May 30, 1939. P. MARTINOTTI 2,160,553

CENTRIFUGAL GOVERNOR

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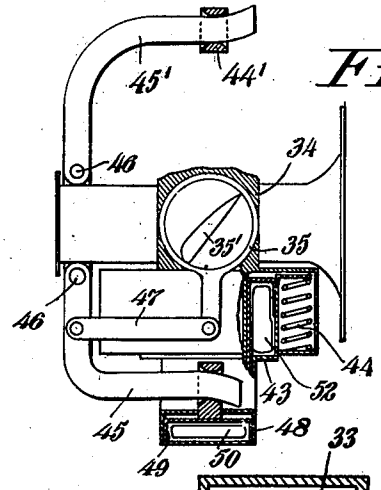


Fig. 6.

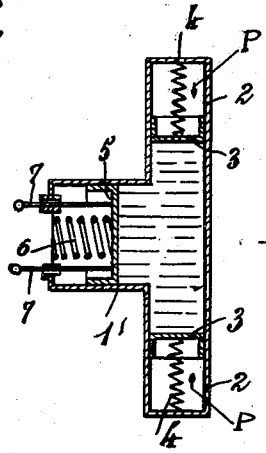


Fig. 1.

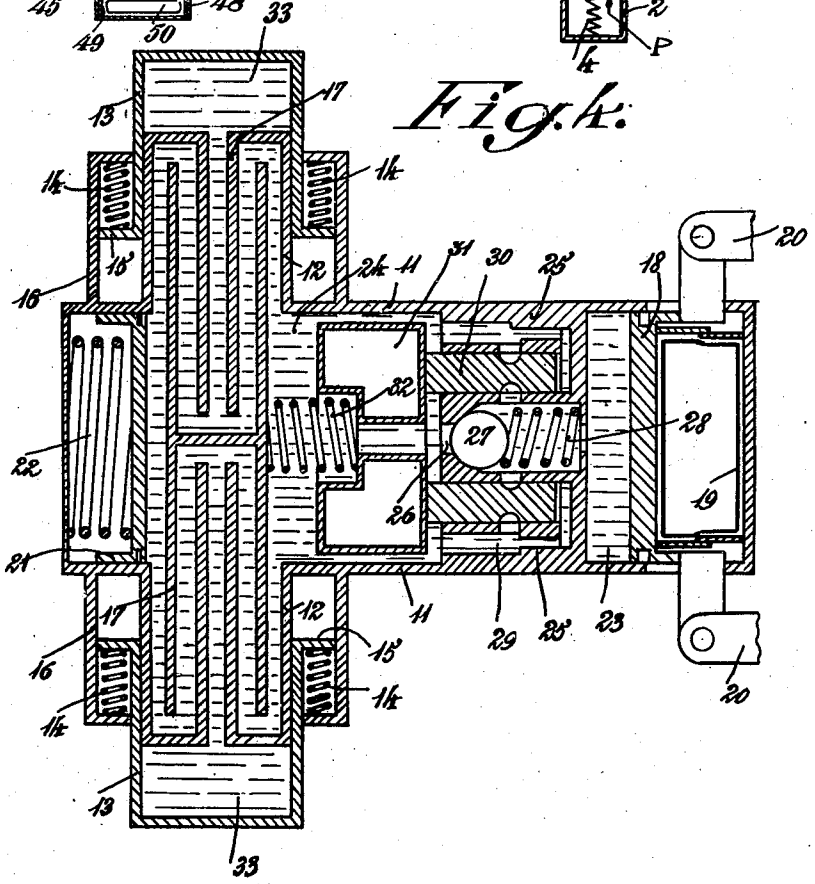


Fig. 4.

