Aug. 12, 1952 R. R. WITHERELL 2,606,497

OIL BURNER PUMPING UNIT

Original Filed March 8, 1948 4 Sheets-Sheet 1

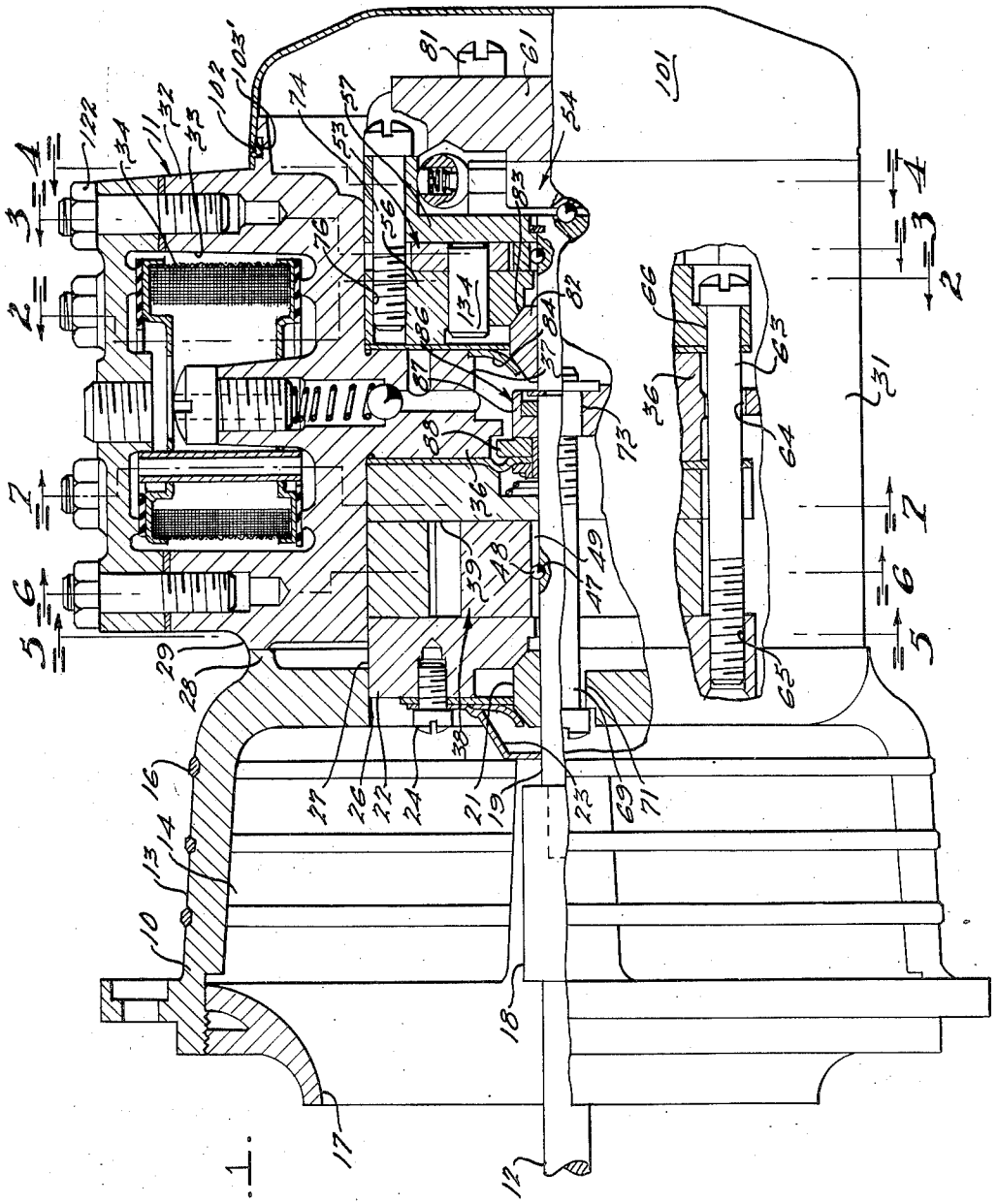


Fig. 1.

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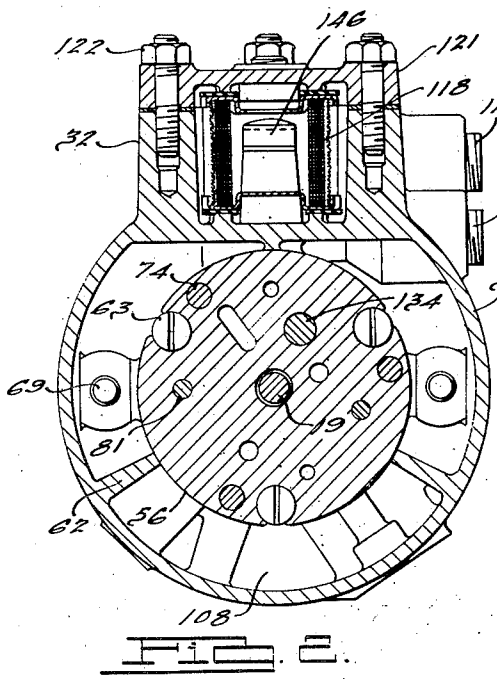


Fig. 2.

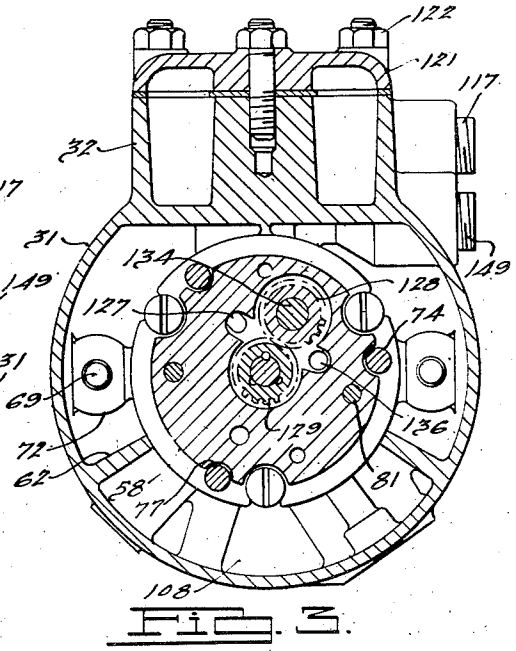


Fig. 3.

