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Franchi et al.

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(54) **WIRE GUIDE FOR ELECTRONICALLY CONTROLLED FUEL INJECTION SYSTEMS**

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(51) **Int. Cl.**[7] **F02B 77/00**; F16L 3/08

(52) **U.S. Cl.** ..... **123/195 A**; 174/72 A; 248/74.1; 123/195 E

(58) **Field of Search** ..... 123/470, 456, 123/446, 468, 469, 195 A, 195 E; 248/68.1, 74.1, 71, 73, 74.4, 74.5, 74.2; 174/72 A

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,029,277	A	*	6/1977	Bulanda	248/74.1
4,771,743	A	*	9/1988	McDowell	123/143 C
4,865,280	A	*	9/1989	Wollar	248/68.1
5,035,637	A		7/1991	Mathews et al.	
5,168,842	A	*	12/1992	Brooks	123/143 C
5,178,115	A		1/1993	Daly	
5,211,149	A	*	5/1993	DeGrace, Jr.	123/470
5,390,648	A		2/1995	Yanase	
5,551,150	A	*	9/1996	Zielinski et al.	29/882
5,567,184	A	*	10/1996	Sasai et al.	439/752
5,597,980	A		1/1997	Weber	
5,607,318	A	*	3/1997	Wakata et al.	439/274
5,642,704	A		7/1997	Gogots et al.	
5,709,559	A		1/1998	Fujitani et al.	
5,771,850	A		6/1998	Okada	
5,893,351	A		4/1999	Akutagawa et al.	
6,068,048	A	*	5/2000	Cude	165/125

* cited by examiner

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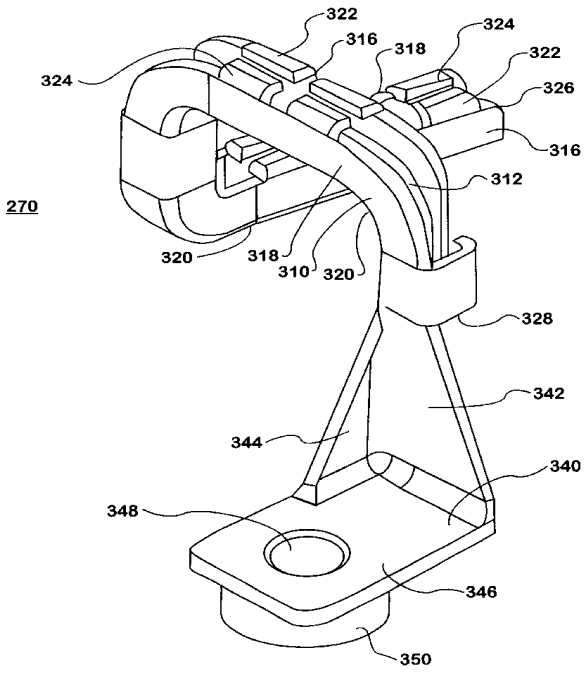
(57) **ABSTRACT**

There is provided a wire guide for guiding and protecting wires from moving parts underneath the valve cover in a diesel engine. The wire guide has a channel portion connected to a base for securing the wire guide to the cylinder head. The base may be comprised of a retaining clip having two prongs that form an assembly that "snaps-on" to an injector clamp holder to secure the wire guide to the cylinder head. The channel portion is configured to cross a rocker arm when the wire guide is mounted on the cylinder head. The channel portion creates a conduit for holding the wires. The conduit is partially closed on at least one side and has an open side with intermittently spaced retaining tabs. The retaining tabs may be intermittently spaced as a series of pair tabs or alternating opposing singular tabs.

