Aug. 30, 1932. C. S. BURTON 1,874,890

CAM ACTUATED FUEL PUMP

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Fig. 1.

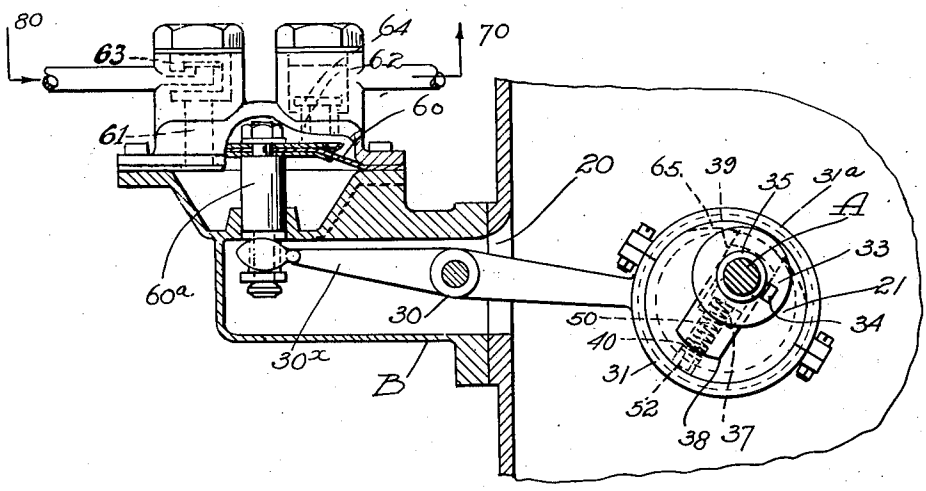
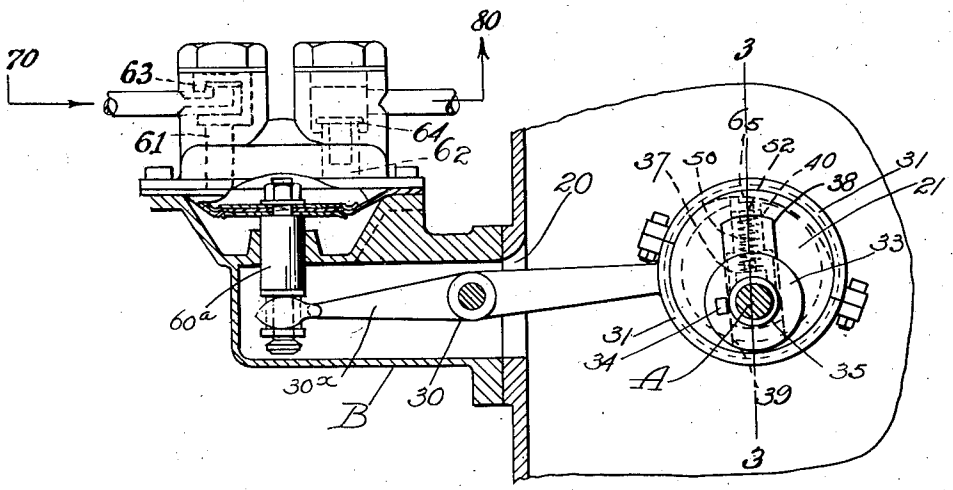


Fig. 2.



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Fig. 3.

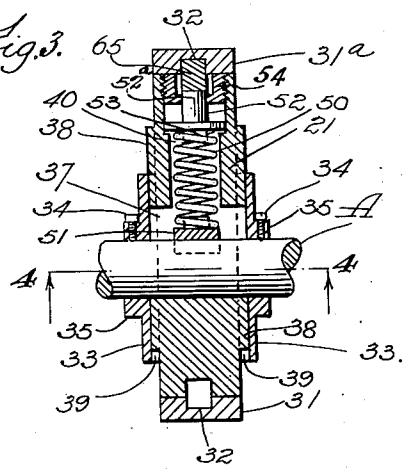


Fig. 4.

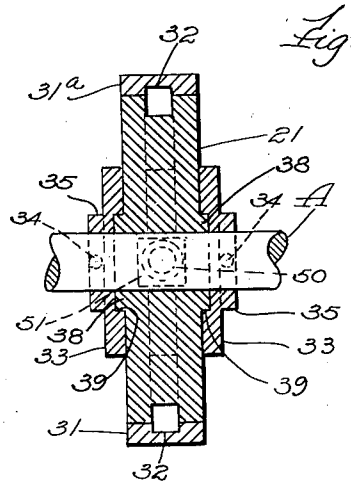


Fig. 5.