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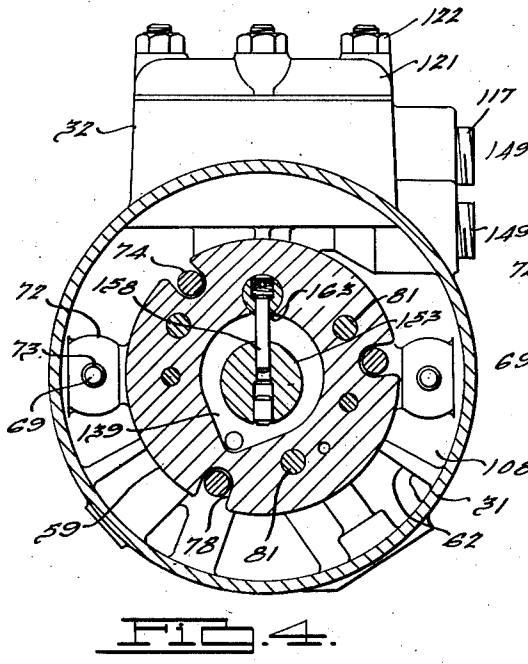


FIG. 4.

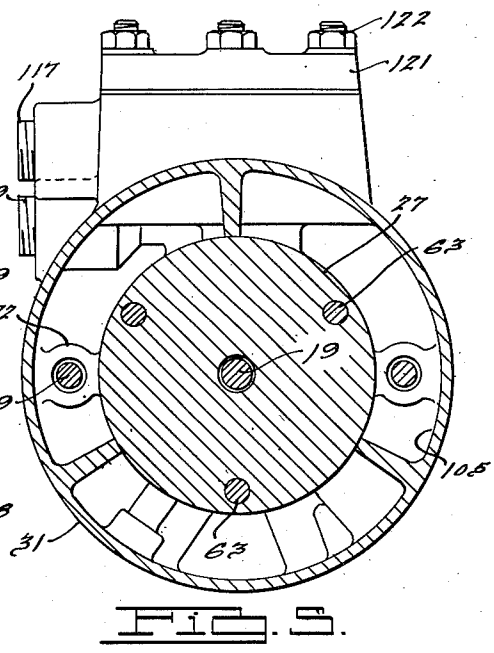


FIG. 5.

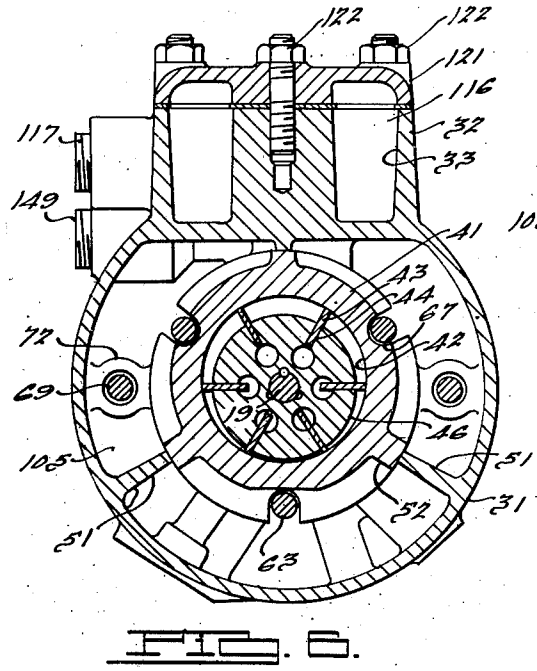


FIG. 6.

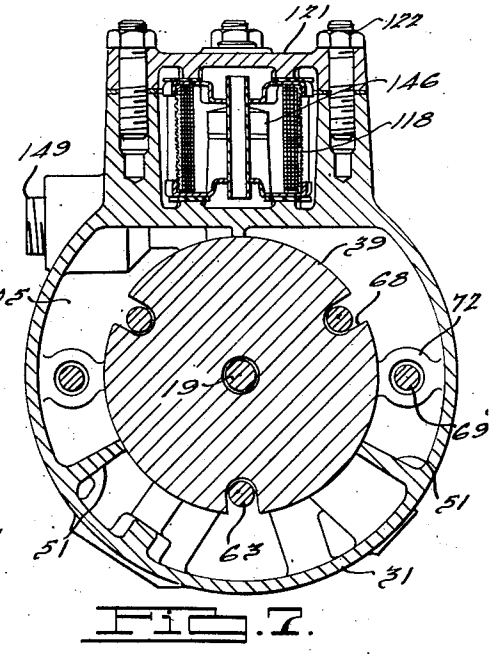


FIG. 7.

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OIL BURNER PUMPING UNIT

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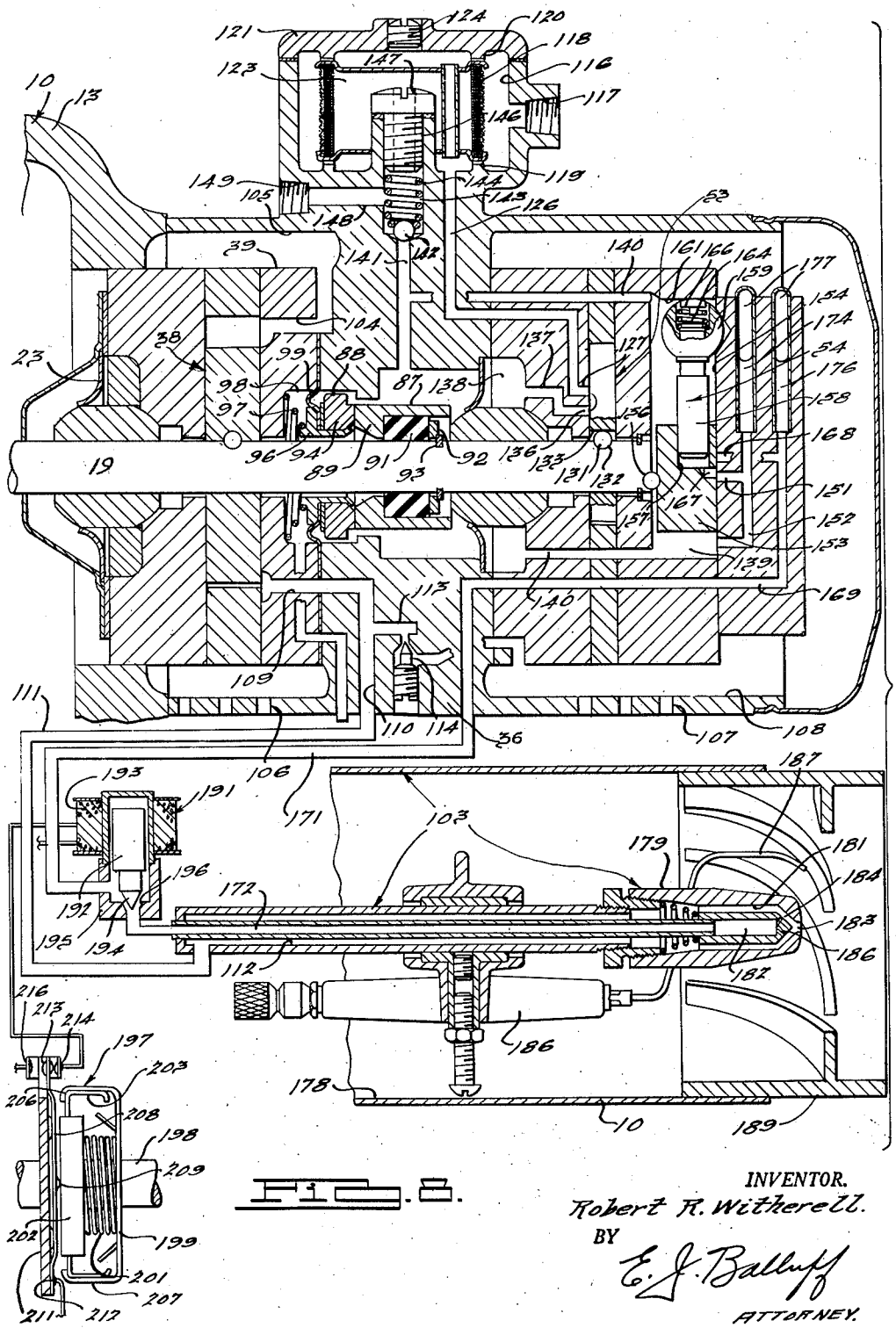


