Oct. 19, 1954 O. A. BARKLOW 2,691,941

PUMP PRESSURE CONTROL FOR ENGINE-PUMP COMBINATION

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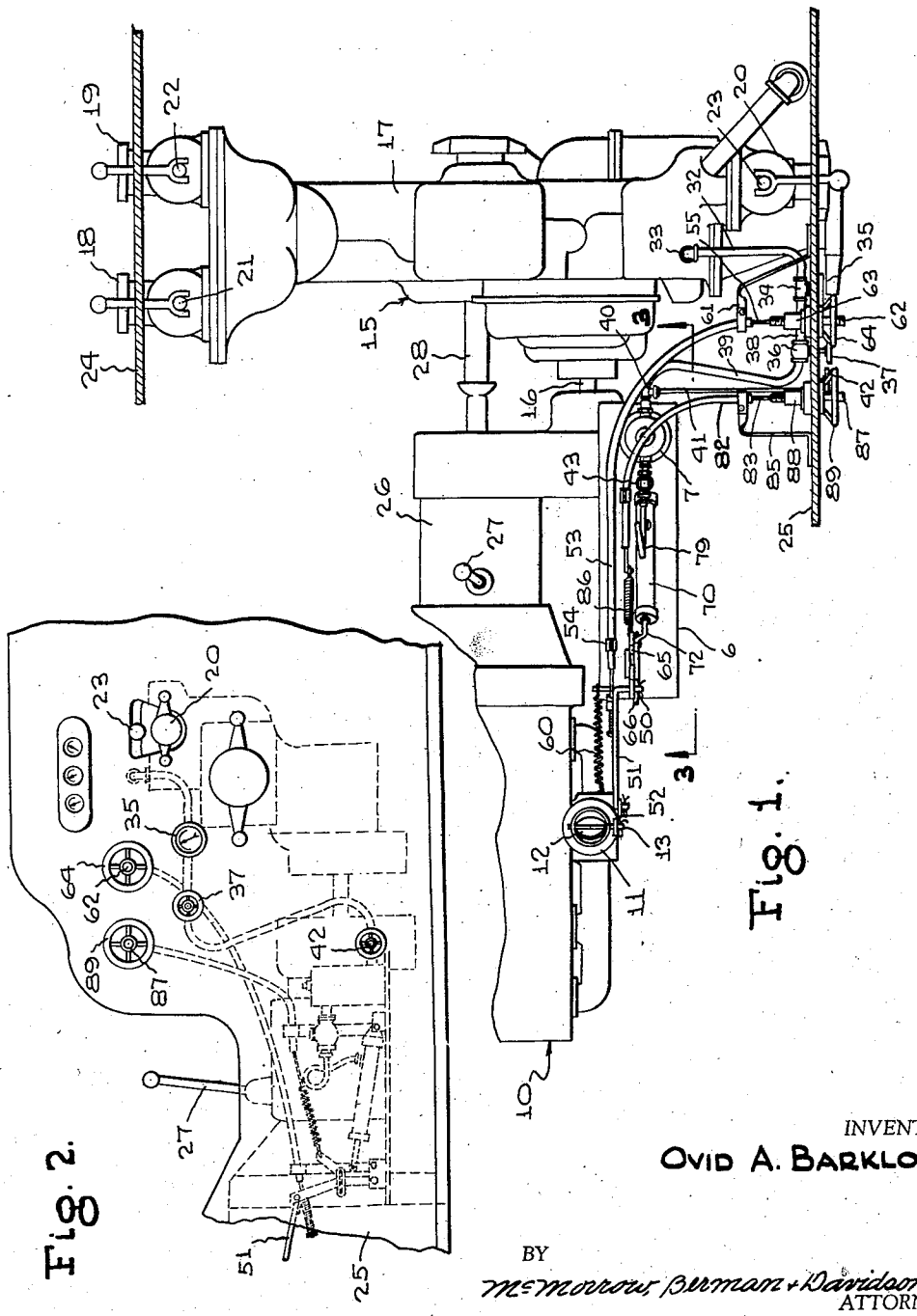


Fig. 1.

