J. G. ZUBATY ETAL

PUMP-PRESSURE REGULATOR

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Fig. 1

Fig. 2

INVENTORS
Joseph G. Zubaty &

BY Harold J. Haven

L. P. Barnard

ATTORNEY
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PUMP-PRESSURE REGULATOR
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The present invention relates to a unique pump and pressure regulator device. More specifically, the present device includes a pump and governor mounted on a drive shaft disposed generally at right angles to a pump operating arm. The governor is adapted to control a fuel pressure regulating valve such that the pressure output from said device is proportional to engine speed. Further, the pump operating arm is so related to the drive shaft that as the back pressure against which the pump is working increases, the pump stroke will be decreased to reduce the pump output.

Specifically, the subject pump, per se, is generally of the type shown in Patent 2,640,424 of Babitch and includes a diaphragm controlled by an actuating member functioning in conjunction with an eccentric device which retracts the diaphragm to charge the pump chamber and spring means which moves the diaphragm in a pump discharge direction. In the present invention, the diaphragm actuating arm includes a portion enlarged with respect to an eccentric formed on the drive shaft whereby pump back pressure can cause the diaphragm and actuating arm to move relative to the eccentric and thereby decrease the pump stroke as said pressure increases. The drive shaft actuates a flyball governor device such that the latter acts through spring means to control an axially spaced pressure regulating valve whereby the pressure output of said pump is controlled in accordance with engine speed.

The details as well as other objects and advantages of the present invention will be apparent from a perusal of the detailed description which follows.

In the drawings:

FIGURE 1 is a sectional view of the subject pump-pressure regulator; and

FIGURE 2 is a view along line 2—2 of FIGURE 1. Referring to FIGURE 1, the pump-pressure regulator is indicated generally at 10 and includes a drive shaft 12 supported on bearings 14 and 16 respectively disposed within casing members 18 and 20. Shaft 12 is recessed at 22 to receive any suitable power input member 24. Casing 20 includes a chamber 26 in which governor device 28 is disposed. As will be considered subsequently in greater detail, governor 23 is mounted on and driven by drive shaft 12.

A pump mechanism is indicated generally at 30 and, except for the unique manner in which the pump is driven by and coaxes with a drive shaft 12, is of the type shown in the aforenoted Babitch patent. Briefly, the pump includes a flexible diaphragm 33 peripherally clamped between inlet casing 20 and an additional casing 34. Fuel inlet and outlet chambers are designated as casing 36 and 38 and include valve members 40 and 42 which permit said chambers to be communicated as the diaphragm is actuated. As the diaphragm is retracted or raised inlet valve 40 is opened to draw fuel from fuel inlet chamber 36 into pumping chamber 44. At the same time, outlet valve 42 is closed to prevent fuel from being drawn back through outlet chamber 38 into the pumping chamber 44. On the other hand, as the diaphragm is depressed or lowered, inlet valve 40 will close and outlet valve 42 will open permitting the volume of fuel contained within chamber 44 to be forced through outlet chamber 38 and to be discharged through outlet passage 46. As thus far described, pump 30 is substantially the same as the aforenoted Babitch pump. A diaphragm 47 is disposed in outlet chamber 38 and moves slightly with variations in pressure to eliminate in part pressure waves in the system.

An actuating arm or member 48 includes a first portion 50 centrally engaging diaphragm 32. Member 48 includes a second portion 52 articulated through pin 54 to first portion 50. The upper end of pump actuating arm portion 52 is enlarged to provide an oblong inner surface 56 adapted to coat with an eccentric portion 58 formed on drive shaft 12. As best seen in FIGURE 2, as shaft 12 rotates, eccentric portion 58 will engage with actuating arm surface 56 causing the same to be raised against the force of springs 60 and 62. Casing 20 includes a chamber 64 within which spring members 60 and 62 are seated and which actuates against a diaphragm reinforcing member 66 to urge the diaphragm in its discharge direction. As eccentric 58 moves to its uppermost position, arm 48 and diaphragm 32 will be raised to the retracted position in which pump chamber 44 is filled with fuel. Thereafter, as the eccentric continues to rotate, springs 60 and 62 will urge arm 48 downwardly maintaining surface 56 in contact with the eccentric and at the same time causing fuel to be discharged through outlet chamber 38.

Inasmuch as the inner surface 56 of actuating arm portion 52 is considerably larger than eccentric 58, it is apparent that as the back pressure in pump chambers 36 and 44 increases, for reasons which will be subsequently considered in greater detail, springs 60 and 62 are not able to return diaphragm 32 to its full discharge position. As a consequence, the pump stroke and hence pump discharge is reduced. In this way, the capacity of the pump is variable so as to supply that quantity of fuel determined by certain other operating conditions.

It is apparent that other "lost motion" arrangements may be provided between shaft eccentric 58 and diaphragm 32. For instance, surface 56 of arm portion 52 could be made to engage on opposite sides with eccentric 58, i.e. no lost motion at this point of articulation. Instead, the lost motion connection could be between diaphragm 32 and actuating arm portion 50.

