Jan. 24, 1950 S. WALLACE 2,495,617

CENTRIFUGAL GOVERNOR DEVICE

Filed Nov. 22, 1946

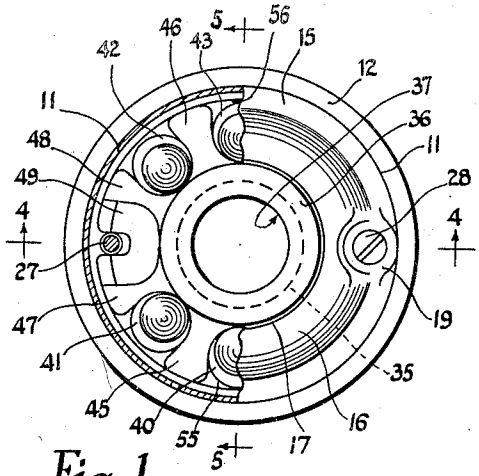


Fig. 1

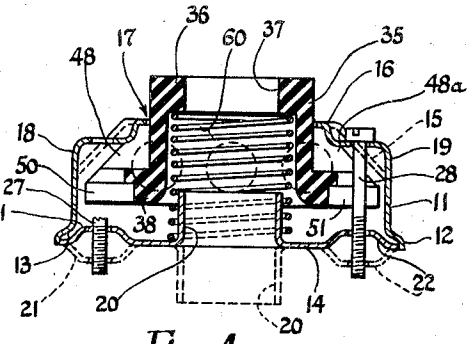


Fig. 4

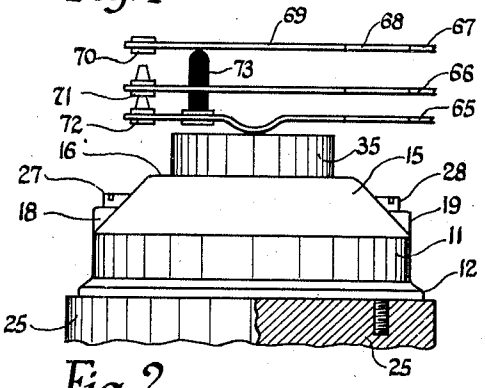


Fig. 2

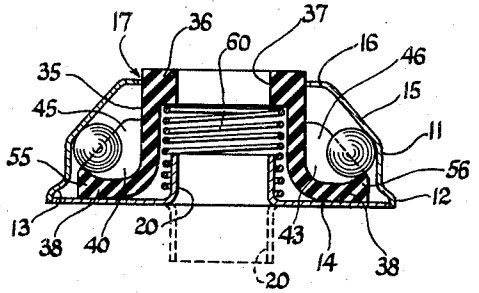


Fig. 5

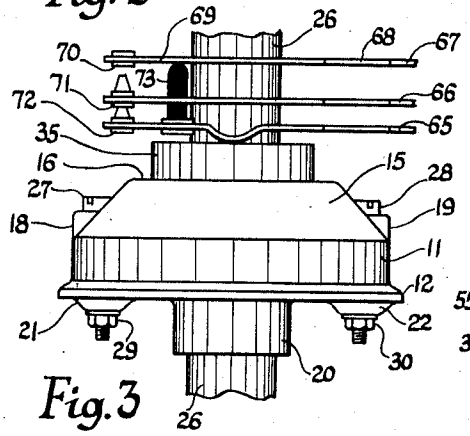


Fig. 3

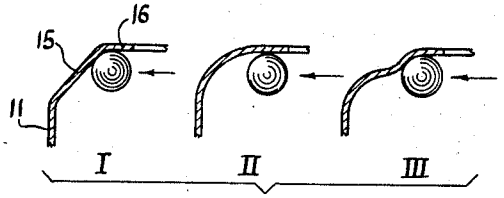


Fig. 6

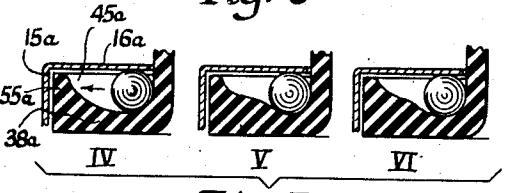


Fig. 7

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CENTRIFUGAL GOVERNOR DEVICE

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5 Claims. (Cl. 264—17)

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This invention is concerned with a centrifugal governor device of the type which employs a number of balls contained in a housing coacting with a rotating member, the balls being adapted to move radially outwardly to displace an axially movable spring-biased operating element in accordance with predetermined speeds of the rotating member, moving such element from a normal to its actuated position for the purpose of operatively affecting desired control means as a function of the rotation of the rotating member.

