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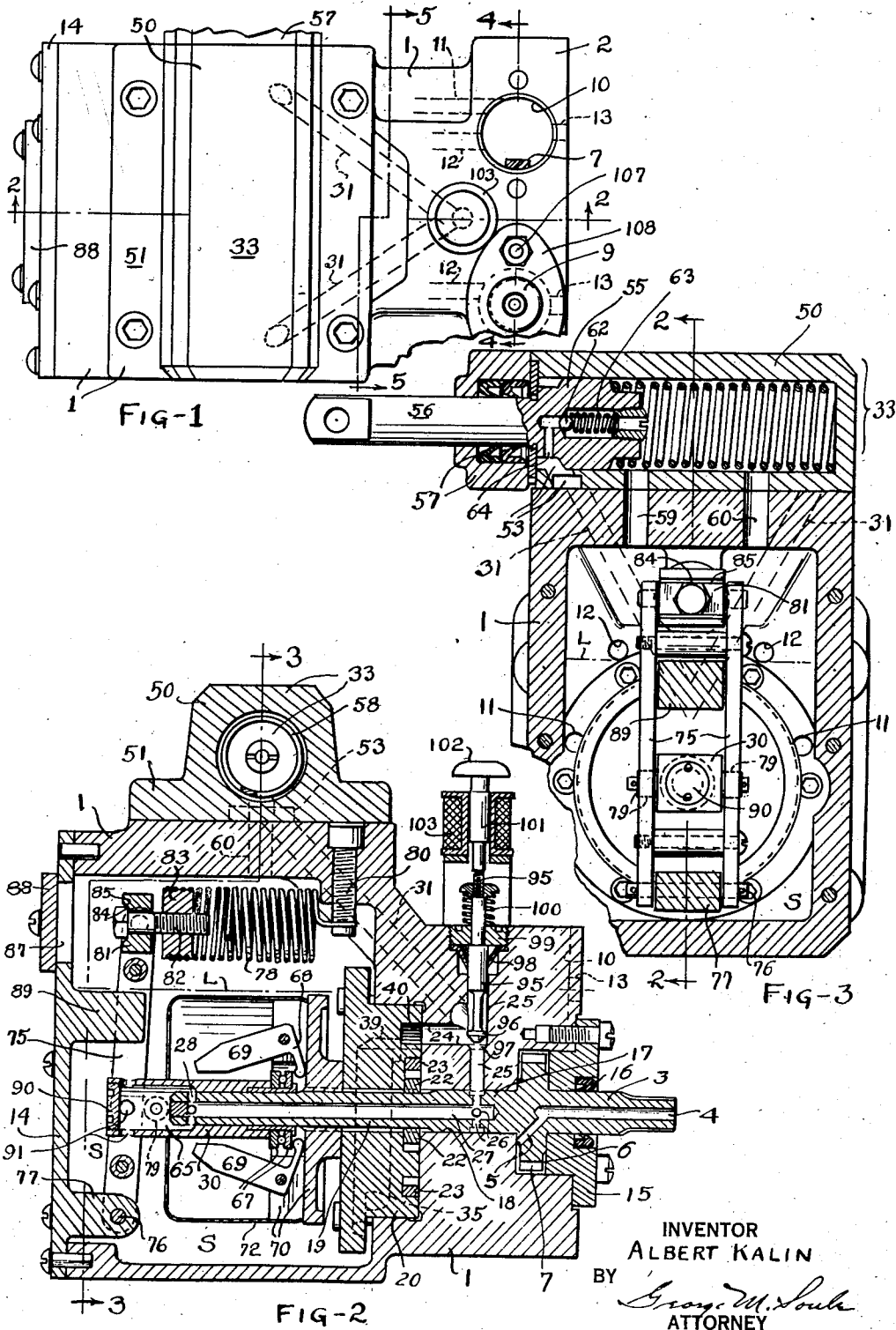
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2,364,853

