United States Patent [19]

Falen et al.

[11] **3,788,287**

[45] **Jan. 29, 1974**

[54] **FUEL INJECTION SYSTEM**

[75] Inventors: **Walter S. Falen,** Greece; **Anthony J. Giardina,** Rochester, both of N.Y.

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

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[21] Appl. No.: **227,428**

[52] **U.S. Cl.. 123/52 MV,** 123/119 R, 123/139 AW

[51] **Int. Cl.** **F02b 75/22**

[58] **Field of Search**. 123/139 AW, 139 BG, 32 AE, 123/32 JV, 32 G, 139 AV, 52 M, 52 MV, 139 AT

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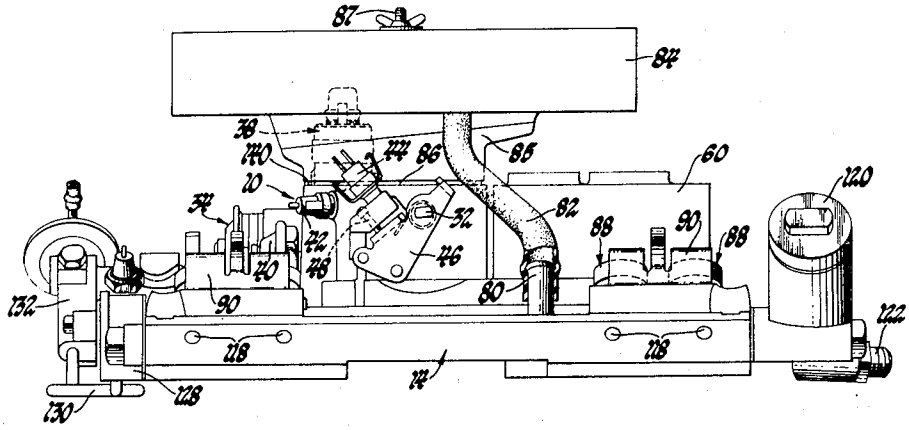
Primary Examiner—Laurence M. Goodridge

Attorney, Agent, or Firm—C. K. Veenstra

[57] **ABSTRACT**

In an electronically controlled fuel injection system, the fuel injectors and other components are mounted on extruded rails each having a fuel passage and an atmospheric air gallery formed during extrusion.

