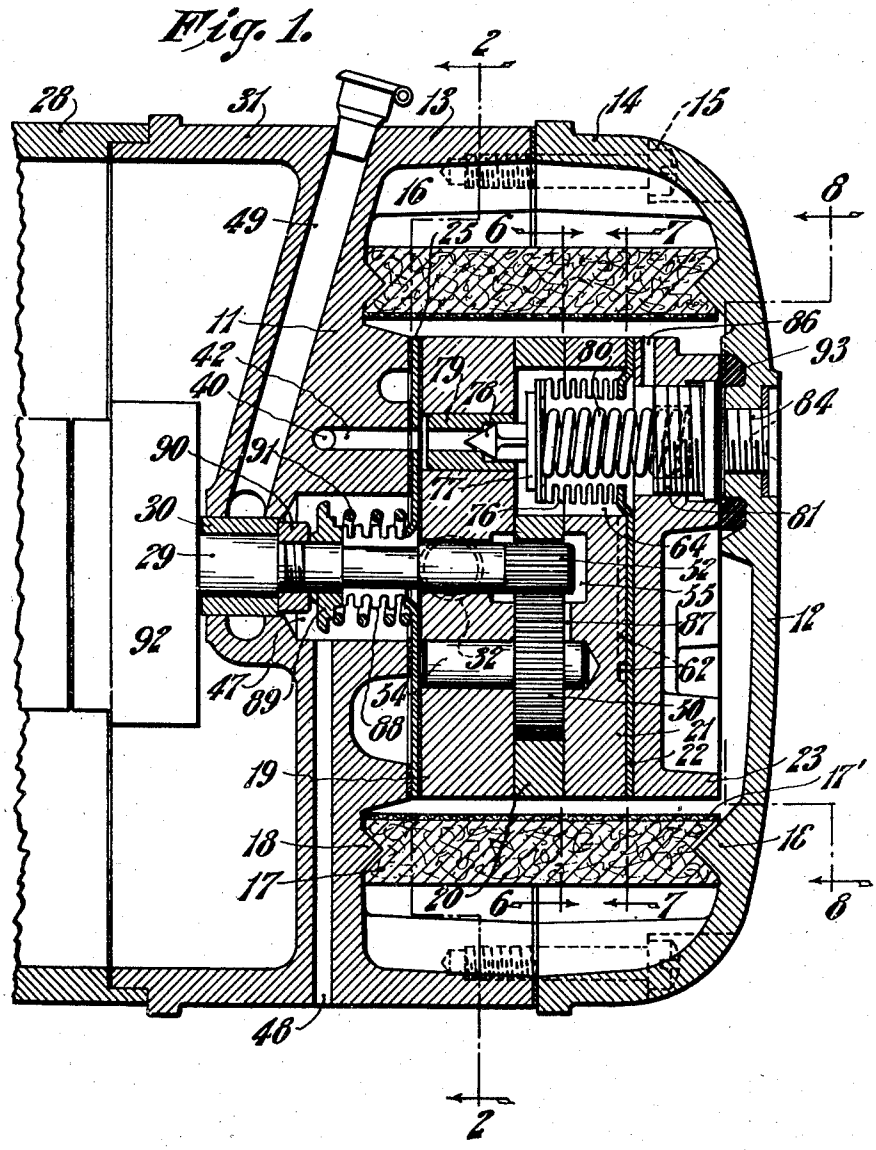
Aug. 24, 1948. V. E. DUEMLER 2,447,744

PUMPING UNIT

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Fig. 1.




INVENTOR,
*Virgil E. Duemler,*

BY

*Chapin & Neal.*
ATTORNEY.

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Fig. 3.

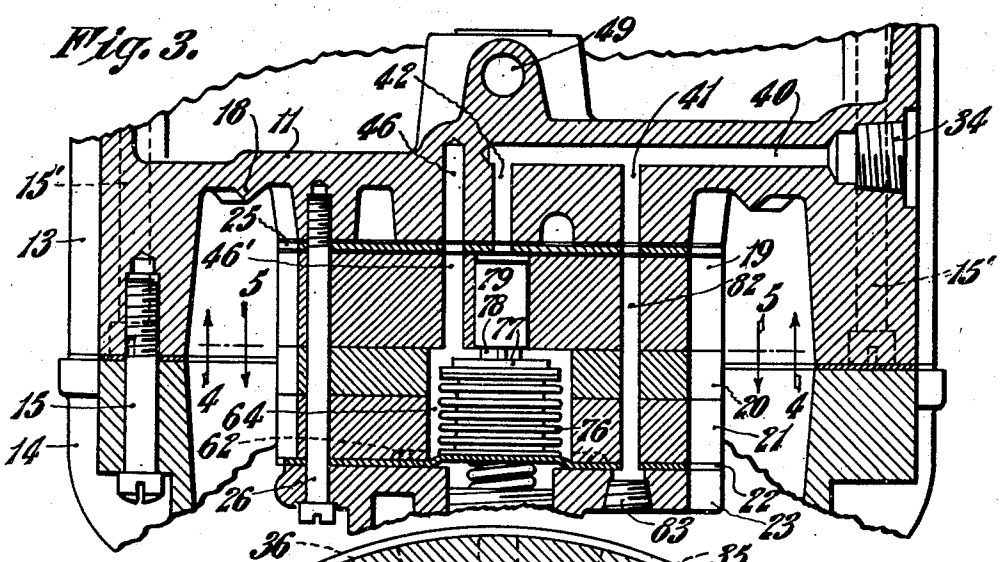
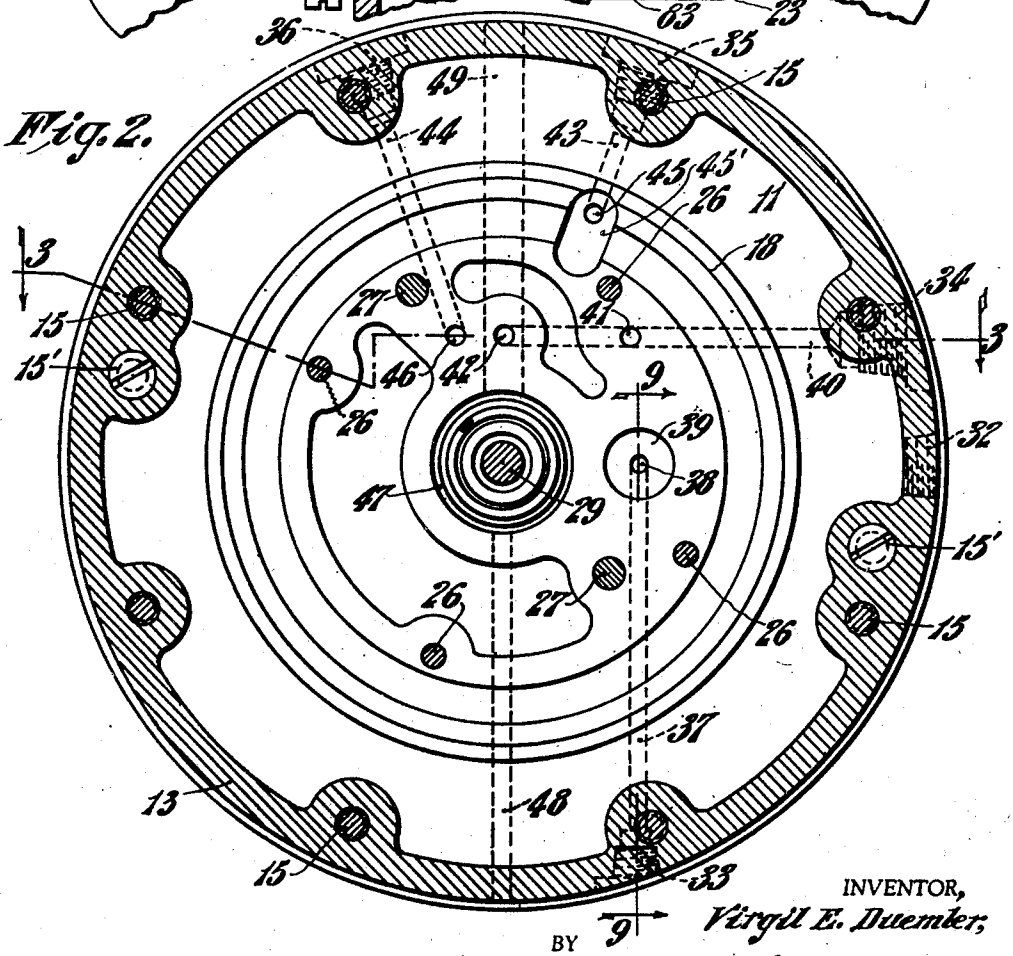