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Fig. 2

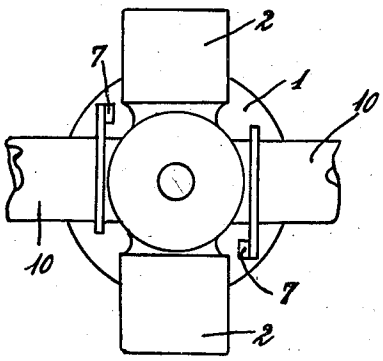


Fig. 3

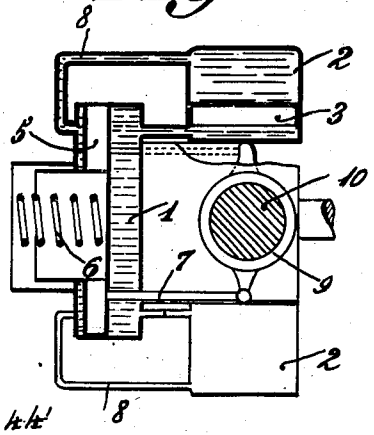
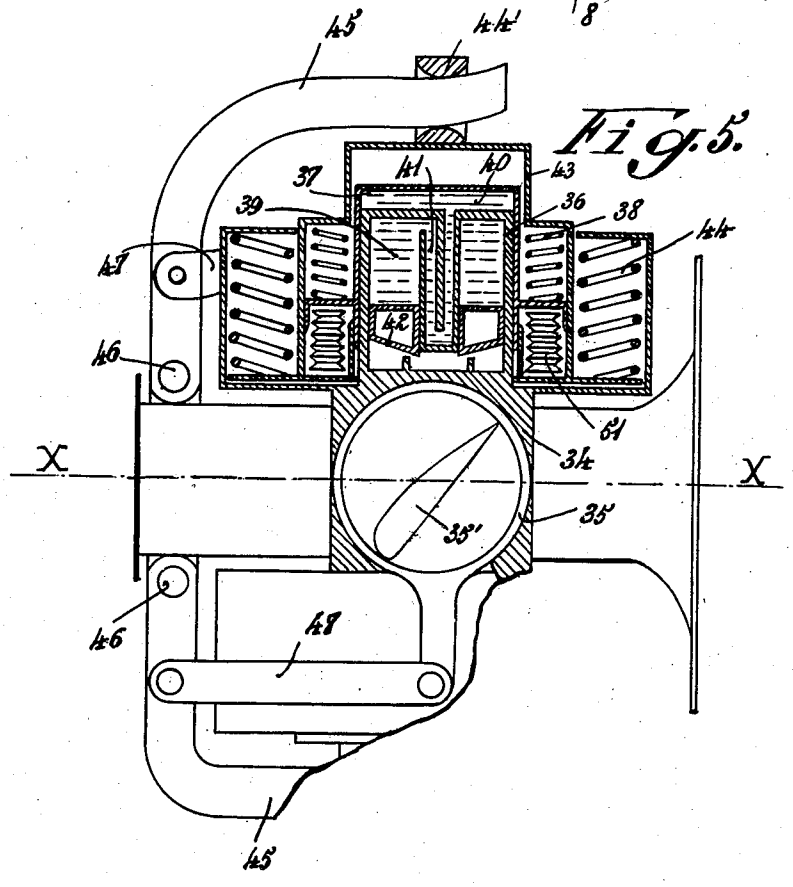


Fig. 5.



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CENTRIFUGAL GOVERNOR

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In Italy June 17, 1935

6 Claims. (Cl. 264—19)

The present invention relates to a centrifugal governor which, although it is adaptable to various applications, is more particularly intended for controlling the variable pitch propellers used in aviation.

The centrifugal governor according to the invention is essentially characterised in that it comprises a fluid mass which rotates proportionally to the speed of rotation of the machine or apparatus to be governed, said mass, owing to its tendency to centrifugate, increasing or decreasing in volume and thereby producing a suction or a pressure on a piston or equivalent member connected to the control member of the machine or apparatus to be governed, said piston being displaced under the action of the said mass against the reaction of an opposing force.

According to another characteristic of the invention, the force opposing the action of the fluid mass is influenced by the variations of pressure of the surrounding air.

The various characteristics of the invention will become apparent from the ensuing description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagram illustrating, according to a first embodiment, the technical principle of the invention,

Figs. 2 and 3 are views similar to that of Fig. 1, showing a modified embodiment;

Fig. 4 is a sectional view of the centrifugal governor,

Fig. 5 is a plan view in part section of the centrifugal governor, as applied to the control of a variable pitch propeller.

