Nov. 30, 1948. L. DE MARCO 2,454,913

CENTRIFUGAL GOVERNOR

Filed Sept. 27, 1944 3 Sheets-Sheet 1

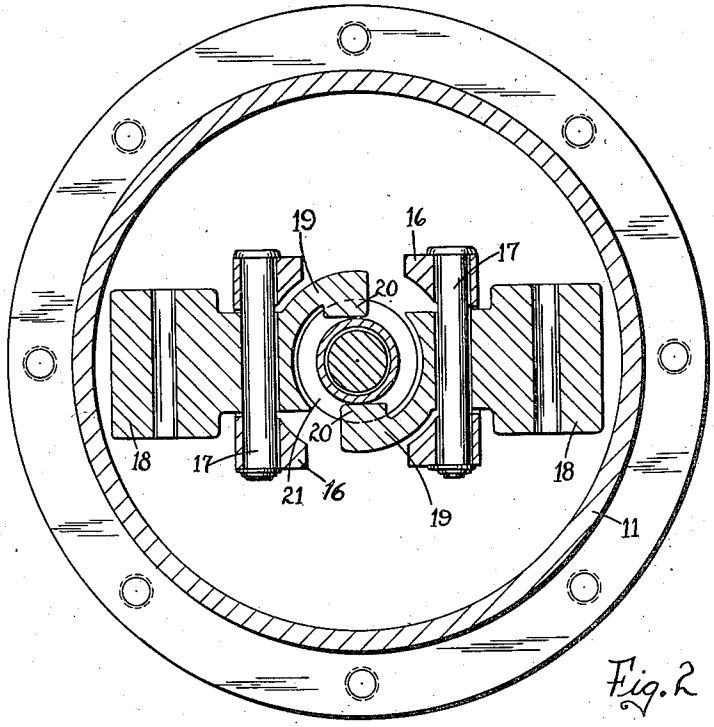

Fig. 2

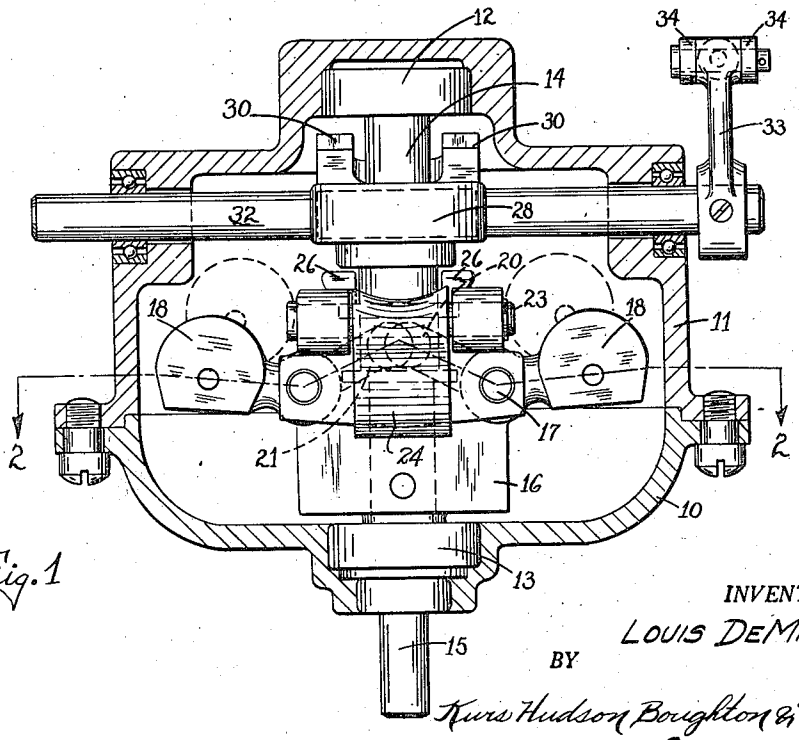

Fig. 1

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Filed Sept. 27, 1944 3 Sheets-Sheet 2