FIG. 8.

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UNITED STATES PATENT OFFICE

2,606,497

OIL BURNER PUMPING UNIT

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Continuation of application Serial No. 13,718, March 8, 1948. This application October 4, 1951, Serial No. 249,727

14 Claims. (Cl. 103—5)

1

This invention relates to a pumping unit for supplying fuel and air to oil burning apparatus and has particular relation to the construction and assembly of the various elements of said unit within and upon a casing for such elements and the construction and assembly of the casing in combination with other units of such oil burning apparatus.

Some of the objects of the invention are to provide:

A pumping unit for oil burning apparatus which consists of elements that are easy to construct and to assemble within a single unit that can be attached to and made a part of the complete oil burning apparatus.

A pumping unit which is simple in construction and easy to adjust, to assemble, and to service.

A pumping unit which is quiet in operation and which will not give off objectionable oil fumes into the surrounding atmosphere.

A pumping unit in which novel means is provided for assembling all of the elements of the unit within a pumping unit casing and for aligning the same with drive shaft means and other elements of the complete oil burning apparatus.

A pumping unit in which novel air pump, fuel pump, and fuel metering pump constructions are employed.

Other and further objects of the invention will be apparent by reference to the accompanying drawings of which there are four sheets, which, by way of illustration, show a preferred embodiment and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims. I also contemplate that of the several different features of my invention, certain ones thereof may be advantageously employed in some applications separate and apart from the remainder of the features.

Referring particularly to the drawings:

Fig. 1 illustrates a longitudinal sectional view with certain parts thereof in elevation of a part of an oil burning apparatus, including therein a pumping unit embracing the principles of the invention.

Fig. 2 is a cross-sectional view through a portion of the structure illustrated by Fig. 1 adjacent the fuel pumping means which is employed in the structure. Fig. 2 is taken on line 2—2 of Fig. 1 looking in the direction of the arrows.

Fig. 3 is another cross-sectional view through the structure disclosed by Fig. 1 illustrating the

2

fuel pumping means employed in such structure. Fig. 3 is taken substantially in the plane of line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a cross-sectional view through the fuel metering means employed in the structure disclosed by Fig. 1. Fig. 4 is taken substantially in the plane of line 4—4 in Fig. 1 looking in the direction of the arrows.

Fig. 5 is a cross-sectional view through the structure disclosed by Fig. 1 and through one of the end plates for the air pumping means included therein. Fig. 5 is taken substantially on the plane of 5—5 on Fig. 1.

Fig. 6 is a cross-sectional view through the air pump structure employed in the pumping unit disclosed by Fig. 1. Fig. 6 is taken substantially in the plane of line 6—6 on Fig. 1.

Fig. 7 is another cross-sectional view through the other of the air pump end plates and the fuel cleaning compartment embraced in the pumping unit. Fig. 7 is taken substantially in the plane of line 7—7 looking in the direction of the arrows thereon.

Fig. 8 is a schematic illustration of certain parts of the oil burning apparatus in which the pumping unit embracing the principles of this invention is employed.

Referring to Fig. 1, the numeral 10 indicates a portion of a motor compressor unit employed in the oil burning apparatus with which the pumping unit indicated by the numeral 11 is adapted to be employed. The motor compressor unit 10 includes a shaft 12 which is adapted to be driven by an electric motor, not shown, and on which is mounted a fan, not shown. The fan referred to supplies the main quantity of secondary supply of air employed in the fuel burning apparatus. The motor compressor unit 10 with which the pumping unit 11 is employed may be a motor compressor unit such as that disclosed in copending application Serial No. 772,970, filed September 9, 1947, for "Motor Compressor Unit," now Patent No. 2,542,121, issued February 20, 1951.

The numeral 13 indicates an inlet portion of the housing for the fan employed in the motor compressor unit 10, the air supplying the fan being admitted through openings 14 which are formed within the housing 13 between circumferential rings 16 extending about the housing. The air admitted through the openings 14 passes into the fan through a fan inlet indicated by the numeral 17.

The shaft 12 drives the pumping unit 11 through a shaft coupling 18 in the opposite end of which a shaft 19 employed in the unit 11 is secured. The shaft 19 is secured in the coupling

18 in such manner as to be axially movable with respect to the coupling 18 and the pumping unit 11. One end of the shaft 19 is rotatably mounted in a sintered, powdered, metallic, self-aligning bearing 21 secured in an opening formed axially in an end plate 22. The bearing 21 is held in position in the opening formed in the end plate 22 by a spring and cap structure indicated by the numeral 23. The spring and cap structure 23 is held in position against the end of the end plate 22 by screws indicated at 24.

