Dec. 10, 1946. P. L. MARDIS 2,412,347

SPEED GOVERNOR SWITCH

Filed Oct. 26, 1944 2 Sheets-Sheet 1

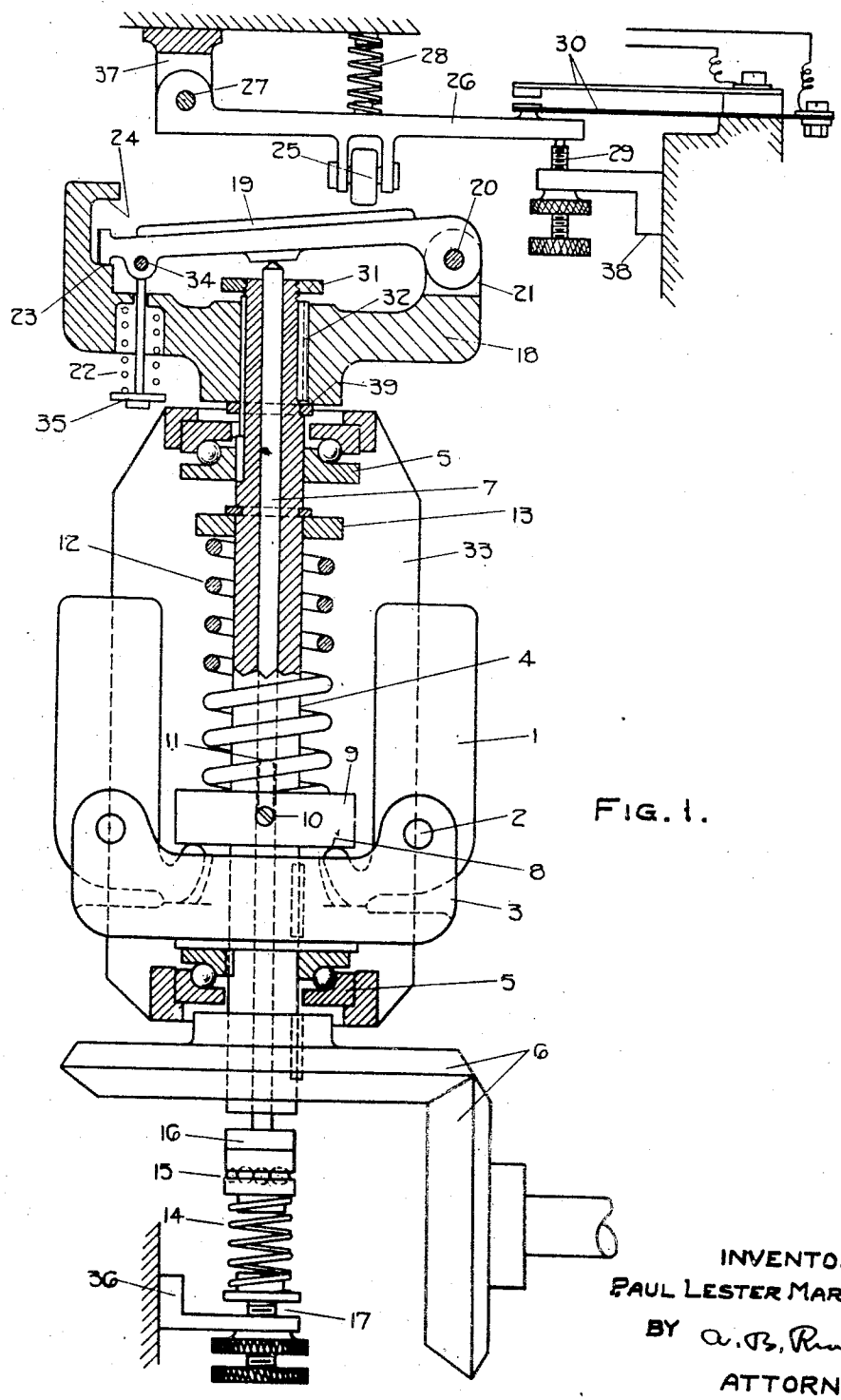


FIG. 1.