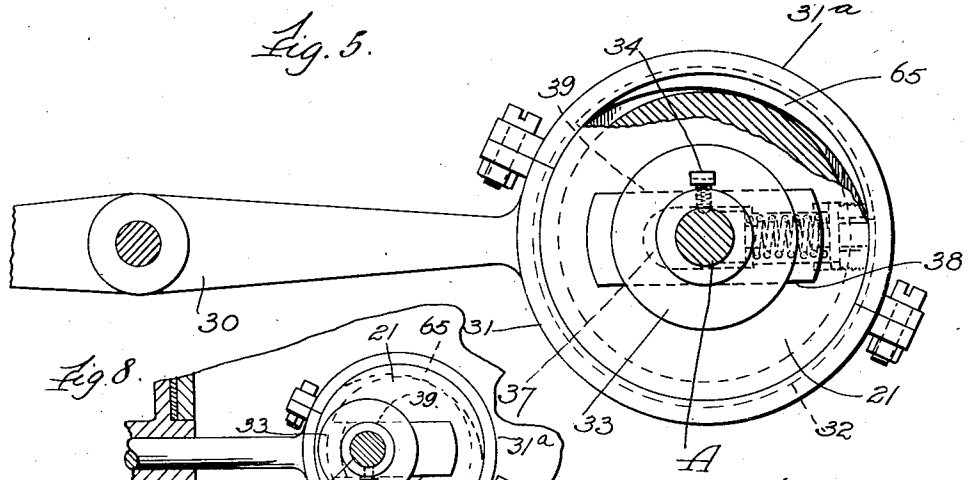


Fig. 8.

Fig. 7.

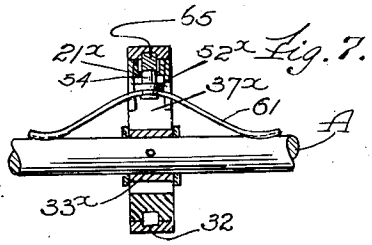
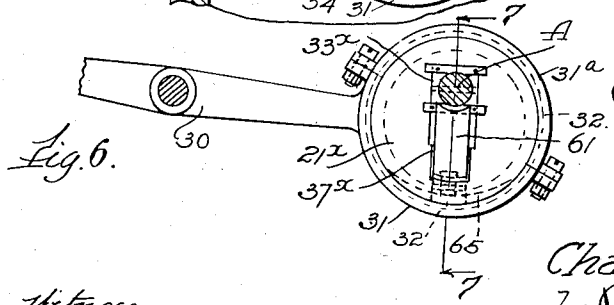


Fig. 6.



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1,874,890

UNITED STATES PATENT OFFICE

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CAM ACTUATED FUEL PUMP

Application filed April 2, 1930. Serial No. 441,009.

The purpose of this invention is to provide an improved means for actuating a pump for supplying fuel to an internal combustion engine by an engine cam, which shall be adapted to the requirement of the maintaining predetermined pressure on the fuel delivery line while varying engine requirement, and at the same time making the pump intake stroke with the force necessary for the maximum fuel lift independently of the predetermined delivery pressure, and at the same time limiting the intake stroke according to the delivery.

It consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:—

Figure 1 is a view sectional with respect to the pump chamber and transverse to the engine shaft in a construction embodying this invention showing the parts at the limit of a full discharge stroke of the pump.

Figure 2 is a detail sectional view in the same plane as Figure 1 showing the cam and actuated lever in the position occupied at a different part of the cycle of the pumping action.

Figure 3 is a detail section at the line 3—3 on Figure 2.

Figure 4 is a section at the line 4—4 on Figure 3.

Figure 5 is a view of the cam-actuated lever and cam similar to those seen in Figures 1 and 2 showing the parts at a different position in the pumping cycle, the cam casing being partly broken away to disclose an interior detail.

Figure 6 is a view similar to Figure 1 on a smaller scale showing a modified construction.

Figure 7 is a section at the line 6—6 on Figure 6.

Figure 8 is a section in vertical plane transverse to the operating shaft showing in side elevation a cam and thrust rod substituted for the cam and lever construction of the previous figures.

