J. GOOD.

BURNER REGULATION SYSTEM.

APPLICATION FILED JAN. 4, 1918. RENEWED MAR. 5, 1921.

1,393,280. Patented Oct. 11, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

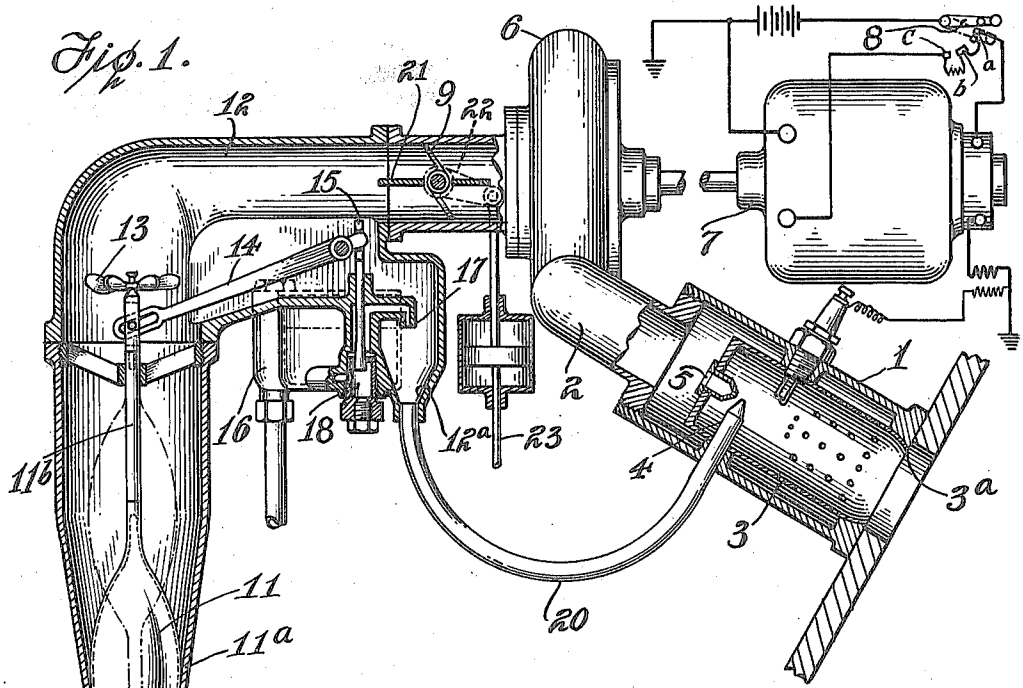
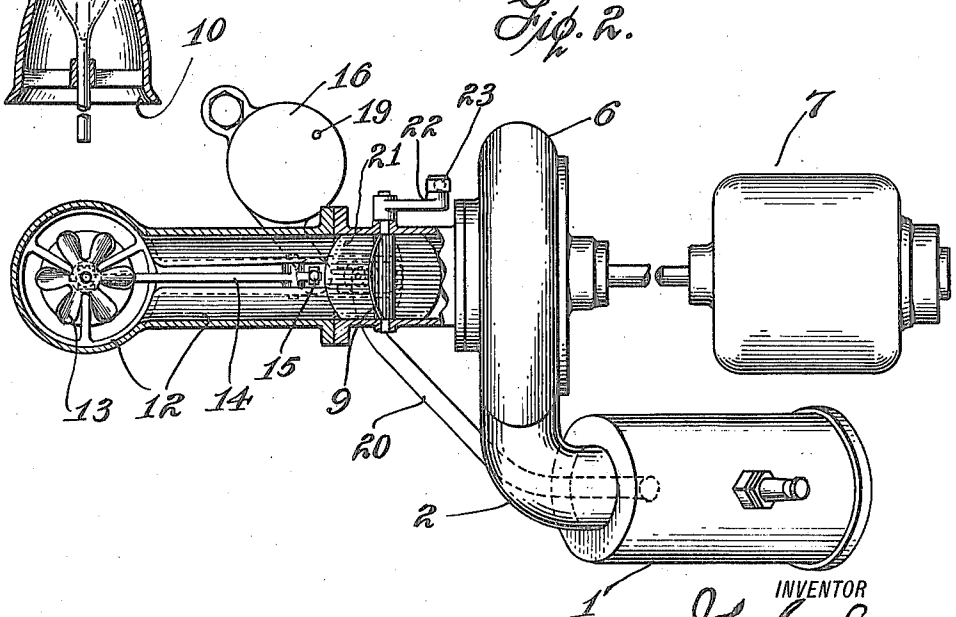


