

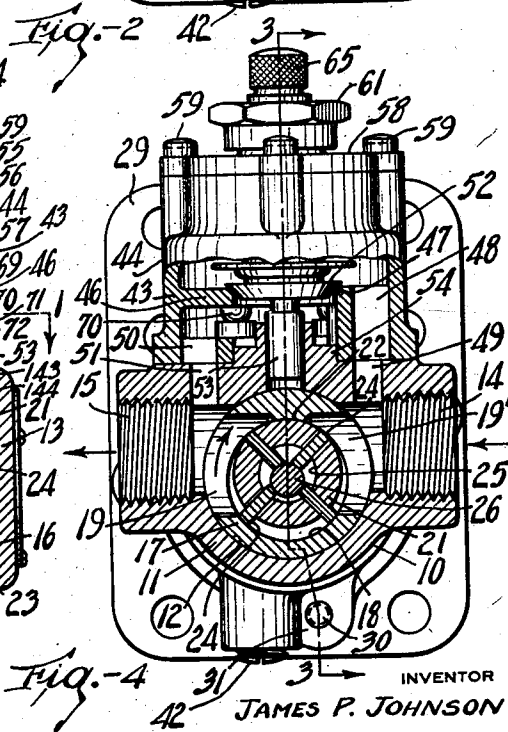
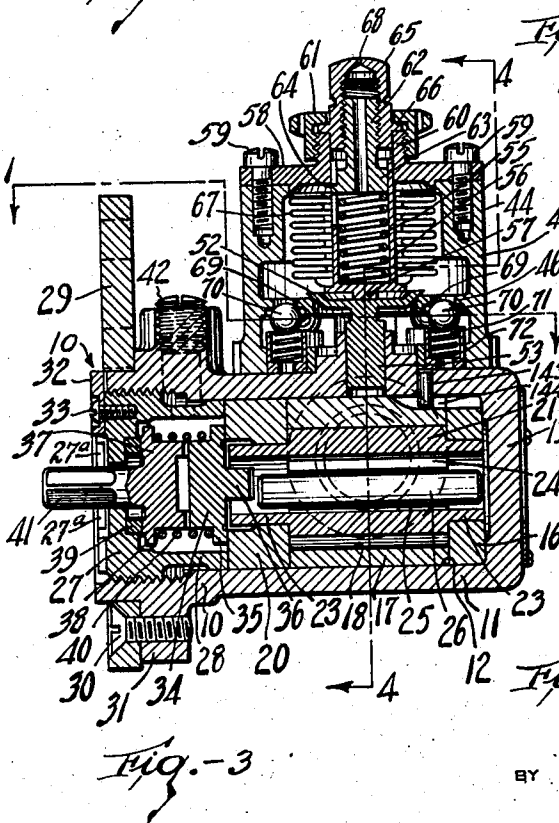
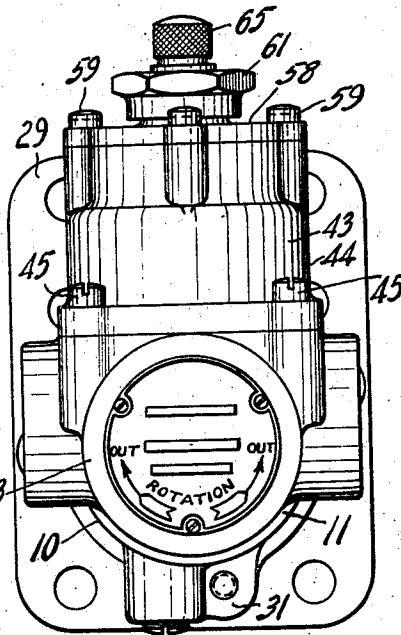
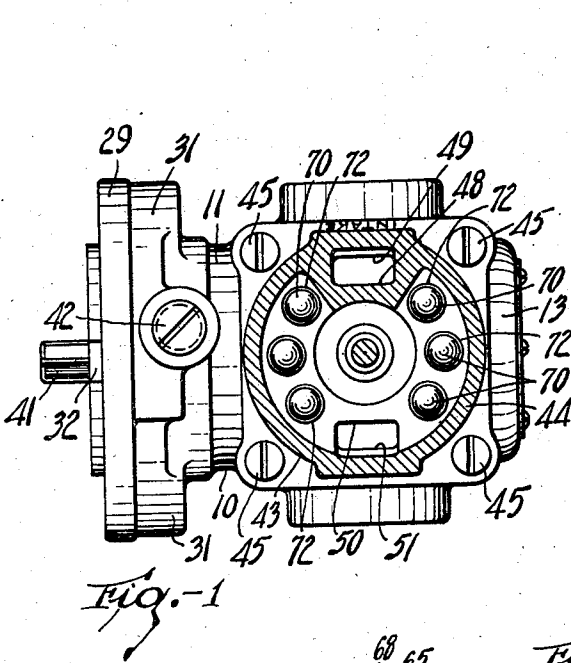
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FUEL PUMP

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FUEL PUMP

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This invention relates to rotary fuel pumps of the blade or vane type designed especially for use on aircraft, although its adaptability is not to be so restricted, and has for its primary object to provide an improved fuel pump which is simple and compact in construction, efficient and dependable in operation, and relatively inexpensive to manufacture.

