United States Patent [19]

Beiswenger et al.

[11] **3,924,408**

[45] **Dec. 9, 1975**

[54] **DIVERTER VALVE AND PRESSURE REGULATOR ASSEMBLY**

[75] Inventors: **David W. Beiswenger; Gordon R. Paddock,** both of Rochester, N.Y.; **Ernst L. Ranft,** Rochester, Mich.

[73] Assignee: **General Motors Corporation,** Detroit, Mich.

[22] Filed: **Oct. 31, 1974**

[21] Appl. No.: **519,530**

[52] **U.S. Cl.** **60/290;** 60/307; 60/410; 60/412; 137/115

[51] **Int. Cl.²** **F02B 75/10**

[58] **Field of Search** 60/289, 290, 307, 410, 60/412; 137/116, 115, 118

[56] **References Cited**

UNITED STATES PATENTS

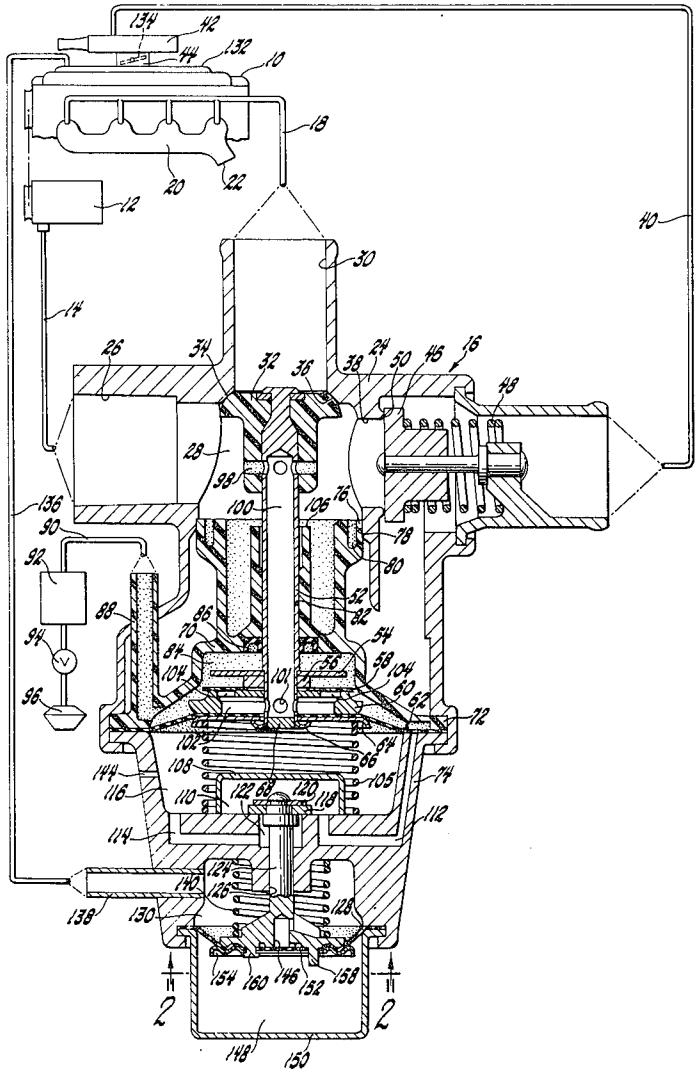
3,789,735	2/1974	Tam	60/307
3,805,522	4/1974	Sheppard	60/290
3,818,702	6/1974	Woo	60/307

Primary Examiner—Douglas Hart
Attorney, Agent, or Firm—C. K. Veenstra

[57] **ABSTRACT**

In a system for delivering air from an air pump to an internal combustion engine exhaust system, a diverter valve and pressure regulator assembly also supplies air to an auxiliary pneumatic device. A diverter valve member is shifted when necessary to recharge the auxiliary device to maintain a predetermined minimum pressure and also during engine deceleration to interrupt air flow to the exhaust system and thus preclude exhaust backfiring.

