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Fuel pump

The invention relates to a fuel pump for use in an automotive fuel system, comprising 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, 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, and clamping means for connecting the body and the housing to one another.

Fuel pumps of the afore-mentioned type are known from US—A—2 786 423 and GB—A—1 413 536, with the outer margin of the diaphragm lying between a flange of the body and a flange of the housing, said flanges being connected to one another by clamping means whereby the outer margin of said diaphragm is held tightly between said flanges.

Another construction is known from FR—A—1 306 702, wherein the outer margin of the diaphragm is enclosed by a lip formed at the open end of the housing which includes part of the means for flexing the diaphragm. The pump body including the fuel pumping chamber is clamped to the housing by means of a lip which is bent over the rim of the housing.

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 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. This risk exists if the clamping connection between the pump body and housing is being damaged.

Federal Motor Vehicle Safety Standard (FMVSS) 30 was 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 otherwise 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.

The invention as claimed is intended to remedy these drawbacks. It solves the problem of how to design a fuel pump for use in an auto-

motive fuel system in which the fuel pump will not leak fuel when struck by an object even though the fuel pump is deformed, by the measures that a lip is 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. The fuel pump of the invention has substantially the same envelope as a conventional fuel pump so as to be readily installed in the engine compartment of a vehicle and take up substantially the same volume therein.

Ways of carrying out the invention are described in detail below with reference to drawings, which illustrate specific embodiments, in which:

Figure 1 is a sectional view of a conventional fuel pump installable in the engine compartment of a vehicle.

Figures 2 and 3 are sectional views of a portion of the fuel pump illustrating the improvement of the present invention.

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

Referring to the drawings, a fuel pump F for use in an 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 projections, 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 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 US—A—3 096 722 are illustrative of those which may be 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 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. In its unstressed condition the diaphragm is essen-

tially 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 is 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 intumed 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 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.

As a consequence of the above described improvement a fuel pump F is made crash-worthy 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 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 and a 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 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 fuel leaks. Additionally shown in Figure 3 is a clamping ring 31' which may be used to join body B and housing 25 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 objects of the invention are achieved and other advantageous results obtained.

Claims

1. A fuel pump (F) for use in an automotive fuel system, comprising a body (B) having a first portion (P1) in which is formed a fuel intake cavity and a fuel discharge cavity, and a second portion (P2) in which is formed a fuel pumping chamber (7), one end of each cavity being in fluid communication with the pumping chamber, a flexible diaphragm (11) closing the pumping chamber, the diaphragm (11) being insertable into the open end of the second portion (P2) of the body (B), means (13) for flexing the diaphragm (11) to pump fuel into and out of the pumping chamber (7) through the respective intake and discharge cavities, a housing (25) in which the flexing means (13) is housed, the housing (25) having one end formed for abutment with the open end portion of the body (B), and clamping means for connecting the body (B) and the housing (25) to one another, characterized in that a lip (29) is formed at the open end of the second portion (P2) of the body (B), the lip (29) being bendable over the outer margin of the diaphragm (11) after it is inserted into the body (B) 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 fuel pump as set forth in claim 1, characterized in that the lip (29) extends around the periphery of the open end of the body portion (B).

3. The fuel pump as set forth in claim 2, characterized in that the diaphragm (11) is supported by a backing plate (21) having a skirt (39) therearound and the lip (29) and skirt (39) are sufficiently long so as to prevent contact between the skirt (39) and the diaphragm (11)

if the fuel pump (F) is deformed and reduce the possibility of the diaphragm (11) being punctured by the skirt (39).

Revendications

1. Pompe à combustible (F) destinée à être utilisée dans un circuit de combustible pour automobile, comprenant un corps (B) ayant une première partie (P1) dans laquelle sont formées une cavité d'entrée de combustible et une cavité de refoulement de combustible, et une deuxième partie (P2) dans laquelle est formée une chambre (7) de pompage du combustible, une extrémité de chaque cavité étant en communication pour le fluide avec la chambre de pompage, un diaphragme flexible (11) fermant la chambre de pompage, le diaphragme (11) pouvant être inséré dans l'extrémité ouverte de la deuxième partie (P2) du corps, des moyens (13) servant à faire fléchir le diaphragme (11), pour pomper le combustible en le faisant pénétrer dans la chambre de pompage (7) et sortie de cette chambre (7), à travers les cavités d'entrée et de refoulement respectivement, un boîtier (25) dans lequel les moyens de flexion (13), sont logés, le boîtier (25) ayant une extrémité formée pour buter contre la partie terminale ouverte du corps (B) et des moyens de serrage servant à relier le corps (B) et le boîtier (25) l'un à l'autre, caractérisée en ce qu'une lèvre (29) est formée à l'extrémité ouverte de la deuxième partie (P2) du corps (B), la lèvre pouvant être repliée par dessus le bord extérieur de diaphragme (11) après qu'il a été inséré dans le corps (B) pour former un joint étanche aux fluides entre le corps et le diaphragme, le joint étant capable de résister à des forces anormales telles que celles qui se manifestent pendant une collision, de manière que le joint conserve son intégrité et qu'il ne se produise pas de fuite de fluide.