In order to properly center the bearing 21 and the shaft 19 with respect to the housing 13, there is provided within the housing 13 an axially disposed cylindrical opening indicated at 26. The opening 26 is adapted to receive the exterior surface 27 of the end plate 22 and to form a close sliding fit therewith in order to locate the plate 22 with respect to the end of the housing 13 and drive shaft 12 of the oil burning apparatus 10. The housing 13 also is provided with an axially extending cylindrical flange 28 which projects from the end of the housing 13 in such a way that the end surface of the flange is disposed normal with respect to the axis of the cylindrical surface 26. The flange 28 is adapted to provide a seating surface against which the end of a similar cylindrical flange 29 formed on a housing 31 for the pumping unit 11 is seated. The housing 31 is generally cylindrical in formation except for the projection from the upper central portion thereof of a projection indicated at 32 and within which a chamber 33 is provided for a liquid fuel cleaning device 34. Formed across the central portion of the casing 31 and disposed in transverse relation to the axis thereof is a web or support indicated at 36 which is provided with a centrally disposed opening 37 through which shaft 19 projects.

Disposed on the side of the support 36 adjacent the apparatus 10 is a rotary vane compressor indicated generally at 38. The compressor 38 (see also Figs. 5, 6, and 7) comprises an end cap 39, a compressor cylinder 41, and the end cap 22 previously referred to. Within the cylinder 41 there is provided an eccentrically disposed pumping chamber 42 which is adapted to be engaged by the ends of blades or vanes 43 which are disposed radially within slots 44 formed in a rotor 46 secured concentrically with respect to shaft 19. In order to provide for the axial movement of the shaft 19 with respect to the rotor 46, the shaft 19 is provided with an arcuate depression indicated at 47 in which a ball 48 is adapted to be seated. Rotor 46 also is provided with a plurality of axially disposed grooves 49 extending between the opposite end surfaces thereof, one of which receives the ball 48. It will be apparent that the ball 48 is free to move with the shaft 19 within its groove 49.

In order to provide means for properly aligning the various parts of the compressor 38 within the casing 31 and the casing 31 with respect to the housing 13, there is provided within the end of the casing 31 within which the compressor 38 is received a plurality of radially disposed, inwardly projecting, longitudinally extending guides indicated at 51. The exterior surface of the end caps 22 and 39 are formed of such a diameter as to slidably fit the inner surface of the guides 51, and the cylinder 41 is provided with a radially disposed projection 52 likewise adapted to slidably engage the inner surfaces of the guides 51.

Disposed beyond the support 36 within the casing 31 is a fuel supply pump indicated generally at 53 and a fuel metering pump indicated generally at 54 (see Figs. 2, 3, and 4). The fuel supply pump 53 consists of a pair of end plates 56 and 57 between which is located a cylinder block 58. Formed as a part of the end plate 57 is a metering pump block 59 beyond which is a metering pump end plate 61. The end of the casing 31 containing the fuel supply pump 53 and the metering pump 54 is similarly provided with longitudinally disposed guide rails 62 within which the various elements of the fuel supply pump 53 and fuel metering pump 54 previously referred to are adapted to be slidably disposed.

In order to secure all of the various elements of the air pump 38, the fuel supply pump 53, and the fuel metering pump 54 together within the casing 31, and in order to secure the casing and its various elements to the housing 13, there is provided a plurality of securing means to be hereinafter described and by the employment of which the various elements of the structure are successively secured to on another and the entire structure secured to the housing 13. One of such securing means is a plurality of machine screws indicated at 63 which extend through openings 64 formed in the support 36 in such manner that the fuel supply pump end cap 56 may be secured by such bolts to one side of the support 36 while the end caps 22 and 39 and the cylinder block 41 are secured to the opposite surface of the support 36. It will be noted from Fig. 1 that the end cap 22 has threaded openings 65 formed therein for receiving the threaded ends of the screws 63 while the end cap 56 has countersunk openings 66 extending thereacross for receiving the heads of the bolts 63. It will be noted from Fig. 6 that the cylinder block 41 is provided with relief openings indicated at 67 for receiving the screws 63, these relief openings being larger than the studs so as to permit proper positioning of the cylinder block within the guides 51. From Fig. 7 it will likewise be apparent that the end cap 39 is also provided with relief openings indicated at 68 which are also larger than the screws 63 for a similar purpose.

It will be apparent that when the end cap 56 is positioned on one side of the support 36 and the end cap 39, the cylinder block 41 and the end cap 22 are positioned upon the opposite side of support 36, all of such elements being properly positioned within the guides 51 and 62, that the screws 63 then may be inserted in the various openings and all of the elements referred to will be properly assembled upon the support 36.

Thereafter the entire casing structure may be assembled upon the housing 13 by the employment of machine screws indicated at 69. In order to be able to employ the machine screw 69, there is provided in the housing 13 within the annular flange 28 countersunk openings indicated at 71 which are formed in the housing in such manner as to be insertable from the interior of the housing 13. By referring to Figs. 5, 6, and 7 it will be noted that the distance between the openings 71 provided for the machine screws 69 is greater than the diameter of any of the elements of the air pump 38 so that the machine screw extends through the casing 31 outside of the elements of the pump 38. However, the support 36 is provided with enlarged bosses indicated at 72 and in which openings are provided for receiving T-nuts 73 in which the inner ends of the machine screws 69 are threaded. When the machine screws 69 are properly secured within the openings 71 and

the nuts 73, it will be apparent that the exterior surface 27 of the cap 22 will be slidably disposed and centrally located within the cylindrical guide surface 26 formed in the housing 13, and the flange projections 28 and 29 formed respectively on the housing 13 and the casing 31 will be brought together. It will be apparent therefore that the entire casing 31 will be located with respect to the housing 13 by the machine screw 69 and that the elements of the air pump 38 and the casing 31 will be centrally located with respect to the housing 13 by the end cap 27 and the guide rails 51.

Thereafter by the employment of machine screws 74, it is possible to properly position within the casing 31 and to secure therein upon the support 36 the various elements of the fuel supply pump 53 and the cylilder block 59 for the fuel metering pump 54. In order to provide for such assembly, end plate 56 is provided with threaded openings indicated at 76, the fuel pump block 58 is relieved as indicated at 77, and the metering pump block and end plate 59 is relieved as indicated at 78. Thereafter when the blocks 58 and 59 have been properly positioned within the guide rails 62, the machine screws 74 are positioned within relief openings 77 and 78 and tightened within the threaded openings 76.

Thereafter the metering pump and block may be secured upon the metering pump block 59 by the employment of screws indicated at 81.

