

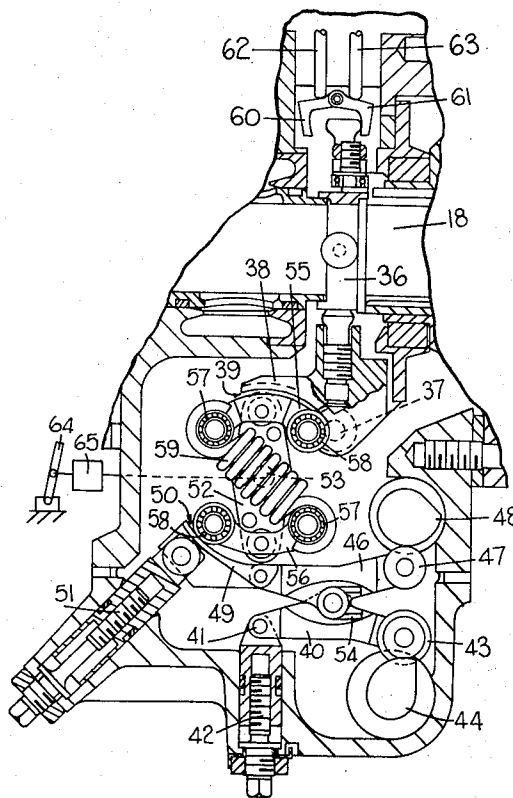
- [54] **SPEED RESPONSIVE GOVERNOR MECHANISM** 3,603,160 9/1971 Bloom..... 73/541
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- [58] Field of Search **73/540, 541, 535, 509; 60/39.28 R, 39.28 T**
- [56] **References Cited**
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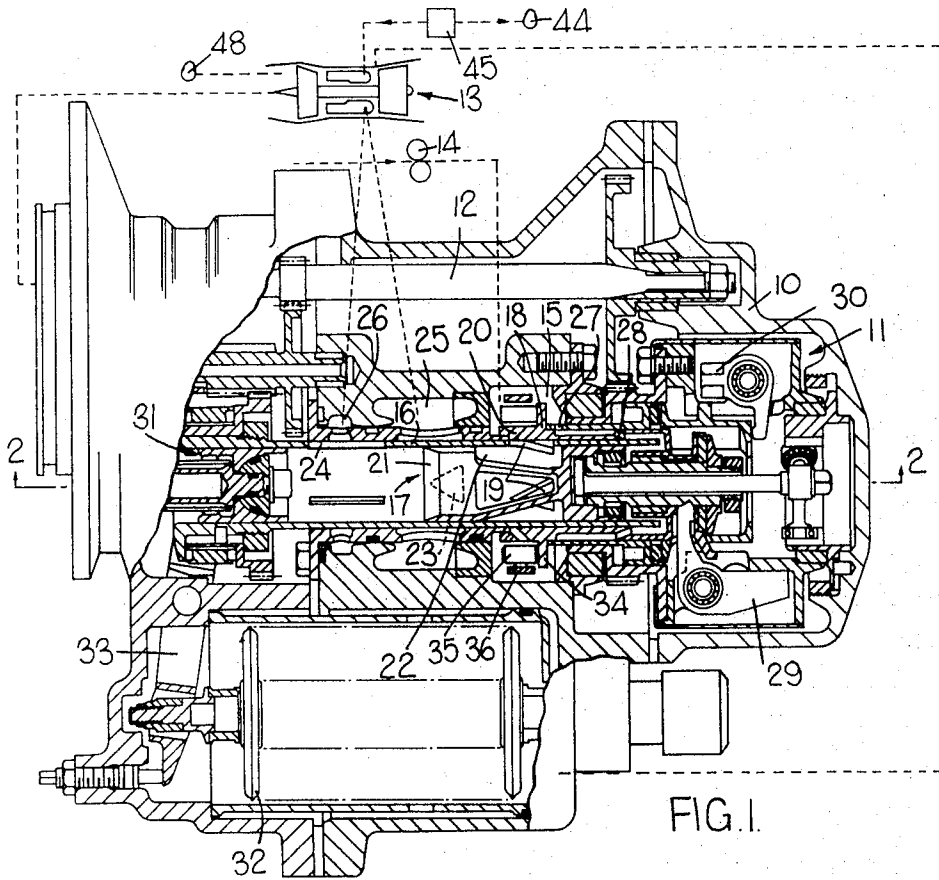
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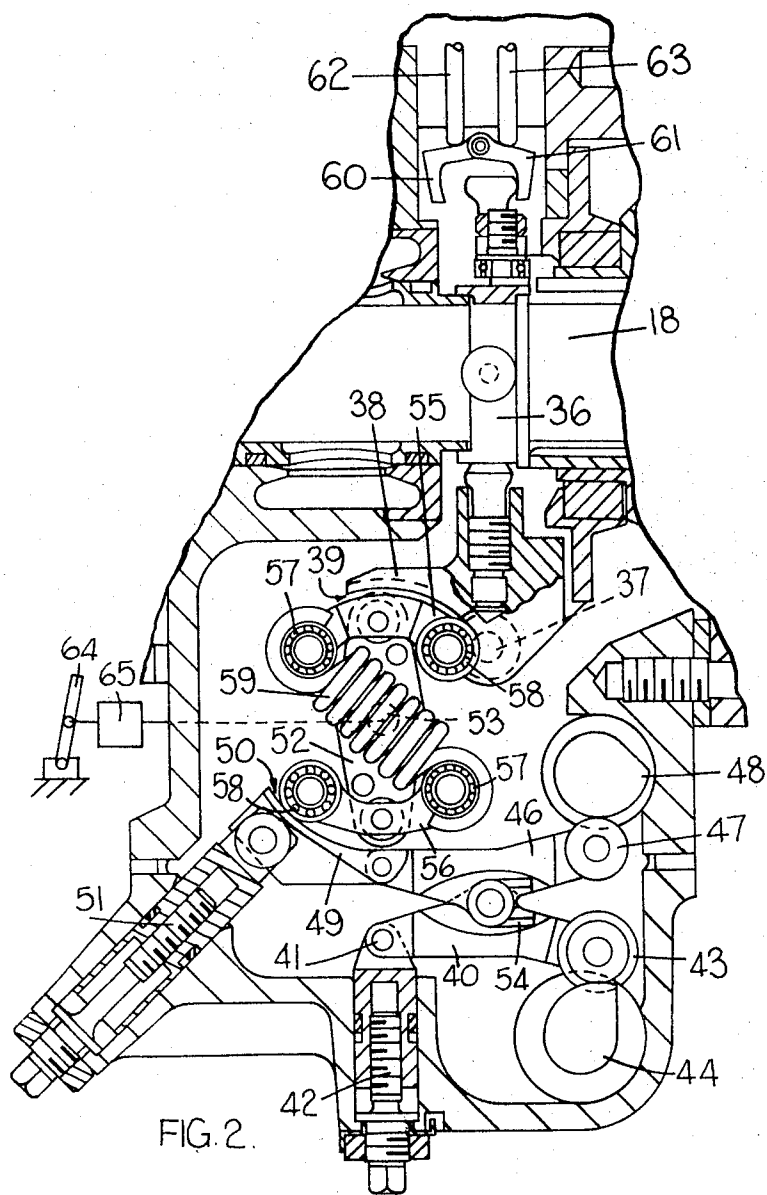
[57] **ABSTRACT**

