June 27, 1933. E. KLAIBER 1,916,181

CENTRIFUGAL GOVERNOR

Filed Feb. 13, 1931

Fig. 1.

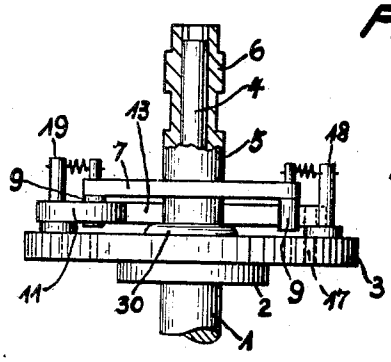


Fig. 3.

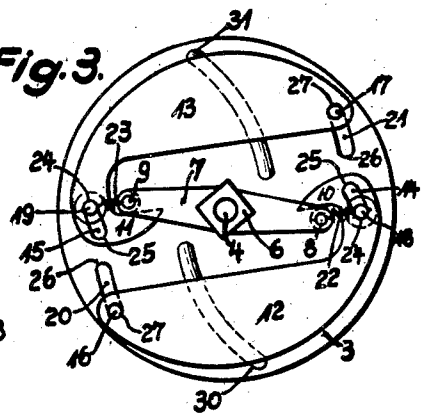


Fig. 2.

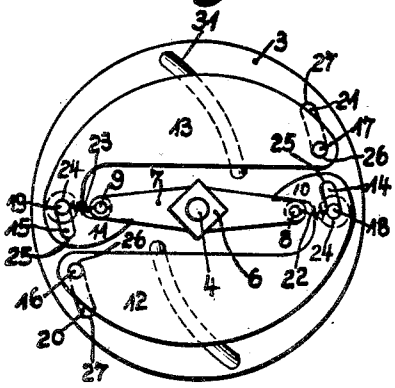


Fig. 4.

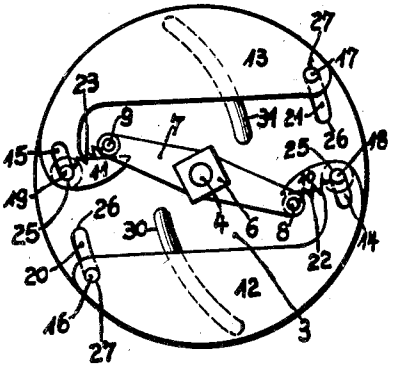


Fig. 5.

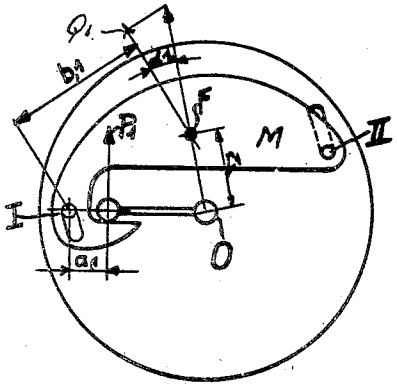
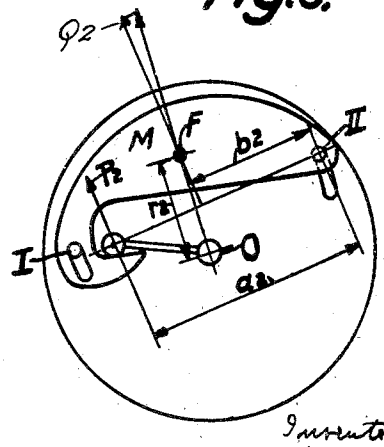


Fig. 6.



Inventor
Erich Klaiber
by Stewart & McKay
his attorneys

Patented June 27, 1933 1,916,181

UNITED STATES PATENT OFFICE

ERICH KLAIBER, OF STUTTGART, GERMANY, ASSIGNOR TO ROBERT BOSCH AKTIENGESELLSCHAFT, OF STUTTGART, GERMANY

CENTRIFUGAL GOVERNOR

Application filed February 13, 1931, Serial No. 515,632, and in Germany February 27, 1930.