1 Claim, 9 Drawing Figures



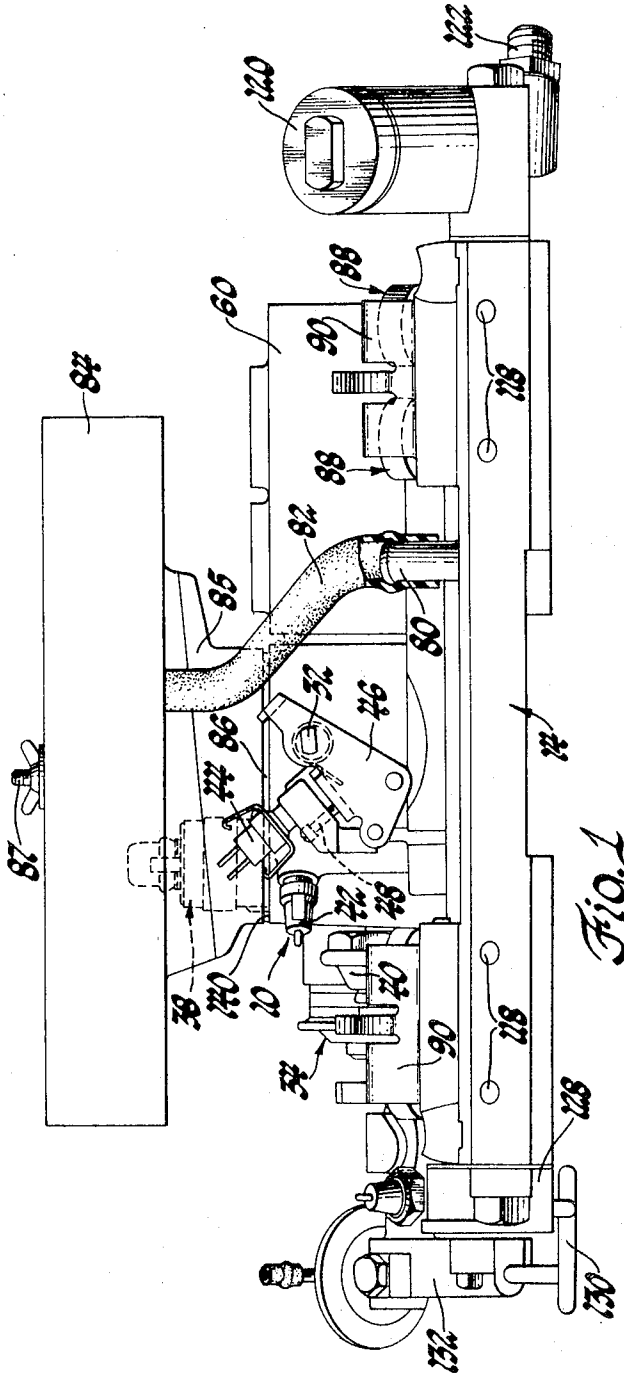


Fig. 1

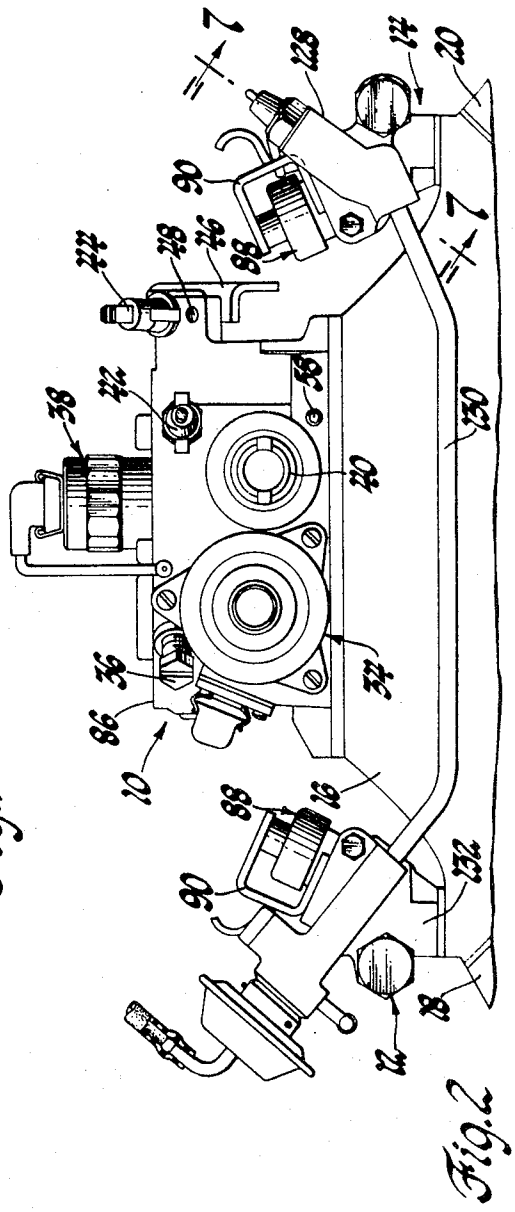


Fig. 2

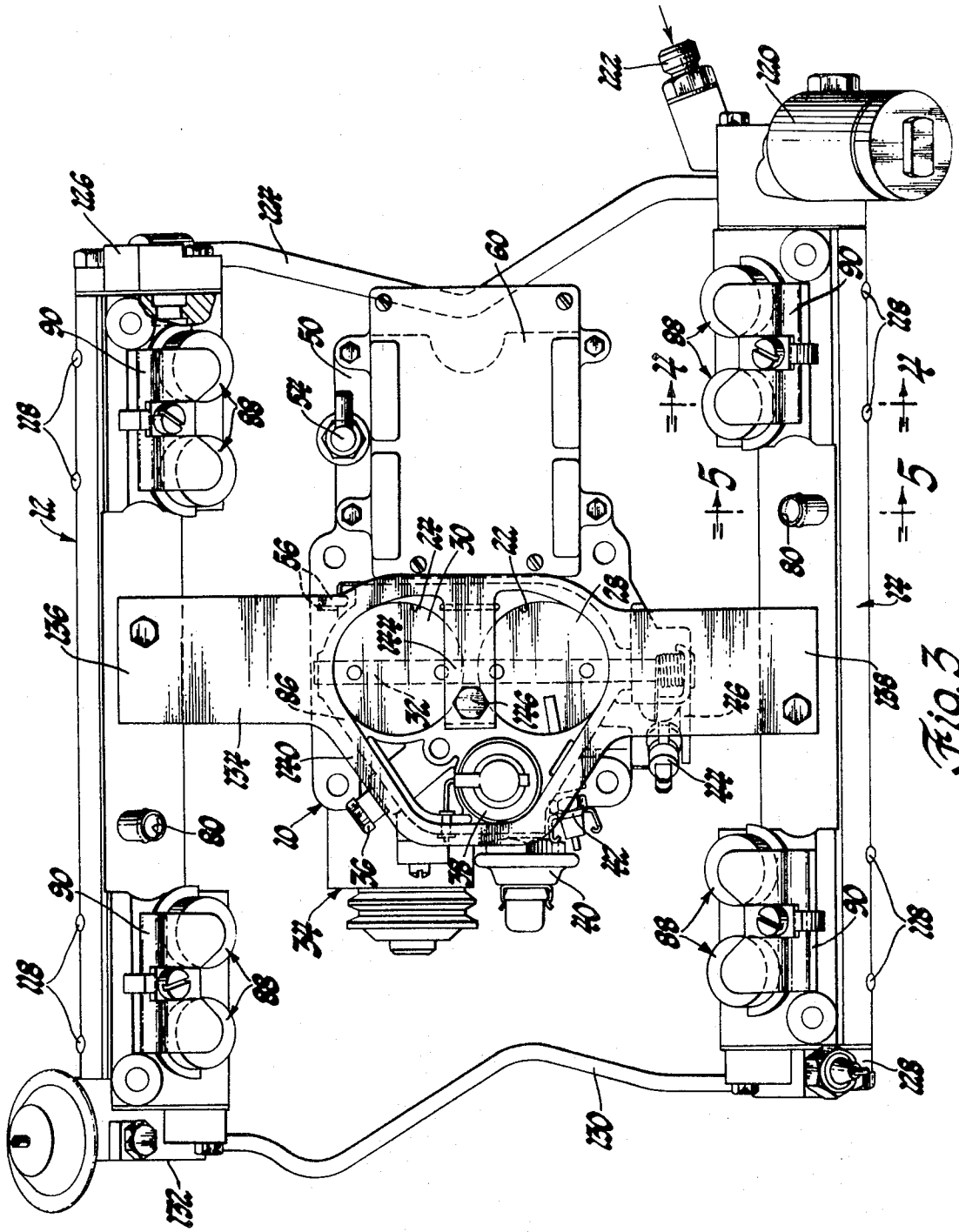


Fig. 3

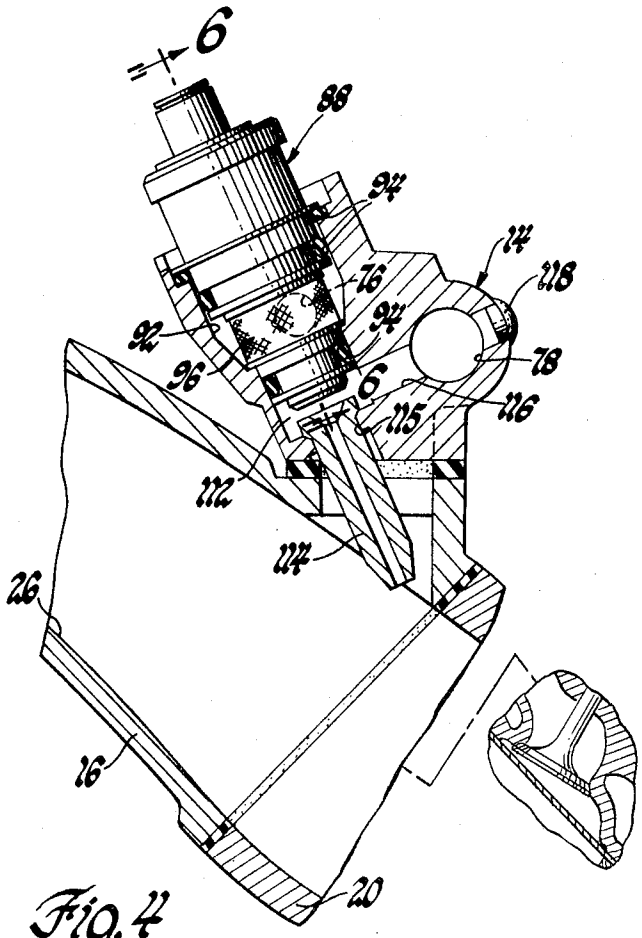


Fig. 4

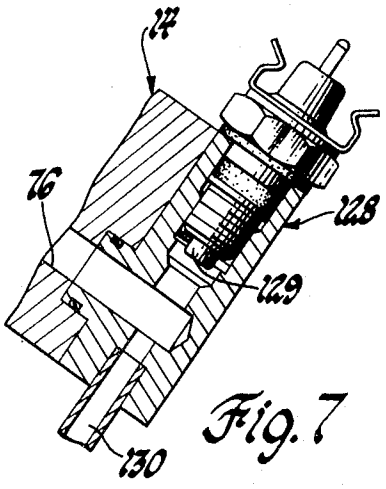


Fig. 7

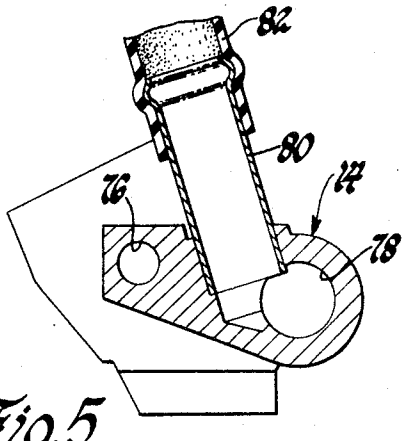


Fig. 5

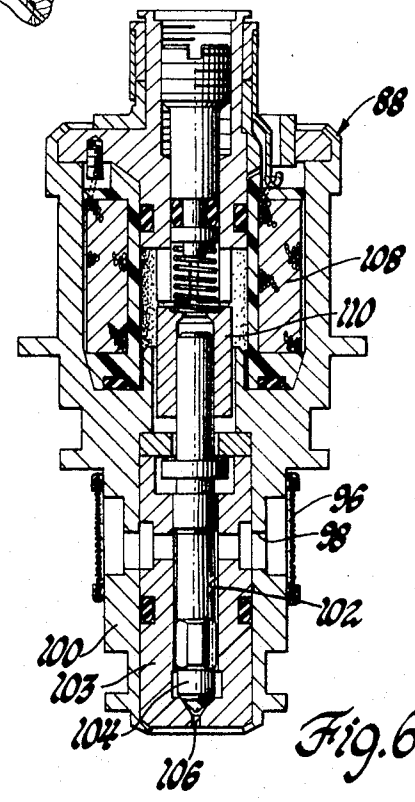


Fig. 6

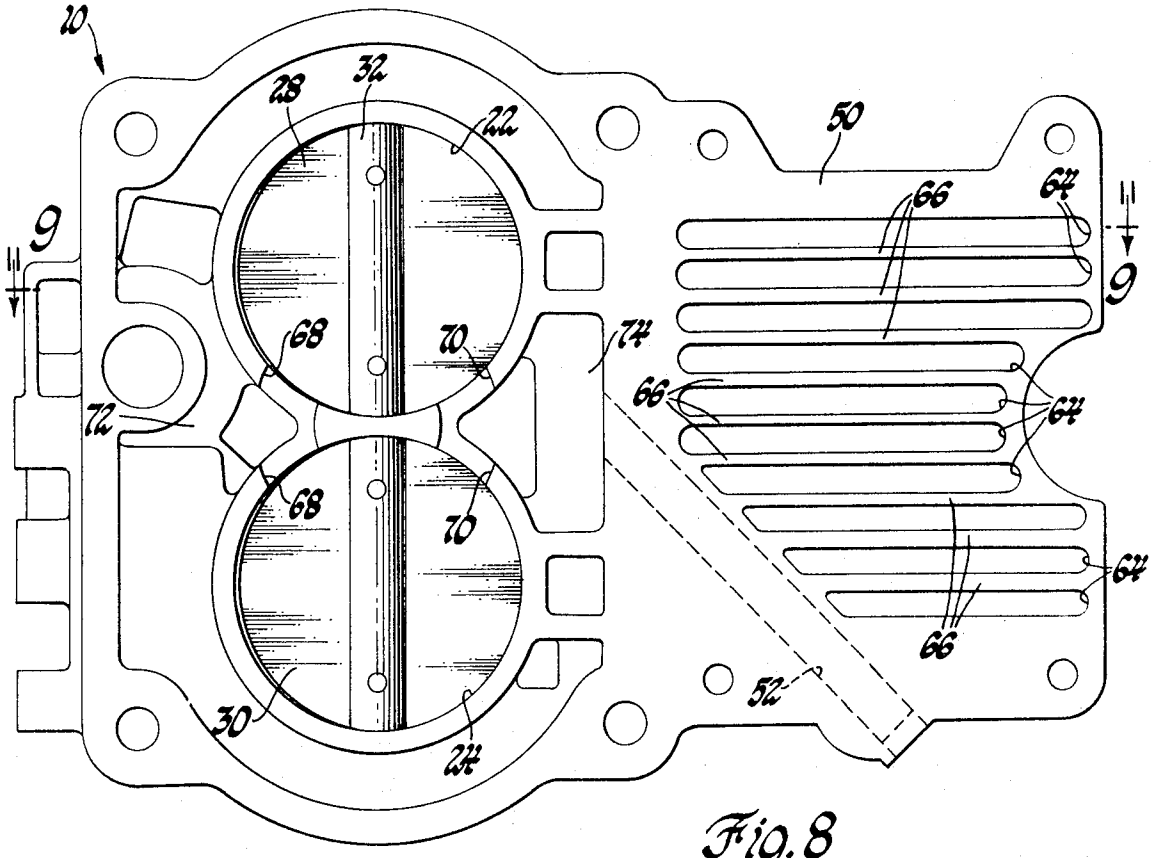

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Fig. 8

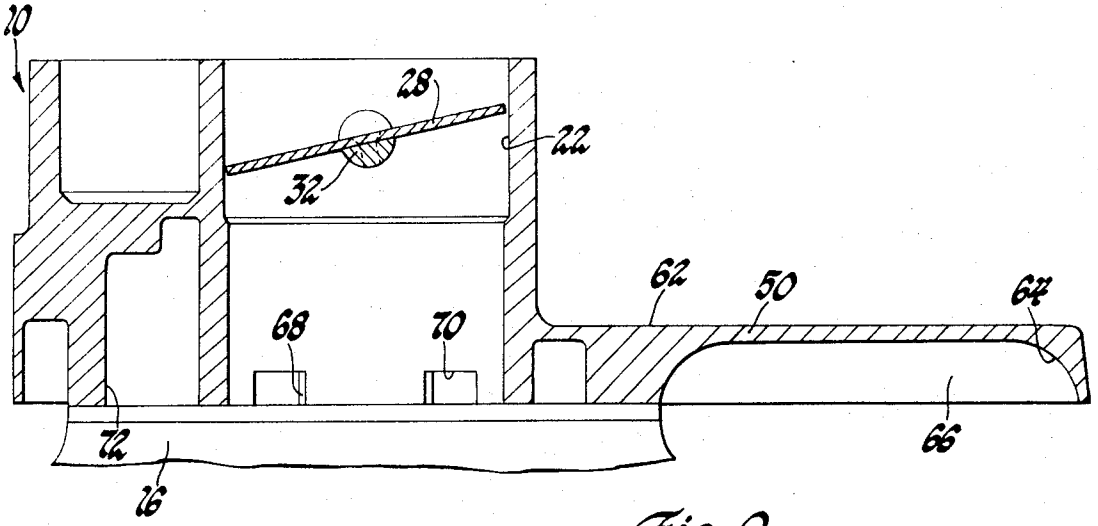

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Fig. 9

FUEL INJECTION SYSTEM

This invention relates to a fuel injection system having numerous advantages of construction and operation over those available heretofore.