The remaining end of the shaft 19 is rotatably secured in a sintered, powdered, metallic, self-aligning bearing 82 which is adapted to be movably supported within a bearing support surface 83 formed in the end plate 56. The bearing 82 is held against the surface 83 by a spring and cap structure indicated at 84 which is secured rigidly between the cap 56 and the support 36. The opening 37 provided in the support 36 is adapted to be closed by a fluid-tight seal indicated at 86, the latter consisting of a rotating element 87 and a stationary element 88. Referring particularly to Fig. 8, it will be noted that the rotating element 87 comprises an internally flanged cap 89 in which a resilient sealing member 91 is disposed around the shaft 19. The opposite end of the sealing member is reinforced by a collar 92 engaging a ring 93 disposed within a circumferential opening formed with the shaft 19. The stationary element 88 of the seal 86 comprises an annular sealing member 94 adapted to run against the adjacent end of the member 89 and being supported upon a flanged sleeve indicated at 96. The flanged portion of the sleeve 96 is engaged by one end of a spring 97, the opposite end of which is disposed against the end surface of an opening 98 formed within the end cap 39. The flanged sleeve 96 also is movably supported by a flexible diaphragm indicated at 99, the inner periphery of which is secured between the flanged portion of the sleeve 96 and the adjacent surface of the sealing ring 94. The outer periphery of the diaphragm 99 is secured regidly between the end cap 39 and the adjacent surface of the support 36.

It will be noted that the end of the casing 31 opposite the housing 13 is closed by a flanged cap 101, the periphery of which is beaded as indicated at 102 in such manner as to snap within a groove 103' formed in the adjacent end of the casing 31. Also, it will be noted that the cap 101 and the outer cylindrical portion of the casing 31 are spaced from the various elements of the pumps 38, 53, and 54, except for the guide rails 51 and 62.

Further, it will be noted that the annular space around the pumping units on opposite sides of the support 36 are in open communication through the enlarged openings 64 through which the machine screws 63 extend.

Referring now particularly to Fig. 8, it will be noted that the pumps 38, 53, and 54 are connected by various internally and externally formed passages to the nozzle 103 of the oil burning apparatus 10. Referring particularly to the air pump 38 it will be noted that the end plate 39 is formed in such manner as to provide an inlet passage 104 communicating with the annular space 105 formed between the pump 38 and the end of the casing 31 between the support 36 and the housing 13. As the rotor 46 of the pump 38 is rotated by the shaft 19, air will be drawn inwardly from the annular space 105 and compressed within the pump 38 by the vanes 43. The air within the annular space 105 is admitted to the casing 31 through a plurality of ports 106 and 107 formed in the casing 31 on opposite sides of the support 36. It will be apparent that the air which is admitted through the ports 107 will be admitted to an annular space 108 formed around the elements of the fuel pump 53 and the fuel metering pump 54 and from the annular space 108 will be admitted to the annular space 105 through the openings 64. It will thus be apparent that any oil fumes which may result from the operation of the pumps 53 and 54 will be drawn into the pump 38 through the inlet 104.

The outlet or discharge from the pump 38 is provided by a passage 109 also formed within the end plate 39 and communicating with a passage 110 formed in the support 36 and communicating with a conduit 111 leading to the air supply passage 112 of the nozzle 103. The passage 110 also has a by-pass indicated at 113 controlled by an adjustable needle valve 114 threaded into the support 36 and accessible from the exterior of the casing 31. The by-pass 113 communicates with the annular space 108. It will be apparent that by adjusting the needle valve 114 in the by-pass 113 it is possible to control the discharge pressure from the pump 38 to the air supply passage 112. However, the air which may be by-passed by the needle valve 114 will not be discharged into the atmosphere except through the inlet passages 106 and 107 communicating with the annular spaces 105 and 108. The annular spaces 105 and 108 therefore constitute muffle chambers surrounding the pumps 38, 53, and 54 for the purpose of absorbing air or other noises incidental to the operation of such devices.

Fuel for operating the supply pump 53 and the metering pump 54 is adapted to be supplied through an outer fuel supply chamber indicated at 116 which constitutes the outer part of the fuel supply chamber 33 formed in the outwardly projecting portion 32 of the casing 31. The chamber 116 communicates with the oil burning apparatus fuel supply tank by means of a threaded opening 117 to which a liquid fuel supply conduit, not shown, is attached to the fuel tank, also not shown. Within the supply chamber 116 is a filtering device or oil cleaner indicated at 34, the filter portion 118 thereof being annular in formation and secured in the chamber in spaced relation to the outer walls between flanges 119 and 120 projecting upwardly and downwardly respectively from the upper and lower extremities of the fuel supply chamber 33. The chamber 116 and the filtering device 118 are accessible through an end plate 121 secured upon the upper end of the pro-

jection 32 by screws indicated at 122. Within the filtering device 118 is an inner chamber 123 into which the oil admitted to the outer chamber 116 is admitted through the filtering device 118. The inner chamber 123 is accessible through the cap 121 and through an opening in the cap 121 within which a threaded plug 124 is adapted to be normally disposed. Communicating with the inner supply passage 123 is an inlet conduit 126 formed in the support 36 and the end plate 56 and the opposite end of which communicates with the fuel inlet port 127 of the supply pump or compressor 53. The compressor 53 within the compressor block 58 comprises a pair of meshing gears 128 and 129, the latter gear being rotatably mounted upon shaft 19 upon a ball 131 disposed in concave depressions or openings 132 in the shaft 19. The ball 131 also extends within one of the grooves 133 formed in the gear 129 throughout the length thereof so as to provide a universal driving connection between shaft 19 and gear 129. The gear 128 is mounted on an idling shaft 134 secured in an opening formed in the end plate 56. The ball 131 is free to move with shaft 19 within the groove 133 so as to provide for axial movement of the shaft 19 relative to compressor 53. The flexible or universal driving connection between the shaft 19 and gear 129 provided by the ball 131, and the universal connection between the shaft 19 and rotor 46 of the air pump 38 provided by the ball 48, will compensate for misalignment of the shaft 19 and rotor 46 or gear 129, and will permit rotation of rotor 46 and gear 129 within their respective chambers without bias from the shaft 19, and rotation of shaft 19 within its bearings without bias from rotor 46 or gear 129.

