Oct. 31, 1939. C. L. WALKER 2,178,152

BRAKE CYCLE FOR INTERNAL COMBUSTION ENGINES

Filed March 14, 1938

Fig.1.

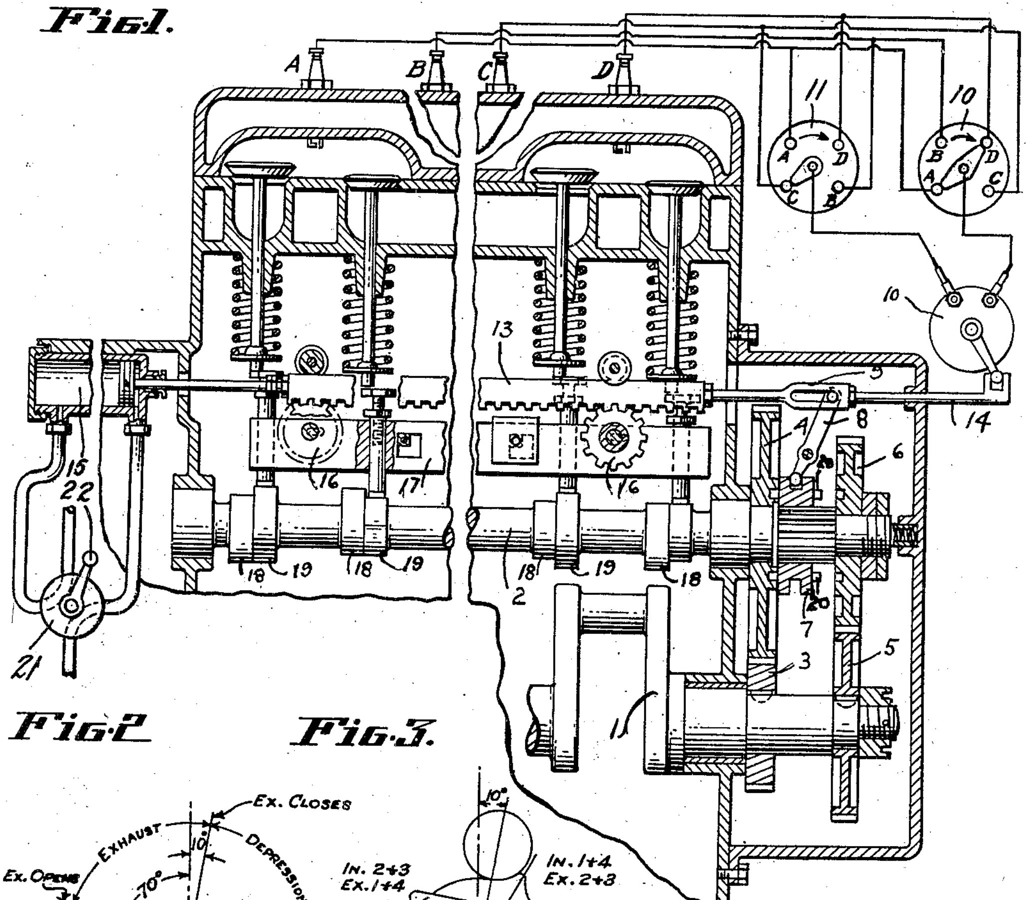


Fig.2

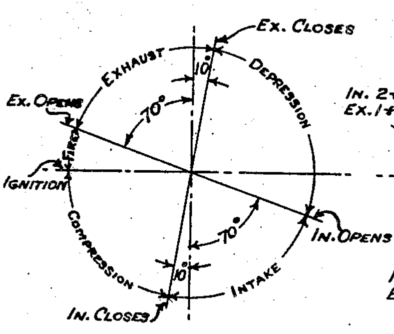


Fig.3.

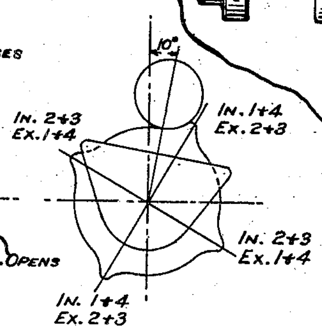


Fig.4.

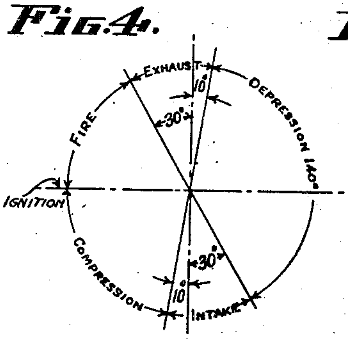
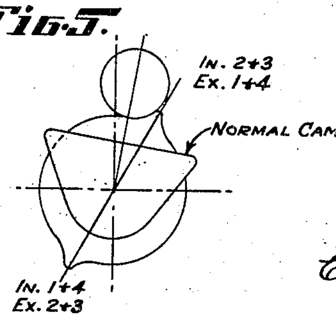


Fig.5.



