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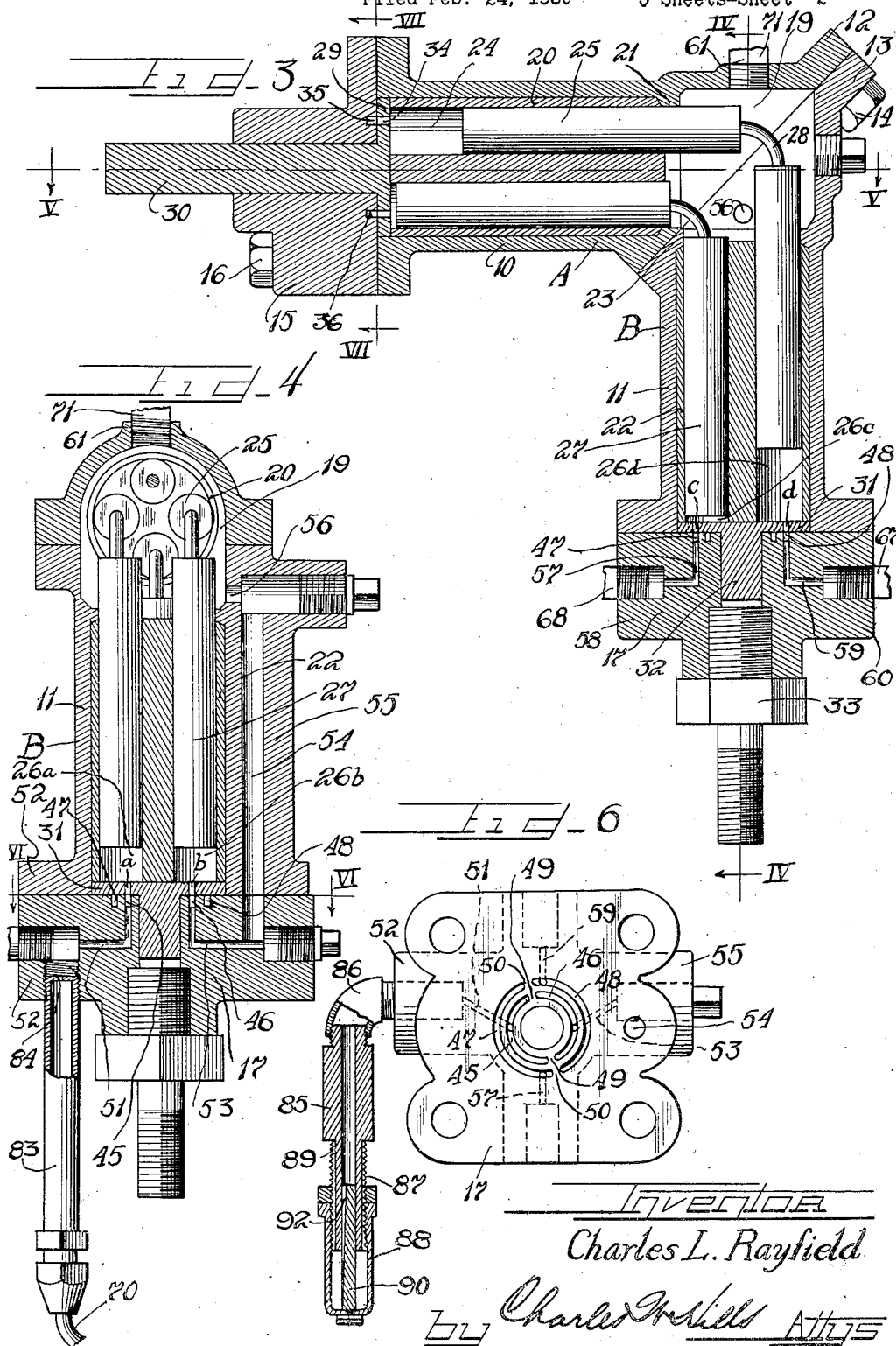
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OIL BURNER SUPPLY SYSTEM