GOVERNOR AND POWER TAKE-OFF UNIT

Filed March 2, 1942

2 Sheets-Sheet 1



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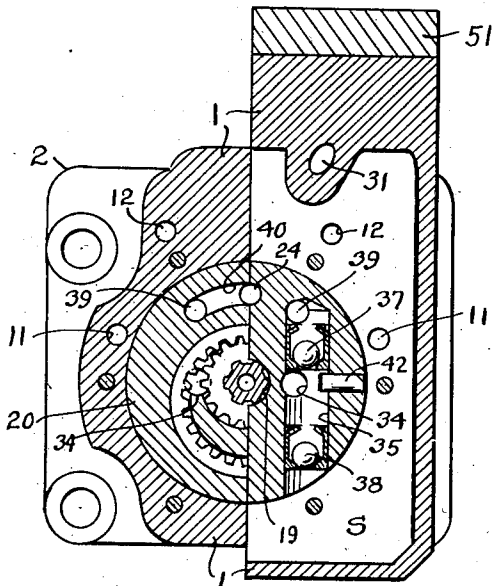


FIG-5

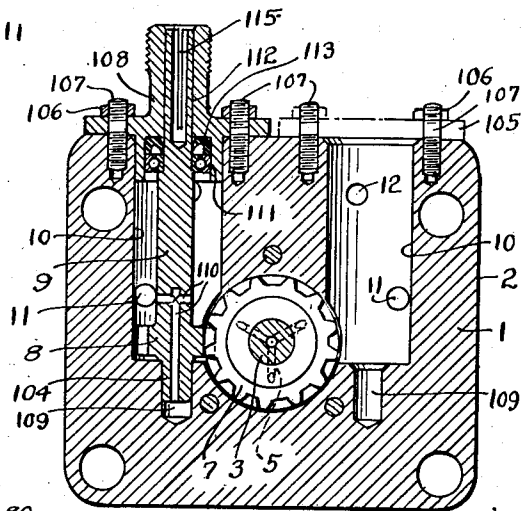


FIG-4

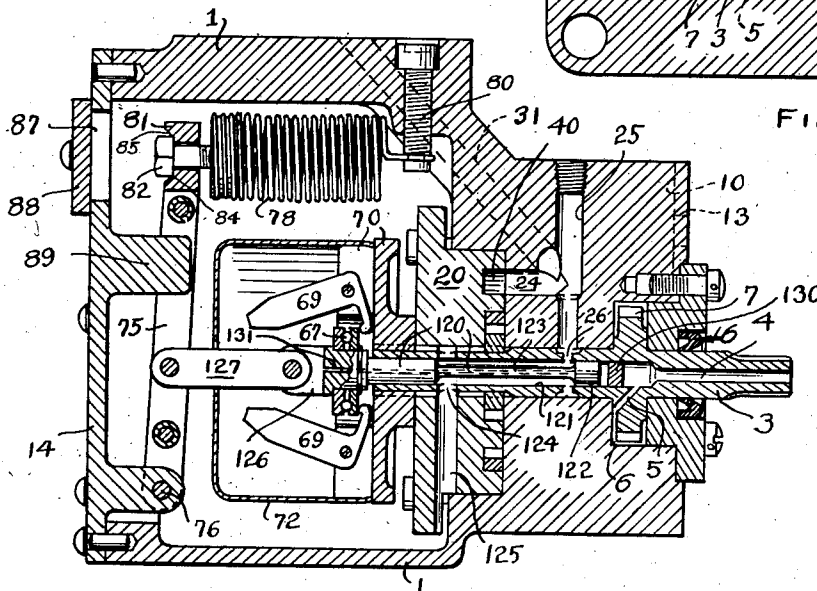


FIG-6

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2,364,853

GOVERNOR AND POWER TAKE-OFF UNIT

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4 Claims. (Cl. 264-14)

This invention relates to hydraulically actuated speed governors for prime movers, and more particularly to a governor for shutting down a prime mover in event of overspeeding or racing thereof.

In my Patent 2,270,306 issued January 20, 1942, typical uses for and various problems relating to overspeed governors are explained in connection with the disclosure of that patent. The present invention is adapted for generally the same uses and to solve generally the same problems as is the mechanism of said patent, and reference is directed to the patent for a more complete discussion of overspeed governors generally than given herein.

Objects of the present invention include the provision of: an improved hydraulically actuated overspeed governor; one which may be made to occupy a relatively small space; one which may be readily supplied with operating fluid from lubricating oil systems of known types of Diesel engines; one which will operate properly with the speed weighing mechanism (e. g. ball head and control valving means) in horizontal position; one which, notwithstanding operation in horizontal position, can be easily adjusted to change, or fix the operating point in relation to speed and wherein the adjustment is effectively maintained; one having an operating fluid pump system which is extremely compact yet positive and of ample capacity, and one which can be easily inspected and serviced.