The principal object of the invention is to provide a reliably operating governor of the above intimated type, which is distinguished by a structural and functional simplicity and furnishes new control means for determining the centrifugal response of the fly balls.

A further object is to furnish a governor equipped with a reversible base or mounting member operating in the nature of an adapter for coaction either with a rotating shaft or with a rotating member having a surface which extends in a radial plane.

Still another object is directed to the structural simplification, novel arrangement and coaction of parts aimed at reduction of manufacturing costs, and therewith reduction of cost of the finished article.

These and other objects and features will appear from the detailed description of certain embodiments of the invention, which is presented below with reference to the accompanying drawing. In this drawing,

Fig. 1 shows at the right of the median center line an elevational top view of an embodiment of the new governor and at the left of the median center line a view of the interior with part of the casing or housing removed;

Fig. 2 illustrates an elevational side view of the new governor mounted on a rotating member having a surface extending in a radial plane, with parts of the rotating member in section, and also illustrates control means in the form of electrical switch contact springs;

Fig. 3 is a view corresponding to Fig. 2, but showing the new governor in connection with a rotating member made in the form of a shaft;

Fig. 4 represents a section through the governor showing its parts in normal or inoperative position, as seen approximately along lines 4—4 in Fig. 1;

Fig. 5 shows a section illustrating the parts of the governor in operated position, as seen approximately along lines 5—5 in Fig. 1; and

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Figs. 6 and 7 indicate modifications through the medium of simplified operating diagrams.

The new governor may be used for widely different purposes, e. g., to regulate the speed of numerous devices, including motors, rotating members associated with machine tools, etc., etc. It is assumed, for the sake of giving an example, that the governor shown in Figs. 1–5 controls the operation of a switching or contact device for the purpose of governing the circuit of an electrical motor. The motor may, for example, be assumed to operate initially over a so-called starter circuit, including normally closed switch contacts. The function of the governor is in such case to switch the electrical connections from the starter to the operating or running circuit when the motor has attained a certain R. P. M.

Like parts are numbered alike throughout the drawing.

The new governor shown in the drawing comprises a circular, generally cup-shaped casing 11. The casing is pressed or punched out of suitable material, e. g., of metal, and is enlarged at its bottom to form the rim 12 which in turn forms an interior circular bottom recess 13, for receiving the edge of the disk-like member 14 which constitutes the previously mentioned reversible mounting member of the device. In its upper part the wall of the casing 11 extends angularly to form a slope in the shape of the frustum of a cone, as shown at 15, terminating at the top in a radially inwardly extending annular section 16 forming a central opening 17. The angle of the sloping wall 15 may be approximately 45°. Portions of the material of the casing are punched or pressed out to form screw bosses, e. g., such as shown at 18 and 19 which are transposed at 180°. Three or more bosses may be provided if desired.

The disk-like reversible mounting member 14 is pressed or punched out from a suitable sheet material to form a central axially projecting tubular extension 20 and screw sockets or bosses, e. g., such as shown at 21 and 22, for coaction with the bosses 18, 19 formed in the casing wall. In the assembled device, the peripheral edge of the disk-like mounting member lies in the annular bottom recess 13 formed in the circular casing 11, as shown in Figs. 4 and 5, and its screw sockets 21—22 are disposed in axial alignment with the screw bosses 18—19 formed in the inclined or sloping casing wall 15.

The mounting member 14 is disposed with the tubular extension 20 and with the screw sockets

21—22 inside the structure, as shown in Figs. 2, 4 and 5, when the governor is mounted on a rotating member having a flat radially extending surface as is assumed in these figures, the rotating member being diagrammatically indicated in Fig. 2 in fraction and marked by numeral 25. The position of the disk-like mounting member is reversed with the tubular extension 20 and the screw sockets 21—22 outside when the governor is mounted on a rotating member made in the form of a shaft or the like, as is assumed in Fig. 3, a portion of the shaft being shown and indicated by numeral 26. The reversed position of the tubular extension 20 and the sockets 21—22 is indicated in Figs. 4 and 5 in dotted lines. The disk-like mounting member 14 thus forms with the casing 11 in either case a unitary housing which is centrally axially open to the outside by way of the tubular extension 20 at one end and the opening 17 at the other end.