The discharge side of the compressor 53 is connected through an exhaust port 136 and an exhaust passage 137 to an exhaust chamber 138 formed within the end plate 56 and the opening 37 within which the seal 86 is located. The exhaust passage 138 communicates with the fuel metering pump chamber indicated at 139 through a passage 140. The exhaust chamber 138 also may communicate with the inner fuel supply passage through a passage 141 controlled by a by-pass valve 142. The by-pass valve 142 is adapted to seat in the bottom of an enlarged valve chamber 143 forming a part of the passage 141 and in which is located a spring 144 adapted to urge the valve 142 into engagement with its seat at the lower part of the valve chamber 143. The opposite end of the spring 144 is disposed against the inner end of a threaded stud 146, the head of which is positioned within the inner supply chamber 123 and accessible through the opening closed by the plug 124. In the event it is desired to have the by-pass 141 communicate with the inner supply chamber 123 a stud 146 having a passage indicated at 147 is employed. When such a stud is employed, then liquid may be by-passed from the exhaust chamber 138 to the inner fuel supply chamber 123 through the by-pass valve 142 and the passage 147. However, it may be desirable to by-pass the fuel through the by-pass valve 142 to the inner chamber 123. In such event a stud like that indicated at 146 is employed without the opening 147 being formed therein. When such a stud is employed then the liquid from the exhaust passage 138 may be by-passed directly to the fuel supply tank previously referred to through a passage 148 which communicates with the chamber 153 and which is adapted to be connected by a threaded opening indicated at 149 to a return conduit, not shown, but which communicates at the opposite end thereof with the fuel supply tank.

It will be apparent that the operation of the pump 53 by the driven shaft 19 will tend to pump liquid fuel from the fuel supply chamber 116 into the exhaust chamber 138 and the fuel metering pump chamber 139. In the event the liquid fuel is not exhausted from the chambers 138 and 139 as fast as it is delivered by the pump 53, a certain amount or all of the fuel supplied by the pump 53 will be by-passed through the conduit 141 either to the inner supply chamber 123 or the fuel supply tank, not shown, this depending upon whether the passage 147 is or is not employed in the stud 146. However, the operation of the fuel metering pump 54 may tend to relieve the pressure in the chambers 138 and 139 by supplying therefrom metered quantities of fuel to the oil burning nozzle 103. For this purpose the inlet port 151 of the fuel metering pump 54 is connected to the fuel metering pump chamber 139 by a passage 152.

The fuel metering pump 54 comprises a rotor 153 which is slidably disposed within the metering pump chamber 139 against the inner surface 154 of the end plate 61. The rotor 153 is driven by a ball 156 disposed in an eccentric opening formed in the adjacent end of the shaft 19 and a centrally disposed opening formed in the adjacent surface of the rotor 153. It will be apparent that the spring 97 will exert a resilient pressure upon the shaft 19 tending to urge the shaft towards the rotor 153 for driving the rotor in a circular path against the wall 154. The ball 156 provides a universal connection between shaft 19 and rotor 153 so as to insure that the rotor 153 will seat against the wall 154 and have a sealing fit therewith. The rotor 153 has a cylindrical radially disposed opening 157 projecting therein in which a piston 158 is reciprocally disposed. The opposite end of the piston 158 is received within an opening formed in a spherical bearing member 159 which is mounted for lengthwise movement and oscillatory movement within a cylindrical opening 161 formed across the end of the metering pump block 59 and which communicates with the metering pump chamber 139 through an elongated opening 163. The piston 158 is resiliently mounted within the bearing 159 upon a spring 164 held between the end of the piston 158 and a cap 166 secured in the bearing member 159 opposite the piston 158. The spring 164 tends resiliently to retain the ball 159 tightly within the cylindrical opening 161. It will be apparent that the spherical bearing member 159, the piston 158, and the rotor 153 are free to move laterally within the metering pump chamber 139 away from the wall or inner surface 154 of the end plate 61. However, the spring 97 will tend to support the shaft 19 in such manner as to resiliently oppose such movement and in such event the rotor 153 will normally be movable in a circular path against the surface 154 of the end plate 61. Since spherical bearing member 159 and rotor 153 are free to oscillate, piston 158 will reciprocate within cylinder 157 upon movement of rotor 153. In order to render the metering pump 54 operative during the rotation of the shaft 19 and the rotor 153, the cylinder 157 formed within the rotor 153 is provided with a port 167 which is adapted to move in a circular path upon the wall 154 during the movement of the rotor 153 by the shaft 19. The port 167 is adapted to communicate with the metering pump inlet port 151 during the movement of the piston 158 outwardly with respect

to the cylinder 157 and to communicate with metering discharge port 168 when the piston 158 moves inwardly with respect to the cylinder 157. The discharge port 168 communicates through discharge passage 169 and conduit 171 with the fuel supply passage 172 formed in the oil burner nozzle 103. It will be apparent that the operation of the fuel metering pump 54 will discharge into the fuel supply passage 172 of the nozzle 103 measured quantities of fuel from the fuel metering pump chamber 139. Also, it will be noted that the passages 152 and 169 each are connected to anti-surge chambers 174 and 176 respectively, these chambers being at all times partly filled with air as is indicated at 177 so as to dampen any pulsations in the flow of the liquid received or delivered by the metering pump 54.

The oil burner nozzle 103 is disposed within a main air supply conduit 178 which communicates with the centrifugal fan located within the fan housing 13 and driven by the shaft 12. The fan supplies to the conduit 178 the main air supply for operating the oil burning apparatus. The nozzle 103 is located centrally and axially within the air supply conduit 178 in such manner that the air delivered by the fan flows around the nozzle 103 toward the mixing chamber end of the nozzle which is indicated by the numeral 179. The mixing chamber portion 179 of the nozzle 103 comprises an annular chamber 181 for receiving air from the air supply passage 112 and a cylindrical chamber 182 for receiving fuel from the fuel supply passage 172. The chamber 182 is disposed internally with respect to the chamber 181. The end of the chamber 182 terminates in a discharge orifice 183 with which chamber 182 communicates through a frusto-conical mixing passage 184. The passage 184 is supplied with fuel from the chamber 182 by spirally formed passages 186.

During operation of the oil burning apparatus, it will be apparent that a main air supply will be delivered to the nozzle 103 by the conduit 178, and that the pumping unit 11 will supply measured quantities of liquid fuel and air to the chambers 182 and 181 respectively. The adjustment of the by-pass 114 and the adjustment of the metering pump 54 is such that the air and fuel will be delivered respectively to the chambers 181 and 182 at about the same pressures. The discharge orifice 183 will therefore discharge into the air flowing within the conduit 178 a relatively rich mixture of fuel and primary air. Such mixture when discharged from the orifice 183 is adapted to be ignited by an igniter 186 comprising a pair of electrodes 187 positioned adjacent the orifice 183. The rich mixture so ignited by the ignitor 186 will burn within the main air supply supplied by the conduit 178 and beyond the end of air cone or nozzle 189 which is provided at the end of the conduit 178 and beyond the discharge orifice 183.