Other objects include the provision of an overspeed governor having a hydraulic servo motor which is self unloading at the end of its power stroke and which is provided with a safety unloader to prevent damage to the governor in event the control linkage becomes jammed or blocked.

Another object is to provide an improved means of operating a hydraulic overspeed trip, (as by hand; remotely controllable motor etc.) for emergency and like purposes independently of the speed of the machine governed.

A still further object is to provide a combined overspeed trip mechanism and power take-off assembly for Diesel engines whereby the governor and magneto, speed indicator or like mechanisms can be driven with substantially a minimum of equipment and power expenditure.

Other objects and features of the invention will become apparent from the following description of the preferred forms.

In the drawings, Fig. 1 is a plan view of one embodiment of the overspeed governor hereof; Fig.

2 is a longitudinal sectional view as indicated at 2-2 Fig. 1; Figs. 3, 4 and 5 are transverse sectional views as indicated on Fig. 1 or Fig. 2, and Fig. 6 is a longitudinal sectional view corresponding to Fig. 2 and showing a different form of centrifugally operated valve for the overspeed governor.

The overspeed governor mechanism, as herein shown is adapted to be secured to an engine housing in alignment with a hollow horizontal driving shaft thereof in which oil is maintained under suitable pressure for forced feed lubrication, e. g. the cam shaft of a Diesel engine. The embodiment shown is especially adapted to serve, interchangeably, port and starboard engines of twin screw marine installations in which the controls are respectively starboard and port for inboard accessibility.

The mechanism, as shown, (Figs. 1 to 6) has a main body or block 1 with an integral flange 2 adapted to be secured to the engine housing in position such that the engine shaft, mentioned above, can be connected, as by a splined collar or sleeve (not shown), to the governor drive shaft 3. The drive shaft 3 is axially bored as at 4 to receive oil from said engine shaft and to deliver said oil as through a lateral passage 5 into a cylindrical recess 6 of the main block 1 which houses a skew gear 7, said gear replacing the usual central driving miter or skew (spiral) gear of the magneto or speed indicator power take-off assembly (not illustrated).

The power take-off hereof includes at least one skew or spiral gear 8 and supporting shaft 9 (Fig. 4) which will later be described more in detail. The recess 6 communicates with two vertical bores 10 in the flange part of the body 1, which bores contain respective shafts 9 and form receiving spaces for oil delivered through the passages 4 and 5 of the shaft 3. The oil passes from the bores 10 through horizontal bores 11 of the main block 1 into a general sump space S of the governor proper; and an oil level L is established in the sump by reason of horizontal overflow or drain holes 12 and 13 (two of each shown) which are formed in the main block 1 and extend, respectively, from the governor sump space S to the vertical bores 10 and from said bores 10 to the engine housing or crank case. A removable vertical plate 14 on the main block (left Fig. 2) cooperates with the latter to form the sump space and enclose the ball head mechanism.

A suitable cap 15 (right Fig. 2) containing an oil seal 16 (surrounding the shaft 3) closes the

cavity 6 (in cooperation with the shaft 3 and oil seal) from free communication with the engine crank case, thereby closing communication between the vertical bores 10 and the crank case at all points below the level of the overflow or drain holes 13.

The governor drive shaft 3 is extended at 17 through—and in running fit contact with—a smooth cylindrical bore 18 of the main block 1, and therebeyond, as at 19, through a pump case or block 20 secured in a counterbore 21 of the main block, as by screws. The screws maintain the right hand face (Fig. 2) of the pump case block—which is lapped in place—in high-pressure oil-tight contact with the end face of the counterbore. The portion 19 of the shaft is splined but turns freely in the pump case.

The pump case 20 contains pump gears 22 and 23 (former splined to the drive shaft) and a reversible valve system (see Fig. 5), all of which will be more fully described later; and the pump operates to draw oil from the sump at a lower portion of the pump case 20 and to maintain the oil normally in idle circulation through passages 24 and 25 of the main block (see particularly Fig. 2), lateral passages 26 and a longitudinal bore 27 of the shaft 3, finally discharging the oil through lateral valve ports 28, in the left end portion of the shaft, back into the sump.