2 Claims, 2 Drawing Figures



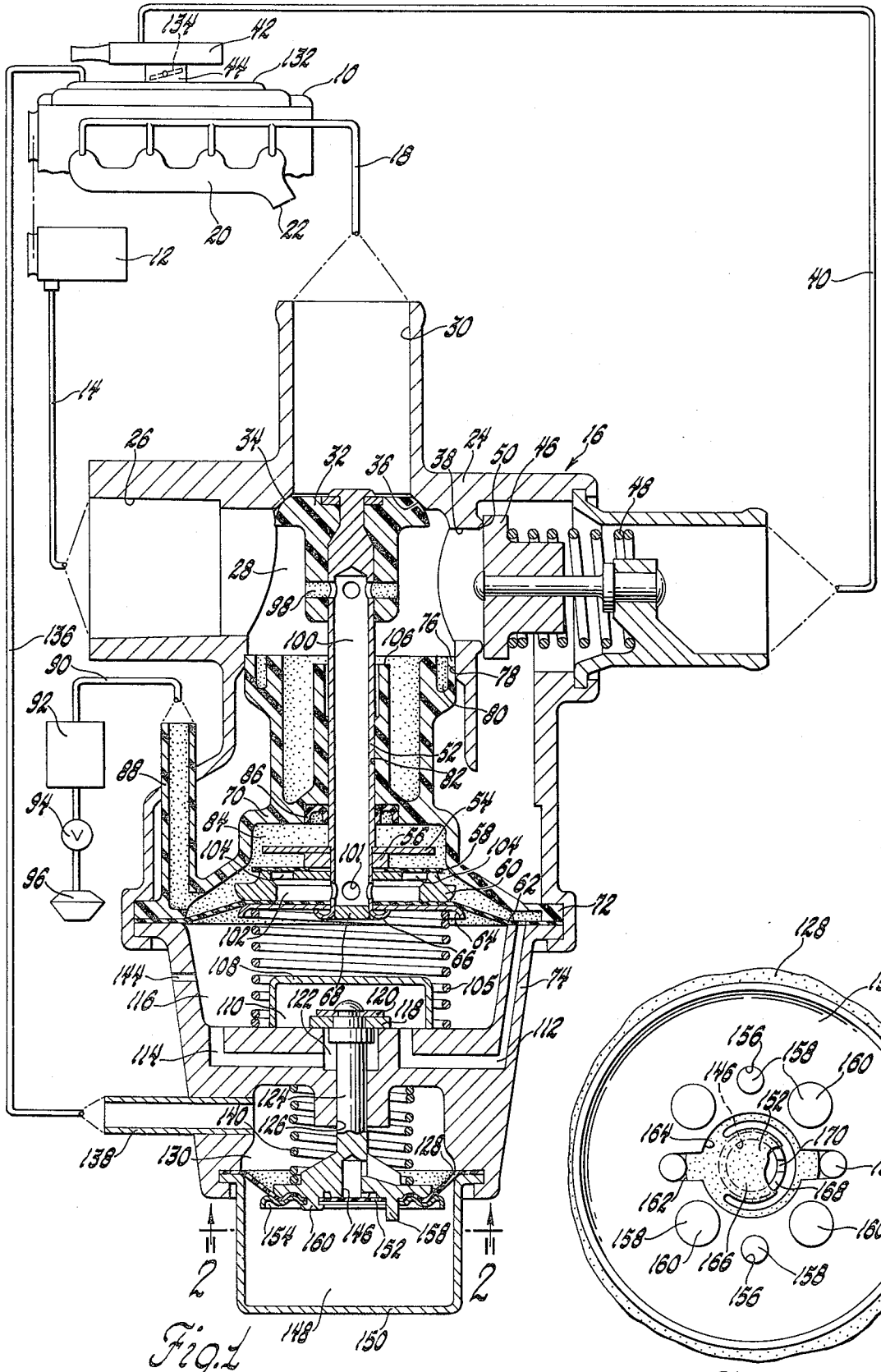

134
42
44
132
10
18
20
22
12
40
30
14
26
34
32
36
38
24
50
46
16
48
28
98
136
100
106
76
90
78
92
80
88
82
86
70
54
94
84
104
58
56
104
101
60
62
96
72
102
64
66
108
144
105
74
116
110
122
68
120
118
112
114
124
140
126
128
138
130
154
160
146
152
158
2
2
148
150

Fig. 1

128
154
156
158
160
146
152
164
170
158
162
168
158
160
160
166
158
156

Fig. 2

DIVERTER VALVE AND PRESSURE REGULATOR ASSEMBLY

This invention relates to a diverter valve and pressure regulator assembly for use in a system which delivers air from an air pump both to the exhaust system of an internal combustion engine and to an auxiliary pneumatic device, and more particularly, to an assembly having pressure regulating means which operate diverter valve means to charge the auxiliary pneumatic device.

