Aug. 27, 1963 E. R. SCHNEIDER 3,102,152

FUEL-HANDLING DEVICES

Filed Nov. 1, 1961 2 Sheets-Sheet 1

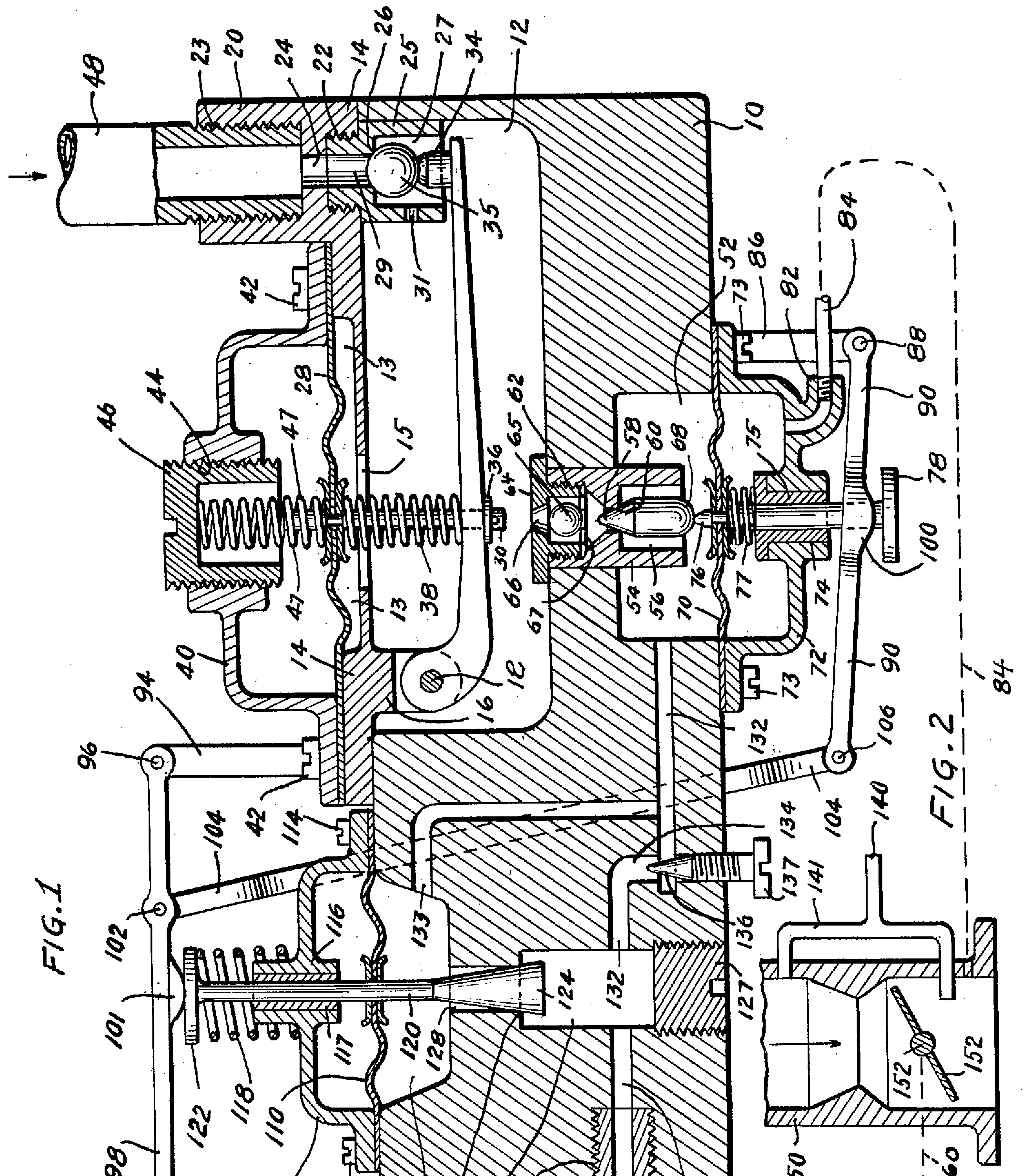

FIG. 1

FIG. 2

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Filed Nov. 1, 1961 2 Sheets-Sheet 2

