Feb. 13, 1951 D. W. DUSINBERRE ET AL 2,541,643

HYDRAULIC GOVERNOR SWITCH MECHANISM

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Fig. 1.

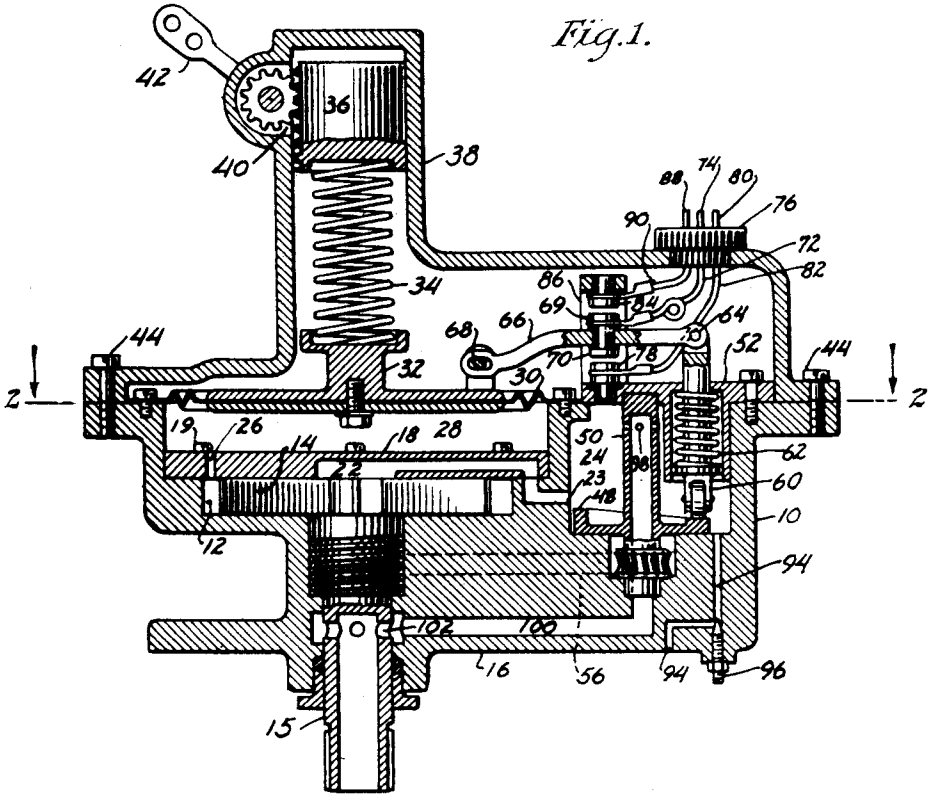
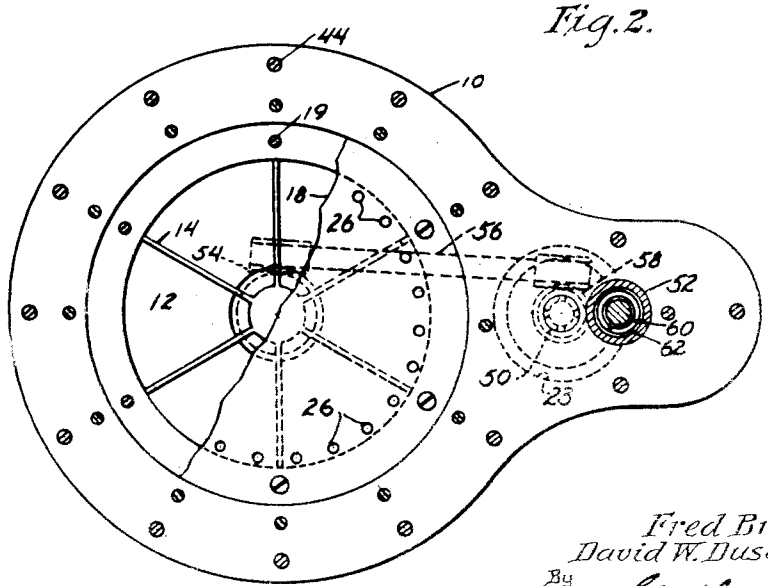


Fig. 2.