A speed responsive governor arrangement comprises a rotatable governor mechanism having an output member engaging one end of a lever whose other end has a cam surface. A further cam surface is opposed to the cam surface on the lever and is movable relative thereto by a linkage responsive to two input parameters. A spring loaded device is located between the cam surfaces so as to bias them apart. This device is rotatable in response to a third parameter, so that the moment applied to the lever, and hence to the output member of the governor mechanism to oppose movement thereof in response to an increase in speed, is variable in accordance with the aforesaid three parameters.

14 Claims, 2 Drawing Figures







SPEED RESPONSIVE GOVERNOR MECHANISM

This invention relates to speed-responsive governor arrangements, and has an object to provide such a mechanism in a convenient form.

According to the invention speed-responsive governor arrangement comprises a body, a governor mechanism rotatably mounted in said body and including an output member movable relative to said body, a first lever pivotally mounted on the body and movable by said output member in response to changes in the speed of a shaft which provides a drive for the governor, said first lever having thereon a cam surface a second lever pivotally mounted on the body and movable in response to a first parameter, a third lever pivotally mounted on the second lever for movement in response to a second parameter, a fourth lever pivotally mounted on said third lever and having a cam surface spaced from, and directed towards, the cam surface on the first lever, whereby the cam surface on the fourth lever is movable relative to the cam surface on the first lever in response to the said first and second parameters, a device angularly movable relative to the pivotal axis of the first lever and a spring carried by said member and acting to urge said cam surfaces apart, whereby angular movement of said device varies the moment of the spring force on the first lever in accordance with the position of the fourth lever.

The invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a section through a fuel control apparatus for a gas turbine engine, and incorporating a mechanism according to the invention, and

FIG. 2 is a scrap section on line 2—2 in FIG. 1.

In the apparatus shown a casing 10 contains a speed responsive governor arrangement 11 driven, via shaft 12, by the shaft of a gas turbine engine 13. Also driven by the engine 13 is a pump 14 which supplied fuel to a space 15 within the casing 10.

Slidable within casing 10 is a sleeve 16, and slidable within sleeve 16 is a piston closure member 17. Surrounding one end of sleeve 16 and also slidable in the casing 10 is a further sleeve 18. Extending through the walls of sleeve 16, 18 are respective ports 19, 20 which combine to define a variable metering orifice whose size is dependent on the relative axial positions of sleeves 16, 18. Closure member 17 includes a hollow cylindrical portion 21 having cut-outs 22 by means of which the said variable metering orifice communicates with the bore of the sleeve 16. The wall of sleeve 16 has further ports 23, 24 which are spaced axially from each other and from the ports 19. Port 23 communicates with an annular space 25 in casing 10, space 25 communicating with the main burners of the engine 13.

The end of member 17 combines with port 23 to control flow from the bore of sleeve 16 to engine 13 in accordance with the relative axial positions of members 17 and sleeve 16. Ports 24 communicate via an annular space 26 in casing 10 with primary burners for the engine 13.

Space 15 communicates via passages 27, 28 with the side of piston closure member 17 remote from the variable metering orifice. Member 17 is thus subjected to the pressure difference across the said variable metering orifice. Governor arrangement 11 includes weights 29 movable in response to an increase in the speed of

engine 13 to urge member 17 in a direction to oppose the metering orifice pressure difference.

Governor arrangement 11 also includes weights 30 movable in response to an increase in engine speed to urge sleeve 18 to the left, as seen in FIG. 1.

Sleeve 16 is rotatable within casing 10 by shaft 12 via gears 31. Sleeve 16 is also axially slidable by a bellows 32 subjected internally to the compressor delivery pressure of engine 13, bellows 32 acting on sleeve 16 via a linkage 33.

Sleeve 18 has projections 34 engaged by rollers 35 carried by a forked lever 36 mounted in the casing 10 for movement about a pivot 37 in the casing 10. Lever 38 formed with a cam surface 39. A lever 40 is mounted for movement about a pivot 41 whose position is adjustable by means of a threaded stem 42. The end of lever 40 remote from pivot 41 carries a roller 43 engaging a cam 44 which is rotatable in response to a control 45 by means of which a water/methanol mixture is supplied to the combustion chambers of the engine 13.

Pivotaly mounted on lever 40 intermediate the ends thereof is a lever 46. One end of lever 46 carries a roller 47 engaging a cam 48 which is rotatable by a signal dependent of the temperature within the jet pipe of engine 13. Rollers 43, 47 are biased apart and into engagement with the respective cams 44, 48 by a torsion spring 54. The end of lever 46, on the opposite side of the pivot thereof, pivotaly supports a fourth lever 49. Lever 49 has a cam surface 50 directed towards cam surface 39. Lever 49 is movable about its pivot by a threaded stem 51.

A member 52 is mounted between levers 38, 49 for movement about an axis 53. Pivotaly mounted at opposite ends of member 52 are rocker arms 55, 56. The respective ends of each of arms 55, 56 carrying ball bearing assemblies 57, 58. Bearing assemblies 58 engage the respective cam faces 39, 50. A tension spring 59 has its ends engaged around the bearing assemblies 57 to bias the latter towards one another, and hence assemblies 58 in directions to urge the cam faces 39, 50 apart.

A pair of stops 60, 61 are pivotaly mounted in the casing 10 and have their positions adjustable by respective stems 62, 63 to limit the pivotal movement of lever 36.