2. Pompe à combustible selon la revendication 1, caractérisée en ce que la lèvre (29) s'étend autour de la périphérie de l'extrémité ouverte de la partie (B) du corps.

3. La pompe à combustible selon la revendication 2, caractérisée en ce que le diaphragme (11) est supporté par une plaque d'appui (21) ayant une jupe (30) autour d'elle, et la lèvre (29) et la jupe (39) sont suffisamment longues pour éviter tout contact entre la jupe (39) et le diaphragme (11) si la pompe à combustible (F)

est déformée et pour réduire la possibilité pour le diaphragme (11) d'être crevé par la jupe (39).

Patentansprüche

1. Brennstoffpumpe (F) für das Brennstoffsystem eines Kraftfahrzeuges, umfassend ein Gehäuse (B) mit einem ersten Teil (P1), der eine Brennstoff-Einlaßöffnung und eine Brennstoff-Auslaßöffnung aufweist, und einem zweiten Teil (P2), in welchem eine Pumpenkammer (7) gegliedert ist, wobei ein Ende jeder Öffnung mit der Pumpenkammer in Verbindung steht, eine die Pumpenkammer verschließende flexible Membran (11), die in das offene Ende des zweiten Teiles (P2) des Gehäuses (B) einsetzbar ist, eine Vorrichtung (13) zum Durchbiegen der Membran (11), um Brennstoff durch die Einlaßöffnung und die Auslaßöffnung in die bzw. aus der Pumpenkammer (7) zu pumpen, einem die Vorrichtung (13) zum Durchbiegen der Membran aufnehmenden Gehäuseteil (25), von dem ein Ende zum Anschließen an das offene Ende des Gehäuses (B) ausgebildet ist, und eine Klemmverbindung zum Aneinanderschließen des Gehäuses (B) und des Gehäuseteiles (25), dadurch gekennzeichnet, daß an offenen Ende des zweiten Teiles (P2) des Gehäuses (B) eine Lippe (29) angeformt ist, die in den äußeren Rand der Membran (11) nach deren Einsetzen in das Gehäuse (B) herumbiegbar ist, um zwischen Gehäuse und Membran eine Abdichtung zu schaffen, die abnormalen Kräften, wie sie bei einem Zusammenstoß auftreten, standhält, wobei der Zusammenhalt der Abdichtung gewahrt bleibt und kein Leck auftritt.

2. Brennstoffpumpe nach Anspruch 1, dadurch gekennzeichnet, daß sich die Lippe (29) rund um den Umfang des offenen Endes des Gehäuses (B) erstreckt.

3. Brennstoffpumpe nach Anspruch 2, dadurch gekennzeichnet, daß die Membran (11) an einer Stützplatte (21) anliegt, die eine rundumlaufende Schürze (39) aufweist, und daß die Lippe (29) und die Schürze (39) hinreichend lang sind, um im Falle einer Verformung der Brennstoffpumpe eine Berührung zwischen Schürze (39) und Membran (11) zu verhindern und die Möglichkeit des Durchstoßenwerdens der Membran (11) durch die Schürze (39) zu verringern.