Filed Feb. 24, 1930

3 Sheets-Sheet 2



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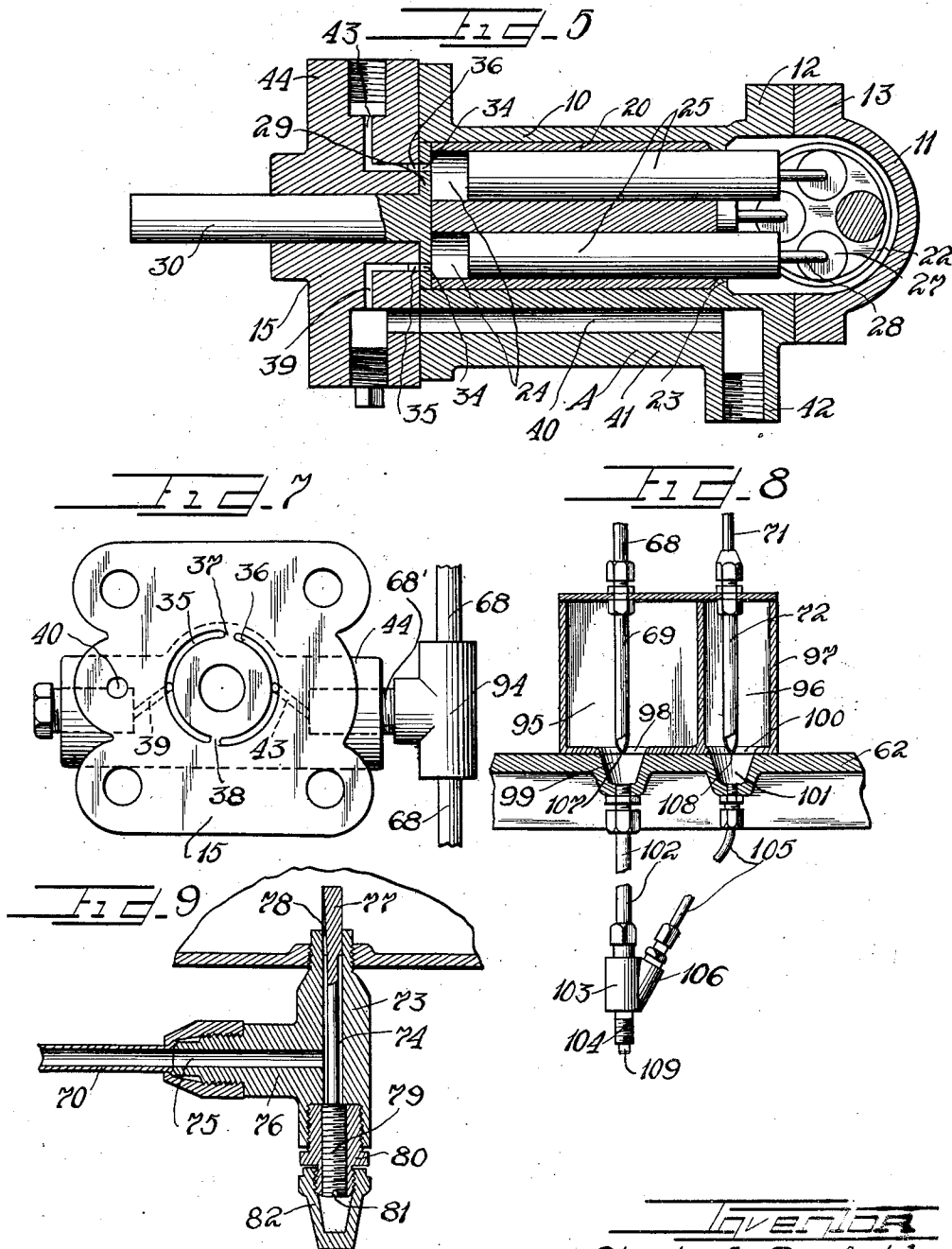
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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OIL BURNER SUPPLY SYSTEM

Application filed February 24, 1930. Serial No. 430,574.

