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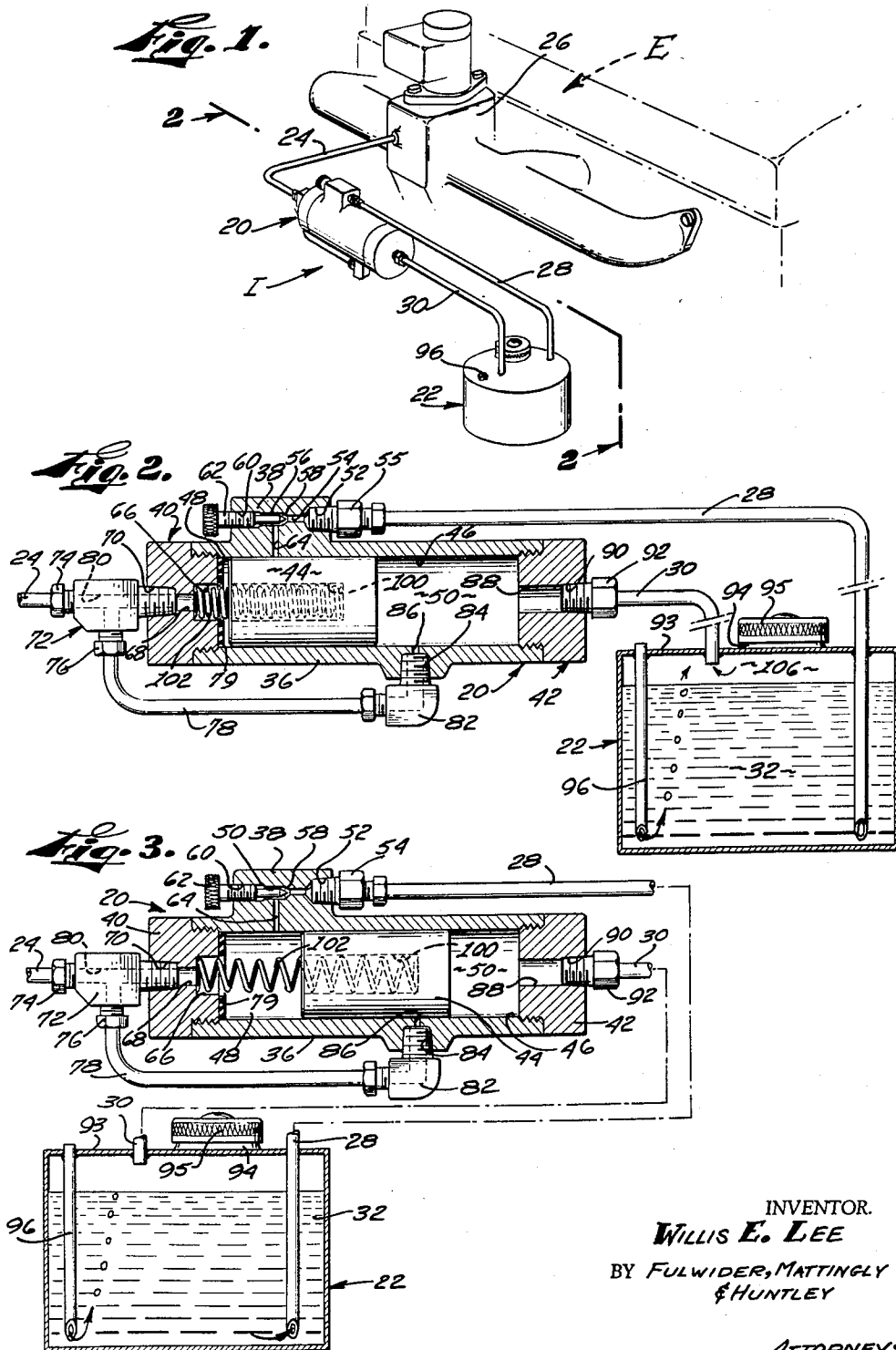
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DECARBONIZER FOR AUTOMOTIVE ENGINES

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2 Sheets-Sheet 1



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1

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DECARBONIZER FOR AUTOMOTIVE ENGINES

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10 Claims. (Cl. 123—25)

The present invention relates generally to internal combustion engines and more particularly to apparatus for restraining the formation of carbon deposits on the parts thereof.

