

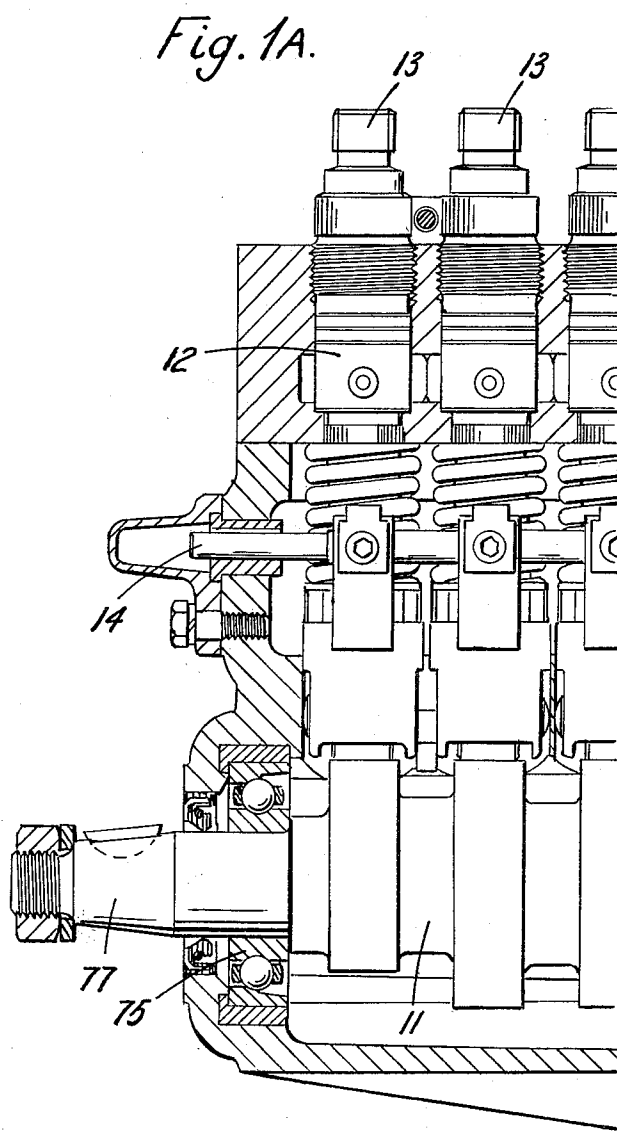
Sept. 17, 1963

Z. S. MIRACKI
SPEED GOVERNORS

3,103,822

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4 Sheets-Sheet 1



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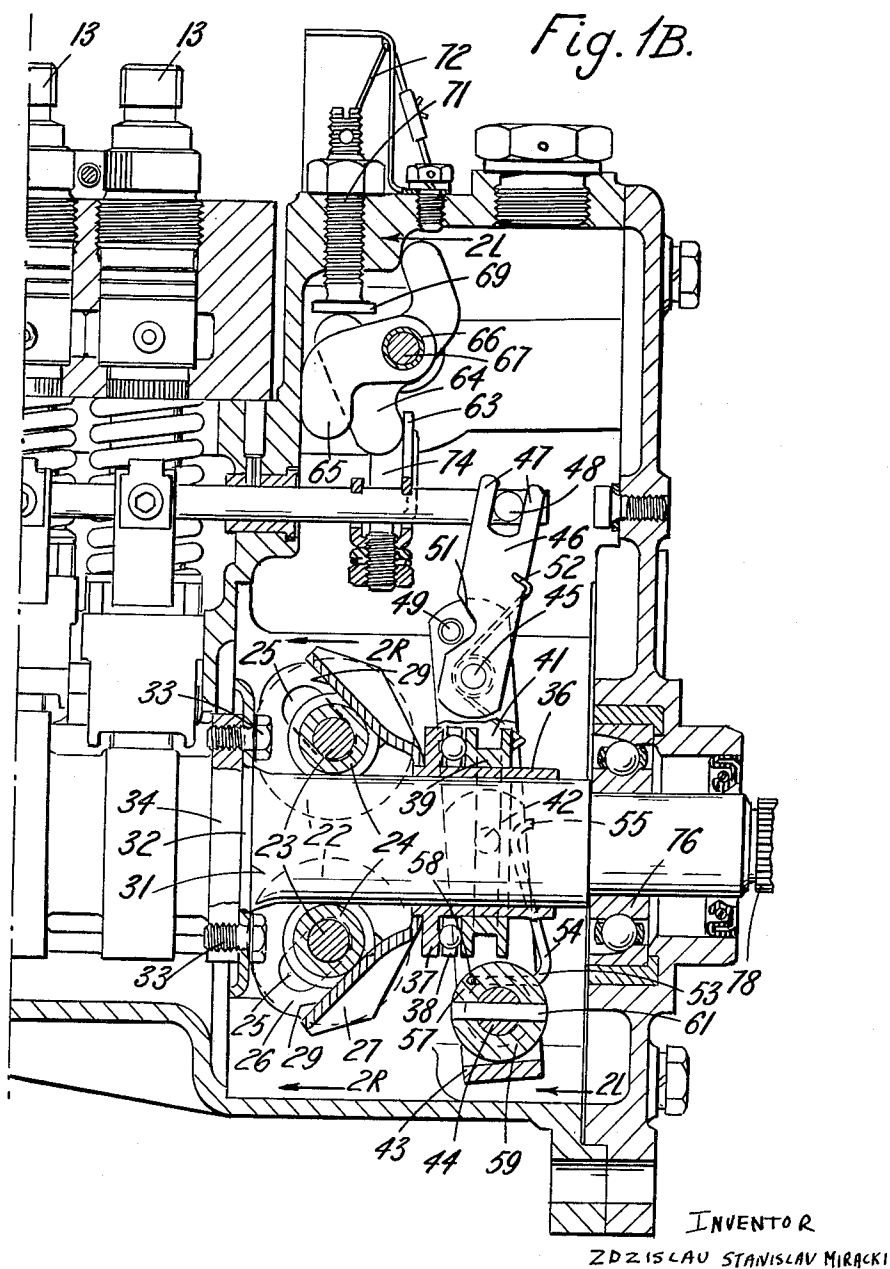