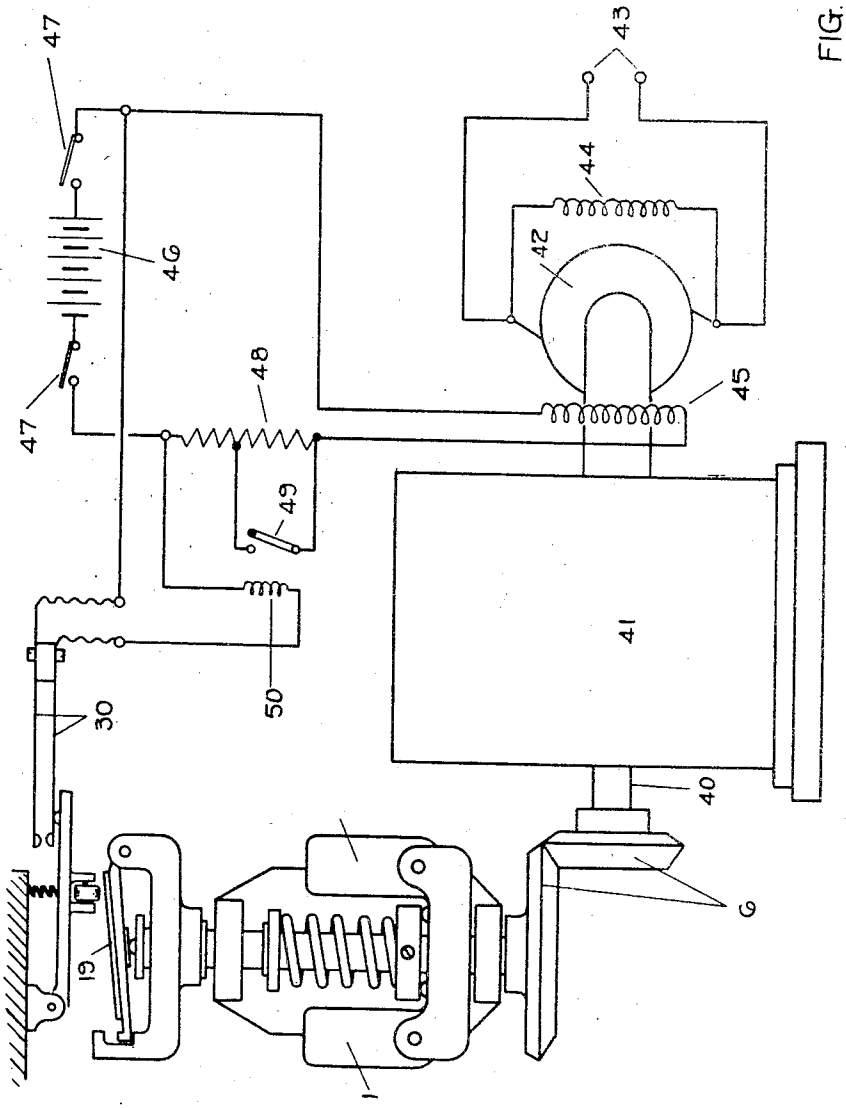
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FIG. 2.



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SPEED GOVERNOR SWITCH

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12 Claims. (Cl. 200—80)

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In the control of an engine driven electric generating plant and in particular of an electric generator driven by an internal combustion engine it is known to control the output of the generator—by controlling its excitation—by a governor driven by the engine and in such manner as to maintain substantially a constant engine speed or a predetermined speed-torque relationship or any chosen one of a number of predetermined speeds or speed-torque relationships.

For this purpose various arrangements of field controlling switches actuated or controlled by centrifugal governors have been proposed. In particular the prior British Patent No. 453,207 is concerned with a vibratory field switch periodically opened and closed by the action of the governor which varies the ratio of the time during which the switch is open to the time during which it is closed. The present invention is concerned with an alternative arrangement for producing a like result.