26 Claims, 9 Drawing Sheets



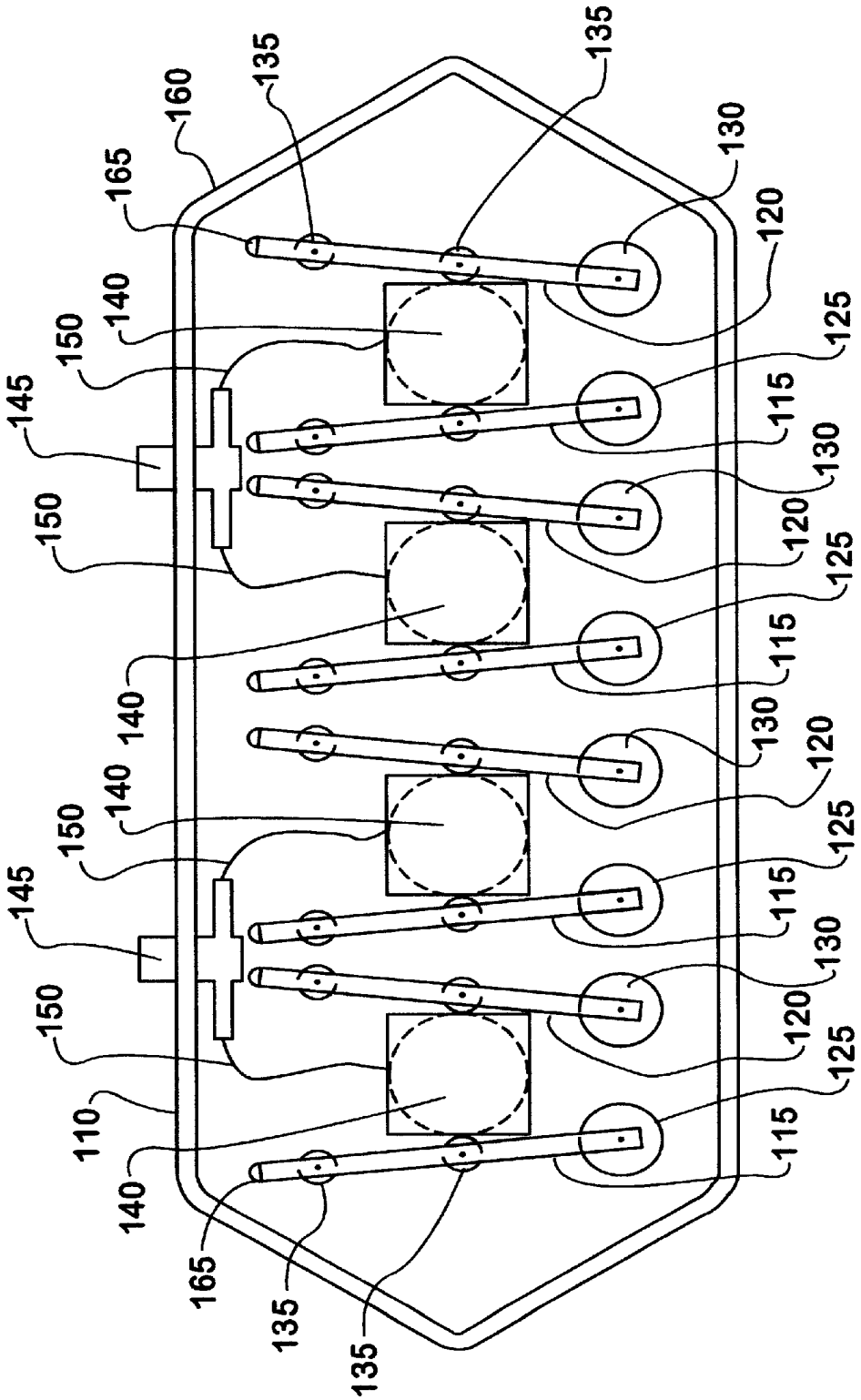


FIG. 1
PRIOR ART

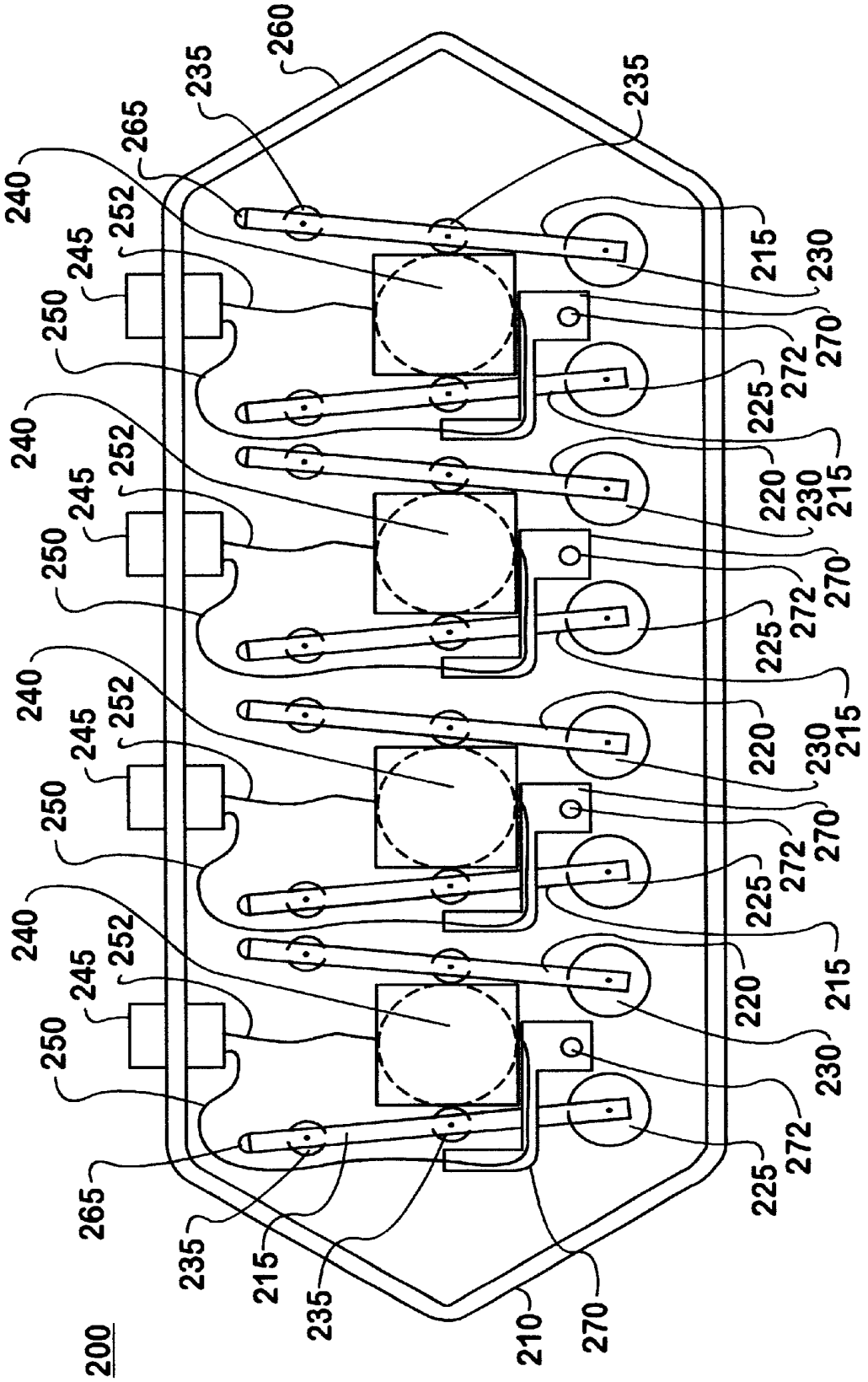


