Jan. 26, 1943. E. C. HORTON 2,309,591

FUEL FEEDING SYSTEM

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FIG. 2.

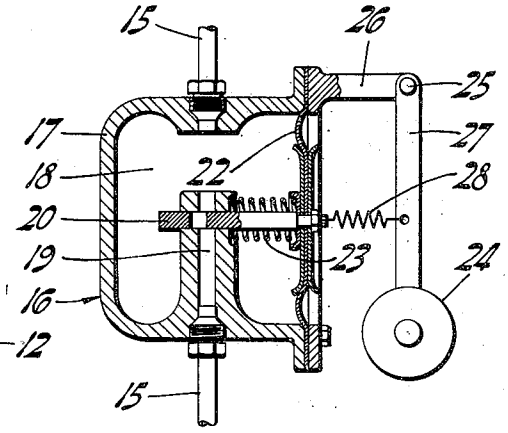


FIG. 1.

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FUEL FEEDING SYSTEM

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20 Claims. (Cl. 180—77)

This invention relates to fuel feeding systems employed in conveying motivating fluid fuel to the propelling engines of vehicles.

It is common in the art to which the present invention appertains to employ fluid pressure, either super-atmospheric or sub-atmospheric, for motivating pumping means for transferring liquid fuel from a storage tank to a carburetor or other point of use. The present invention provides means for counteracting certain influences tending to produce irregularity in the delivery pressure or the amount of fuel delivered by the pumping means.

According to the teachings of the present invention apparatus is provided whereby the amount of motivating fluid pressure applied to the pumping means is regulated, in the first instance, inversely in accordance with variations in the differential pressure of such fluid and, secondly, in such manner as to take into account the condition of the vehicle as to acceleration, deceleration, and the ascent and descent of inclines.

In pursuing my invention I so arrange the secondary control means as to effect control of effective motivating fluid by automatically modifying the operation of the primary control means, whereby a single regulating valve may be automatically varied in its fluid capacity by operation of means responsive to several quite different operating conditions which are found to influence operation of the fuel pumping system.

In a preferred form I provide a pressure chamber having an element therein which is movable in response to fluid pressure changes within said chamber, together with a second movable member which is responsive to changes in the inclination of the longitudinal axis of the vehicle as well as to acceleration and deceleration of the vehicle.

A specific example of apparatus embodying the principles of my present invention is shown in the accompanying drawing in which:

Fig. 1 is a fragmentary elevational view of the carburetor portion of a vehicle engine with a remote fuel supply tank therefor indicated somewhat diagrammatically; and

Fig. 2 is a detailed cross sectional view of the pressure control element of Fig. 1 viewed from the same direction as in Fig. 1.

Like characters of reference denote like parts throughout the drawing and the numeral 10 designates schematically the intake manifold of an internal combustion engine, a fuel storage tank for which is likewise indicated schematically at 11 in the general view, Fig. 1. A conventional carburetor 12 is shown associated with the intake manifold 10 and a fuel conduit 13 extends between the fuel storage tank 11 and the carburetor 12. A fluid activated pumping device is preferably interposed in the fuel line between the storage tank 11 and the carburetor 12, and in the illustrated embodiment is shown disposed directly above the fuel storage tank 11, as at 14.

The pumping device may be any one of the general class of fluid pumps adapted to be operated by an associated fluid motor means. For the purposes of exemplification, this pump may be of the type shown in my prior Letters Patent No. 2,094,560, granted September 28, 1937. This pump is adapted to be operated by employing the sub-atmospheric pressure normally obtaining in the intake manifold of internal combustion engines during operation. For conducting activating differential fluid pressure from the intake manifold 10 to the pumping unit 14, I provide a conduit 15 which has interposed therein a pressure control device indicated generally at 16 in Fig. 1 and shown in detail in the cross sectional view, Fig. 2.