According to the invention the rotation of a speed governor driven by the engine acts mechanically on vibratory contacts to open and close them periodically while means actuated by or under the control of the governor vary the fraction of a revolution during which the contacts are closed. In particular the contacts are actuated by a swashplate rotated by the governor and such that its angle of inclination to the governor axis can be varied.

The invention is illustrated by the accompanying drawings of which:

Fig. 1 is a view, partly in axial section, of one form of governor according to the invention and

Fig. 2 shows a complete governing system incorporating said governor.

In Fig. 1 the governor weights 1 are pivotally mounted on the pivot pins 2 in the carrier 3 which is secured to the hollow shaft 4 journalled top and bottom in the combined radial and thrust bearings 5 mounted on bracket 33. Shaft 4 is driven through the bevel wheels 6. Axially slidable within this hollow shaft 4 is an operating rod 7 actuated by the inward and outward movement of the governor weights 1 through the engagement of the arms 8 inwardly extending from weights 1 with an axially slidable collar 9 on the hollow shaft 4 secured to the operating rod 7 by the peg 10 which can slide in the longitudinal aperture 11 in the shaft 4.

The governor is loaded by a spring 12 compressed between the slidable collar 9 and a collar 13 axially immovable on the hollow shaft 4; in order to facilitate adjustment of the governor

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loading a further compression spring 14 is provided between the thrust bearing 15—mounted on an extension 16 of the operating rod 7—and an adjusting screw 17 on the fixed bracket 36. Compression of this spring 14 thus reduces the governor loading and vice versa and the adjustment may be carried out when the governor is rotating, if so desired.

Slidably mounted on and rotating with the hollow shaft 4 is a carrier 18 on which a disc or swashplate 19 is pivotally mounted by means of a pin 20 fixed in the lug 21. The disc or swashplate 19 carries, on pivot pin 34, the eyebolt 35 through which the disc is spring biassed by means of spring 22 against a stop 23 formed on the carrier 18 which limits its downward movement so that when the disc or swashplate 19 is in contact with this stop it is inclined at a maximum angle to the axis of the hollow shaft 4, whilst a further stop 24 also formed on the carrier 18 limits the upward movement to a position in which the disc or swashplate 19 is in a substantially horizontal plane.

The disc or swashplate 19 is utilised as a swashplate engaged by a roller 25 carried on the lever 26 which is pivoted at 27 on fixed bracket 37 and spring biassed by means of spring 28 towards the disc or swashplate 19, downward movement of the lever 26 being limited by the adjustable stop 29 on fixed bracket 38 so that the roller 25 thereon is clear of the disc or swashplate 19 when the governor is at rest whilst upward movement brings the switch contacts 30 into engagement.

The carrier 18 can make a small amount of axial movement on the hollow shaft 4, sliding on the feather 32, being biassed by gravity on to the washer 39 resting on a shoulder on shaft 4 whilst its upward movement is limited by the stop 31 fastened on the end of the shaft 4; the carrier is prevented from rotating relatively to the hollow shaft 4 by means of the feather 32.

On rotation of the governor at minimum speed, the initial outward movement of the weights 1 moves the operating rod 7 upwards; the end of rod 7 thus engages the underside of the disc or swashplate 19. The biassing force acting on the disc or swashplate 19 due to the spring 22 is more than that acting on the disc carrier 18 and accordingly disc and carrier together are moved to the extent limited by the stop 31 on the hollow shaft 4 without change of the angle of inclination of the disc or swashplate 19 so as to bring the latter to such a position that during a predetermined part of each revolution it will

engage and lift the roller 25 and lever 26—after the fashion of a swashplate—whereby the switch contacts 30 are closed over a predetermined small fraction of the revolution.