This invention relates to oil burner supply systems and particularly to improved pumping apparatus and arrangement for delivering accurately proportioned combustion mixture to a heating device or furnace.

An important object of the invention is to utilize a pump structure of the angular rotary type providing two interconnected pump legs or sections, and the selective utilization of pump plungers for pumping oil and air and forming the combustion mixture.

A further object of the invention is to utilize part of the plungers of one pump section for pumping oil for the combustion mixture and to utilize the other plungers of such pump section and all the plungers of the other pump section for pumping air for the combustion mixture.

Another object is to provide an arrangement in which oil and air is delivered in measured quantities to the pump sections to produce an accurately proportioned combustion mixture.

A further object is to utilize some of the plungers of one of the pump sections for pumping metered oil and air for the combustion mixture, and to utilize the other plungers of such pump section and the plungers of the other pump section for respectively pumping independent streams of air supply for the combustion mixture.

Another important object is to utilize an auxiliary oil supply source in the form of a vacuum tank and to utilize part of the pump structure for creating vacuum in said tank to maintain the oil supply therein, and utilizing another part of the pump structure for pumping oil from the tank, together with means for mixing the pumped oil and air to form the combustion mixture.

Still a further object of the invention is to utilize an intermediate source of oil supply in the form of a vacuum tank; to utilize part of the plungers of one pump section for drawing air supply for the combustion mixture from the vacuum tank to thereby create vacuum in the tank to maintain the oil supply thereto from a main source, and to utilize the other plungers of such pump section for pumping oil from the vacuum tank for

the combustion mixture; and to utilize the other pump section for delivering air from the atmosphere to the combustion mixture.

Another important phase of the invention is to utilize the greater part of the capacity of the pump structure for delivering air for the combustion mixture and to utilize the lesser part of the pump capacity for pumping and mixing measured quantities of oil and air for the combustion mixture in order to produce a rich properly and efficiently proportioned combustion mixture.

A further object is to provide improved means and arrangement for accurately metering oil and air supply to the pump structure.

Still another object is to provide improved means for stabilizing the pressure and volume of the air and oil delivered by the pump structure to the burner nozzle or other source of consumption of the combustion mixture.

A further object is to interpose closed pressure balancing and stabilizing chambers between the discharge ends of the air and oil streams from the pump structure and the combustion mixture injection nozzle or burner for the heating device to be served.

The above enumerated features and other features of the invention are incorporated in the structure disclosed on the drawings, in which drawings

Figure 1 is a side elevation of my improved compactly arranged apparatus and circuits for supplying combustion mixture;

Figure 2 is a plan view of the apparatus;

Figure 3 is a vertical diametral section of the angular pump structure;

Figure 4 is a section on line IV—IV of Figure 3;

Figure 5 is a section on plane V—V of Figure 3;

Figure 6 is a plan view of the head of the vertical pump section on plane VI—VI of Figure 4;

Figure 7 is a view of the inner side of the head of the horizontal pump section on plane VII—VII of Figure 3;

Figure 8 is an enlarged sectional view showing the pressure stabilizing chambers and a main ejector or nozzle; and

Figure 9 is an enlarged vertical diametral section of the oil metering fitting on the vacuum tank.

The angular pump structure shown has the pump sections A and B comprising respectively the cylindrical housings 10 and 11 detachably secured together at their inner ends along a plane of 45° by means of the flanges 12 and 13 and screws 14, the housings being thus at a right angle with each other. A head 15 is applied to the outer end of the housing 10 by means of screws 16, while a head 17 is detachably secured to the outer end of the housing 11 by screws 18.

At the juncture of the housings is the chamber 19 between which and the head 15 of pump section A is the rotary cylinder 20 which is confined axially between the head and the annular shoulder or flange 21. Between the chamber 19 and the head 17 of pump section B is the rotary cylinder 22 which is axially confined between the head and the annular shoulder 23.