This unitary housing is held together by two screws 27 and 28. The screws may engage threaded holes or suitable sockets in the rotating member 25, as shown in Fig. 2, holding the governor firmly in engagement and rotatable therewith. Nuts 29—30 may be used when the governor is mounted on a rotating shaft, as shown in Fig. 3, and in this case the tubular extension 20 now projecting to the outside may be provided with a reinforcing sleeve or the like and may be firmly attached to the shaft 26 by any suitable means, for example, a screw (not shown).

The tubular extension 20 of the disk-like mounting member may be longitudinally slotted, if desired, and a suitable clamp may be used for securing it and therewith the governor on a shaft like the shaft 26 shown in Fig. 3.

Inside the housing formed by the disk-like mounting member 14 and the cup-like casing 11 is disposed a tubular operating member having the shank 35 which carries at one end a radially inwardly projecting flange 36 forming the central opening 37, and at the other end a generally radially outwardly extending enlargement 38. The shank 35 with its radially inwardly extending flange 36 projects to the outside of the housing through the opening 17. This operating member may be made of any suitable and desired material, preferably a light-weight synthetic material, e. g., a suitable phenol condensation product, Bakelite or the like.

The enlargement 38 is provided with a number of ball sockets, e. g., six sockets, such as indicated at 40—43, separated by radially extending ribs or ridges such as 45—46. The ball sockets 41—42 terminate in similar ribs 47—48 which define a recess 9. This recess is radially slotted for accommodating the screw 27. The screw 28 is accommodated in a radial slot provided in a similar recess 180° removed from the slotted recess 49. Underneath each slotted recess 49 is a larger recess, as indicated at 50—51. In the assembled device, the recesses 50—51 lie above and axially in alignment with the screw sockets 21—22 projecting from the disk-like mounting member 14, and the recesses 49 lie below and axially in alignment with the screw sockets or bosses 18—19 formed in the inclined wall 15 of the casing 11. The operating member is axially movable. In its normal position, as shown in Fig. 4, the screw sockets 18—19 are accommodated in the recesses 49, and in its operated position, as shown in Fig. 5, the screw sockets 21—22 (assuming the arrangement Figs. 2–5) are accommodated in the recesses 50—51, respectively.

The radial ribs such as 45—46 disposed between the ball sockets and also the terminal ribs such as 47, 48 and 48a form an inclined section, similar to the frustum of a cone, the angle of which corresponds substantially to the angle of the inclined section 15 of the casing 11. Each rib terminates on top in a radially inwardly extending surface, thus likewise following the configuration of the casing inside thereof. The outer rim of each ball socket may project slightly upwardly, as indicated in connection with the ball sockets 40 and 43 at 55—56 (Figs. 1 and 5). There are thus six ball sockets and in each is disposed a metal ball, as shown. Suitable slugs or the like may be used in place of the balls. The upwardly projecting rims such as 55—56 hold the balls in the associated sockets in their normal position and thus facilitate the assembling of the balls with and placing them in their sockets in the operating member incident to the assembling of the device.

The operating member is biased and held in its normal or inoperative position in which it is shown in Figs. 2, 3 and 4 by a spring 60, one end of which engages a radially inwardly projecting shoulder formed by the flange 36 inside thereof and the other end of which surrounds the tubular extension 20 and rests on the disk-like mounting member 14. The home or normal position of the balls disposed in their sockets in the enlargement 38 of the operating member 35 with respect to the inside of the angularly extending wall 15 of the casing 11 corresponds approximately to the relationship shown in diagram I of Fig. 6. The arrangement may be such that the balls lie in the curved section of the casing wall where the inclined wall 15 merges with the radially inwardly projecting wall portion 16, as shown in Fig. 6, diagram I, or it may be such that the balls are in normal position free of either or both of casing wall portions 15 and 16. The centrifugal force acting on the balls when the device is rotated is indicated in Fig. 6, diagram I, by the arrow.

Suitably disposed at the operating end of the embodiment of the governor shown in the drawings is the switching means which is assumed to comprise three contact springs 65, 66 and 67. Each spring is forked, carrying at its free end two spring blades or branches each provided with a contact. Thus the spring 67 is forked as indicated in Figs. 2 and 3 at 68, carrying two blades or branches 69, each branch provided with a contact such as 70. The springs 66 and 65 are similarly formed, carrying the contacts 71 and 72, respectively. The fork-like extensions of the spring 65 are crimped as shown in Figs. 2 and 3 and the crimped portions rest on the radially extending annular face formed by the flange 36 of the operating member.