A further object of the invention is to provide relief means for the excess of fuel delivered by the pump over the amount capable of being handled by the carburetor and adjustable so as to vary the pressure at which the fuel is discharged from the pump.

A still further object of the invention is to provide means by which the fuel may be bypassed from the inlet side to the outlet side of the pump and subsequently to the carburetor in the event the pump should become incapacitated.

It is well known that changes in flying conditions, such as different altitudes, banking, rising, diving, etc., result in pressure changes particularly with respect to the fuel supply which causes the fuel to be supplied to the pump at varying pressures. This condition is undesirable because the fuel delivered from the pump to the carburetor is likewise delivered at varying pressures whereas the most efficient operation demands that the fuel be delivered at a constant pressure. It is, therefore, a further object to provide a balancing means for the excess fuel relief means which is unaffected by changes in flying conditions so that the fuel is delivered constantly at the desired pressure.

Another object of the invention resides in providing a pump which may be operated in either direction without requiring any changes or adjustment in the operating parts and with the by-pass and relief valve arranged as a unit so as to require adjustment only by reversing the position thereof to correspond with the direction of rotation of the rotor of the pump.

With the objects above indicated and other objects hereinafter explained in view, the invention consists in the construction and combination of elements hereinafter described and claimed.

Referring to the drawing,
Figure 1 is a top view, partly in section, taken on line 1—1 in Figure 3 showing a fuel pump embodying the present invention;

Figure 2 is an end elevational view of the same;

Figure 3 is a longitudinal sectional view taken on line 3—3 in Figure 4;

Figure 4 is an end elevational view, partly in section, taken on line 4—4 in Figure 3.

In the drawing a fuel pump embodying the present invention is illustrated and for sake of clarity a brief explanation of its use in connection with aircraft will be set forth. In connecting the fuel pump for operation the outlet opening of the pump is connected with the inlet side of the carburetor for supplying fuel to the motor. The carburetor is designed to handle a varying volume of fuel at a definite pressure for the most efficient operation of the motor. It has been found that the pressure of the fuel should be maintained at approximately $3\frac{1}{2}$ pounds under all flying conditions and heretofore this has not been possible. The failure to deliver the fuel to the carburetor at a constant pressure has been due to the fact that the pressure of the fuel delivered to the pump from the storage tanks varies materially by reason of changes in altitude, banking, diving, rising and other causes. With the improved fuel pump this disadvantage is eliminated and not only is the fuel delivered at a constant pressure but this pressure may be varied at will to adapt the pump to different conditions.

The fuel pump is indicated generally by the numeral 10 and consists of a housing 11, preferably of aluminum or some other similar lightweight material, having an axial opening 12 therein extending inwardly from one end of the housing and which is closed by an integral end wall 13, more clearly shown in Figure 3. The housing is provided with an interiorly screw-threaded opening 14 on one side thereof which extends inwardly into communication with the axial bore 12 while the opposite side of the housing is provided with a similar interiorly screw-threaded opening 15 extending inwardly and likewise communicating with the bore 12, as more clearly shown in Figure 4. These openings 14 and 15 are adapted to be connected one with the fuel supply and the other with the carburetor which supplies the fuel to the motor, and the respective openings will be connected in the manner herein stated, depending upon the direction of operation of the fuel pump in a manner hereafter more specifically described.

A spacer member 16 is positioned within the axial bore 12 and abuts the end wall 13 of the housing and positioned ahead of the spacer member is a liner 17 preferably of hardened steel and which is provided with an axial bore 18

eccentric with the axis of the bore 12. This liner 17, as more clearly shown in Figure 4, has oppositely disposed, transversely extending openings 19' and 19 communicating respectively with the screw-threaded openings 14 and 15 so as to provide communication with the interior of the bore 18, the latter constituting a circular chamber. A second spacer member 20 is positioned within the bore 12 of the housing and abuts the adjacent end of the liner 17.

A rotor 21, preferably of hardened steel, is eccentrically positioned within the chamber 18 and has a running engagement with the inner peripheral wall of the chamber at 22 which separates the opening 19' from the opening 19. The body of the rotor extends between the spacer members 16 and 20, as shown in Figure 3, and is provided with axial extensions 23 formed integral upon the opposite ends thereof which are rotatably mounted in the spacer members 16 and 20.