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

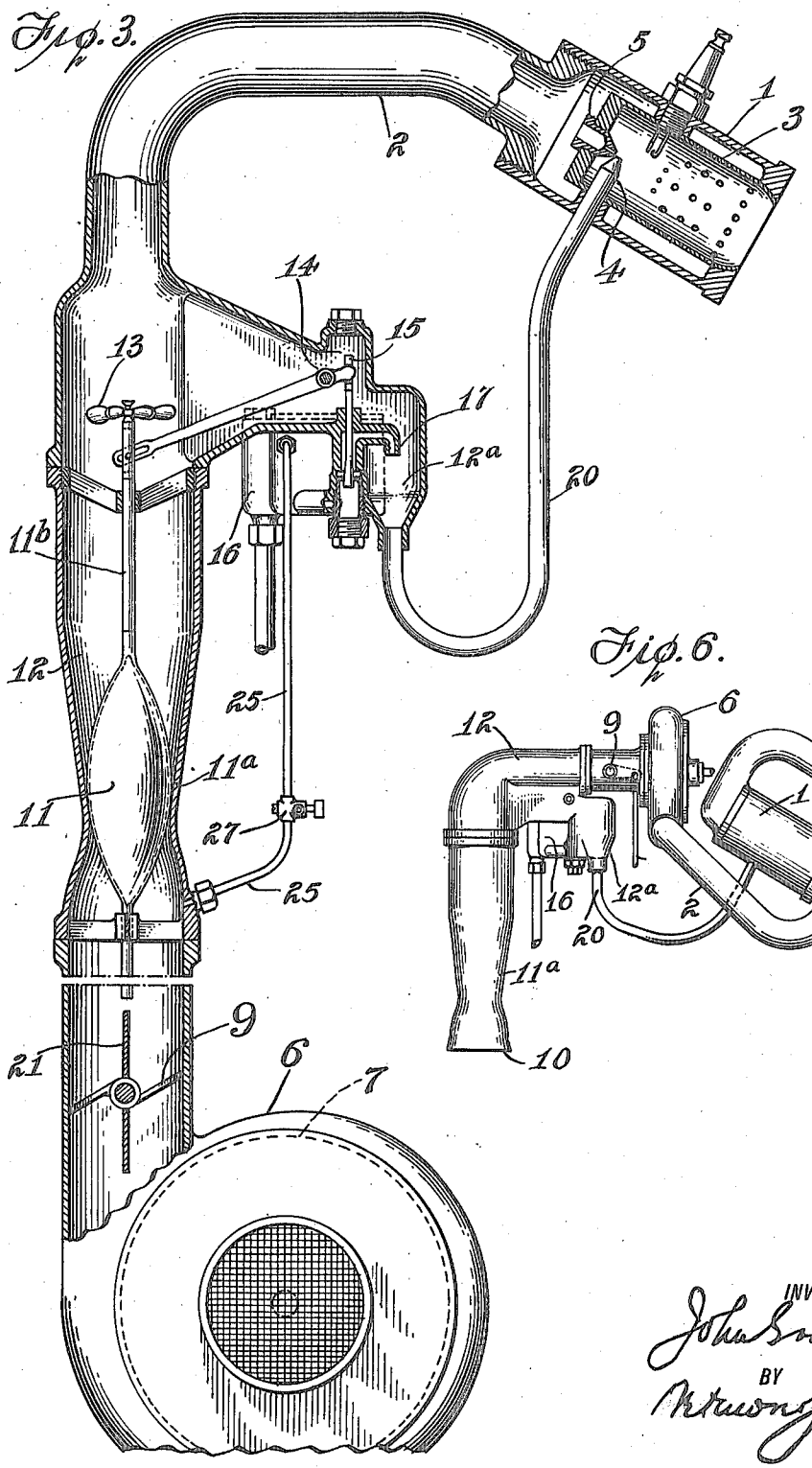

Fig. 6.

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3 SHEETS—SHEET 3.

Fig. 4.