Fig. 2.

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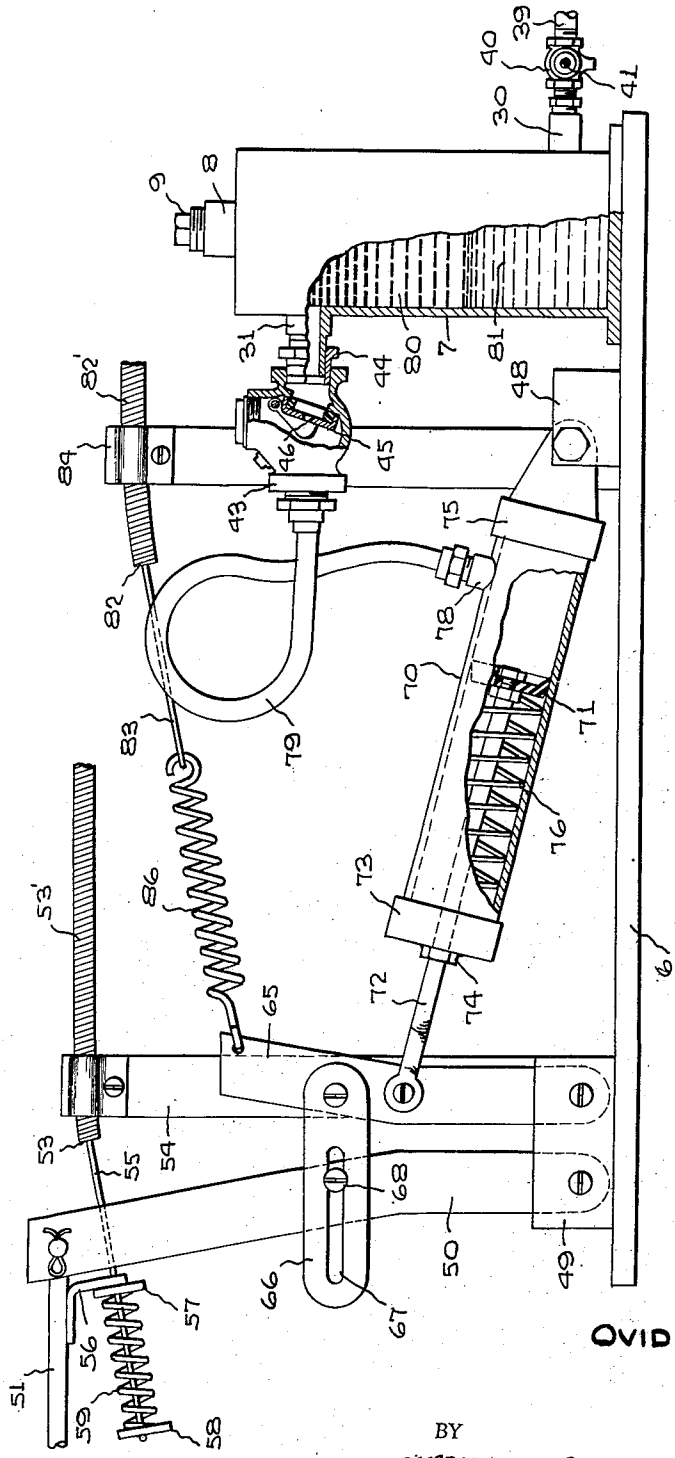


Fig. 3

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PUMP PRESSURE CONTROL FOR ENGINE-PUMP COMBINATION

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3 Claims. (Cl. 103—16)

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This invention relates to pressure responsive controls for engine-pump combinations and more particularly to an adjustable control effective to regulate the speed of an engine in response to variations in the outlet pressure of an associated engine driven pump to maintain the pump pressure within selected limits.