The "tripping" operation of the mechanism is that of stopping the engine, by reason of blocking the free or idle circulation of oil described above (note valve sleeve 30 on the left end of the drive shaft 3, Fig. 2), thus directing the output of the gear pump through the passage 24 and a duct constituted by either of two communicating diagonal bores 31 of the main block 1, (Figs. 1, 2 and 3), to a hydraulic servo-motor 33 surmounting the main block and connected to the control or throttle mechanism of the engine. In case the governor serves a Diesel engine the connections from the servo-motor to the engine (not illustrated) are such that the servo-motor linkage acts mechanically to block or prop the injector rocker arms in final injecting position, thus preventing the fuel pumps from reloading.

Referring further to the gear pump, the gear 22 has external teeth meshing with internal teeth of the gear 23 (cf. Figs. 2 and 5) the latter gear being mounted to turn in an eccentric groove at the right face of the gear case or block 20. Horizontal inlet-outlet holes 34 extend from vertical valve chambers 35 to points near the meshing region of the gears.

The valves which are shown in Fig. 5, comprise one inlet valve 37 of one set of two valves, and one outlet valve 38 of the other set of two valves, the two sets thus constituting essentially the usual reversible pump gear valve system in order that the shaft 3 may turn in either direction as may be required on reversible engines. Outlets for the valve chambers are formed by horizontal holes 39 (Fig. 5) communicating at one end (left Fig. 2) with respective valve chambers 35 and at the other with an arcuate groove 40 in the right hand face of the pump case. The groove 40, in turn, communicates with the delivery duct 24, already described, from which the two diagonal bores 31 may branch.

The vertical bores forming the valve chambers 35 extend upwardly from lower portions of the cylindrical surface of the pump case 20, part of which is exposed to the left (Fig. 2) of the right hand inner wall of the sump chamber of the main block, said bores extending through

the attaching flange of the pump case as well. The lower or intake valve assemblies (valves 37, one shown) are thus blocked from falling out of the chambers, in event of loose fitting, by the cylindrical counterbore surface 21 of the main block 1. Pins 42 (one shown at right Fig. 5) prevent the outlet valves from being displaced downwardly into blocking relation to respective inlet-outlet holes 34. The internal-external gear pump obviates the necessity for a countershaft such as usually provided in hydraulic governors, and the whole pump occupies much less space axially and transversely than would be necessary to accommodate the usual gear pump arrangement. Furthermore the pump is self contained in and all parts carried on the single block 20, the external gear 22, although splined to the drive shaft 3, being in effect also carried by the pump case block 20 and insertable into place thereon along the drive shaft splines.

Referring to the servo-motor 33 (Figs. 2 and 3) this has a block or body 50 attachable in either of two positions at the top face of the main block 1 as by paired flanges 51, depending upon which side of the engine has the fuel control mechanism. In the mounted position shown the diagonal duct 31 lying to the left in Fig. 3 supplies the servo-motor cylinder bore 52 through a passage 53 in the servo-motor block designed to communicate with a different diagonal duct 31 in each of the two positions of the servo-motor (turned end for end, crosswise of the governor generally).

The power piston 55 of the servo-motor has an operating stem 56 for connection to the engine fuel control mechanism as outlined above, such that the power piston blocks the injector rocker arms by movement to the right (Fig. 3), in the mounted position of the servo-motor shown, to shut down the engine. An oil seal assembly 57 blocks flow of oil along the stem so that when the oil delivery of the pump is diverted to the acting duct 31, as above explained, the power piston is forced to the right against a return spring 58 in the servo-motor cylinder.

Leading into the sump case of the governor from the spring-containing portion of the servo-motor cylinder are two vent holes 59 and 60. In the mounted position of the servo-motor shown, the hole 59 constitutes a stroke limit unloader vent for servo-motor-actuating oil when the piston moves past and starts to uncover said hole 59, thus limiting servo-motor travel. The hole 60 acts as an air vent and inlet as will be obvious from Fig. 3.

In the event the control mechanism sticks or is blocked against movement in the shut-down direction a safety unloader valve 62, ordinarily held closed by a highly stressed spring 63, enables the venting of oil from the pump, duct 31 etc. through the power piston to the vents 59, 60, the inlet to the valve comprising cross passages 64 in a reduced diameter portion of the piston.

