Oct. 27, 1942. A. KALIN 2,299,824

GOVERNOR

Filed July 24, 1941

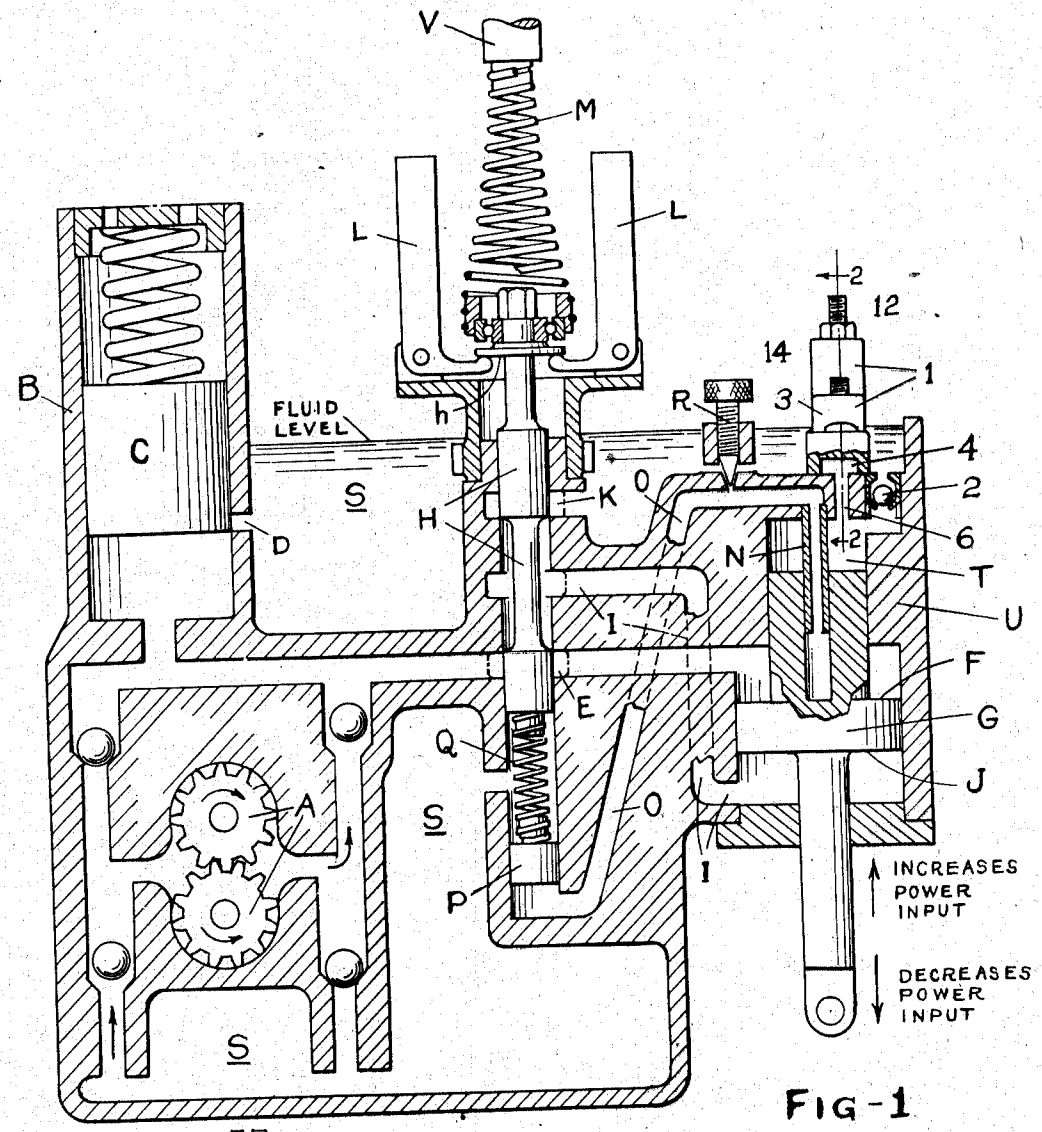


FIG-1

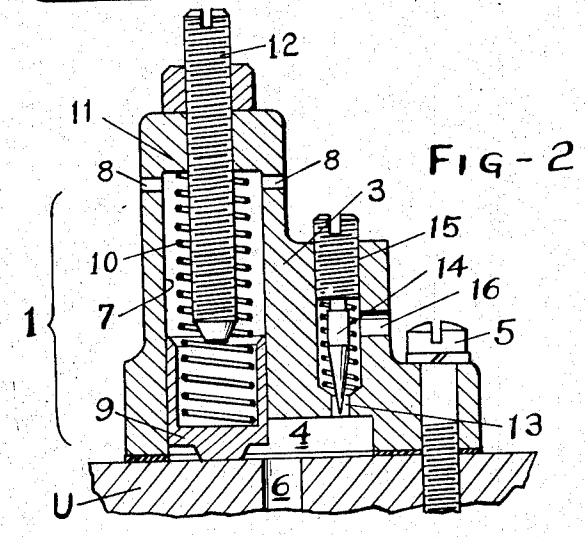


FIG-2

INVENTOR
ALBERT KALIN
BY
George M. Soule
ATTORNEY

Patented Oct. 27, 1942

2,299,824

UNITED STATES PATENT OFFICE

2,299,824

GOVERNOR

Albert Kalin, Cleveland, Ohio

Original application June 2, 1941, Serial No. 396,338. Divided and this application July 24, 1941, Serial No. 403,806

8 Claims. (Cl. 264—3)

This invention relates to an improvement in governors of the type adapted to control the speed of prime movers (e. g. Diesel engines) when subject to varying load. The application is a division of my application Serial No. 396,338 filed June 2, 1941. The governor mechanism generally is shown herein more or less schematically, whereas the same is shown in detail in the parent application.

Under certain conditions serious damage can be done to prime movers by attempting repeatedly to increase power input thereto at too high a rate. Diesel engines if operated at nearly maximum capacity loading can be injured by injecting too much fuel during acceleration under load or when cold. The present invention is concerned mainly with an arrangement for preventing operation of a speed regulating servo-motor of the governor in power-input-increasing direction at rates which could endanger such an engine, while nevertheless enabling acceleration of such engine from zero fuel to idling fuel at a rate insuring positive governing and such a rate as will keep the engine from stalling when the speed level setting has been suddenly reduced to low value. The above indicates one object hereof.

Other objects include the provision of: means modifying the rate of operation of a regulating power piston or servo-motor of a governor during part of a stroke thereof in one direction; adjustable means for modifying such rate for different parts of a full stroke; and adjustable means to vary the degree of modification of the normal rate of operation of such power piston or servo-motor. More specific objects will be brought out later herein.

The drawing shows one illustrative form of the invention and one type of governor on which it can be used, namely that shown in my Patent 2,219,229, issued Oct. 22, 1940.