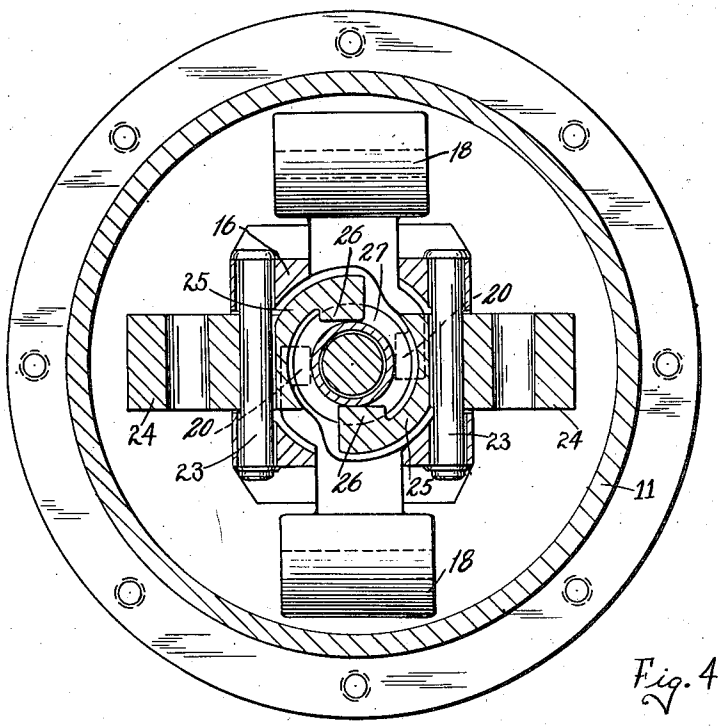

Fig. 4

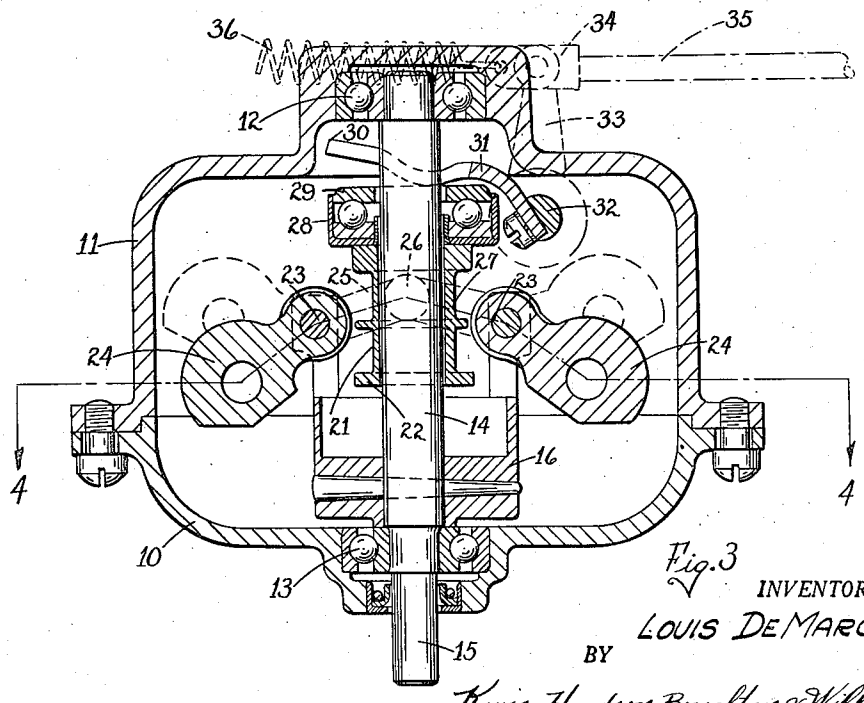

Fig. 3

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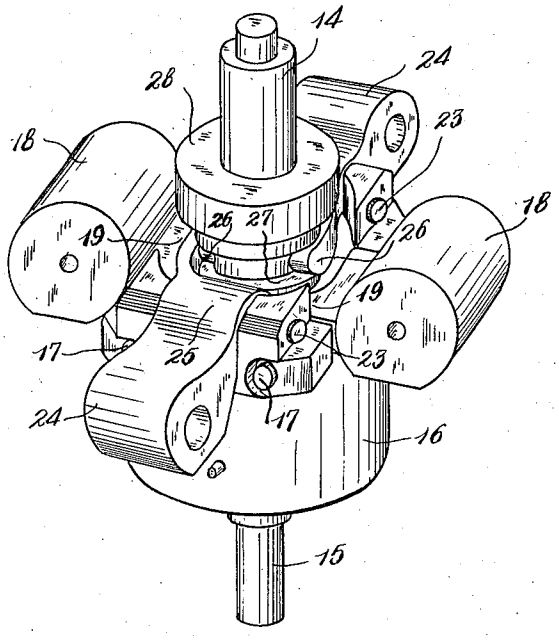

FIG. 5

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CENTRIFUGAL GOVERNOR

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6 Claims. (Cl. 264—15)

1

This invention relates to improvements in governors, particularly governors for operating control means which must be sensitive to wide variations in speed.