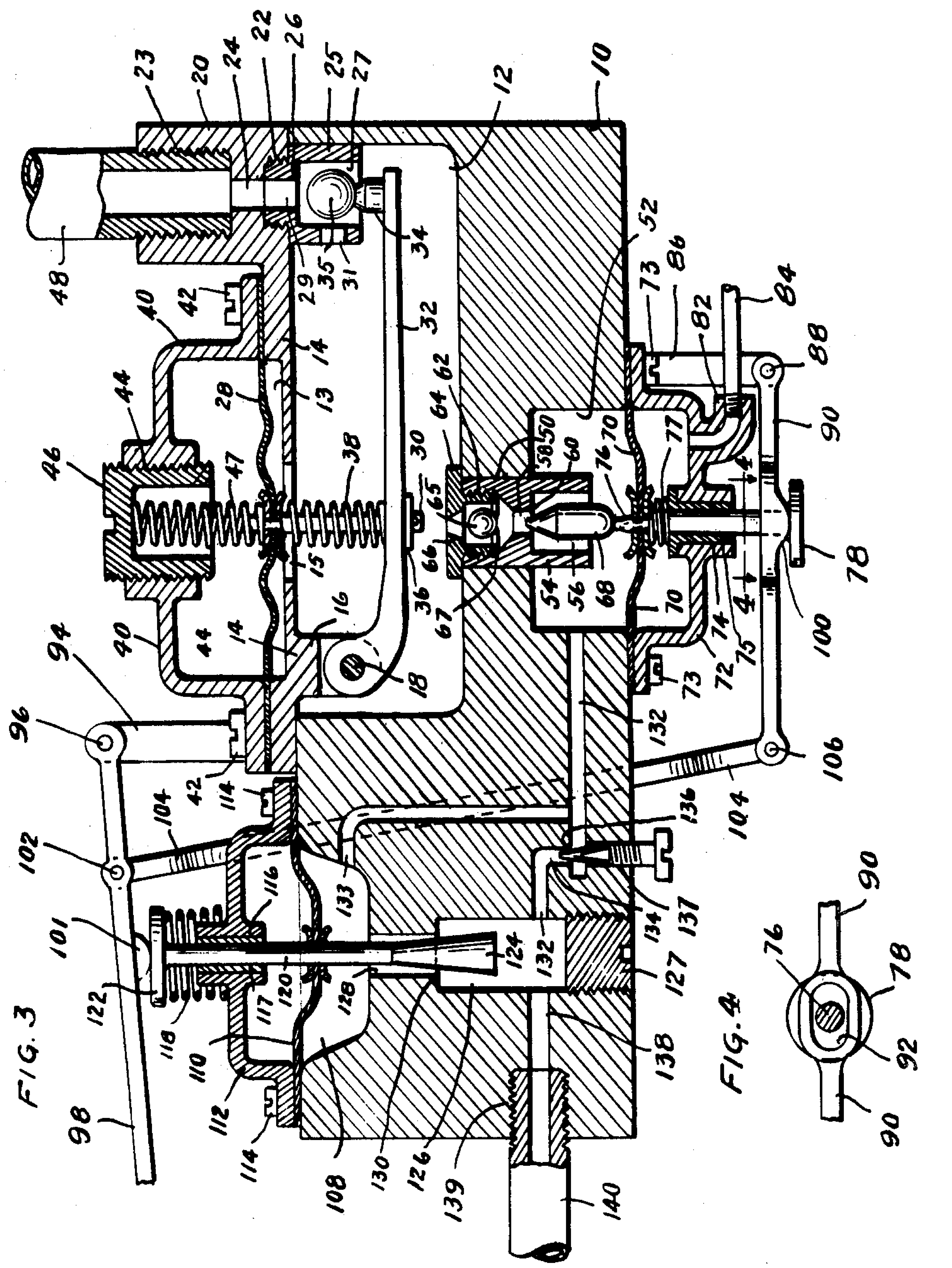

FIG. 3

FIG. 4

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FUEL-HANDLING DEVICES

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This invention relates to improvements in fuel-handling devices. More particularly, this invention relates to improvements in devices that inject fuel into the air stream of an engine.

It is therefore an object of the present invention to provide an improved device that injects fuel into the air stream of an engine.

This invention is a continuation-in-part of the invention disclosed and claimed in my co-pending patent application Serial No. 1,258 for Fuel-Handling Devices which was filed January 8,, 1960, now abandoned.

It is desirable to use a positive pressure to introduce fuel into the air stream of an engine rather than to rely upon the ability of that air stream to aspirate the fuel from jets mounted in that air stream. In recognition of that fact, a number of devices have been proposed which would introduce fuel into the air stream of an engine under a positive pressure. However, several of those devices tended to "flood" the engine during the starting of the engine. Any such "flooding" is objectionable, and it is avoided by the fuel-handling device provided by the present invention. It is therefore an object of the present invention to provide a device that introduces fuel into the air stream of an engine by means of a positive pressure and yet avoids "flooding" of that engine.

It is important that a device which introduces fuel into the air stream of an engine be capable of providing an accelerator pump action. Such action is needed to assure the supplying of sufficient fuel to the engine to enable that engine to apply the power needed to accelerate or to overcome increased loads. For example, an accelerator pump action is needed when the engine is to be speeded up or is to be subjected to a heavy additional load. The present invention provides a fuel-handling device that has an accelerator pump action; and it is therefore an object of the present invention to provide a device that can introduce fuel into the air stream of an engine by means of a positive pressure and that provides an accelerator pump action.

It is important that a device which introduces fuel into the air stream of an engine have a metering system to regulate the fuel when the engine is idling, and that it also have a second metering system to regulate the fuel when the engine is running. Furthermore, it is important that the two metering systems be capable of individual adjustment. The present invention provides a device that can introduce fuel into the air stream of an engine by means of a positive pressure, and that has individually different and individually adjustable idling and running systems.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description, a preferred embodiment of the present invention is shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing,

FIG. 1 is a longitudinal section through a fuel-handling device that is made in accordance with the principles and teachings of the present invention, and it shows the components of that device in their normal, at-rest positions,

FIG. 2 is a vertical section through the venturi ring of an engine,

FIG. 3 is another longitudinal section through the device of FIG. 1, and it shows the components of that device in their running positions, and

FIG. 4 is a sectional view through the device of FIGS. 1 and 3, and it is taken along the plane indicated by the line 4—4 in FIG. 3.

Referring to the drawing in detail, the numeral **10** generally denotes the housing for a fuel-handling device that is made in accordance with the principles and teachings of the present invention. That housing is generally prismatic in elevation and in plan. An elongated recess **12** is provided in the upper part of that housing adjacent the right-hand end of that housing, and that recess opens to the upper face of that housing. A cylindrical bore **50** is provided in the lower part of the housing **10**, and that bore communicates with the recess **12**.