Fig. 1 is a generally schematic assembly view of the governor incorporating the present invention, and Fig. 2 is a sectional detail view taken as indicated at 2—2 on Fig. 1.

The principal parts of the illustrative governor mechanism are indicated by letters; the special subject matter hereof by numerals.

Referring to the general arrangement of governor elements, a gear pump A is shown with a well known check valve system and ducts arranged to enable the pump to draw hydraulic fluid from a sump S and deliver it to an accumulator B having a spring loaded plunger C and discharge vent D which cooperate to keep the pressure in the accumulator at constant positive value. Fluid from the accumulator is supplied to a governor port E and continuously therebeyond to one face F of a double acting hydraulic servo-motor power piston G. The port E is controlled by a lower land portion of a pilot valve plunger H which, if moved downwardly from the normal position in which shown, opens the port E to a duct I leading to the opposite (effectively larger) face J of the power piston, causing upward movement of the piston. Upward movement of the pilot valve plunger from its normal position causes an upper land portion thereof to open the duct I at a port K, dumping pressure fluid from below the power piston into the sump and causing the piston to descend by reason of the constant pressure maintained at the piston face F.

The pilot valve plunger H is moved vertically in opposite directions as a result of the difference between centrifugal force on a set of fly-balls L rotated by the prime mover and opposing force exerted by an adjustable speeder spring M, so that an increase in speed on part of the prime moved raises the pilot valve plunger and a decrease in speed lowers said plunger. Regulation of speed by the servo-motor incident to change in load is initiated by such movement of the pilot valve plunger H.

Power input to the governed prime mover is increased by raising the power piston G (and decreased by lowering the piston) as indicated on the drawing. Thus, in governing, for example, a Diesel engine, increase in load causes decreased centrifugal force on the fly-balls and lowering of the pilot valve plunger, thus initiating an increase in the rate of supply of fuel to the engine; and decrease in load causes raising of the pilot valve plunger and consequent decrease in the rate of supply of fuel.

