Application August 4, 1940, Serial No. 351,427

1 Claim. (Cl. 299—114)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

The invention herein described may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to the art of burning liquid fuels.

The principal object of this invention is to provide a burner for liquid fuels wherein the fuel is maintained under a substantially constant pressure and during operation of the burner the rate of flow of the fuel is increased or decreased inversely as to the pressure of the fluid used for atomizing such fuel. Another object of this invention is to provide a burner for liquid fuel under substantially constant pressure where not only the rate of flow of fuel is controlled by the pressure of the fluid used to atomize the same but also to cut off the flow of fuel entirely by increasing the pressure of the atomizing fluid beyond a critical pressure. A further object of this invention is to provide a burner which is suitable for the oxidation of liquids such as elemental phosphorus which is ordinarily not considered as a fuel, even though such oxidation is highly exothermic. Other objects of this invention include the provision of a burner for liquid fuels which is readily susceptible to regulation not only in respect to changes in character of the fuel being burned but also changes in conditions under which it is desired to burn a given fuel.

I have discovered a burner nozzle comprising a fuel receiving chamber, a pressure fluid chamber concentric with said fuel receiving chamber, and a radially disposed jet at the discharge end of the burner so constructed and arranged in respect to its angular position and its clearance from the fuel receiving chamber as to impart control of the flow of fuel under substantially constant pressure from the burner nozzle so that its rate of flow is inverse as to the pressure of fluid in said pressure fluid chamber until said rate of flow is substantially zero.

In the accompanying drawings, which form a part of the specification and wherein reference symbols refer to like parts wherever they occur,

Fig. 1 is a top plan view of the burner.

Fig. 2 is a half sectional, half elevational view of the burner.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 2.

Fig. 5 is a sectional view taken on line 5—5 of Fig. 2.

Fig. 6 is a part sectional, part plan view of the

air jet, showing the plurality of declined air ducts.

Fig. 7 is a half elevational, half sectional view taken on line 1—1 of Fig. 6, and

Fig. 8 is a sectional, elevational view showing the arrangement of the burner nozzle and burner tip.

In all figures a body member 1 is provided with a plurality of concentric chambers consisting of an inner or primary chamber 3, surrounded by a secondary chamber 5, which is surrounded by a tertiary chamber 7, surrounded by an outer chamber 9. A body flange 11 integral with the body member 1 has a plurality of apertures, represented by aperture 13, which provides a means for mounting the burner in a suitable position in conjunction with a combustion chamber. A flange 15, threadedly affixed to that portion of the body member defining the primary chamber 3, connects to a companion flange (not shown) of a phosphorus feed pipe. The phosphorus is fed, as indicated by arrow 17, into the primary chamber 3 under such pressure and temperature that an optimum operation of the burner is maintained at all times. A steam inlet 19 for the secondary chamber 5 admits steam into that portion of chamber 5 designated as chamber 5a and which is formed by interposition of a portion of the body member 1. The steam admitted into chamber 5a passes downwardly, in uniform distribution due to a plurality of guide vanes, represented by guide vane 21, for substantially the entire length of primary chamber 3, then passes through communicating passages 23 and 25 into chamber 5b which is the remaining portion of the chamber 5 as formed by interposition of a portion of the body member 1. The steam then passes upwardly through chamber 5b where it is emitted by outlet 27. An air inlet 29 admits air, as indicated by arrow 31, into tertiary chamber 7 wherein the air is distributed as it passes downwardly by a plurality of guide vanes, represented by guide vane 33. An air jet 35, integral with that portion of the body member forming the primary and secondary chambers, is radially disposed at the lower extremity of tertiary chamber 7 and is provided with a plurality of declined ducts, represented by duct 37, which imparts an eddying motion to the air as it passes through annulus 39. A phosphorus nozzle 41 is threadedly secured to the air jet 35 and is so secured that adjustment of the nozzle 41 relative to a burner tip 43 is such that the area of the annulus 45 may be varied as desired. The burner tip 43 is threadedly secured to the body member