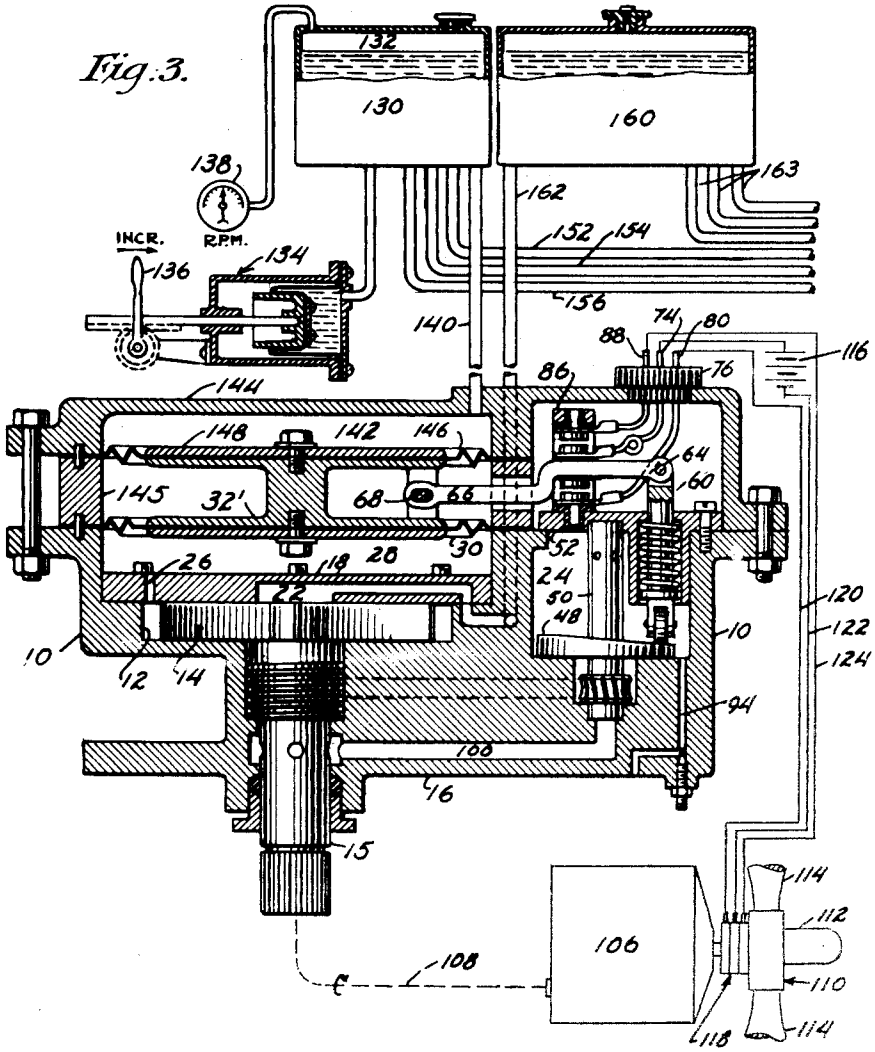
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Fig. 3.



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HYDRAULIC GOVERNOR SWITCH MECHANISM

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4 Claims. (Cl. 200—80)

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This invention relates to speed governors and is concerned particularly with improvements in hydraulic governors wherein the sensitive portion of the governor is responsive to hydraulic pressure developed by a rotating impeller driven by an engine or mechanism whose speed is to be governed. Objects of the invention are to provide a unitary, speed responsive hydraulic governor for an engine, to provide a regulating system for a plurality of engines and governors, to provide an improved mechanism for translating off-speed responses in a governor to speed corrective impulses in an engine, and to provide an improved form of proportional governor wherein the amount of off-speed of the engine determines the extent of speed correction imposed on the engine.

The above objects, along with additional objects, will become apparent in reading the annexed detailed description when read in connection with the accompanying drawings. It is to be expressly understood that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings,

Fig. 1 is a section through one embodiment of the governor of this invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a section through an alternative form of governor with associated controls and environment.

While the governor of this invention has general utility for single speed controlled engines of any type or for a plurality of speed controlled engines of any type, it is particularly adapted for use with internal combustion engines and propellers as used on aircraft. The term engine used herein is to be considered in its broad sense, to include motors, turbines and other mechanisms with which governors are used.