Fig. 2.




INVENTOR,
Virgil E. Duemler,
BY Chapin & Neal
ATTORNEY.

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PUMPING UNIT

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Fig. 4.

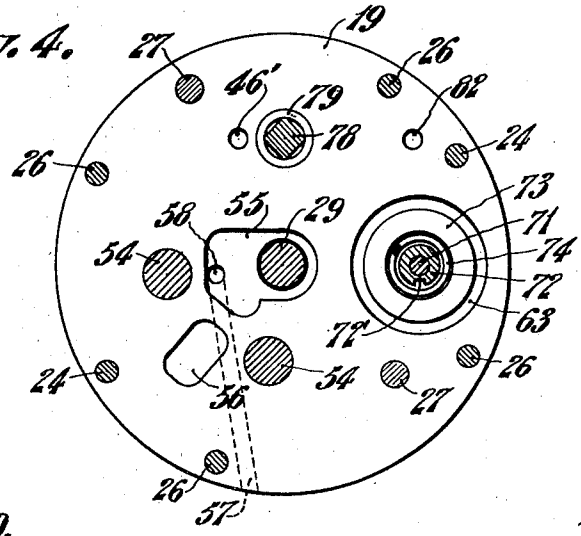



Fig. 10.

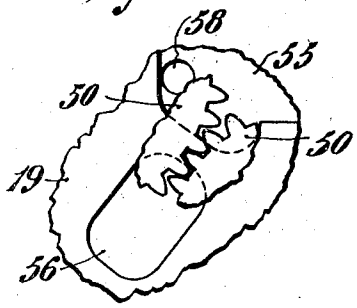



Fig. 5.

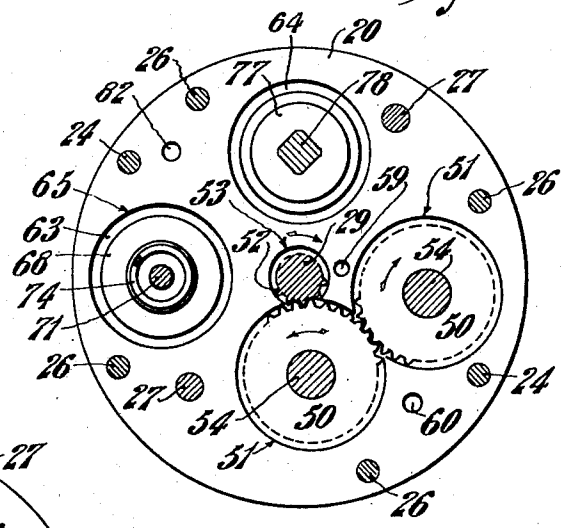
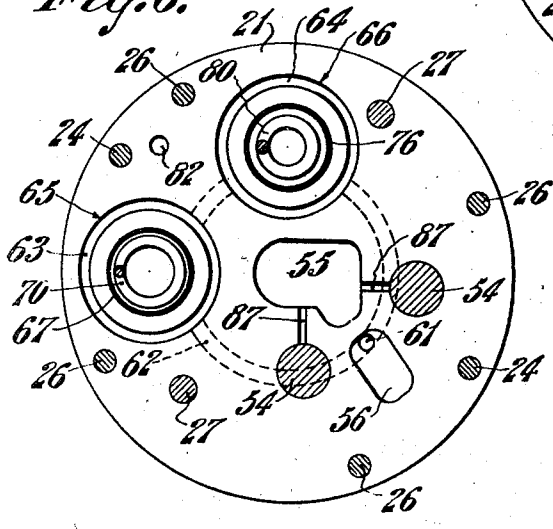



Fig. 6.




INVENTOR,
Virgil E. Duemler,
BY
Chapin & Neal.
ATTORNEY.

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PUMPING UNIT

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Fig. 7.