It may be remarked here that the operating member may be made of metal, if desired, and die-cast and, inasmuch as means is required in the assumed use of the governor to insulate the operating member electrically from the contact spring branches projecting or forking from spring 65, an insulating insert may be provided in the annular face of the flange 36. It is also possible to make the operating member of metal and to provide the forked extensions of the spring 65 with suitable insulating plates.

In normal position, in which the device is shown in Figs. 1–4, inclusive, the operating member is biased axially outwardly by the pressure of the spring 60 and therefore presses outwardly and against the branches or blades of the contact

switch spring 65, holding the contacts 72 in engagement with the contacts 71 carried by the forked blades or branches which project from the switch spring 66, thus conductively connecting the springs 65 and 66. The contacts 70 of switch spring 67 are separated from the contacts 71 on the forked extensions of the spring 66 by the action of insulating nipples 73 one mounted in known manner on each of the extensions of the spring 65 and projecting through an opening in the associated branch extending from spring 66.

If it is assumed that the operating member is retracted axially, from the normal position in which it is shown in Figs. 2, 3 and 4, it will be clear that spring 65 and its forked branches will follow the retractile movement, with the result that the contacts 72 and 71 separate while the contacts 70 engage and make connection with contacts 71. This accomplishes the previously mentioned switching function of the device, transferring the circuit of the motor from contact springs 66—65 to springs 67—66 or, in other words, switching the motor from the starting to the running circuit.

The operation, more in detail, is as follows:

When the rotating member on which the governor is mounted, e. g., the member 25 in Fig. 2 or member 26 in Fig. 3, begins to rotate, centrifugal force manifests itself, which tends to move the balls radially outwardly in the direction of the arrow, as shown in diagram I in Fig. 6. Bunching of the balls is prevented by the ridges which confine them radially. As the speed of the rotating member increases, the centrifugal force increases and the balls are forced to move along the inside of the angularly extending wall 15 of the casing 11, thereby axially displacing the operating member 35 against the pressure of the spring 60, from the position shown in Fig. 4 to that indicated in Fig. 5. The operating member is thus axially retracted, actuating the switch springs, as previously described, and switching the circuit of the motor from the contact switch springs 66—65 to the running circuit which includes the springs 67—66. The coiled spring 60 of the governor is now compressed. The bottom of the operating member or, rather, the bottom of the enlargement 38 thereof is in engagement with the inside surface of the disk-like mounting member 14. The screw sockets 21—22 of the disk-like mounting member (assuming the full line arrangement of Fig. 4) are now accommodated within the recesses 50—51, respectively.

The operating member has thus moved from its inoperative or static position shown in Fig. 4, in which its angularly extending radial ribs are accommodated within the angularly extending wall of the casing, to its operated position in which the enlargement 38 engages the surface of the disk-like mounting member 14. The operating member 35 is guided in its axial motion from normal to operated position by the shanks of the screws 27—28; that is to say, the operating member is rotatable with the governor housing and with the rotating member, but is axially movable within the housing, as described. It moves from one extreme position to the other, always into engagement with the inside walls of the casing or with the mounting member 14, respectively, the indentations formed by the screw sockets or bosses in the casing and in the mounting member being accommodated in the recesses formed in the enlargement 38.

The slope 15 of the conical or inclined section

of the casing 11, as noted before, may be about 45°. Changes, however, may be made.

For example, the casing may extend angularly, forming a curve, such as diagrammatically indicated in diagram II, Fig. 6, to provide for greater sensitivity at low speed. In other words, assuming the curvature is approximately as shown in diagram II, the balls will quickly respond at low speed, but beyond a certain point the centrifugal response will be sluggish and the operating member will be retracted slowly and progressively until a maximum speed is attained at which time the movable members, i. e., the balls, are in their terminal positions.

It may be desirable to obtain an action which in a sense is the reverse of the one just described, that is to say, to provide for an action which is less sensitive at low speeds, furnishing a transition in the form of a snap action when a certain higher speed is attained. This may be accomplished by providing the casing wall with a curvature approximately as indicated in diagram III, Fig. 6. The curve of the casing wall in the critical section thereof is a composite or stepped curve furnishing a cam-like action. It will be seen that the centrifugal force imparted to the balls in the direction of the arrow shown in diagram III will have a relatively small operative effect at low speeds; that is, the device will be less sensitive at low speeds, but after the transition point between the two curves forming the composite curve has been passed the governor will be extremely sensitive and, as the critical speed is exceeded, the balls will move in a snap action quickly radially outwardly to their extreme terminal positions, and will correspondingly move the operating member axially into its actuated position, providing a snap switch action for the switching contacts at a predetermined speed of the rotating member.