Referring now to governor device 28, it will be seen that shaft 12 includes a portion 70 extending beyond bearing 16 into chamber 26. A flyweight separator cage 72 is fixed to shaft portion 70 for rotation therewith and is adapted to confine flyweights 74 so that rotation of shaft 12 will cause the flyweights to be moved radially outwardly in accordance with centrifugal force. A dish-shaped member 76 is mounted on shaft portion 70 so as to be freely movable axially relative thereto as flyweights 74 move radially outwardly. Dish-shaped member 76 includes a sleeve portion 78 adapted to support a ball bearing member 80. A collar 82 is fixed to the outer race of bearing 80. Bearing 80 permits dish-shaped member 76 to rotate relative to collar 82. Collar 82 includes an axially extending boss 84 which supports one end of a spring member 86, the other end of which biases against a flexible diaphragm 88 peripherally clamped between valve casing 90 and intermediate casing 92. Intermediate casing 92 is suitably secured to casing 23 through studs 94 to enclose governor chamber 26.

Diaphragm 88 is a part of a pressure regulator mechanism indicated generally at 96. Pressure regulator 96 is contained within the casings 90 and 92 and includes an outlet chamber 98 and an inlet chamber 100. Inlet chamber 100 is actually formed by an end cap member 102 and a valve seat member 104 each adapted to be suitably threaded within casing 90. Inlet chamber 100 receives the output from pump 30 through passage 46.
Inlet and outlet chambers 180 and 98 are adapted to communicate through valve seat member 104. A ball valve member 106 coats with seat member 104 to regulate the pressure in outlet chamber 98.

One end of a spring 108 is supported within end cap 102 and the other end biases ball valve member 106 against seat member 104. A web 110 is formed in casing 99 and includes a central opening therethrough to slidably support a pin member 112 centrally secured to diaphragm 88. The other end of pin 112 is adapted to engage ball member 106 to urge the same off its seat against the force of spring 106. Thus governor controlled spring 86, through diaphragm 88 and pin 112, and fuel outlet pressure tend to unseat ball member 106 while spring 106 and fuel inlet pressure tend to seat the ball member.

With the engine stopped and the parts in the position shown in FIGURE 1, spring 86 will predominate and maintain ball member 106 off its seat. As the rotative speed of shaft 12 progressively increases, flyweights 74 will move outwardly urging dish-shaped member 76 axially to the left to increase the force of spring 86 and thereby move ball member 106 further off its seat permitting fuel to pass from inlet chamber 180 to outlet chamber 98. As the speed of shaft 12 increases the opening of ball valve member 106 permits progressively higher pressure fuel to be discharged from outlet chamber 98 through discharge opening 114. There is a restriction downstream of the device consisting of a metering needle and orifice, not shown, which regulates the fuel flow to the engine. Due to this restriction, the fuel pump builds pressure almost immediately which will act on diaphragm 88 and cause valve 106 to close, thus reducing the pressure in chamber 98 to a predetermined value depending on the speed of shaft 12 and governor device 28.

Collar 82 may be moved axially by member 76 and flyweights 74 until it engages an axially extending abutment 116 formed on intermediate casing 92. Under these conditions, ball valve 106 will be fully opened and the full output pressure of pump 30 will be discharged through outlet opening 114. As already noted, as valve member 106 is moved progressively toward a more closed position, with decreased rotative speeds of shaft 12, the back pressure in pressure regulator chamber inlet chamber 100 and passage 46 will be increased thereby reducing the output of pump 30 to an amount compatible with the demand of the system in which the subject device is incorporated.

We claim:
1. A combination pump and pressure regulator comprising casing means, a shaft rotatably supported within said casing means, a pump disposed in said casing means, said pump including a flexible diaphragm, an actuating arm centrally fixed to said diaphragm and disposed at substantially right angles to said shaft, an eccentric portion formed on said shaft, said actuating arm including an enlarged portion having a surface adapted to contact with said eccentric, said surface being larger than said eccentric portion whereby a clearance is provided between portions of said surface and said eccentric, first spring means urging said diaphragm in a discharging direction tending to maintain said surface in pumping engagement with said eccentric, pump output pressure being adapted to act against said diaphragm to move said arm surface relative to said eccentric to vary the stroke of said pump, a pressure regulator device, conduit means communicating the output side of said pump with said device, said pressure regulator device including an inlet chamber communicating with said conduit means and an outlet chamber, a valve member controlling flow between said inlet and outlet chambers, second spring means urging said valve member in a direction tending to restrict flow between said chambers, and a centrifugal governing device coaxial with and driven by said shaft adapted to urge said valve member in an opening direction with a force proportional to the speed of said shaft.
2. A combination pump and pressure regulator as claimed in claim 1 in which the centrifugal governing device includes speed responsive means mounted on said shaft, sleeve means slidably mounted on said shaft intermediate speed responsive means and the second spring means, the speed responsive means being adapted to move the sleeve means toward the second spring member with a force proportional to the speed of said shaft.

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