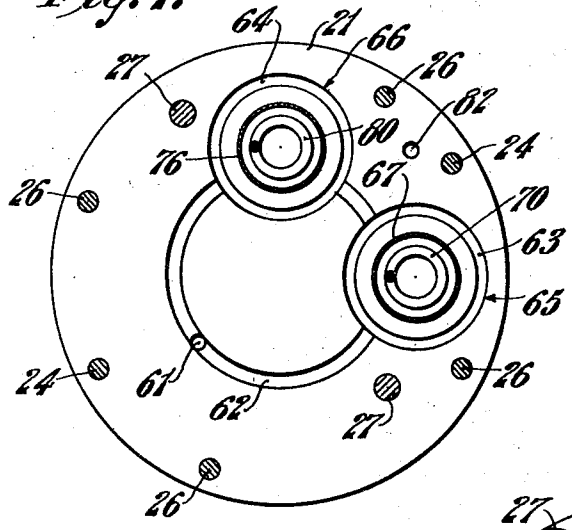



Fig. 13.

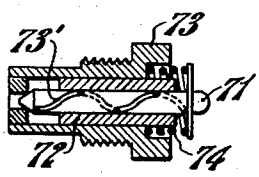



Fig. 8.

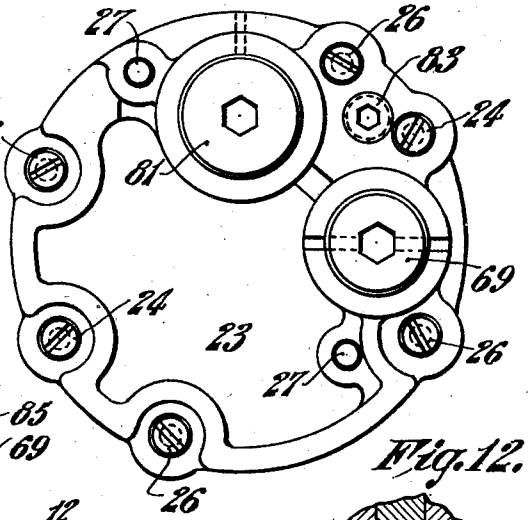



Fig. 9.

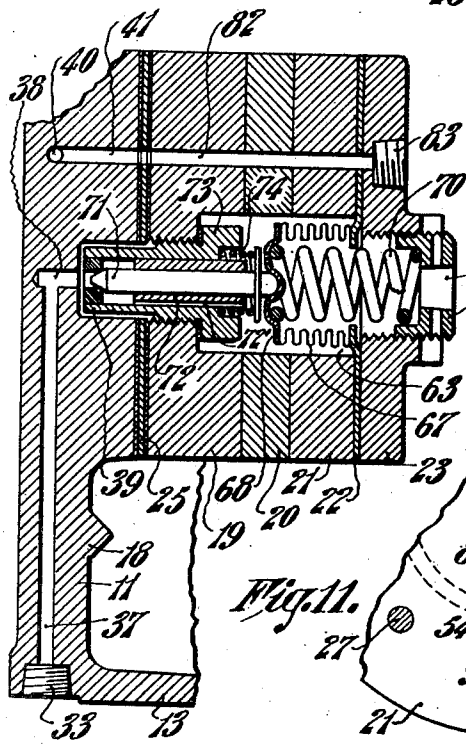



Fig. 11.

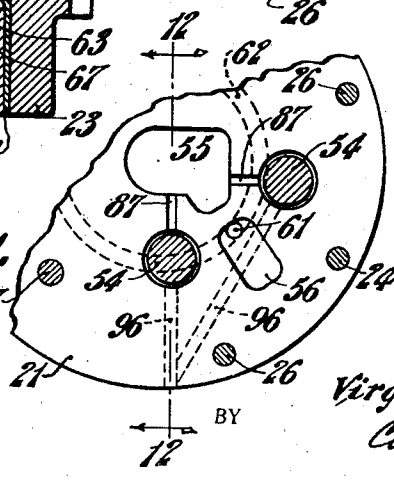
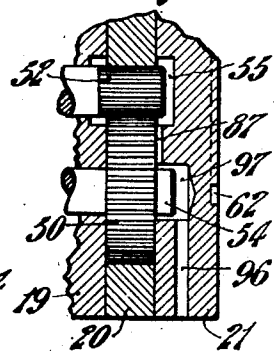



Fig. 12.




INVENTOR,
Virgil E. Duemler,
BY
Chapin & Neal.
ATTORNEY.

Patented Aug. 24, 1948 2,447,744

# UNITED STATES PATENT OFFICE

2,447,744

## PUMPING UNIT

Virgil E. Duemler, West Springfield, Mass., assignor to Gilbert & Barker Manufacturing Company, West Springfield, Mass., a corporation of Massachusetts

Application April 1, 1944, Serial No. 529,048

12 Claims. (Cl. 103—42)

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This invention relates to an improved pumping unit which is particularly suitable for use with oil burners.

The invention affords a single unitary structure which includes the pump, its driving motor and a pressure regulating valve and may also, and preferably does, include a burner cut-off valve and a filter.

The invention has for general objects the provision of a fuel pumping unit which is economical to manufacture, quiet and efficient in operation, and easily serviced.

A particular object of the invention is to provide a compact arrangement of the parts, above described, within a substantially cylindrical housing of substantially uniform diameter from end to end and having a smooth, unbroken exterior surface without any substantial projections and of streamlined form.

Another object of the invention is to provide a compact unit having a rotary pump and a pressure-responsive valve, mounted in a single substantially cylindrical casing with the pumping elements and valve grouped in a circular series about the pump drive shaft, which is coaxial with the casing, and with the axes of the elements, valve and shaft in parallel relation.

According to another object of the invention, the pressure-responsive valve may be either the pressure-regulating valve or the nozzle cut-off valve of an oil burner. Also, both such valves may be, and preferably are, housed in the one pump casing.

Another object of the invention is to provide a fuel pumping unit, having its casing made up of a stack of plates, fastened together face to face, an intermediate plate containing interengaging pump elements, such as gears, located between other plates, one on each side of the first-named plates, the pump casing having a chamber formed therein parallel with the axes of the pumping elements to house one or more control valves, such as the pressure-regulating valve and the nozzle cut-off valve.

Another object of the invention is to provide in connection with either or both the valves described, a valve-actuating bellows, movable in one direction by a spring and in the other by pressure of the pumped oil, said bellows being carried by a disc clamped between one pair of plates of the pump casing.

Another object of the invention is to provide in a pumping unit, a pump casing fastened to a body member having therein a pump driving shaft, together with seal ring elements for said shaft, one

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such element being carried by a bellows, mounted on a disc, clamped between the pump casing and said body member.

A further object of the invention is to provide, as a safety feature, a means for venting the interior of the bellows of the pressure-regulating or of the cut-off valve to the fuel supply chamber, whereby any leak through the bellows will establish a by-pass around the pump and reduce the pressure in the pumping unit, thus allowing the cut-off valve to close and prevent flow to the nozzle.