It will be noted that the fuel supply conduit 171 is provided with a solenoid actuated control valve indicated at 191. The valve 191 comprises an armature 192 disposed within the solenoid 193 and adapted to open and close a needle valve 194 with respect to an orifice 196 formed in a valve casing 195 which is connected within the conduit 171. The electrical circuit for operating the solenoid 193 is connected in parallel with the running windings for the motor employed in the apparatus 10 by a centrifugally actuated switch 197 which is operated by the motor shaft 198. The switch 197 comprises a bracket 199 secured rigidly to the shaft 198 which abuts one end of a spring 201 disposed about the shaft 198 and the opposite end of which engages an axially movable ring 202 also disposed about the shaft 198. The ring 202 under influence of spring 201 reacts on switch element 208 to close the circuit through the running windings for the motor. L-shaped lever weights 203, which are adapted to fulcrum about points 206 formed at the ends of supports 207 projecting laterally with respect to the bracket 199, reach on ring 202, under the influence of centrifugal force to shift ring 202 against spring 201 to open the circuit through the running windings when the motor has attained its normal operating speed. The ring 202 engages a switch element 208 at 209, the switch element 209 being secured to a casing 211 of the motor of the oil burning apparatus 10 as is indicated at 212. The opposite end of the switch element 208 carries a pair of contacts indicated at 213 adapted in one position to engage a contact 214 and in another to engage a contact 216. In the position in which the elements of the centrifugal switch 197 are illustrated in Fig. 8, the motor shaft 198 has attained normal operating speed and under such conditions the solenoid atcuated valve 191 is open to allow fluid to flow from the metering pump 54 through the conduit 171 to the fuel compartment 182. However, before the shaft 198 has reached such normal operating speed and after the controls of the oil burning apparatus have been actuated in such manner as to reduce the speed of the shaft 198 below normal operating speed the ring 202 will be moved by the spring 201 away from the bracket 199 and in such manner as to move the switch element 208 to break the circuit between contacts 213 and 214 and to make an electrical circuit between the contacts 213 and 216. Under such circumstances it will be apparent that the solenoid actuated valve 191 will operate to close the flow of fuel through the passage 171 by closing the needle valve 194 upon the orifice 196. The switch 197 therefore will not permit the flow of fuel from the metering pump 54 to the nozzle 103, except when the shaft 198 of the motor of the oil burning apparatus 10 is operating at a predetermined or normal speed. However, since the motor shaft 198 operates the fan shaft 12 and the pumping unit shaft 19, it will be apparent that the fuel metering pump 54, the fuel supply pump 53, and the air pump 38 will be operated both before and after the motor shaft 198 reaches such predetermined or normal operating speed and the centrifugal switch 197 is actuated in such manner as to open the solenoid actuated valve 191. Under such circumstances the air from the air pump 38 will continue to be delivered through the orifice 183, but the closing of the valve 194 will prevent a normal flow of fuel from the passages 186 into the mixing passage 184. Under such circumstances the pressure will rise in the oil supply conduit 171 to such an extent that the fluid pressure between the rotor 153 and the wall 154 will force the rotor 153 away from the wall 154 to an extent great enough to relieve the pressure in the conduit 171. The rotor 153 is movable in response to such increase in pressure within the conduit 171 by reason of the fact that it is possible for both the rotor 153 and the piston 158 to move axially with the shaft 19 within the metering pump chamber 139. Such axial movement is provided for by movement of the shaft 19 withing the coupling 18 and against the compression of the

spring 97, the universal connections between the shaft 19 and air pump rotor 46 and gear pump 53 permitting such axial movement of shaft 19.

This application is a continuation of my copending application Serial No. 13,718 for "Oil Burner Pumping Unit," filed March 8, 1948, now abandoned.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. An oil burning apparatus including a driving shaft and a fuel and air pumping unit, said pumping unit comprising a casing having a support extending thereacross and a plurality of guides, bearing means disposed on opposite sides of said support, a driven shaft extending within said casing and across said support and being rotatably mounted within said bearings, fuel and air pumping means disposed on opposite sides of said support in driven relation to said shaft, said fuel and air pumping means being mounted within said casing in engagement with said guides, means for securing said fuel and air pumping means against the opposite surfaces of said support, fuel metering means secured to said fuel pumping means within said casing, said fuel metering means being driven by said shaft and being operatively associated with the discharge side of said fuel pumping means, and means for securing said pumping unit to said oil burning apparatus with said shaft of said pumping unit in operative relation to said driving shaft of said apparatus.

2. An oil burning apparatus including a driving shaft and a fuel and air pumping unit, said pumping unit comprising a casing having a support extending thereacross and a plurality of guide rails extending radially inwardly thereof, bearing means disposed on opposite sides of said support, a driven shaft extending within said casing and across said support and being rotatably mounted within said bearings, fuel and air pumping means disposed on opposite sides of said support in driven relation to said shaft, said fuel and air pumping means being mounted within said casing in peripheral engagement with said guide rails, means for securing said fuel and air pumping means against the opposite surfaces of said support, and means for securing said support to said oil burning apparatus with said shaft of said pumping unit in operative relation to said driving shaft of said apparatus.

3. An oil burning apparatus including a driving shaft and a fuel and air pumping unit, said pumping unit comprising a casing having a support extending thereacross and a plurality of guide rails extending radially inwardly thereof, bearing means disposed on opposite sides of said support, a driven shaft extending within said casing and across said support and being rotatably mounted within said bearings, fuel and air pumping means mounted on opposite sides of said support and being driven by said shaft, said fuel and air pumping means being mounted within said casing in peripheral engagement with said guide rails and means for securing said pumping unit to said oil burning apparatus with said shaft of said pumping unit in operative relation to said driving shaft of said apparatus.