In cases where the range of speed during which the governor must be effective is considerable, for example from 300 R. P. M. to 3000 R. P. M., and where the control element is biased in one direction by a spring or equivalent means, the biasing means must of course be effective against the load imposed by centrifugal force at the maximum speed. With a conventional governor construction this means that the spring must be a heavy one, and a heavy spring will not yield to the force exerted by the governor at the lower speeds. Under such circumstances the control mechanism will operate only through the upper range of speeds. On the other hand, if the spring is light enough to function for the lower speeds, it cannot oppose the force exerted by the governor in the higher range of speeds.

In order to obtain satisfactory operation over a wide range, the present invention employs two sets of weights working in opposition to each other throughout the upper speed range, to thereby reduce the force acting in opposition to the spring or other biasing means, and thus to maintain a minimum variation in spring load throughout a wide range of speeds. Preferably also the two sets of weights are so disposed and mounted that their effect is additive throughout a selected low speed range.

One of the objects of the invention therefore is the provision of a governor which is effective for control purposes over a wide range of speeds.

Another object is the provision of such a governor of simple and compact construction.

A further object is the provision of a governor of the character described having control movements operating at a relatively constant rate over the entire speed range of the governor.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which:

Fig. 1 is a view, largely in diametrical section, of a governor embodying the invention;

Fig. 2 is a cross-sectional view of the same taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is another diametrical sectional view taken at right angles to that of Fig. 1;

Fig. 4 is a cross-sectional view taken substantially on the line 4—4 of Fig. 3, and

2

Fig. 5 is a perspective view of the governor with the casing removed.

In the drawings, 10, 11 is a two-part casing carrying anti-friction bearings 12 and 13 in which is rotatably mounted a shaft 14, one end 15 of which projects from the casing to receive any suitable driving means having a wide range of speeds, such for example as might be encountered in an internal combustion engine.

Shaft 14 has pinned or otherwise secured thereto bracket means 16, this means in the illustrated case being a single member, although a plurality of such members is within the spirit of the invention. In this bracket means there are mounted two parallel pins 17 which extend through bores in the fulcrum portions of a set of weights 18. Each of the weights of this set has a work arm 19 with a boss 20 at its inner end which runs in a groove 21 in a sleeve 22 that is mounted to slide on shaft 14.

Bracket means 16 also carries a pair of parallel pins 23 disposed at right angles to pins 17, and on these pins 23 there are pivotally mounted the fulcrum portions of a second pair of weights 24 which have work arms 25 with bosses 26 running in a groove 27 in sleeve 22.

One end of sleeve 22 abuts against an anti-friction thrust bearing 28 surrounding the shaft. A race 29 of this bearing contacts bifurcations 30 of an arm 31 which is secured to a flattened portion of a rock shaft 32 mounted in bearings in the casing member 11. Outside the casing a crank arm 33 is secured to shaft 32. The outer end of this crank arm is pivotally mounted between bifurcations 34 of a control rod 35, which may be connected to any piece of apparatus or mechanism whose movements are to be controlled, as for example the throttle of an internal combustion engine. A tension spring 36 is also connected directly or indirectly with the crank arm 33, and acts to bias that arm so as to maintain pressure through bifurcations 30 against bearing race 29.

Operation.—The weights 18 are main or primary weights, while the weights 24 are secondary or auxiliary weights and are preferably of lower mass than weights 18. Weights 18 function in somewhat the same manner as the weights of the ordinary or conventional centrifugal governor. Their position when the shaft 14 is at rest is indicated in broken lines in Fig. 1. When the shaft begins to rotate and its speed gradually increases, weights 18 swing gradually toward the full line position of Fig. 1, thereby shifting sleeve 22 upwardly as viewed in Figs. 1 and 3 of the

drawings, turning the arms 31 and 33 clockwise, as viewed in Fig. 3, and exerting a push on the control rod 35, that is after centrifugal force acting upon the weights is sufficient to cause spring 36 to yield. As the speed increases, the weights 18 move further outward, but their centers of gravity never quite reach the plane through the axes of pins 17. In other words, the weights always exert leverage tending to move sleeve 22 upwardly, as viewed in the drawings, although they are so disposed and mounted that their leverage decreases from low speed to high speed. However, even with this decreased leverage these weights alone would exert relatively great force at higher speeds, and a very strong spring 36 would be required to oppose such force.