A further object of the invention is to provide in connection with both the pressure-regulating and the cut-off valves, vents to interconnect the interior and spring-housing parts of the two bellows, whereby the fluid pressure inside each bellows will be equalized to avoid any unequal influence by fluid pressure on the valve-closing spring-pressure.

Another object of the invention is to provide a fuel supply unit, which easily primes itself and which includes an outer housing affording within it a fuel supply chamber, a pump casing inside said chamber, and a filter of absorbent material within the chamber and surrounding the pump, characterized in that the suction passage of the pump has its intake end at substantially the lowest point of its casing and adjacent the inner periphery of the filter whereby if pumping ceases because of exhaustion of fuel and said intake end becomes uncovered, oil will subsequently seep from said filter and raise the liquid level in the chamber far enough to cover said intake end and prime the pump.

These and other objects will best be understood as the detailed description proceeds and they will be particularly pointed out in the appended claims.

The invention will be disclosed with reference to the accompanying drawings, in which,

Fig. 1 is a sectional elevational view of a fuel feeding unit embodying the invention;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1 and showing the body or supporting member of the unit;

Fig. 3 is a fragmentary sectional plan view taken on the line 3—3 of Fig. 2;

Figs. 4 and 5 are cross sectional views taken on the lines 4—4 and 5—5, respectively, of Fig. 3 and showing one face of one of the end plates for the pump and the pump plate, respectively;

Figs. 6, 7 and 8 are cross sectional views taken on the lines 6—6, 7—7, and 8—8, respectively of Fig. 1 and showing the inner face of the other end

plate for the pump; the outer face of the last-named end plate; and the cover plate for the pumping unit;

Fig. 9 is a fragmentary sectional view taken on the line 9—9 of Fig. 2;

Fig. 10 is an enlarged fragmentary cross sectional view showing the relationship of the intermeshed gear teeth with the inlet and outlet ports.

Fig. 11 is a fragmentary view of the same end plate as is shown in Fig. 6 and illustrates a modification in detail;

Fig. 12 is a fragmentary sectional view taken on the line 12—12 of Fig. 11; and

Fig. 13 is a fragmentary sectional view taken similarly to Fig. 9 and showing a modification.

Referring to these drawings, the pumping unit (Fig. 1) includes a housing having a body member 11 and a cover member 12. These members 11 and 12 have mating and confronting circular flanges 13 and 14, respectively, which are suitably held together, as by cap screws 15 (see also Figs. 2 and 3). These two housing members afford between them an inlet chamber 16 for the pump. They also support between them a suitable filter 17 of annular form, as by means of the annnuar rings 18 (Figs. 1, 2, and 3) of triangular section which engage one in each end face of the filter. This filter is preferably made of absorbent material for a purpose which will later be explained. It may, for example, consist of cotton thread wound upon a coarse mesh wire screen 17'.

Within the inner chamber, which is formed within the filter 17, is located the pumping unit proper. This unit (Fig. 1) comprises an inner end plate 19, a pump plate 20, an outer end plate 21, a thin bellows-bearing disc 22 and a cover plate 23. These several plates and disc 22 are held together by a pair of cap screws 24, which are indicated in Figs. 4 to 8 and which pass loosely through plates 23, disc 22 and plates 21 and 20 and thread into plate 19. These screws 24 serve to hold the component parts of the unit in proper assembled relation while it is being mounted in place on the body or supporting member 11. The assembled unit is held to one finished face of member 11, with a seal-ring bearing disc 25 and suitable gaskets clamped therebetween, by a plurality of cap screws 26, which are best shown in Fig. 3 and also indicated in Fig. 2 and Figs. 4 to 8 inclusive. These screws 26 pass loosely through all the plates and both discs and are threaded into member 11. A pair of dowels 27, fixed in member 11 extend through and closely fit, registering holes in the several plates and both discs and gaskets and serve accurately to hold all these plates and discs in proper angular relation with each other and with member 11.

The housing member 11 may be, and desirably is as shown, an end plate for a pump driving member, such as an electric motor. This motor has a smooth, cylindrical exterior, indicated in part at 28 and of the same diameter as the smooth cylindical exterior of the parts 13 and 14. The motor serves to drive the shaft 29, which has a bearing 30 in the member 11. The latter has a circumferential flange 31 to fit the motor casing and is suitably held thereto, as by screws 15'. Flange 31 is of smooth cylindrical form and of the same diameter as parts 28, 13 and 14. An outer casing of smooth, unbroken, streamlined form is thus provided.

All pipe connections are made to the body member 11, whereby the cover 12, filter 17 and the pump unit may be removed without disturbing any pipe connections.



Referring to Fig. 2, there are ports 32, 33 and 34 for connection, respectively, to a suction pipe leading from the fuel oil supply tank; to a pipe leading to the burner nozzle; and to a return pipe leading back to said tank. There are also ports 35 and 36 for connection to vacuum and pressure gauges, respectively. The inlet port 32 opens directly into chamber 16 through the peripheral wall 13 thereof. The burner port 33 is connected by a passage 37 (see also Fig. 9) which leads upwardly to and connects with a short passage 38, leading outwardly to and opening into a well 39 formed in the outer face of the member 11. The by-pass port 34 (Figs. 2 and 3) is connected by a horizontal passage 40 to each of two short passages 41 and 42 which open outwardly to said face of member 11. The ports 35 and 36 are connected by passages 43 and 44 to short passages 45 and 46, respectively, which lead outwardly to said face of member 11. The passages 38, 41, 42 and 46 open in said face at points within the area covered by the end plate 19 of the pumping unit, while the passage 45 opens into a recess 45' which lies outside said area and inside the filter 17.

The body member 11 also contains a central recess 47 coaxial with shaft 29 and a passage 48 for venting and draining said recess. Another passage 49 serves to conduct lubricant to bearing 30.

Referring now to the pumping unit proper, this includes a pair of intermeshing gears 50 (Fig. 5) housed one in each of a pair of cylindrical holes 51 formed in, and passing entirely through, the pump plate 20. One of these gears is driven by a small pinion 52 formed on the outer end of shaft 29 (Fig. 1). The pinion is housed in a cylindrical hole 53 (Fig. 5) formed in and passing entirely through plate 20. The outer extremities of the teeth of gears 50 and those of pinion 52 closely fit the peripheral wall of their respective holes 51 and 53. The teeth of the gears and those of the pinion are preferably relatively pointed as shown. The gears 50, as shown, are of equal size. The pinion 52 is much smaller so as to effect a reduction of the speed of the gears to approximately one third of the speed of shaft 29. Each gear 50 is rotatably mounted on a stud 54. Each such stud is fixed at one end by being pressed into plate 19 (Fig. 1) and has its other end extending into a hole in plate 21. The faces of the gears 50 closely fit the adjacent faces of said end plates, as shown in Fig. 1.