The above described operations may also be obtained by the use of a simple cup-like casing provided with a substantially uniform or straight angularly extending wall which forms the sliding surface for the balls and coacting with an axially movable or slidable operating member provided with ball sockets so constructed and arranged as to furnish the desired centrifugal response of the balls. Suitable structures are diagrammatically indicated in Fig. 7.

Diagram IV in Fig. 7 shows part of the radially outwardly extending flange 38*a* of the operating member substantially as shown in the previously discussed embodiments. Each ball socket is provided with an axially projecting rim 55*a*. The casing wall 15*a* forms a straight angularly extending slide surface 16*a* for the associated balls. When the device rotates, the balls move by centrifugal force radially outwardly as described before. In the embodiment shown in diagram IV, the centrifugal response of the balls will be sensitive at low speeds and somewhat retarded at higher speeds, displacing the operating member correspondingly until the balls reach terminal position which will correspond approximately to the position of the balls shown in Fig. 5. The action will be similar to the one obtained by the structure made in accordance with diagram II, Fig. 6.

The bottom of each ball socket may also be curved, as indicated in diagram V, in which case the centrifugal response of the balls will be sluggish at low speeds, similar to the response obtained in the embodiment diagram III, Fig. 6, providing a snap action at a predetermined

R. P. M. when the balls move quickly outwardly until they reach the second section of the composite or stepped curve formed by the rim of the socket. The displacement at high speeds is again somewhat sluggish until the balls finally move to terminal position.

The operation, in case of the embodiment indicated in diagram VI, is somewhat similar to that obtained in diagram V, except for the timing of the displacement of the balls (and consequent axial displacement of the operating member) responsive to the speed of rotation of the rotating member.

The bottom of each ball socket may also be formed so as to provide for an operation similar to the one obtained in the embodiment Figs. 1 to 5; that is to say, the bottom of each ball socket may be inclined, at a desired angle, from the normal or home position of the associated ball in a substantially straight line so as to furnish progressive and substantially uniform centrifugal response in accordance with progressively increasing speed.

It is understood, of course, that the operating members shown in diagrams IV to VI are axially biased in a manner similar to the one discussed in connection with Figs. 1 to 5. The radially outwardly extending enlargements of the operating members shown in the diagrams IV to VI or, rather to say, the ribs forming the ball sockets, such as the rib **45***a*, may be of suitable depth. They may stop short of the inside surface of the angularly extending casing wall section **16***a*, as shown in the diagrams.

It will be noted that the curves shown in diagrams IV to VI provide for a low normal or home position of the balls into which the balls move by the action of the biasing spring, such as spring **60** shown in Figs. 4 and 5, upon cessation of rotation of the rotating member on which the governor is mounted. In the presence of diminishing speed, the balls move partially to home position. The angle of each section of the curves shown in Fig. 7 may be as desired or required. The casing wall **16***a* may be provided with a curve corresponding to the curve in the flange **38***a* of its associated operating member shown in diagrams IV to VI. The diameter of the balls is, in such case, correspondingly larger; that is, it fills the space between the home positions of the curves in the casing wall **16***a* and in the flange **38***a*, respectively.

The governor may be mounted in any desired position. The biasing spring is chosen to provide the pressure which is desired or necessary for any given purpose.