An arrangement such as thus far described requires stabilization in order to prevent vacillation in speed or hunting consequent upon load change and subsequent speed-correcting operation of the governor. The stabilizing mechanism includes a hydraulic compensation system supplied with fluid from the sump and actuating and receiving compensation pistons of said system operating as a function of regulating movement of the servo-motor piston G to damp or check each movement of said piston and prevent temporary overregulation of the prime mover thereby.

The actuating compensation piston N works in a trunk portion of the power piston G and displaces hydraulic fluid in a duct O leading to the receiving compensating piston P, slidably mount-

ed in a cylindrical extension of the outer pilot valve element, whenever the power piston G starts to perform a regulating operation in either direction. The motion of the receiving compensation piston P is always opposite the regulation-initiating movement of the pilot valve plunger H, and places temporary primary yielding compensating restraint on each movement of said valve plunger through the intermediary of a coil spring Q connecting the compensating piston P and valve plunger H. The primary compensating force is removed, after regulation is effected, by relieving the positive or negative pressure in the duct O through an adjustable secondary compensation leak-off needle valve R communicating the duct O with the sump.

As fully explained in my Patent 2,219,229, the fly-balls cause continuous rotation of the pilot valve plunger in its coacting fixed valve sleeve through contact of the ball-arm fingers with a disc portion *h* of the plunger; and the spring Q is so connected with the plunger and receiving compensation piston P that the piston is likewise rotated in its fixed cylinder. This eliminates the possibility of binding of either the valve plunger or said piston due to foreign matter in the hydraulic fluid and assures that the pilot valve is free from friction and therefore free to respond to very slight changes in speed. The spring also allows relative axial movement between the parts connected thereby so that the valve is always free to respond promptly to any change in centrifugal force acting on the fly-balls.

In operation, when the engine load is increased the resultant decrease in speed causes relative inward movement of the fly-balls; lowering of the pilot valve plunger; opening of the port E; admission of hydraulic fluid through duct I to the lower side of the power piston G, and increase of fuel to the engine. The upward movement of the piston G pumps fluid through duct O; raising the receiving compensation piston P; compressing the spring Q and exerting an upward slight force on the pilot valve plunger sufficient to offset the temporary overbalance of speeder spring force relative to the centrifugal force on the fly-balls, thus closing the port E. The port E is ordinarily closed sufficiently quickly to prevent overtravel of the power piston in the speed correcting direction; and, as the engine returns to normal speed, the compression force of the spring Q is dissipated by reason of leakage of fluid from the duct O into the sump through the secondary compensation leak-off aperture of the needle valve R.

The mechanism operates the same as described above for a decrease in load except that all the movements are reversed, the compensating spring Q being placed in tension by suction action of the compensation fluid system, and hydraulic fluid being finally drawn from the sump into the duct O through the aperture of the needle valve R to relieve said tension.

Speed adjusting or changing means is represented by the speeder plug V at the upper end of the speeder spring M. Additional speed changing means would, of course, be provided, for example as in my application Serial No. 396,338 of which this application is a division, or in other ways as well known in the art.

The device 1 in cooperation with a self closing valve 2 shown at the upper right in Fig. 1 (1 being detailed in Fig. 2) may be called a "servo-check" in that the cooperating elements prevent too rapid operation of the power piston G of the speed regulating servo-motor in the power-input-increasing direction during a critical range of operation of the governed engine. The servo-check, however, allows the power piston to move rapidly in said direction an adjustable distance and then damps or checks the remaining travel in that direction. There is no damping in the power-input-decreasing direction, wherefore deceleration and shut-down can always be accomplished quickly.

The servo-check comprises, in part, a body 3 having a cavity or chamber 4 which is in constant free communication with a space T of the servo-motor cylinder above the trunk portion of the power piston. The body 3 may be rigidly attached to the servo-motor block U as by screws 5 (one shown) so that the cavity 4 is fully closed from below except at the constant communication passage 6. The space T is kept full of hydraulic fluid from the sump through the valve 2 (gravity opened, upwardly closing ball type check valve, as shown) and the main exit for fluid from said space T is through the passage 6. The valve aperture of the valve 2 in the lowered position of the ball is sufficiently large so as to place no restraint on movement of the power piston, as during speed decreasing or shut-down movement thereof in respect to the engine.

