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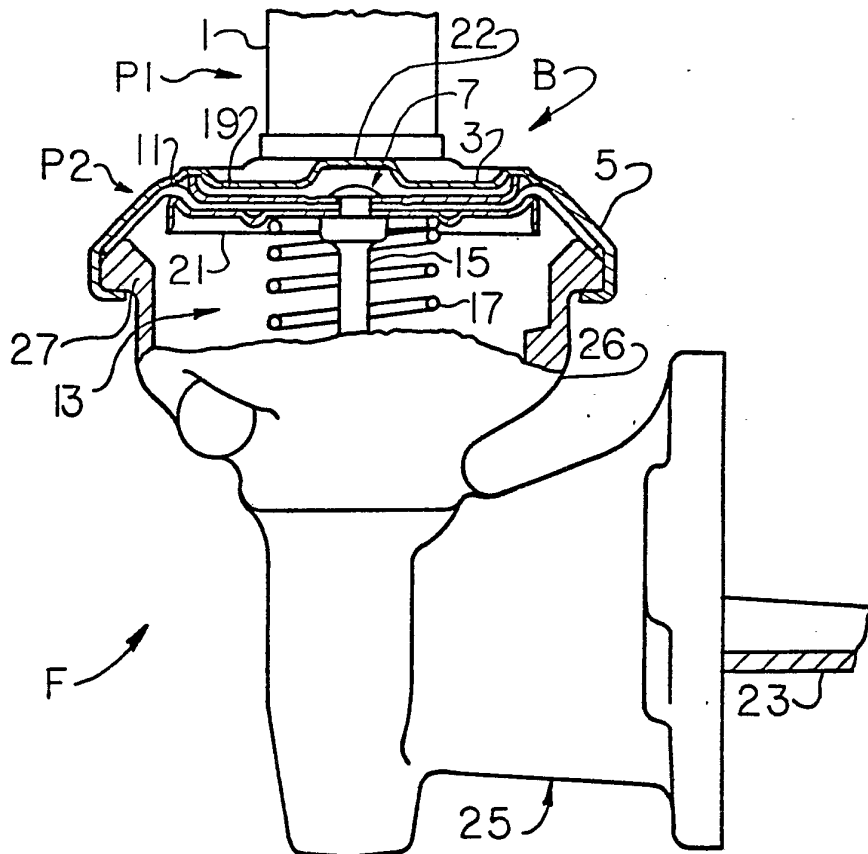
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<p>(21) International Application Number: PCT/US80/01224 (22) International Filing Date: 19 September 1980 (19.09.80) (31) Priority Application Number: 080,266 (32) Priority Date: 1 October 1979 (01.10.79) (33) Priority Country: US (71) Applicant: ACF INDUSTRIES, INCORPORATED [US/US]; 750 Third Avenue, New York, NY 10017 (US). (72) Inventors: BASCH, Walter, E.; 12121 Franclar Drive, St. Louis, MO 63044 (US). HANEY, John, W.; 12914 Fox Haven Drive, Florissant, MO 63033 (US). (74) Agent: MULLER, J., Joseph; ACF Industries, Incorporated, Carter Carburetor Division, 9666 Olive Street Road, St. Louis, MO 63132 (US).</p>		<p>(81) Designated States: DE (European patent), FR (European patent), GB (European patent). Published <i>With international search report Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments</i></p>

(54) Title: CRASHWORTHY FUEL PUMP

(57) Abstract

An improvement to a fuel pump comprising a lip formed at the open end of a fuel pump body. The lip (29) is bendable over the outer margin of diaphragm (11) inserted into the body to form a fluid seal between the body and the diaphragm. The seal is capable of withstanding abnormal forces such as occur during a crash while retaining its integrity.



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Background of the Invention

This invention relates to fuel pumps and, more particularly, to a crashworthy fuel pump capable of withstanding extreme forces such as occur during a crash without leaking
5 fuel.