Referring first to Figs. 1 and 2, we provide a governor comprising a lower housing element 10 adapted to be mounted on an engine or on other suitable mounting, the housing having formed therein, a cylindrical cavity 12 within which is disposed a vaned rotor 14 mounted on a shaft 15 extending through the lower face 16 of the housing for connection to, and drive by, some portion of the engine whose speed is to be governed. The cavity 12 is covered by a plate 18 secured to the housing 10 by screws 19, said plate 18 having formed therein a passage 22 opening

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at one end to the center of the impeller 14 and at its other end 23 to a well 24 formed in the housing. The cover 18 is provided with a plurality of holes or ducts 26 formed preferably in a circle substantially at the outer ends of the vanes of the rotor 14. The rotor cavity 12 is fed with hydraulic fluid through the passage 22 in a manner which will be described, and upon rotation of the shaft 15 and the impeller 14, the fluid in the cavity 12 is pressurized by centrifugal force to an extent dependent upon the impeller rotational speed. Any static pressure on the fluid in the passage 22 exists throughout the cavity 12, the ducts 26 and a chamber 28. When the vaned rotor or impeller 14 is rotated, a pressure rise, caused by centrifugal force, will be imparted to the fluid, with or without substantial fluid flow, and this pressure rise will be a function of the rotational speed of the impeller. The pressure rise created at the impeller periphery is transmitted to the chamber 28 through the ducts 26 and thus pressure in the chamber is a function of engine speed. The side faces of the impeller, preferably, have small clearance with the bottom of the cavity 12 and with the cover 18, to minimize recirculation within the cavity. The impeller pressure rise would be partially lost if recirculation were permitted by wide clearances in the cavity.

In the housing 10 and above the cover 18, the chamber 28 is formed, with which the ducts 26 communicate. The chamber is closed by a diaphragm 30 secured at its edges to the housing and secured in its central portion to a member 32 capable of movement toward and away from the housing 10. The chamber 28 is normally full of hydraulic fluid and with increases in the fluid pressure, movement of the member 32 will be urged in an outward direction. Such movement is resisted by a spring 34, commonly called a speeder spring in the propeller governor art, the force exerted by said spring being adjustable by means of a movable abutment 36 slidable in an upper housing 38 and movable in an axial direction by a pinion and rack connection 40. Rotation of the pinion 40 is afforded by the control lever 42. The upper housing 38 is secured to the lower housing 10 by screws 44.

The spring 34 may be set by the lever 42 to exert force on the member 32 corresponding to a certain desired R. P. M. setting for the engine. If the rotational speed of the impeller 14 is less than the speed corresponding to the desired engine speed, fluid pressure in the chamber 28 will be less than that necessary to balance the spring

34, whereby the member 32 may move downwardly. If the impeller rotational speed is higher than that corresponding to the desired engine speed, pressure in the chamber 28 will be greater than that necessary to balance the spring 34 and the member 32 will move upwardly. Mechanism is provided, as will be described, to translate movements of the member 32 into control effects upon the engine to increase or diminish its speed until proper balance between the spring 34 and the pressure in the chamber 28 is obtained, resulting in an on-speed condition of the engine.

Within the well 24, a face cam 48 is disposed, said cam including a hollow shaft 50 borne at its ends in the lower housing 10 and in a bearing plate 52 secured to the lower housing 10. The shaft 50 is rotated from the shaft 15 through a worm and wheel drive 54, a transverse shaft 56, and a worm and wheel drive 58, whereby the shaft 50 and the cam 48 are positively rotated at a speed substantially less than the speed of the shaft 15. A vertically reciprocable cam follower 60 is carried in the plate 52 and is pressed by a spring 62 into engagement with the cam 48. The upper end of the cam follower 60 protrudes through the plate 52 and carries a pivot 64 to which a transverse beam 66 is articulated. The other end of the beam 66 is articulated to the member 32 by a pin and slot connection 68. Between the ends of the beam 66, upper and lower electrical contact points 69 and 70 are secured in insulated relation to the beam, and a flexible connector 72 connects the contact points 69 and 70 with a pin 74 on a connector plug 76 secured in the upper housing 38. A lower contact point 78 is secured to the plate 52 in insulated relation and is connected to a pin 80 on the connector plug 76 by a wire 82. An upper contact 84, carried in insulated relation by a bridge element 86 secured to the plate 52, is connected to a pin 88 in the connector plug 76 through a wire 90. When the governor is in operation, the cam follower 60 will continually rise and fall by the action of the cam 48 which will continually cause up and down movement of the right-hand end of the beam 66. When the member 32 is in a central, on-speed condition, the left end of the beam 66 will not move and the spacing of the contact points will be so arranged that as the points 69 and 70 move with the beam they will not touch the points 84 and 78. However, if an off-speed error exists, the member 32 will rise or fall, causing corresponding movement of the pivot 68, whereupon, with a small off-speed condition, a succession of contacts will be established between the points 69 and 84 or alternatively between the points 70 and 78. If the off-speed condition is severe, the member 32 will have moved from its neutral position a considerable amount causing longer contact dwells of the several points and if the off-speed is even more severe, regardless of the up and down movement of the cam follower 60, continuous switch point contacts will be obtained until speed corrections enable interrupted contacts and eventually no contacts. If continuous or long dwell switch point contacts occur, the member 32 will yield during up and down movement of the cam follower, since the beam 66 will swing about the engaged switch points as a fulcrum. Since the pressure exerted either by the centrifugally caused fluid pressure in the chamber 28 or by the spring 34 is elastic, the member 32 may yield without affecting the restoring effect either of the fluid pressure or of the spring, but will continue to exert pressure until an off-speed error is corrected and until the several contact points move relatively without contacting one another.