Particular advantages may be noted in the provision of extruded rails which extend along each bank of combustion chambers. Each rail contains a fuel passage and an atmospheric air gallery formed during extrusion and provides for mounting the injectors and other fuel injection system components in an easily handled unit.

The details as well as other objects and advantages of this invention are set forth in the remainder of the specification and are shown in the drawings in which:

FIG. 1 is a side elevational view of a fuel injection system, also showing an air cleaner mounted on the air inlet body but omitting any showing of the inlet manifold and other engine components for clarity of detail;

FIG. 2 is a front elevational view of the fuel injection system, showing its relationship to the inlet manifold and cylinder heads;

FIG. 3 is a top plan view of the fuel injection system, showing the bracket securing the air inlet body and the fuel rails into a single package for testing and shipping;

FIG. 4 is a sectional view, as it would appear along line 4—4 of FIG. 3, showing one of the injectors mounted in the fuel rails and also showing the relationship of the components to the induction passage in the inlet manifold and cylinder heads;

FIG. 5 is a sectional view, as it would appear along line 5—5 of FIG. 3, showing one of the air inlet fittings for the atmospheric air galleries in the fuel rails;

FIG. 6 is a sectional view along line 6—6 of FIG. 4 showing the constructional details of one of the fuel injectors;

FIG. 7 is a sectional view along line 7—7 of FIG. 2 showing the mounting of a fuel temperature thermistor;

FIG. 8 is a bottom plan view of the air inlet body and the heating conducting pad; and

FIG. 9 is a sectional view along line 9—9 of FIG. 8 showing further details of the heat conducting pad.

Throughout the drawings, some portions of the electrical wiring and the air and vacuum hoses are illustrated but most portions of such have been omitted for a clearer illustration of other components of the fuel injection system.

Referring to the drawings, the fuel injection system includes an air inlet body **10** and a pair of extruded fuel rails **12** and **14**. Mounted on an inlet manifold **16** which in turn is mounted on cylinder heads **18** and **20**, air inlet body **10** has a pair of air inlet passages **22** and **24** which register with the induction passage **26** extending through inlet manifold **16** and heads **18** and **20** to the combustion chamber inlet ports. Throttles **28** and **30** are disposed in inlet passages **22** and **24** on a rotatable shaft **32** for controlling air flow through induction passage **26**.

