June 1, 1965 W. A. BRADLEY 3,186,351

FUEL PUMP

Filed May 13, 1963

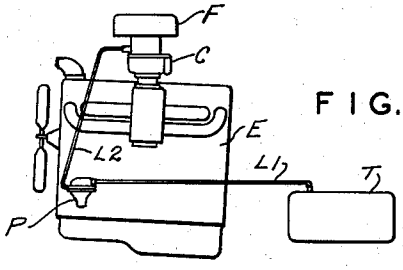


FIG. 1.

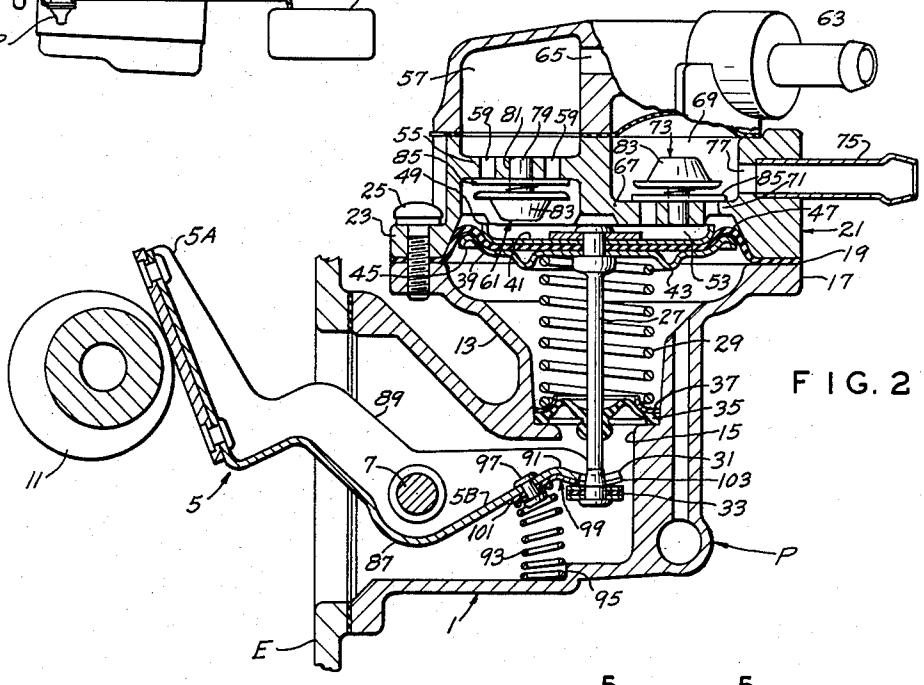


FIG. 2.

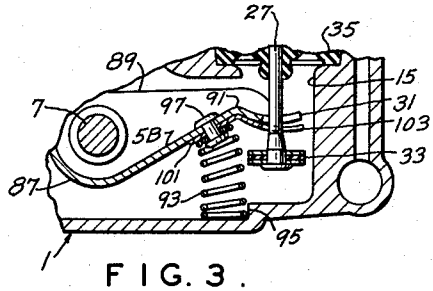


FIG. 3.

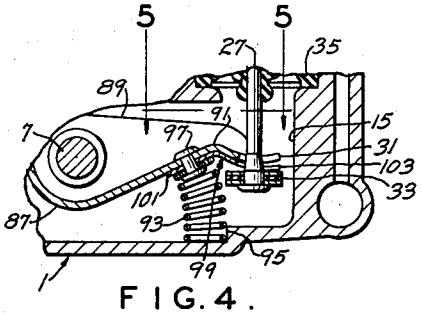


FIG. 4.

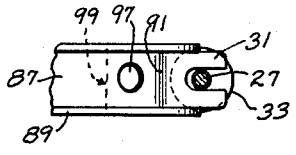


FIG. 5.

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FUEL PUMP

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This invention relates to fuel pumps, and more particularly to an automotive fuel pump for pumping automotive fuel from the fuel tank of an automotive vehicle to the carburetor of the internal combustion engine of the vehicle.