The several pins 74, 80 and 88 in the plug 76 are connected to a speed control system which will be more fully explained in connection with Fig. 3.

In order to provide lubrication for the mechanism in the well 24, and to supply fluid for the impeller 14 and chamber 28, a fluid supply passage 94 carrying oil or fluid leads from the mounting face 16 of the governor to the well 24, and a needle valve 96 is provided in the passage to regulate the amount of fluid feed. Ordinarily, the amount of fluid needed is quite small. The passage 94 is intended to be supplied with fluid from an appropriate supply passage on the governor mounting pad on the engine or mechanism which will coact with the end of the passage 94. Fluid flowing through the passage 94 fills the well 24 and overflow passes through openings 98 in the hollow cam carrying shaft 50 whence the fluid passes through a passage 100 in the housing 10 and thence through ports 102 through the hollow of the shaft 15 to dump into the engine or mechanism upon which the governor is mounted. The well 24 acts as a reservoir, making fluid available to the opening 23 of the passage 22 and thence to the impeller cavity. If an overspeed condition occurs the impeller 14 will pump fluid into the chamber 28 and the diaphragm 30 and its member 32 will rise increasing the volumetric capacity of the system. Fluid make-up for this occurrence is obtained from the well 24. If an underspeed condition exists in the governor, the member 32 will reduce the volumetric capacity of the chamber 28 and the impeller cavity and some of the fluid in the system will back up and be returned to the well 24 for overflow through the holes 98 and the passage 100. The feed of fluid through the passage 94 and past the valve 96 will be adjusted to meet all expected underspeed and overspeed conditions so that the well 24 will at all times contain a sufficient amount of fluid.

Referring now to Fig. 3, the lower and right hand parts of the governor assembly are substantially the same as the corresponding portions of the embodiment of Fig. 1 and similar parts bear the same reference characters. In Fig. 3, we show schematically, a power plant or engine or other device whose speed is to be controlled, at 106, such engine being provided with a governor drive connection 108 effective to rotate the governor shaft 15. The engine as shown drives a controllable pitch propeller 110 having a conventional reversible electric pitch changing motor 112 which serves when energized to alter the pitch of propeller blades 114 for greater or lesser angle of attack. Power to drive the electric motor 112 is provided by a power source 116 and the propeller carries slip rings 118, three being shown, connected by wires 120, 122 and 124 respectively to the governor contact pins 80, 74 and 88. The wire 122, containing the power source 116, comprises a common conductor while the wires 120 and 124 respectively carry current when the appropriate governor contacts are closed, to actuate the propeller to decrease or increase its pitch, thus to vary the engine load and consequently its R. P. M. The electrical system just described is equally applicable to the arrangement of Fig. 1 but is not a specific part of this invention. The electrical system is susceptible of considerable

modification and is merely presented as exemplary of a simple circuit for accomplishing the desired speed control of an engine or speed controllable mechanism.

In Fig. 3, we provide a hydro-pneumatic speed control system in lieu of the speeder spring arrangement of Fig. 1. This system comprises a header tank 130 having fluid therein and having an air or gas space or bell 132. The fluid and gas is placed under pressure by a manually operable pump 134, such as a plunger pump, which is adjustable by a handle 136 either directly as shown or through indirect or servo mechanisms. The pressure in the tank may be read on a gage 138 which if desired may be calibrated directly in R. P. M., rather than pressure, so that the handle 136 may be adjusted directly to secure a desired R. P. M. The preset pressure in the tank 130 is then transmitted through a pipe 140 to a chamber 142 formed by an upper housing 144 secured to the lower governor housing 10 through an adapter 145. The chamber 142 is formed in part by a diaphragm 146 with an associated movable member 148 secured to or integral with the movable member here designated as 32'. The fluid under pressure in the chamber 142 is equivalent in effect to a spring since the pressurized gas or air at 132 in the tank 130 provides elastic means to permit the member 32' to move up and down in response to speed errors and to finally reach equilibrium when the fluid pressure in the chamber 142 and that in the chamber 28 is equal. The space between the diaphragms 30 and 146 may be vented to atmosphere since the pressure between the diaphragms has no effect on the operation of the system. Alternatively, bellows, resilient sleeves or pistons could be used in lieu of the diaphragms.