The inlet and outlet ports for the gear pump are shown at 55 and 56, respectively. They are formed in those faces of plates 19 and 21 which engage the pump plate 20. One set of these ports is shown in Fig. 4 and the other in Fig. 6. Both inlet ports are alike and both outlet ports are alike. Fuel oil is drawn from the chamber 16 through a passage 57 (Fig. 4) leading from substantially the lowest point in the periphery of plate 19 upwardly to about the lever of the shaft 29 but at a point laterally offset therefrom where it communicates with a hole 58 which opens into the inlet port 55 in plate 19. The two inlet ports 55 are interconnected by a through passage 59 in pump plate 20 (Fig. 5). The two outlet ports 56 are similarly interconnected by a through passage 60 in plate 20. The outlet port 56 in plate 21 is connected by a passage 61 (Fig. 6) to a circular groove 62 in the outer face of the plate (see also Fig. 7). This groove serves to conduct the pumped oil into two cylindrical chambers 63 and 64. The chamber 63 is formed

by registering holes 65 in plates 21, 20 and 19. These holes extend entirely through plates 21 and 20 but only partly through plate 19. The chamber 64 is formed by registering holes 66 formed in and extending entirely through the plates 21 and 20. These chambers 63 and 64 respectively receive part of the cut-off valve mechanism (controlling the flow of oil to the burner) and part of the by-pass valve (controlling the flow of oil back to the suction side of the pump or to the supply tank, whichever is desired).

The disc 22, above referred to, carries a bellows 67 which extends into the chamber 63 and forms a movable partition therefor. Within the bellows and acting between the closed end wall 68 thereof and an adjustable seat 69 on cover plate 23 is a spring 70. The cut-off valve is shown at 71. It is slidably mounted in a sleeve 72. Sleeve 72 fits in a bushing 73 and has a longitudinal groove 72' (Figs. 4 and 9) in its exterior enabling oil to flow from chamber 63 to the valve. Instead of the groove 72', a spiral groove may be formed in valve 71 as shown in Fig. 13 for the same purpose. The oil flowing through this spiral groove serves to lubricate the valve stem and prevent it from sticking in its guides. The bushing 73 carries the seat for valve 71. This bushing is threaded into plate 19 and has an end extending into the well 39, above described. The outer end of the stem of valve 71 rests against the wall 68 of the bellows. A small spring 74 tends to open valve 71, when permitted by an outward movement of wall 68 under the pressure of oil in chamber 63. Oil will then flow into hole 38 and thence by passage 37 to the burner port 33. The valve 71 will open when the oil attains the desired pressure for atomization, say for example 85 pounds per square inch.

The disc 22 also carries a second bellows 76 (Fig. 1) which extends into chamber 64 and forms a movable partition therefor. Its inner and closed end 77 bears the pressure-regulating valve 78 which engages with a seat formed in a bushing 79 fixed in plate 19. The stem of this valve is of modified square section (Fig. 4) and slidably fits in the round hole of bushing 79 (Fig. 1) to guide the valve, spaces being left between the wall of the hole and the flat sides of the square section of the stem for oil to flow from chamber 64 to reach the valve. A spring 80 acts between wall 77 and an adjustable seat 81 in cover plate 23 to hold valve 78 closed. When, however, the pressure of the pumped oil reaches a predetermined figure, the wall 77 will be moved outwardly (to the right as viewed in Fig. 1) and open the valve 78, allowing oil to escape into passage 42 and thence into passage 40. The valve 78 is intended to open at a somewhat higher pressure than the cut-off valve, say from 90 to 125 pounds per square inch.

The cut-off valve 71 is preferably made of very hard and non-corrosive material. An example of one suitable material, having these characteristics, is "Nitralloy." The seat for this valve is a small insert, preferably made from softer material, which is also non-corrosive, such for example, as stainless steel. The valve 78 may have the usual nick or scratch in its needle-pointed end to maintain a small by-pass even when valve 78 is on its seat.

The oil escaping into passage 40 may be returned to the fuel supply tank by means of a pipe connected to the port 34 or it may be returned directly to the inlet chamber 16 by means



of a passage 82 (Fig. 9) made up of a series of registering holes formed in plates 19, 20, 21 and 23, in disc 22 and in disc 25 and the gaskets therefor, which holes are coaxial and communicate with the hole 41 above described. When a separate return pipe connected to port 34 is used, then the outer end of passage 82 will be closed, as by a plug 83, threaded into cover 23. When an internal by-pass is used, the port 34 is closed by a plug and the plug 83 is removed.

Access to plug 83 may be had by removing cover 14. Access may also be had in the same manner for adjusting the tension of the cut-off valve spring 70 by turning the threaded spring seat 69. The adjustment of spring 80 of the pressure-regulating valve may be varied without removing cover 14. A plug 84 is provided in cover 14 and by removing this plug, access may be had for turning the adjustable nut 81 which varies the tension of spring 80. It is seldom necessary to adjust the tension of the spring of the cut-off valve. Hence, the adjustment therefor need not be accessible from outside cover 14.

The bellows 67 is vented to the inlet chamber 16 by means of a hole 85 (Fig. 9) formed in plug 69. The bellows 76 is also vented to this chamber by a hole 86 (Fig. 1) formed in cover plate 23. By these vents the force which is due to liquid pressure and which acts internally on these bellows and the valves is exactly equalized. Also, because of the vents, pressure cannot build up in the pump and cause an unsafe condition. In the event, that a bellows breaks, the leak is to the suction side of the pump. This leak establishes a by-pass for the pump. If the leak is large enough, the pressure in chambers 63 and 64 will be reduced to such an extent that both valves will close. The pump will then idle and cannot build up any substantial and dangerous pressure.

In the end plate 19 (Fig. 3) and in the disc 25 are registering holes 46' which align with the passage 46 leading to the pressure gauge. The hole 46' in plate 19 opens into the pressure chamber 64 which houses the bellows for the pressure-regulating valve and thus to the pressure side of the pump.

The bearings and faces of the gears 50 may be lubricated by the pumped oil, as by means of a pair of passages 87 (Fig. 6) in plate 21. Each passage 87 leads from an inlet port 55 radially to the stud receiving recess in plate 21 of the gear it is intended to lubricate. One such passage 87 is shown in section in Fig. 1.