An automotive fuel pump is typically a diaphragm pump having a pumping chamber closed by a diaphragm with a compression spring for driving the diaphragm in one direction through its discharge stroke and a diaphragm actuating rod or stem connected to the diaphragm for returning the diaphragm through its suction stroke in the opposite direction. A rocker arm actuated by an engine-driven cam engages a head on the end of the actuating rod and moves the actuating rod positively through the suction stroke of the diaphragm, and upon the diaphragm reaching the end of its suction stroke the compression spring returns the diaphragm and its actuating rod through the discharge stroke of the diaphragm. On strokes of the diaphragm less than a full stroke, the rocker arm idles for part of its cycle in regard to the diaphragm actuating rod and moves out of contact with the head on the actuating rod. This occurs, for example, when there is low demand for fuel by the carburetor, and a full discharge stroke of the diaphragm is not obtained. Since the rocker arm is driven directly by a cam on the engine, the speed of rocker arm oscillation and the force produced by the rocker arm on the head of the operating rod will be proportional to the engine speed. As the speed of the engine increases, the head of the rod will move into lever arm contacting position more often due to an increase in fuel consumption by the engine. At high engine speeds therefore the strike of the lever arm against the head of the operating rod not only will occur more often than at low engine speeds, but also will cause a very severe shock when contact is made. This results in a very high rate of wear on the rocker arm and the head of the operating rod. The operating life of the diaphragm is also limited by the severity and shock of the operating action involved.

In normal operation, the rocking arm of a fuel pump of the type described not only slaps or contacts the head of the operating rod with a very high impact, as mentioned above, but also produces a high level of operating noise. As the parts begin to wear and tolerances increase, there is an even further increase in the noise level involved in normal operation. It is desirable that the noise level of a modern automotive engine as well as other internal combustion engines be kept at a low level and that fuel pump noise be greatly reduced. Fuel pump noise is also very annoying when the engine is running at idle or low operating speeds, when background noises such as road noise and noise caused by wind are not present. Another consideration involving fuel pump noise concerns the rocker arm pivot. Normal wear on the rocker arm pivot in fuel pumps of the type described is likely to result in unduly noisy rattling. Rattling of the rocker arm on its pivot also accelerates wear and reduces the life of the fuel pump.

It is, therefore, an object of this invention to provide a fuel pump wherein the noise produced by the lever arm striking the head of the operating rod is minimized at all speeds of engine operation.

Another object of this invention is the provision of a fuel pump construction wherein the rate of wear on the parts is minimized thus increasing the normal expected operating life of the fuel pump.

It is among the objects of this invention to provide a fuel pump wherein excessive noise in the action of the rocker arm pivot is minimized and wherein excessive accelerated wear of the rocker arm on its pivot is also minimized.

Another object of this invention is the provision of a fuel pump which is economical to manufacture and reliable in use as well as one in which the noise and wear is minimized.

In general, these objects are attained by providing the rocker arm of the pump with a shock absorbing means which cushions the impact of the rocker arm on the head of the diaphragm actuating rod and muffles the noise which would otherwise occur. Rattling of the rocker arm on its pivot after wear has occurred is minimized by a special arrangement of a biasing means which biases the rocker arm into engagement with the engine-driven cam. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a view in elevation illustrating a diaphragm pump of this invention in use on the engine of an automotive vehicle;

FIG. 2 is a vertical section of the pump, parts being shown in their position at the end of a discharge stroke;

FIG. 3 is a fragment of FIG. 2, showing parts in another position;

FIG. 4 is a fragmentary section similar to FIG. 3 but showing parts in still another position; and

FIG. 5 is a section taken on line 5—5 of FIG. 4.

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

Referring to the drawings, there is indicated in FIG. 1 at E the engine of an automotive vehicle on which is mounted a fuel pump P constructed in accordance with this invention. Fuel is delivered from fuel tank T of the vehicle through a line L1 to the fuel pump P and delivered by the latter through a line L2 to the carburetor C for the engine. The carburetor is mounted on the intake manifold of the engine, and an air-filter F is shown mounted on the air horn of the carburetor.