The body portion of the rotor 21 is provided with angularly disposed slots extending longitudinally thereof and within which are slidably mounted a plurality of blades 24, the blades being coextensive with the space between the adjacent inner surfaces of the spacer members 16 and 20. The outer ends of the blades 24 are adapted for engagement with the inner peripheral wall of the chamber 18, while the inner ends of the blades extend inwardly within an axial bore 25 provided in the rotor and extensions 23. A roller member 26 is freely positioned within the bore 25 and is adapted for engagement with the inner ends of the blades 24 to maintain the latter in spaced relation.

The outer open end of the housing 11 is interiorly screw-threaded to receive an exteriorly screw-threaded plug 27 having a laterally extending flange 28 adapted to abut with the adjacent end of the spacer member 20 and to maintain the spacer members and liner 17 in assembled relation. An attaching plate 29 is mounted on the outer end of the housing and secured in place by a plurality of screws 30 which engage screw-threaded openings in a circumferential flange 31' formed integral with the outer surface of the housing 11, as more clearly shown in Figure 3. The outer end of the plug 27 is provided with angularly arranged slots 27a so that the plug 27 may be locked in any desired adjusted position and is maintained in locked condition by means of a plate 32 fitting within one of the slots 27a and an aligned slot in the adjacent end of the housing 11 being removably secured in place by means of a screw 33.

It is desirable to provide a flexible or yieldable coupling between the driving means and the rotor, and in the present instance this is accomplished by providing a driven member 34 mounted within the flange 28 of the plug 27 and having a laterally extending flange 35 which abuts the adjacent surface of the spacer member 20. This member is also provided with a transverse projection 36 which fits within transversely aligned recesses provided in the outer end of the extension 23, as more clearly shown in Figure 3.

A drive member 37 is in axial alignment with the driven member 34 and has a laterally extending flange 38, the outer portion of which abuts a ring 39 secured to the inner side of the plug 27. A coiled spring 40 surrounds the members 34 and 37 and has its opposite ends abutting the adjacent flanges 35 and 38 to maintain the members in spaced relation. The adjacent ends

of the members 34 and 37 have interengaging formations providing a positive driving connection and of such construction as to provide full floating of the driving member 37. An axial extension 41 is provided upon the outer side of the driving member 37 which projects through an opening in the plug 27 and which is adapted for connection with the motor or other driving means.

Screw-threaded openings are provided in the housing 11 which are normally closed by removable screw-threaded plugs 42 and provide means by which a suitable lubricant may be supplied to the movable parts of the pump. A pin 43 secured in the housing has its inner end disposed in a longitudinally extending slot 44 provided in the liner 17 to prevent relative angular movement with respect to the housing.

The operating parts of the pump are, of course, so arranged that the pump may be operated in either direction without the necessity of rearrangement, which is quite advantageous in view of the fact that different types of motors operate in different directions. It is not necessary, therefore, to change the position of the pump irrespective of the direction of rotation of the motor.

When the pump is used on an airplane the rotor is operated at various speeds, depending upon the R. P. M. of the motor, as the rotor is usually connected to the motor to operate at the same or slightly greater R. P. M. The volume of fuel pumped by the pump therefore varies with the changes in the R. P. M., and at 2000 R. P. M. approximately 350 gallons of fuel per hour is pumped by the pump. Such a volume of fuel is, of course, out of proportion to the volume of fuel adapted to be handled by the carburetor, and means must therefore be provided to return the excess fuel to the inlet side of the pump. Furthermore, for efficient operation of the motor, the fuel should be delivered at a constant pressure irrespective of the volume required and the pressure most effective has been found to be approximately 3½ pounds, although this may vary somewhat, depending upon different conditions. Means are, therefore, provided in the pump to maintain the volume of fuel discharged at a constant pressure and irrespective of flying conditions.

The preferred arrangement consists of a second housing 43 having a circular wall 44 and removably connected to the top of the first housing 11 by a plurality of bolts 45. The housing 43 has a transverse partition 46 adjacent its lower end provided with a transverse axial opening forming a valve seat 47 and a second transverse opening 48 in alignment with a transverse opening 49 provided in the housing 11 adjacent the fuel inlet opening 14 when the rotor operates in the direction of the arrow shown in Figure 4 to provide a fuel passageway in communication with the upper side of the valve seat 47. The lower end of the housing 43 has an opening 50 in alignment with an opening 51 provided in the housing 11 adjacent the fuel outlet opening 15 and provides a passageway for the fuel on the under side of the valve seat 47.