On further increase of speed and further outward movement of the governor weights 1 the operating rod 7 moves the pivoted disc 19 relatively to its carrier 18 to decrease its angle of inclination, thereby increasing the fraction of a revolution during which the switch contacts 30 are closed. Further increases in speed will further decrease the angle of inclination of the disc or swashplate 19 until the surface of the disc or swashplate 19 is substantially at right angles to the axis of rotation when the switch contacts 30 will remain permanently closed.

It will be understood that in order to select different speeds, the adjusting device such as 17 is used for varying and selectively choosing different loadings of the governor.

In Fig. 2 the bevel gearing 6 driving the governor shaft 4 is driven by the shaft 40 of the engine 41 which also drives the D. C. electric generator 42 connected to terminals 43 and having shunt field winding 44 and another field winding 45 supplied from source 46 through switches 47. In series with winding 45 is the resistor 48, part of which is periodically shunted by the contactor 49 having its coil 50 controlled by the governor contacts 30. Normally, with the latter open, the resistor 48 is permanently in circuit and the generator excitation is at a minimum. As the speed of the plant increases and the weights 1 move outwards, the fraction of a revolution during which the contactor 49 shunts part of the resistor 48 increases, thereby increasing the excitation of the generator; this counteracts the tendency for the speed of the plant to increase, a condition of equilibrium being reached in known manner. When the disc or swashplate 19 is substantially at right angles to the axis of rotation, and the contacts 30 accordingly remain closed, the generator excitation is at a maximum.

It will be seen that the arrangement provides a simple and readily adjustable means of obtaining a large number of values of generator excitation over a range and that the device will be largely free from hunting.

What I claim as my invention and desire to secure by Letters Patent is:

1. A speed governor comprising in combination a rotary member, a variable-angle swashplate pivoted thereon, means responsive to speed of the rotary member for tilting said swashplate, a follower periodically engaged by said swashplate, and a switch which is opened and closed by said follower.

2. A loaded centrifugal speed governor comprising in combination a rotary unit with an axially slidable part incorporated therein, flyweights pivoted on said rotary unit, and operatively connected with said slidable part, a loading spring acting axially on said slidable part in a sense to bias the flyweights inwards, an inclined swashplate pivoted on and rotatable with said rotary unit, a second spring acting on said swashplate in a sense urging it against said slidable part in the same sense as said loading spring, a follower periodically engaged by said swashplate and an intermittent switch in operative connection with said follower.

3. A speed governor according to claim 2 including a second axially slidable part on said rotary unit, biassed in the same direction as the direction of action of the two said springs and having only a very limited amount of movement, the swashplate being pivoted on said second axially slidable part and said second spring being connected between this part and the swashplate.

4. A speed governor according to claim 2 including a non-rotating adjusting spring positioned to act axially on said first-mentioned axially movable part, a fixed adjustable holder for one end of said spring and an anti-friction thrust bearing between the other end of said spring and said first-mentioned axially movable part.

5. A speed governor comprising in combination a rotary member, a swashplate rotated by the rotary member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rotation, a switch, a follower for opening and closing the switch and operated by the swashplate, and means responsive to speed of the rotary member for tilting the swashplate for operation of the follower to vary the ratio of the intervals during which the switch is closed and opened for each revolution of the swashplate.

6. A speed governor comprising in combination a rotary member, a swashplate rotated by the rotary member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rotation; a switch; follower mechanism operated by the swashplate for opening and closing the switch and including a follower element cooperating with the swashplate, a spring for biasing the follower element toward the swashplate, and an adjustable stop for limiting the extent of movement of the follower toward the swashplate; and means responsive to speed of the rotary member for tilting the swashplate for operation of the follower mechanism to vary the ratio of the intervals during which the switch is closed and opened for each revolution of the swashplate.

7. A speed-responsive governor comprising in combination a rotary member, a swashplate rotated by the rotary member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rotation, a switch, a follower for opening and closing the switch and operated by the swashplate, axial means providing movement of the swashplate to place it in operative or in inoperative positions with respect to the follower, and means responsive to speed of the rotary member to effect movement of the swashplate and to tilt the latter for operation of the follower to vary the ratio of the intervals during which the switch is closed and opened for each revolution of the swashplate.

