

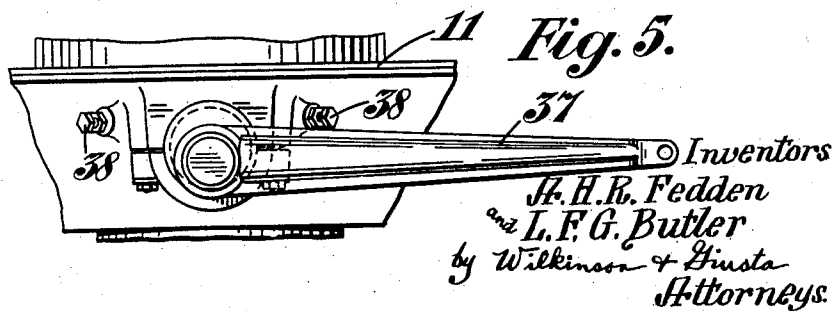
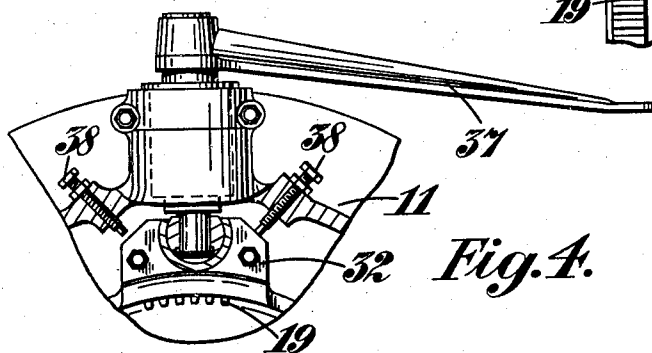
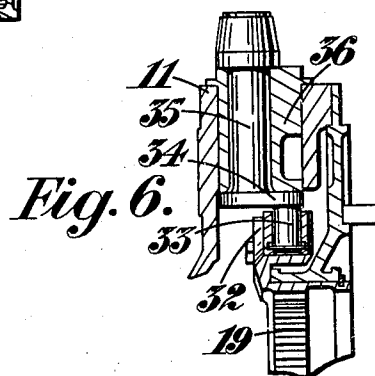
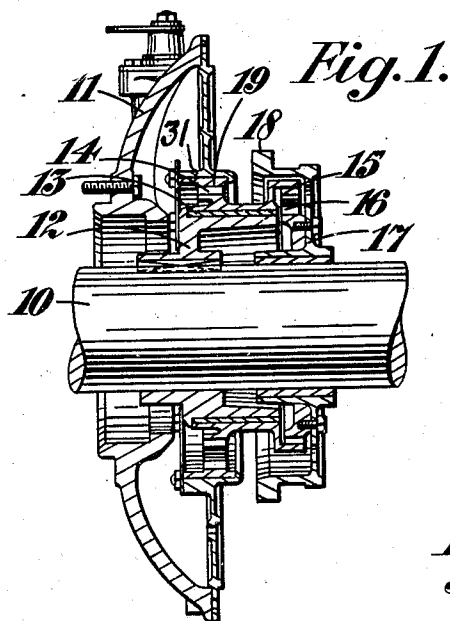
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VALVE OPERATING MECHANISM

Filed Jan. 14, 1926

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

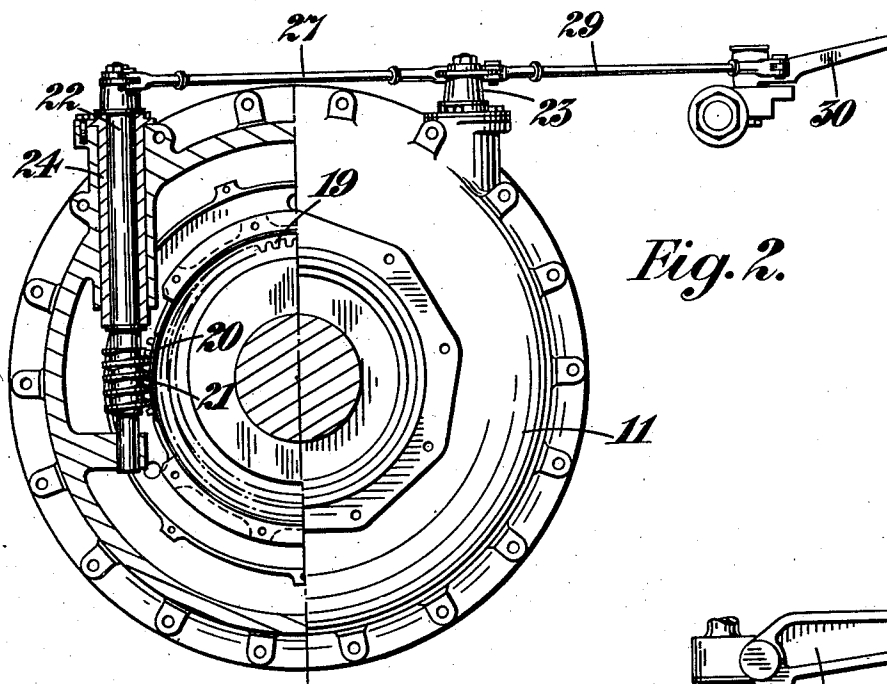


Fig. 2.