The primary and fundamental idea of this invention consists in providing on a revolving shaft an eccentric cam element whose eccentricity with respect to the shaft shall be variable, the cam being carried by the shaft in the rotation of the latter by means permitting the cam to move transversely of the shaft for varying the degree of its eccentricity, with spring means operating for holding it yieldingly at a position of predetermined maximum eccentricity, so that predetermined maximum resistance to the movement which the cam might give to an actuated part by virtue of eccentricity of the cam, will operate to render the cam concentric and defeat such movement or reduce it proportionately to the approximation of said resistance to the resilient reaction of the cam spring.

In the structure illustrated in the drawings, referring to Figure 1, the shaft, A, may be understood as being a shaft of an internal combustion engine contained in the engine casing and accessible through an opening in the engine casing indicated at 20. On this shaft there is shown mounted in a manner and by means hereinafter described, so as to be revolved by the shaft, a circular plate, 21, which is hereinafter referred to as the cam, because, when positioned eccentrically with respect to the shaft, it cooperates camwise with the actuated part. For cooperating with this cam there is provided an actuated member, which, as shown, is a lever, 30, fulcrumed on a part which is fixed with respect to the bearing of the shaft, A, and which, as shown, is the casing, B, of the pump which is to be operated, said part, 30, being formed for embracing the cam in the plane of rotation of the shaft,—A, being the plane of eccentricity when the cam is eccentrically positioned,—the embracing feature, as shown, being a terminal, 31, of the actuated member, formed for embracing,—and as

illustrated completely encompassing,—the cam. A convenient method and means for mounting the cam on the shaft, so that it may be rotated by the shaft and also be movable transaxially of the shaft from concentric to eccentric position, is seen in Figure 3, consisting of a pair of collars, 33, 33, secured fixedly on the shaft, as by the set screws, 34, set in the exteriorly,—oppositely—protruding hubs, 35, of the collars, the cam having a diametrically positioned slot, 37, through which the shaft extends, and the cams on the one hand, and the collars on the other hand, having cooperating ribs and grooves, 38 and 39, for engagement of the cam with the collars, and guidance of the cam transversely of the shaft in the direction of said cooperating ribs and grooves. As illustrated, the ribs are formed on opposite sides of the cam, and the grooves on the inwardly facing sides of the collars.

In alignment with the diametrically positioned slot, 37, of the cam, there is formed by boring in radially from one side, a cylindrical chamber, 40, for a coil spring, 50, and in line with this bore, 40, there is fitted a seating member, 51, for the inner end of the coil spring, 50, which seating member bears upon the shaft; and there is provided for closing the outer end of the bore, a plug, 52, having a reduced inner end terminal portion, 53, for centering the spring, 50, the parts being dimensioned so that the spring may be compressed in the process of entering the plug to a position flush at its outer end with the circumferential periphery of the cams, so that it may be entered into and retained by the encompassing terminal ring, 31, in whose interior groove, 32, hereinafter described, it is engaged by the reaction of the spring, 50, so that it constitutes the stop for the spring against which the latter reacts for holding the cam normally in position eccentric with respect to the shaft.

Preferably, as above indicated, the cam-embracing terminal of the cam-actuated pump operating member, 30, is formed and arranged for completely encompassing the cam. For convenience of assembling, this cam-embracing part is made comprising a semi-circular fork terminal, 31, of the lever, 30, and a semi-circular clasping member, 31^a, arranged to have its extremities coupled to the corresponding extremities of the fork terminal after the latter is applied in cam-embracing position as seen in Figure 1.

This construction dispenses with any other means for checking the plug, 52, against being ejected by the reaction of the spring, 50, in that part of the revolution of the shaft and cam at which the cam is not acting by its eccentricity for actuating the lever one way or the other. But if for any reason it should be judged more convenient to make the lever terminal for embracing the cam, without completely encompassing it, there may be provided, for checking the plug to retain it in the bore against the reaction of the spring, 50, a ring, 54, screwed into the outer end of the bore which is interiorly threaded for a short distance for that purpose; and this construction is shown in Figure 3.