The valve sleeve 30 which, as will be apparent from Fig. 2, telescopes a cylindrical left hand end portion of the drive shaft 3 and is counterbored as at 65 to a point such as will just leave the ports 28 of the drive shaft fully open for delivery of oil through the left end portion of the sleeve during operation of the engine within its working speed range. The valve sleeve is normally held in position to maintain said ports open by a spring mechanism operatively connected to the valve sleeve and bearing to the right (Fig. 2)

thereon. Said mechanism also holds the valve sleeve against rotation so that the latter is never subject to sticking, i. e. static friction.

By virtue of the spring mechanism the valve sleeve 30, through an antifriction thrust bearing assembly 67, acts on arms 68 of flyballs 69 pivoted to a ball head 70 on the drive shaft 3, normally to maintain the flyballs in the inactive position in which shown. The ball head 70 is preferably keyed to turn with said shaft by extensions of the same spline grooves as cause the pump gear 22 to turn with the shaft. The flyballs also, preferably, are at least partially isolated from the general oil supply by a cover 72 attached to the ball-head. The cover can be nearly closed at its outer end if desired, for more complete isolation of oil in the ballhead from that of the sump generally (cf. Fig. 6).

The spring mechanism which counteracts the centrifugal force of the flyballs, so long as the engine is not racing, includes an upright arm 75 shown (see Fig. 3) as comprising spaced rigidly interconnected bars pivoted as on a pin 76 carried on a bracket formation 77 of the cover plate 14. The bars constituting the arm 75 straddle a rectangular end portion of the valve sleeve 30 and positively prevent the sleeve from turning. A spring 78 connected to an upper portion of the arm 75 swings the arm toward the ballhead; and the spring force is transmitted to the valve sleeve through rollers 79 on said sleeve bearing against the arm members. The right hand end of the spring is shown as anchored to a depending stud 80 carried on the top wall of the main body 1 and the opposite end is adjustably connected to the arm 75 at a horizontally pivoted cross piece 81 thereof. The adjustable connection comprises a screw 82 extending somewhat loosely through the pivoted cross-piece 81 into threaded engagement with a circular helically grooved block 83 to which the spring is tightly secured by friction as will be apparent from Fig. 2.

To maintain adjustment, the head of the screw is hexagonal as shown in Fig. 3 and opposite corner portions 84 of the screw head seat against relatively converging wall surfaces 85 formed on the surface of the cross piece opposite the spring. During adjustment the head of the screw 82 is cammed outwardly (i. e. to the left, Fig. 2) by the converging surfaces but the spring reseats the head in snugly held relation to the converging surfaces in three positions for each complete turn of the screw.

To enable convenient adjustment of the tension of the spring 78, thus to change the point in respect to speed at which the mechanism operates as an overspeed trip an opening 87 is provided in the cover plate 14 in alignment with the head of the adjusting screw. The opening which may also serve as an inspection and oil charging opening is ordinarily closed by a small plate or cap 88. It will be noted that the spring mechanism enables spring exposure and adjustment without losing any oil, which would be impossible if the spring were to be in axial alignment with the valve sleeve 30 as in the patent identified above; and also that the spring, by virtue of being in the transverse plane of the flyball mechanism requires much less space in a direction parallel to the drive shaft axis than it would if arranged in axial alignment with the ball head. A guide bracket 89 for the upper end of the arm 75 may be carried on the cover plate 14 to prevent lateral movement of the upper end of the arm.

To counteract the jet effect of discharging oil lengthwise from the valve sleeve 30—such as might tend to make the mechanism trip at higher than the desired speed by augmenting the force of the spring—the outer end of the counterbore 65 may be plugged as at 90 and lateral discharge openings 91 provided in the walls of the sleeve 30 adjacent the plug.

It is desirable to enable shutting down of the engine through the intermediary of the overspeed governor at times when no overspeeding is occurring—as when something goes wrong with the engine not manifested by speed change—or possibly at times when tripping is desirable at an engine speed less than that at which the overspeed governor is set to stop the engine. In Fig. 2 there is shown a valve mechanism which may be operated directly by hand or from points remote from the engine. A plunger valve 95, as shown, is slidably mounted in the bore 25, the plunger having a poppet type head 96 adapted to seat in a shoulder, provided at 97 as by counterboring the bore 25, and to cut off the normal free idle circuit flow of oil from the pump outlet 24 to the sump S through the bore 27 of the governor drive shaft.