1 and is so secured that adjustment of the burner tip 43 relative to the nozzle 41 may also be varied to alter the area of the annulus 45 as desired. A plurality of indentations, represented by indentation 47, is provided for screwing the nozzle 41 into position and for making any further subsequent adjustments. A water inlet 49 for the quadriary chamber 9 admits cooling water into that portion of chamber 9 designated as chamber 9a and which is formed by interposition of a portion of the body member 1. The water admitted into chamber 9a passes downwardly, in uniform distribution due to a plurality of guide vanes, represented by guide vane 51, for substantially the entire length of the burner, then passes through communicating passages 53 and 55 into chamber 9b which is the remaining portion of the chamber 9 as formed by interposition of a portion of the body member 1. The water then passes upwardly through chamber 9b where it is emitted by outlet 57.

In the present invention the fuel receiving chamber from which liquid fuel is discharged and atomized provides for the delivery of such fuel under constant pressure and the regulation of the rate of flow of such fuel without any restrictions whatever such as usually are employed through the use of valved control. This permits a substantially uniform flow of the fuel regardless of occasional variations in quality of the fuel as may be evidenced by the action of solid matter carried with it. Ordinarily, the presence of such solid matter seriously changes the subsequent characteristics of the burner while in the present invention such solid matter may pass through and operation returns to normal.

Furthermore, in the present invention the fuel receiving chamber is in juxtaposition with a pressure chamber adapted to supply a suitable fluid over a variable pressure range for atomizing the fuel delivered to the receiving chamber. This pressure fluid chamber is provided with means for causing the atomizing fluid to be discharged therefrom with a violent but, at the same time, uniformly swirling motion.

A burner tip is so associated with the fuel receiving and discharging chamber and the pressure fluid chamber, both in respect to its angular position and its clearance from the fuel receiving chamber as to impart a control of the rate of flow of the fuel through the receiving chamber solely through the control of the pressure

of the fluid used for atomization. The present combination is unusual in that with an increase in the pressure of the fluid in the pressure fluid chamber the rate of flow of the fuel decreases. This rate of flow continues to decrease until the pressure of the atomizing fluid reaches a critical point whereupon the flow of fuel stops entirely.

The burner of the present invention has been used successfully for some time in plant sized scale operations involving the combustion of elemental phosphorus. The burner unit, in which a plurality of declined ducts, as represented by duct 37, was placed 30° from the horizontal, delivered the atomizing fluid under an adjustable pressure to the annulus 45 which is positioned at a 45° angle and has a $\frac{3}{4}$ " clearance from the tip of the burner nozzle 41. The elemental phosphorus in fuel chamber 3 is delivered through the nozzle tip at the rate of from 800 pounds per hour to 1800 pounds per hour for a corresponding pressure in the fluid chamber 7 of 100 pounds per square inch to 50 pounds per square inch. When it is desired to stop the flow of phosphorus entirely the pressure within the fluid chamber 7 is increased to 125 pounds per square inch.

The present invention does not necessarily contemplate the necessity of having a heating chamber concentric with the fuel chamber in all cases. However, such a heating chamber is generally desirable to facilitate the flow of most types of liquid fuels used. Neither does the present invention contemplate the necessity of always using a cooling chamber concentric with and outside of the pressure fluid chamber. However, such a cooling chamber is often necessary or desirable to prevent damage to the burner which might be caused by undue overheating.

I claim:

A method of controlling the rate of flow of a fluid stream through a constricted orifice which comprises (a) supplying fluid to said orifice under substantially constant pressure, (b) maintaining a concentric confluent vortical stream of pressure fluid around said constricted orifice at a pressure in excess of said constant pressure whereby the rate of flow of said fluid stream varies inversely with variation in the pressure of said stream of pressure fluid, and (c) adjusting the pressure of said stream of pressure fluid to provide a desired rate of flow of said fluid stream.

JOHN N. JUNKINS.