A bracket plate **14** rests upon the upper face of the housing **10**, and that bracket plate overlies the recess **12**. That bracket plate has a generally circular recess **13** in the upper face thereof, and an opening **15** extends downwardly through that bracket plate from that recess. The opening **15** communicates with the recess **12** in the housing **10**. Where the housing **10** is narrow, the sides of the bracket plate **14** may project beyond the sides of that housing. The bracket plate **14** has an upwardly-projecting cylindrical boss **20** adjacent the right-hand end thereof. That boss has a threaded recess **22** on the bottom thereof, has a threaded recess **23** in the top thereof, and has a passage **24** connecting those recesses. The diameter of the passage **24** is smaller than the diameter of either of the recesses **22** and **23**. The bracket plate **14** has a downwardly-depending pivot stud **16** adjacent the left-hand end thereof, and that pivot stud extends into the recess **12**. A horizontally-directed pivot **18** is supported by the pivot stud **16** adjacent the lower end of that stud.

A cylinder **25** has a threaded upper end and has a recess **27** in the bottom thereof. A passage **29** is provided at the center of the cylinder **25**, and that passage coacts with the recess **27** to form a seat **26**. Ports **31** are provided in the side walls of the cylinder **25**, and those ports extend radially outwardly from the recess **27**. The threaded upper end of the cylinder **25** fits into the recess **22** in the bracket plate **14**; and when that threaded upper end is within that recess, the passage **29** is aligned with the passage **24**.

A flexible diaphragm **28** of circular configuration overlies the portions of the bracket plate **14** which define the recess **13**. Consequently, that diaphragm constitutes a flexible closure for that recess. A vertically-directed rod **30** is secured to the diaphragm **28** by having the upper end thereof reduced in diameter, extended upwardly through a cup-shaped washer and through a central opening in the diaphragm **28** and through an upper cup-shaped washer, and then riveted over. The lower end of the rod **30** extends downwardly into the recess **12** in housing **10** and extends downwardly through an opening, not shown, in an elongated lever **32** which is rotatably mounted on the pivot **18**. A shallow groove is provided in the rod **30** adjacent the bottom thereof, and that groove accommodates a hairpin-like fastener **36**; and that fastener underlies the lever **32**. An upwardly extending abutment **34** is provided on the right-hand end of the lever **32**, and that abutment is in register with, and can extend part way into, the recess **27** of the cylinder **25**. That abutment holds a ball **35** in the recess **27**, and it can move upwardly to move that ball into engagement with the seat **26** to prevent the flow of fuel through the passages 24 and 29 into the recess 27.

A helical compression spring 38 is telescoped around the rod 30; and its upper end bears against the cup-shaped washer that abuts the lower face of the diaphragm 28. The lower end of the spring 38 bears against the upper face of the lever 32 and urges that lever against the fastener 36. The spring 38 and the fastener 36 permit ready rotation of the lever 32 relative to the rod 30 while avoiding lost motion between that rod and that lever.

A generally cup-shaped bracket 40 is mounted above the diaphragm 28, and that bracket preferably is circular in configuration. The bracket 40 has a horizontally-directed flange that overlies and engages the outer portions of the diaphragm 28. Fasteners 42 extend downwardly through the flange of the bracket 40 and through the outer portions of the diaphragm 28, and then seat in threaded openings in the bracket plate 14. Those fasteners fixedly secure the diaphragm 28 between the bracket plate 14 and the bracket 40 and provide an air-tight engagement between the diaphragm 28 and the bracket plate 14 and between that bracket plate and the housing 10. The cup-shaped bracket 40 has a threaded passage 44 adjacent the center thereof, and that passage accommodates a threaded plug 46. That plug has a recess in the under side thereof which accommodates the upper end of a helical compression spring 47. The lower end of that spring bears against the cup-shaped washer at the upper face of the diaphragm 28. A slot will preferably be provided in the upper end of the plug 46 to accommodate a screw driver; and that screw driver can be used to rotate the plug 46 relative to the bracket 40 and thereby adjust the force which the spring 47 will apply to the diaphragm 28.

A tube 48 has a threaded lower end, and that lower end extends into the threaded recess 23 of the cylindrical boss 20 on the bracket plate 14. The other end of the tube 48 will be connected to the outlet of the fuel pump of the engine.

The recess 12, the bracket plate 14, the diaphragm 28, the lever 32, the ball 35, the bracket 40, and the springs 38 and 47 are comparable to corresponding parts in my Letters Patent No. 2,774,374 for Pulsation Smoothing Valve. Those parts regulate the pressure on the fuel within the recess 12, and thereby contribute to the operation of the fuel-handling device provided by the present invention, but they are not per se a part of that invention.

The lower end of the cylindrical bore 50 is contiguous with a large recess 52, and that recess opens to the bottom face of the housing 10. The recess 52 will preferably be cylindrical in configuration. A cylindrical insert 54 is dimensioned to fit within the bore 50 with a press fit; and that insert has a recess 56 extending upwardly from the bottom thereof. A reduced diameter passage 58 extends upwardly from the upper end of the recess 56, and that passage and that recess coact to define a seat 60. The passage 58 opens into a threaded recess 62 which is larger in diameter than is the passage 58; the diameter of the recess 62 generally approximating the diameter of the recess 56 in the lower portion of the cylindrical insert 54. A retainer 67, as for example a rim with a number of inwardly-directed fingers, is set in the recess 62; and that retainer underlies and supports a ball 65. The threaded recess 62 also accommodates a threaded cage 64, and that cage has a frusto-conical seat 66 adjacent the top thereof. That seat 66 can be engaged by the ball 65 to prevent movement of fuel upwardly through the passage 58. The ball 65 will normally rest upon the retainer 67 and be below, and out of engagement with, the seat 66; but that ball can respond to any upward movement of fuel through the passage 58 to engage the seat 66 and thereby prevent any further such movement.