It is well known that carbon deposits form on certain parts of an internal combustion engine during the operation thereof. The pistons, piston rings, valves and spark plugs are particularly susceptible to the formation of such deposits. The gradual build-up of carbon deposits gradually lowers the power output of an engine. Additionally, such deposits can cause extensive damage to the engine unless removed.

It is a major object of the present invention to provide an apparatus for injecting a liquid and its vapor into the combustion chambers of an internal combustion engine during the operation thereof so as to restrain the formation of carbon deposits on the engine parts in communication with the combustion chambers.

Another object of the invention is to provide apparatus of the aforescribed nature which is entirely automatic in operation, requiring only periodic replenishment of liquid employed therewith.

A further object of the invention is to provide apparatus of the aforescribed nature which may be readily installed upon conventional internal combustion engines without requiring other than minor modifications of such engines.

Yet a further object is to provide apparatus of the aforescribed nature which is simple in design and rugged of construction whereby it may afford a long and useful service life.

An additional object of the invention is to provide apparatus of the aforescribed nature which may be manufactured and sold at a low cost so as to be available to a wide market.

A further object of the invention is to provide apparatus of the aforescribed nature which will prevent undesirable pre-ignition or "ping" in an internal combustion engine.

Yet another object of the present invention is to provide apparatus of the aforescribed nature which automatically admits a decarbonizing liquid into the engine's intake manifold during acceleration and higher cruising speeds and admits the liquid's vapor into the intake manifold during idling, deceleration and lower cruising speeds.

An additional object is to provide apparatus of the aforescribed nature wherein a single unit may be employed with engines of varying sizes and power.

These and other objects and advantages of the present invention will become apparent from the following detailed description, when taken in conjunction with the appended drawings wherein:

Figure 1 is a perspective view showing a first form of injector apparatus embodying the present invention installed upon an internal combustion engine;

Figure 2 is a side elevational view of said apparatus taken primarily in central vertical section;

2

Figure 3 is a view similar to Figure 2, but showing the parts of said apparatus in a different operative position;

Figure 4 is a central vertical sectional view showing a second form of injector apparatus embodying the present invention;

Figure 5 is a view similar to Figure 4, but showing the parts of said second form arranged in a different operative position;

Figure 6 is a vertical sectional view taken on line 6—6 of Figure 4;

Figure 7 is a vertical sectional view taken on line 7—7 of Figure 4;

Figure 8 is a perspective view showing a modified metering rod that may be utilized with said second form of apparatus;

Figure 9 is a perspective view showing a second modified metering rod that may be utilized with said second form of apparatus; and

Figure 10 is a perspective view of a spring cage utilized with said second form of apparatus.

Referring to the drawings and particularly Figures 1, 2 and 3 thereof, there is shown a first form of injector apparatus I embodying the present invention installed upon a conventional internal combustion engine E of an automotive vehicle. The apparatus broadly includes a control housing, generally designated 20, a liquid reservoir, generally designated 22, a first conduit 24 connecting the control housing with the intake manifold 26 of the engine E, a second conduit 28 connecting the lower portion of the liquid reservoir 22 with the control housing 20, and a third conduit 30 connecting the upper portion of the liquid reservoir with the control housing 20. The reservoir 22 contains a suitable decarbonizing liquid 32, as for example water. In the broad operation of this apparatus, during acceleration and higher cruising speeds of the automotive vehicle powered by the engine E, the control housing 20 admits liquid 32 from the reservoir 22 into the intake manifold 26 by means of conduits 28 and 24. During idling, deceleration and lower cruising speeds of the automotive vehicle, the control housing 20 admits the vapor accumulating in the upper portion of the reservoir 22 into the intake manifold 26 by means of conduits 30 and 34.

More particularly, the control housing 20 is generally cylindrical in configuration and includes a horizontally extending tubular body 36. The front portion of this body 36 is integrally formed with an offset block element 38. The front end of the body 36 is closed by a front plug, generally designated 40, while the rear end of the body 36 is closed by a rear plug, generally designated 42. A piston valve 44 is slidably disposed within the bore 46 of the tubular body 36. The portion of the bore 46 forwardly of the piston valve 44 defines a liquid-receiving chamber 48, while the portion of the bore 46 rearwardly of the piston valve 44 defines a vapor-receiving chamber 50.