The cylinder 20 has a plurality of bores 24 extending therethrough equidistant from its axis. Four such bores are shown regularly spaced around the cylinder axis, and reciprocable in each bore is a plunger 25. The arrangement in cylinder 22 is the same as in cylinder 20, the bores 26a, 26b, 26c, and 26d having the pistons 27 reciprocable therein. The plungers of the corresponding bores of the two cylinders are integrally secured together by suitable connections or joints 28 so that, when one cylinder is rotated, the angular plunger structures will reciprocate in the bores of the cylinders and will also partake of bodily movement and will transmit the rotation of the rotated cylinder to the other cylinder, all in a manner well understood in the art.

The outer end of the cylinder 20 is closed by a wall 29 from which extends axially a drive shaft 30, this shaft being journaled in the head 15. The outer end of the cylinder 22 is closed by a wall 31 from which extends axially a bearing stub 32 journaled in the head 17. A supporting stud 33 extends from the head 17 by means of which the pump structure may be mounted on and secured to a support.

The end wall 29 of cylinder 20 has four ports 34 therethrough, one for each of the bores 24, the ports being equidistant from the cylinder axis and spaced 90° apart. In the inner face of the head 15 are two arcuate channels 35 and 36 extending concentric with the axis of the cylinder and adapted to register with the cylinder ports 34. These channels are not quite semi-circular but their ends are separated by spaces 37 and 38 whose width is equal to or slightly greater than the diameter of the cylinder ports 34. A passageway 39 through the head 15 connects the channel 35 with one end of the passageway

40 through the longitudinally extending boss 41 on the side of the housing 10, which passage at its other end has the inlet 42. A passageway 43 through the head 15 connects the channel 36 with the outlet boss 44 extending from the head.

During each rotation of the cylinder 20, each of its plungers will make a complete back and forth stroke in its bore, and, during the inward stroke of each plunger, the associated port 34 will be in register with the inlet channel 35 in the head 15, and, during the outward stroke of each plunger, the port will be in communication with the outlet channel 36. At the end of each stroke of a plunger, its associated port will be closed by either of the faces 37 or 38 between the ends of the channels. The plungers operate consecutively, and during the inward strokes, fluid will be drawn into the respective bores from the circuit connected with the channel 35, and during the outward strokes, such drawn-in fluid will be expelled through the outlet channel 36 and to the fluid circuit connected with the outlet boss 44.

The end wall 31 of the cylinder 22 has two diametrically opposite ports *a* and *b* for the diametrically opposite plunger bores 26a and 26b, as shown in Figure 4. The wall 31 has also two other diametrically opposite ports *c* and *d* spaced 90° from the ports *a* and *b*, respectively, and communicating with the other pairs of diametrically opposite plunger bores 26c and 26d, as shown in Figure 3. In the inner face of the head 17, there are diametrically opposite channels 45 and 46 for registering with the ports *a* and *b*, and concentric with such channels are the outer channels 47 and 48 for registering with the ports *c* and *d* as the cylinder 22 rotates.

The channels 45 and 46 are not quite semi-circular but are separated at their ends by spaces 49 and the ends of the channels 47 and 48 are separated by spaces 50, the width of the faces being equal to or slightly greater than the diameter of the ports in the cylinder wall 31.

A passageway 51 through the head 17 connects the channel 45 with the inlet boss 52 on the head. A passageway 53 through the head connects the channel 46 with the passageway 54 through the longitudinal boss 55 on the side of the housing 11, this passageway communicating through a port 56 with the chamber 19 at the juncture of the housings. A passageway 57 through the head 17 connects the channel 47 with the outlet boss 58 on the head and the passageway 59 through the head connects channel 48 with the inlet boss 60 on the head.