The numeral 68 denotes a valve element which has a frusto-conical upper end. That upper end can engage the seat 60 and keep fuel from passing downwardly through the passage 58, or that upper end can move downwardly away from that seat to permit fuel to pass downwardly through the passage 58 and enter the recess 52. The lower end of the valve element 68 rests upon the upper end of a rod 76, and that rod extends upwardly through a flexible diaphragm 70. The upper end of the rod 76 has a reduced diameter portion; and that reduced diameter portion extends upwardly through a cup-shaped washer and through the diaphragm 70 and through an upper cup-shaped washer and is then staked or otherwise secured to that upper washer. The reduced diameter portion of the rod 76 projects a short distance above the top of the upper cup-shaped washed. The outer portions of the diaphragm 70 underlie those portions of the housing 10 which define the recess 52.

A cup-like bracket 72, that is preferably circular in plan, is provided with a horizontally directed flange; and that flange underlies the outer portions of the diaphragm 70. Fasteners 73 extend upwardly through the flange of the bracket 72, extend upwardly through openings in the outer portions of the diaphragm 70, and seat in threaded openings in the housing 10. Those fasteners fixedly secure the bracket 72 to the housing 10; and those fasteners enable that bracket to hold the diaphragm 70 in sealing engagement with the housing 10, and those fasteners also hold the flange of that bracket in sealing engagement with the outer portions of the diaphragm 70.

The bracket 72 has a vertically-directed passage 74 through it, and a bushing 75 is located within the passage 74. The rod 76 extends through and is guided by the bushing 75, and that rod is freely movable relative to that bushing. A flange or plate 78 is provided at the bottom of the rod 76, and that flange or plate is disposed a short distance below the bottom of the passage 74 in the bracket 72. An L-shaped outlet fitting 82 is provided on the bracket 72, and that outlet fitting has a passage through it which communicates with the space defined by the bracket 72 and the lower face of the diaphragm 70. A tube 84 extends from the outlet fitting 82 to the venturi ring 150 of FIG. 2 which has the lower end thereof secured to the intake manifold of the engine.

A helical compression spring 77 surrounds the portion of the rod 76 intermediate the passage 74 of bracket 72 and the cup-shaped washer at the lower face of the diaphragm 70. That spring biases the rod 76 upwardly relative to the bracket 72, and it will normally cause that rod to hold the valve element 68 up in engagement with the seat 60. However, that spring can yield to permit movement of the rod 76 downwardly and thereby permit movement of the valve element 68 downwardly to the position shown by FIG. 3. The engagement between the rod 76 and the bushing 75 in the passage 74 of bracket 72 will be close enough to limit in-leakage of air but will not be so tight that it will prevent ready movement of that rod relative to that bushing.

The numeral 86 denotes a pivot bracket which is carried by the housing 10, and a pivot 88 is carried by that pivot bracket adjacent the lower end thereof. A lever 90 is rotatably supported by the pivot 88, and that lever extends to the left from the pivot 88. The lever 90 has a lot 92 therein, as shown by FIG. 4, and that slot accommodates the lower end of the rod 76 but is smaller than the flange or plate 78. The upper end of the rod 76 will be telescoped through the slot 92, through the bushing 75, and through the spring 77 before it passes through the cup-shaped washers and the diaphragm 70. The lever 90 has a downwardly-extending, rounded protuberance 100, and that protuberance is initially spaced above, but can be moved downwardly into engagement with, the flange or plate 78 on the bottom of the rod 76.

The numeral 94 denotes a pivot bracket that extends upwardly from the upper face of the housing 10, and that bracket is adjacent the left-hand side of the cup-shaped bracket 40. A horizontally-directed pivot 96 is supported by the bracket 94, and that pivot rotatably supports a lever 98. That lever will be suitably connected to the accelerator pedal or to the hand throttle of the engine with which the fuel-handling device of FIGS. 1 and 3 is used. The lever 98 has a rounded protuberance 101 projecting downwardly therefrom at a point to the left of the pivot 96. That lever has a lever 104 rotatably secured to it by the pin joint 102; and that pin joint is located intermediate the pivot 96 and the rounded protuberance 101. The lower end of the lever 104 is pivotally connected to the left-hand end of the lever 90 by a pin joint 106.

The numeral 108 denotes a generally frusto-conical recess in the housing 10 adjacent the left-hand end of the upper portion of that housing. A flexible diaphragm 110 overlies and closes the upper end of the recess 108; and the outer portions of that diaphragm are overlain by a horizontally-directed flange on a cup-shaped bracket 112. That flange clamps those portions of the diaphragm 110, which extend outwardly beyond the periphery of the recess 108, to the housing 10; and fasteners 114 extend downwardly through that flange and through those portions of the diaphragm 110 to seat in threaded openings in the housing 10. The bracket 112 has a passage 116 through it, and that passage has a bushing 117 disposed within it. An elongated rod 120 extends upwardly through a cup-shaped washer at the lower face of diaphragm 110, through that diaphragm, through a cup-shaped washer at the upper face of that diaphragm, and then through the bushing 117 within passage 116. The rod 120 will be staked or otherwise secured to the cup-shaped washers and will thereby be secured to the diaphragm 110. A flange or plate 122 is suitably fixed to the upper end of the rod 120; and a helical compression spring 118 surrounds the rod 120 and extends between the lower face of that disc or plate and the upper face of the bracket 112. That spring biases the rod 120 and the diaphragm 110 upwardly; but that spring can yield to permit downward movement of that rod and diaphragm. Such downward movement will occur whenever the lever 98 is rotated in the counter clockwise direction.