The disc 25 (Fig. 1) carries a bellows 88 located coaxially thereof and extending into the recess 47 in housing member 11. This bellows carries a seal ring element 89 which engages a rotary seal ring element 90 threaded and sealed on shaft 29. A spring 91 acts between disc 25 and element 89 to urge the latter against element 90. The element 90 and the motor driven member 92 engage opposite ends of bearing 30 and serve to hold the pump drive shaft 29 against undue axial displacement.

A rubber gasket 93 (Fig. 1) is clamped between the inner cover 23 and the outer cover 12 and forms a tubular passage between the openings in which plug 84 and spring seat 81 are mounted. This passage is sealed off from the rest of the inlet chamber so that no fluid can enter or leave the chamber when plug 84 is removed to adjust the spring seat 81. In the case of a gravity feed (one-pipe) system, oil would flow out from chamber 16 on removal of plug 84, except for seal 93.

In the case of a suction feed from a low-level tank in a two-pipe system, the removal of plug 84 would break the vacuum and cause the pump to lose its prime, if the seal 93 were not provided.

Referring to Figs. 11 and 12, the intake for the pump may be arranged so that the gears 50 and their bearings may be lubricated by the fuel oil in the course of its travel to intake port 55. Thus, instead of the single intake passage 57 in pump plate 18, two intake passages 96 may be provided in end plate 21. These passages lead from the lowest point in the periphery of plate 21 upwardly one to each of the wells 97 in which the gear studs 54 loosely fit. Oil from these wells flows by way of the grooves 87 to the intake port 55. As distinguished from the plan of lubrication above described for gears 50, the present plan maintains the oil in circulation and keeps the wells 97 sweat free from sediment.

The pumping unit is shown as adapted for connection to a low-level supply tank by a suction pipe, connected to port 32, and a return pipe connected to port 34. Operation of the motor will rotate the gears 50 and create a vacuum to draw oil up through the suction pipe and into chamber 16, where the oil will rise to a level above the intake end of suction passage 57. Oil entering this passage will eventually reach the gears 50 and be carried around in the tooth spaces of these gears to outlet ports 56, whence the oil will flow through hole 61 to groove 62 and thence to chambers 63 and 64. When sufficient pressure has been built up in chamber 63, the cut-off valve 71 will open and allow oil to flow through passages 38 and 37 and port 33 to the nozzle of the oil burner. When the oil in chamber 64 reaches a somewhat higher pressure, valve 78 will open and allow excess oil to pass by passages 42 and 40 to port 34 and thence by the return pipe to the low-level tank.

To adapt the unit for a gravity-feed, one-pipe system, the port 34 is plugged and the plug 83 is removed. Operation of the pump will draw in liquid from the supply chamber 16 and force it to the burner port 33, as before, but on opening of the pressure-regulating valve 78, the excess oil will be carried through passages 42, 40, 41 and 82 back to the inlet chamber 16, these passages forming an internal by-pass for the pump.

The pump is especially quiet in operation. Contributing to this result is the relatively low speed of the gears 50 due to the reduction effected by the drive from pinion 52. Reduction in pulsations in the oil stream is also a factor in reducing noise. The oil is fed in pulses by a gear pump. A large number of small teeth in the gears 50 produce a larger number of smaller pulses per revolution than would be the case if the gears had a smaller number of larger teeth. A better and smoother stream, more nearly approximating uniform flow, is had. A very substantial factor in reducing noise is the avoidance of trapping of the oil and the subsequent compression of the oil between the teeth of gears 50 at the time when they near and pass through full mesh position. Oil thus trapped will be placed under heavy pressure, resulting in a hydraulic hammer noise and also in an undesired thrust on the studs of the gears which tend to spread them apart and produce rapid wear and higher power consumption. Reduction of the "land" between the ports 55 and 56, to the extent shown in Fig. 10, prevents any oil from being



trapped between the teeth until they do reach the full mesh position. The use of relatively pointed teeth reduces the spaces available to hold oil near full mesh positions of the gears. The oil is fed to the tooth spaces of the gears simultaneously from both ends and there is a relatively large amount of time for these spaces to fill, which helps in securing quiet operation. Oil once fed to the tooth spaces is retained therein, against the action of centrifugal force, by the closely-fitting cylindrical walls of the gear cavities 51, which extend as far around as possible toward full mesh position, where the spaces empty into the discharge ports 56. The high pressure zone is concentrated in a relatively small area to avoid undue pressure on the studs of the gears. The pump operates under a high vacuum condition without producing noise. It does not become noisy when air is allowed to pass into the pump with the oil.

In the event that the fuel supply becomes exhausted and no more fuel enters the chamber 16, the level of oil in the latter will drop until the intake end of the suction passage 57 becomes uncovered, whereupon flow of fuel from the pump will soon cease. When the supply tank has been replenished, the pump will readily prime itself because some of the oil contained in the filter 17, which is made of absorbent material, will seep out into the chamber and raise the level until the intake end of suction passage 57 is covered. Thus, the pump will be primed and enabled to pump liquid and establish a sufficient vacuum in the supply pipe to draw up oil from a low-level tank. By the use of the term "absorbent material," I mean any material that will retain oil for the purpose described whether the material is non-metallic as above described or metallic. Finely divided metal, such as steel wool or the like will retain in the interstices of the mass sufficient oil for the purpose.

The fuel unit is characterized by a very compact arrangement of parts which enables the pump, filter, pressure-regulating and cut-off valves to be contained in a small housing no larger in diameter than the motor casing and without the protuberances or projections which have heretofore been customary. The outer housing may be substantially cylindrical and of uniform diameter from end to end, presenting a smooth, unbroken, and streamlined appearance. The motor and fuel unit combined appears hardly any different than an ordinary motor itself. The unit is slightly longer than the end plate of the ordinary motor casing but this is hardly noticeable.

Contributing to the compactness is the construction of the pump casing proper. The pump gears 50 are offset from the center of plate 20 because of the drive from pinion 29. Because the gears 50 are thus offset and because the driving pinion is small, sufficient room is left for the chambers 63 and 64. The four holes 51, 51, 63 and 64 are distributed over the area of the plate 20 in a circular series about the axis of the plate. A large part of the area of the plate is thus usefully employed. By locating the valves and valve chambers with their axes paralleling the axes of the pumping elements 50, the described compact arrangement within a cylindrical casing is made possible. The arrangement allows the pump casing to be located coaxially of the motor casing which is desired. Then the filter 17 can also be located coaxially with the motor casing and with the inner periphery thereof close to the outer

periphery of the pump casing. Thus, all the necessary parts are grouped within the area of the motor casing. By arranging the valves and pump gears and filter in parallel and overlapping relation, endwise space is saved so that the endwise extension of the motor casing, necessary to house the fuel pumping unit, is reduced to a minimum. As will be clear from an inspection of Fig. 1, the many parts have been packed into a space of relatively small volume within the end portion of an electric motor.