With the arrangement above described in connection with the pump section B, the bores 26a and 26b will communicate through the respective ports *a* and *b* first with the inlet channel 45 and then with the outlet channel

46, so that during instroke of the plunger in each bore, the bore will be filled with fluid which will be discharged during outstroke of the plunger, fluid drawn in through the boss 52 and passageway 51 being thus pumped through passageways 53 and 54 and port 56 into the chamber 19 from where it is discharged through an outlet 61 from the chamber.

The plungers in the other bores 26*c* and 26*d* of the pump section B will draw in fluid through the inlet boss 60 and passageway 59 through port *c* or *d* and will discharge it through the passageway 57 and the outlet boss 58. There are thus two separate paths of fluid through the pump section B, the flow through one path being controlled by the plungers operating in the bores 26*a* and 26*b*, and flow through the other path being controlled by the operation of the plungers in the bores 26*c* and 26*d*.

In Figures 1 and 2 I have shown my improved pump structure in service in a system for supplying combustion mixtures for an oil burner. The angular pump structure is mounted and secured on a suitable base 62 by means of its lug 33. A motor 63, preferably electric, is mounted on the base and by a suitable coupling 64 is connected with the drive shaft 30 which extends from the cylinder 20 of the pump section A.

An oil supply source 65 is also supported on the base 62, and this source may be a well-known type of vacuum tank ordinarily used on motor vehicles. The upper part of the vacuum tank is connected by a pipe 66 with an oil supply reservoir (not shown) from which the oil is drawn by suction into the vacuum tank. This suction is generated by the pump section B, a pipe 67 extending from the top of the vacuum tank to the inlet boss 60 so that the operation of the plungers in the bores 26*c* and 26*d* will pump air from the vacuum tank and discharge it through the outlet boss 58 and pipe 68 to an air ejector end or nozzle 69.

The oil outlet of the vacuum tank is connected by a pipe 70 with the inlet boss 52 in head 17 of the pump section B, so that the plungers in the bores 26*a* and 26*b* will operate to pump the oil from the vacuum tank and discharge it through the passageways 53 and 54 and the port 56 into the chamber 19 from where it flows through the pipe 71 to the ejecting end or nozzle 72. The oil flowing through the chamber 19 under pressure will act as a sealing medium for the plungers and cylinders and will lubricate the bearing surfaces, and the pressure against the inner ends of the cylinders will hold them with their ported outer walls in firm seating engagement against the inner faces of the respective pump heads.

The flow of oil from the vacuum tank is preferably metered. In Figure 9, I show

a practical form of adjustable metering fitting interposed between the vacuum tank and the pipe 70. This fitting comprises a body 73 having its inner end threaded through the bottom of the vacuum tank to communicate with the interior thereof. The bore 74 in the body 73 communicates with the passage 75 in the lateral extension 76 with which the pipe 70 is connected. Engaging in the inner end of the bore 74 is a metering pin 77 which has the longitudinal metering port 78 of gradually increasing depth, so that, as the pin is moved relative to the inlet end of the bore 74, the available oil passage area will be increased or diminished. A rod 79 extends from the metering pin through the bore 74 and through the plug 80 in which it terminates at its outer end in a head 81 provided with a screw-driver slot. The plug 80 is secured to the outer end of the body 73 and the rod 79 has threaded engagement with the plug, so that, when the rod is turned, the metering pin 77 will be shifted axially in the bore 74 to effect the proper flow adjustment. A protection cap 82 is preferably applied to enclose the head of the rod, and this cap may thread onto the outer end of the plug 80.

The oil flow is further metered and limited by a fitting 83 in the form of a conduit interposed between the pipe 70 and the inlet boss 52 of the head 17. This conduit has the restricted metering outlet port 84, as clearly shown in Figure 4.