The lower end of the rod 120 has a frusto-conical portion 124, and that portion is disposed within a recess 126 in the lower left-hand portion of the housing 10. That recess is formed by a tool that cuts upwardly from the bottom face of the housing 10; and the lower end of that recess is threaded to receive a plug 127. That plug will make a liquid-tight connection with the housing 10 to seal the lower end of the recess 126. A passage 128 extends upwardly from the recess 126 and communicates with the recess 108, and a seat 130 is defined by the junction of passage 128 with recess 126. That seat can be engaged by the frusto-conical lower portion 124 of the rod 120, as shown by FIG. 1, and that seat can coact with that lower portion to prevent the flow of fuel downwardly from the recess 108 into the recess 126. However, the frusto-conical lower portion 124 can be moved downwardly relative to the seat 130 to permit the flow of fuel downwardly from the recess 108 through the passage 128 to the recess 126; and the distance which the rod 120 is moved downwardly will determine the rate at which the fuel can flow downwardly from the recess 108 into the recess 126.

The numeral 132 denotes a passage which extends from the recess 52 to the recess 126; and that passage has an offset 134 intermediate the ends thereof. That offset forms a seat 136; and a threaded recess is in register with that offset. An idling control 137 is mounted in that threaded recess; and that idling control has a frusto-conical upper end that is readily adjustable relative to the seat 136. The idling control 137 can be rotated relative to the threaded recess, by a screwdriver, to set the rate at which fuel is supplied to the engine for idling purposes.

An L-shaped passage 133 extends upwardly from the passage 132, at a point intermediate the recess 52 and

the offset 134; and that passage extends to the recess 108. A passage 138 extends to the left from the recess 126, and that passage communicates with a threaded recess 139 at the left-hand end of the housing 10. One end of a tube 140 extends into the recess 139, and that tube extends to a U-shaped tube 141 adjacent the venturi ring 150 of the engine. A butterfly valve 152 is mounted on a rotatable shaft 154 below the level of the narrowest cross section of the ring 150; and that valve will move in response to movement of the accelerator pedal or of the hand throttle of the engine. The upper end of the tube 141 opens into the ring 150 above the level of the butterfly valve 152, and the lower end of that tube opens into the ring 150 below the level of that valve. When the butterfly valve 152 is close to its closed position, air passing through the venturi ring 150 will by-pass that valve by passing through the tube 141.

The fact that both the lever 98 and the butterfly valve 152 are connected to the accelerator pedal or hand throttle of the engine means that both that lever and that butterfly valve will move when that accelerator pedal or hand throttle is moved. The angular extent of the movement of the butterfly valve 152 will be several times greater than the angular extent of the movement of the lever 98, but an appropriate linkage can be used to provide the requisite movements of that butterfly valve and of that lever. The dotted line 160 on Sheet 1 of the drawing schematically represents such a linkage and thereby indicates that when the butterfly valve 152 is rotated in the counter clockwise direction the lever 98 will also be rotated in that direction.

The normal, at rest positions of the various components of the fuel-handling device are shown in FIG. 1. The spring 118 holds the frusto-concial lower portion 124 of the rod 120 up in engagement with the seat 130, the spring 77 holds the valve element 68 in engagement with the seat 60, and the pressure on the fuel in recess 12 acts upon the diaphragm 28 to cause the lever 32 and its abutment 34 to hold the ball 35 against the seat 26. That fuel was supplied to the recess 12 by the fuel pump of the engine, and that fuel will hold the diaphragm in raised position until the valve element 68 is permitted to move downwardly. The idling control 137 has its frusto-conical upper end spaced from the seat 136. The flange or plate 78 on the lower end of the rod 76 is spaced a short distance from the rounded protuberance 100 on the lever 90, as shown by FIG. 1.

To start the engine, the operator will press down slightly on the accelerator pedal or will move the hand throttle a short distance, thereby causing the lever 98 to rotate a short distance in the counter clockwise direction. Such rotation will enable the protuberance 101 on the lever 98 to move the rod 120 downwardly a short distance and will also enable the protuberance 100 on the lever 90 to move downwardly a short distance. The downward movement of the rod 120 will move the diaphragm 110 downwardly a short distance; and that movement will cause that diaphragm to force a quantity of fuel downwardly from the recess 108 past the frusto-conical portion 124, and that fuel will cause a corresponding amount of fuel to issue from the tube 140 and enter the tube 141. That fuel will mix with and be carried away by the air that by-passes the butterfly valve 152, by passing through the tube 141, and be drawn to the intake manifold of the engine. The downward movement of the protuberance 100 on the rod 90 will not, at this time, cause that protuberance to engage the flange 78. However, if the engine fails to start, and if further priming fuel is needed, the operator can move the lever 98 down a distance somewhat greater than one-half of the total length of movement of said lever; and the resulting downward movement of the rod 76 will permit the valve element 68 to move downwardly away from the seat 60. Such movement of the valve element 68 will relieve the pressure within the recess 12. Thereupon the spring 47 will rotate the lever 32 downwardly, and that rotation will permit the ball 35 to move downwardly away from the seat 26.

As soon as the engine starts turning over, the operator can release the pressure on the accelerator pedal or can return the hand throttle to its closed position. The lever 98 will no longer hold the rod 120 in lowered position, but the reduced pressure at the intake manifold of the engine will be communicated to the under face of the diaphragm 70 by the venturi ring 150 and the tube 84, and it will cause that diaphragm to move the rod 76 downwardly and permit the valve member 68 to move downwardly. Consequently, as long as the engine is idling, the diaphragm 70 will be in lowered position and will hold the rod 76 down to permit the valve element 68 to be below and out of engagement with the seat 60. Fuel will be delivered to the passage 24 by the fuel pump and the tube 48, and that fuel will pass downwardly through the passage 29 and outwardly through the ports 31 into the recess 12. That fuel will then move downwardly through the passage 58 past the valve element 68, and then will flow through passage 132 past idling control 137, through recess 126 and passage 138, and then through tube 140 to the tube 141. The rate of flow of that fuel will be regulated by the idling control 137, and that fuel will be caused to flow smoothly by the pressure-regulating action of the diaphragm 28 and ball 35. The fuel will be introduced under pressure into the air stream that passes through the by-pass tube 141 and then passes to the intake manifold.