As shown in FIG. 2 pump P comprises a rocker arm housing 1 which is open at one end (its left end as appears in FIG. 2), this end being referred to as the inner end of the housing. The housing is of generally rectangular form in vertical cross section and of decreasing height from its inner end to its outer end (which is closed). At its inner end is a flange 3 for attaching it to the engine E. A rocker arm 5 is pivoted at 7 in the housing for rocking motion on a horizontal axis transverse to the housing. Arm 5 has an end portion 5A projecting out of the open inner end of the housing and an opposite end portion 5B within housing 1. When the pump is mounted on the engine, end portion 5A of the rocker arm is engaged by an engine-driven eccentric or cam 11. On rotation of the cam through half a revolution from its FIG. 2 position (wherein the low point of the cam engages portion 5A of the rocker arm), the rocker arm is rocked clockwise from its FIG. 2 position.

Extending upward from the rocker arm housing 1 at its outer end is a hollow conical pump base 13. An opening 15 is provided between the interior of housing 1 and the hollow base 13 at the bottom of the latter. The conical base 13 has an outwardly projecting rim or flange 17 at

its top. The top of flange 17 constitutes a seating surface for the margin of an annular diaphragm 19 consisting of a relatively thin disk of flexible fuel resistant material, such as a suitable synthetic rubber, which, when in unstressed condition, is flat or substantially flat. The outer margin of the diaphragm is clamped against the top of flange 17 by a pump body generally designated 21 having an outwardly projecting flange 23. Bolts 25 extending through flanges 17 and 23 draw flanges 17 and 23 together against the margin of the diaphragm under sufficient pressure to provide a fuel-tight seal all around the margin of the diaphragm and maintain pump body 21 in assembly with base 13.

The diaphragm is adapted to be pulled or flexed downward by a diaphragm-actuating rod or stem 27 and to be pushed or flexed upward by a spring 29. Rod 27 extends downward through base 13 and through the opening 15 into the rocker arm housing 1. Portion 5B of the rocker arm has a bifurcated or forked free end 31 which receives the rod 27. The latter has a head 33 at its lower end constituted by a collar riveted in place at the lower end of the rod.

The rod extends slidably through an oil seal and rod guide 35 held in an annular recess at the bottom of the base 13 by the reaction on a seal retainer ring 37 of the spring 29, this spring being a coil compression spring surrounding the rod. The diaphragm is mounted on the upper end of the rod 27 between a pair of circular plates 39 and 41, plate 39 being the lower plate and plate 41 the upper plate. The lower plate is formed with an annular corrugation or rib 43 forming a seat for confining the upper end of spring 29. The lower plate is of larger diameter than the upper plate and the margin of the lower plate which overhangs the upper plate is flared outward and upward to provide a rim 45 constraining the diaphragm to have an annular, free, nonreversing loop 47. The upper plate has a curved rim 49 engaging the loop. In the upward position of the diaphragm illustrated in FIG. 2, the outside of the loop engages the inner surface of the pump body 21. When arm 5 is rocked clockwise by cam 11, it lowers the rod and pulls the diaphragm downward. This loads the spring 29. Then when arm 5 rocks counterclockwise, spring 29 is adapted to drive the diaphragm and rod upward.

Pump body 21 is formed with a pumping chamber 53 above diaphragm 19. A partition 55 separates an inlet or intake chamber 57 from pumping chamber 53. A series of circular ports 59 provide communication from intake chamber 57 to pumping chamber 53 under control of an intake check valve 61. An inlet nipple 63 is connected to supply line L1 and supplies fuel to intake chamber 57 through passage 65. A partition 67 separates a discharge chamber 69 from pumping chamber 53. A series of circular ports 71 provide communication from discharge chamber 69 to pumping chamber 53 under control of a discharge check valve 73. Line L2 is connected to an outlet nipple 75 to supply fuel to carburetor C from discharge chamber 69 through passage 77.