The block 38 is formed at its rear portion with an internally threaded socket 52 that receives a complementary fitting 55 affixed to the front end of the conduit 28. The front portion of the socket 52 merges into a coaxial forwardly extending bore 54. The front end of this bore 54 merges into a larger coaxial intermediate bore 56, with a frusto-conical valve seat 58 being formed at the intersection of the bores 54 and 56. The front end of the intermediate bore 56 merges into an internally threaded bore 60 of enlarged diameter. The internally threaded bore 60 supports a conventional needle valve 62. The pointed end of this needle valve 62 is disposed adjacent the seat 58. The needle valve is rotatable so as to be longitudinally adjusted relative to the bores 56 and 60 and it thereby serves to control

the volume of fluid flow through bore 54 into intermediate bore 56. Forwardly of the seat 58 the intermediate bore 56 intersects a radially inwardly extending fluid passage 64. The radially inner end of this passage 64 intersects the bore 46 of the tubular body 36 within the liquid-receiving chamber 48 thereof.

The front plug 40 is coaxially formed at its rear portion with a cylindrical spring cavity 66. The front end of this spring cavity 66 merges into a coaxial bore 68. The front end of this bore 68 in turn merges into the rear end of an internally threaded cavity 70. The cavity 70 receives a T-fitting, generally designated 72. This T-fitting 72 supports a smaller fitting 74 connected to the rear end of the conduit 24. The T-fitting 72 also supports a second fitting 76 which is connected to the front end of a transfer conduit 78. The interior of the T-fitting 72 is provided with a T-shaped passage 80 which places the front end of the liquid-receiving chamber 48 in communication with both conduits 24 and 78. A resilient seal 79 is positioned between the front end of body bore 46 and the front plug 40.

The rear end of the conduit 78 is connected to an elbow fitting 82. The elbow fitting 82 is received by an internally threaded socket 84 formed at one side of the tubular body 36. This socket 84 is in communication with the interior of the vapor-receiving chamber 46 by means of a port 86. The rear plug 42 is formed with a coaxial bore 88, the rear end of which merges into an internally threaded socket 90 that receives a fitting 92 connected to the front end of the conduit 30.

The reservoir 22 may be of cylindrical configuration having a top wall 93 provided with a filling neck 94 to which a cap 95 is removably attached. The reservoir 22 is also provided with a vent pipe 96 which is rigidly affixed at its upper portion to the top wall 93 and extends downwardly therethrough into the lower portion of the reservoir. The upper end of the vent pipe 96 extends through the top wall 93 and is open to the atmosphere. As shown in Figure 2, the rear portion of the conduit 28 is bent downwardly and is affixed to and extends through the top wall 93 of the reservoir 22. This conduit 28 terminates within the lower portion of the reservoir.

The piston valve 44 is formed with a coaxial blind bore 100 which extends rearwardly from the front end thereof. This blind bore 100 receives a major portion of a coil compression spring 102. The front portion of the spring 102 is disposed within the spring cavity 66 of the front plug 40.

In the operation of the aforescribed form of injector apparatus I, during idling, deceleration and lower cruising speeds of the engine E, the intake manifold vacuum will be of a comparatively high magnitude. This vacuum is communicated from the intake manifold 26 to the liquid-receiving chamber 48 by means of the conduit 24, T-fitting 72, bore 68 and spring cavity 66. The strength characteristics of the spring 102 should be so chosen that during such comparatively high intake manifold vacuum conditions, the piston valve 44 will be drawn forwardly within the tubular body 36 until it covers the passage 64, as indicated in Figure 2. Accordingly, communication between the liquid-receiving chamber 48, and the interior of the reservoir 22 will at this time be blocked. Concurrently, the piston valve 44 will be disposed forwardly of the port 86. The interior of the vapor-receiving chamber 46 will be placed in communication with the interior of the intake manifold 26 by means of conduits 78 and 24, and with the space 106 between the upper surface of the liquid 32 and the underside of the top wall 93 of the reservoir 22 by means of conduit 30. Thus, a mixture of air and liquid vapor will be drawn from the space 106 through the vapor-receiving chamber 46 and into the interior of the intake manifold 26.