Each part may be standardized and made interchangeable. Casings and operating members may be made and carried in stock, conforming to different requirements, e. g., such as diagrammatically shown in Figs. 6 and 7, each part interchangeable for the other and each for coaction with the reversible mounting member which in turn adapts the governor for use with different rotating members whose speed is to be governed or, as the case may be, utilized for predetermined control, signalling or other purposes. Each part has been designed with a view to facilitate manufacture as well as assembly of the unit and to provide for reliable operation under widely varying operating conditions.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. As a unitary commercial article of manufacture, a centrifugal governor for selective removable attachment as a unit to a rotatable body for coaction with control means which govern the speed of rotation of said rotatable body, said governor comprising a generally circular generally cup-shaped shell-like casing member forming at one end a generally axially extending open-ended wall portion and at the other end a generally radially inwardly extending end wall portion, a generally circular disklike end plate member associated edgewise with said open-ended wall portion of said cup-shaped shell-like casing member and extending radially inwardly therefrom and forming a unitary housing therewith for selective removable attachment to said rotatable body for rotation with such rotatable body, the side wall of said casing member sloping angularly inwardly and merging with said generally radially inwardly extending end wall portion thereof, said end wall portion of said casing forming a centrally disposed opening, an operating element axially movably disposed within said housing, means for holding said operating element against rotation relative to said housing, said operating element forming at the end which faces the inside wall of said disklike end plate member a generally radially outwardly directed annular portion from which extends centrally axially solely toward the end wall portion of said casing a tubular shank with its free end projecting through the central opening therein for coaction with said control means, said tubular shank forming near its free end a radially inwardly directed shoulder, a coiled compression spring disposed within said tubular shank, one end of said spring being in engagement with said shoulder and the other end thereof being in engagement with the inside wall of said end plate member to bias said operating element in normal position relative to said housing with its annular portion axially away from the inside wall of said end plate member and with an appreciable portion of said shank protruding from the central opening in the end wall of said casing, and actuating bodies within said housing which respond to centrifugal force responsive to rotation of the rotatable body to which said governor is attached, said bodies coacting with the annular portion of said operating element and with the inwardly sloping side wall of said casing to effect axial inward retraction of said operating element for the purpose of moving the shank thereof axially inwardly to cause operative actuation of the control means associated therewith.

2. The structure defined in claim 1, wherein said disklike end plate member forms a centrally disposed normally axially inwardly directed tubular extension, the end of said compression spring which is in engagement with the inside wall of said end plate surrounding said tubular extension.

3. The structure defined in claim 1, wherein said disklike end plate member forms a centrally disposed axially projecting tubular extension, said end plate member being reversible for selectively positioning said tubular extension to project either axially inwardly or axially outwardly.

4. The structure defined in claim 1, together with fastening members connected with said casing member and with said disklike end plate member, each fastening member extending through a recess formed in the radially outwardly directed annular portion of said operating element, said fastening members constituting the means for holding said operating element against rotation relative to said housing.

5. As a unitary commercial article of manufacture, a centrifugal governor for selective removable attachment as a unit to a rotatable body for coaction with control means which govern the speed of rotation of said rotatable body, said governor comprising a generally circular generally cup-shaped shell-like casing member forming at one end a generally axially extending open-ended wall portion and at the other end a generally radially inwardly extending end wall portion, a generally circular disklike end plate member associated edgewise with said open-ended wall portion of said cup-shaped shell-like casing member and extending radially inwardly therefrom and forming a unitary housing therewith for selective removable attachment to said rotatable body for rotation with such rotatable body, the side wall of said casing member sloping angularly inwardly and merging with said generally radially inwardly extending end wall portion thereof, said end wall portion of said casing forming a centrally disposed opening and said disklike end plate member forming a centrally disposed normally axially inwardly projecting tubular extension, an operating element axially movably disposed within said housing, said operating element forming at the end which faces the inside wall of said end plate member a generally radially outwardly directed annular portion from which extends centrally axially solely toward the end wall portion of said casing a tubular shank with its free end projecting through the central opening therein for coaction with said control means, fastening members connected with said casing member and with said disklike end plate member, each fastening member extending through a recess formed in the radially outwardly directed annular portion of said operating element to hold said element against rotation relative to said housing, said tubular shank forming near its free end a radially inwardly directed shoulder, a coiled compression spring disposed within said tubular shank, one end of said spring being in engagement with said shoulder and the other end thereof surrounding the tubular normally inwardly projecting extension formed by said disklike end plate member and being in engagement with the inside wall of said end plate member to bias said operating element in normal position relative to said housing with its annular portion axially away from the inside wall of said end plate member and with an appreciable portion of said shank protruding from the central opening in the end wall of said casing, and actuating bodies within said housing which respond to centrifugal force responsive to rotation of the rotatable body to which said governor is attached, said bodies coacting with the annular portion of said operating element and with the inwardly sloping side wall of said casing to effect axial inward retraction of said operating element for the purpose of moving the shank thereof axially inwardly to cause operative actuation of the control means associated therewith, said disklike end plate member being reversible to dispose the central tubular extension thereof selectively to project axially outwardly thereof.

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