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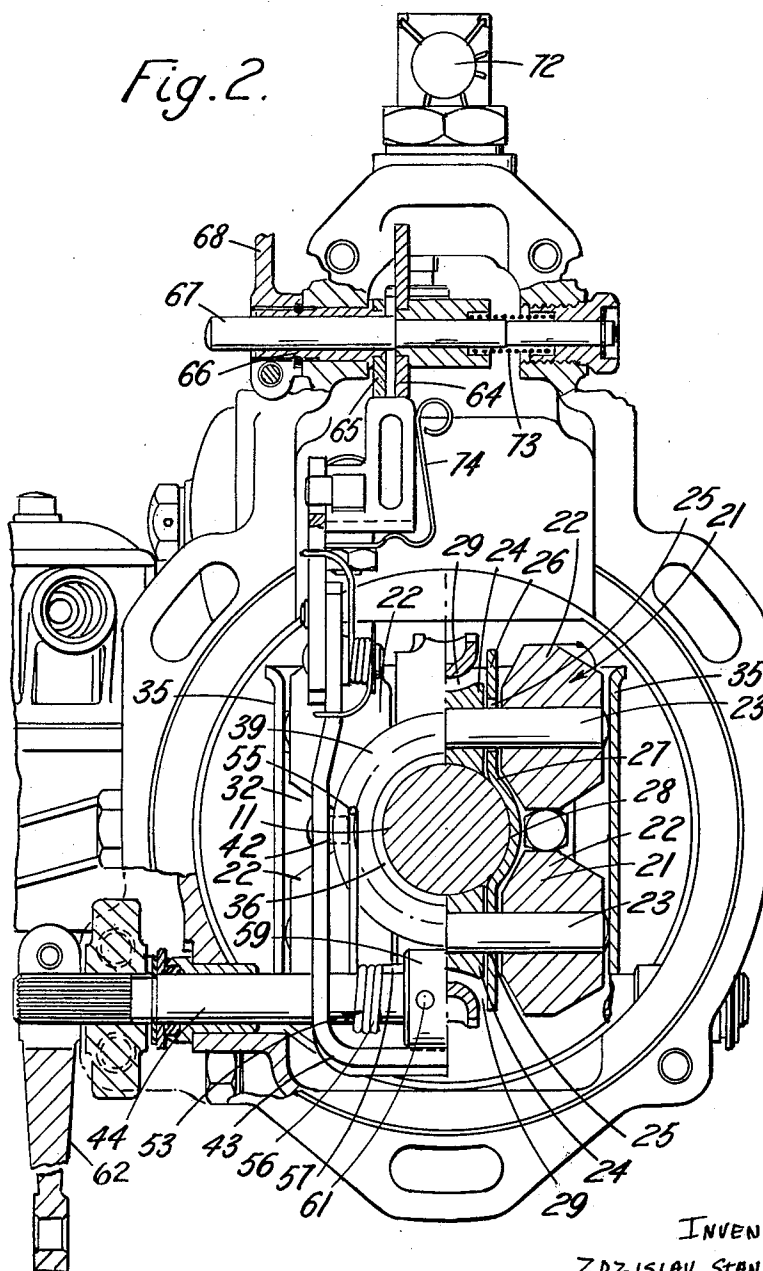
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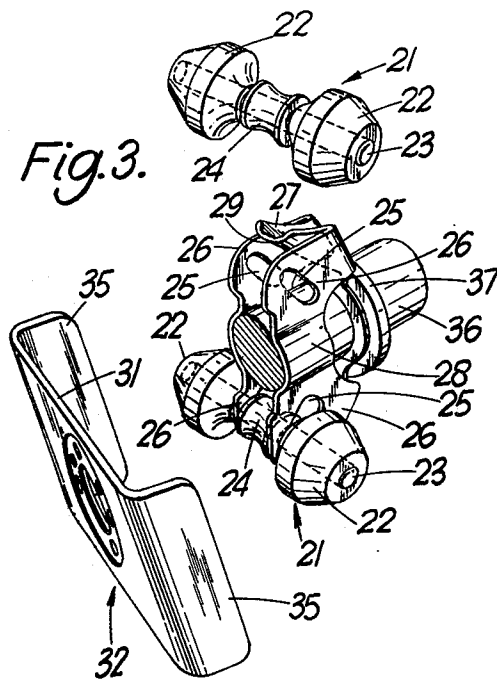
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3,103,822