A valve member 52 is adapted to engage the valve seat 47 and has a depending extension 53 slidably mounted in an opening provided in the housing 11. The housing 11 may also have a flange 54 which extends into an opening in the housing 43 and centers one with respect to the other. The extension 53 of the valve member is

mounted so as to have a dash pot operation for a purpose to be later described. The valve member 52 therefore controls the flow of excess fuel from the outlet opening 15 to the inlet opening 14 permitting a recirculation of the fuel in excess of that capable of being handled by the carburetor.

The valve member 52 is yieldably resisted in its movement by a spring 55 of the desired size, which spring is disposed in a sleeve 56 closed at its lower end and provided with an extension 57 which loosely engages the adjacent end of the valve member 52 as clearly shown in Figure 3. The sleeve 56 is slidably mounted in an opening 15 provided in a cover plate 58 removably connected to the upper open end of the housing 43 by a plurality of bolts 59. The cover plate 58 has an axial hollow extension 60 exteriorly screw-threaded to receive a locking nut 61.

A member 62 which is exteriorly screw-threaded at its upper end has an enlarged portion 63 slidably mounted in the upper end of the sleeve 56 and engageable with the upper end of the spring 55. The sleeve 56 is longitudinally slotted at its upper portion to receive a projection 64 formed on the lower end of the enlarged portion 63 to prevent relative angular movement therebetween. A manually operated member 65 has an axial interiorly screw-threaded opening which cooperates with the screw-threaded portion of the member 62 and by turning the same in one direction or the other about the axis the pressure of the spring 55 may be varied. A circumferential flange 66 is formed on the member 65 and is adapted to be secured between the nut 61 and the end of the extension 60 so as to clamp the member in the desired adjusted position. With this arrangement a very fine adjustment of the spring is made possible as there is no tendency for the spring to wind or unwind while it is being compressed or released. Thus by adjusting the member 65 any desired compression may be obtained in the spring 55, thereby exerting the proper pressure on the valve member 52, say $3\frac{1}{2}$ pounds, or the pressure at which fuel is delivered to the carburetor.

To assure that the fuel will be delivered at the pressure at which the valve 52 is set irrespective of flying conditions which tend to produce varying pressures at the inlet opening 14, a balancing means is provided which consists in the present instance of an expansible and contractible bellows 67 encircling the sleeve 56 and having its lower end sealed to the lower end of the sleeve. The upper end of the bellows 67 is secured to the cover plate 58 and the effective outside area of the bellows is equivalent to the effective area of the upper surface of valve 52 subject to the suction of the pump created at the inlet opening 14. The inside of the bellows 67 is in communication with the atmosphere by means of an opening in the member 62 and a small hole 68, approximately #80 drill, provided in the member 65, this hole being so small as to prevent any great loss of vacuum, in the event the bellows should break, but which would not prevent proper operation of the pump. The dash pot mounting of the valve member 52 also tends to prevent impulses from the four-blade driven rotor from oscillating the bellows which might otherwise cause fatigue.

In the event the pumping means should become inoperative for any reason, a fuel by-pass is provided by which fuel may be supplied to the carburetor. In the present instance, the transverse partition 46 is provided with a plurality of

transverse openings 69, six of which are shown although not restricted thereto, angularly spaced as shown in Figure 1. A plurality of ball valves 70 engage the under side of the openings 69 and normally close the latter to prevent the passage of fuel therethrough. Springs 71 are housed in sleeves 72 secured to the housing 43 and have one end engaging the ball valves to yieldingly hold them in closed position. The inlet opening 14 may be connected with a hand pump on the instrument board and by operating the latter fuel will be forced into the inlet opening 14 and will pass upwardly through the openings 49 and 48 to the upper side of the partition 46. The pressure of the fuel will unseat the ball valves 70 and permit the fuel to pass through into the openings 50 and 51 to the outlet opening 15 and ultimately to the carburetor.

It should also be noted that all of the control mechanism is mounted in the housing 43 and that the latter as a unit may be reversed from the position shown in Figure 3 if the pump is to be operated in a direction opposite to that indicated by the arrow. The housing 43 is suitably marked "intake" on one end so that that end will be positioned adjacent the fuel inlet opening of the pump. The end of the pump housing 11 may also be marked as shown in Figure 2 to indicate the "outlet" depending upon the direction of rotation of rotor as indicated by the "arrows."

In the operation of the pump with the parts in the relation shown in the drawing, the rotor creates a suction or vacuum at the inlet opening 14 drawing the fuel from the tanks and forcing it through the outlet opening 15 to the carburetor at a definite pressure, the valve member 52 having been first set for that pressure. The carburetor, of course, can only handle a relatively small volume of fuel compared with that handled by the pump and the excess of fuel therefore passes upwardly through the openings 51 and 50 and unseats the valve member 52 passing downwardly through the openings 48 and 49 to the inlet opening 14 also aided by the suction at this point.