Because of their location in the engine compartment of an automobile, fuel pumps are susceptible to damage during a crash as the result of being struck by debris flying about in the compartment. As a consequence, fuel leaks from
10 the pump may occur. The presence of gasoline in the engine compartment due to a broken fuel pump creates a great risk of fire and potential harm to both the vehicle and its occupants.

Federal Motor Vehicle Safety Standard (FMVSS) 30 was
15 issued in an attempt to reduce the hazards attendant the location of the fuel pump in the engine compartment by requiring that the risk of damage to a fuel pump during a crash be minimized. To comply with this standard, various schemes have been proposed to shield the fuel pump or other-
20 wise protect it from flying debris. However, these protective shields add weight to the vehicle, may be difficult to fit into already crowded engine compartments, and may not always prevent an object from striking a fuel pump.

Summary of the Invention

25 Among the several objects of the present invention may be noted the improvement to a fuel pump by which the fuel pump is made crashworthy; the provision of such an improvement by which the fuel pump will not leak fuel when struck by an object even though the fuel pump is deformed; the
30 provision of such a fuel pump which has substantially the same envelope as a conventional non-crashworthy fuel pump so as to be readily installed in the engine compartment of a vehicle and take up substantially the same volume therein.

Briefly, the improvement of the present invention comprises
35 a lip formed at the open end of a fuel pump body, the lip being bendable over the outer margin of a diaphragm after the diaphragm has been inserted into the body thereby to form a fluid seal between the body and the diaphragm, the



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seal being capable of withstanding abnormal forces such as occur during a crash whereby the seal retains its integrity and no fluid leak occurs. Other objects and features will be in part apparent and in part pointed out hereinafter.

5 Brief Description of the Drawings

Figure 1 is a sectional view of a conventional fuel pump installable in the engine compartment of a vehicle; and Figures 2 and 3 are sectional views of a portion of the fuel pump illustrating the improvement of the present inven-
10 tion.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Description of a Preferred Embodiment

Referring to the drawings, a fuel pump F for use in an
15 automotive fuel system comprises a pump body, generally indicated B, which is of one-piece, thin-walled, sheet metal construction. Body B has a first portion P1 in which are formed two integral deep-drawn cylindrical cup-shaped projec-
20 tions, one of which is partially shown in Figure 1 and is indicated by reference numeral 1. One of the projections defines an intake cavity for the fuel pump and the other projection defines a discharge cavity for the pump. A
properly oriented check valve (not shown) is located in each cavity to control fuel flow into and out of the fuel pump
25 and appropriate fittings (also not shown) are located at the outer end of each projection for connecting the fuel pump into the fuel system. Check valves and fittings of the type shown in United States Patent 3,096,722 to Fitzgerald et al, issued July 9, 1963, are illustrative of those which may be
30 used in fuel pump F.

Body B has a second portion P2 of a shallow cup shape having an end wall 3 and a flaring annular peripheral wall 5 forming a fuel pumping chamber 7. One end of each cavity 1 is in fluid communication with the pumping chamber. The
35 lower end of body portion P2 is open.

An annular diaphragm 11 closes pumping chamber 7. The diaphragm consists of a relatively thin disk of flexible, fuel resistant material such as a suitable synthetic rubber.



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In its unstressed condition the diaphragm is essentially flat. The diaphragm is insertable into the open end of the second portion of body B.

Means, indicated generally 13, flex diaphragm 11 to pump fuel into and out of pumping chamber 7 through the respective intake and discharge cavities. Means 13 comprises a diaphragm actuating rod 15 and a spring 17. Diaphragm 11 is sandwiched between a pair of backing plates 19 and 21 respectively. Rod 15 extends through the backing plates and the diaphragm and the end of the rod is spun over. One end of spring 17 seats against the underside of plate 21. A rocker arm 23 is operable by an engine driven eccentric cam (not shown). The inner end of the rocker arm is attached to the other end of rod 15 and pulls the rod downward as it is rocked by the cam. This pulls diaphragm 11 downwardly and creates the intake stroke of the pump. Spring 17 pushes the diaphragm upwardly at the end of the intake stroke to produce the discharge stroke of the pump.