Referring now to Figure 3, during acceleration and

higher cruising speeds of the engine E, the magnitude of the intake manifold vacuum will be reduced to an approximate range of 8 to 14 inches. Accordingly, the force of the spring 102 will urge the piston valve 44 rearwardly towards its position shown in Figure 3. The piston valve 44 will thus uncover the port 64 formed in body 36 and the liquid-receiving chamber 48 will consequently be placed in communication with the lower portion of the reservoir 22 by means of conduit 28. At the same time, communication between the vapor-receiving chamber 46 and the intake manifold 26 will be blocked. Accordingly, liquid 32 will be drawn from the reservoir 22 through conduit 28, liquid-receiving chamber 48 and conduit 24 into the interior of the intake manifold 26 and thereafter into the engine's combustion chambers (not shown).

It has been determined that the injection of the liquid 32 and its vapor will serve to restrain the formation of carbon on the engine parts in communication with its combustion chambers. It is important to observe that the injector apparatus I introduces liquid within the intake manifold during acceleration and higher cruising speeds of the engine while the liquid's vapor is introduced during idling, deceleration and lower cruising speeds of the engine. This arrangement automatically provides for greater decarbonizing action during those operating conditions of the engine when carbon deposits have a greater tendency to form. It has also been determined that the use of the aforescribed apparatus tends to prevent undesirable pre-ignition or "ping" from taking place during operation of the engine E. The volume of liquid injected into the engine may be readily controlled by means of the needle valve 62. This volume will vary in accordance with the size and power of the engine whereon the apparatus is installed.

Referring now to the remaining figures of the drawings there is shown a second form of injector apparatus embodying the present invention. This second form of apparatus is adapted to employ a liquid reservoir similar to the reservoir 22 hereinbefore described and shown in Figures 1, 2, and 3. The second form of injector apparatus, however, is provided with a modified control housing, generally designated 110. The control housing 110 may conveniently be cast from a suitable synthetic plastic and it includes a horizontally extending tubular body 112 of cylindrical configuration. The front end of the body 112 is closed by a front wall 114 while the rear end of the body 112 is closed by a rear wall 116. A piston valve 118 is slidably disposed within the bore 120 of the tubular body 112. The portion of the bore 120 forwardly of the piston valve 118 defines a liquid-receiving chamber 122 while the portion of the bore 120 rearwardly of the piston valve 118 defines a vapor-receiving chamber 124.

The upper portion of the tubular body 112 is formed with a longitudinally extending passage 126 that extends forwardly from the rear end of the body. The front end of this passage 126 intersects a radially inwardly extending port 128 that places the front end of the passage 126 in communication with the liquid-receiving chamber 122 of the bore 120. The rear end of the longitudinally extending passage 126 telescopically receives the front tubular portion 130 of a fitting 132. The rear portion 134 of this fitting 132 is also of tubular configuration but is of larger diameter than the front portion 130. The rear portion 134 receives the front end of a conduit 28' corresponding to the conduit 28 shown in Figures 1, 2 and 3. A metering rod 136 is slidably disposed within the passage 126 for longitudinal movement relative thereto. The metering pin 136 includes a shank 138 upon the rear end of which is formed an integral head 140. The head 140 is confined within the rear portion 134 of the fitting 132. A coil compression spring 142 is interposed between the frusto-conical intermediate portion 144 of the fitting 132 and the forwardly-facing side of the head 140.

The lower portion of the body 112 is formed with a second longitudinally extending passage 146 that projects rearwardly from the front end of the body. The rear end of the longitudinal passage 146 intersects a radially inwardly extending port 148 so as to place the rear end of the passage 146 in communication with the vapor-receiving chamber 124 of bore 120. The front end of the longitudinal passage 146 is closed by a suitable plug 150. A radially-inwardly extending port 152 places the front end of the longitudinal passage 146 in communication with a radially extending passage 154 formed through the front wall 114. The radially inner end of the passage 154 is aligned with a port 156 formed in one side of a tubular fitting 158. The rear portion of this fitting 158 is affixed within a bore 160 coaxially formed in the front wall 114. The front portion of the fitting 158 receives the rear end of a conduit 24' corresponding to the conduit 24 shown in Figures 1, 2 and 3. The rear end of the bore 160 merges into a coaxial enlarged annular cavity 162 formed at the rear portion of the front plug 114. The front end of a spring cage, generally designated 164, is received within the cavity 162.

The details of this spring cage 164 are shown in Figure 10. Referring thereto, the spring cage 164 is seen to include an annular front wall 166 from the outer periphery of which extend rearwardly directed tubular side walls 168. The side walls 168 are formed with a plurality of longitudinally extending liquid-admitting apertures 170.