The tank 130 may be used as a controllable elastic pressure source for a plurality of engines and governor assemblies, and pipes 152, 154 and 156 leading from the tank 130 are extended to similar governor units applied to serve additional engines or power plants. Thus, when used for controlling a plurality of governors, the single pressure tank 130 and the single tank pressure controller 136 serve to adjust all governors simultaneously in order that speed synchronism between several engines may be maintained.

We further show a tank 160 connected by a pipe 162 to the impeller intake cavity 22 of the governor to supply hydraulic fluid to the impeller. Pipes 163 similar to 162 may lead from the central supply to other governors of a multiple system. This tank 160 furnishes fluid to the governor impellers 14 in lieu of fluid supply from the well 24 of each governor. However, each governor may be arranged as in Fig. 1 with fluid supply for the impeller 14 leading from the well 24.

In the hydraulic speed control system exemplified by Fig. 3, utilizing an impeller supply tank such as 160, the tank may be held under a controlled positive absolute pressure so that the entire system is independent of altitude or atmospheric pressure.

The electrical contactor systems disclosed merely exemplify one means for ataining speed control of engines or other mechanisms. The speed control may be accomplished mechanically, hydraulically, or by other electrical means without departing from the spirit or scope of the invention. Likewise, no limitation on the scope of the invention is to be implied by the showing of the electrically operated controllable pitch propeller as a means for speed control on an

engine or mechanism—other forms of control such as fuel or energy input control or other means of load control are considered as being wholly within the scope of the invention.

Though but two embodiments illustrating the invention have been shown and described, it is to be understood that the invention may be applied in other and various forms. Changes may be made in the arrangements, without departing from the spirit of the invention. Reference should be had to the appended claims for definitions of the limits of the invention.

What is claimed is:

1. A hydraulic speed governor comprising a driven rotor having vanes, a housing within which said rotor is contained having a duct for feeding hydraulic fluid to the rotor center and a duct for passing fluid at the rotor periphery, a chamber fed by the last said duct, a movable member in said chamber, movable under the influence of fluid pressure changes caused by variation in the rotational speed of said rotor, adjustable resilient means acting on said movable member for counteracting the fluid pressure acting thereon, and means operated by and sensitive to movements of said movable member to adjust the speed of said rotor, said adjusting means comprising a fixed electrical contactor assembly having spaced speed increasing and decreasing contacts, a contact movable with and with respect to said movable member to engage at times either of said spaced contacts, and means operated by and at a speed proportional to that of said rotor to move said movable contact cyclically toward and away from said spaced speed increasing and decreasing contacts and with respect to said movable member, movements of said movable member causing contacts of said movable contact with one or the other of said spaced contacts, at times, only when both said members' movements are in the same direction.

2. In a switch adapted for use with a speed governor, a member movable in response to speed deviations from a set value, a reciprocable member movable at a substantially uniform frequency and through a substantially fixed range in a direction substantially parallel to the direction of movement of said first member, a beam connecting said members, movable therewith, having a speed control element thereon, and a fixed control element cooperable at times with and upon movement of said beam-carried element only when said first member is displaced from a neutral on-speed position.

3. In a switch adapted for use with a speed governor, a member having a neutral on-speed position and movable therefrom with off-speed conditions, a member movable over a substantially fixed range and at substantially fixed frequency and in a direction substantially parallel to the direction of movement of said first member, means connecting said members, movable therewith, and carrying a speed control element, and a substantially fixed speed control element with which said first speed control element engages only when said first member is in an off-speed position.

4. In a switch for a control system, a member movable along a path according to a controlled effect, a reciprocating member movable in a path substantially parallel to the other path at a substantially uniform frequency and through a substantially fixed range, a beam connecting said members, movable therewith, having a control element fixed thereon intermediate said

members, and a fixed control element contactable at times with and upon movement of said beam carried element, only when said first member is displaced from a certain position in its range of movement.

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