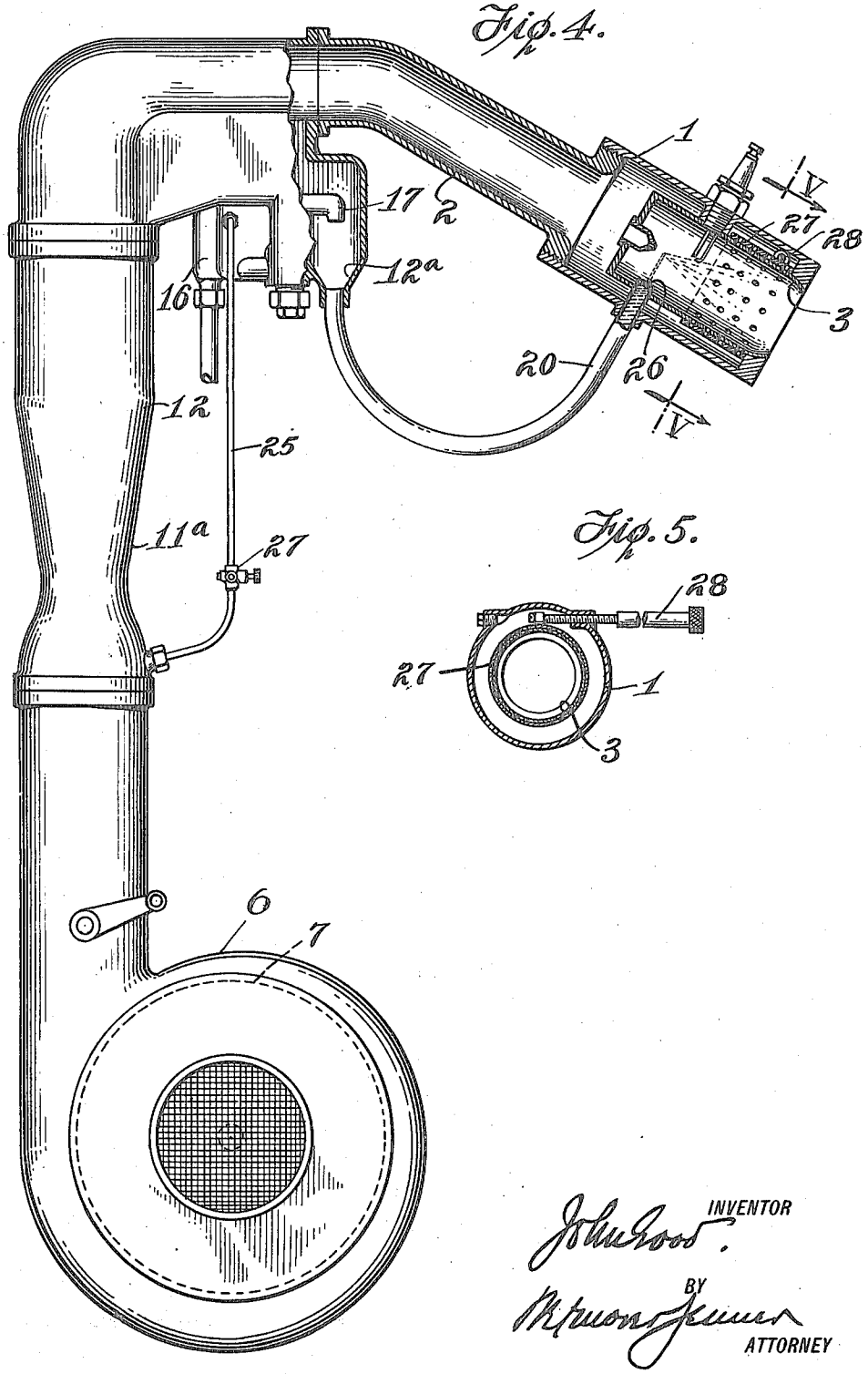

Fig. 5.

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JOHN GOOD, OF GARDEN CITY, NEW YORK, ASSIGNOR TO GOOD INVENTIONS CO., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

BURNER-REGULATION SYSTEM.

1,393,280. Specification of Letters Patent. Patented Oct. 11, 1921.

Continuation in part of application Serial No. 86,455, filed March 24, 1916. Patent No. 1,267,760, dated May 28, 1918. This application filed January 4, 1918, Serial No. 210,298. Renewed March 5, 1921. Serial No. 449,744.

To all whom it may concern:

Be it known that I, JOHN GOOD, United States citizen, residing in Garden City, Long Island, N. Y., have invented the following described Improvements in Burner-Regulation Systems.