The present invention relates to centrifugal governors and more particularly to governors for automatically adjusting the time of ignition in internal combustion engines having a large range of rotational speeds. Such governors should be suitable with quite low speeds of rotation, whilst the resistance moment of the cam to be adjusted remains very much the same over the entire range of speeds. The resistance of the cam therefore could only be opposed to a small lever arm of the centrifugal weight with the small centrifugal forces of the lower speeds. The force of the centrifugal weight is multiplied several times with a greater speed so that there is an ample surplus of adjusting force which must be taken up by strong return springs. Such a governor is however large and expensive for the very great range of adjustment required to-day if the transmission is to remain the same and is to be suitable for very low speed in spite of the governor. In order to avoid compensating the great centrifugal forces of the high speeds through the return springs alone and to be able to keep the governor small at an early commencement of the regulation, it is provided according to the invention with centrifugal weights which swing within the range of adjustment one after the other about two different points.

One form of construction of the invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a partial longitudinal section through a centrifugal governor without the front centrifugal weight.

Figure 2 is a plan view of the governor in the position of rest.

Figure 3 is a plan view in the operative position on the upper edge.

Figure 4 is a plan view in the operative position on the upper limit of the high speeds.

Figures 5 and 6 are diagrams of force for various positions of the centrifugal weights.

A flange 2 and a base plate 3 of an automatic ignition adjuster are mounted on a driving shaft 1. A cam sleeve 5 which carries a cam 6 is rotatably mounted on an extension 4 of the driving shaft, this extension projecting over the base plate. A double arm 7 is rigidly connected to the cam sleeve. Two studs 8, 9 are secured to this double arm and arms 10, 11 of two centrifugal weights 12, 13 engage on these studs. These centrifugal weights are provided on one side with slots 14, 15 and on the other side facing the base plate 3 with studs 16, 17. The studs 18, 19 firmly mounted in the base plate project into slots 14, 15 and studs 16, 17 of the centrifugal weights project in their turn into slots 20, 21 in the base plate. The springs 22 23 which are tensioned between the studs 8, 9 and 18, 19 tend to return the cam when it has been rotated out of its position of rest. In order to reduce friction the centrifugal weights slide on narrow bearing pads 30, 31 of the base plate.

The methods of operation of the automatic adjuster is as follows:

When at a standstill or rotating at speeds below the commencement of the range of adjustment the governor, the weights assume the position shown in Figure 2. The studs 18, 19 of the base plate lie against the ends 24 of the slots 14, 15 of the centrifugal weights and the studs 16, 17 of the centrifugal weights lie against the ends 26 of the slots 20, 21 of the base plate. With increased speed of rotation the centrifugal weights swing outwards about the studs 18, 19 until the studs 16, 17 of the centrifugal weights strike the ends 27 of the slots 20, 21. The arms 7 of the cam shaft are then rotated for an angle corresponding to the angle of rotation of the arms 10, 11 (Figure 3). When the speed of rotation is further increased, the centrifugal weights swing about the studs 16, 17 which now have an abutment surface on the ends 27 of the slots 20, 21 so that the arms adjacent the cam arm move outwards further until they strike the studs 18, 19 with the ends 25 of the slots 14, 15. The double arm 7 is further displaced and adjusted by the arms 10, 11 during this second part of the outward movement (Figure 4).

It can be seen from the plans of forces according to Figures 5 and 6 that force P_1 acts on the cam arm for the commencement of the

displacement when the centrifugal weight swings about the point I and that force P_2 acts when the centrifugal weight swings about the point II. Let F be the centre of gravity of the mass of the centrifugal weight of mass M, and r_1 and r_2 the distances from the axis of rotation O of the governor, b_1 one lever arm and a_1 the other and ω the angle of velocity of the system. The force $Q1 = M.r_1.\omega_1^2.\cos\alpha_1$ acts on the lever arm b_1. The force P_1 exerted on the cam arm therefore $= Q1.C_1 : a_1$. In the second case when the centrifugal weight swings about the point II, the force $P_2 = M.r_2.\omega_2^2.\cos\alpha_2.C_2 : a_2$. From the equations it can be easily seen that when the centre of gravity of the mass lies near the point of rotation II through a suitable formation of the centrifugal weight such a ratio of the lever arms can easily be obtained that the force at the cam arm only varies a little in spite of the speedily increasing centrifugal force of the centrifugal weight.