It is among the objects of the invention to provide improved control mechanism connected between the throttle of a pump driving engine and the outlet portion of a pump driven by the engine to maintain the outlet pressure of the pump within predetermined or selected limits by varying the speed of the engine; which can be conveniently mounted on pumping apparatus, such as a fire engine or pumper, with no material modification of the construction of the apparatus; which is manually adjustable to set the engine throttle for a selected pump outlet pressure and to maintain the pump outlet pressure substantially at the selected value; which can be placed in and out of operation as desired; and which is simple and durable in construction, economical to manufacture, and positive and effective in operation.

Other objects and advantages will become apparent from a consideration of the following description and the appended claims in conjunction with the accompanying drawings wherein:

Figure 1 is a fragmentary top plan view of an engine-pump combination with control mechanism illustrative of the invention operatively applied thereto;

Figure 2 is a fragmentary side elevational view of a control panel showing the adjusting devices for the control apparatus mounted on the control panel; and

Figure 3 is a side elevational view on an enlarged scale of the control apparatus with portions broken away and shown in cross section to better illustrate the construction thereof.

With continued reference to the drawings, the numeral 10 generally indicates a pump driving engine, such as an internal combustion engine, having fuel admitting or charge-forming means, such as the carburetor 11 controlled by the throttle valve 12 and valve shaft 13 for regulating the speed of the engine. The numeral 15 generally indicates a water pump, illustrated as a centrifugal pump, driven by the engine 10 through a drive shaft 16 and including a pump outlet portion 17 provided with hose connection fittings as indicated at 18, 19 and 20, each having a manually operated cut off valve, as indicated at 21, 22 and 23 respectively.

With this arrangement, as many as three fire hoses can be connected to the pump at the same time. This number of fire hoses, however, is only

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exemplary, as different pumps may provide connections for different numbers of hoses. When the fire hoses are in use, they are frequently turned on or off at the nozzle end and each time one or more of the hoses are turned off this action causes a pressure surge in the output pressure of the pump 15 and, with a constant setting of the engine throttle, an increase in pump output pressure above the desired value for such pressure. The control mechanism of the present invention is effective to maintain the output pressure of the pump substantially constant at any selected value within the practical operative range of pump output pressures and to substantially eliminate pressure surges and excessive increases in the pump output pressure when the volumetric output of the pump is reduced.

Instrument panels 24 and 25 are mounted in substantially vertical position at respectively opposite sides of the pump 15 and the hose connecting fittings and handles of the cut off valves project through these panels and the hose connection fittings may carry screw caps at the outer side of the corresponding panels, if desired.

The engine 10 may be used to propel a vehicle, such as a fire engine, on which the engine and pump are mounted, and in this case, will be provided with a change speed transmission 26 having a gear shift lever 27 and a drive shaft 28 extending from the transmission to the drive axle or axles of the vehicle, the pump driving shaft 16 extending from a power take off connection of the transmission 26.

The pump pressure control mechanism comprises a flat base 6 of elongated, rectangular shape mounted in substantially horizontal position adjacent the engine 10, and between the engine charge-forming device 11 and the pump 15. The base may be mounted on the engine or on some part of the engine supporting structure, such as the vehicle frame, as may be found most convenient or desirable, and a container 7, preferably of elongated, cylindrical shape, is mounted in upstanding position on the base 6 at the end of the base remote from the charge-forming device 11 of the engine. The container 7 is completely closed and has an apertured and internally screw threaded boss 8 on its upper end wall which boss provides a filler neck for the container and is normally closed by a screw plug 9. The container encloses a fluid receiving chamber and a tubular fitting 30 projects from the container near the bottom end thereof in communication with the interior chamber while a second tubular fitting 31 projects from the container near the upper end thereof in communication with the included chamber.

