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J. L. BOYER

VALVE OPERATING MECHANISM FOR INTERNAL COMBUSTION ENGINES

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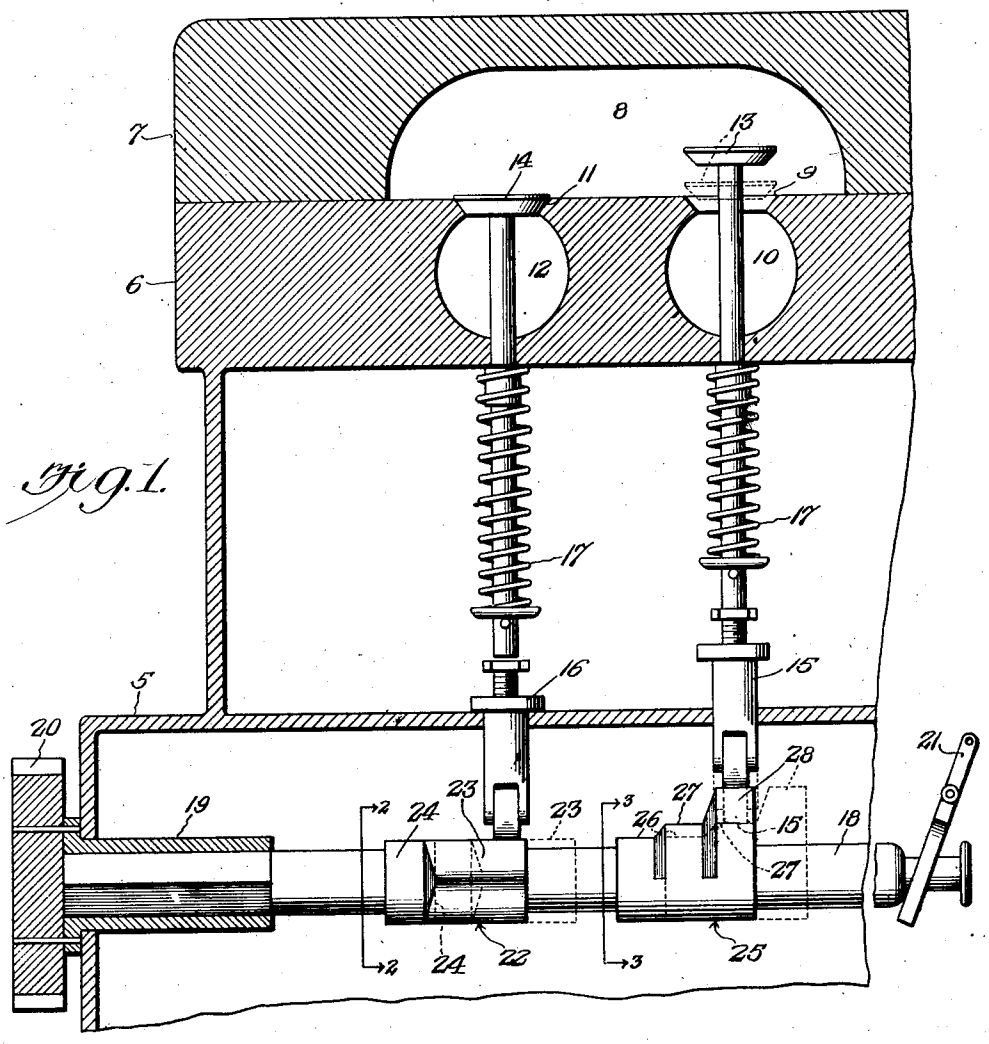


Fig. 1.

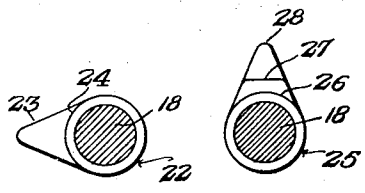


Fig. 2. Fig. 3.

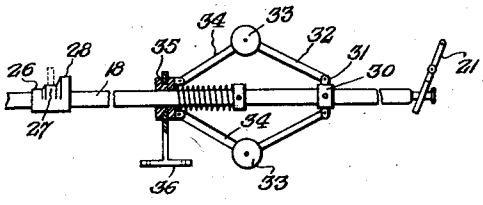


Fig. 4.