SPEED GOVERNORS

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The invention relates to speed governors.

The invention provides a centrifugal speed governor comprising at least one weight assembly arranged for rotation with a shaft or other rotatable member and comprising two rollers interconnected for rotation relative to one another about a common axis and engaging respectively with two surfaces which are inclined relatively towards each other, as they extend in the direction away from the axis of the rotatable member, and are biased towards one another, the arrangement being such that as the weight assembly moves, under centrifugal force, outwards from the rotatable member when it is rotated, the rollers roll along the respective surfaces and urge them apart against their bias.

Preferably two such weight assemblies and co-operating pairs of surfaces are provided on opposite sides respectively of the rotatable member.

The invention also provides a centrifugal speed governor comprising a weight or weights arranged for rotation with a shaft or other rotatable member and to move under centrifugal force outwardly from the rotatable member when it is rotated, the said movement being opposed by a biasing spring, in which the biasing spring is adjustable to provide different rates of change of biasing force with respect to amount of outward movement of the weights.

Preferably means are provided to adjust a load on the spring to set the speed to which the governor tends to limit the rotation of the rotatable member, and the characteristics of the spring are preferably such that when the load on the spring is so adjusted the spring is automatically adjusted to provide at the set speed an appropriate rate of change of biasing force with respect to amount of outward movement of the weights. Preferably the said rate of change of biasing force with respect to amount of outward movement of the weights decreases with decrease in the governed speed setting, to improve the speed regulation at lower speeds.