Check valves 61 and 73 are of identical construction. Each comprises a stem 79 press fitted at one end within hole 81 and having at its other end a mushroom head 83. A ring-shaped disk valve member 85, which may be made of a suitable fuel-resistant synthetic rubber for cushioned sealing, is slidable on the stem 79, and is biased toward engagement with a valve seat formed by the adjacent face of the respective partition by a coil compression spring.

Rocker arm 5, as shown, is formed of sheet metal, having a web portion 87 and side flanges such as indicated at 89. These flanges extend upward from the web. The pivot at 7 is constituted by a pin extending between the side walls of the rocker arm housing 1 and through holes in the flanges 89. As to the outer end portion 5B of the rocker arm, web 87 inclines upward and is bent as indicated at 91 thereby forming a pocket. The forked free end 31 of portion 5B of the rocker arm extends outward from bend 91 and is curved to present a convex lower surface toward the head 33.

The rocker arm is biased in the direction for engagement of its outer end portion 5A with cam 11 by a coil compression spring 93. This spring seats against the bottom of the rocker arm housing and against a shoulder 95 on the bottom of the rocker arm housing and has its upper end secured to the web of the rocker arm inward from the bend 91 by a rivet 97. This constrains the spring 93 into a curved form as appears in FIGS. 2–4. Rivet 97 also holds in assembly with the rocker arm a leaf spring 99. The leaf spring 99 is positioned on the bottom of web 87 of the rocker arm, having a flat inner portion 101 lying flat against the web 87 inward of the bend 91, and a curved free outer end portion 103 which, like free end 31 of portion 5B of the rocker arm, is forked or bifurcated to receive the rod 27. The free outer end portion 103 of the leaf spring presents a convex lower surface toward the head 33, and, in its unstressed condition, is normally spaced from the free end 31 of rocker arm portion 5B so as to be capable of flexing toward and away from the latter.

Operation is as follows:

The inner end 5A of the rocker arm 5 is maintained in engagement with the cam 11 by the coil compression spring 93. On each revolution of the cam, the arm is swung clockwise from its FIG. 2 position, then returned counterclockwise to its FIG. 2 position. As it swings clockwise, it pulls rod 27 downward to flex the diaphragm 49 downward through a suction stroke. As it swings counterclockwise, it permits rod 27 to move upward and permits diaphragm 49 to flex upward through a discharge stroke under the bias of the spring 29. The free end portion 103 of the leaf spring 99 is sufficiently flexible to be flexed into engagement with the convex lower surface of the free end 31 of the arm (see FIG. 2).

It will be understood that under conditions of low demand for fuel by carburetor C, diaphragm 49 is blocked from flexing upward through a full discharge stroke to the extreme upper position in which it appears in FIG. 2. Under these circumstances, rod 27 remains in a downward position such as shown in FIG. 3, and free end 31 of arm 5 moves upward away from head 33 on the lower end of the rod. The free end 103 of the leaf spring then flexes downward away from the free end 31 of arm 5 as appears in FIG. 3. On the next downstroke of the free end 31 of arm 5, the free end 103 of the leaf spring engages the head 33 before free end 31 of arm 5 completes its downstroke (see FIG. 4), and thus the leaf spring acts as a cushion or shock absorber for absorbing the shock and diminishing or muffling the noise which would otherwise occur on the free end 31 of the arm 5 striking the head 33.

In the course of operation of the pump, wear occurs at pivot pin 7, and arm 5 tends to become loose on the pin. With spring 93 arranged as shown, however, it exerts a bias tending to hold the arm 5 up against the bottom of the pin, and this tends to avoid rattling of the arm 5 on the pin.