Due to the fact that the bellows 67 is subjected to the vacuum or suction at the inlet opening produced by the rotor and being in communication with the atmosphere upon the opposite side, the pressure on the valve member 52 always remains constant and positively unchanged so that varying pressures in the fuel line to the inlet opening have no effect upon the pressure exerted on the valve member 52.

While I have described the preferred embodiment of the invention, it should be understood that I am not to be limited thereto inasmuch as changes and modifications may be resorted to without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A fuel pump comprising a housing provided with fuel inlet and outlet openings, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, said housing having an excess fuel return passageway communicating with said inlet and outlet openings, a movable valve member mounted in said housing and operatively associated with said fuel return passageway for controlling the flow of excess fuel therethrough, a sleeve mounted in said housing and having its inner end closed and freely engageable with said valve member, a bellows surrounding said sleeve and having its lower end in sealing engagement therewith, the

upper end of said bellows being connected to said housing, a coiled spring disposed within said sleeve and having one end engaging the closed end of said sleeve, an axially movable member disposed in said sleeve and having its inner end engageable with the other end of said spring and its outer end exteriorly screw-threaded, said member having an opening extending longitudinally therethrough in communication at one end with the interior of said bellows, cooperating means on said sleeve and axially movable member to prevent independent relative movement about the axis thereof but permitting free relative movement axially, an internally screw-threaded cap mounted on the end of said axially movable member for moving the same to vary the tension of said spring and having a lateral extension engageable with said housing, said cap having an opening extending therethrough in communication with the opening in said axially movable member, and a clamping nut removably mounted on said housing and having a portion engageable with said lateral extension to secure the latter in adjusted position.

2. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings on opposite sides thereof, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a projection on the outside of said housing located between said inlet and outlet openings and having an axial opening therein, a tubular shaped housing detachably connected to the outside of said housing proper concentrically with respect to said projection, a transversely extending partition formed integral with said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition concentric with respect to the opening in said projection, a valve member having a portion engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within the opening in said projection, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening said valve member being adapted to control the flow of fuel thereby, a cap detachably connected to the outer end of said tubular housing, a coiled spring disposed within said tubular housing and having one end engageable with said valve member for normally urging the latter into engagement with said valve seat, and an axially movable member having its inner end engageable with the outer end of said spring and adjustably connected to said cap for varying the tension in said spring.

3. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings on opposite sides thereof, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a projection on the outside of said housing located between said inlet and outlet openings and having an axial opening therein, a tubular shaped

housing detachably connected to the outside of said housing proper concentrically with respect to said projection, a transversely extending partition formed integral with said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition concentric with respect to the opening in said projection, a valve member having a portion engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within the opening in said projection, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening, said valve member being adapted to control the flow of fuel thereby, a cap detachably connected to the outer end of said tubular housing, a sleeve mounted in said tubular housing and having its inner end closed and engageable with said valve member, a coiled spring disposed within said sleeve and having one end engaging the closed end thereof for normally urging the latter into engagement with said valve member, and an axially movable member having its inner end engageable with the outer end of said spring and adjustably connected to said cap for varying the tension in said spring.

4. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings on opposite sides thereof, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a projection on the outside of said housing located between said inlet and outlet openings and having an axial opening therein, a tubular shaped housing detachably connected to the outside of said housing proper concentrically with respect to said projection, a transversely extending partition formed integral with said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition concentric with respect to the opening in said projection, a valve member having a portion engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within the opening in said projection, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening, said valve member being adapted to control the flow of fuel thereby, a cap detachably connected to the outer end of said tubular housing, a sleeve mounted in said tubular housing and having its inner end closed and engageable with said valve member, a bellows surrounding said sleeve and having its lower end in sealing engagement therewith, the upper end of said bellows being connected between said cap and the adjacent end of said tubular housing, a coiled spring disposed within said sleeve and having one end engaging the closed end thereof for normally urging the latter into engagement with said valve member, and an axially movable member having its inner end engageable with the outer end of

said spring and adjustably connected to said cap for varying the tension in said spring.

5. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings on opposite sides thereof, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a projection on the outside of said housing located between said inlet and outlet openings and having an axial opening therein, a tubular shaped housing detachably connected to the outside of said housing proper concentrically with respect to said projection, a transversely extending partition formed integral with said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition concentric with respect to the opening in said projection, a valve member having a portion engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within the opening in said projection, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening, said valve member being adapted to control the flow of fuel thereby, a cap detachably connected to the outer end of said tubular housing, a sleeve mounted in said tubular housing and having its inner end closed and engageable with said valve member, a bellows surrounding said sleeve and having its lower end in sealing engagement therewith, the upper end of said bellows being connected between said cap and the adjacent end of said tubular housing, a coiled spring disposed within said sleeve and having one end engaging the closed end thereof for normally urging the latter into engagement with said valve member, an axially movable member having its inner end engageable with the outer end of said spring and adjustably connected to said cap for varying the tension in said spring, said partition having a plurality of openings on diametrically opposite sides of said valve member providing valve seats upon the under side of said partition, individual ball valve members adapted for cooperating engagement with said valve seats, coiled springs having one end engaging said ball valve members for normally urging the latter against said valve seats, and sleeves to receive said coiled springs and having portions against which the opposite ends of said springs abut, said sleeves being secured in said tubular housing, said ball valve members permitting the flow of fuel from the inlet opening to said outlet opening independently of said pumping means.