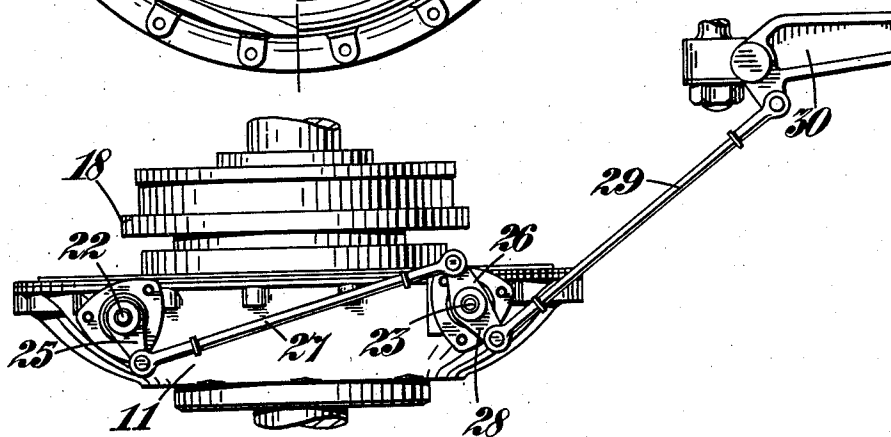


Fig. 3.

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UNITED STATES PATENT OFFICE.

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VALVE-OPERATING MECHANISM.

Application filed January 14, 1926, Serial No. 81,315, and in Great Britain January 19, 1925.

This invention is for improvements in or relating to valve-operating mechanism for internal-combustion engines, and has for its object to provide an improved construction of the same whereby it is possible to alter the timing of the valve for the purpose of varying the power developed by the engine. The desirability for such variation arises in the case of engines used on aircraft. The power developed by an internal-combustion engine diminishes with reduction in atmospheric pressure due to the ascent of the aircraft to higher levels; this falling-off in power can be delayed by arranging that the engine has a higher compression ratio than is suitable for working at ground level, and making the timing of the valves adjustable so that when running at ground level the power developed by the engine can be reduced to such an extent as not to overstress the engine, and then readjusting the timing at higher altitudes in order to get the full benefit of the high compression ratio and develop the maximum power of which the engine is capable.

This invention is applied to engines of the type in which the valve-operating mechanism comprises a cam-shaft driven through a train gearing which is of an epicyclic type; that is to say, a train of gearing in which two coaxial gear-wheels are coupled by another gear-wheel or -wheels which are not coaxial with them. The last-mentioned wheel or wheels may in the normal operation have a planetary movement, in which case the train is a true epicyclic gear, or their axis of rotation may be normally stationary, in which case the train is of an epicyclic type although it is not in normal operation an epicyclic gear.

According to this invention, there is provided in an internal-combustion engine, the combination with valve-operating mechanism which comprises a cam-member driven through an epicyclic type of gear-train whereof one of the elements is normally held stationary, of means for moving said element whilst the gear is in operation to permit adjustment of the timing of the valves to vary the power developed by the engine.

This invention also covers the application of the said adjustment to the valve-operating mechanism described in the specification of British Patent No. 180,436 the adjusting movement being imparted to the normally-stationary internally-toothed rack mentioned in that specification.

In the accompanying drawings—

Figure 1 is a sectional elevation showing the crank-shaft of an internal-combustion engine and gearing whereby the valve-operating cams are driven, with the present invention applied to such gearing;

Figure 2 is an end view of Figure 1 partly in section;

Figure 3 is a plan of Figure 2;

Figure 4 is an end view partly in section showing a detail of a modified construction;

Figure 5 is a plan of Figure 4;

Figure 6 is a longitudinal section of the parts shown in Figure 4.

Like reference characters indicate like parts throughout the drawings.

In the arrangement illustrated in Figures 1 to 6, this invention is shown as applied to a valve-operating mechanism of the type described in the specification of British Patent No. 180,436.

Referring to Figures 1 to 3, the rotatable crank-shaft of the engine is indicated at 10, and the stationary crank-case at 11. An eccentric 12 is keyed on the crank-shaft to rotate therewith, and it carries rotatably mounted upon it a sleeve 13 carrying a spur-gear 14 at one end and an internally-toothed wheel 15 at the other end. The internally-toothed wheel 15 meshes with a wheel 16 which is rotatable on the crank-shaft 10 but which is bolted to a drum or casing 17; the operating-cams for the inlet- and exhaust-valves of the engine are formed on the outer periphery of this drum 17 as indicated at 18.