The fuel unit is easily serviced. If adjustment of the pressure-regulating valve only is required, this may be effected by merely removing plug 84. By removing cover 12, access is had to the filter which may easily be removed, cleaned and replaced. Also, access is had for adjustment of the cut-off valve. Removal of the pump unit may then be effected simply by removing the four cap screws 26 and drawing the pump casing axially outward to pull it off the driving shaft 29. The pump parts are still held together as one unit by the two cap screws 24. A new pump unit may be quickly substituted or, if necessary or desired, the pump unit may be opened up by simply removing the two cap screws 24.

The invention provides a fuel pumping unit which is quiet and efficient in operation, easy to service, economical to manufacture and which embodies a compact arrangement of parts enabling all necessary parts of the unit to be housed within one end portion of the housing of an electric motor.

What I claim is:

1. A fuel supply unit for oil burners, including a casing made up of a pump plate having holes therethrough, first and second side plates located one on each side of the pump plate for closing said holes, rotary pump elements housed in the holes of the pump plate and between the side plates, aligned openings extending through the first side plate and the pump plate and forming a chamber closed at one end by the second side plate, a disc carrying a bellows, the latter extending into said chamber and closing the other end thereof, a fourth plate between which and the first side plate said disc is located, means for clamping said plates and disc together, a valve seat provided in the second side plate, a valve cooperating with said seat and movable with the bellows, and a spring inside the bellows and between the fourth plate and the valve-engaging part of said bellows.

2. A fuel supply unit for oil burners, comprising, an outer housing made up of body and cover members affording between them an inlet chamber, an inner housing secured to one wall of the body member, a rotary pump housed in the inner housing; the inner housing having a suction passage extending from the inlet chamber to said pump, a valve chamber, a passage connecting the outlet of the pump to the valve chamber, and an outlet from the valve chamber, a pressure regulating valve housed in the valve member and controlling said outlet, an imperforate bellows mounted in said valve chamber for movement in one direction by pressure of the pumped fluid and connected on one side to the valve to open the same when moved in said direction, and a spring acting on the other side of the bellows to move it in the other direction and close the valve, said inner housing provided with a passage for connecting the interior of the bellows to said inlet chamber, whereby should the bellows break, a leak path to said chamber is established forming a by-pass for the pump to prevent the building up of excessive pressure in the inner housing.



3. A fuel supply unit for oil burners, comprising, an outer housing made up of body and cover members affording between them an inlet chamber, an inner housing secured to one wall of the body member, a rotary pump housed in the inner housing; the inner housing having a suction passage extending from the inlet chamber to said pump, two valve chambers, a passage connecting the outlet of the pump to each valve chamber and an outlet from each valve chamber, a pressure regulating valve and a cut-off valve mounted one in each valve chamber and controlling the outlet thereof, an imperforate bellows in each valve chamber and movable in one direction by the pressure of the pumped fluid, the bellows in each valve chamber being connected on one side to the valve in such chamber and operable when moved in said direction to move the valve to open the outlet of such chamber, and a spring in each chamber to move the bellows in the other direction and cause the connected valve to close the outlet of such chamber, said inner housing provided with a passage for connecting the interior of each bellows to said inlet chamber, whereby the pressure within each bellows is equalized and whereby on fracture of the bellows the leak therethrough unloads the pump.

4. A fuel supply unit for oil burners, comprising, an outer housing made up of a body member and a cover member, said members affording between them a fuel supply chamber; a pump casing made up of a pump plate having holes extending therethrough, first and second side plates located one on each side of the pump plate and closing said holes, and a cover plate adjacent the second side plate; said casing being fastened to an end wall of the body member with the first side plate adjacent thereto, a drive shaft mounted in said end wall and extending through the first side plate and into the pump plate, interengaging rotary pumping elements mounted in the openings of the pump plate, registering openings extending through the second side plate and the pump plate and forming a chamber closed by the cover plate, an outlet passage extending from the last-named chamber through the first side plate and said body member, a valve in said last-named chamber for controlling the outlet passage, said casing having a passage connecting the pressure side of said pumping elements to said chamber and a passage connecting the suction side of the pumping elements to said fuel supply chamber, and means in said chamber responsive to a predetermined pressure of the pumped fuel for opening said valve and outlet passage.

5. A fuel supply unit for oil burners, comprising, an outer housing made up of a body member and a cover member, said members affording between them a fuel supply chamber; a pump casing made up of a pump plate having holes extending therethrough, first and second side plates located one on each side of the pump plate and closing said holes, and a cover plate adjacent the second side plate; said casing being fastened to an end wall of the body member with the first side plate adjacent thereto, a drive shaft mounted in said end wall and extending through the first side plate and into the pump plate, interengaging rotary pumping elements mounted in the openings of the pump plate, registering openings extending through the second side plate and the pump plate and forming a chamber closed by the cover plate, an outlet passage extending from the

last-named chamber through the first side plate and said body member, a valve in said last-named chamber for controlling the outlet passage, said casing having a passage connecting the pressure side of said pumping elements to said chamber and a passage connecting the suction side of the pumping elements to said fuel supply chamber, a movable wall in said chamber actuated in one direction by the pressure of the pumped oil to open said valve, a spring for actuating said wall in the other direction, and an adjustable seat for said spring mounted in said cover plate.

6. A fuel supply unit for oil burners, comprising, an outer housing made up of a body member and a cover member, said members affording between them a fuel supply chamber; a pump casing made up of a pump plate having holes extending therethrough, first and second side plates located one on each side of the pump plate and closing said holes, and a cover plate adjacent the second side plate; said casing being fastened to an end wall of the body member with the first side plate adjacent thereto, a drive shaft mounted in said end wall and extending through the first side plate and into the pump plate, interengaging rotary pumping elements mounted in the openings of the pump plate, registering openings extending through the second side plate and the pump plate and forming a chamber closed by the cover plate, an outlet passage extending from the last-named chamber through the first side plate and said body member, a valve in said last-named chamber for controlling the outlet passage, said casing having a passage connecting the pressure side of said pumping elements to said chamber and a passage connecting the suction side of the pumping elements to said fuel supply chamber, a disc clamped between the second side plate and cover plate and having a bellows extending into said chamber and engaging said valve, a spring within the bellows for moving the latter to close the valve, and an adjustable seat for said spring mounted in the cover plate.