The rear wall 116 is coaxially formed with a bore 172 that receives the front portion of a tubular fitting 174. The rear portion of the fitting 174 receives the front end of a conduit 30' corresponding to the conduit 30 shown in Figures 1, 2 and 3.

The piston valve 118 is coaxially formed with a rearwardly extending blind bore 176. The front portion of this blind bore 176 slidably receives the spring cage 164. A coil compression spring 178 is disposed within the spring cage 164 with this rear portion being received by the blind bore 176. The spring 178 constantly biases the piston valve 118 rearwardly within bore 120.

In the operation of the aforescribed second form of injector apparatus, during idling, deceleration and lower cruising speeds of the engine, the intake manifold vacuum will be of a comparatively high magnitude. This vacuum is communicated from the intake manifold to the liquid-receiving chamber 122 by means of the conduit 24'. The strength characteristics of the spring 178 should be so chosen that during such comparatively high intake manifold conditions the piston valve 118 will be drawn forwardly within the tubular body until it covers the port 128, as indicated in Figure 4. Accordingly, communication between the liquid-receiving chamber 122 and the liquid reservoir will at this time be blocked. Concurrently, the piston valve 118 will be disposed forwardly of the port 146. Accordingly, the interior of the vapor-receiving chamber 124 will be placed in communication with the interior of the intake manifold by means of the conduit 24', port 156, passage 154, port 152, longitudinal body passage 146 and port 148, and with the upper portion of the liquid reservoir by means of conduit 30'. Thus, a mixture of air and liquid vapor will be drawn from the upper portion of the reservoir, through the vapor-receiving chamber 124 and into the interior of the intake manifold, as in the case with the first form of apparatus shown in Figures 1, 2 and 3.

Referring now to Figure 5, during acceleration and higher cruising speeds of the engine, the magnitude of the intake manifold vacuum will be reduced and the spring 178 will urge the piston valve 118 rearwardly towards its position indicated in Figure 5. The piston valve 118 will thus uncover the port 128 and the liquid-receiving chamber 122 will be placed in communication with the lower portion of the reservoir through the conduit 28'. Concurrently, communication between the vapor-receiving

chamber 124 and the interior of the intake manifold will be blocked since the piston valve 118 covers the port 148. Accordingly, liquid will be drawn from the reservoir into the intake manifold.

The provision of the spring cage 164 insures that should the spring 178 become broken, it will remain confined within the cage. Unless such provision is made for confining a broken spring, the latter could wedge the piston valve 118 in a rearwardly disposed position so that the intake manifold would constantly remain in communication with the lower portion of the reservoir. Under these conditions, all of the liquid within the reservoir could be drawn into the engine and cause it to stall.

It should be particularly noted that the metering rod 136 serves a dual function in the aforescribed second form of apparatus. The diameter and/or length of the metering rod may be varied in accordance with the type of engine upon which the apparatus is installed so as to control the volume of liquid injected by the apparatus into the intake manifold. Additionally, the metering rod will serve to maintain the longitudinal passage 126 free of foreign material so as to prevent such foreign material from accumulating within the passage and ultimately effecting stoppage of liquid flow therethrough. In this regard, at such time as the port 128 is uncovered by the piston valve 118, the metering rod 136 will be drawn forwardly within the longitudinal passage 126 against the force of the spring 142, as indicated in Figure 5. When the piston valve 118 returns forwardly to its position of Figure 4 so as to block the port 128, the spring 142 will return the metering rod 136 to its original position. Such sliding movement of the metering rod within the longitudinal passage 126 will serve to loosen any foreign particles or material entering the passage 126.

Referring now to Figure 8, there is shown a modified form of metering rod 200 which may be substituted for the metering rod 136 shown in Figures 4 through 7. It will be observed that the stem of the modified metering rod 200 is not of uniform diameter but instead comprises three steps 202, 204, and 206, the step 202 being disposed at the front of the stem and having the smallest diameter. Assuming the diameter of the rear step 206 to be the same as the diameter of the stem 138 of metering rod 136, the modified metering rod 200 will admit more volume of liquid through passage 126 than the metering rod 136. This arrangement makes it possible to utilize a single body 112 for several types of automotive engines without the necessity of providing a needle valve or the like to control the liquid flow through the longitudinal passage 126.