The spur-gear 14 aforesaid meshes with an internally-toothed rack 19, and, as described in our prior specification aforesaid, this rack was stationary, being secured on the crank-case 11.

The feature of the present invention is

that this rack 19 is adjustable, being made capable of a slight rotation about the axis of the crank-shaft with which it is concentric. Although it is adjustable, it is normally stationary in the operation of the mechanism, and constitutes a stationary sun-wheel with which the spur-wheel 14 meshes, having a planetary movement.

The double planetary train of gears 19, 14, 15, 16, determines, so long as the gear 19 is stationary, the angular relationship between the crank-shaft 10 and the cams 18, but if the gear 19 receives a rotational movement, this angular relationship becomes modified. In practice, as applied to an aero-engine, the cam is retarded to give a late closing of the inlet-valve when the engine is running at ground level.

As the aircraft rises to higher altitudes, the setting of the cam relatively to the crank-shaft is advanced, so as to advance the closing of the inlet-valve until, with maximum advance, the full compression ratio of the engine is made available and the maximum power is thereby developed. In practice it is possible to retard the inlet cam to such an amount that the engine develops say about 80% of what would be its normal full power when at ground level, and then at an altitude of say, 6,000 feet, when the full compression ratio can be utilized, the same power can be developed; in other words, there is no falling-off in power due to the increased altitude of the engine, and the power which is developed is the maximum for which the engine is designed.

The means for effecting the angular adjustment of the gear 19 is shown most clearly in Figure 2. The gear 19 is mounted in a bearing 31 (see Figure 1) on the crank-case, and its outer periphery is formed at opposite ends of a diameter with two sets of worm-wheel teeth 20, two such sets being provided in order to balance the forces acting on the gear and to secure ease of adjustment. The bearing 31 is interrupted to accommodate these teeth. These teeth 20 are engaged by worms 21 mounted on shafts 22, 23 which are rotatable in suitable bearings 24 on the crank-case of the engine. The angular movement of the worms 21 is effected by rotating their shafts 22, 23, and for this purpose the shafts are provided with arms 25, 26 respectively which are coupled by a tie-rod 27. The arms 25, 26 are so disposed relatively to one another that the shafts 22, 23, are rotated in the appropriate direction for their worms to impart rotation to the gear 19.

The shaft 23 carries a second arm 28 coupled by a link 29 to a lever 30 which is in turn coupled by any convenient means to an operating lever in the pilot's cock-pit of the aircraft. Movement of the pilot's lever

rocks the lever 30 and this movement is transmitted through the link 29 to the shafts 23, 22 so that the adjustment of the gear 19 can be easily effected even whilst the engine is running.

Figures 4, 5 and 6 illustrate a slightly modified construction. Instead of using a worm-gear to effect the rotation of the gear 19, it is provided at one point on its periphery with a radially-extending bracket 32 which is engaged by a pin 33 carried on an arm 34 on a spindle 35. This spindle is capable of a slight rotational movement in its bearing 36 on the crank-case 11, and the parts are so disposed that this rotation of the spindle imparts the desired small rotatory movement to the gear 19. The spindle 35 is connected in any convenient manner, as for example, by the lever 37 fast on it to the pilot's control-lever.

Adjustable stops may be provided to limit the angular movement of the gear 19, and these are conveniently constituted by bolts 38 mounted in the crank-case or a part carried thereby, as shown in Figure 4, these bolts engaging the bracket 32 aforesaid or some other convenient part carried by the gear 19.

In order to facilitate the adjustment of the gear it is preferred to make the bush 36 eccentric, that is to say, its outer periphery is cylindrical, and is eccentric from the bore which receives the spindle 35. With this construction the position of the gear-wheel can be adjusted in the initial timing of the engine, and then the bush 36 and spindle 35 can be set in the most convenient angular relationship to enable the pin 33 to impart the desired adjusting movement to the gear 19, it being appreciated that when the bush 36 has been adjusted it has been locked in place and the adjusting control is effected by rotation of the spindle 35 in it.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An engine crank case for accommodating epicyclic valve operating gearing having adjustable advancing and retarding means, having an opening in one end through which the crank shaft of the engine is adapted to pass, said crank case having a portion overhanging the crank shaft when in position and spaced thereabout, and a support mounted on said portion overhanging the crank-shaft and disposed in position to provide a space between the support and the crank shaft for accommodating an epicyclic valve operating gearing on the crank shaft, and means on the crank case for supporting the adjustable advancing and retarding means of said gearing.

2. An engine crank case for accommodating a crank shaft and an epicyclic valve operating gearing on the shaft and provided with adjustable means for advancing and retard-

ing the gearing, having a portion adapted to enclose a crank shaft and provided with means for mounting the adjustable advancing and retarding means, and a support
5 mounted on the crank case adapted to encircle the crank shaft and spaced therefrom for accommodating within the support the epicyclic valve operating gearing on the

crank shaft, said support arranged in line with and adapted to support the adjustable 10 element of said gearing.

In testimony whereof we have signed our names to this specification.

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