A conduit 32 is connected at one end to the

outlet portion 17 of the pump through a suitable elbow fitting 33 and is connected at its other end to a T fitting 34 mounted in an aperture in the control panel 25. A pressure gauge 35 is mounted on the outer side of the panel 25 and connected to the T fitting 34 for indicating the pressure of the liquid in the outlet portion 17 of the pump. A cut off valve 36 is mounted on the rear side of the panel 25 and has an operating knob 37 at the front side of the panel and a conduit section 38 connects the T fitting 34 to one side of the valve 36. A conduit section 39 connects the other side of the valve 36 to the tubular fitting 30 on the container 7, a drain valve 40 being interposed between the tubular fitting 30 and the adjacent end of the conduit 39 and having an operating handle or knob 42, so that the drain valve can be opened and closed, as found necessary or desirable.

A flap type check valve 43, of well known construction, is connected at one side to the tubular fitting 31 through a coupling or union 44 and has its flap 45 positioned to permit free passage of fluid from the container 7 through the check valve, but precludes the return of fluid through the check valve to the container. The flap, however, is provided with an aperture 46 therein constituting a restricted orifice through which fluid may return through the valve into the container at a greatly reduced rate of flow.

A bracket 48 is mounted on the base 6 adjacent the container 7 and a bracket 49 is mounted on the base at a location spaced from the bracket 48 in a direction away from the container 7 and near the end of the base remote from the container.

A first lever 50 is pivotally mounted at one end on the bracket 49 in upstanding position relative to the base 6 and has its other or upper end connected to the throttle shaft 13 of the engine through a link 51 and a crank 52 mounted on the throttle shaft. The arrangement is such that movement of the upper end of the link 50 toward the throttle shaft closes the engine throttle, and movement of the upper end of the link in a direction away from the throttle shaft opens the throttle.

A flexible push and pull device 53 has a flexible casing or sheath 53' secured at one end in a clamp 54 which extends upwardly from the bracket 49 adjacent the lever 50 and has a core wire 55 which extends slidably through the sheath 53' and past the lever 50. A bracket 56 is secured to the link 51 adjacent the lever 50 and carries an abutment washer 57, the bracket and abutment washer being apertured for the passage of the core wire 55 therethrough, and a second abutment washer 58 is secured to the core wire 55 at the corresponding end thereof and at a location spaced from the washer 57. A coiled compression spring 59 surrounds the core wire 55 between the washers 57 and 58 and is effective to transmit a pull on the core wire 55 to move the lever 50 in its throttle opening direction, the lever being moved toward its throttle closing position by a spring 60 connected between the link 51 and the charge-forming device 11.

At its end remote from the clamp 54 the sheath 53' is secured in a clamp 61 mounted on the panel 25 and disposed at the rear side of the panel and the core wire 55 is connected at its end remote from the washer 58 to a screw shaft 62 which extends slidably through a sleeve 63 mounted in an aperture in the panel 25, means, not illustrated, being provided to preclude rotation of the shaft 62 relative to the sleeve. A handwheel 64 is threaded onto the shaft 62 at the outer side of the panel 25 and is effective to move the shaft 62 longitudinally of the sleeve 63 and apply a pull to the core wire 55 to move the lever 50 in its throttle opening direction.

By manually rotating the handwheel 64 the engine throttle can be adjusted to provide an engine speed producing a selected pump output pressure most desirable for the particular operating condition, but the lever 50 may move against the resistance of spring 59 to change the manually adjusted throttle setting when this lever is subjected to sufficient force through means other than the push and pull device 53.

A second lever 65, shorter than the lever 50, is pivotally mounted at one end on the bracket 49 and upstands from the bracket 49 adjacent the lever 50. A link 66 is pivotally connected at one end to the second lever 65 near the upper end of the latter and has a longitudinally extending closed slot 67 therein. A screw or pin 68 extends through the slot 67 in the link 66 and is secured in the lever 50, this pin, together with the link 66 constituting a lost motion connection between the lever 65 and the lever 50.