Referring now to Figure 9 there is shown another modified metering rod 210 which may be substituted for metering rod 136 or 200. The metering rod 210 is provided with two stepped portions 212 and 214 and will admit a smaller volume of water through passage 126 than metering rod 200.

While there has been shown and described hereinbefore two forms of apparatus embodying the present invention, various modifications and changes may be made thereto without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, said piston valve being biased away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a reservoir

for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

2. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a liquid-receiving chamber and a vapor-receiving chamber, both of said chambers being in communication with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber; metering means for controlling the volume of liquid passing through said first-mentioned conduit means; and valve means in said control housing selectively connecting one of said chambers with its respective conduit means while blocking fluid flow through the other of said chambers.

3. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber, and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, said piston valve being biased away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; metering means for controlling the volume of liquid passing through said first-mentioned conduit means; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

4. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a liquid-receiving chamber and a vapor-receiving chamber, both of said chambers being in communication with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; said conduit means including an elongated passage formed in said housing; a metering rod slidably disposed in said elongated passage whereby it may undergo longitudinal movement therein, the cross-sectional area of said rod controlling the volume of liquid flowing through said conduit means; second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber; and valve means in said control housing selectively connecting one of said chambers with its respective conduit means while blocking fluid flow through the other of said chambers.

5. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, said piston valve being biased away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a res-

ervoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber, said conduit means including an elongated passage formed in said housing; a metering rod slidably disposed in said elongated passage whereby it may undergo longitudinal movement therein, the cross-sectional area of said rod controlling the volume of liquid flowing through said conduit means; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

6. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber, and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, the end of said piston valve proximate said one end of said passage being formed with a cavity; a spring cage on said body extending away from said one end of said passage towards said piston valve so as to be received by said cavity when said piston valve moves towards said one end of said passage; a compression spring in said spring cage constantly biasing said piston valve away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

7. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber, and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, the end of said piston valve proximate said one end of said passage being formed with a cavity; a spring cage on said body extending away from said one end of said passage towards said piston valve so as to be received by said cavity when said piston valve moves towards said one end of said passage; a compression spring in said spring cage constantly biasing said piston valve away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; metering means for controlling the volume of liquid passing through said first-mentioned conduit means; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

8. Apparatus for injecting a liquid and its vapor into the intake manifold of an internal combustion engine, comprising: a control housing formed with a passage, one end of said passage being in communication with said intake manifold; a piston valve slidably disposed in said passage with the portion of said passage between said one end of said passage and said piston valve defining a liquid-receiving chamber, and the portion of said passage between the opposite end of said passage and said piston valve defining a vapor-receiving chamber, the end of said piston valve proximate said one end of said passage being formed with a cavity; a spring cage on

9

said body extending away from said one end of said passage towards said piston valve so as to be received by said cavity when said piston valve moves towards said one end of said passage; a compression spring in said spring cage constantly biasing said piston valve away from said one end of said passage; fluid-transfer means connecting said vapor-receiving passage with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber, said conduit means including an elongated passage formed in said housing; a metering rod slidably disposed in said elongated passage whereby it may undergo longitudinal movement therein, the cross-sectional area of said rod controlling the volume of liquid flowing through said conduit means; and second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber.

9. Apparatus as set forth in claim 8 wherein said metering rod is formed with a head slidable within an enlarged portion of said first-mentioned conduit means and a compression spring is interposed between said head and a fixed point within said first-mentioned conduit means.

10. Apparatus for injecting a liquid and its vapor into

10

the intake manifold of an internal combustion engine, comprising: a control housing formed with a liquid-receiving chamber and a vapor-receiving chamber, both of said chambers being in communication with said intake manifold; a reservoir for said liquid, the upper portion of said reservoir being filled with liquid vapor; conduit means connecting the lower portion of said reservoir with said liquid-receiving chamber; second conduit means connecting the upper portion of said reservoir with said vapor-receiving chamber; and means in said control housing that automatically connects said liquid-receiving chamber with said first-mentioned conduit means during acceleration and higher cruising speeds of said engine while blocking flow through said vapor-receiving chamber, and connects said vapor-receiving chamber with said second conduit means during idling, deceleration and lower cruising speeds of said engine while blocking flow through said liquid-receiving chamber.

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