Known diverter valve units, such as that set forth in U.S. Ser. No. 301,619 filed Oct. 27, 1972 and now U.S. Pat. No. 3,835,646, include anti-backfire and pressure relief provisions. In those units, a diaphragm is actuated by a sudden decrease in manifold pressure to shift a diverter valve member for a selected period during deceleration; in its shifted position, the valve member diverts the entire air flow away from the exhaust system to preclude exhaust backfiring and instead directs the air flow either to the engine induction system air cleaner or through a separate silencer. In addition, that diverter valve unit has a pressure relief valve member which permits a portion of the air flow to divert away from the exhaust system and escape to the air cleaner or through the silencer when the air pump discharge pressure exceeds a certain value.

This invention provides an improved diverter valve and pressure regulator assembly which, in addition to the functions of the known units, also supplies and regulates the pressure of air for an auxiliary pneumatic device.

In a diverter valve and pressure regulator assembly provided by this invention, an actuating diaphragm positions a diverter valve member in response to variations in the pressure of the air supplied to the auxiliary pneumatic device. If such pressure drops below a predetermined minimum value, the diverter valve member is shifted to interrupt flow from the air pump to the engine exhaust system until the auxiliary device is recharged. In addition, a control diaphragm responds to the abrupt increase in induction manifold vacuum which occurs upon engine deceleration and opens a control valve which equalizes the pressures across the actuating diaphragm; while this occurs, the actuating diaphragm again shifts the diverter valve member to interrupt air flow to the exhaust system to preclude exhaust backfiring.

The details as well as other features and advantages of this invention are set forth in the detailed description below and are shown in the drawing in which:

FIG. 1 is a schematic view of an internal combustion engine having an air pump for delivering air to the exhaust system and showing this diverter valve and pressure regulator assembly in an enlarged sectional elevational view; and

FIG. 2 is a view indicated by the line 2—2 in FIG. 1 further enlarged to show a check valve used as a portion of the anti-backfire mechanism.

Referring to the drawing, an internal combustion engine **10** drives an air pump **12** which supplies air through a conduit **14**, a diverter valve and pressure regulator assembly **16**, and a second conduit **18** to the exhaust manifold **20** or other portion of the exhaust system **22**. As is well known, air supplied in this manner supports combustion of exhaust gas hydrocarbonns and carbon monoxide and reduces emission of those constituents to the atmosphere.

Assembly **16** includes an upper housing **24** having a lateral inlet **26** receiving air from conduit **14** and opening to a valve chamber **28**. Housing **24** also has a main outlet **30** opening from valve chamber **28** for discharging air to conduit **18**. A diverter valve member **32** is disposed in valve chamber **28** and has a valve surface **34** engageable with a valve seat **36** surrounding main outlet **30**.

Housing **24** also has a diversion outlet **38** opening from valve chamber **28** to a conduit **40** which may extend to an engine induction air cleaner **42** secured above a carburetor **44**. A pressure relief valve member **46** is biased by a spring **48** to engage a valve seat **50** surrounding diversion outlet **38**. Spring **48** allows relief valve **46** to move away from seat **50** and permit air flow to air cleaner **42** or another silencer whenever the pump discharge pressure in valve chamber **28** exceeds a certain level. This can occur when diverter valve member **32** engages seat **36** or when the engine and pump are operating at high speeds.

Diverter valve member **32** is secured to the upper end of a hollow stem **52**. Adjacent its lower end, stem **52** extends through a backing plate **54**, a ring spacer **56**, a flexible check valve **58**, a dished plate **60**, an actuating diaphragm **62**, and a retainer plate **64**. The bottom **66** of stem **52** is spun outwardly over plate **64** and is closed by a plug **68**.