Fig. 6 is a view of a modified form of the structure shown in Fig. 5.

Referring to Fig. 1, the centrifugal governor comprises a reservoir 1 adapted to be rotated and provided with two radial extensions 2, placed in alignment with each other and being preferably of cylindrical shape. In each of the cylinders 2 is mounted a piston 3 subjected to the action of a force P obtained, for example, by means of a spring 4. In the reservoir 1 proper, is mounted a piston 5 which is subjected to the force exerted by a spring 6 or a system of springs the force exerted by which can counterbalance the pressure due to the springs 4. The space between the pistons 3 and 5 is filled with a heavy liquid, mercury for example.

When the apparatus is at rest, the pistons 3 and 5 are in a position of equilibrium. On the contrary, when the apparatus rotates about the axis of the reservoir 1, under the action of the variations of centrifugal force which, as is known, is proportional to the square of the speed of rotation of the apparatus, the pistons 3 move towards or away from the axis of rotation. As a consequence, the piston 5 is forced in or driven out.

The displacements of the piston 5 can be used to actuate any member through the instrumentality of links 7, and for example, to vary the pitch of a propeller.

In the modification shown in Figs. 2 and 3, the springs 4 are replaced by a lighter liquid than the one with which the reservoir 1 is filled and, for example, by oil. The cavities filled with oil communicate with each other through ducts 8 so that the pistons 3 and 5 are positively connected by the liquid which unites their movements.

In said Figs. 2 and 3, the apparatus is supposed to be mounted on the hub of a variable pitch propeller, links 7 connecting the piston 5 to the rings 9 each supporting a blade 10 of the propeller.

In Fig. 4 a governor has been shown to which is applied the principle described with reference to Fig. 1. The governor has a reservoir 11, provided at its front end with two radially disposed cylindrical extensions 12 placed in alignment with each other. On each extension 12 is mounted a sliding cylinder 13. Springs or pneumatic boxes 14 exert a pressure on the cylinders 13, said springs or pneumatic boxes being interposed between a flange 15 provided on said cylinders and the outer wall of each of two chambers 16 secured to the reservoir 11 and concentric with the extensions 12.

Communication between the interior of each extension 12 and the corresponding cylinder 13 is ensured by a syphon device, designated generally by 17.

Within reservoir 11, and at its rear end, is mounted a piston 18 subjected to the action of a system of springs or of a pneumatic box 19. The piston 18 is connected by a linkage 20 to the member to be controlled.

At its front end, the reservoir 11 is closed by a piston 21 subjected to the action of a force due either to a spring 22 or to a pneumatic box.

As previously mentioned, the reservoir 11 is filled with a heavy liquid, mercury for example.

The portion of the reservoir 11 between its rear end and the two extensions 12 is divided into two compartments 23 and 24 by a closure device. The latter is composed of a partition 25 which is fixed relatively to the reservoir 11 and

which is provided at its centre with a duct 26 closed by a ball 27 subjected to the action of a spring 28. By means of this arrangement, the mercury can only pass from the compartment 24 to the compartment 23. The two compartments 23 and 24 furthermore communicate through a duct 29, controlled by a cylindrical slide valve 30 secured to a float 31 urged towards the rear of the reservoir 11 by a spring 32. In the position shown in Fig. 4, communication is established between the compartments 23 and 24.

The compartment 24 communicates with the chambers 33 formed between the sliding cylinders 13 and the extensions 12 through the syphons 17.

The operation of the apparatus is as follows:

When the governor is rotated about the axis of the reservoir 11, the mercury is subjected to the action of centrifugal force. A part of the mercury which is contained in the compartment 24, then flows through the syphons 17 into the chambers 33. The quantity of mercury which thus acts on the ends of the sliding cylinders 13, against the action of the springs 14, increases or decreases proportionally to the speed of rotation of the apparatus.