FIG. 2

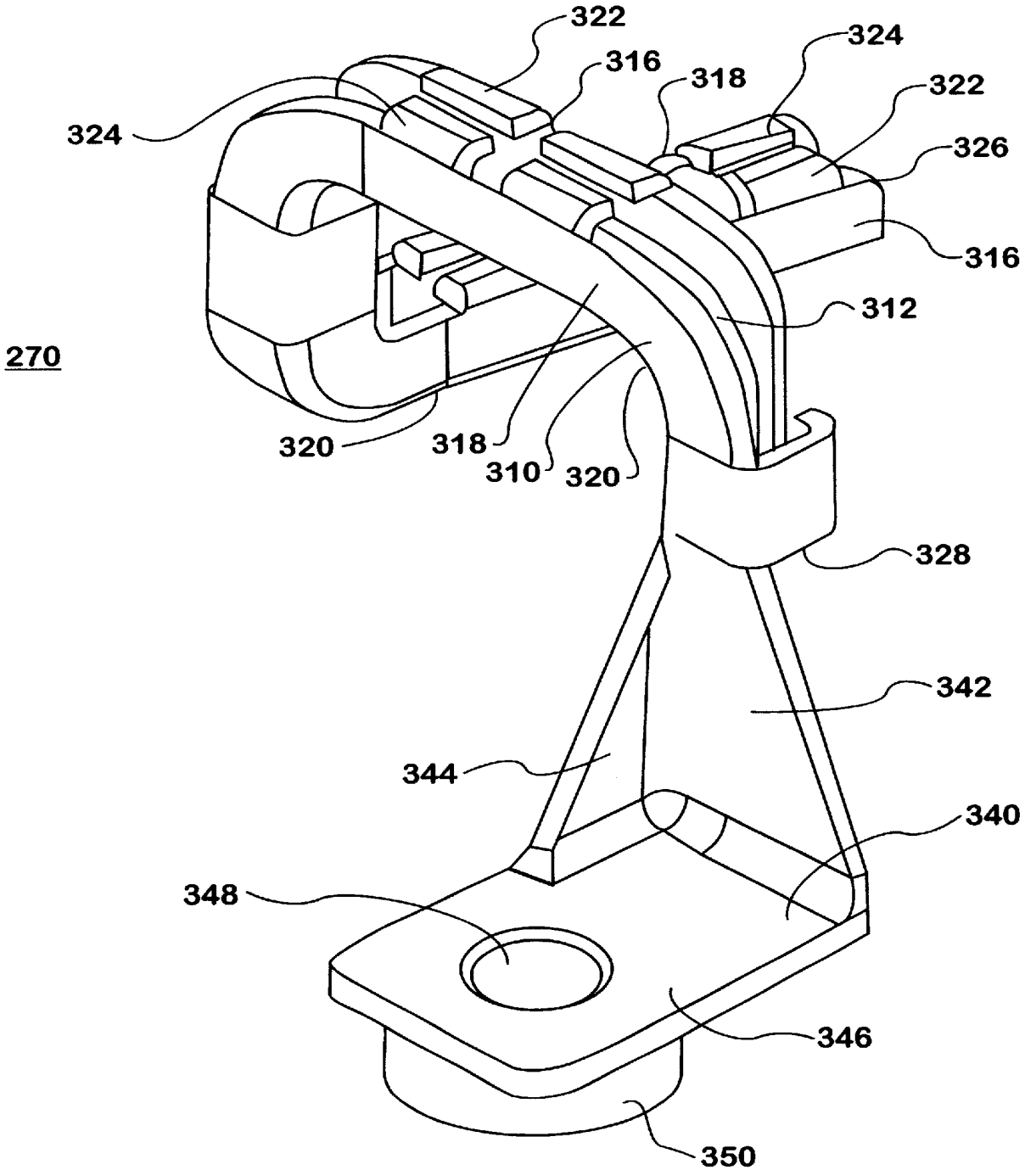
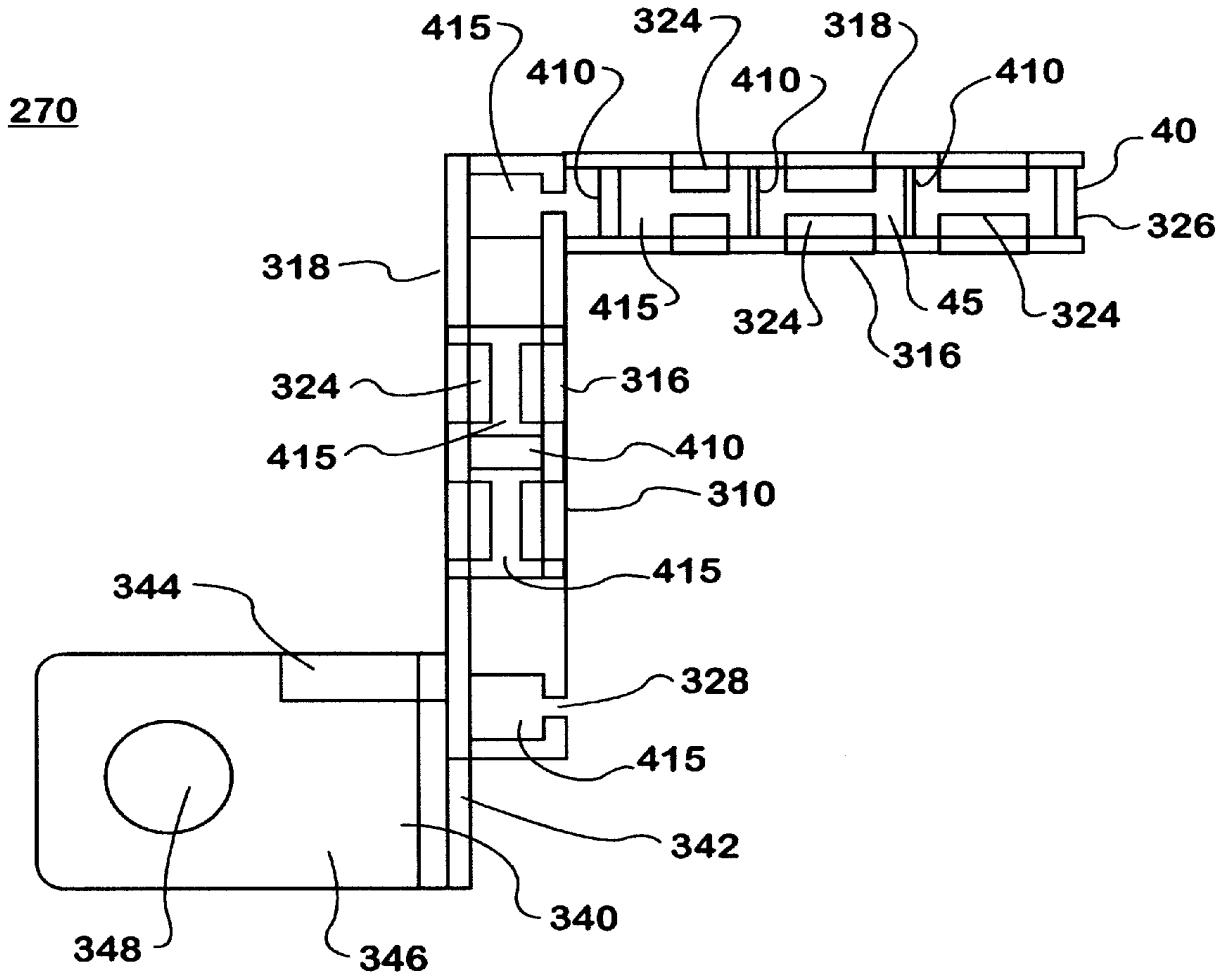