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

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 or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A fuel pump comprising means defining a pumping chamber, a diaphragm closing the pumping chamber, a housing enclosing the diaphragm, a rocker arm housing extending laterally from the diaphragm housing, a spring member in the diaphragm housing biasing the diaphragm in discharge direction, a diaphragm actuating rod extending from the diaphragm into the rocker arm housing and

naving a head on its extending end, a rocker arm for driving the rod pivoted in and extending longitudinally of said rocker arm housing, a cam member for actuating said rocker arm, said arm having a bifurcated free end receiving the rod adjacent its head, a second spring member seating against the bottom of the rocker arm housing and against the rocker arm for biasing said rocker arm against said cam, said arm biasing spring member being connected to the arm at a point between said free end and the pivot of said arm, a leaf spring secured to the rocker arm having a bifurcated free end generally in vertical alignment with the bifurcated free end of the rocker arm, the free end of the leaf spring normally being spaced from the arm and interposed between the arm and the head, and engageable with the head to yield toward the arm for muffling the impact of the arm on a driving stroke thereof, and a fastener securing one end of said second spring member and one end of said leaf spring to said arm, said leaf spring being interposed between the second spring member and the arm.

2. A fuel pump as set forth in claim 1 wherein the rocker arm housing is formed with an outwardly facing shoulder and the second spring member seats at its lower end opposite the arm against said shoulder and is curved from the rocker arm housing to the arm.

3. A rocker arm assembly for a fuel pump having a rocker arm housing and a diaphragm operating rod having a head thereon, said rocker arm assembly including a rocker arm having an engine cam engaging end and a free end, said rocker arm including means for pivotal movement intermediate its ends, the free end of said rocker arm being adapted to apply force to the head of the operating rod of said fuel pump, said free end of said rocker arm having a bend therein defining a pocket, said free end having a convex surface located outwardly of said bend, a resilient impact cushioning member, means mounting said member on said rocker arm near said bend with an intermediate portion thereof engaging said rocker arm in the pocket formed by said bend, said member having a curved end portion normally spaced from said free end of said rocker arm and adapted to be interposed between said rocker arm and said head, said curved portion of said member adapted to yield toward said arm as said arm moves into engagement with said head to absorb the impact between said arm and said head, a spring having one end thereof attached to said rocker arm between said bend and said pivotal means and adapted to urge said rocker arm into engagement with said engine cam and out of engagement with the head of said operating rod.

4. A rocker arm assembly for a pump having a rocker arm housing and a diaphragm operating rod having a head thereon, said assembly including a rocker arm, said rocker arm having a cam driven end and a free end, said

rocker arm adapted to be pivoted intermediate its ends within the rocker arm housing of said pump, a resilient impact cushioning member, means mounting said member on said rocker arm adjacent said free end, said member having a portion thereof adapted to be interposed between said rocker arm and the head of the operating rod of said pump, said portion of said cushioning member being normally disposed in spaced relation with said arm and adapted to yield toward said arm for absorbing the impact of said arm against said head, said assembly including a spring having one end thereof attached to said rocker arm and adapted to bias said rocker arm into engagement with said engine cam and out of engagement with the head of said operating rod, a fastening means securing said resilient member and said one end of said spring to said rocker arm.

5. A fuel pump comprising means defining a pumping chamber, a diaphragm closing the pumping chamber, a housing enclosing the diaphragm, a rocker arm housing extending laterally from the diaphragm housing, a spring member in the diaphragm housing biasing the diaphragm in discharge direction, a diaphragm actuating rod extending from the diaphragm into the rocker arm housing and having a head on its extending end, a rocker arm for driving the rod pivoted in and extending longitudinally of said rocker arm housing, a cam member actuating said rocker arm to bias said diaphragm in the opposite direction against the tension of said spring member, said arm having a bifurcated free end receiving the rod adjacent its head, a second spring member seating against the bottom of the rocker arm housing and against the rocker arm for biasing said rocker arm against said cam, a leaf spring secured to the rocker arm adjacent its bifurcated end, said leaf spring having a bifurcated free end generally in vertical alignment with the bifurcated free end of the rocker arm, the free end of said spring normally being spaced from the arm and interposed between the arm and the head, said spring further being normally spaced from said head when said diaphragm is in its lowermost position and engageable with the head to yield toward the arm for muffling the impact of the arm on a driving stroke thereof, and a fastener securing one end of said second spring member and one end of said leaf spring to said arm.

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