Inside the body 3, at the left Fig. 2, is a relatively large vertical bore 7 in open communication with the chamber 4 at the lower end of said bore. The upper end of the bore has air vents 8. A cup shaped plunger 9 slidably seals the bore 7 so as to block the exit of hydraulic fluid through the bore from the chamber 4, the plunger being biased downwardly by a light coil spring 10 reacting upwardly against an upper wall 11 of the body. An abutment screw 12 threaded in said wall 11 is arranged adjustably to limit upward movement of the plunger by engagement therewith as will be obvious. Communicating with the chamber 4 is a restricted outlet orifice 13 to the sump for hydraulic fluid from the space T above the servo-motor piston. The outlet orifice may be adjustable by reason of a needle valve pin 14 aligned with the orifice and threaded into the body 3 at 15. Fluid escapes from the body past the needle valve at a suitable relatively enlarged lateral passage 16 in the body 3 beside the reduced tapered lower end of the needle valve pin.

In operation, as the servo-motor moves from its lowered (shut down) position, fluid is forced through the duct 6 by raising the plunger 9 from the position shown into a raised position in which the plunger abuts the screw 12. The screw is set, for example, so as to abut the plunger when the throttle moves suddenly from zero throttle to substantially idling throttle position, and thereupon further upward motion of the servo-motor piston is retarded in accordance with the amount of restriction set by the needle valve 14. Thus even though the operator habitually moves the speeder mechanism rapidly from low to high speed setting the engine will always accelerate at an adjusted rate appropriate to long life on part of the engine. The check valve 2 allows unrestricted rate of throttle closure or fuel reduction.

During ordinary governor operation, because it takes a sudden upward surge of hydraulic fluid through the check valve 2 in order to close said valve, the servo-check mechanism does not operate unless the rate of increase of fuel exceeds predetermined limits. Such limits may be varied by increasing or decreasing (e. g.) the weight of

the ball in the check valve 2 or changing the character of the outlet passages around the ball.

I claim:

1. In a governor for prime movers, means operable to regulate power input to the prime mover, speed responsive means arranged to control the operation of the regulating means, speed changing means operatively associated with the speed responsive means and operable to accelerate and decelerate the prime mover through the agency of the regulating means, and means operatively connected to the regulating means in a manner progressively to retard the rate of operation thereof in a speed increasing direction irrespective of the rate of accelerating operation of the speed changing means beyond a predetermined value.

2. The combination according to claim 1 wherein the rate retarding means becomes operative only after a predetermined unretarded movement of the regulating means in speed increasing direction.

3. In a governor for prime movers, hydraulically acting means operable to regulate power input to the prime mover, speed responsive means arranged to control the operation of the regulating means, speed changing means operatively associated with the speed responsive means and operable to accelerate and decelerate the prime mover through the agency of the regulating means, and fluid-operated braking means operatively connected to the regulating means in a manner to cause relatively slow operation thereof during part of the movement thereof in a speed increasing direction consequent upon operation of the speed changing means in accelerating direction at an undesired high rate.

4. In a governor for prime movers, a hydraulically operated servo-motor cylinder having a piston therein operable to regulate power input to the prime mover, speed responsive means and speed changing means arranged to control the operation of the servo-motor, means forming a displacement chamber communicating with the cylinder, the volume of which chamber is diminished as the piston moves to increase speed, a relatively restricted fluid outlet for the chamber, movable means forming a yieldably expansible space with said chamber, and abutment means operable on the last named means to limit expansion of said space whereby the restricted outlet becomes operative to restrain movement of the servo-motor piston only after the abutment means becomes effective.

5. The combination according to claim 4, wherein the abutment means is adjustable toward and away from the movable means.

6. The combination according to claim 4 wherein the restricted fluid outlet is adjustable in size whereby to vary the rate of fuel increasing movement of the piston.

7. The combination according to claim 4 wherein the displacement chamber has a substantially unrestricted inlet so arranged that the regulator can move unrestrictedly in a direction to decrease power input to the prime mover.

8. In a governor for prime movers, a hydraulically operated servo-motor operable to regulate power input to the prime mover, speed responsive means and speed changing means arranged to control the operation of the servo-motor, means forming a displacement chamber which is contracted and expanded as the servo-motor moves to increase and decrease power input respectively, a relatively restricted fluid outlet for the chamber, a cylinder communicating with said chamber, a displaceable element slidably sealing the cylinder, and abutment means arranged to engage and limit movement of said element in said cylinder, whereby the restricted outlet becomes operative to restrain movement of the servo-motor only after the displaceable element has moved into contact with the abutment means.

ALBERT KALIN.