6. A rotary fuel pump for use on aircraft comprising a housing proper provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pumping means in said housing proper for delivering fuel from said inlet opening to said outlet opening and adapted for rotation in either direction, said pumping means having a portion projecting outwardly beyond said housing proper by which said pumping means is adapted to be driven, a second hollow housing extending laterally of said housing proper and detachably connected to the latter, cooperating means on

said housings for definitely positioning one with respect to the other, said second housing being provided with a partition extending transversely thereof, said partition having an axial opening therethrough providing a valve seat on its outer side, a movable valve member having a valve head engageable with said valve seat and an axial projection piloted in an opening provided in said housing proper and adapted to control the flow of excess fuel from said fuel outlet opening to said fuel inlet opening, the opposite sides of said valve head being in communication with said fuel inlet and outlet openings respectively through openings provided in said housing proper adjacent the respective fuel inlet and outlet openings, resilient means mounted in said second housing and engageable with said valve head for normally maintaining the latter in engagement with its valve seat, said partition being further provided with openings extending transversely therethrough providing valve seats on the under side of said partition and adapted to by-pass fuel from said inlet opening to said outlet opening through the openings provided in said housing proper adjacent the respective fuel inlet and outlet openings independently of said pumping means, and valve members resiliently mounted in said second housing and normally engageable with said valve seats, said second hollow housing being removable as a unit and having two positions of mounting on said housing proper, depending upon the direction of rotation of said pumping means, the inner side of said valve head always being in communication with the fuel outlet opening through one or the other of said openings provided in said housing proper adjacent the respective fuel inlet and outlet openings.

7. A rotary fuel pump for use on aircraft comprising a housing proper provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pumping means in said housing proper for delivering fuel from said inlet opening to said outlet opening and adapted for rotation in either direction, said pumping means having a portion projecting outwardly beyond said housing proper by which said pumping means is adapted to be driven, a second hollow housing extending laterally of said housing proper and detachably connected to the latter, cooperating means on said housings for definitely positioning one with respect to the other, said second housing being provided with a partition extending transversely thereof, said partition having an axial opening therethrough providing a valve seat on its outer side, a movable valve member having a valve head engageable with said valve seat and an axial projection piloted in an opening provided in said housing proper and adapted to control the flow of excess fuel from said fuel outlet opening to said fuel inlet opening, the opposite sides of said valve head being in communication with said fuel inlet and outlet openings respectively through openings provided in said housing proper adjacent the respective fuel inlet and outlet openings, resilient means mounted in said second housing and engageable with said valve head for normally maintaining the latter in engagement with its valve seat, said partition being further provided with openings extending transversely therethrough providing valve seats on the under side of said partition and adapted to by-pass fuel from said inlet opening to said outlet opening through the openings provided in said housing proper adjacent the respective fuel inlet and outlet openings

independently of said pumping means, individual ball valve members normally engageable with the valve seats on the under side of said partition, and coiled springs having one end engaging said ball valve members and their opposite ends secured in said second housing, said second hollow housing being removable as a unit and having two positions of mounting on said housing proper, depending upon the direction of rotation of said pumping means, the inner side of said valve head always being in communication with the fuel outlet opening through one or the other of said openings provided in said housing proper adjacent the respective fuel inlet and outlet openings.