What is claimed is:

1. A centrifugal governor comprising an element adapted to be displaced, a centrifugal weight having a slot formed therein and adapted to displace said element, a base plate having a slot formed therein, a spring between said plate and said element resiliently restraining said element to a predetermined angular relation with said plate, a pivot stud on said base plate adapted to slide in the slot in said centrifugal weight and a pivot stud on said weight adapted to slide in the slot in said base plate, said slots and studs being so arranged as to cause said weight to swing about one of said studs at low speeds of rotation and about the other stud at high speeds of rotation.

2. A centrifugal governor comprising a base plate having a slot therein, a resiliently controlled control arm adapted for angular displacement relative to the base plate, a centrifugal weight having a slot therein, a lever arm on said centrifugal weight adjacent said slot and adapted to bear upon said control arm, a pivot stud on said base plate adapted to engage in the slot in said centrifugal weight, and a stud on said centrifugal weight adapted to engage in the slot in said base plate.

3. A centrifugal governor comprising a rotatable driving member, an element journaled for angular movement about the axis of rotation of said member and spring means connecting said member and element for resiliently restraining said element against angular displacement with respect to said member, a centrifugal weight adapted to displace said element, and means so pivotally mounting said weight on said driving member as to provide two spaced axes for the swinging of said weight on said member at different speeds of rotation of said member.

4. A centrifugal governor comprising a rotatable driving member, an element journaled for angular movement about the axis of rotation of said member and spring means resiliently restraining said element against angular displacement with respect to said member, a centrifugal weight adapted to displace said element, and means so pivotally mounting said weight on said driving member as to provide two axes for the swinging of said weight on said member with the axes so arranged that the leverage exerted on said element by said weight is greater when said weight swings about one axis than about the other.

5. A centrifugal governor comprising a rotatably driven base member, an element journaled for angular movement on said base member and spring means resiliently restraining said element from said angular movement, a centrifugal weight member for angularly displacing said element, and means comprising two loose pivotal connections between said weight member and said base member so mounting said weight member on said base member as to cause said weight member to swing about changing pivotal axes upon rotation of said base member through the ranges of low and high speeds.

6. A centrifugal governor as defined in claim 5 and in which each of said pivotal connections comprises a pivot stud fixed on one of said members and freely engaging the other of said members and in which one of said connections is formed for the swinging of said weight member about the stud of the other connection at low speeds of rotation of said base member and the other of said connections is formed for the swinging of said weight member about the stud of the first-mentioned connection at high speeds of rotation of said base member.

7. A centrifugal governor comprising a rotatably driven base plate, an element journaled for angular movement on said base plate and spring means resiliently restraining said element to a predetermined angular relation with said plate, a centrifugal weight for angularly displacing said element, and means comprising slot-and-pin connections between said plate and weight so pivotally mounting said weight on said plate as to cause said weight to swing about changing axes upon rotation of said plate through ranges of low and high speeds.

8. A centrifugal governor comprising a rotatably driven base plate, an element journaled for angular movement on said base plate and spring means resiliently restraining said element from said movement, a centrifugal weight for angular displacement of said element, and means comprising two spaced slot-and-pin connections between said base plate and said weight so pivotally mounting said weight on said plate as to cause said weight to swing about the pin of one of said

connections as an axis at low speeds of rotation of said plate and about the pin of the other of said connections as an axis at high speeds of rotation.

9. A centrifugal governor comprising a rotatably driven base plate, an element journaled for angular movement on said plate and spring means resiliently restraining said element from said movement, a centrifugal weight for angular displacement of said element, and means comprising a pivot stud on said weight engaging in a slot formed in said plate and a pivot stud on said plate engaging in a slot formed in said weight so pivotally mounting said weight on said plate as to cause said weight to swing successively on increasing speeds of rotation of said plate first about one and then about the other of said studs as axes.

10. A centrifugal governor as defined in claim 9 and in which said slots and pivot studs are so arranged that the center of gravity of said weight is nearer its axis of displacement for high speeds of rotation of said plate than for low speeds.

In testimony whereof I have hereunto affixed my signature.

ERICH KLAIBER.