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UNITED STATES PATENT OFFICE.

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VALVE-OPERATING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

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To all whom it may concern:

Be it known that I, JAMES L. BOYER, a citizen of the United States, residing at Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Valve-Operating Mechanism for Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to valve operating mechanism for internal combustion engines, and has particular reference to improved means for regulating the speed and power of the engine by providing mechanism whereby the extent of opening of the intake and exhaust valves may be manually or automatically controlled.

The object of my invention is to provide an improved cam shaft for operating the intake and exhaust valves of an internal combustion engine, the said cam shaft being provided with cam surfaces of varying height to selectively vary the extent of opening of the valves.

A further object of my invention is to provide a longitudinally shiftable cam shaft having stepped valve-operating cam surfaces mounted thereon, and to provide manual or automatic means for presenting the desired cam surface beneath the valve stem or tappet, to vary the extent of opening of the intake valve to thus control the volume of combustible mixture admitted to the cylinder or cylinders.

A further object of my invention is to provide a valve operating mechanism including a cam shaft having cam surfaces for operating the intake and exhaust valves of an internal combustion engine in a variable manner, and which is controllable to permit the valves to remain in closed position and thereby set up in the cylinder of the engine alternate suction and compression which yieldably resist to a proper degree the movement of the pistons within the cylinders of the motor and thereby brake or retard the progress of a vehicle in which the motor is mounted.

A still further object of my invention is to provide a device of the above mentioned character that is simple in construction, reliable in operation, and highly efficient in the purposes for which designed.

In the accompanying drawings forming a part of the specification and in which like numerals are employed to designate like parts throughout the several views,

Fig. 1 is a fragmental view partly in section and partly in elevation showing an internal combustion engine in which my invention is embodied,

Fig. 2 is a sectional view on the line 2—2 of Fig. 1, showing the relative form and position of the exhaust valve operating cams,

Fig. 3 is a sectional view on the line 3—3 of Fig. 1, showing the relative form and position of the intake valve operating cams, and

Fig. 4 is a fragmentary diagrammatic view partly in section and partly in elevation and showing a control including speed responsive means for automatically shifting the cam shaft.

Referring to the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral 5 designates a conventional crank case structure, supporting the cylinder block 6, and the removable cylinder head 7. Within the cylinder head 7 is a chamber 8 communicating with the explosive chamber of the engine cylinder, and this chamber 8, is adapted to receive the combustible mixture for the engine cylinders through the valve controlled opening 9 leading from the passage 10, connected with the carbureter and intake manifold of the engine. The exhaust from the engine cylinders passes through the exhaust opening 11 and discharges through the passage 12. The intake and exhaust openings 9 and 11 are controlled by the intake and exhaust valves 13 and 14, respectively, actuated by the valve tappets 15 and 16 and normally held in closed position by the valve springs 17. All of the above construction is conventional and well known in the art and of itself and per se forms no part of my present invention.

My invention particularly resides in the means for actuating and controlling the intake and exhaust valves 13 and 14, to provide for a novel regulation and control of the admission and exhaust of the motive fluid to and from the cylinders and also to permit the valves to remain closed to obtain a braking action when the same is desirable. To this end there is provided a longitudinally shiftable cam shaft 18, the forward end of which is mounted in a bearing sleeve 19 driven by the timing gear 20. The for-

ward end of the cam shaft 18 is squared and is slidably mounted in a correspondingly squared opening in the bearing sleeve 19, so that while the shaft 18 is free to move axially with respect to the bearing sleeve it is constrained to partake of the rotary movement thereof. Adjacent the opposite end of the shaft 18 from that to which the timing gear 20 is connected, the shaft 18 is rotatably and slidably mounted in a second bearing (not shown). The shaft 18 is adapted to be longitudinally shifted by means of a pivoted lever 21, having a forked end operatively associated with a grooved portion of the shaft 18. The movement of the lever 21 is controlled by the operator of the engine.