FIG. 3

FIG. 4



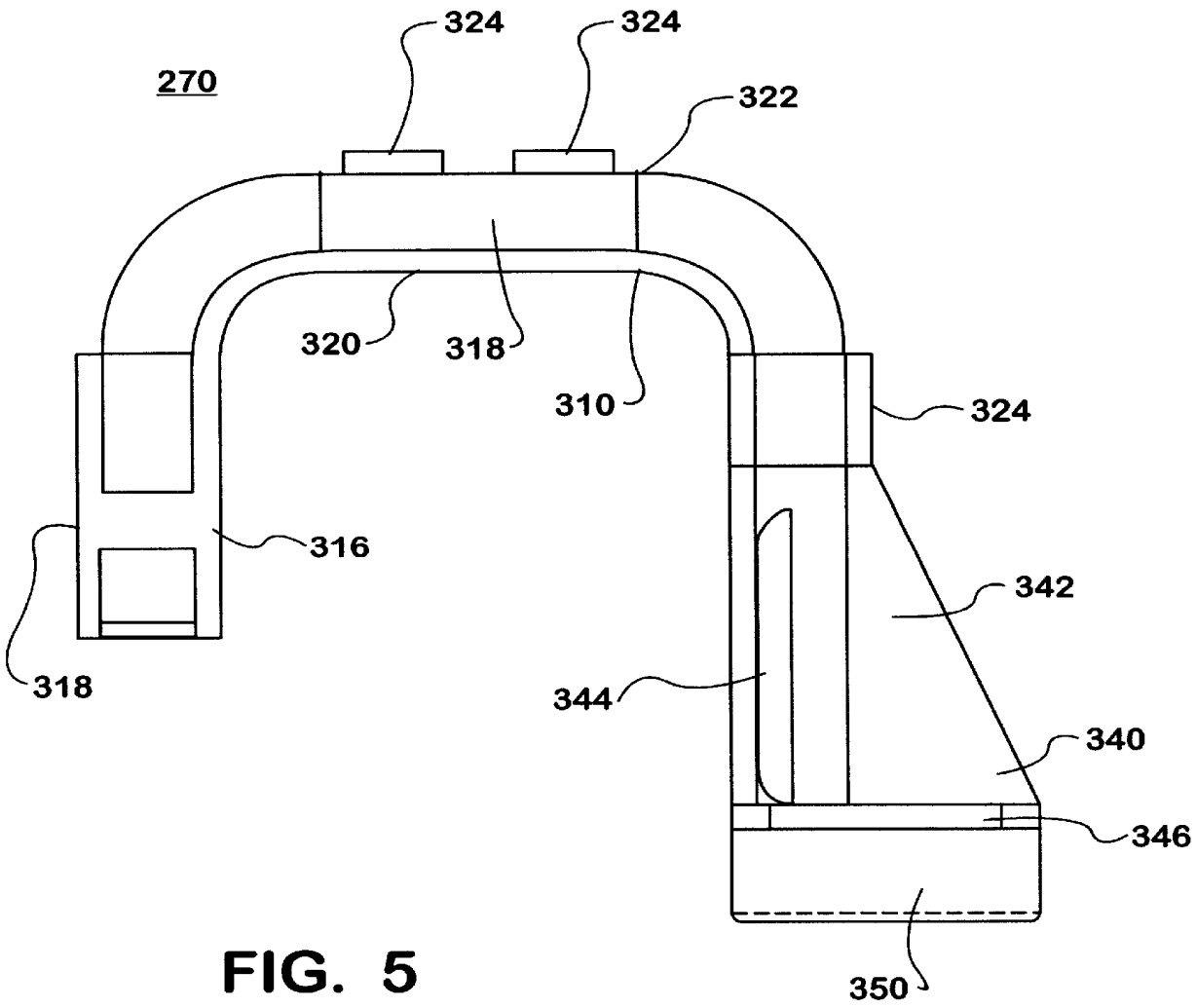


FIG. 5

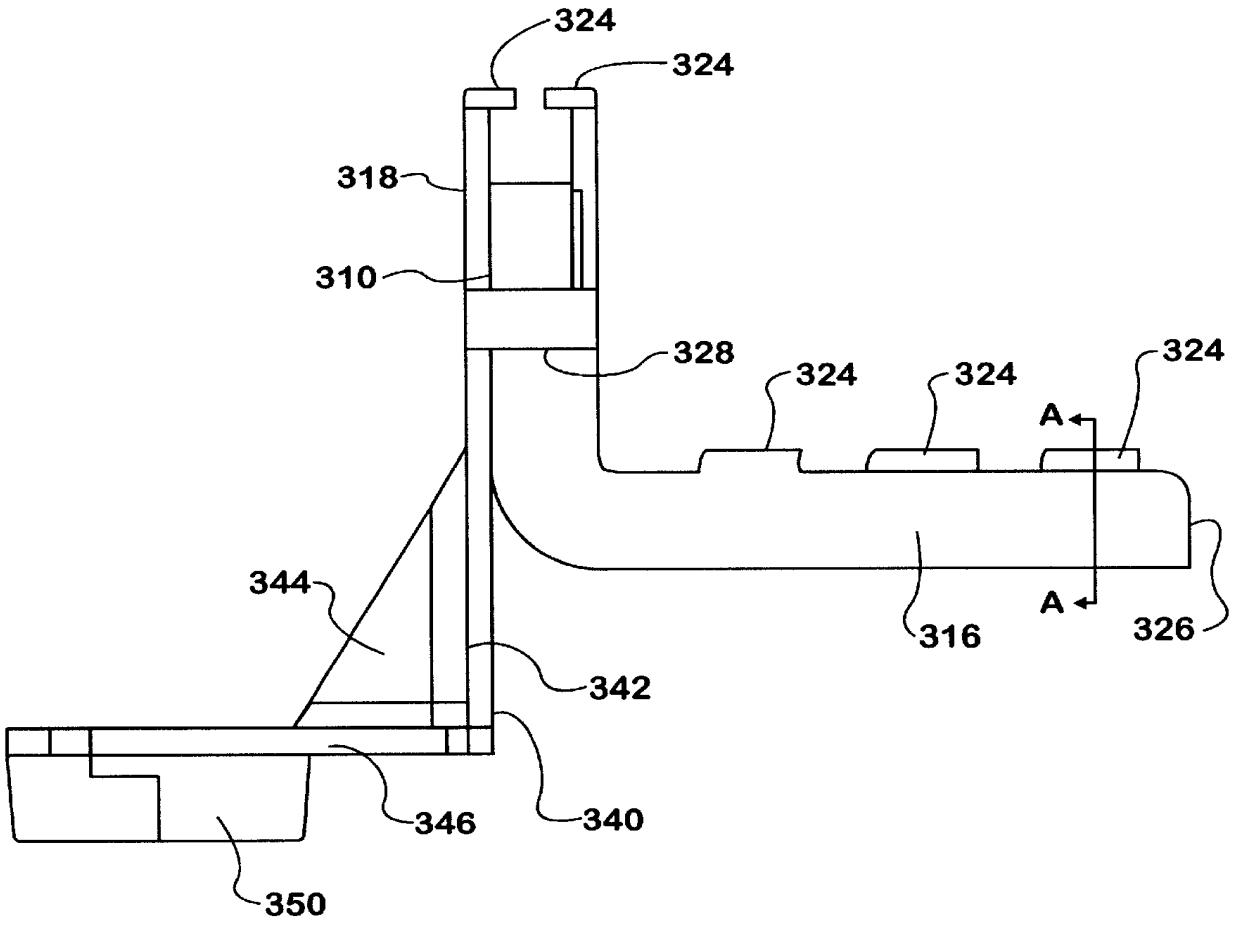


FIG. 6

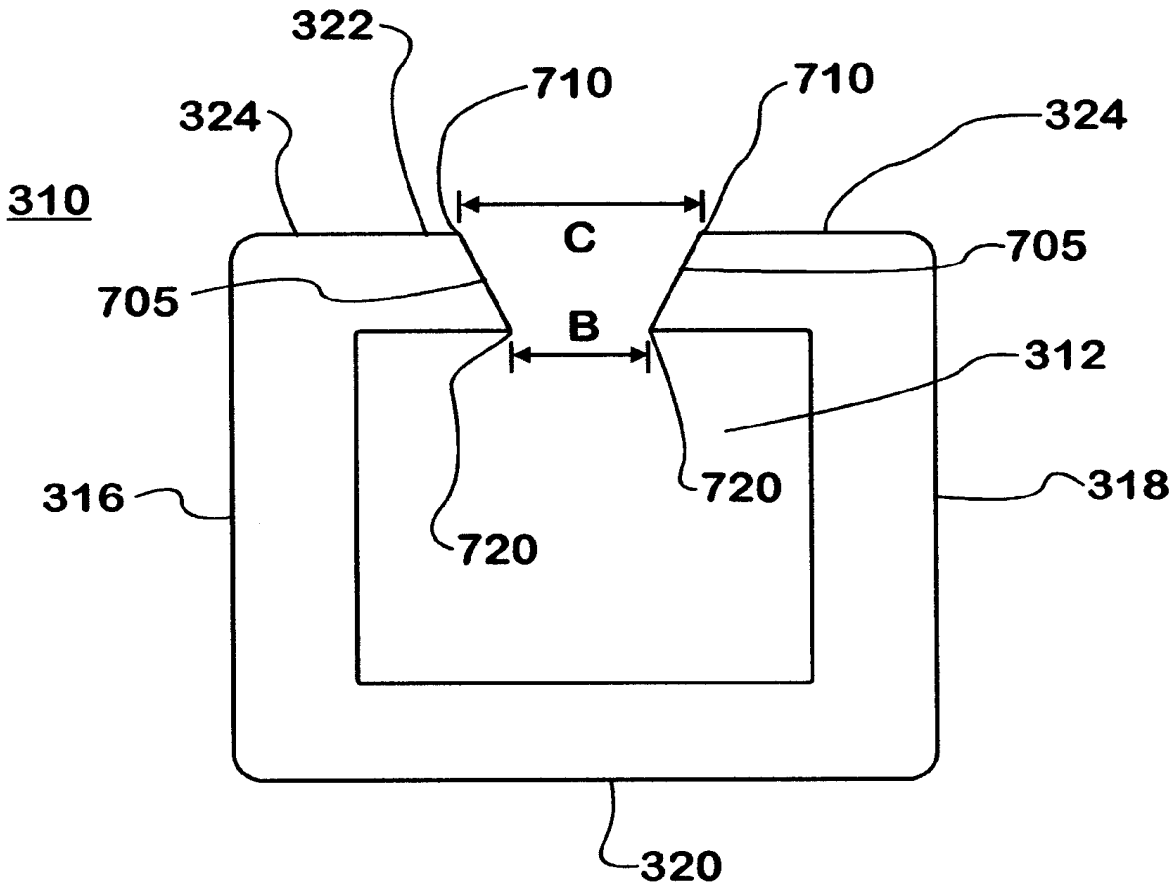


FIG. 7
SECTION A-A

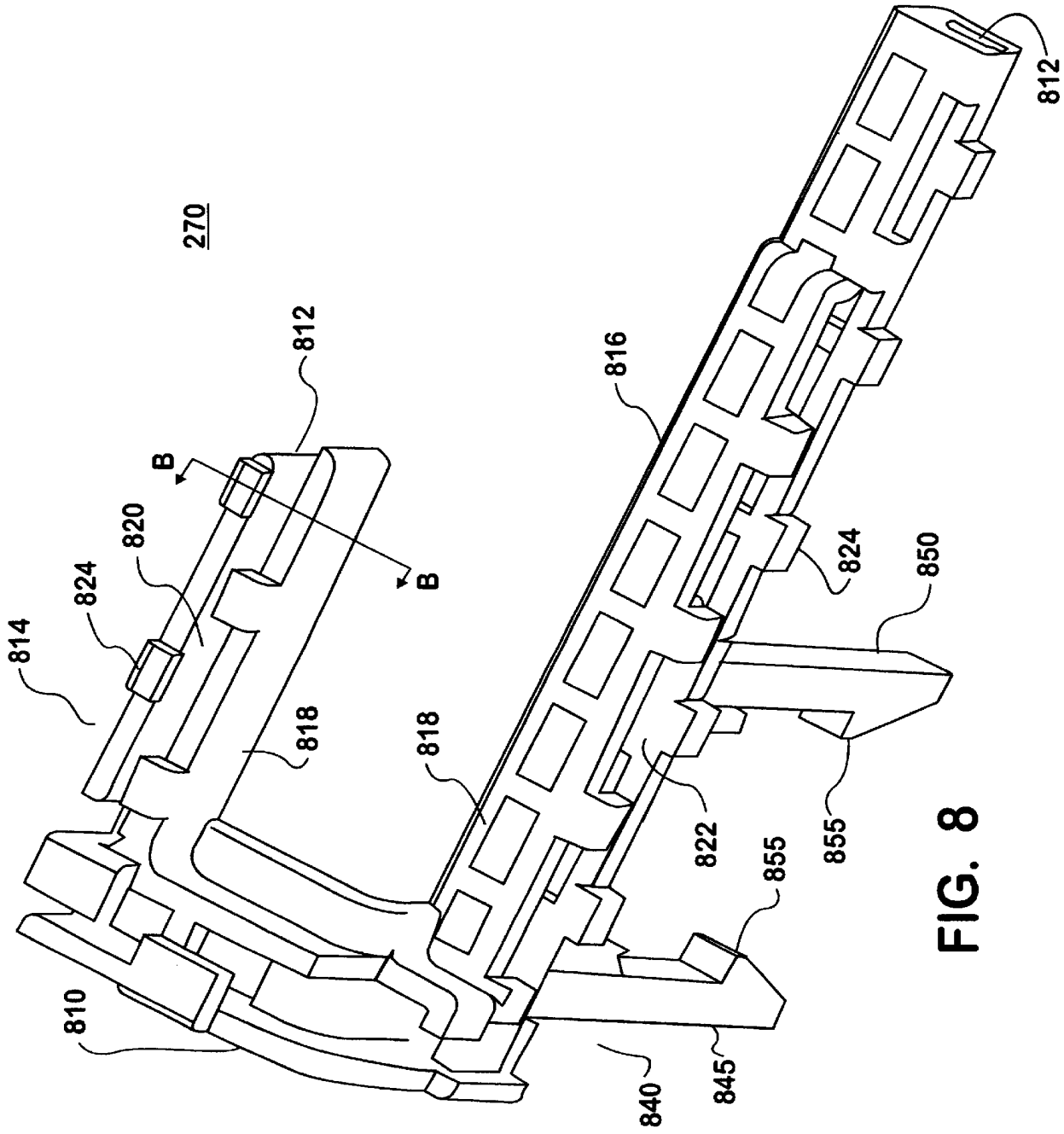


FIG. 8

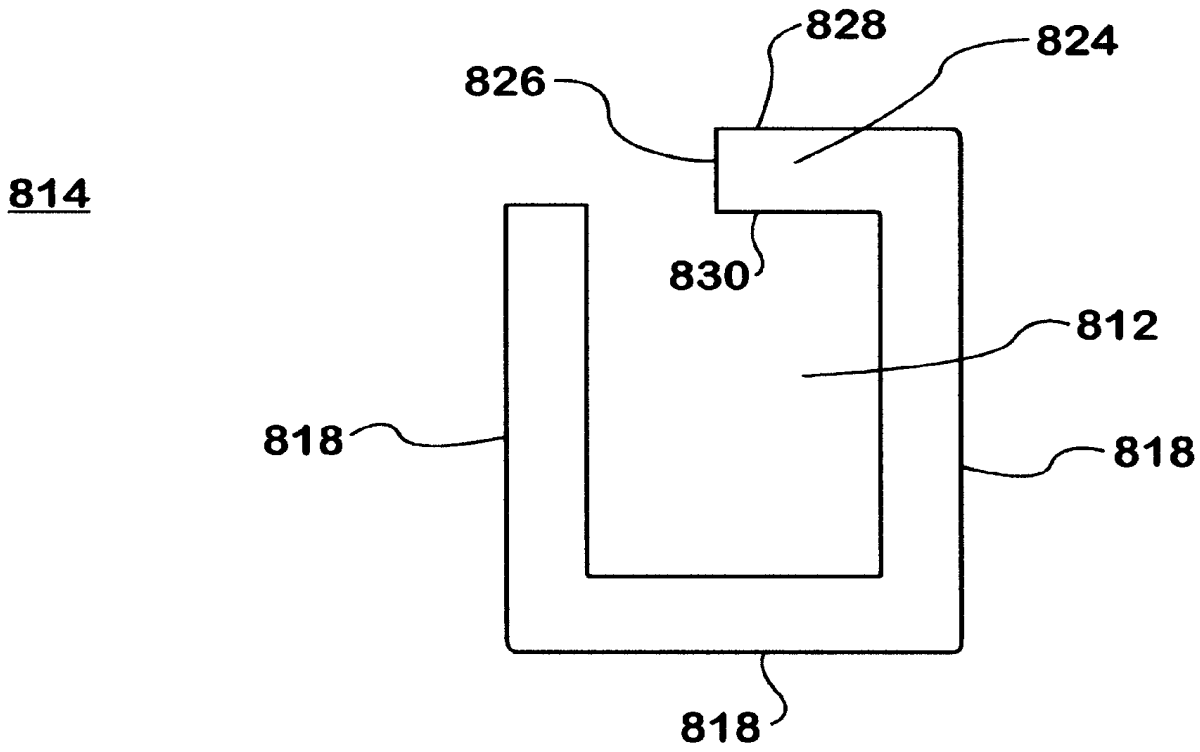


FIG. 9
SECTION B-B

WIRE GUIDE FOR ELECTRONICALLY CONTROLLED FUEL INJECTION SYSTEMS

This patent application claims the benefit of Provisional U.S. patent application Ser. No. 60/165,821 filed on Nov. 16, 1999.

FIELD OF THE INVENTION

This invention relates generally to wiring systems for internal combustion engines. More particularly, this invention relates to wire guides for electronically controlled fuel injection systems in diesel engines.

BACKGROUND OF THE INVENTION

Many diesel engines have hydraulically-activated electronically-controlled unit injection (HEUI) fuel systems. In these systems, each injector has a solenoid for activating a poppet valve. The poppet valve regulates the flow of high pressure oil in the injector. The high pressure oil controls the fuel injection into the cylinder.