The control means comprises a casing element 17 which provides a pressure chamber 18 in the path of the fluid differential pressure conduit 15 and a fluid passage 19 formed in the casing 17 is controlled by means of the slide valve 20, whereby fluid passage through the chamber 18 may be regulated.

Automatic means for effecting such regulation comprise a movable element which, in the illustrated embodiment, is in the form of a flexible diaphragm 22 which forms a wall of the control unit 16. In the form shown, the center of the diaphragm is directly connected to the slide valve 20 so that movements of the diaphragm resulting from an enlargement of the pressure chamber 18 (indicating an increase in the absolute pressure within the sub-atmospheric pressure chamber 18 and a consequent decrease in the differential between such pressure and the atmospheric pressure at the opposite side of the diaphragm) tends to produce an enlargement of the valved orifice by movement of the slide valve 20 to the right, as viewed in the drawing. Compression coil spring 23 may be interposed between the diaphragm 22 and the stationary portion of the casing which provides the valved passage 19 for biasing the diaphragm 22 to a normal outward position.

It will be noted from the description thus far

that disposition of the slide valve 20 for controlling the effective capacity for fluid flow through the pressure chamber 18 is determined, in the first instance, by the relative differential fluid pressure existing within and without the control chamber 18. A secondary control of such disposition is automatically produced by virtue of a pendulum 24 which is mounted for swinging movement at a fixed pivot 25 on an arm 26 secured to the casing 17. The arm 27 of the pendulum is connected to the center of the outside of the diaphragm 22 by means of a spring 28 which resiliently transmits movement of the pendulum 24 to the diaphragm 22.

The spring 28 serves to additionally bias the diaphragm 22 to the right, as viewed in Fig. 2, and in fact, if the mass of the pendulum 24 be sufficient, the spring 28 might serves as a sole biasing means for the diaphragm 22.

In the form of my invention illustrated in the drawing, I intend that the control means be so disposed that the front end of the vehicle with which the device is associated be to the left, as seen in the drawing. It will therefore appear that when the vehicle is ascending an incline the pendulum 24 will tend to move rearwardly or to the right, as viewed in the drawing, and thereby tend to move the diaphragm 22 in such manner as to produce an increased effective area of the valve passage 19. A like impulse will be transmitted to the diaphragm 22 by the pendulum 24 by acceleration of the vehicle, due to the inertia of the pendulum resisting such acceleration.

Conversely, when the vehicle is descending an incline the pendulum will move to the left, as viewed in the drawing, partially relieving the tension of the spring 28 and accordingly permitting a partial closing of the valve 20 to reduce the capacity for fluid flow of the passage 19. Again, deceleration of the vehicle will result in a similar movement of the pendulum to the left, as viewed in the drawing, and a consequent partial closing movement of the vehicle 20, due to the inertia of the pendulum 24 opposing deceleration.

While the illustrated embodiment shows the control means as governed in the first instance by the pressure differential existing between the partial vacuum in the conduit 15 and the outside atmosphere, it will appear to those skilled in the art that, in the case of super-atmospheric systems, the pressure differential of the pumping fluid over the surrounding atmosphere may be employed. Likewise, the pressure differential between the fluid being pumped and the surrounding atmosphere may be used for effecting the desired control and, in fact, the control may be arranged to respond to the pressure differential between the motivating fluid and the fluid fuel being pumped by exposing one side of the movable member to each of these pressure influences.

It will be apparent to those skilled in the art that my proposed control system may be varied in numerous respects from the single specific embodiment described in detail without departing from the spirit or scope of my invention, which is not to be considered limited otherwise than as defined in the appended claims.

I claim:

1. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy, and conduit means between said tank and said engine, a fluid pressure operated pump interposed in said conduit, a conduit for supplying operating fluid pressure to said pump, and control means interposed in said fluid pressure conduit, said control means comprising a regulating valve and means for controlling the position thereof, said latter means comprising an element movable in response to variations in the fluid pressure in said conduit, and a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle, said pendulum having connection with said movable element to bias said element auxiliary to its movements under the influence of said fluid pressure variations.

2. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy, and conduit means between said tank and said engine, a fluid pressure operated pump interposed in said conduit, a conduit for supplying operating fluid pressure to said pump, and control means interposed in said fluid pressure conduit, said control means comprising a regulating valve and means for controlling the position thereof, said latter means comprising an element movable in response to variations in the fluid pressure in said conduit, resilient means biasing said movable element toward one of its extreme positions of valve adjustment, and a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle, swinging movement of said pendulum being adapted to modify the biasing action of said resilient means on said movable element.

3. In a motor vehicle having an internal combustion propelling engine and a carburetor and an intake manifold associated therewith, a fuel storage tank and a conduit leading therefrom to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting with said pump and the intake manifold of said propelling engine for supplying differential operating pressure for said pump, control means interposed in said fluid pressure conduit comprising an element movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said movable element to vary fluid carrying capacity of said conduit, and secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum.

4. In a fluid pressure operated fuel feeding system for motor vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy, and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, a fluid pressure connection between said pump and the intake manifold of said engine to utilize the subatmospheric pressure prevailing therein whereby said operating fluid pressure is characteristically subnormal when said engine is laboring and abnormal when said engine is idling, and control means responsive to fluid pressure in said intake manifold for governing the rate of transfer of fuel by said pump, said control means compris-

ing a passage and a valve in said connection for varying fluid flow therethrough, a fluid pressure responsive element for primarily controlling the position of said valve, and a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle, said pendulum being arranged and proportioned so that swinging movement thereof exercises a secondary adjustment of said valve to compensate for said subnormality and said abnormality.

5. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, and control means for governing the rate of transfer of fuel by said pump, said control means comprising a passage and a valve for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof, and a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle, said pendulum being connected to said pressure responsive element by an energy-storing play connection for modifying the controlling action of the latter when the pendulum tends to swing due to the force of inertia or the force of gravity acting thereon.

6. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, and control means for governing the rate of transfer of fuel by said pump, said control means comprising a passage and a valve for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof, a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle whereby conditions of ascent, descent, acceleration and deceleration of said vehicle tend to produce movement of said pendulum, and resilient means connecting said pendulum with said pressure responsive element whereby tendency of the pendulum to move is resiliently applied to said pressure responsive element to modify its valve controlling action.

7. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, a fluid pressure conduit connecting with a source of differential operating pressure, and control means for governing the rate of transfer of fuel by said pump, said control means comprising a valve in one of said conduits for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof, said fluid pressure responsive element having a side thereof acted upon by a fluid pressure differential in said fluid pressure conduit, and spring means connecting with one side of said element to bias it to one direction of movement, a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle whereby conditions of ascent, descent, acceleration and deceleration of said vehicle tend to produce movement of said pendulum, said tendency to movement being communicated to said pressure responsive element to modify the bias of said spring means to modify the valve controlling action in accordance with varying operating conditions.

8. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, a fluid pressure conduit connecting with a source of differential operating pressure and control means for governing the rate of transfer of fuel by said pump, said control means comprising a passage and a valve in said fluid pressure conduit for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof, said fluid pressure responsive element having a side thereof exposed to fluid pressure at a point within said fluid pressure conduit and an opposite side exposed to the atmosphere, whereby pressure differentials tend to produce movement thereof, and spring means connecting with said element to bias it in one direction, a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle whereby conditions of ascent, descent, acceleration and deceleration of said vehicle tend to produce movement of said pendulum, said tendency to movement being communicated to said pressure responsive element to modify its valve controlling action by modifying the bias of said spring means and accordingly vary the rate of fuel delivery to suit varying operating conditions.

9. In a motor vehicle having an internal combustion propelling engine and a carburetor and an intake manifold associated therewith, a fuel storage tank and a conduit leading therefrom to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting with said pump and the intake manifold of said propelling engine for supplying differential operating pressure for said pump, control means interposed in said fluid pressure conduit comprising a wall portion movable in response to variations in the degree of said fluid pressure, spring means biasing said wall portion toward one of its extreme positions of movement, a valve in said conduit movable by said movable wall portion to vary fluid carrying capacity of said conduit, and secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said movable wall portion toward a closed position of said valve upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum.