Fixedly mounted on the longitudinally shiftable cam shaft 18 and rotatable and longitudinally shiftable therewith is an exhaust-valve operating cam designated generally by the numeral 22, and comprising a relatively long cam surface 23, and a plain surface 24, which is concentric with the shaft 18 and only slightly larger than the diameter of the said shaft. Fixedly mounted on the shaft 18 and rotatable and longitudinally shiftable therewith is a second cam designated generally by the numeral 25, for operating the intake valve 13. The cam 25 comprises, first, a plain surface 26, which is concentric with the shaft 18 and only slightly larger than the diameter of the said shaft; secondly, a low cam surface 27; and thirdly a high cam surface 28. It is to be understood that the cams 23 and 27 and 28, are so angularly positioned on the shaft that their rotation with the shaft 18, driven by the timing gear 20, effects the opening and closing of the intake and exhaust valves at the proper point in the operation of the engine cycle; that is, on the intake stroke of the piston in a four cycle engine, the intake valve 13 is normally opened and the exhaust valve 14 is closed; on the compression stroke and power stroke, both valves are in closed position; and on the exhaust or scavenging stroke, the exhaust valve 14 is normally open and the intake valve 13 closed. It is to be further understood that the combined width of the cams 27 and 28 is approximately equal to the entire width of the cam 23.

When the motor vehicle is operated at speeds not in excess of approximately thirty miles per hour and on a level roadway the cam shaft 18 is positioned as illustrated in dotted lines in Fig. 1. In such adjustment the cam surface 27 is positioned to coact with the valve tappet 15 and at the proper time in the engine cycle, the intake valve is open partially but not to the maximum extent. The exhaust valve 14 is opened to the maximum extent by the action of the cam surface 23 on its tappet 16. It is considered most advisable to open the exhaust valve to its fullest extent whenever the engine is in operation, since this promotes thorough and efficient scavenging. The partial opening of the intake valve at low and moderate engine speeds on a level road is consistent with the demands and requirements of the engines and enables a greater mileage per gallon of gasoline to be had. It also limits the speed of the engines and thus acts as a governor.

When the motor vehicle is operated at high speeds or on grades, the shaft 18 is positioned as shown in full lines in Fig. 1, so that the cam surface 28 coacts with the valve tappet 15 to open the intake valve 13 to the maximum extent. The cam surface 23 coacts with the valve tappet 16 as before. By increasing the extent to which the intake valve 13 is opened, the volume of the combustible mixture drawn into the engine cylinder on each suction stroke is correspondingly increased and hence an increase of speed and power may be had.

If the shaft 18 is shifted to the extreme right as viewed in Figure 1, and the surfaces 24 and 26 brought into engagement with the tappets 16 and 15 respectively, the valves 14 and 13 will remain closed notwithstanding the rotation of the cam shaft. This adjustment is used on down grades or whenever it is desirable to brake or retard the movement of the vehicle, for with the valves closed the movement of the pistons in the cylinders will be resisted by the suction and compression set up therein. As the engine is operatively connected to the traction wheels of the vehicle, this braking of the engine retards the movement of the vehicle. It is to be understood that when the valves are permitted to remain closed in the manner described, the engine is not running or functioning as a power plant. Whenever the engine is running, its cycle is not disturbed but only the extent or degree of opening of the intake valve is varied. The provision of the concentric smooth surfaces 24 and 26 also make it possible and convenient to simultaneously set all of the valves. The invention is adapted to be embodied in an engine having any number of cylinders and the advantages and capacities herein set out are had in each and every cylinder irrespective of the number of cylinders employed.

The cam shaft 18 may be shifted to the several positions above described in any suitable manner, either manually or automatically. The manual shifting of the shaft may be effected by the lever 21, hereinabove described. The automatic shifting may be carried out by any suitable automatic device, one type of which will be hereinafter described. When the lever 21 is utilized to shift the cam shaft 18 it is proposed to use any suitable type of motion transmission

means, any suitable system of levers or any suitable form of gearing to control the lever from the driver's seat.