The valve plunger 95 extends upwardly through an oil seal 98 and annular plug and guide element 99 to a point outside the main body 1 of the governor. The plunger 95 abuts the annular plug 99, just above the oil seal, and the abutment may normally be maintained by a spring 100 acting upwardly against the plunger and downwardly against the annular plug.

When the valve plunger is thrust downwardly, against the restraining force of the spring 100, forcing the valve head 96 against its seat, the governor mechanism acts to shut down the engine, just the same as it would act in event the ports 28 of the hollow governor shaft are closed by outward movement of the ball arms 69. As shown, a plunger 101 adapted to constitute a solenoid core rests on the upper end of the valve plunger 95, so that, by depressing the plunger 101, as at a button 102, the engine may be shut down by an operator adjacent the engine. A solenoid coil 103, arranged also to act downwardly on the core, effects shutdown of the engine when current is supplied to the coil of the solenoid as by closing a suitable switch (not shown) in the power circuit of the solenoid.

If it is desired to maintain the mechanism in tripped condition after stopping the engine, a suitable latch (not shown) may be associated with the upper end of the arm 75. Such latch can be mounted on the main body over the arm 75 so as to cooperate with the upper end of the arm or, for further example, on the plate 88 which covers the adjustment opening 87. In the latter case two plates 88 would ordinarily be supplied with each governor one with such latch and the other without any latch. For further example the latch may comprise a steel ball in a vertically enlarged downwardly open recess on the upper wall of the casing, which ball normally rides the top face of the cross piece 81 idly and drops into latching position beyond the right face of the cross piece when the fly balls force the arm 75 to the extreme left. Such ball would have a suitable release pin acting against the ball to move it to unlatching position. Thus, in event anti-reset latching is not desired, as in the arrangement illustrated, the ball would simply be omitted. The same essential purpose

could be served by latching the power piston of the servo-motor.

Referring particularly to Fig. 4, the power take-off is arranged for port or starboard mounting of mechanism to be driven thereby, or both if desired. One take-off shaft 9 only is shown in one of the vertical bores 10, secured in place in an upper bearing body 108 attached as by nuts 106 on studs 107. Another identical shaft could be similarly mounted in the other bore 10 when or if desired. If only one shaft 9 is used, the unoccupied bore 10 is closed by a suitable cap plate 105 diagrammatically shown at the right, Fig. 4.

A feature of the power take-off construction is the making of the gear 8 integral with the shaft so that there is no possibility of improper assembly, looseness or backlash in the concealed portions of the power take-off mechanism. The construction greatly facilitates the mounting of the shaft 9 in either of the two positions provided for it. A footstep bearing for the shaft 9 comprises a reduced extension 104 in a bearing bore 109 below the gear 8 which bearing bore is relieved against dead pocketing of oil as by vent holes 110 in the shaft.

The upper bearing in the body 108 for the shaft 9 preferably comprises an antifriction bearing assembly 111 on a reduced portion 112 of the shaft and within the body 108, above which bearing an oil seal may be provided around the reduced shaft portion as at 113. A driving key slot 115 in the upper hollow end of the shaft 9 serves to enable driving connection of said shaft with the magneto, speed indicator or other mechanism of the engine which is required to be driven by the engine. The gears 7-8 may be one-to-one ratio skew or spiral gears by providing meshing angles which offset the difference in pitch diameters of the two gears. The teeth on the gear 7, which is shown as twice the size of the gear 8, would be inclined with reference to the axis of the shaft 9 at 30° and the teeth on the gear 8 at 60°, making it an easy matter to insert the shaft 9 into position by a turning motion of the shaft after the skew gear teeth are brought together.

Referring to Fig. 6, that shows another manner of arranging the speed actuated valve elements. Instead of the valve sleeve 30 for effecting overspeed responsive operation of the trip mechanism a central valve plunger 120 slides in a left hand portion of an axial bore 121 of the drive shaft 3. Said left hand portion of the bore 121 may be discommunicated from the oil supply passages 4, 5 as by a plug 130. The valve plunger 120 has a cylindrical plug portion 122 normally disposed to the right of the lateral ports or passages 26 of the shaft 3 but which (plug portion) is moved to close the lateral ports when the flyballs move to their outward position. A vent to sump for the space between the plug portion 122 and the plug 130 may be provided as a small axial bore 131 through the valve plunger. A necked portion 123 of the valve plunger extends from the plug portion 122 to a point beyond lateral outlet passages 124 in the hollow wall of the drive shaft and which are always in communication with a suitable discharge passage 125 leading to the sump as through the pump case block 20.