A hydraulic cylinder 70 is pivotally mounted at one end on the bracket 48 and is inclined from the bracket 48 in a direction toward the lever 65 and away from the base 6. A piston 71 is slidably mounted in the cylinder 70 and a piston rod 72 is connected at one end to the piston 71 and extends through an aperture in the end cap 73 of the piston remote from the bracket 48, the piston rod 72 being pivotally connected at its other end to the lever 65 at a location adjacent the pivotal connection between the lever 65 and the link 66. A stop nut 74 is threaded onto the piston rod 72 at the outer side of the end cap 73 and contacts this end cap to limit movement of the piston 71 toward the end cap 75 disposed at the other end of the cylinder and pivotally connected to the bracket 48. A compression spring 76 surrounds the piston rod 72 within the cylinder 70 between the piston 71 and the end cap 73 and resiliently urges the piston in a direction away from the end cap 73.

A tubular fitting 78 extends from the cylinder 70 between the piston 71 and the end cap 75 and a flexible conduit 79 connects this fitting 78 to the valve 43 at the side of the valve remote from the container 7.

A body 80 of suitable hydraulic fluid, such as oil, is disposed in the container 7, the valve 43, the conduit 79 and the space within the cylinder 70 between the piston 71 and the end cap 75 of the cylinder, and this body 80 of hydraulic fluid floats on a body 81 of water forced into the container from the pump 15 through the conduit including the sections 32, 38 and 39.

A second flexible push and pull device 82 has a sheath 82' and a core wire 83 extending slidably through the sheath. The sheath is clamped at one end in a clamp 84 extending upwardly from the bracket 48 and is clamped at its other end in a clamp 85 which is secured to the panel 25 at the rear side of the panel. The core wire 83 is connected at one end to one end of a tension spring 86, the other end of which is connected to the arm or lever 65 at the upper end of this lever. The other end of the core wire 83 is connected to one end of a screw shaft 87 which extends slidably, but nonrotatably through a sleeve 88 mounted in an aperture in the control panel

25 and a handwheel or knob 89 is threaded onto the screw shaft 87 at the outer sides of the control panel.

Operation

When it is desired to place the pump in operation, as when a fire engine has been located in proximity to a fire and the inlet portion of the pump connected to a suitable source of water, such as a fire hydrant or a body of water, with the valve 36 closed and the handwheel 89 screwed along the shaft 87 to hold the lever 65 in its inoperative position in which the stop nut 74 is against the end cap 73 of the cylinder 70 and the pin 68 is intermediate the length of the slot 67 in the link 66, the operator, after drivingly connecting the engine to the pump, will turn the handwheel 64 in a direction to compress the spring 59 and move the throttle controlling lever 50 in a throttle opening direction until the speed of the engine has been increased to a value at which the pump produces pressure in its outlet portion to a value desirable for the particular operating condition. The engine will now maintain a substantially constant speed and a substantially constant pump pressure as long as the volumetric output of the pump remains substantially constant. However, if the volumetric output of the pump is materially changed, as by being suddenly reduced by closing off one or more fire hoses connected to the pump outlet portion, the speed of the engine will tend to increase and the outlet pressure of the pump will be increased until it balances the power of the engine, and the operator would have to constantly readjust the control wheel 64 to maintain the engine speed and pump pressure substantially constant.

Once a satisfactory pump pressure has been obtained, however, the operator may then place the engine throttle under automatic control to maintain this pressure substantially constant regardless of variations in the volumetric output of the pump. In order to do this, he will first open the valve 36 connecting the outlet portion 17 of the pump to the chamber within the container 7 through the conduit including the sections 32, 38 and 39, it being assumed that the drain valve 40 is closed at this time and that the body 80 of hydraulic fluid substantially fills the chamber in the container 7, the valve 43, the conduit 79 and the space within the cylinder 70 between the piston 71 and the end cap 75 of the cylinder. The introduction of the pump outlet pressure into the chamber within the container 7 will cause the body 80 of hydraulic fluid to exert pressure on the piston 71 to move the piston in a direction away from the end cap 75 of the cylinder and toward the lever 65.