10. In a motor vehicle having an internal combustion propelling engine associated therewith, a fuel storage tank and a conduit leading therefrom to said engine, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said engine, a fluid pressure conduit connecting with said pump and a source of differential fluid pressure, control means interposed in said fluid pressure conduit comprising an element movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said movable element to vary fluid carrying capacity

of said conduit, and secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum.

11. In a motor vehicle having an internal combustion propelling engine and a carburetor and an intake manifold associated therewith, a fuel storage tank and a conduit leading therefrom to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting with said pump and the intake manifold of said propelling engine for supplying differential operating pressure for said pump, control means interposed in said fluid pressure conduit comprising a wall portion movable in response to variations in the degree of said fluid pressure, spring means urging said wall portion outwardly against the action of atmospheric pressure tending to move said wall portion inwardly by reason of sub-atmospheric pressure normally prevailing in said conduit, a valve in said conduit movable by said wall portion to vary the fluid carrying capacity of said conduit, and secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum.

12. In a motor vehicle having an internal combustion propelling engine and a carburetor and an intake manifold associated therewith, a fuel storage tank and a conduit leading therefrom to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting with said pump and the intake manifold of said propelling engine for supplying differential operating pressure for said pump, control means interposed in said fluid pressure conduit comprising a wall portion movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said wall portion to vary the fluid carrying capacity of said conduit, secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open posiiton upon rearward swinging of said pendulum, and spring means having its opposite ends connected to said movable wall portion and said pendulum respectively for resiliently transmitting impulses from said pendulum to said movable wall portion.

13. In a motor vehicle having an internal combustion propelling engine and a carburetor associated therewith, a fuel storage tank and a conduit leading therefrom to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting said pump with a source of differential operating pressure, control means interposed in said fluid pressure conduit comprising a wall portion movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said wall portion to vary the fluid carrying capacity of said conduit, secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum, and spring means having its opposite ends connected to said movable wall portion and said pendulum respectively for resiliently transmitting impulses from said pendulum to said movable wall portion.

14. In a motor vehicle having an internal combustion propelling engine and a carburetor associated therewith, a fuel storage tank and a conduit leading there from to said carburetor, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said carburetor, a fluid pressure conduit connecting said pump with a source of differential operating pressure, control means interposed in said fluid pressure conduit comprising a wall portion movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said wall portion to vary the fluid carrying capacity of said conduit, secondary control means for said valve comprising a weighted member mounted for movement under the forces of gravity and inertia in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward movement of said weighted member and toward an open position upon rearward movement of said weighted member.

15. In a motor vehicle having an internal combustion propelling engine associated therewith, a fuel storage tank and a conduit leading therefrom to said engine, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel from said storage tank to said engine, a fluid pressure conduit connecting with said pump and a source of differential fluid pressure, control means interposed in said fluid pressure conduit comprising an element movable in response to variations in the degree of said fluid pressure, a valve in said conduit movable by said movable element to vary fluid carrying capacity of said conduit, and secondary control means for said valve comprising a weighted member disposed for movement in a plane extending substantially in the direction of movement of the vehicle under the forces of gravity and inertia to influence said valve toward a closed position upon forward movement of said weighted member and toward an open position upon rearward movement of said weighted member.

16. In a motor vehicle having an internal combustion propelling engine associated therewith, a fuel supply system comprising a fuel storage tank and a conduit leading therefrom to said engine, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel under pressure from said storage tank to said engine, a fluid pressure conduit connecting with said pump and a source of differential operating fluid pressure, control means interposed in said fluid pressure conduit comprising an element movable in response to variations in the degree of fluid pressure in said fluid pressure conduit, a valve in said conduit movable by said movable element to vary the fluid carrying capacity

of said conduit, and secondary control means for said valve comprising a weighted member disposed for movement in a plane extending substantially in the direction of movement of the vehicle under the forces of gravity and inertia to influence said valve toward a closed position upon forward movement of said weighted member and toward an open position upon rearward movement of said weighted member.