8. A rotary fuel pump for use on aircraft comprising a housing proper provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pumping means in said housing proper for delivering the fuel from said inlet opening to said outlet opening and adapted for rotation in either direction, said pumping means having a portion projecting outwardly beyond the housing proper by which said pumping means is adapted to be driven, a second hollow housing extending laterally of said housing proper and detachably connected to the latter, cooperating means on said housings for definitely positioning one with respect to the other, said second housing being provided with a partition extending transversely thereof, said partition having an axial opening therethrough providing a valve seat on its outer side, a movable valve member having a valve head engageable with said valve seat and an axial projection piloted in an opening provided in said housing proper, the end of said projection being spaced from the bottom of said opening to provide a dash pot, and adapted to control the flow of excess fuel from said outlet opening to said inlet opening, the opposite sides of said valve head being in communication with said fuel inlet and outlet openings respectively through openings provided in said housing proper adjacent the respective fuel inlet and outlet openings, resilient means mounted in said second housing and having one end freely engageable with the adjacent side of said valve head for normally maintaining the latter in engagement with its valve seat, means operatively connected with said resilient means and adjustably mounted in said second housing for varying the pressure exerted upon said valve head, and an expansible and contractible siphon disposed concentrically with respect to said resilient means and having its inner end in sealing engagement with the latter, the outer end being open and having its marginal edge connected to said second housing, the interior of said siphon being vented to atmosphere by means of a small opening substantially ineffective to cause loss of vacuum in the event said siphon should become broken and effective to balance said resilient means, said second hollow housing being removable as a unit and having two positions of mounting on said housing proper, depending upon the direction of operation of said pumping means, the inner side of said valve head always being in communication with the fuel outlet opening through one or the other of the openings provided in said housing proper adjacent the respective fuel inlet and outlet openings.

9. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening,

pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a tubular shaped housing detachably connected to the outside of said housing proper, a transversely extending partition within said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition, a valve member having a valve head engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within an opening provided in the adjacent portion of said housing proper, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening, said valve member being adapted to control the flow of fuel thereby, means engageable with said valve member and adjustably connected to said tubular housing for yieldable urging said valve member into engagement with its valve seat, said partition having a plurality of openings on diametrically opposite sides of said valve member and providing valve seats upon the under side of said partition, individual ball valve members adapted for cooperating engagement with said valve seats, coiled springs having one of their ends secured to said tubular housing and their other ends engaging said ball valve members for normally urging the latter against said valve seats, said ball valve members permitting the flow of fuel from the inlet opening to the outlet opening independently of said pumping means.

10. A fuel pump comprising a housing proper provided with fuel inlet and outlet openings, said housing being further provided with a transverse opening adjacent the inlet opening and a similar transverse opening adjacent the outlet opening, pumping means in said housing for delivering the fuel from said inlet opening to said outlet opening, a tubular shaped housing detachably connected to the outside of said housing proper, a transversely extending partition within said tubular shaped housing and having an axial opening therethrough to provide a valve seat on the outer side of said partition, a valve member having a valve head engageable with the valve seat and an axial extension projecting through the opening in said partition and slidably disposed within an opening provided in the adjacent portion of said housing proper, the end of said extension terminating short of the bottom of said opening to provide a dash pot, the under side of said valve being in communication with the transverse opening in said housing proper adjacent the outlet opening and the top side being in communication with the transverse opening adjacent the inlet opening, said valve member being adapted to control the flow of fuel thereby, a cap detachably connected to the outer end of said tubular housing, a sleeve mounted in said tubular housing and having its inner end closed and engageable with said valve member, a bellows surrounding said sleeve and having its lower end in sealing engagement therewith, the upper end of said bellows being connected between said cap and the adjacent end of said tubular housing, a coiled spring disposed within said sleeve and having one end engaging the closed end thereof for normally urging the latter into engagement with said valve member,

and an axially movable member having its inner end in engagement with the outer end of said spring and adjustably connected to said cap for varying the tension in said spring.

11. A rotary fuel pump for use on aircraft comprising a housing provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pump means in said housing for delivering fuel from said inlet opening to said outlet opening, said housing having an excess fuel return passageway connecting said outlet opening with said inlet opening, a movable valve member mounted in said housing and operatively associated with said fuel return passageway for controlling the flow of fuel therethrough, said valve member having a valve stem slidably disposed within an opening provided in the adjacent portion of said housing to provide a dash pot for minimizing vibrations imparted to said valve member, a bellows having a closed end freely engageable with said valve member and its opposite end open and secured to said housing in sealing relation, resilient means having one end in engagement with the closed end of said bellows and extending outwardly therefrom, said means being adapted to maintain a constant pressure on said valve member, and means adjustably mounted on said housing and having one end operatively connected to the outer end of said resilient means whereby the resiliency of the latter may be varied, the inside of said bellows being vented to atmosphere so that said valve member is always in balanced condition therefore unaffected by changes in atmospheric pressure under flying conditions.