In the construction shown in Figure 1, in which, as mentioned, the cam-actuated pump operating member, 30, is a lever fulcrumed on the pump casing, B, the pump shown is of familiar simple form comprising as the pumping member a diaphragm, 60, having a stem, 60^a, which is connected to the arm, 30^x, of the lever, 30, the pump chamber above the diaphragm having fuel inflow and discharge connections indicated at 61 and 62, with intake and discharge valves, 63 and 64, opening for fuel flow from the fuel source by pipe indicated at 70 to the engine intake by pipe indicated at 80. For well understood reason, it is important that a fuel pump for supplying an internal combustion engine should be constructed and arranged for maintaining pressure on the fuel delivery line to the engine, to a predetermined degree adequate for meeting the maximum engine requirement of fuel and furnishing such supply varyingly in quantity according to engine requirements.

And it will be understood from the foregoing description that the apparatus described is adapted to meet these requirements, because the force of the feeding stroke of the pump is limited by the reaction of the cam spring, 50; and when the fuel delivery line from the pump to the engine is filled, the feeding stroke of the pump will be no greater than necessary to deliver fuel to replace the amount which has been taken by the engine in the interval since the preceding feeding stroke.

In the installation of a fuel feeding system on a motor vehicle, the force necessary for maintaining proper pressure on the delivery line is less than the force necessary for lifting the fuel from the main supply tank to the pump; and since in the construction shown the force available for either purpose is the reaction of the cam spring, it is desirable to provide for making that reaction stronger in the intake stroke than in the feeding stroke.

In the construction illustrated in the drawings, this is accomplished by providing the stop plug, 52, at the outer end with a reduced terminal projection, 52^a, which under the reaction of the spring, 50, is held protruding radially from the circumference of the cam, and in the rotation of the cam travels in a groove, 32, provided on the inner side of the cam-encompassing ring terminal, 31, 31^a, of the cam actuated member, 30, this groove being continuous through about 270° of the circumference of said encompassing ring, the remaining 90° being occupied by a cam rib,

65, which protrudes inward from the bottom of the groove, taperingly from both ends toward the middle part; and which at the middle part of its circular extent in the ring terminal 31, 31^a occupies the full depth of the groove, 32, and may protrude inward radially therefrom as shown.

This cam feature is located at the side of the encompassing ring, 31, 31^a, against which the eccentric cam acts by virtue of its eccentricity for giving the cam-actuated pump operating member, 30, its intake stroke, which, in the construction as shown, is the upper side.

Upon considering this device it may be seen that when, in the rotation of the eccentric cam, the stop plug, 52, comes around to the cam, 65, and is passing it, the cam operates to thrust the stop plug, 52, inward, compressing the spring, 50, and increasing its reaction for resisting the movement of the cam toward concentric position on the shaft, and causing the cam to actuate the pump-operating member, 30, more strongly for the pump intake stroke than it is actuated by the cam for the feeding stroke.

In Figure 8, the invention is shown embodied in a construction in which the cam-actuated pump operating member is a plunger instead of a lever, so that the movement produced by the cam is a thrusting and retracting movement instead of an oscillating movement. The operation of the invention in this form may be understood from the drawings without further description, the only difference between this form and the first described form being, as mentioned, that the cam-caused movement is a longitudinally reciprocating movement instead of an oscillating movement.

The principle of the invention may be embodied in a construction somewhat simpler in form, shown in Figures 6 and 7, which, by reason of its simplicity, may be preferred when the engine shaft utilized for operating the pump affords sufficient length for accommodating the means for mounting the cam thereon shown in these figures.

In this form, the eccentric cam, 21^x, having a diametric slot, 37^x, corresponding to the slot, 37, of the first described form, is mounted on the shaft by means of an exteriorly square collar, 33^x, which may be pinned to the shaft and exteriorly dimensioned for sliding fit in the cam slot, the cam being carried eccentrically on the shaft by means of a bow spring, 61, made of flat spring bar which extends longitudinally through the cam slot, having its ends bearing upon the shaft at opposite sides of the cam at a substantial distance from the latter necessary for accommodating a spring of suitable length. This square collar serves for rotating the cam with the shaft; and the flat spring reacts between the shaft and the cam for the same purpose and with the same value as the coil spring in the previously described form.

In this form the flat bar bow spring is furnished at the middle point of its length and crest of its bow with a stud or button, 52^x, which protrudes into the groove, 32, in the inner circumference of the cam-encompassing member, 31, 31^a, and co-operates with the interiorly protruding cam, 65, in the same manner as in the first described form for forcing the spring, 61, inward toward the shaft at the stage of the revolution of the shaft at which the cam operates for the suction or intake stroke of the pump.