4. An oil burning apparatus including a driving shaft and an oil and air pumping unit, said pumping unit comprising a hollow casing having a support extending transversely thereof intermediate the ends thereof, oil and air pumping means disposed on opposite sides of said support, means for securing said oil and air pumping means to said support, bearing means disposed on opposite sides of said support and carried by said oil and air pumping means, said support having an aperture therein forming a seal chamber, a driven shaft extending through said aperture and rotatably mounted within said bearings, said oil and air pumping means being arranged in driven relation to said shaft, and a running seal arranged in said chamber and around said shaft and forming a running seal between said shaft and said support, part of said support being exposed to the exterior of said casing, said support being provided with ducts forming passages communicating with the inlet and discharge sides of said oil and air pumping means and terminating in the outer surface of said casing whereby oil and air lines of the oil burning apparatus may be connected in fluid flow relation with said oil and air pumping means, said aperture forming a part of one of said passages, said seal being disposed between said oil and air pumping means so as to prevent leakage of oil along said shaft into said air pumping means.

5. An oil burning apparatus including a driving shaft and an oil and air pumping unit, said pumping unit comprising a hollow tubular casing having a support extending transversely thereof, oil and air pumping means disposed on opposite sides of said support, means for securing said oil and air pumping means to said support, bearing means disposed on opposite sides of said support and carried by said oil and air pumping means, said support having an aperture therethrough, a driven shaft extending through said aperture and rotatably mounted within said bearings, said oil and air pumping means being arranged in driven relation to said shaft, oil metering means secured to said oil pumping means within said casing, said oil metering means being driven by said shaft and being operatively associated with the discharge side of said oil pumping means and a running seal arranged in said aperture and around said shaft and forming a seal between said shaft and said support, said seal being disposed between said oil and air pumping means so as to prevent leakage of oil along said shaft into said air pumping means.

6. An oil burning apparatus including a driving shaft and a fuel and air pumping unit, said pumping unit comprising a hollow tubular casing having a suport extending transversely thereof, fuel and air pumping means disposed on opposite sides of said support, means for securing said fuel and air pumping means against the opposite sides of said support, bearing means disposed on opposite sides of said support and carried by said fuel and air pumping means, said support having an aperture therethrough, said driving shaft extending through said aperture and being rotatably mounted within said bearings, said fuel and air pumping means being arranged in driven relation to said shaft, fuel metering means within said casing, said fuel metering means including a pump element driven by said shaft and being operatively associated with the discharge side of said fuel pumping means, a block against which said pump element is adapted to move during opera-

tion of said metering means, said block having a duct communicating with said discharge side of said fuel pumping means, said pump element having a port adapted to be brought into and out of registry with said duct during operation of said metering means, and ball arranged in a socket in said pump element and a socket in the end of said shaft, said ball providing a universal connection between said shaft and pump element for maintaining a sealing engagement between said pump element and said block.

7. An oil burning apparatus including a driving shaft, an oil supply pump mounted on said shaft and including a rotary element having a driving connection with said shaft adapted to permit axial movement of said shaft relative thereto, an oil metering pump arranged at the end of said shaft and including a pump element having a universal connection with said shaft and adapted to be driven thereby, a block having a lapped face and an oil duct terminating at one end in said face, said duct at its other end communicating with the discharge side of said oil supply pump, said pump element having a lapped face seated against the lapped face of said block and a port adapted to be brought into and out of registry with said duct in said block upon operation of said metering pump, said universal connection between said shaft and pump element comprising a ball arranged in a socket in said pump element and a socket in the end of said shaft, and spring means reacting on said shaft, ball, and pump element for resiliently holding the lapped face of the later in sealing relation with the lapped face of the block.

8. Oil burning apparatus according to claim 7 wherein said rotary element of said oil supply pump is provided with an axially extending groove, said shaft having a depression therein, said driving connection between said shaft and rotary element comprising a ball projecting into said depression and into said groove so as to provide a universal connection between said shaft and said rotary element.

9. An oil burning apparatus including a driving shaft, an air supply pump mounted on said shaft and having a driving connection therewith adapted to permit axial movement of said shaft relative to said air pump, an oil supply pump mounted on said shaft and having a driving connection therewith adapted to permit axial movement of said shaft relative to said oil supply pump, an oil metering pump arranged at the end of said shaft and including a pump element having a universal connection with said shaft and adapted to be driven thereby, a block having a lapped face and an oil duct terminating in said face, said pump element having a lapped face seated against the lapped face of said block and a port adapted to be brought into and out of registry with said duct in said block upon operation of said metering pump, said universal connection between said shaft and pump element comprising a ball arranged in a socket in said pump element and a socket in the end of said shaft, and spring means reacting on said shaft, ball, and pump element for resiliently holding the lapped face of the latter in sealing relation with the lapped face of the block.

10. An oil burning apparatus including a driving shaft, an air supply pump mounted on said shaft and including a rotor through which said shaft extends, a driving connection between said rotor and said shaft, and oil supply pump mounted on said shaft and having a rotary element through which said shaft extends, said rotary element having an axial slot therein, said shaft having a concave depression therein, a ball driving member arranged in said slot and said depression in said shaft so as to provide a universal driving connection between said shaft and said rotary element thereby permitting relative axial movement between said shaft and said rotary element, a fuel metering pump having a driven element arranged at the end of and connected to said shaft so as to be driven thereby, a block against which said driven element of said metering pump is adapted to move and seat during operation thereof, a ball arranged between the end of said shaft and said driven element, and spring means operable for biasing said shaft, ball, and driven element toward said block, said ball providing a universal connection between said shaft and said driven element for seating said driven element against said block.

11. An oil burning apparatus including a driving shaft, an air supply pump mounted on said shaft and including a rotor through which said shaft extends, a driving connection between said rotor and said shaft, an oil supply pump mounted on said shaft and having a rotary element through which said shaft extends, said rotary element having an axial slot therein, said shaft having a concave depression therein opposite said slot, a ball driving member arranged in said slot and said depression in said shaft so as to provide a universal driving connection between said shaft and said rotary element, a fuel metering pump having a driven element arranged at the end of and connected to said shaft so as to be driven thereby, a block against which said driven element of said metering pump is adapted to move and seat during operation thereof, a ball arranged between the end of said shaft and said driven element, said ball providing at least a part of a universal connection between said shaft and said driven element.

12. Apparatus according to claim 5 wherein said shaft is movable axially relative to its bearings and to said oil and air pumping means and wherein a universal driving connection is provided between said shaft and said oil and air pumping means.

13. Apparatus according to claim 5 wherein said metering pump is arranged at one end of said shaft in driven relation therewith and so as to take axial thrust of said shaft, and wherein said seal includes a spring biasing said shaft towards said metering pump.

14. Apparatus according to claim 5 wherein said metering pump is arranged at one end of said shaft and a ball provides a universal driving connection and thrust member between said shaft and said metering pump.

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