The improvements relate to the automatic regulation of the proportions of fuel and air in liquid fuel burners being directed more particularly to that type of burner mechanism in which the proportions to be controlled and maintained are those of an explosive mixture such for example as illustrated in my prior but co-pending application, Serial No. 86,455, filed March 24, 1916, and in other types of burners using a forced draft supply of combustion-supporting air, and also in burners generally which are adapted to be ignited by electrical means. The present application is in part a continuation of my said earlier application, being directed broadly to certain matters therein shown and specifically claimed as well as to additional features. The objects of the invention are among other things, to maintain with close accuracy a constant or any predetermined proportion of liquid fuel and air as discharged into or from the burner head and throughout a wide range of control of the combustion rate, thus permitting the burner mechanism to be turned up and down, so to speak, and to any extent desired without departing from the desired proportions or disturbing the efficiency of the heat development or varying the chemical composition of the exhaust product. Other objects and various incidental features and uses of the present invention will appear from the description which follows or become apparent therefrom to those skilled in this art.

Referring to the drawings—

Figure 1 is a general sectional view of apparatus incorporating the present invention, the several parts thereof being purposely arranged for convenient illustration in a single view;

Fig. 2 is a top plan of Fig. 1 with parts in section;

Fig. 3 is a general sectional view of a modified form of the invention; and

Figs. 4, 5 and 6 are details of modifications.

The burner head taken for illustration consists of a main casing 1 supplied with air from a pipe 2 and containing an inner air-distributing shell 3 and an oil nozzle 4. The shell contains a central spray nozzle 5 and some of the air passing through this nozzle serves to atomize and aspirate the liquid fuel from the oil nozzle while the remainder passing through a number of very fine holes in the shell wall is sufficient to support or complete the combustion of the fuel so that an intense flame emerges from the end of the burner head into whatever space is to be heated. A spark plug with its electrodes intercepting the lateral edge of the spray, before it mixes or is greatly diluted by the combustion-supporting air, serves to ignite the fuel in the type of burner head shown, providing the proportions of air and fuel and the velocity within the shell are properly correlated. This particular form of burner head is a preferred one for the present invention being the subject of another co-pending application, Ser. No. 195,506, filed Oct. 9, 1917. For general burner use in heating muffle furnaces, boilers and the like it is desirably provided with a slight constriction of the flame orifice as indicated at 3^a. However, and so far as the regulation system herein disclosed is concerned, various other types of burners may be used in place of that shown.

The forced air flow through the burner may be obtained in various ways and in the case of Figs. 1 and 2 is derived from a fan blower 6 driven by a motor 7. The motor switch 8 is arranged with three or more contact stations; the first, marked *a* is a double or split contact adapted for simultaneously energizing the motor and the spark coil of the spark plug in the burner head to produce the ignition sparks. When the switch handle is set on this first contact, delivery of air and fuel is begun in the burner head and ignition is automatically produced therein, the fuel proportions and the flow velocity in the burner being properly coördinated to that end as later described. Movement of the switch handle to contact *b* continues the motor in action but discontinues the spark and movement to the last contact *c* cuts out resistance from the motor circuit as indicated in the diagram of Fig. 1 and thereby

speeds up the motor to increase the air delivery and hence the rate of combustion. The switch may be a controller for the motor as respects its speed and may be assumed for the purposes of this description, to be the equivalent of any suitable means for regulating or adjusting the rate of air flow to the burner head. In this respect it duplicates the function of a throttle 9 which in the case of Figs. 1 and 2, controls the suction intake of the blower. Either the switch or the throttle may be used for controlling the rate of air flow, it being understood that the air flow creates and controls the pressure conditions which move the fuel liquid to the burner head and on that account that the regulation of the throttle or the switch may be the means of varying the rate of combustion as above stated.