The engine's electronic control module transmits electrical signals to the solenoid via a connector in the valve cover. The connector also may be in the valve cover gasket, a valve fence, or part of the cylinder head. Under the valve cover, wires usually complete the circuit for transmitting signals from the electronic control module to the solenoids.

Generally, a pair of wires runs from the connector to each fuel injector. The pair of wires usually has a plug or a wire pigtail for connecting to the solenoid. The wires are positioned under the valve cover to avoid interference or entanglements with the rocker arms, valve rotators, and other moving parts. There may also be more than one pair of wires running from the connector to each fuel injector. Also, multiple connectors may be used to properly position the wires.

In a typical configuration, the connector is positioned between two fuel injectors. The connector may be placed on either the inboard or outboard side of the valve cover. From the connectors, wires run somewhat parallel to the valve cover before making almost perpendicular turns toward the fuel injectors to connect with the solenoids. In this manner, the wires avoid the rocker arms and other moving parts.

As alternatives to having wires under the valve cover, the wires or other types of conductors may be incorporated into the cylinder head, valve cover, or other parts. In one approach, the injectors are connected to electronics in or along the fuel rail. In a second approach, the wires are integral with the valve cover. The wires emerge underneath the valve cover at specific points for connecting to a particular injector. The wires emerge outside the valve cover to connect with the electronic control module. In a third approach, the wires lie along the inside surface of the valve cover. These wires have plugs at appropriate positions for connecting to the injectors when the valve cover is installed.

In other alternatives, the wires may be kept separated from the other parts underneath the valve cover. In one approach, wires are enclosed in a box or channel mounted on the fuel injection assembly. In a second approach, conductors are mounted in a connector block, which is mounted above the injectors. In a third approach, the wires are suspended on clips to keep the wiring above the injectors and other engine parts.

While these alternatives may provide suitable connections from the electronic control module to the injectors, they increase manufacturing costs and the assembly time of the engine. For example, incorporating the wires with the valve cover, fuel rail, or other engine parts increases the cost of those parts. It also increases the adverse impact of part failures. If the wire inside the valve cover or fuel rail does not operate, the valve cover or fuel rail must be replaced. This problem also increases maintenance costs because a new valve cover or fuel rail would be needed rather than replacement of a troublesome wire.

These alternatives also make assembly of the engine difficult. The plugs or connections on a valve cover or fuel rail must be aligned with the injectors before the cover or rail is secured in place. In some cases, it may be impossible to make the connections unless the wires have sufficient length. This "extra" length would be stored under the valve cover.

In addition, separating wires from other parts increases the space required under the valve cover. The height and width of the cylinder head and valve cover have to increase to accommodate a box or channel for the wires. Alternatively, a valve fence could be used, but it would increase the number of parts required. The height also has to increase for wires suspended on a clip above the injectors.

In comparison to the alternatives, wires routed in the available spaces underneath the valve cover make an engine easier to manufacture and cost less. However, using wires underneath the valve cover is difficult in a new HEUI fuel system. Improvements in HEUI fuel systems use fuel injectors with multiple solenoids. Usually, there are two solenoids on opposite sides of the injector. The solenoids control a spool valve in the injector. Each solenoid requires its own pair of wires (or a single wire if an alternate ground connection is used).

As opposed to facing the rocker arms, the fuel injectors are installed with one solenoid facing the side of the valve cover or fence. The other solenoid faces the valve rotators. One pair of wires runs somewhat parallel to the valve cover before making an almost perpendicular turn toward the fuel injector to connect with the solenoid. The wires have a straightforward run between the rocker arms. However, to reach the solenoid on the other side of the injector, the other pair of wires must cross the rocker arms or curve dangerously around the valve rotators. In either position, these wires interfere with or become entangled in the moving parts.

Going over the injector top is not an option. The high pressure oil rail sits upon and spans the top of the injectors. While wires may be routed on top or along the oil rail, they need to be secured in some manner so as not to move during engine operation. Tie bands and other securing means may be used. However, they increase manufacturing time and may not keep the wires from moving along the oil rail as the engine vibrates.

Accordingly, there is a need for guiding wires underneath the valve cover of a diesel engine so the wires do not interfere or become entangled with moving parts.

SUMMARY OF THE INVENTION

The present invention provides a wire guide for guiding and protecting wires from moving parts underneath the valve cover in a diesel engine. The wire guide has a channel portion connected to a base. The channel portion is configured to cross a rocker arm when the wire guide is mounted on the cylinder head.

The base has a main support connected to a side support and a foot section. A pedestal extends from the foot section to assist mounting on the cylinder head. The foot section and pedestal form a bore for securing the wire guide to the cylinder head with a bolt.

The channel portion creates a conduit for holding the wires. The conduit is essentially closed on two sides and partially closed on the bottom side, which has alternating cross-supports and open spaces, or simply intermittently spaced cross-supports. The top side is an open side, but constrained intermittently by pairs of retaining tabs.

The retaining tabs form along the top of the channel portion. They each have a tapered face, which has an upper edge and a lower edge. The upper edge helps to form the top side of the channel portion. The lower edge helps define the conduit. In a pair of retaining taps, the distance between the lower edges is less then the distance between the upper edges. This configuration creates an inverted wedge-shaped opening between the retaining tabs. Tapered faces and a wedged-shaped opening make it easier to push and retain wires in the conduit. In an alternate embodiment, the base is comprised of a retaining clip section that extends away from a side of the channel portion to assist in mounting the channel guide to the cylinder head. The retaining clip section is comprised of two prongs forming a snap-on assembly that "snaps" onto the injector clamp that holds the injector in place. The snap-on assembly secures the wire guide to the cylinder head.

In this embodiment, the conduit may be partially or completely closed on three sides. There is an open fourth side that is constrained intermittently by alternating and opposing retaining tabs. The retaining tabs form along the open side of the channel portion in an alternating and opposing fashion creating a series of alternating retaining tabs and open spaces along the channel portion. In use, the wires from the connectors pass through the wire guide. The wire guide crosses the rocker arms thereby keeping the wires from interfering and becoming entangled in the rocker arms and other moving parts.

The following drawings and description set forth additional advantages and benefits of the invention. More advantages and benefits are obvious from the description and may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood when read in connection with the accompanying drawings, of which:

FIG. **1** is a top view of a cylinder head according to the prior art;

FIG. **2** is a top view of a cylinder head with a first embodiment of the wire guide of the present invention in use;

FIG. **3** is a perspective view of the first embodiment of the wire guide of the present invention;

FIG. **4** is a top view of the first embodiment of the wire guide of the present invention;

FIG. **5** is a rear view of the first embodiment of the wire guide of the present invention;

FIG. **6** is a side view of the first embodiment of the wire guide of the present invention;

FIG. **7** is a cross-sectional view along the line A—A of the wire guide depicted in FIG. **6**;

FIG. **8** is a perspective view of a second embodiment of the wire guide of the present invention; and

FIG. **9** is a cross-sectional view along the line B—B of the wire guide depicted in FIG. **8**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows a cylinder head **110** with the valve cover (not shown) removed according to the prior art. The cylinder head **110** has a gasket **160** for joining to the valve cover. Within the cylinder head **110**, fuel injectors **140** are positioned to inject fuel into the cylinders (not shown). Rocker arms **115** are mounted on pedestals **135** adjacent to the fuel injectors **140**. Push rods (not shown) engage the rocker arms **140** at valve lashes **165**. The push rods rotate the rocker arms **140** to depress the intake valve rotators **125** and exhaust valve rotators **130** at the appropriate times. The valve rotators **125**, **130** actuate the engine valves (not shown).