The connection between the plunger element (120) of the modified valve and the lever 75 may comprise a bifurcated head 126 of the valve plunger, a portion of which head supports the

antifriction thrust bearing as will be apparent, said head being connected to the arm 75 of the spring mechanism as by a link 127 extending through the open end of the ballhead cover 72.

The hand and/or solenoid or other remotely controllable shutdown valve mechanism of Fig. 2 would or could be provided on the arrangement according to Fig. 6, without essential modification of said arrangement, also a suitable anti-reset latch for the main valve or operating arm or servo-motor as suggested above, may be provided.

The mechanism hereof, obviously, could be used for purposes other than for overspeed tripping of an engine; and, irrespective of the purpose served, the mechanism may be used to actuate pressure responsive means separate from the governor unit, for example, as in my patent identified above.

I claim:

1. In a hydraulically acting speed governor having a casing providing an oil chamber, means establishing a definite oil level in the chamber, a ball head mechanism rotatable on a fixed horizontal axis in a lower part of the chamber, a main governor valve coaxial with the ball head and operated by the ball head mechanism in one direction initiating a governing operation, a coil spring in the casing above the oil level in the chamber for operating the valve in the opposite direction, a lever pivoted to the casing and having portions extending adjacent the axes of the spring and valve respectively and operatively connected to the spring and valve, and means in the casing above said oil level and connected with the spring for adjusting the effective spring strength.

2. A hydraulically acting speed governor comprising a casing with a horizontal drive shaft journaled therein, speed responsive ball head mechanism coaxial with the shaft and driven thereby and a hydraulic fluid valve controlled by said mechanism, means to supply oil to the casing, means establishing a normal oil level in the casing such that the ball head is substantially immersed in oil, a speeder spring in the casing above the oil level, an upstanding lever operatively connecting the spring with a speed responsive element of the ball head, adjusting means associated with the spring within the casing for enabling the effective stress of the spring to be changed, said means being above said oil level, and means detachably secured to the casing adjacent the adjusting means for normally concealing the adjusting means but rendering the same accessible for adjustment when detached.

3. An engine overspeed governor, comprising a casing provided with a bearing bore at one end and a relatively enlarged speeder chamber and sump space at the opposite end, a drive shaft, adapted for connection to a rotary part of the engine, journaled in the bore and having an inner end extending into said chamber, a positive displacement pump mounted in the casing and drivingly connected with the shaft, means supplying the pump with hydraulic fluid from the sump space, said pump having a discharge duct including a bore extending axially of said shaft and open laterally thereof near said inner end, a centrifugally responsive ball head mounted on the shaft in said chamber, a sleeve slidably surrounding the inner end of the shaft and having a bore portion capable of sealing the lateral opening of the shaft bore in one position of the sleeve and a counterbore having an end wall

portion and connected inner surface continued beyond the lateral opening away from the shaft and larger than the shaft, said wall and surface being capable of unsealing the lateral opening in another position of the sleeve, spring means connected to and normally holding the sleeve in the latter position, said ball head being operable to move the sleeve to the first mentioned position.

4. An engine overspeed governor, comprising a casing provided with a bearing bore at one end and a relatively enlarged speeder chamber and sump space at the opposite end, a drive shaft adapted for connection to a rotary part of the engine and having an inner end extending into said chamber, a positive displacement pump mounted in the casing and drivingly connected to the shaft, means supplying the pump with hydraulic fluid from the sump space, said pump having a discharge duct including an axial bore

portion of the shaft which bore is closed at the end thereof remote from the speeder chamber said duct also including a lateral inlet opening of said shaft bore and a lateral outlet opening leading from the shaft bore and spaced from the inlet opening along the shaft, a valve plunger slidable in the shaft bore, said plunger having spaced plug portions sealing the bore and a neck normally enabling communication of the lateral openings with each other through the shaft bore, and spring opposed overspeed responsive valve plunger operating means in the speeder chamber driven by the shaft and operatively connected to the plunger to cause one of the plug portions to seal and unseal one of the lateral openings under respectively different conditions of operation of the engine.

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