17. In a motor vehicle having an internal combustion propelling engine associated therewith, a fuel supply system therefor comprising a fuel storage tank and a conduit leading therefrom to said engine, a pump operable by differential fluid pressure interposed in said conduit for transferring fuel under pressure from said storage tank to said engine, a fluid pressure conduit connecting with said pump and a source of differential fluid pressure, control means interposed in said fluid pressure conduit comprising an element movable in response to variations in the degree of fluid pressure in said fluid pressure conduit and resilient means biasing said movable element in one direction against the action of the differential fluid pressure, a valve in said conduit movable by said movable element to vary fluid carrying capacity of said conduit, secondary control means for said valve comprising a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle to influence said valve toward a closed position upon forward swinging of said pendulum and toward an open position upon rearward swinging of said pendulum, and resilient means connecting said pendulum and said movable element for yieldably transmitting force from the former to the latter.

18. In a fluid pressure operated fuel feeding system for motor vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy, and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit, a fluid pressure connection between said pump and the intake manifold of said engine to utilize the subatmospheric pressure prevailing therein whereby said operating fluid pressure is characteristically subnormal when said engine is laboring and abnormal when said engine is idling, and control means responsive to fluid pressure in said fluid pressure connection for governing the rate of transfer of fuel by said pump, said control means comprising a passage and a valve in said connection for varying fluid flow therethrough, a fluid pressure responsive element for primarily controlling the position of said valve, and a weighted member mounted for movement in a plane extending substantially in the direction of movement of the vehicle, said weighted member being arranged and proportioned so that inertia movement thereof exercises a secondary adjustment of said valve to compensate for said subnormality and said abnormality.

19. In a fluid pressure operated fuel feeding system for vehicles, a liquid fuel storage tank, an engine employing said liquid fuel as its source of energy and conduit means between said tank and said engine, a fluid pressure motivated pump interposed in said conduit and a conduit for supplying differential fluid pressure thereto, and control means for governing the rate of transfer of fuel by said pump, said control means comprising a passage and a valve in one of said conduits for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof and exposed to the differential fluid pressure in one of said conduits, and a weighted member disposed for inertia movement in a plane extending substantially in the direction of movement of the vehicle, said weighted member being connected to said pressure responsive element but arranged for movement relative thereto for modifying the controlling action of the latter when the weighted member tends to move relative to said vehicle due to the force of inertia or the force of gravity acting thereon.

20. In a fluid pressure operated fuel feeding system for vehicles wherein a liquid fuel storage tank and an engine employing liquid fuel as its source of energy are connected by conduit means between said tank and said engine and the fuel is fed by a fluid pressure motivated pump which is interposed in said conduit and connected by a fluid pressure conduit to a source of differential operating pressure, a control means for governing the rate of transfer of fuel by said pump, comprising a passage and a valve for insertion in the fluid pressure conduit for varying fluid flow therethrough, a fluid pressure responsive element connected to said valve for primarily controlling the position thereof, said fluid pressure responsive element having a side thereof for being exposed to the fluid pressure of said source of differential operating pressure and an opposite side exposed to the atmosphere, whereby pressure differentials tend to produce movement thereof, a pendulum disposed for swinging movement in a plane extending substantially in the direction of movement of the vehicle whereby conditions of ascent, descent, acceleration and deceleration of said vehicle tend to produce movement of said pendulum, and resilient means connecting said pendulum with said pressure responsive element whereby tendency of the pendulum to move is resiliently applied to said pressure responsive element to modify its valve controlling action and accordingly vary the rate of fuel delivery to suit varying operating conditions.

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