Means 13 is housed in a housing 25. The housing has a hollow conical pump head 26. The pump head has an outwardly extending circumferential rim 27 the upper face of which is downwardly and outwardly sloped. Body B and housing 25 are assembled as is well known in the art with the outer margin of diaphragm 11 clamped between the abutting surfaces of the body and the housing.

An improvement of the present invention comprises a lip 29 formed around the open end of body portion P2. As shown in Figure 2, lip 29, which extends around the periphery of the open end of body portion P2, is bendable over the outer margin of diaphragm 11 after the diaphragm is inserted into the open end of the body. This creates a fluid seal between the body and the diaphragm. A circular ring 31 is now fitted around the body and the housing to clamp the two together. Ring 31 has an inturned lower margin forming a lip 35. The inner face of this lip abuts the bottom outer surface of rim 27 when the pump is assembled. The ring has an upwardly extending circumferential side 37 whose height is such that the side extends beyond the joining surfaces of body B and



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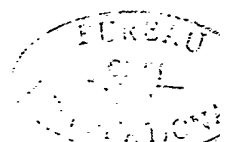
housing 35. The upper portion of side 37 is crimped over the top of body B after the body and housing are brought into mating abutment so as to clamp the body and housing together as shown in Figure 2.

5 As a consequence of the above described improvement, a fuel pump F is made crashworthy in that a fluid seal is created which can withstand severe distortions of the pump. It has been experimentally found that the seal created between the body and diaphragm remains intact even when the
10 body is essentially flattened such as might occur if the pump were struck by flying debris. Thus, the danger of fuel leakage following a crash is substantially reduced as is the necessity of brackets or shields for the fuel pump. At the same time, the fuel pump envelope is essentially unchanged
15 and a crashworthy fuel pump of the present invention will occupy substantially the same space in an engine compartment as a conventional non-crashworthy fuel pump.

Referring to Figure 3, backing plate 21 has a circumferential skirt 39. The length of lip 29 and the height of
20 skirt 39 are made sufficiently great so the outer end of the skirt cannot contact diaphragm 11 if the body of the fuel pump is so deformed that the skirt and body/diaphragm assembly come into contact. This prevents the diaphragm from being punctured by the skirt and thus further safeguards against
25 fuel leaks. Additionally shown in Figure 3 is a clamping ring 31' which may be used to join body B and housing 26 to form a fuel pump assembly. Ring 31 has its upper end bent back upon itself prior to or during the crimping operation.

In view of the above, it will be seen that the several
30 objects of the invention are achieved and other advantageous results obtained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.
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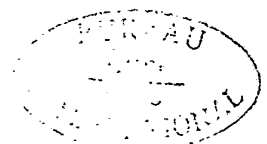
What is claimed is:

1. In a fuel pump for use in an automotive fuel system, the fuel pump including a body having a first portion in which is formed a fuel intake cavity and a fuel discharge cavity and a second portion in which is formed a fuel pumping chamber, one end of each cavity being in fluid communication with the pumping chamber, a flexible diaphragm closing the pumping chamber, the diaphragm being insertable into the open end of the second portion of the body, means for flexing the diaphragm to pump fuel into and out of the pumping chamber through the respective intake and discharge cavities and a housing in which the flexing means is housed, the housing having one end formed for abutment with the open end portion of the body, the improvement comprising:

15 a lip formed at the open end of the second portion of the body, the lip being bendable over the outer margin of the diaphragm after it is inserted into the body to form a fluid seal between the body and the diaphragm, the seal being capable of withstanding abnormal forces such as occur during a crash whereby the seal retains its integrity and no fluid leak occurs.