Air inlet body **10** also is provided with a transducer **34**, such as that described in U.S. Ser. No. 202,760, filed Nov. 29, 1971, which measures the absolute pressure in air inlet passages **22** and **24** and induction passage **26** downstream of throttles **28** and **30** and provides an electrical signal proportional thereto.

Air inlet body **10** also has provision for a curb idle adjustment **36** and a fast idle control valve **38** such as those shown in U.S. Ser. No. 41,141, filed May 25, 1970, now U.S. Pat. No. 3,645,509.

If desired, air inlet body **10** also may include provision for a transducer **40** which provides an electrical signal indicative of a sudden increase in pressure in air inlet passages **22** and **24** and induction passage **26** downstream of throttles **28** and **30** and thus indicative of engine acceleration.

In addition, air inlet body **10** includes provision for mounting a thermistor **42** which senses the temperature of the air entering air inlet passages **22** and **24** and induction passage **26**. Further, air inlet body **10** may include provision for an electrical switch **44** which is opened and closed by a throttle lever **46** secured on throttle shaft **32** and which thus indicates the position of throttles **28** and **30**. An adjusting screw **48** may be provided to limit throttle closing movement of throttle lever **46**.

A heat conducting pad **50** extends horizontally from air inlet body **10** toward the rear of the engine. As shown in FIG. **8**, a drilled passage **52** provides a manifold vacuum tap to which the manifold vacuum connection **54** shown in FIG. **3** may be mounted. Other fittings **56** also shown in FIG. **3** may be provided for various vacuum signals created as throttle **30** traverses various ports (not shown) provided in air inlet passage **24**. Other vaccum taps, such as that shown at **58** in FIG. **2**, also may be provided.

As shown in FIGS. **1** and **3**, an electronic package **60** is mounted on heat conducting pad **50**. Electronic package **60** receives electrical signals from the components, such as transducers **34** and **40**, throttle switch **44**, and thermistor **42**, which meter air flow to the engine and controls energization of the injectors which meter fuel flow to the engine as described below. Referring to FIGS. **8** and **9**, electronic package **60** is designed to mate with the heat transfer surface **62** of pad **50** whereby heat generated during operation of electronic package **60** may be conducted into heat conducting pad **50**. The lower surface of pad **50** has a plurality of elongated recesses **64** which define a plurality of fins **66** therebetwen. Fins **66** radiate heat from pad **50** into the atmosphere ambient pad **50**, space being provided between the lower portion of pad **50** and inlet manifold **16** to permit air circulation. Recesses **64** and fins **66** are generally parallel and their major axes extend longitudinally toward air inlet body **10**, thus facilitating heat conduction to air inlet passages **22** and **24**. Heat generated during operation of electronic package **60** also is dissipated, therefore, into the air flowing through inlet passages **22** and **24** to induction passage **26**.

Still referring to FIGS. **8** and **9**, it may be noted that several ports **68** and **70** provide openings from air inlet passages **22** and **24**, below throttles **28** and **30**, to manifold pressure chambers **72** and **74**. Manifold vacuum passage **52** extends from chamber **74**, while manifold pressure transducer **34**, idle air controls **36** and **38**, acceleration transducer **40**, as well as other desired components, are associated with chamber **72**.

Fuel rail **12** extends longitudinally along the right-hand bank of combustion chambers while fuel rail **14** extends longitudinally along the left-hand bank of combustion chambers. Rails **12** and **14** are shown in FIG. **2** as being mounted on inlet manifold **16**, but provision could be made for mounting the rails on cylinder heads **18** and **20**, if desired.

As shown in FIGS. **4** and **5**, rails **12** and **14** have fuel passages **76** and air passages or galleries **78** which are

formed during the process of extruding rails **12** and **14**. Air galleries **78** having fittings **80** provided with hoses **82** to receive air from an air cleaner **84**. As shown in FIG. **1**, cleaner **84** is supported by an adapter ring **85**, received on a ledge **86** formed about air inlet body **10**, and is secured by a stud **87**.