The position of weights 24, when the governor is stationary, is shown in broken lines in Fig. 3. Their centers of mass are then above the plane through the axes of pins 23. As the shaft 14 begins to rotate and its speed increases, weights 24 at first swing outward until their centers of gravity lie in the plane of the axes of pins 23. During this time the effect of these auxiliary weights is added to that of the primary weights 18 for raising the sleeve 22 against the action of spring 36, thereby obtaining movement of control rod 35 in the low speed range. As soon as the centers of mass of weights 24 reach their outermost position however, this additive effect ceases. For any increase in speed beyond that point the weights 24 swing inwardly because of their connection with sleeve 22, which in turn is raised by the heavier weights 18. Centrifugal force acting upon weights 24 throughout the higher speed range is therefore in effect subtracted from the force acting upon weights 18. It will be noted also that the leverage exerted by the weights 24 increases as the speed increases, and thus their effect in opposition to the centrifugal force set up by weights 18 is augmented.

Under the combined effect of the two sets of weights, the sleeve 22 moves steadily upward throughout any period of speed increase, but the load exerted upon spring 36 through the bearing 28 and intermediate parts is maintained low enough to permit the use of a spring of moderate strength. Because of the light load also, wear upon the bearing 28 is moderate and its life correspondingly long.

The secondary set of weights are mounted independently of the primary set, that is to say they are mounted to turn upon axes that are different from the axes of the primary set. Because of this independent mounting it is possible to build governors for special jobs with a minimum number of new parts. In most cases one pair of weights of the necessary mass may be designed along with levers of a required length and angularity, while for the other set a pair of weights and levers of standard design may be utilized. This combination gives flexibility and great range of application with a minimum of expense.

Having thus described my invention, I claim:

1. In a centrifugal governor, a shaft, control means movable axially relative to said shaft, a set of weights mounted to turn with the shaft and to swing on parallel axes under the influence of centrifugal force for moving said control means in one axial direction under speed increases throughout the range of the governor, a second set of weights mounted independently of the first set to turn with the shaft and to swing on parallel axes separate from said first named axes and functioning at low speeds to augment the action of the first set, but adapted to be forced inward by the control means at higher speeds for opposing by centrifugal force the effect of the first set.

2. In a centrifugal governor, a shaft, bracket means secured thereto, two sets of weights mounted independently of each other on said bracket means, each weight swinging about its own individual axis separate from that of every other weight, a sleeve slidable on said shaft, one of said sets of weights being adapted to move said sleeve in one direction under speed increases throughout the range of the governor, the second set of weights being mounted to move to their outermost position at a given speed for augmenting the effect of the first set and being adapted thereafter at higher speeds to be moved inward by said sleeve for opposing the effect of the first set.

3. In a centrifugal governor, a shaft, control means movable axially relative to said shaft, a set of weights mounted to turn with the shaft and to swing on parallel axes under the influence of centrifugal force for moving said control means in one axial direction under speed increases throughout the range of the governor, a second set of weights mounted independently of the first set to turn with the shaft and to swing on parallel axes separate from said first named axes and functioning at low speeds to augment the action of the first set, but adapted to be forced inward by the control means at higher speeds for opposing by centrifugal force the effect of the first set, said first set having decreasing leverage from minimum to maximum speed and said second set having increasing leverage from intermediate to maximum speed.

4. In a centrifugal governor, a shaft, bracket means secured thereto, a sleeve slidable on said shaft, a primary set of weights pivotally mounted on said bracket means and operatively connected with said sleeve for moving the latter in one direction under speed increases throughout the range of the governor, an auxiliary set of weights, pivotal mountings therefor on said bracket means separate from the mountings for said primary set, and operatively connected with said sleeve, said auxiliary set being arranged to reach its outermost position at a relatively low speed and thereafter to be swung inwardly by sleeve movement for opposing through centrifugal force and leverage the effect of the first set.

5. In a centrifugal governor, a shaft, control means movable axially relative to said shaft, a set of weights mounted to turn with the shaft and to swing on parallel axes under the influence of centrifugal force for moving said control means in one axial direction under speed increases throughout the range of the governor, a second set of weights mounted independently of the first set to turn with the shaft and to swing on parallel axes at right angles to the said first named axes, said second set of weights functioning at low speeds to augment the action of the first set but adapted to be forced inward by said control means at higher speeds for opposing by centrifugal force the effect of the first set.

6. In a centrifugal governor, a shaft, bracket and sleeve members surrounding said shaft, one of said members being rotatable with said shaft and carrying two pairs of parallel pivots disposed in planes at right angles to said shaft, the pivots of one pair being at right angles to those of the other pair, a first pair of weighted levers carried on one pair of pivots, a second pair of weighted levers carried on the other pair of pivots, the inner ends of all said levers having pivotal connection with

the other of said members, the pivots, pivotal connections and masses of said weighted levers being so disposed that increases of speed cause said first pair of levers to exert force throughout the range of the governor tending to separate said members axially and cause said second pair of levers to exert force in the higher speed range of the governor opposing the separation of said members.

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