12. A rotary fuel pump for use on aircraft comprising a housing proper provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pumping means in said housing proper for delivering fuel from said inlet opening to said outlet opening and adapted for rotation in either direction, a second hollow housing extending laterally of said housing proper and detachably connected to the latter, cooperating means on said housings for definitely positioning one with respect to the other, said second housing being provided with a partition extending transversely thereof, said partition having an axial opening therethrough providing a single valve seat on its outer side, a movable valve member having a valve head provided with a single valve seat engaging surface and an axial projection piloted in an opening provided in said housing proper, said valve member being adapted to control the flow of excess fuel from said outlet opening to said inlet opening, the opposite sides of said valve head being in communication with said fuel inlet and outlet openings respectively through openings provided in said housing proper adjacent the respective fuel inlet and outlet openings, means for balancing the inlet suction effect on said valve irrespective of the values thereof due to the varying speed of said pump, said means comprising a bellows mounted in said second housing and having its inner end closed and having limited engagement with the adjacent side of said valve head about the central portion thereof only, the inside of said bellows being open to atmosphere, said bellows being sealably connected about the periphery to the adjacent housing, said valve having an effective suction area whereby the inlet suction tends to open the same with a predetermined force for a given pump speed, said bellows being constructed with an effective suc-

tion area such that the inlet suction acting thereon produces a force tending to hold said valve closed, which force is equal to said predetermined force, whereby to balance said suction opening effect acting on said valve, said relationship prevailing over a wide range of inlet suction, resilient means mounted in said second housing and having a portion engageable with the closed end of said bellows to normally maintain the latter in engagement with said valve member, and means adjustably mounted in said second housing and operatively connected to said resilient means whereby the resiliency of the latter may be varied.

13. A rotary pump for use on aircraft comprising a housing proper provided with fuel inlet and outlet openings adapted for connection with the fuel tank and carburetor respectively, rotary pumping means in said housing proper for delivering fuel from said inlet opening to said outlet opening and adapted for rotation in either direction, a second hollow housing extending laterally of said housing proper and detachably connected to the latter, said second housing being provided with a valve seat, a movable valve member having a valve head engageable with said valve seat and adapted to control the flow of excess fuel from said fuel outlet opening to said fuel inlet opening, the opposite sides of said valve head being in communication with said fuel inlet and outlet openings respectively, a sleeve mounted in said second housing and having its inner end closed and engageable with the adjacent side of said valve head, a bellows surrounding said sleeve and having its lower end in sealing engagement therewith, the upper end of said bellows being connected to said second housing and the inside open to atmosphere, resilient means mounted in said sleeve and having a portion engageable with the closed end thereof to normally maintain said valve head in engagement with said valve seat, and means adjustably mounted in said second housing and operatively connected to said resilient means whereby the resiliency of the latter may be varied, said second housing being removable as a unit and having two positions of mounting on said housing proper depending upon the direction of rotation of said pumping means.

14. In an aircraft fuel pump and relief valve assembly effective to deliver a constant outlet pressure irrespective of the varying speed of the pump, said assembly comprising a housing having fuel inlet and outlet openings, means in said housing for pumping fuel from said inlet to said outlet, means defining a relief passage leading from said outlet to said inlet, a valve seat positioned in said passage facing generally away from said outlet, a valve arranged to be received on said seat for controlling the flow of fluid through said relief passage, the underside of said valve being in communication with said outlet and the opposite side of said valve being in communication with said inlet, said arrangement being particularly characterized by the provision of means for balancing said inlet suction effect on said valve irrespective of the varying values thereof due to the varying speed of said pump, said means comprising a flexible sealing means, means connecting said flexible sealing means about the periphery thereof to the adjacent housing, said sealing means including means at the axial portion thereof for urging said valve to closed position, said flexible sealing means being in communication on the side thereof adjacent said valve with said inlet, resilient means acting on said urging means in valve closing direction with

a predetermined force, the effective suction area of said sealing means responsive to inlet suction tending to close the valve being made equal to the effective suction area of said valve tending to open the same, whereby widely varying inlet suction do not affect the operation of said valve.

15 In a fuel pump adapted for aircraft and including a housing having fuel inlet and fuel outlet openings, means in said housing for pumping fuel from said inlet to said outlet, a passage in said housing leading around said pumping means therein from the outlet to the inlet of said pump, a valve seat in said passage facing generally away from said pump outlet, a valve arranged to be received on said seat for controlling the flow of fuel through said passage, said valve being in communication on the underside thereof with said outlet and on the other side thereof with said inlet, sealing means for rendering said valve unresponsive to the effects of suction at said pump inlet in communication therewith, said means comprising a flexible seal-

ing member, means attaching said member at its periphery to the surrounding housing, means at the axial portion of said flexible sealing member effective to cause the movement of said valve in the closing direction, said sealing member being in communication on the other side thereof with said inlet resilient means acting through said means at said axial portion of said sealing member for urging said valve toward closed position with a predetermined force, the effective suction area of said sealing means being made equal to the effective suction area of said valve whereby the inlet suction effect on said sealing means tending to close said valve balances the inlet suction effect on said valve tending to open the same, said arrangement being further particularly characterized by the provision of a second valve means communicating said pump inlet with said pump outlet around said pumping element and adapted to respond to an emergency pressure supply introduced into said pump inlet.

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