In use, a desired engine speed is selected by means of a lever 64 connected to member 56 via a linkage arrangement (shown generally at 65), whereby response of member 56 to movement of lever 64 in either direction from a neutral position is in accordance with desired parameters. Fuel supply to the main burners of engine 13 is dependent on flow through the metering orifice defined by ports 19, 20. For a given axial position of sleeve 16, flow through the metering orifice thus depends on the position of sleeve 18. Sleeve 18 is urged by governor weight 30 in a direction to reduce fuel flow as engine speeds increases, and in the opposite direction by the bias applied to lever 36 by spring 59. Rotation of member 52 in an anticlockwise direction as seen in FIG. 2, increases the moment of the force exerted by spring 59 on lever 36. This clockwise movement thus has the effect that, for a given speed of rotation of shaft 12, sleeve 18 adopts an equilibrium position which is to the right of its initial equilibrium position, thereby allowing an increased flow to the engine 13.

The provision of cam of cam surfaces 39, 50 has the effect that the rate of fuel flow with respect to the angular position of member 52 is not necessarily linear, but follows a desired curve. Moreover, the position of cam surface 50 with respect to surface 39 may be adjusted by threaded stem 51, and for given positions of cams 44, 48, by stem 42. Stems 42, 51 are adjusted initially and not thereafter normally moved. Cams 44, 48 are rotated, as above described, in accordance with engine operating parameters and also, by moving cam face 50 relative to cam face 38 modify the moment of the force of spring 59 on lever 36, for given positions of member 52.

The provision of a tension spring on member 52, together with bearing assemblies 57, 58 has the effect that in comparison with known arrangements, friction forces are significantly reduced between member 52 and lever 36. Reduction in static friction reduces hysteresis between movement of lever 64 and the response of sleeve 18 to vary flow.

I claim:

1. A speed-responsive governor arrangement comprising a body, a governor mechanism rotatably mounted in said body and including an output member movable relative to said body, a first lever pivotally mounted on the body and movable by said output member in response to changes in the speed of a shaft which provides a drive for the governor, said first lever having thereon a cam surface, a second lever pivotally mounted on the body and movable in response to a first parameter, a third lever pivotally attached to said body and pivotally mounted on the second lever for movement in response to a second parameter, a fourth lever pivotally mounted on said third lever and having a cam surface spaced from, and directed towards the cam surface on the first lever, a support mounted in said body and engaging said fourth lever at a location thereon spaced from the pivotal mounting thereof, whereby the cam surface on the fourth lever is movable relative to the cam surface on the first lever in response to said first and second parameters, a device angularly movable relative to the pivotal axis of the first lever and a spring carried by said member and acting to urge said cam surfaces apart, whereby angular movement of said device varies the moment of the spring force on the first lever in accordance with the position of the fourth lever.

2. An arrangement as claimed in claim 1 which includes means for varying the position of the pivotal axis of said second lever.

3. An arrangement as claimed in claim 1 in which the

pivotal axis of said second lever is adjacent one and thereof, and which includes a first actuating member engageable with the other end of said second lever to move the latter in response to said second parameter.

4. An arrangement as claimed in claim 3 in which said first actuating member cam.

5. An arrangement as claimed in claim 3 which includes a second actuating member engageable with one end of said third lever to move the latter in response to said third parameter.

6. An arrangement as claimed in claim 5 in which said second actuating member comprises a cam.

7. An arrangement as claimed in claim 5 in which said third lever is pivotally mounted on said second lever intermediate said pivotal axis and said other end thereof.

8. An arrangement as claimed in claim 7 in which said one end of said third lever and said other end of said second lever lie on the same side of the pivotal axis of said third lever on said second lever.

9. An arrangement as claimed in claim 8 which includes means for biasing said one end of said third lever away from said other end of said second lever.

10. An arrangement as claimed in claim 8 in which the pivotal axis of said fourth lever on said third lever is adjacent the other end thereof.

11. An arrangement as claimed in claim 1 which includes means for moving said fourth lever about its pivotal axis independently of said first and second parameters.

12. An arrangement as claimed in claim 11 in which said means for moving said fourth lever comprises a member slidable in said body and engaging an end of said fourth lever remote from the pivotal axis thereof.

13. An arrangement as claimed in claim 1 in which said angularly movable device includes a member pivotally mounted in said body for movement about an axis intermediate said cam surfaces and fifth and sixth levers pivotally mounted on said member, said spring comprising a tension spring engaging one end of each of said fifth and sixth levers, the other ends of said fifth and sixth levers being biased by said spring towards said respective cam surfaces.

14. An arrangement as claimed in claim 13 in which said fifth and sixth levers include rollers at said other ends thereof, said rollers engaging said respective cam surfaces.

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