As the handwheel 89 is now threaded along the shaft 87 in a direction to pull on the wire 83 and stretch the spring 86, holding the lever 65 in its inoperative position, there will be no material movement of the piston 71 at this time, since its movement will be effectively resisted by the force of spring 86.

The operator will now turn the handwheel 89 in a direction to relieve the tension on spring 86 permitting the piston 71 to move toward the end cap 73 of the cylinder adjacent the lever 65 and to move the lever 65 to first bring the end of the slot 67 in the link 66 adjacent the lever 65 against the pin 68 carried by the lever 50 and to then move the lever 50 in its throttle closing direction.

As the spring 59 is a light spring having a strength materially less than the strength of the spring 86, although somewhat greater than the strength of the throttle closing spring 60, the lever 50 will be moved against the force of the spring 59 reducing the engine speed and the outlet pressure of the pump. When the outlet pressure of the pump has fallen somewhat below the pressure for which the hand control was set, as described above, as indicated by the pressure gauge 35, the operator will turn the handwheel 89 in the opposite direction increasing the tension of spring 86 and resisting the force exerted by piston 71 until the pump pressure has been brought back to the desired value.

Under these conditions, the fluid pressure exerted on the piston 71 is balanced by the force of the spring 86 and to a small extent by the forces of the springs 59 and 76, the spring 59 forcing the lever 50 to follow the throttle opening movement of the lever 65 whenever the force of the spring 86 overcomes the force exerted by the fluid pressure on the piston 71. There will now be a tendency for the levers 50 and 65 to oscillate back and forth as they hunt for a balanced condition between the spring forces and the force exerted by fluid pressure on the piston 71. This hunting tendency of the levers 50 and 65 is damped by the action of the check valve 43.

When the hydraulic fluid flows from the container into the cylinder 70, the valve opens rapidly and widely permitting a rapid flow of the fluid and a rapid movement of the levers 50 and 65 in the throttle closing direction. When the pump pressure has been reduced consequent to a reduction in the engine speed by dimunition of the engine fuel supply and the fluid tends to flow from the cylinder back into the container, the flap 45 of the check valve closes and the fluid is constrained to flow from the cylinder through the restricted orifice 46 in the flap of the check valve at a slow rate. The levers 50 and 65 will then move slowly in their throttle opening direction, so that, as the engine speed increases, the increase in the outlet pressure of the pump will keep up with the increase in engine speed and the levers will be stopped at a position at which the spring forces and the force exerted by the fluid pressure on the piston 71 are balanced and the proper engine speed is maintained for the desired pump outlet pressure.

If the outlet pressure of the pump is now varied by a change in the volumetric output of the pump, the spring force and the force exerted by fluid pressure on the piston 71 will be unbalanced and the levers 50 and 65 will be moved in the proper direction to change the engine speed in a manner to restore the desired pump outlet pressure.

When it is desired to discontinue the automatic control of the engine, the valve 36 is closed and the handwheel 89 turned in a direction to increase the tension on spring 86 and move the lever 65 to its inoperative position. If necessary, the drain valve 40 will be opened at this time to vent fluid trapped in the system between the valve 36 and the body 80 of hydraulic fluid, so that the piston 71 can move in the cylinder in a direction away from the lever 65 and permit this lever to move to its inoperative position. Care must, of course, be taken to close the drain valve before the hydraulic fluid constituting the fluid body 80 flows out of the drain valve. The drain valve will also be used to drain water out of the system if the apparatus is to be subjected to freezing temperatures and, if desired, a piston or diaphragm may be disposed in the container 7 between the fluid bodies 80 and 81 to prevent loss of fluids from the body 80.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

What is claimed is:

1. In combination with an engine having a throttle and a pump driven by the engine and having an outlet portion, pump outlet pressure responsive mechanism controlling said engine throttle and comprising a base supported in substantially horizontal position adjacent said engine, a container mounted in upright position on said base and including a vertically disposed chamber, a first conduit connecting said pump outlet portion to said container at the bottom end of the latter and subjecting said chamber to the fluid pressure in said pump outlet portion, a bracket mounted on said base at a location spaced from said container, a first lever pivotally mounted at one end on said bracket and upstanding from said base with its other end connected to said engine throttle, manually adjustable means connected to said first lever for adjusting the setting of the engine throttle, a second lever pivotally mounted at one end on said bracket and upstanding therefrom adjacent said first lever, lost motion connecting means connecting said second lever to said first lever, a hydraulic expansible chamber device connected at one end to said base and at its other end to said second lever and effective to move said first and second levers in a throttle closing direction upon expansion thereof, a second conduit connecting said container near the upper end thereof to said expansible chamber device, a body of liquid in said chamber, said second conduit and said expansible chamber device and effective to expand said expansible chamber device when subjected to pump outlet pressure above a selected value in said chamber, and manually adjustable means connected to said second lever and resiliently resisting expansion of said expansible chamber device, said lost motion connection between said levers providing freedom of throttle adjusting movements of said first lever while said second lever is held stationary in an inoperative position.

2. In combination with a pump driving engine having a speed controlling throttle and a pump driven by said engine and having an outlet portion, pump pressure control mechanism comprising a fixed support adjacent said engine, a first lever pivotally mounted on said fixed support and connected to said throttle at a location spaced along said first lever from said fixed support, manually adjustable resilient means connected to said lever and urging the latter in a throttle opening direction, a second lever pivotally mounted on said support adjacent said first lever, means providing a lost motion connection between said levers providing limited freedom of movement of said first lever relative to said second lever and enabling said second lever to move said first lever in a throttle closing direction, an expansible chamber device mounted on said fixed support adjacent said second lever, means connecting said expansible chamber device to said second lever for movement of said levers in a throttle closing direction upon expansion of said device, manually adjustable resilient means connected to said second lever and urging said second lever in a direction against the force exerted thereon by said expansible chamber device, conduit means connecting said pump outlet portion to said expansible chamber device, and a valve interposed in said conduit means and effective to provide a substantially unrestricted flow of fluid from said pump outlet portion to said expansible chamber device and a restricted flow of fluid from said expansible chamber device to said pump outlet portion to thereby damp the tendency of said levers to hunt for a stable position between the forces exerted thereon by said manually adjustable resilient means and said expansible chamber device.

3. In combination with a pump driving engine having a speed controlling throttle and a pump driven by said engine and having an outlet portion, pump pressure control mechanism comprising a fixed support adjacent said engine, a first lever pivotally mounted on said fixed support and connected to said throttle at a location spaced along said first lever from said fixed support, manually adjustable resilient means connected to said lever and urging the latter in a throttle opening direction, a second lever pivotally mounted on said support adjacent said first lever, means providing a lost motion connection between said levers providing limited freedom of movement of said first lever relative to said second lever and enabling said second lever to move said first lever in a throttle closing direction, an expansible chamber device mounted on said fixed support adjacent said second lever, means connecting said expansible chamber device to said second lever for movement of said levers in a throttle closing direction upon expansion of said device, manually adjustable resilient means connected to said second lever and urging said second lever in a direction against the force exerted thereon by said expansible chamber device, conduit means connecting said pump outlet portion to said expansible chamber device, a valve interposed in said conduit means and effective to provide a substantially unrestricted flow of fluid from said pump outlet portion to said expansible chamber device and a restricted flow of fluid from said expansible chamber device to said pump outlet portion to thereby dampen the tendency of said levers to hunt for a stable position between the forces exerted thereon by said manually adjustable resilient means and said expansible chamber device, and a container interposed in said conduit and including a vertically disposed chamber the bottom end of which is connected to said pump outlet portion and the upper end of which is connected to said expansible chamber device, and a body of hydraulic fluid substantially filling said chamber, said expansible chamber device and the portion of said conduit between said container and said expansible chamber device.

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