This carefully metered oil flow from the vacuum tank is supplied with air in metered quantities to be mixed therewith during flow through the pump section B. As best shown in Figure 6, the air intake tube 85 is connected with the inlet boss 52 of the pump head 17 by means of the elbow fitting 86. The outer end 87 of the tube is exteriorly threaded and receives a cap 88. The end 87 has longitudinal grooves 89 forming air inlet passageways communicating with the atmosphere and with the interior of the cap 88. A metering pin 90 is secured to the outer end of the cap 88 and extends axially in the end of the tube 85. This pin has a longitudinal channel 92 whose cross sectional area gradually increases toward its outer end so that as the pin is adjusted longitudinally when the threaded cap 88 is turned, the cross sectional area of the passage 92 at the inlet end of the tube 85 determines the volume of air flow. Air enters the cap 88 through the channels 89 in the threaded end 87 and from there flows through the metering pin passage 92 into the bore of the tube and then into the boss 52 to mix with the metered oil flow from the orifice 84, the air and oil during passage through the pump being thoroughly mixed together under the pump pressure. By means of the metering described, the proper proportion of air and oil can be

adjusted for to a nicety. The flow of the oil through the restricted orifice 84 under the suction of the pump causes the oil to be more or less broken up and sprayed so that it will more thoroughly mix with the measured air delivered thereto, the combined flow of oil and air through the pump passageways, ports and bored together with the pump pressure, producing a very intimate mixture of the air and oil. This rich uniform combustion mixture is delivered by the pump section B through the passage 54 and port 56 into the chamber 19 and from there through the pipe 71 to the injector end or nozzle 72, as best shown in Figure 8. This mixture, being delivered under pressure to the chamber 19, will be intimately applied to the plunger and cylinder structures to thoroughly lubricate these structures and to seal them against leakage. The pressure exerted against the cylinders will serve to hold them intimately and accurately against the faces of the respective pump section heads to thereby cause accurate portage of the mixture through the pump and to prevent leakage.

As has already been explained, the plungers in the bores 26c and 26d of the pump section B serve to draw air through the vacuum tank 65 and pump it to the ejector end or nozzle 69. This air is more or less laden with vapors and fumes of the oil flowing through the vacuum tank, and provision is made to mix air from the atmosphere with such impregnated air before it reaches the nozzle 69. Referring to Figure 2, an air pipe 93 is connected with the inlet 42 of the passageway 40 through the boss 41 on the pump housing 10. Referring to Figures 5 and 7, air is taken in through this path by the pump section A and delivered thereby under pressure through pipe 68¹ to the pipe 68 by means of a fitting 94, so that this atmospheric air will flow with the impregnated air to the ejector end 69, this atmospheric air flow being thus in parallel with the impregnated air stream pumped by the pump section B.

The air supply pipe 93 has preferably a calibrated or restricted inlet orifice 93¹ so that the air flow is metered.

Instead of connecting the air and oil supply terminals 69 and 72 respectively directly with a burner or main injector nozzle, these terminals preferably extend into closed chambers 95 and 96, respectively, as best shown in Figure 8. These air and oil chambers are provided in a housing 97 which may be mounted on the support 62. The air supply terminal 69 extends to an opening 98 at the bottom of the chamber 95 which communicates with a downwardly tapering depression or pocket 99. The oil terminal 72 extends to an opening 100 at the bottom of the chamber 96 which communicates with a downwardly tapering depression or pocket

101. These pockets or depressions may be formed in the support 62. The pocket 99 is connected by a pipe 102 with the inlet end of a main ejector or nozzle structure 103, whose outlet end 104 may be connected to discharge directly into the firebox of a furnace or to discharge into a burner structure. The pocket 101 is connected by a pipe 105 with a lateral induction inlet 106 on the main nozzle structure for conducting the oil stream into the path of the air flow through the nozzle structure so that during normal operation the oil will be inducted or drawn into the air stream, the combined air and oil being then delivered from the main nozzle structure.