When the mercury passes from the compartment 24 to the chambers 33, the pistons 18 and 21 are forced in, piston 21 serving to absorb part of the variations in the volume of the mercury contained in the reservoir and thus decreasing the amplitude of the displacements of piston 18 which would otherwise be necessary to counteract such variations. On the contrary, when the mercury passes from the chambers 33 to the compartment 24, the pistons 18 and 21 are driven back. The displacements of the piston 18 are transmitted to the member to be actuated through the links 20.

The closure device connecting the compartments 23 and 24 only comes into play if the apparatus takes up inclined position relatively to the horizontal plane passing through the axis of the reservoir 11. If the apparatus tilts towards the rear, under the action of the float 31, the slide valve 30 rises and closes the duct 29.

The liquid contained in the compartment 23 no longer being able to pass into the compartment 24 the piston 18 is locked in the position which it occupies. In the case where the links 20 control the pitch of the blades of a variable pitch propeller, this arrangement creates a desirable condition whereby when the airplane assumes a certain inclination the pitch of the propeller will be maintained at a given value. As soon as the apparatus returns to its horizontal position, the spring 32 brings the float 31 back to the position in which the slide valve 30 keeps the duct 29 open.

It must be noted that if the members 14, 19 and 22 acting on the cylinders 13, 18 and piston 21, consist of metal springs, the variations of the pressure of the surrounding air have no influence on the operation of the governor.

On the contrary, if the members 14 and 22 acting on the cylinders 13 and piston 21 consist of pneumatic boxes having a certain pressure within them and the member 19 consists of a metal spring, it is obvious that a decrease or an increase in the pressure of the surrounding air will produce an increase or decrease in the action exerted on the cylinders 13 and piston 21.

On the contrary, if the members 14 and 22 consist of metal springs and the member 19 consists of a pneumatic box, the action of the latter on the piston 18 will decrease or increase according to whether an increase or a decrease occurs in the pressure of the surrounding air.

The governor of Fig. 5 which is adapted to control variable pitch propellers, has a body 34 secured to the moving hub 35 of the propeller, one blade of which is shown at 35'. The body 34 is provided with two cylindrical radial extensions 36 on each of which slides a cylinder 37 held by a spring 38. The extensions 36 are hollow and form the chambers 39 containing the liquid to be centrifugated. Each chamber 39 is in communication with the chamber 40, formed by the extension 36 and the corresponding cylinder 37, through a syphon 41. Each chamber 39 furthermore contains a piston 42.

On each cylinder 37 is mounted another movable cylinder 43 held by springs 44.

The apparatus is completed either in the manner shown at the upper part of Fig. 5, or in that shown at the lower part of Fig. 6.

In the first case, the cylinder 43 is provided with a bearing member 44' through which is inserted the curved end of a lever 45 pivoted at 46 on the body 34 and connected by a link 47 to the moving hub 35 of the propeller. The curve of the end of the lever 45 is calculated as a function of the increase in volume of the liquid contained in the chamber 40 so that the amplitude of the oscillating movement of the said lever 45 is constant.

In the second case, the cylinder 43 is extended by a cylindrical compartment 48 in which slides a piston 49 secured to the bearing member 44'. The piston 49 is subjected to the action of a pneumatic box 50 tending push it back towards the axis of the apparatus. According to the pressure of the surrounding air, the bearing member 44' will be moved closer to or further away from the axis of the apparatus.

The operation of the governor is as follows: When the apparatus rotates about the axis X—X, under the action of the liquid, the cylinders 37 are displaced against the action of the springs 38. The latter then transmit a force to the cylinders 43 which are also displaced, through a distance proportional to the difference in compression of the springs 38 and 44.

In their displacements, the cylinders 43 rock the levers 45 which, through the instrumentality of the links 47, rotate the blades 35' and, consequently modify the pitch of the propeller.

The variation of the pitch of the propeller is therefore a function of the speed of rotation of the engine, said variation being effected in a completely automatic manner.

It is possible, by an adjustment of the initial degree of compression of the springs 38 and 44 to determine the speed of rotation of the engine for which the governor will begin to operate. In order to take into account the variations of pressure of the surrounding air, either pneumatic boxes 51 can be associated with the springs 38, or said springs 38 can be replaced by pneumatic boxes 52.