Preferably the spring comprises a coil torsion spring and the diameter of the coil changes with the loading on the spring.

A specific construction of apparatus embodying the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIGURE 1 (which is in two parts—1A and 1B) is a longitudinal sectional view of a fuel injection pump fitted with a speed governor,

FIGURE 2 is a transverse sectional view partly on the line 2L—2L of FIGURE 1 and partly on the line 2R—2R of FIGURE 1, and

FIGURE 3 is an exploded view, in perspective, of the flyweights and associated members.

In this example the fuel injection pump comprises a camshaft 11 which, when the apparatus is in use, is driven from a four cylinder diesel engine in timed relationship therewith. The camshaft 11 reciprocates plungers in barrels 12 and thereby pumps fuel from outlets 13 which, when the apparatus is in use, are connected to the respective cylinders of the engine. The amount of fuel which is supplied from each outlet 13 during each pumping stroke of each of the plungers is determined by the lengthwise position of a control rod 14. The rate of fuel delivered to the engine is at a maximum when the control rod 14 is

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moved as far as possible to the left (as viewed in FIGURE 1) and is reduced to zero when the control rod is moved as far as possible to the right.

In this example the speed governor comprises two weight assemblies 21, each of which assemblies comprises two main weight rollers 22 mounted on a spindle 23 and secured against rotation relative thereto, and a centre roller 24 which is rotatable on the spindle 23. The spindles 23 pass through elongated slots 25 provided in the side walls 26 of a member 27 which is formed from sheet steel and is of generally channel shape. The camshaft 11 passes through a circular hole in the base of the channel, and the centre parts of the sides 26 are curved as shown at 28 to embrace the shaft 11. The end parts of the base of the member 27 are bent inwardly to provide inclined surfaces 29 which abut respectively against the centre rollers 24 of the weight assemblies. The member 27 is hardened after being bent to shape. Each of the surfaces 29 is convex and co-operates with the concave surface of the co-operating centre roller 24. This tends to maintain the centre rollers 24 in line with one another and so that they each roll in a straight line path along the length of the appropriate surface 29.

The weight rollers 22 abut against the inner surface 31 of the base of the wide channel member 32 which is secured by screws 33 to a flange 34 provided on the camshaft 11. The sides 35 of the channel member 32 engage with convex ends provided on the spindles 23 to cause the weight assemblies 21 and the members 27 to rotate with the camshaft 11. The member 32 is of sheet steel bent to shape and hardened. The member 32 is such that it can flex slightly under the forces which it transmits when the engine is accelerated and so provides a cushioned drive between the camshaft and the rest of the governor.

As the camshaft rotates, the weight assemblies 21 tend to move outwardly from the shaft, under centrifugal force, and owing to the engagement of the weight rollers 22 with the surface 31 and the engagement of the central rollers 24 with the inclined surfaces 29, the member 27 is subjected to a force tending to move it away from the member 32 in the axial direction of the shaft 11, to the right as shown in FIGURE 1.

The member 27 is secured to a sleeve 36 which is axially slidable on the shaft 11 and has an integral flange 37 which acts through a ball thrust bearing 38 on a collar 39. The collar 39 has an annular groove 41 into which project, at diametrically opposite positions, two pins 42 carried by a stirrup 43 which is pivotally mounted on a rod 44. The stirrup 43 is pivotally connected at 45 to a link 46 which has a bifurcated end 47 engaging with a pin 48 on the control rod 14. The stirrup 43 carries a pin 49 for abutment with a notch 51 in the link 46, the link 46 being urged into engagement with the pin 49 by means of a coiled wire spring 52. Thus, when the engine speed is sufficient to cause the weight assemblies to move the upper end of the stirrup 43 sufficiently far about its pivot to the right (as viewed in FIGURE 1) the control rod is thereby moved to the right to reduce the amount of fuel supplied to the engine at each injection period, and consequently to reduce the speed of the engine.