The end of the air terminal pipe 69 is preferably contracted to leave only a reduced orifice 107 and the end of the oil pipe 72 is likewise contracted to leave an orifice 108. When the system is started, the air delivered under pressure by the pump sections tends to flow through the main nozzle structure, but, as the outlet from this nozzle structure is through a more or less restricted orifice 109, there will be resistance to the flow of the air and, consequently, the air will flow from the terminal 69 into the chamber 95 to build up pressure therein until such pressure becomes sufficient to drive the air through the main nozzle structure. Likewise, the oil delivered by the pump under pressure to the terminal 72 tends to flow through the pipe 105 to the main bore of the main nozzle structure, but, if the oil is not sufficiently rapidly ejected by the main nozzle structure, the oil will back up in the chamber 96 until the orifice 108 is submerged and then the air above the oil will be compressed and the built up pressure will tend to force the oil through the main nozzle structure. Such building up of pressure in the chambers serves several purposes. It maintains a more balanced and more stable pressure of the air and oil flow to the main nozzle structure, and prevents sudden fluctuation of the main nozzle discharge and the combustion flame during otherwise disturbing conditions. For example, in the case of sudden change of draft in the firebox the built-up reserve pressure in the chambers 95 and 96 will efficiently deliver the proper charge of air and oil through the main nozzle structure so as to maintain the flame.

Another purpose served by the reserve back pressure built up in the chambers is to cause thorough cleansing of the oil path from the terminal 72 to and through the main nozzle structure, so that, after the system is closed down, there will be no dripping of oil from the nozzle structure. As soon as the system is shut down and the pumps are stopped, the reserve back pressure in the chamber 95 will cause continued air flow through the main nozzle structure until the pressure in the chamber is relieved, and the accumulated pressure behind any oil which may be left in

the chamber 96 or in the pocket 101 will force this oil out and into the path of the air flow through the nozzle structure so that such surplus oil will be delivered to the flame or the burner to be consumed after the system has been shut down.

Briefly repeating the operation of the system, the plungers of the bores 26c and 26d of the pump structure B serve to draw air from the vacuum tank and deliver it to the terminal 69, the suction effect generated in the vacuum tank being sufficient to maintain the necessary oil supply flow through pipe 66 to the vacuum tank from the oil reservoir. To this air supplied to the terminal 69 is added the atmospheric air pumped by all four plungers of the pump structure A, so that six plungers are effective in pumping the air supply under pressure for the main nozzle structure.

The plungers in bores 26a and 26b of the pump section B pump from the vacuum tank, in measured quantity, the combustion oil to which air in accurately metered quantities is added to be thoroughly mixed therewith before reaching the terminal 72. I have found that by carefully metering the oil flow and by metering and more or less restricting the air intake and supply, the operation of the pump will be much smoother and knocking or pounding will be prevented.

While I have shown and described my invention in a preferred form, changes and modifications in the structure and arrangement may be made without departing from the spirit and scope of the invention, and I therefore do not limit the invention except as specified in the appended claims.

I claim as my invention:

1. In a combustion mixture supply system, the combination of an angular rotary pump structure comprising two pump sections having interconnected pistons, a combustion mixture delivery element, means for causing part of the pistons of one of the pump sections to pump combustion fluid to said combustion delivery element, and means for causing the other pistons of said pump section and all the pistons of the other pump section to pump air to said combustion delivery element.

2. In a combustion mixture supply system, the combination of an angular rotary pump structure comprising two pump sections having interconnected pistons, means for driving said structure, a source of fuel supply, a combustion mixture delivery element, and means defining two separate pumping paths through one of said pump sections, one of said paths being connected to pump fuel and the other being connected for the pumping of air, the other pump section pumping air, the discharge ends of both pumping sections being connected with said combustion mixture delivery element.

3. In a combustion mixture supply system, the combination of an angular rotary pump

structure providing two pump sections having interconnected pistons, a main source of fuel supply, an auxiliary source of fuel supply in the form of a vacuum tank, delivery means for delivering combustion mixture, means providing two separate pumping paths through one of said pump sections, one of said paths being connected for the pumping of air from the vacuum tank for maintaining the suction therein to replenish said tank from the main source of fuel supply, said other path being connected to pump fuel from said tank, said other pump structure being adapted to pump air, the discharge from both pump sections being received by said combustion delivery element.