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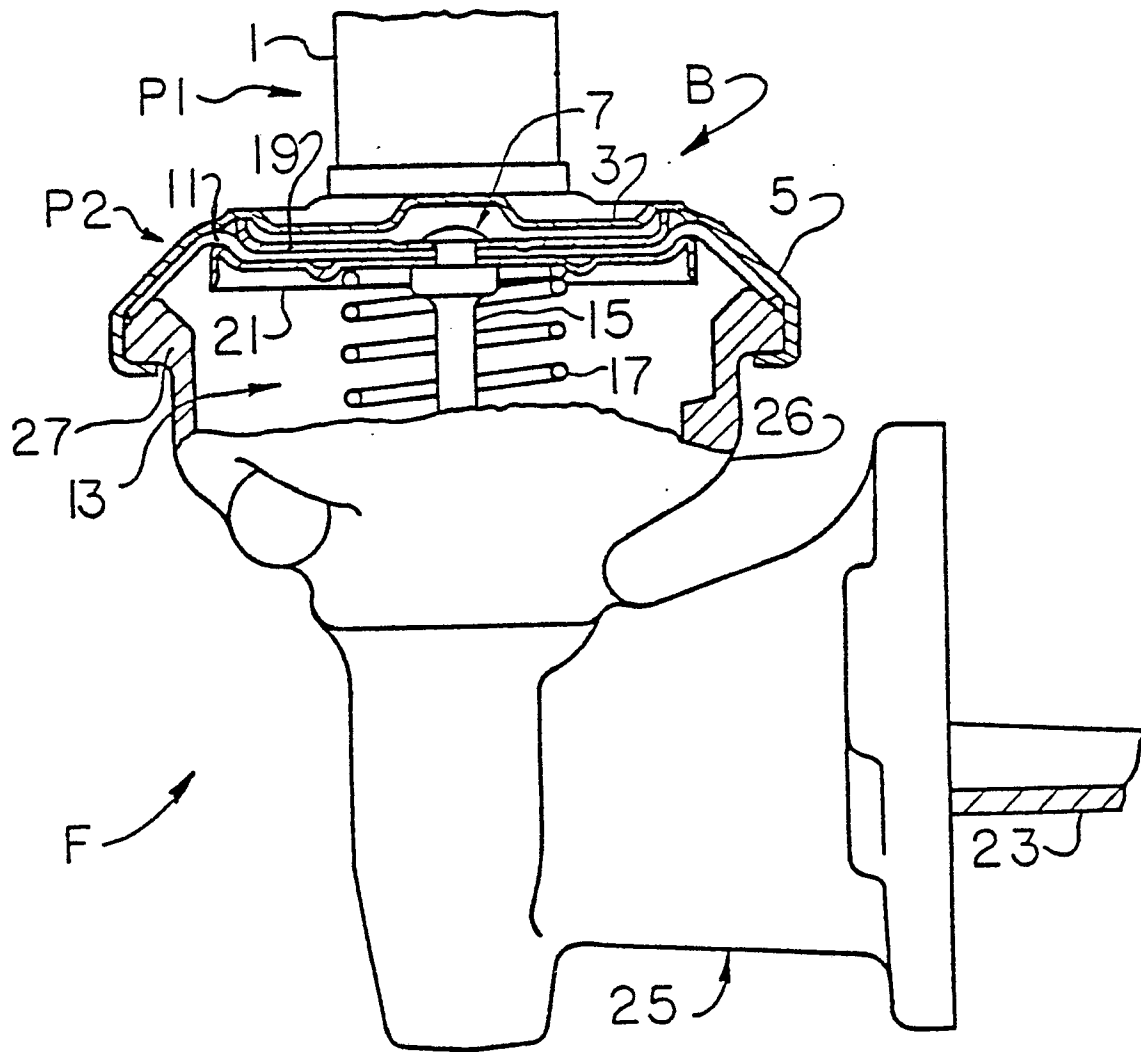


FIG. 1

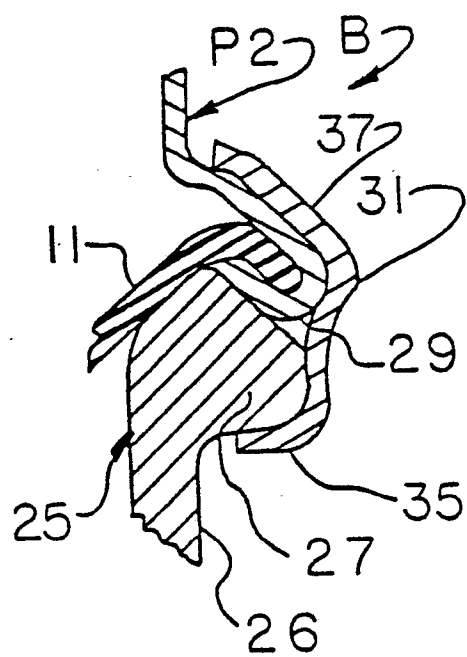


FIG. 2

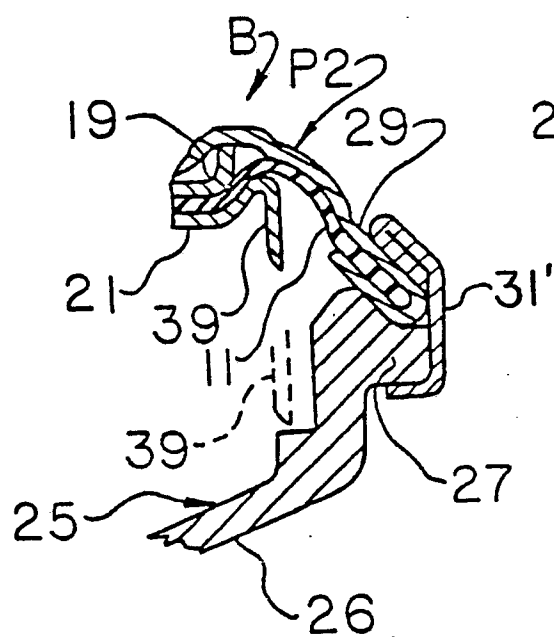


FIG. 3