When the air source is a fan blower, it may be located at any point in the path of the air flow, being located, in Figs. 1 and 2, just in rear of the burner head. It draws air from the atmosphere through the intake 10 and past a stream line control body 11 which is lifted or displaced thereby to an extent proportional to the velocity of inflow. This body is mounted on a staff 11^b guided in spider bearings in the intake passage and is rendered extremely sensitive to fluctuations of air flow by the action of the small wind wheel 13 mounted upon it. The said wheel is rapidly revolved by the air and is purposely made out of balance so that it sets up a tremor in the staff 12 which removes any tendency for the latter to stick in its bearings. The wind wheel is thus essentially a shaker or vibrator and keeps the air control body as well as other moving parts of the apparatus in a sensitive and mobile condition notwithstanding that these parts are likely to become clogged with dirt and dust incoming with the air. Inasmuch as this vibrator device is of great utility in the present construction and has other than burner uses, it is regarded as an independent feature and is separately claimed as such. The air-sustained body 11 is displaced, in the case in hand, against its gravity only but a spring could be employed to close or seat it additionally to gravity or instead of it if desired. The variations in its degree of displacement are accurately transmitted through the lever 14 to a liquid fuel metering device constituted in the present case by a tapered pin 15 occupying the restricted outlet passage from a liquid fuel receptacle 16 to the liquid discharge nozzle 17 of that receptacle. The position of the control body and the pin will be understood to be correlated so that for any position of the former the liquid discharge from the nozzle 17 will take place in a definite ratio to the air flow. This ratio may be constant and in the case of some types of burners that are electrically ignited, may be made variable and so as to give a certain richness of the fuel mixture at the starting speed of the fan which will adapt it to be readily and instantly ignited even though the fuel be in a cold state. This may be assumed to be the case with the burner head illustrated. The automatic regulation of proportions is accurately obtained in the present case by using a straight tapered metering pin and by giving the chamber wall around the control body 11 a special curvature, as indicated at 11^a previously computed to make up for the known characteristics of variation of liquid flow through small orifices. The restricted outlet controlled by the metering pin is formed in a thimble 18 which is adjustable with reference to the pin by screwing it one way or the other. Such adjustment regulates the proportion of fuel and air which the apparatus will thereafter automatically maintain. A similar adjustment could be made by changing the normal position of the air-sustained body 11 with reference to the lever 14 or the pin 15.

The liquid nozzle 17 is placed in a lateral discharge chamber 12^a or extension from the air intake pipe 12, being therefore in communication with the pressure condition caused by the control body 11. The liquid receptacle 16 which supplies this nozzle, through the metering devices above described, is kept with a constant liquid level by means of a float valve or other means not shown and with its interior at atmospheric pressure by reason of a vent to atmosphere marked 19 in Fig. 2. The level in the chamber, in the system of Figs. 1 and 2, is close to and only slightly below the level of the orifice of nozzle 17. Liquid delivery takes place through the nozzle by reason of, and substantially in proportion to, the pressure depression established in the intake pipe 12 by the suction of the blower and the control body 11. That is to say, the fuel in receptacle 16 is always at the pressure of the air entering the entrance 10 and the nozzle 17 is at that of the air after having passed the control body; the difference of pressure on opposite sides of the control body produces the liquid flow. The difference is constant when the control body is gravity seated as in the present case and therefore the flow occurs under the equivalent of a constant head, the rate being varied solely by movement of the metering device. The discharged and measured liquid falling into the chamber 12^a is conducted therefrom and separately from the air flow in the air pipe 12 by means of the transfer pipe 20, which latter pipe conducts it straight without admixture with air to the burner nozzle 4 or to whatever device is employed for preparing the liquid for combustion with the air. Movement of the liquid through this transfer pipe is pro-

duced, in the system of Figs. 1 and 2, solely by the aspirating effect of the spray nozzle 5 but can obviously be supplemented by a gravity head if desired, depending upon the relative levels of the chamber 12a and the burner head. The throttle 9, which controls the rate of combustion as already explained, is a butterfly valve, so-called, consisting of a single circular disk with offset vanes and with its axle located in the plane of a longitudinal central partition 21, so that one vane is located in the compartment on each side of the partition. In this location the air flow has no tendency to turn the throttle on its axis and the valve is therefore balanced and thereby admirably adapted for sensitive control by thermo-static action. For this purpose its crank arm 22 is shown connected to a rod 23 which may be assumed to be a thermostat or the stem of one, the active element thereof being omitted from the drawing but understood to be located where it will experience the temperature produced by the burner. The same rod 23 may also be assumed to be a manual control element in which case it could be provided with a dash pot as shown in the drawing, especially if the pipe 20 is of considerable length, in which case it serves to prevent changes in the air flow so abrupt as to become effective in the burner before corresponding changes at the measuring point have become effective at the fuel nozzle.