Each rail **12** and **14** has a plurality of injectors **88** retained, by clamps **90** as shown in FIG. **3**, in sockets **92** formed as shown in FIG. **4**. Sockets **92** intersect fuel passages **76**, and **0**-rings **94** surrounding injectors **88** above and below passages **76** prevent leakage of fuel from sockets **92**.

As shown in FIG. **6** each injector **88** has a screen **96** through which fuel is received from passage **76**. Fuel passes from screen **96** through an opening **98** in the injector body **100** and then through a central bore **102** in the nozzle **103**. A valve plunger **104** controls flow of fuel from bore **102** through nozzle opening **106**. When energized by electronic package **60**, a solenoid coil **108** lifts a magnetically responsive member **110** secured on the end of valve plunger **104**, thus metering and delivering fuel from fuel passage **76** through injector socket **92**, screen **96**, opening **98**, bore **102**, and opening **106** into the base region **112** of socket **92**. Nozzle opening **106** sprays the fuel through a critical flow orifice member **114** which is disposed in the outlet **115** opening from base region **112** of socket **92**. Orifice members **114** are aimed through induction passage **26** toward the inlet ports for the combustion chambers located at the ends of induction passage **26**.

Branch passages **116** extend from air galleries **78** to base regions **112** of sockets **92** to provide atmospheric pressure regions at the outlets of injectors **88** and to supply a constant flow of air through orifice members **114**. Branch passages **116** receive plugs **118** at the outer ends.

As best shown in FIG. **3**, the rearward end of rail **14** is provided with a filter housing **120** which receives fuel through a fitting **122** from a fuel pump such as that set forth in U.S. SER. No. 211,934, filed Dec. 27, 1971. Filter housing **120** supplies fuel to fuel passage **76** in rail **14** and, through a crossover pipe **124**, to a similar fuel passage in rail **12**. A fitting **126** may be provided on the rearward end of rail **12** to receive fuel from crossover pipe **124**. At the forward end of rail **14**, a fitting **128** houses a fuel temperature responsive thermistor **129** and provides a connection between fuel passage **76** in rail **14** and a crossover pipe **130** which extends to a fitting **132** at the forward end of rail **12**. Fitting **132** includes means for bleeding fuel vapor from fuel passages **76** in rails **12** and **14** as set forth in U.S. Ser. No. 221,640, filed Jan. 28, 1972.

As shown in FIG. **3**, a bracket **134** is bolted at its outboard ends **136** and **138** to rails **12** and **14** and has a central portion **140** which is received on air cleaner adapter ring ledge **86** formed about air inlet body **10**. A central arm **144** carries a bolt **146** which is received in a hole tapped in body **10** to receive air cleaner stud **87**, thereby securing bracket **134** to air inlet body **10**. By this means, air inlet body **10** and rails **12** and **14** are secured in a single package whereby both air and fuel metering components of the fuel injection system may be tested and shipped as a single unit. If desired, the bracket may be removed during installation of the air inlet body **10** and rails **12** and **14** on the engine.

I claim:

1. In a fuel injection system on an internal combustion engine having a plurality of longitudinally spaced combustion chambers, each of said combustion chambers having an air and fuel inlet passage:

a fuel rail assembly mounted longitudinally on said engine, said fuel rail assembly comprising:

a fuel rail member extruded from a single piece of material and having longitudinally extending fuel and air passages formed during extrusion of the rail member, injector receiving sockets extending transversely into said fuel rail member and intersecting said fuel passage, branch air passages extending transversely from said air passage to said sockets adjacent the bases thereof, and outlets opening from the bases of said sockets into said combustion chamber air and fuel inlet passages,

and injectors disposed in said sockets for controlling fuel flow from said fuel passage to said outlets.

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