The gasket **160** has connectors **145** for passing electrical contacts (not shown) through the gasket **160**. The connectors **145** are shown located in the outboard side of the engine. Outside the valve cover, the connectors **145** connect to the engine's electronic control module (not shown). Inside the valve cover, pairs of wires run from the connectors **145** to the fuel injectors **140**. For each fuel injector **140**, a pair of wires **150**, or more than one pair of wires in some cases, run essentially parallel to the valve cover **110** before turning perpendicular to run between the rocker arms **115** for connection with the solenoid (not shown) on the fuel injector **140**. The pair of wires **150** may have a plug (not shown) for attaching to the solenoid.

FIG. **2** shows a cylinder head **210** with the valve cover (not shown) removed according to the present invention. The cylinder head **210** has a gasket **260** for joining to the valve cover. Within the cylinder head **210**, fuel injectors **240** are positioned to inject fuel into the cylinders (not shown). Each fuel injector **240** has a first solenoid (not shown) and a second solenoid (not shown). Rocker arms **215** are mounted on pedestals **235** adjacent to the fuel injectors **240**. Push rods (not shown) engage the rocker arms **240** at valve lashes **265**. The push rods rotate the rocker arms **215** to depress intake valve rotators **225** and exhaust valve rotators **230** at the appropriate times. The valve rotators **225**, **230** actuate the engine valves (not shown).

The gasket **260** has connectors **245** for passing electrical contacts (not shown) through the gasket **260**. Although the connectors **245** are shown passing through the gasket **260**, the connectors **245** may be in the valve cover, a valve fence, or another part of the cylinder head **210**. For example, the connectors **245** shown in FIG. **2** are physically located on the outboard side of the engine or cylinder head **210**. But, the connector may be placed on either the inboard or outboard side of the valve cover. While multiple connectors **245** are shown, any number of connectors **245** including a single connector **245** may be used.

Outside the valve cover, the connectors **245** connect to the engine's electronic control module (not shown). Inside the valve cover, at least one pair of wires **250**, **252** runs from the connectors **245** to the fuel injectors **240**. FIG. **2** shows each fuel injector **240** is connected to the connectors **245** by a first pair of wires **250** and a second pair of wires **252**. However, there may be more or less pairs of wires **250** and **252** connecting the connector **245** and fuel injectors **240**. While the wires are described as pairs, single or multiple wires may be used for additional control of the solenoids. A single wire also may also be used if another grounding means is provided. In addition, each pair of wires **250**, **252** may have a plug (not shown) for attaching to the solenoids.

The first pair of wires **250** runs essentially parallel to the valve cover **210** before turning perpendicular to run parallel to rocker arm **215** on the side opposite the fuel injector **240**. As the first pair of wires **250** nears the valve rotators **225**, **230**, the first pair of wires **250** enters a wire guide **270** before crossing the rocker arm **215**. After crossing the rocker arm **215**, the first pair of wires **250** exits the wire guide **270** and

connects to the first solenoid on the fuel injector **240**. The wire guides **270** are preferably mounted on the cylinder head **210** by bolts **272**. However, those of skill in the art will recognize that other means, such as an adhesives, clips, and similar devices, may be used to mount the wire guides **270** to the cylinder head **210**.

The second pair of wires **252** runs between the rocker arms **215** for connection with the second solenoid in the fuel injector **240**. In the embodiment of FIG. **2**, the connectors **245** are positioned for the second pairs of wires **252** to have essentially unobstructed runs to the fuel injectors **240**. If the connectors **245** were in different positions or different in number, one or more of the second pairs of wires **252** would run parallel to the valve cover before turning perpendicular to run between the rocker arms **215**.

FIG. **3** shows a perspective view of a first embodiment of the wire guide **270** according to the present invention. FIGS. **4–6** show the top, back, and side views respectively of the first embodiment of the wire guide **270** shown in FIG. **3**. The wire guide **270** has a channel portion **310** connected to a base **340**. The channel portion **310** is configured to cross the rocker arm **215** without interfering with it once the wire guide **270** is mounted on the cylinder head **210**. While one preferred configuration of the channel portion **310** is shown in FIGS. **3–6**, the channel portion **310** may be configured in numerous ways to cross the rocker arm **215**, including crossing underneath it.

The channel portion **310** creates a conduit **312** formed by sides **316**, **318**, bottom **320**, and top **322**. The channel portion **310** also forms a first opening **326** and a second opening **328**. The top is an open side **322** and is preferably constrained by retaining tabs **324**. The bottom side **320** is preferably partially solid having cross supports **410** and open spaces **415**, or simply intermittently spaced cross-supports. However, the bottom side **320** may also be completely solid. The sides **316**, **318** are preferably solid, but may also be partially solid or closed by having intermittently spaced cross-supports. The cross-support may also be perpendicular or angled relative to the sides they lie between.

The top open side **322**, bottom side **320**, and sides **316**, **318** are labeled relative to the orientation of the wire guide **270** shown in FIG. **3**. For example, side **316** "becomes" the top **322** due to the configuration of the wire guide **270**. Similarly, the bottom **320** "becomes" the side **316**.

The base **340** has a main support **342** connecting the channel portion **310** to a foot section **346**. A side support **344** is connected perpendicular to the main support **342** and the foot section **346**. The foot section **346** has a pedestal **350** for mounting on the cylinder head **210**. Both the foot section **346** and the pedestal **350** form a bore **348** for securing the wire guide **270** to the cylinder head **210** using bolt **272**. The pedestal **350** may form one or more prongs (not shown) to prevent the wire guide **270** from rotating on the cylinder head **210**.

FIG. **7** shows a section view along the line A—A of the wire guide shown in FIG. **6**. This is a cross-sectional view of the channel portion **310** at a pair of retaining tabs **324**. The retaining tabs **324** work in pairs and are preferably formed adjacently to each other along the top **322** at intermittent positions. Each retaining tab **324** has a face **705**, having an upper edge **710** and a lower edge **720**. The upper edge **710** helps form the top **322** of the channel portion **310**. The lower edge **720** helps define the conduit **312**. The faces **705** are preferably tapered such that distance B, the distance between the lower edges **720**, is less than distance C, the distance between the upper edges **710**. The tapered faces **705** make it easier to push wires into and retain wires in conduit **312**.

FIG. **8** shows a second embodiment of the present invention that is preferably used when the connectors **245** are located on the inboard side of the engine or cylinder head **210** (not shown). The second embodiment of the wire guide **270** preferably has a U-shaped channel portion **810** connected to a base **840**. The channel portion **810** is configured to cross the rocker arm **215** without interfering with it once the wire guide **270** is mounted on the cylinder head **210**. The channel portion **810** may also be configured in numerous ways to cross the rocker arm **215**, including crossing underneath it.

The channel portion **810** can be viewed as being comprised of a first leg **814** and a second leg **816** that together create a U-shaped wire conduit **812**. The second leg **816** is preferably longer than the first leg **814**. However, the leg **814** and **816** lengths can vary depending on the requirements of a particular engine application. The first leg **814** and second leg **816** each have three sides **818** that may be completely or partially solid. When partially solid or closed, the three sides **818** have intermittently spaced cross-supports (also shown in FIG. **3**). The cross-support may be perpendicular or angled relative to the sides **818** they lie between. The fourth side **818** of the first leg **814** and second leg **816** is an open side and preferably forms a first leg opening **820** and a second leg opening **822** respectively.