It will be apparent that with the organization above described the proportions may be maintained constant notwithstanding that either the pipe 20 or 2 may be subjected to considerable heating which is sometimes desirable to facilitate the movement or the vaporization of certain liquid fuels. Both of these pipes may be of any length required by the conditions of installation, the same being also true of the intake pipe. The metering device should be located in a position of substantially constant temperature to avoid change of proportion from change of viscosity due to temperature and it will be observed that the invention provides the means whereby such device can be located at any suitable position without in any way affecting the operation of the system as a whole. The control body wherever located, will serve to establish a pressure difference and its position will control the fuel delivery.

Fig. 3 shows the same principle as above described but in the form wherein the fan blower is located at the entrance to the intake pipe 12 and in which the entire system is operated above atmospheric pressure. In this form the liquid fuel receptacle 16 is subject to the air pressure below the air-sustained body 11 through a pressure pipe 25 and the discharge chamber 12a is at the pressure—greater than atmosphere—determined by the position of the said body so that the movement of liquid to chamber 12a takes place under the same pressure difference as above described and so that the movement of the measured liquid through the transfer pipe 20 occurs in part by reason of the pressure acting upon it rather than solely by the aspirating suction of the air jet in the burner. In fact, in this form, the aspirating effect need not be relied upon at all, the pressure in chamber 12a being sufficiently above that in the burner head to give adequate flow and even to lift the fuel to some considerable distance above the constant level in the liquid receptacle. On this account the particular type of burner head taken for illustration can be equipped with a very reliable and efficient type of spraying means, as presently explained.

The adjustment of proportions in this pressure system may be made by the adjustment of the thimble 18, as already described, but it may also be accomplished by varying the capacity of a small vent to atmosphere in the pressure pipe 25, such vent being provided in a valve 27, and being normally open so as to permit a small quantity of air constantly to escape to atmosphere. By closing such valve more or less the pressure in the liquid receptacle 16 may be varied accordingly and up to a maximum in which the vent will be substantially closed and the full pressure of the blower exerted on the liquid.

Fig. 4 illustrates the special fuel spraying means above referred to. The fuel nozzle 26 terminates just within the air distributing shell and is provided with a fine needle orifice, such as would be made by a No. 68 drill or even finer. The liquid fuel in the transfer pipe 20 is under pressure sufficient to discharge a slender solid needle of liquid from this orifice into the path of the air jet from the nozzle 5, which shatters it into an extremely fine mist, particularly well suited for electric ignition and not at all subject to disarrangement by slight variations in the relative position of the air jet. The latter may issue from a relatively large orifice in the air nozzle 5, such as would be made by a No. 40 or 50 drill. The reliability and effectiveness of its atomizing action without need of specially accurate adjustment very materially simplifies manufacture. This method of spraying is reserved for a separate patent. It may be noted that as employed with the regulation system of the present patent, the nozzle 26 is located at about the level of the transfer chamber 12a and such chamber is above atmospheric pressure.

Fig. 4 also illustrates that the regulation of the combustion rate may take place at the air distributing shell in the burner head instead of in the intake pipe as in the pre-

ceding figures. The rotary sleeve 27 mounted upon and around the said shell 3, is perforated in registry with holes in the latter and subject to slight rotary adjustment by a thumb screw 28, by means of which the number, or the effective areas, of the air holes in the shell may be enlarged or restricted. Such restriction imposes a corresponding back pressure in the air intake pipe 2, thereby diminishing the pressure difference which controls the liquid flow from the nozzle 17 in proportion to the restriction and consequently maintaining the predetermined proportion of fuel and air.

Fig. 6 illustrates the air pipe 2 of Fig. 1, subject to the heat of the burner prior to its entrance thereto, the said pipe being indicated as formed into a coil 2^a around the flame for that purpose, but this means of heating the air is merely illustrative of any other suitable means of heat exchange that might be used.

Claims:

1. A forced combustion system for liquid fuel comprising a burner mechanism, an air pipe, means for creating a regulable flow of combustion supporting air through the same to said burner mechanism, a liquid fuel receptacle having a discharge nozzle opening into a space or chamber in communication with said air pipe so as to be subject to the pressure condition therein and a transfer pipe conducting liquid fuel from said chamber separately from the air flow in said air pipe to said burner mechanism, the said parts being organized and arranged to discharge liquid fuel to said transfer pipe in a predetermined and substantially constant proportion to the rate of air flow in said air pipe.