The cam shaft 18 may also be automatically shifted, and for the sake of illustration one type of means for effecting automatic operation is shown in Fig. 4. With the automatically operated device the lever 21 and the grooved portion of the shaft 18 with which it coacts may also be used as shown in Fig. 4. The end of the shaft 18 opposite the timing gear 20 has, fixed thereto a collar 30 and is provided with lugs 31, pivotally connected to one end of each member of a pair of links 32, the opposite ends of said links 32 being connected to balls or weights 33. A second pair of links 34 are connected to the weights 33 and to a collar 35. The collar 35 is held against axial movement with respect to the shaft 18 but the shaft is freely movable through the collar. For the sake of illustration the collar 35 is shown as provided with a peripheral groove in which the forked end of a bracket 36 is fitted, the bracket being attached to the adjacent stationary structure of the engine. It is to be understood that any suitable type of speed responsive device may be as advantageously utilized to shift the cam shaft 18 automatically as the type just described. With the speed responsive device shown in Fig. 4, when the engine is running at high speed the centrifugal force acting on the balls 33 will be effective to shift the shaft 18 to the left as viewed in Figs. 1 and 4. This action of the speed responsive device is of course against the action of a coil spring 37 such as is usually employed, and when the engine slows down this spring 37 is effective to move the shaft to the right as viewed in Figs. 1 and 4. The action of the speed responsive device is limited to shifting the surfaces 27 or 28 into or out of cooperative engagement with the tappet 15 of the intake valve 13, and this action or shifting of the cam 25 is accompanied by a corresponding shifting of the cam 22. Preferably the manual control means 21 is employed to shift the shaft 18 to such an extent as is necessary to bring the surfaces 24 and 26 into engagement with the tappets 16 and 15.

It is to be understood that the form of my invention above described is to be taken as a preferred embodiment of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or scope of the subjoined claims.

Having thus described my invention, I claim:—

1. A valve operating mechanism for use with internal combustion engines having an intake and an exhaust valve and comprising a shiftable cam shaft; a cam for the intake valve fixed to the shaft and having a smooth surface concentric to the shaft and adapted to permit the intake valve to remain in closed position when brought into cooperative relation therewith, said cam also having a plurality of stepped cam surfaces adapted to be selectively aligned with the intake valve, one of said cam surfaces being adapted to open the intake valve to the maximum extent and the other being adapted to open the intake valve to a predetermined extent less than the maximum; a cam for the exhaust valve fixed to the shaft and having a wide cam surface cooperable with the exhaust valve when any of the stepped cam surfaces are cooperating with the intake valve, the cam for the exhaust valve also having a smooth surface concentric to the shaft and adapted to permit the exhaust valve to remain in closed position when brought into cooperative relation therewith; and control means for shifting said cam shaft.

2. A valve operating mechanism for use with internal combustion engines having an intake and an exhaust valve, comprising a longitudinally shiftable cam shaft; a cam for the intake valve fixed to the cam shaft and designed to effect the operations of said intake valve; and a cam for the exhaust valve fixed to the cam shaft and designed to effect the operations of said exhaust valve, each of said cams having a smooth surface concentric to the shaft and designed to permit all of said valves to remain in closed position to provide for convenient and simultaneous setting of the valves and also to provide for braking the engine.

3. A valve operating mechanism for use with internal combustion engines having an intake and an exhaust valve and comprising a shiftable cam shaft; a cam for the intake valve fixed to the shaft and having a smooth surface concentric to the shaft and adapted to permit the intake valve to remain in closed position when brought into cooperative relation therewith, said cam also having a plurality of stepped cam surfaces adapted to be selectively aligned with the intake valve, one of said cam surfaces being adapted to open the intake valve to the maximum extent and the other being adapted to open the intake valve to a predetermined extent less than the maximum; a cam for the exhaust valve fixed to the shaft and having a wide cam surface cooperable with the exhaust valve when any of the stepped cam surfaces are cooperating with the intake valve, the cam for the exhaust valve also having a smooth surface concentric to the shaft and adapted to permit the exhaust valve to remain in closed position when brought into cooperative relation therewith, and control means for shifting said cam shaft, said control means including a manu-

ally operable lever and a speed responsive device.

4. A valve operating mechanism for use with internal combustion engines having an intake and an exhaust valve and comprising a shiftable cam shaft; a cam for the intake valve fixed to the shaft and having a plurality of stepped cam surfaces adapted to be selectively aligned with the intake valve, one of said cam surfaces being adapted to open the intake valve to the maximum extent and the other being adapted to open the intake valve to a predetermined extent less than the maximum; a cam for the exhaust valve fixed to the shaft and having a wide cam surface cooperable with the exhaust valve when any of the stepped cam surfaces are cooperating with the intake valve, and control means for shifting said cam shaft, said control means including a speed responsive device.

In testimony whereof I hereunto affix my signature.

JAMES L. BOYER.