The bias for the weight assemblies 21, and the parts 27, 36, 38, 39, 43 on which they act, is provided by a governor spring 53. This spring has elongated portions 54 having curved ends 55 which abut against the collar 39, two intermediate annular torsion spring portions 56 which are coiled round the rod 44, and a central straight portion 57. The central portion 57 of the spring is received in a slot 58 formed in a bush 59 which is pinned at 61 to the rod 44. The speed to which the engine is to be governed is determined by the angular position of the rod 44 about its axis, and that rod is rotated to the desired setting by a lever 62. When the rod 44 is ro-

tated anti-clockwise (as viewed in FIGURE 1) the load on the spring 53 is thereby increased and the governed speed of the engine is correspondingly increased. Such anti-clockwise rotation of the rod 44 also causes the coil portions 56 of the spring to be wound more tightly so that their diameter is slightly decreased. This has the effect of automatically adjusting the spring so that the rate of change of biasing force with respect to amount of outward movement of the weight assemblies, is increased. When the rod 44 is rotated in the opposite direction (clockwise as viewed in FIGURE 1) the loading of the spring 53 is correspondingly reduced and the rate of the spring is at the same time decreased owing to the increase in the diameter of the coil portions 56 of the spring 53. The increase in centrifugal force due to any particular increase in the speed of the engine above its nominal governed speed is less when the governed speed is relatively low (e.g. 1,000 r.p.m.), than when the governed speed is relatively high (e.g. 2,000 r.p.m.). Consequently, the reduction in the rate of the spring at lower nominal governed speeds enables the governor to provide improved control of the engine at lower speeds, compared with the case where the rate of the governor spring is substantially the same for lower speeds as for higher speeds.

The fact that the weight rollers 29 and the centre rollers 24 are capable of relative rotation reduces the possibility of jamming of the weights between the surfaces 31 and 29 and also reduces friction. As the weights move outwardly under centrifugal force, or inwardly under the action of the biasing spring 53, the weights 22 (which roll on the surface 31) rotate in the opposite direction to the rollers 24 (which roll on the surfaces 29). These rotations in opposed directions reduce or prevent any tendency of the weight assemblies to rotate continuously about the axes of the respective spindles 23, while providing relative rotation between the rollers 24 and the respective spindles 23 which is double the amount of rotation of the individual rollers 24 and 22. This doubling of the amount of rotation is believed to be advantageous.

The control rod 14 carries an abutment plate 63 for co-operation with either of two levers 64, 65. The lever 65 is fast on a sleeve 66 which is rotatable on a rod 67 and is fast with an engine stop lever 68. The engine is stopped, when required, by moving the engine stop lever 68 to rotate the lever 65 anti-clockwise (as viewed in FIGURE 1) to engage the abutment 63 to move the control rod 14 to the right, thereby over-riding the action of the governor.

The maximum amount of fuel which can normally be provided by the pump at each injection period is determined by the lever 64 which abuts against a stop 69. The position of the stop 69 is adjustable by screwing it through the pump casing at 71, and after such adjustment its position is sealed, the seals being indicated at 72. When an excess rate of supply of fuel is required for starting the engine, the rod 67 is pressed inwardly carrying the lever 65 to the right (as viewed in FIGURE 2) against the action of a return spring 73. The lever 64 in its passage to the right, abuts against and carries with it a pawl in the form of a leaf spring 74. When the lever 64 is outside the path of the abutment 63, the control rod 14 is permitted to move further to the left (as viewed in FIGURE 1) to provide an excess rate of fuel supply. As soon as the engine starts, the governor moves the control rod 14 to the right and when the leaf spring 74 passes beyond the lever 64 it springs back against the abutment 63. If the rod 64 is maintained depressed, in an attempt to obtain an excess rate of fuel supply while the engine is running, the attempt is frustrated as the maximum rate of fuel supply is then determined by abutment of the spring 74 (instead of the abutment 63) against the lever 64.