4. In a combustion mixture supply system, the combination of an angular rotary pump structure providing two pump sections having interconnected pistons, a main source of fuel supply, an intermediate source of fuel supply in the form of a vacuum tank, a combustion mixture delivery element, means providing two separate pumping paths through one of said pump sections, one of said paths being connected to pump air from said vacuum tank for maintaining the suction therein for the fuel supply from said main source, said other pump path being connected to pump fuel from said tank, adjustable metering means for metering the oil flow through said fuel pumping path, a metered air supply inlet to said fuel pumping path, and means connecting said other pump sections for the pumping of air from the atmosphere, the discharge outlets of said pump sections being connected with said combustion mixture delivery element.

5. In a combustion mixture supply system, the combination of an angular rotary pump structure having interconnected pistons, a source of oil supply, a vacuum tank connected with said source, means causing part of said pistons to pump air from the atmosphere, means causing others of said pistons to pump air from said tank for maintaining the vacuum therein, means causing the remaining pistons to pump oil from said tank, and means combining the pumped air and oil to form a combustion mixture.

6. In a combustion mixture supply system, the combination of an angular rotary pump structure comprising interconnected pumping elements, vacuum controlled fuel supply apparatus, means defining separate air pumping paths through said pump structure and an oil pumping path therethrough separate from said air paths, said oil pumping path being connected to receive oil from said supply apparatus, one of said air pumping paths being connected with said oil supply apparatus to furnish the vacuum therefor, and means combining the pumped air and oil to form a combustion mixture.

7. In a combustion mixture supply system,

- the combination of a pump structure providing an air pumping path and an oil pumping path, air and oil ejector members for the pumped air and oil respectively, a combustion mixture delivery element having an air passage and an oil intake communicating with said air passage, a closed chamber having an outlet connected with the air passage of the delivery element, said air ejector member extending into said chamber and terminating at its outlet, a second closed chamber having an outlet connected with the oil intake of said delivery element, said oil ejector extending into said second chamber and terminating at its outlet, said chambers serving to accumulate pressure caused by the resistance to the air oil flow through said delivery element and to apply said pressure to stabilize the flow from said delivery element.
8. In a combustion mixture supply system the combination of a container divided into separate chambers, a pocket formed at the bottom of each chamber arranged for connection to an outlet conduit, an ejector member secured in the top of each chamber having a lower end disposed adjacent to said pocket, one of said ejector members being for air and the other for a combustible fluid, and a combustion mixture delivery element connected to the outlet conduits from said containers where the air and combustible fluid from the chambers are combined, said combustible fluid ejector being arranged so as to be sealed by the accumulation of combustible fluid within its associated chamber.
9. In a combustion mixture supply system, the combination of an angular rotary pump structure having two pumping sections, a housing for said sections defining a mixing chamber at the junction of said sections, vacuum controlled fuel supply apparatus, means defining separate auxiliary air pumping paths through said pump structure and a combined oil and primary air pumping path separate from said auxiliary air paths, said oil and primary air pumping paths connected to receive oil from said supply apparatus and primary air from atmosphere and deliver the same to said chamber, one of said auxiliary air pumping paths being connected with said oil supply apparatus to furnish the vacuum therefor, and means combining the primary air and oil with the auxiliary air to form a combustible mixture.
10. A combustion mixture supply system, the combination of an angular rotary pump structure having two pumping sections, a housing for said sections defining a mixing chamber at the junction of said sections, reciprocal pumping elements in said sections having their adjacent ends interconnected within said chamber, vacuum controlled fuel supply apparatus, means to cause part of said elements to pump auxiliary air from said supply apparatus to furnish a vacuum
- therefor, means causing other pump elements to pump primary air from the atmosphere and oil from said supply apparatus and deliver the same to said mixing chamber, the action of said elements in said chamber causing the primary oil and air to be uniformly mixed, and means combining the uniformly mixed primary air and oil with the auxiliary air to form a combustible mixture.
- In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, Illinois.

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