7. A fuel supply unit for oil burners, comprising, an outer housing made up of a body member and a cover member, said members affording between them a fuel supply chamber; a pump casing made up of a pump plate having holes extending therethrough, first and second side plates located one on each side of the pump plate and closing said holes, and a cover plate adjacent to the second side plate; said casing being fastened to an end wall of the body member with the first side plate adjacent thereto, a drive shaft mounted in said end wall and extending through the first side plate and into the pump plate, interengaging rotary pumping elements mounted in the openings of the pump plate, registering openings extending through the second side plate and the pump plate and forming a chamber closed by the cover plate, a burner outlet passage, a return passage extending from the last-named chamber through the first side plate and into and through said body member, a valve in said last-named chamber for controlling the return passage, said casing having a passage connecting the pressure side of said pumping elements to said burner outlet passage and to said last-named chamber and a passage connecting the suction side of the pumping elements to said fuel supply chamber, and means in said chamber responsive to a predetermined pressure of the pumped fuel for opening said valve and outlet, said plates having registering holes therethrough forming an internal by-pass communicating at one end with said return passage in said body member and at the other end with said fuel supply chamber, and means for closing the return passage when the internal by-pass is desired and for closing the internal by-pass when the return passage is desired.

8. A fuel supply unit for oil burners, comprising, a driving motor having a casing and including an end member chambered in its outer end, a cover member closing said outer end and cooperating with the end member to form a fuel supply chamber; the exterior peripheral contour of said casing, end and cover members being substantially uniform and presenting a substantially smooth unbroken streamlined surface; fuel inlet, burner outlet and return passages formed in said end member; a pump casing secured to the latter, pumping elements in said pump casing connected to be driven from said motor, a pressure regulating valve housed in the pump casing; the latter having a suction passage from the fuel supply chamber to the pumping elements, a discharge passage from said elements to the burner outlet, and a passage from said elements to said return passage and controlled by said valve; a filter in the fuel supply chamber surrounding the pump, said fuel inlet passage opening into the fuel supply chamber at a point outside the filter and said suction passage having its intake end inside the filter.

9. A fuel supply unit for oil burners, comprising, a driving motor having a casing and including an end member chambered in its outer end, a cover member closing said outer end and cooperating with the end member to form a fuel supply chamber; the exterior peripheral contour of said casing, end and cover members being substantially uniform and presenting a substantially smooth unbroken streamlined surface; fuel inlet, burner outlet and return passages formed in said end member; a pump casing secured to the latter, pumping elements in said pump casing connected to be driven from said motor, a pressure-regulating valve and a burner cut-off valve both housed in the pump casing, the latter having a suction passage from the fuel supply chamber to the pumping elements, a discharge passage from said elements to the burner outlet controlled by said cut-off valve, and a passage from said elements to said return passage and controlled by said first-named valve; a filter in the fuel supply chamber surrounding the pump, said fuel inlet passage opening into the fuel supply chamber at a point outside the filter and said suction passage having its intake end inside the filter.

10. A fuel pumping unit, comprising a casing made up of a plurality of plates fastened together face to face, an intermediate plate of the series having two intersecting cylindrical openings through it extending from one face to the other, interengaging rotary pumping elements mounted one in each of said openings, the abutting plates on opposite sides of said intermediate plate closing said openings, said casing having pump inlet and outlet ports, said casing also having a cylindrical chamber with its axis paralleling the axes of said elements and closed at its ends by two of said plates together with a passage connecting the chamber and pump outlet and an outlet passage for the chamber, a valve for controlling said outlet and housed in said chamber, and means also housed in said chamber and responsive to the pressure of the pumped fuel for actuating said valve opening and closing the valve accordingly

as the pressure of the pumped fuel rises above or falls below a predetermined value.

11. A fuel pumping unit, comprising a casing made up of a plurality of plates fastened together face to face, an intermediate plate of the series having two intersecting cylindrical openings through it extending from one face to the other, inter-engaging rotary pumping elements mounted one in each of said openings, the abutting plates on opposite sides of said intermediate plate closing said openings, said casing having pump inlet and outlet ports, said casing also having two cylindrical chambers each disposed with its axis paralleling the axes of said elements and each closed at its ends by two of said plates, said casing having a passage connecting the pump outlet to each of said chambers and separate outlet passages for said chambers, a burner cut-off valve housed in one chamber and controlling the outlet passage of that chamber, means also housed in the last-named chamber and responsive to the pressure of the pumped fuel for actuating said valve opening and closing the same as the pressure of the pumped fuel exceeds or falls below a predetermined value, a by-pass valve housed in the other chamber and controlling the outlet passage of that chamber, and means also housed in the last-named chamber and responsive to the pressure of the pumped fuel for actuating the second-named valve opening and closing the same accordingly as the pressure of the pumped fuel rises above or falls below another and higher predetermined value.

12. A fuel pumping unit, comprising a cylindrical casing made up of a plurality of plates fastened together face to face, an intermediate plate of the series having two intersecting cylindrical openings through it extending from one face to the other, interengaging rotary pumping elements mounted one in each of said openings, the abutting plates on opposite sides of said intermediate plate closing said openings, said casing having pump inlet and outlet ports, said casing also having two cylindrical chambers each disposed with its axis paralleling the axes of said elements and each closed at its ends by two of said plates, said chambers including openings passing through said intermediate plate, the four openings in said intermediate plate being distributed in angularly spaced relation around the axis of said casing with the two pump openings and the two chamber openings located on opposite sides of a diameter of said casing, said casing having a passage connecting the pump outlet to each of said chambers and separate outlet passages for said chambers, a burner cut-off valve housed in one chamber and controlling the outlet passage of that chamber, means also housed in the last-named chamber and responsive to the pressure of the pumped fuel for actuating said valve opening and closing the same as the pressure of the pumped fuel exceeds or falls below a predetermined value, a by-pass valve housed in the other chamber and controlling the outlet passage of that chamber, and means also housed in the last-named chamber and responsive to the pressure of the pumped fuel for actuating the second-named valve opening and closing the same accordingly as the pressure of the pumped fuel rises above or falls below another and higher predetermined value.



VIRGIL E. DUEMLER.


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