The camshaft 11 is supported between two bearings 75, 76 and can be driven from either of its ends 77, 78. A

drive is available from its other end for any other device which it may be desired to drive from the engine.

The invention is not restricted to the details of the foregoing example. For instance, the governor may be employed with devices other than fuel injection pumps.

I claim:

1. A centrifugal speed governor comprising a member rotatable about an axis; a first surface member and a second surface member which are inclined relatively toward each other in directions transverse to the said axis so that the said surface members are progressively closer to each other as they progressively extend in the direction away from the axis of the rotatable member; biasing means for biasing the first and second surface members toward each other; a generally channel-shaped member with its channel extending in a direction transverse to the said axis and supported from the rotatable member for rotation therewith and having two opposed walls each formed with a slot, which slot extends parallel to the said first surface; a weight assembly comprising a spindle carrying a first roller and a second roller, the spindle passing through and being guided by the said slots, the first roller being positioned between the said walls of the channel-shaped member and engaging the said first surface, and the second roller comprising two roller parts one toward each end of the spindle and each roller part separated axially of the spindle from the first roller by one of the said walls, the roller parts engaging the said second surface at spaced positions, the arrangement being such that as the weight assembly moves, under centrifugal force, outward from the rotatable member as it is rotated, the rollers roll along their respective surfaces and urge them apart against their bias, and the said spindle moves along the said slots so that its movement is at least in part guided thereby.

2. A centrifugal speed governor comprising a member rotatable about an axis; a first channel-member with its channel extending in a direction transverse to the said axis and supported from the rotatable member for rotation therewith and having two opposed walls; a second channel-member with its channel extending in a direction transverse to the said axis and supported from the rotatable member for rotation therewith and having opposed walls, between which two walls lie both the aforesaid walls of the said first channel-member; a first surface member and a second surface member which are inclined relatively toward each other in directions transverse to the said axis so that the said surface members are progressively closer to each other as they progressively extend in the direction away from the axis of the rotatable member; biasing means for biasing the first and second surface members toward each other; a weight assembly comprising a spindle carrying a first roller and a second roller, the spindle passing through the said walls of the first channel member, the end of the spindle engaging the inner faces respectively of the said walls of the second channel member by which engagement the second channel member rotates the weight assembly, the first roller being positioned between the said walls of the first channel member and engaging the said first surface and the second roller comprising two roller parts, one positioned between one wall of the first channel member and the adjacent wall of the second channel member and the other roller part positioned between the other wall of the first channel member and the adjacent wall of the second channel member, the roller parts engaging the said second surface at spaced positions, the arrangement being such that as the weight assembly moves, under centrifugal force, outward from the rotatable member when it is rotated, the rollers roll along the respective surfaces and urge them apart against their bias.

3. A centrifugal speed governor as claimed in claim 2, in which the second channel member includes a base part extending between the two said walls, which base part provides the said second surface.

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4. A centrifugal speed governor comprising a cylindrical shaft rotatable about its axis, a generally channel-shaped member with its channel extending in a direction transverse to the said axis and having two opposed walls and attached to the shaft for rotation therewith; a first surface and a second surface which are inclined relatively toward each other in directions transverse to the said axis so that the said surface members are progressively closer to each other as they progressively extend in the direction away from the axis of the shaft; biasing means for biasing the first and second surface members toward each other, a weight assembly comprising a first roller and a second roller the first roller of which is contained between the said walls of the channel-shaped member and has a concave surface which engages and co-operates with the said cylindrical shaft, and the second roller of which comprises two roller parts spaced apart axially and separated by the said first roller and which engages the said second surface at spaced positions, the arrangement

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being such that as the weight assembly moves, under centrifugal force, outward from the rotatable member when it is rotated, the rollers roll along the respective surfaces and urge them apart against their bias.

5. A centrifugal speed governor as claimed in claim 2, in which the first channel member includes a base part extending between the said two opposed walls, which base part has an end part which is bent inwardly between the said two opposed walls to provide the said first surface.

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