A fiberglass-reinforced nylon insert **70** has a lower rim **72** secured between upper housing **24** and a lower housing **74**, diaphragm **62** being retained between insert **70** and lower housing **74**. Insert **70** also has an upper rim **76** pressed into a bore **78** of upper housing **24** — a deep groove **80** in rim **78** facilitating the press fit.

Insert **70** additionally has a guide portion **82** which supports and guides stem **52**. A regulated pressure chamber **84** is defined between diaphragm **62** and insert **70**, and a lip seal **86** surrounds stem **52** to prevent air leaks between chambers **28** and **84**.

Insert **70** further has a fitting **88** connected through a conduit **90** to a reservoir **92**. A valve **94** controls the flow of air from reservoir **92** to a pneumatic motor **96** in any desired manner.

In operation, pump **12** delivers air through conduit **14** and inlet **26** to valve chamber **28** where it enters lateral holes **98** in diverter valve member **32** and stem **52** and passes down through a passage **100** defined in stem **52**, through openings **101** at the bottom of stem **52** into a chamber **102** defined by dished plate **60**, and upwardly through a plurality of openings **104** in dished plate **60** into regulated pressure chamber **84**. When chamber **84** and reservoir **92** are charged to a predetermined minimum pressure, diaphragm **62** is lowered against the bias of a spring **105** to lower stem **52** and thus valve member **32** until it engages a stop defined by the upper surface **106** of guide portion **82**. As the pump discharge pressure in valve chamber **28** and in chamber **102** drops below the pressure in chamber **84**, the outer rim of check valve **58** flexes downwardly and engages over openings **104** to prevent back flow of air from reservoir **92**. As the pressure in reservoir **92** and chamber **84** drops below the predetermined minimum value, spring **105** raises stem **52** to again engage valve member **32** with valve seat **36**, thus directing air flow through valve stem passage **100** to recharge chamber **84** and reservoir **92**. Reservoir **92** thus may be main-

tained at a predetermined minimum pressure of, for example, 3 psi. It will be appreciated, of course, that pressure relief valve **46** does not open until a higher pump discharge pressure of, perhaps, 10 psi is reached.

A cup **108** is welded to lower housing **74** to define a control chamber **110.** A passage **112** leads through lower housing **74** from regulated pressure chamber **84** to control chamber **110,** and a passage **114** leads through lower housing **74** from control chamber **110** to a bias chamber **116** defined between diaphragm **62** and lower housing **74.**

A control valve disc **118,** backed by a washer **120,** overlies the entrance **122** to passage **114** from control chamber **110.** Valve disc **118** and washer **120** are secured to a stem **124** which extends through a guide **126** formed by lower housing **74.** Stem **124** is secured to a control diaphragm **128.**

A vacuum chamber **130,** defined between diaphragm **128** and lower housing **74,** is subjected to the vacuum in the engine induction manifold **132,** downstream of the carburetor throttle **134,** by a conduit **136** and a fitting **138.** A spring **140,** disposed in vacuum chamber **130,** biases stem **124** and valve disc **118** to the position shown.

During engine deceleration, manifold vacuum rises abruptly, and the vacuum in chamber **130** increases to raise diaphragm **128** and stem **124** and lift valve disc **118** away from entrance **122.** Air is then admitted from regulated pressure chamber through passage **112,** control chamber **110,** and passage **114** to bias chamber **116.** Bias chamber **116** has only a restricted outlet through a small aperture **144** formed in lower housing **74,** and the air admitted to bias chamber **116** from regulated pressure chamber **84** thus equalizes the pressures across diaphragm **62.** Spring **105** thereupon raises stem **52** to engage valve member **32** with valve seat **36,** thus preventing air flow to the exhaust system to preclude exhaust backfiring. At such time, or as soon as chamber **84** and reservoir **92** are recharged, the entire air flow is diverted through outlet **50** past relief valve member **46.**

Valve stem **124** has a passage **146** to connect vacuum chamber **130** with a timing chamber **148** defined between control diaphragm **128** and a lower cup **150.** A flap-type check valve **152** is disposed in passage **146** to regulate flow from chamber **148** to chamber **130.**

The details of check valve **152** are shown most clearly in FIG. **2.** A washer member **154** is disposed under diaphragm **128** and has a plurality of apertures **156** which receive legs **158** formed on the lower portion of stem **124.** Four of these legs are riveted, as at **160,** to retain washer **154.**