I claim:

1. In combination with an internal combustion engine and a pump for supplying fuel thereto, means for operating the pump consisting of a cam device carried by an engine shaft and spring means rendering it yieldingly eccentric, and an actuated member comprising means at one portion of its extent for embracing the cam in the plane of its eccentricity, and at another portion of its extent connected for operating the pump; means carried respectively by the cam-embracing element and the cam positioned on the respective parts for encounter and cooperation to condition the spring for increased reaction in the 90 degrees of the cam's revolution in which the cam operates for giving the pump its intake stroke.

2. In combination with an internal combustion engine and a pump for supplying fuel thereto, means for operating the pump consisting of a yieldingly eccentric cam device carried by an engine shaft, and an actuated member comprising means at one portion of its extent for embracing the cam in the plane of its eccentricity, and at another portion of its extent connected for operating the pump; a follower carried in the cam at the end of the spring at which it reacts on the cam for holding the latter in eccentric position, said follower having a terminal protruding from the periphery of the cam in the plane of the cam-embracing element, the latter having a protrusion inwardly toward the shaft at the side of the cam-embracing element against which the cam operates by virtue of its eccentricity for giving the pumping member its intake stroke, said protrusion of the cam-embracing element being positioned in the plane of rotation of the protruding terminal of the spring follower, and adapted to cam the follower inwardly for compressing the spring upon the encounter of said protruding element in the rotation of the cam.

3. In combination with a motor mechanism having a revolving shaft, means for communicating back and forth movement to an operating member of an auxiliary mechanism apart from the motor, said means consisting of a yieldingly eccentric cam device carried

by the motor shaft, and an actuated member comprising means at one portion of its extent for embracing the cam in the plane of its eccentricity and at another portion of its extent connected for operating the auxiliary mechanism, said cam device having an aperture for accommodating the shaft in the movement of the cam element to varyingly eccentric positions relatively to the shaft; a pair of collars arranged to be secured to the shaft on the opposite sides of the cam element for engagement of the cam element with the collars for rotating the cam element and guiding it in its movement to varyingly eccentric positions; and a spring located in the aperture of the cam element between the collars and reacting between the shaft and the cam element for holding the latter normally in eccentric position, the actuated member being a lever having its fulcrum fixed with respect to the journal bearing of the shaft, and the cam-embracing element carried on one arm and having the other arm connected for operating the pump, and means carried respectively by the first mentioned lever arm and the cam positioned on the respective parts for encounter and cooperation for conditioning the spring for increased reaction in the 90 degrees of the shaft's rotation at which the cam operates on the lever for communicating one of the back and forth movements of the auxiliary mechanism.

4. In combination with an internal combustion engine and a pump for supplying fuel thereto, means for operating the pump consisting of a cam carried by the engine shaft and a lever arranged at one part of its extent for cooperating with the cam and connected at another part of its extent with the pumping member for reciprocation of the latter, the cam being mounted on the engine shaft for positive rotation therewith, and spring means reacting between the cam and the shaft for adapting the cam to yield relatively to the shaft in its camming action on the lever in both directions, and means comprising cooperating parts carried by the lever and the cam respectively, for increasing the reaction of the spring to diminish its yielding in one direction of the lever's movement.

5. In combination with a motor mechanism having a revolving shaft, means for communicating back-and-forth movement to an operating member of an auxiliary mechanism apart from the motor, said means consisting of a yieldingly eccentric cam device carried by the motor shaft and an actuated member comprising means at one portion of its extent for embracing the cam in the plane of its eccentricity and at another portion of its extent connected for operating the auxiliary mechanism, said cam device having an aperture for accommodating the movement of the cam to varyingly eccentric positions relatively to the shaft; a pair of collars arranged to be secured to the shaft at the opposite sides of said cam element for engagement of the cam element and guiding it in its movement to varyingly eccentric positions; and a spring located in the aperture of the cam element between the collars and reacting between the shaft and the cam element for holding the latter normally in eccentric position, and means carried respectively by the cam-embracing element and the cam positioned on the respective parts for encounter and cooperation to condition the spring for increased reaction in the 90 degrees of the cam's revolution in which the cam operates for communicating one of the back-and-forth movements of the auxiliary mechanism.

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