8. A speed governor comprising in combination a rotary member, a swashplate rotated by the rotary member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rotation, stops cooperating with the swashplate for limiting the extent of tilting movement thereof, means for biasing the swashplate in the direction of its angle of inclination with respect to its plane of rotation, a switch, a follower for opening and closing the switch and operated by the swashplate, and means responsive to speed of the rotary member and acting on the swashplate in opposition to said biasing means to vary the ratio of the intervals during which the switch is closed and opened for each revolution of the swashplate.

9. In governing apparatus, a rotary member, a swashplate rotatable with said member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rota-

tion, means for biasing the swashplate in a direction to increase its angle of inclination with respect to its plane of rotation, a switch, a follower for opening and closing the switch and operated by the swashplate, a thrust rod having one end abutting the swashplate to exert force on the latter against the force of said biasing means, a load spring exerting force on the thrust rod in the same direction as that exerted thereon by said biasing means, and flyweights rotated by said rotary member and arranged so that the centrifugal force thereof is applied to the thrust rod in opposition to the forces of the biasing means and of the load spring so that, as the speed of the rotary member is increased, the increasing centrifugal force applied to the thrust rod acts on the swashplate to decrease the angle of inclination thereof with respect to its plane of rotation to increase the ratio of the interval of closing of the switch with respect to the interval of opening thereof for each revolution of the swashplate.

10. Apparatus as claimed in claim 9 with a speed-changing spring operatively connected to the end of the thrust rod remote from the abutment rod and means for adjusting the speed-changing spring.

11. In governing apparatus, a rotary member; a swashplate rotatable with said member and mounted for tilting movement to vary its angle of inclination with respect to its plane of rotation; means for limiting tilting movement of the swashplate so that it is movable through a range from a maximum to substantially zero angle of inclination with respect to its plane of rotation; means for biasing the swashplate in a direction to increase its angle of inclination; a switch; follower mechanism for opening and closing the switch and including a follower element cooperating with the swashplate, a spring for moving the follower element toward the swashplate, and an adjustable stop for limiting movement of the follower element toward the swashplate; a thrust rod having one end abutting the swashplate to exert force thereon against the force of said biasing means; a load spring exerting force on the thrust rod in the same direction as that exerted thereon by said biasing means; and flyweights rotated by said rotary member and arranged so

that the centrifugal force thereof is applied to the thrust rod in opposition to the forces of the biasing means and of the load spring so that, as the speed of the rotary member is increased, the increasing centrifugal force applied to the thrust rod acts on the swashplate to decrease the angle of inclination thereof with respect to its plane of rotation to increase the ratio of the interval of closing of the switch with respect to the interval of opening thereof for each revolution of the swashplate.

12. In governing mechanism, a vertical tubular drive shaft; a switch; a follower for opening and closing the switch; a carrier member at the upper end of the drive shaft; a swashplate rotatable with the carrier member for operating the follower; a slidable coupling between the drive shaft and the carrier member and including upper and lower stops engageable by the carrier member to place the swashplate in operative position with respect to the follower when the upper stop is engaged and in inoperative position with respect to the follower when the lower stop is engaged; gravity acting on the carrier member and the swashplate serving to move the latter to engage the carrier member with the lower stop when insufficiently opposed by lifting force; means for mounting the swashplate on the carrier member for tilting movement to vary its angle of inclination with respect to its plane of rotation so that, with the carrier member in upper position, the ratio of switch-closing interval to switch-opening interval may be varied; biasing means acting on the swashplate to increase its angle of inclination with respect to its plane of rotation; stops provided on the carrier member for limiting the extent of tilting movement of the swashplate; a thrust rod within the tubular drive shaft and having one end abutting the swashplate to exert force on the latter against the force of said biasing means; and centrifugal flyweights rotatable with the tubular drive shaft and arranged to apply centrifugal force to the thrust rod to move the carrier member from its lower to its upper position and then to tilt the swashplate against the force of its biasing means.

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