The outer rim **162** of check valve member **152** is supported by the inner rim **164** of washer **154.** A central flap **166** of check valve **152** overlies an annular valve seat **168** formed at the base of stem **124.** A notch **170** is coined in seat **168.** During the period when manifold vacuum in vacuum chamber **130** is increasing, flow from chamber **148** through passage **146** to chamber **130** is restricted to pass through notch **170.** Thus, the volume of chamber **148** and the size of notch **170** determine the time required for the pressure in chamber **148** to be reduced to the point where spring **140** will lower diaphragm **128,** stem **124** and valve disc **118** to the position shown. During a period of increasing pressure in chamber **130,** central flap **166** will be pushed downwardly to allow unrestricted flow from chamber **130** through passage **146** to chamber **148** and thus permit immediate return of diaphragm **128,** stem **124** and valve disc **118** to the position shown.

When valve disc **118** returns to the position shown, flow from regulated pressure chamber **84** to bias chamber **116** is interrupted, the pressure in bias chamber **116** bleeds down to atmospheric through aperture **144,** and the higher pressure in regulated pressure chamber **84** lowers diaphragm **62** and stem **52** to move diverter valve member **32** away from seat **36** and re-establish air flow through outlet **30** to the exhaust system.

It will be appreciated, therefor, that this diverter valve and pressure regulator assembly supplies and regulates the pressure of air for an auxiliary pneumatic device in addition to controlling the air flow to the engine exhaust system in the desired manner.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A diverter valve and pressure regulator assembly for use on an internal combustion engine having an exhaust system, an air pump, and an auxiliary pneumatic device, said assembly comprising a housing having an inlet adapted to receive air from said pump, an outlet adapted to discharge air to said exhaust system, and a valve seat intermediate said inlet and said outlet, a diverter valve member associated with said valve seat, a spring biasing said diverter valve member toward said valve seat to restrict air flow from said inlet to said outlet, and a diaphragm secured to said housing to define a regulated pressure chamber therebetween, a passage extending from said inlet to said chamber to supply air thereto, said chamber being adapted for connection to said device to supply air thereto, said diaphragm being connected to said diverter valve member and responsive to the pressure in said regulated pressure chamber to shift said diverter valve member away from said valve seat against the bias of said spring when the pressure in said chamber exceeds a predetermined minimum and to permit said spring to shift said diverter valve member toward said valve seat when the pressure in said chamber drops below said minimum whereby air flow through said outlet is restricted to charge said regulated pressure chamber and said device to said minimum pressure, and which further comprises means responsive to engine operating conditions for equalizing the pressures across said actuating diaphragm to permit said spring to shift said diverter valve member toward said valve seat whereby air flow through said outlet to said exhaust system is restricted.

2. A diverter valve and pressure regulator assembly for use on an internal combustion engine having an exhaust system, an air pump, and an auxiliary pneumatic device, said assembly comprising an upper housing having an inlet adapted to receive air from said pump, an outlet adapted to discharge air to said exhaust system, and a valve seat intermediate said inlet and said outlet, a diverter valve member biased into engagement with said valve seat, a stem secured to said valve member, a diaphragm secured to said stem and defining a regulated pressure chamber with said housing, said stem having a passage connecting said inlet and said chamber for supplying air thereto, said chamber being adapted for connection to said device for supplying air thereto, a check valve in said passage for preventing air flow from said chamber to said inlet, said diaphragm being responsive to the pressure in said regulated pressure chamber to shift said diverter valve member away from said valve seat when the pressure in said chamber

exceeds a predetermined minimum and to permit said diverter valve member to engage said valve seat when the pressure in said chamber is below said minimum whereby air flow through said outlet is restricted to charge said regulated pressure chamber and said device to said minimum pressure, a lower housing defining a bias chamber with said actuating diaphragm, said lower housing having a restricted aperture opening from said bias chamber and a passage connecting said regulated pressure chamber and said bias chamber, a control valve in said housing passage biased to prevent flow from said regulated pressure chamber to said bias chamber, and means for operating said control valve to permit flow from said regulated pressure chamber to said bias chamber and thereby equalize the pressures therein to permit said diverter valve to engage said valve seat and thus restrict flow to the engine exhaust system.

* * * * *