2. The improvement as set forth in claim 1 wherein the lip extends around the periphery of the open end of the body portion.

25 3. The improvement as set forth in claim 2 wherein the diaphragm is supported by a backing plate having a skirt therearound and the lip and skirt are sufficiently long so as to prevent contact between the skirt and the diaphragm if the fuel pump is deformed and reduce the possibility of the diaphragm being punctured by the skirt.



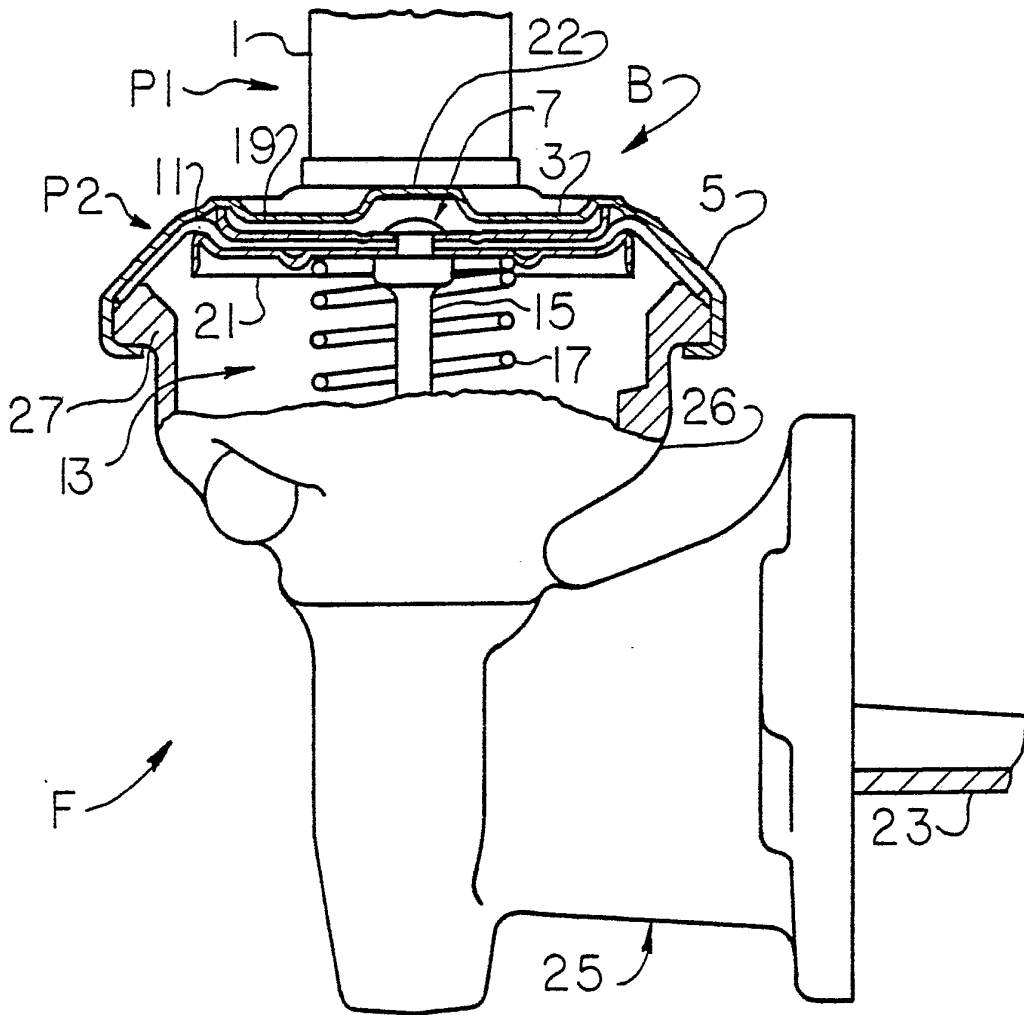


FIG. 1



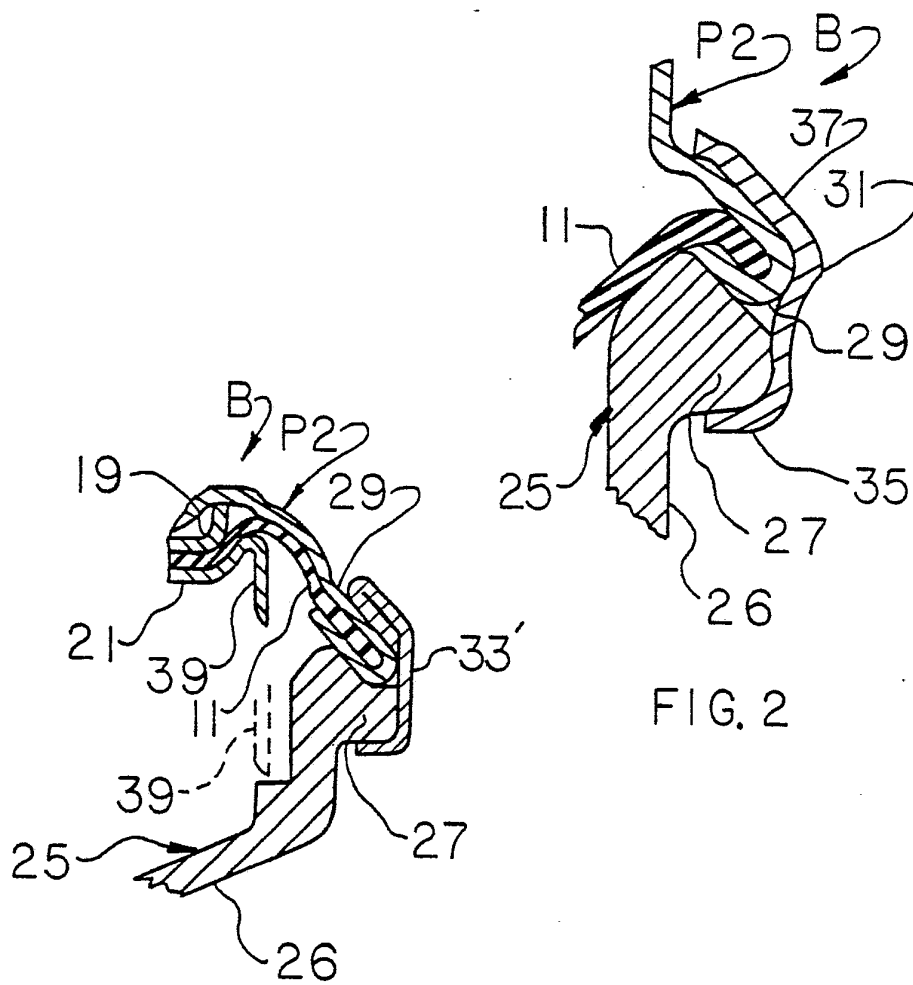


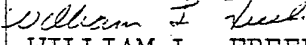
FIG. 2

FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No PCT/US80/01224

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³				
According to International Patent Classification (IPC) or to both National Classification and IPC				
F04B 43/02 - IPC. 5 417/471 - U.S. CL.				
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁴				
Classification System	Classification Symbols			
U.S.	417/313, 370, 371, 570, 571 92/98R, 102			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵				
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴				
Category [*]	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸		
X	US,A, 1,108,146 Published 25 August 1914 DEEGAN	1 to 3		
A	US,A, 2,834,299 Published 13 May 1958 COFFEY	1 to 3		
A	USA 3,362,341 Published 9 January 1968 QUATREDENIERS ET AL	1 to 3		
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<p>[*] Special categories of cited documents: ¹⁶</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> </td> <td style="width: 50%; border: none;"> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> </td> </tr> </table>			<p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>
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IV. CERTIFICATION				
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