When it is desired to accelerate the engine or to enable it to match a heavy load, the lever 98 will be rotated in the counter clockwise direction. As that lever so rotates, the rounded protuberance 101 thereon will engage the flange 122 at the top of the rod 120 and move that rod downwardly, and it will also move the diaphragm 110 downwardly. The downward movement of the diaphragm 110 will provide an accelerator pump action by forcing a quantity of fuel to pass downwardly through the passage 128 and to move to the tube 141. That quantity of fuel will not be able to move back up into the recess 12 because the ball 65 and the seat 66 serve as a check valve to prevent such movement. Consequently, the diaphragm 110 will enable the engine to operate smoothly during the transition from idling to running operation. The speed at which the engine will operate will principally be determined by the setting of the frusto-conical portion 124 relative to the seat 130; and this, despite the fact that fuel will also be supplied through the passage 132 and the offset 134.

As the accelerator pedal or hand throttle is progressively opened, the pressure at the intake manifold will rise; and at some position of that pedal or throttle, when the lever 98 has been moved a distance greater than one half of the total length of movement of said lever, the reduced pressure at the under side of the diaphragm 70 will be too small to overcome the force of the spring 77. That spring will tend to restore the flexible diaphragm 70 to the position shown in FIG. 1, but the rounded protuberance 100 on the lower face of lever 90 will, at that time, engage the flange 78 on the rod 76 and hold that rod in lowered position. As a result, a full flow of fuel downwardly through the passage 58 will be assured.

As long as the pedal or throttle is set in open position, fuel will flow to the tube 141 under the force applied by the fuel pump, and that fuel will mix with the air that flows downwardly through the venturi ring 150, as indicated by the arrow in FIG. 2. If the engine is to be decelerated, the frusto-conical portion 124 will be permitted to move upwardly and engage the seat 130; but fuel will continue to flow past the idling control 137 and keep the engine idling. At such time, the pressure at the intake manifold will again decrease; and although the protuberance 100 will have moved upwardly, the reduced pressure adjacent the lower face of the diaphragm 70 will keep that diaphragm in the lowered position shown in FIG. 3. If the engine is to be accelerated to a still faster

rate of operation, the lever 98 will be moved further in the counter clockwise direction; and as it moves, it will increase the spacing between the seat 130 and the frusto-conical lower portion 124 of the rod 120. That lever will also cause the diaphragm 110 to provide an additional accelerator pump action.

The normally-closed valve element 68 is important because it serves as a pressure-controlled shut-off valve. Such a valve is important in minimizing the risk of flooding during the starting of the engine.

The fuel-handling device provided by the present invention can be connected to the venturi ring of any engine. Hence, it has far more versatility than does a fuel-handling device that is usable with just one carbureting device.

The diaphragm 110 will act to smooth out any pulsations on the fuel introduced into the recess 108 by the passage 133. That diaphragm will do so by yielding in the upward direction as the pressure increases and by subsequently restoring itself when the pressure returns to normal. The yielding and restoration of the diaphragm 110 will not affect the position of the rod 120 because that rod will be held by the protuberance 101 on lever 98.

Whereas the drawing and accompanying description have shown and described a preferred embodiment of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a flexible diaphragm that is exposed to the pressure on fuel in said recess and that is adapted to be flexed by said pressure, said flexible diaphragm constituting a flexible closure for said recess, a seat intermediate said inlet for said housing and said recess, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet for said housing to said recess and that is movable out of engagement with said seat to permit flow of fuel from said inlet for said housing to said recess, a second seat intermediate said recess and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said second seat to permit flow of fuel from said recess to said outlet for said housing, a second recess in said housing that is connectable to said passage, a second flexible diaphragm that has one surface thereof exposed to the pressure in said second recess and that has the opposite surface thereof exposed to the pressure in said passage, said second flexible diaphragm constituting a flexible closure for said second recess, a member that is movable by said second flexible diaphragm and that can cause movement of the first said valve member relative to the first said seat, a spring biasing said second flexible diaphragm to move said movable member to cause the first said valve member to engage the first said seat and thereby prevent the flow of fuel from said inlet for said housing to the first said recess, said pressure in said passage being adapted to cause said second flexible diaphragm to overcome the bias of said spring and to move in a predetermined direction to move said movable member and thereby permit the first said valve member to move away from the first said seat and thereby permit fuel to flow from said inlet for said housing to the first said recess, a lever that is movable in one direction to move said second flexible diaphragm in said predetermined direction to move said movable member and thereby permit the first

said valve member to move away from the first said seat and thereby permit fuel to flow from said inlet for said housing to the first said recess and that is movable in the opposite direction to permit said second flexible diaphragm to move oppositely to said predetermined direction, a lost-motion connection between said second flexible diaphragm and said lever that enables said pressure in said passage to cause movement of said second flexible diaphragm in said predetermined direction even though said lever has not moved, said second valve member and the first said flexible diaphragm being connected together for conjoint movement, a second lever that is movable in a certain direction to move said second valve member away from said second seat and to move the first said flexible diaphragm and thereby force a quantity of fuel to move past said second valve member and past said second seat to said outlet for said housing, a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction, said second valve member being a frusto-conical metering rod, an idling passage that by-passes the first said recess and the first said seat, and an adjustable idling screw in said idling passage, the flexing of the first said flexible diaphragm by said pressure on said fuel in the first said recess tending to minimize pulsations of the fuel issuing from said outlet for said housing.

2. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a flexible diaphragm that is exposed to fuel in said recess, a seat intermediate said inlet for said housing and said recess, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet for said housing to said recess and that is movable out of engagement with said seat to permit flow of fuel from said inlet for said housing to said recess, a second seat intermediate said recess and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said second seat to permit flow of fuel from said recess to said outlet for said housing, a second flexible diaphragm that has one surface thereof exposed to the pressure in said passage, a member that is movable by said second flexible diaphragm and that can cause movement of the first said valve member relative to the first said seat, a spring biasing said second flexible diaphragm to move said movable member to cause the first said valve member to engage the first said seat and thereby prevent the flow of fuel from said inlet for said housing to the first said recess, said pressure in said passage being adapted to cause said second flexible diaphragm to overcome the bias of said spring and to move in a predetermined direction to move said movable member and thereby permit the first said valve member to move away from the first said seat and thereby permit fuel to flow from said inlet for said housing to the first said recess, a lever that is movable in one direction to move said second flexible diaphragm in said predetermined direction to move said movable member and thereby permit the first said valve member to move away from the first said seat and thereby permit fuel to flow from said inlet for said housing to the first said recess and that is movable in the opposite direction to permit said second flexible diaphragm to move oppositely to said predetermined direction, a lost-motion connection between said second flexible diaphragm and said lever that enables said pressure in said passage to cause movement of said second flexible diaphragm in said predetermined direction even though said lever has not moved, said second valve member and the first said flexible diaphragm being connected together for conjoint movement, a second lever that is movable in a certain direction to move said second valve member away from said second seat and to move the first said flexible diaphragm and thereby force a quantity of fuel to move past said second valve member and past said second seat to said outlet for said housing and a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction.

3. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a movable element that is exposed to fuel in said recess, a seat intermediate said inlet for said housing and said recess, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet for said housing to said recess and that is movable out of engagement with said seat to permit flow of fuel from said inlet for said housing to said recess, a second seat intermediate said recess and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said second seat to permit flow of fuel from said recess to said outlet for said housing, a second movable element that has one surface thereof exposed to the pressure in said passage, a member that is movable by said second movable element and that can cause movement of the first said valve member relative to the first said seat, a spring biasing said second movable element to move said movable member to cause the first said valve member to engage the first said seat and thereby prevent the flow of fuel from said inlet for said housing to the first said recess, said pressure in said passage being adapted to cause said second movable element to overcome the bias of said spring and to move in a predetermined direction to move said movable member and thereby permit the first said valve member to move away from the first said seat and thereby permit fuel to flow from said inlet for said housing to the first said recess, said second valve member and the first said movable element being movable together, and a lever that is movable in a certain direction to move said second valve member away from said second seat and to move the first said movable element and thereby force a quantity of fuel to move past said second valve member and past said second seat to said outlet for said housing.

4. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a seat intermediate said inlet and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet past said seat and that is movable out of engagement with said seat to permit flow of fuel past said seat, a second seat intermediate the first said seat and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel past said second seat and that is movable out of engagement with said second seat to permit flow of fuel past said second seat, a lever that is movable in one direction to enable the first said valve member to move away from the first said seat, a second lever that is movable in a certain direction to move said second valve element away from said second seat, and a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction.

5. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pres-

surized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a flexible diaphragm exposed to fuel in said recess, a seat intermediate said inlet for said housing and said recess, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet for said housing to said recess and that is movable out of engagement with said seat to permit flow of fuel from said inlet for said housing to said recess, a second seat intermediate said recess and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said second seat to permit flow of fuel from said recess to said outlet for said housing, a lever that is movable in one direction to facilitate movement of the first said valve element away from the first said seat, a second lever that is movable in a certain direction to move said second valve element away from said second seat, and a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction, said second valve member and the first said flexible diaphragm being connected together for conjoint movement, whereby opening movement of said second lever causes said flexible diaphragm to provide an accelerator pump action.

6. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a pressure-responsive member that is exposed to the pressure on fuel in said recess and that is adapted to have a portion thereof move in response to said pressure, said pressure-responsive member constituting a yieldable closure for said recess, a seat intermediate said recess and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said seat to permit flow of fuel from said recess to said outlet for said housing, said valve element and said portion of said pressure-responsive member moving together, and a member that is movable in a certain direction to move said valve member away from said seat and to move said movable portion of said pressure-responsive member and thereby force a quanity of fuel to move past said valve member and past said seat to said outlet for said housing.

7. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a movable member that is exposed to fuel in said recess, a seat intermediate said recess and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said seat to permit flow of fuel from said recess to said outlet for said housing, said valve element and said movable member moving together, and a member that is movable in a certain direction to move said valve member away from said seat and to move said movable member and thereby force a quantity of fuel to move past said valve member and past said seat to said outlet for said housing.

8. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable

to the passage through which said air stream passes, an idling passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, and a running passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, said idling passage having an idling screw therein intermediate the ends thereof, said running passage having a main fuel-metering valve member, said idling screw and said fuel-metering valve member being individually movable.

9. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, an idling passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, and a running passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, said running passage having a main fuel-metering valve member and a movable member that moves with said fuel-metering valve member, said movable member causing fuel to move past said main fuel-metering valve member and thereby provide an accelerator pump action.

10. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a passage through which said air stream passes, a valve that is disposed within said passage and that is movable to close or to open said passage, a by-pass that extends from and communicates with the atmospheres in said passage that are ahead of and that are behind said valve, said by-pass having a cross section that is small compared to the cross section of said passage, an inlet for said by-pass that is intermediate the ends of said by-pass, and a housing that is connected intermediate said inlet for said by-pass and a source of pressurized fuel, said housing having a valve therein that is openable to permit fuel under pressure to pass to and to enter said inlet for said passage.

11. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a fuel passage in said housing that receives fuel from said inlet for said housing and that conducts said fuel to said outlet for said housing, a second fuel passage in said housing that receives fuel from said inlet for said housing and that conducts said fuel to said outlet for said housing, a metering element in the first said passage intermediate the ends of said passage, a second metering element in said second passage intermediate the ends of said second passage, the first said metering element being adjustable but being fixed during normal operation of said fuel-handling device, said second metering element being movable relative to said second seat during normal operation of said fuel-handling device.

12. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a movable member that is exposed to fuel in said recess, a seat intermediate said recess and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said seat to permit flow of fuel from said recess to said outlet for said housing, a check valve intermediate said recess and said inlet for said housing that opens to permit fuel to flow from said inlet toward said recess but that closes to prevent flow of fuel from said recess to said inlet for said housing, said valve element and said movable member moving together, and a member that is movable in a certain direc-

tion to move said valve member away from said seat and to move said movable member and thereby force a quantity of fuel to move past said valve member and past said seat to said outlet for said housing, said check valve being adapted to close during the enforced movement of said quantity of fuel.

13. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a seat intermediate said inlet and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet past said seat and that is movable out of engagement with said seat to permit flow of fuel past said seat, a second seat intermediate the first said seat and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel past said second seat and that is movable out of engagement with said second seat to permit flow of fuel past said second seat, a lever that is movable in one direction to enable the first said valve member to move away from the first said seat, a movable element that is exposed to the pressure in said passage and that responds to reductions in said pressure to permit the first said valve member to move away from the first said seat, and a lost-motion connection between said movable element and said lever that enables reductions in said pressure in said passage to cause greater movement of the first said valve member than said lever may require.

14. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a throttle in said passage, a seat intermediate said inlet and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet past said seat and that is movable out of engagement with said seat to permit flow of fuel past said seat, a lever that is movable in one direction to enable said valve member to move away from said seat, a movable element that is exposed to the pressure in said passage and that responds to redutions in said pressure to permit said valve member to move away from said seat, and a lost-motion connection between said movable element and said lever, said valve member being biased toward said seat and being in engagement with said seat whenever said throttle is in its normal position, said lever permitting said valve element to remain in engagement with said seat during the first part of the movement of said throttle, said movable element thereafter responding to said pressure in said passage to move and thereby permit said valve member to move away from said seat, said lever and said movable element subsequently coacting to hold said valve member away from said seat.

15. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, an idling passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, and a running passage in said housing that receives fuel from said inlet for said housing and that delivers fuel to said outlet for said housing, said idling passage having an idling screw therein intermediate the ends thereof, said running passage having a main fuel-metering valve member, a seat intermediate said inlet for said housing and said idling and running passages, a valve member that normally engages said seat, and an actuator that is movable to free said valve member for movement away from said seat to permit fuel to flow from said inlet to said idling and running passages, said actuator being manually-operable or operated by reductions in the pressure in said passage through which said air stream passes.

16. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a seat intermediate said inlet and said outlet for said housing, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet past said seat and that is movable out of engagement with said seat to permit flow of fuel past said seat, a second seat intermediate the first said seat and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel past said second seat and that is movable out of engagement with said second seat to permit flow of fuel past said second seat, a lever that is movable in one direction to enable the first said valve member to move away from the first said seat, a second lever that is movable in a certain direction to move said second valve element away from said second seat, and a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction, said first said lever being initially spaced from a position in which it can enable said first said valve element to move away from said first said seat whereby said second lever will move said second valve element away from said second seat before said first said lever enables said first said valve element to move away from said first said seat, the movement of said second valve element prior to the movement of said first said valve element enabling fuel to flow to said outlet while said first said valve element is in engagement with said first said seat.

17. A fuel-handling device that can introduce fuel under pressure into an air stream and that comprises a housing, an inlet for said housing that is adapted to receive pressurized fuel, an outlet for said housing that is connectable to the passage through which said air stream passes, a recess in said housing that is intermediate said inlet and said outlet of said housing, a flexible diaphragm exposed to fuel in said recess, a seat intermediate said inlet for said housing and said recess, a valve member that is movable into engagement with said seat to prevent flow of fuel from said inlet for said housing to said recess and that is movable out of engagement with said seat to permit flow of fuel from said inlet for said housing to said recess, a second seat intermediate said recess and said outlet for said housing, a second valve member that is movable into engagement with said second seat to prevent flow of fuel from said recess to said outlet for said housing and that is movable out of engagement with said second seat to permit flow of fuel from said recess to said outlet for said housing, a lever that is movable in one direction to facilitate movement of the first said valve element away from the first said seat, a second lever that is movable in a certain direction to move said second valve element away from said second seat, and a connection between said levers whereby the first said lever will move in said one direction whenever said second lever is moved in said certain direction, said second valve member and the first said flexible diaphragm being connected together for conjoint movement, whereby opening movement of said second lever causes said flexible diaphragm to provide an accelerator pump action, said first said lever being initially spaced from a position in which it can facilitate movement of said first valve element away from said first said seat whereby said second lever will move said second valve element way from said second seat before said first said lever enables said first said valve element to move away from said first said seat.

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