It is obvious that the invention is in nowise limited to the embodiments which have been more especially described by way of example, but that it extends to all possible modifications coming, fairly, within the scope of the appended claims.

I claim:

1. A centrifugal governor comprising a rotating element having a plurality of hollow radial extensions, elements telescopically mounted with respect to said extensions, forming a watertight

movable closure therefor, a liquid mass within each chamber thus formed, responsive to the action of centrifugal force to displace said telescopically mounted elements, elastic means tending to force said telescopically mounted elements inwardly so as to hold the liquid mass to a constant volume, and a control element responsive to the displacements of said telescopically mounted elements, said elastic means being responsive to variations in the atmospheric pressure.

2. A centrifugal governor comprising a rotating element having a plurality of hollow radial extensions, elements telescopically mounted with respect to said extensions, forming a watertight movable closure therefor, a liquid mass within each chamber thus formed, responsive to the action of centrifugal force to displace said telescopically mounted element, an additional element telescopically mounted with respect to each of said first mentioned telescopically mounted elements, elastic means interposed between said rotating element and said second mentioned telescopically mounted elements, tending to oppose outward movement of the latter, elastic means interposed between said second and first mentioned telescopically mounted elements tending to force the latter inwardly so as to hold the liquid mass to a constant volume, a compensating piston within each extension, and a control element operatively associated with said second mentioned telescopically mounted elements.

3. A centrifugal governor comprising a rotating element having a plurality of hollow radial extensions, elements telescopically mounted with respect to said extensions, forming a watertight movable closure therefor, a liquid mass within each chamber thus formed, responsive to the action of centrifugal force to displace said telescopically mounted element, an additional element telescopically mounted with respect to each of said first mentioned telescopically mounted elements, elastic means interposed between said rotating elements and said second mentioned telescopically mounted elements, tending to oppose outward movement of the latter, elastic means interposed between said second and first mentioned telescopically mounted elements tending to force the latter inwardly so as to hold the liquid mass to a constant volume, a compensating piston within each extension, a control element, and levers actuating said control element operatively associated with said second mentioned telescopically mounted elements, said levers causing displacement of said control element in a ratio directly proportional to the displacements of said last mentioned telescopically mounted elements.

4. A centrifugal governor comprising a rotating element having a plurality of hollow radial extensions each having a syphon-like passage leading to the outer end thereof, a cylinder telescopically mounted upon each extension, forming a watertight collapsible and extensible chamber therewith, a liquid mass within each chamber, responsive to the action of centrifugal force to displace said telescopically mounted cylinders, elastic means tending to force said telescopically mounted cylinders inwardly so as to hold the liquid mass to a constant volume, and a control element responsive to the displacements of said telescopically mounted cylinders.

5. A centrifugal governor comprising a rotating reservoir having an axial extension and a plurality of radial extensions, each radial extension havin a syphon-like passage leading to the outer end thereof, a cylinder telescopically mounted upon each radial extension, forming a watertight collapsible and extensible chamber therewith, a compensating piston within said axial extension, a liquid mass within said reservoir, and extensions, elastic means tending to force said telescopically mounted cylinders and said piston inwardly so as to hold the liquid mass to a constant volume, a partition within said axial extension interposed between said piston and said reservoir, said partition being provided with a through passage, a check valve permitting liquid to flow from said reservoir towards said piston and preventing its flowing in the opposite direction, a by-pass between said through passage and said reservoir, a float actuated valve controlling said by-pass, and a control element operatively associated with said piston.

6. A centrifugal governor comprising a rotating element having a plurality of hollow radial extensions, a primary control element movably mounted with respect to each extension, elastic means interposed between each extension and its corresponding primary control element, tending to oppose outward movement of the latter with respect to the former, an element telescopically mounted with respect to each extension, forming a watertight movable closure therefor, a liquid mass within each chamber thus formed, responsive to the action of centrifugal force to displace said telescopically mounted element, elastic means interposed between each telescopically mounted element and its corresponding primary control element, tending to force said telescopically mounted element inwardly so as to hold the liquid mass to a constant volume, and a secondary control element operatively associated with said primary control elements.

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