2. The combustion system identified in claim 1 having a metering device for the liquid fuel operated by a body in the air flow which is sustained at different positions of displacement in proportion to the rate of flow.

3. The system identified in claims 1 and 2 in which the metering device operated by a body in the air-flow comprises a straight-tapered liquid metering member and the coacting seat portion for said body is specially curved with relation to said body to maintain constant proportion of fuel and air for different rates of flow.

4. The system identified in claim 1 in which the air flow is provided by a fan type blower intervening between the liquid discharge chamber and the burner mechanism.

5. In the system identified in claim 1, electric ignition means in the burner mechanism, an electrically driven fan for furnishing the air flow to the mechanism and a single switch device for controlling both.

6. In the system identified in claim 1, a throttle disposed in the air pipe between the said liquid discharge chamber and the point of mixture of the liquid fuel with the air from said pipe.

7. The system identified in claim 1, in which the proportions of fuel and air and the manner of their mixing in the burner mechanism are correlated to permit electric ignition of the fuel and in which the air supply is produced by an electric motor adapted to run at such speed as to produce a flow velocity in the burner mechanism suitable to permit such ignition, and in which the ignition means is automatically energized when the said motor is set to run at the speed referred to.

8. The system identified in claim 2 in which the liquid fuel receptacle is subject to the same pressure as exists on the entrance side of said air-sustained body, the discharge nozzle from said receptacle being on the burner side of said body whereby the liquid is discharged by virtue of the pressure depression produced by said body.

9. A fuel and air proportioning device comprising an air-sustained body interposed in the air flow through said device and means for shaking or vibrating said body to reduce its tendency to stick.

10. A fuel and air proportioning device comprising an air-sustained body interposed in the air flow through the same and an air-operated member adapted to impart vibration to said device.

11. A fuel and air proportioning device comprising moving measuring parts and an unbalanced wind wheel disposed in the air flow through said device and adapted to impart vibration thereto.

12. The combination with a pipe, of a throttle therein comprising a single disk and a pivotal mounting therefor, a central longitudinal partition in said pipe occupying the plane of the pivotal axis of said mounting and the vanes of said disk on opposite sides of the partition being of substantially equal area, whereby the disk is balanced.

13. Combustion apparatus comprising a burner with a liquid fuel nozzle and an air pipe leading to the burner having an air-sustained control body therein, in combination with a liquid fuel supply receptacle having means for delivering liquid to said nozzle and arranged to discharge said liquid by virtue of the difference of pressure on opposite sides of said body, means whereby the position of said body regulates the said discharge, and a transfer pipe conducting the so discharged liquid to the burner.

14. Combustion apparatus comprising a burner, an air pipe connected to it, means for creating an adjustable rate of air flow therethrough to said burner, a body adapted to be variably displaced by said air flow, a liquid fuel chamber having its liquid outlet

within said air pipe between said body and burner and adapted to deliver liquid in proportion to the air flow without substantial mixture with the air at said outlet, a transfer pipe having its opening within said air pipe and receiving the liquid from said outlet and conducting the same separately from the air pipe to form the mixture in said burner, and means whereby a difference of pressure is maintained between the ends of said transfer pipe to move the fuel therethrough.

15. Combustion apparatus comprising a burner, an air pipe and means for creating an adjustable rate of air flow therethrough to said burner, a body adapted to be variably displaced by said air flow, a liquid fuel chamber having its liquid outlet within said air pipe between said body and burner and adapted to deliver liquid in proportion to the air flow but without mixing with the air at said outlet, a transfer pipe having its opening within said air pipe and receiving the liquid from said outlet and conducting the same separately from the air pipe to form the mixture in said burner, means whereby a difference of pressure is maintained between the ends of said transfer pipe to move the fuel therethrough and means for heating one of said pipes between the said liquid outlet and the burner.

16. A forced draft liquid fuel combustion system comprising an air pipe, means for creating a forced flow of combustion-supporting air through the same to a burner, and means for varying said flow, said burner comprising a liquid nozzle and an air-jet nozzle arranged to aspirate liquid fuel from a liquid nozzle and a chamber for distributing and mixing the combustion-supporting air with the aspirated fuel, in combination with means for supplying liquid fuel to the fuel nozzle and regulating devices for said means controlled by the air flow independently of the aspirating action of the air-jet and automatically maintaining the rate of fuel supply in a predetermined proportion to the air flow.

In testimony whereof, I have signed this specification.

JOHN GOOD.