The first leg opening **820** and second leg opening **822** are constrained by intermittent retaining tabs **824**. The retaining tabs **824** are preferably placed on alternating and opposite sides of the leg openings **820** and **822** so as not to be directly across from each other. However, retaining tabs may also be arranged as intermittently spaced retaining tab pairs. For example, like the retaining tab pairs shown and discussed with reference to FIGS. **3–7**. Thus, in this second embodiment, the retaining tabs **824** are preferably formed in an alternating and opposing arrangement along the leg openings **820** and **822** at intermittent positions.

The base **840** is preferably a retaining clip section comprised of a first prong **845** and a second prong **850**. The retaining base clip section **840** will secure the wire guide to the cylinder head by snapping onto the injector clamp which holds the injector in place. The retaining base clip section **840** first and second prongs **845** and **850** are preferably attached to a side **818** of the second leg **816** and together extend away from the second leg **816**. The retaining clip first and second prongs **845** & **850**, comprising a first and second retaining tooth **855** respectively, cooperatively "snap-on" or clip on to the injector clamp to secure the wire guide to the cylinder head **210**.

FIG. **9** shows section view along the line B—B of the wire guide shown in FIG. **8**. This is a representative cross-sectional view of the channel portion **810** at one of the retaining tabs **824** on one side of the leg opening **820** or **822**. Each retaining tab **824** has a face **826**, having an upper edge **828** and a lower edge **830**. The upper edge **828** helps form the top of the channel portion **810**. The lower edge **830** helps define the conduit **812**. The face **826** is shown vertically flat but may also be tapered, as shown in FIG. **7**, to make it easier to push wires into and retain wires in the wire conduit **835**.

In addition to protecting and guiding wires from moving parts, the wire guide **270** makes the assembly of the fuel injection system easier and faster. The wire guide **270** may be pre-assembled with the pair of wires **250** and other parts of the fuel injection system. For example, the connector **245**, the wire guide **270**, and the pairs of wires **250**, **252** along with plugs for connecting to the solenoids may be pre-assembled.

During assembly of the fuel injector system, each fuel injector **240** and its associated rocker arms **215** are installed as appropriate on the cylinder head **210**. The appropriate wire guide **270** is mounted on the cylinder head **210** using the securing bolt **272** or by "snapping" the wire guide securely into place on the injector hold down clamp. The appropriate wires or pair of wires **250** are plugged into a first solenoid on the fuel injector **240**. The appropriate first pair of wires **250** is then routed around the rocker arm **215**. The connector **245** is installed in the valve cover, valve fence, or other part. The appropriate second pair of wires **252** is then routed and connected to the second solenoid on fuel injector **240**.

The wire guide **270** may also be pre-assembled with other combinations of parts. The wire guide **270** may have numerous shapes and configurations as long as they are suitable for guiding and protecting the wires from moving parts in the cylinder head **210** area. The wire guide **270** may also be mounted at other locations on the cylinder head depending on where the connectors **245** are located on the cylinder head **210**.

The present invention has been described and illustrated by way of certain examples of preferred embodiments only. Additional advantages will be readily apparent to those skilled in the art, who may modify the embodiments without departing from the true spirit and scope of the invention. Therefore, this invention is not limited to the specific details, representative devices, and illustrated examples in this description. The present invention is limited only by the following claims and equivalents.

We claim:

1. A wire guide for use in an engine, the wire guide comprising:

a) a channel portion having an open side with intermittently spaced retaining tabs, wherein the channel portion comprises at least two members forming at least one bend; and

b) a base connected to the channel portion, the base configured such that the wire guide can be secured to a cylinder head;

c) whereby wires are guided and protected from moving parts underneath a valve cover in an engine.

2. The wire guide of claim **1**, wherein the channel portion and the base are connected by a support section, the support section comprising:

a) a main support connected to a side support;

b) a foot section connected to the side support; and

c) a pedestal extending away from the foot section.

3. The wire guide of claim **2**, wherein the foot section and pedestal form a bore for securing the wire guide to the cylinder head with a bolt.

4. The wire guide of claim **1**, wherein the base is secured to the cylinder head via a bolt, an adhesive, or a clip.

5. The wire guide of claim **1**, wherein the channel portion has at least one partially closed side comprised of intermittent cross-supports.

6. The wire guide of claim **1**, wherein the retaining tabs are formed as a series of tab pairs along the open side of the channel portion.

7. The wire guide of claim **1**, wherein the retaining tabs comprise:

a) a tapered face;

b) an upper edge that forms an outer edge of the channel portion; and

c) a lower edge that defines a conduit.

8. The wire guide of claim **7**, wherein the tab pair defines

a) a first distance between the upper edges of the tab pair; and

b) a second distance between the lower edges of the tab pair wherein the first distance is larger than the second distance;

c) whereby the tab pair results in an inverted wedge-shaped opening between the retaining tab pair.

9. A wire guide for use in an engine, the wire guide comprising:

a) a channel portion having an open side with intermittently spaced retaining tabs, wherein the channel portion comprises at least two members forming at least one bend; and

b) a base connected to the channel portion;

c) whereby the wire guide can be secured to a cylinder head such that wires are guided and protected from moving parts underneath a valve cover in an engine.

10. The wire guide of claim **9**, wherein the retaining tabs are formed as a series of alternating opposing tabs along the open side of the channel portion.

11. The wire guide of claim **9**, wherein the base is comprised of a first prong with a first retaining tooth and a second prong with a second retaining tooth whereby the base snaps-on to an injector clamp holder.

12. The wire guide of claim **9**, wherein the channel portion has at least one partially closed side comprised of intermittent cross-supports.

13. The wire guide of claim **9**, wherein the retaining tabs further comprise:

a) a tapered face;

b) an upper edge that forms an outer edge of the channel portion; and

c) a lower edge that defines a conduit.

14. The wire guide of claim **9**, wherein the channel portion is configured in a u-shape with a first leg and second leg.

15. The wire guide of claim **14**, wherein the base extends away from the second leg.

16. The wire guide of claim **9**, wherein the retaining tabs are formed as a series of tab pairs along the open side of the channel portion.

17. A wire guide for use in an engine, the wire guide comprising:

a channel having at least one open side, wherein a first plurality of retaining tabs are intermittently spaced on a first edge of the open side and a second plurality of retaining tabs are intermittently spaced on a second edge of the open side, such that at least one wire is guided within the channel;

a base connected to the channel portion;

wherein the wire guide protects the at least one wire from moving parts underneath a valve cover in the engine.

18. The wire guide of claim **17**, wherein the base is securable to a cylinder head.

19. The wire guide of claim **17**, wherein the channel has at least one partially closed side comprised of intermittent cross-supports.

20. The wire guide of claim **17**, wherein the first and second plurality of retaining tabs comprise a plurality of tab pairs intermittently spaced along the at least one open side of the channel.

21. The wire guide of claim **17**, wherein at least some of the first and second plurality of retaining tabs further comprise:

a tapered face;

an upper edge that forms an outer edge of the channel portion; and

a lower edge that defines a conduit.

22. The wire guide of claim **17**, wherein the channel and the base are connected by a support section, the support section comprising:

a main support connected to a side support;

a foot section connected to the side support; and

a pedestal extending away from the foot section.

23. The wire guide of claim **17**, wherein the channel comprises at least two member forming at least one bend.

24. The wire guide of claim **17**, wherein the retaining tabs are formed as a series of alternating opposing tabs along the open side of the channel portion.

25. The wire guide of claim **17**, wherein the base is comprised of a first prong with a first retaining tooth and a second prong with a second retaining tooth whereby the base snaps-on to an injector clamp holder.

26. The wire guide of claim **17**, wherein the channel portion is configured in a U-shape with a first leg and second leg.

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