INVENTOR.

Clinton L Walker

Patented Oct. 31, 1939 2,178,152

UNITED STATES PATENT OFFICE

2,178,152

BRAKE CYCLE FOR INTERNAL COMBUSTION ENGINES

Clinton L. Walker, Piedmont, Calif.

Application March 14, 1938, Serial No. 195,705

13 Claims. (Cl. 123—97)

This invention pertains to internal combustion engines and more particularly to a cycle for such engines whereby to produce resistance to onward rotation when the engine is driven by an outside force, such for instance as when a vehicle equipped with such an engine is descending a steep grade. Such an engine would have to be capable of operating on the normal power cycle and have means for shifting to the resistance cycle under control of the operator.

The prior art discloses various means for increasing the resistance of the motor when driven from an outside power being mostly by means of auxiliary cams to relieve the compression at top center, one releases the compression at top center and the suction stroke at bottom center. Applicant has a copending application covering a resistance structure of this general nature and he has built and operated a vehicle equipped with such a motor and has found that the arrangement offers considerable resistance to the motor. However applicant believes that the resistance added by such means is not sufficient and the present application is for a system which will offer far greater resistance than any of the above-mentioned types. The art discloses one Patent No. 1,160,659, issued in November of 1915 for a resistance structure or system which provides the resistance of an explosion ignited adjacent bottom center for each cycle of four strokes. This is accomplished by merely advancing the spark approximately 180 degrees, and by providing auxiliary cams to actuate the valves in the proper order to relieve the exhaust at top center but such structure is not disclosed in the patent. This arrangement or suggestion would add more resistance than any of the nonexplosive resistance types. By the present invention I propose to improve on the explosive type just referred to by adapting it to a two-stroke cycle type of motor and with means to convert a four-stroke cycle motor into a two-stroke cycle motor on the resistance cycle. By such means it is obvious that the number of resistance explosions will be doubled. I also add the resistance of partial vacuum on the intake stroke for each revolution by opening the intake valve as near to bottom center as is found desirable with due regard for an adequate intake period. Applicant has reduced this invention to practice using a Ford vehicle. Means were provided for actuating the cam shaft at crank shaft rotation speed, auxiliary cams were provided on the cam shaft, means for shifting from one cycle to the other were provided, the intake on the resistance cycle opened at about 45 degrees before bottom center, and closed at about the usual position. Compression was carried to half of the upstroke of the piston when ignition took place. The exhaust opened as near to top center as could be provided and still have the exhaust close at about ten degrees past top center. It will be observed that in shooting four explosions in two cycles that it is necessary to shoot two per stroke so that an auxiliary ignition system was necessary of the type known as two-spark ignition whereby two cylinders are ignited at the same instant. In such a system it is desirable to reduce the opening of the valves so as to provide as long partial vacuum and explosion strokes as possible. On this account it is preferable to actuate the cam shaft at crank shaft rotation speed rather than to accomplish a similar result by the addition of twice the number of auxiliary cams for the resistance cycle, for it is obvious that the time period in the latter case is just twice what the period would be with a given cam profile with the cam shaft operating at crank shaft rotation speed. For this reason and for the simplification of the auxiliary ignition for the resistance cycle I prefer to rotate the cam shaft at crank shaft speed.

This application is directed to the resistance cycle and with means for shifting from the normal cycle to the two-stroke cycle whereas my copending application Serial No. 99,924 filed in September, 1936, is directed to the mechanical means for shifting from the normal to the auxiliary cam actuating positions. The exact cycle will have to be determined by experiment and for the particular motor and its requirements. The exact timing of the opening and closing of the valves, the degree of compression prior to ignition should be determined by experiment to produce the results desired. In my reduction to practice I determined the valve openings and closings and the point of ignition by estimation and found by actual tests of the car on a steep hill that the resistance was ample even with only a partially opened throttle to stop the car in a short space, in fact I was able to skid the rear tires on a dry pavement. From my tests it appears that such an arrangement might offer too much resistance and be too harsh and hence the timing of the valves and ignition would have to be determined to avoid an excess of resistance over the amount required. The resistance however is under control of the operator through the use of the throttle control of the intake.

One form which the invention might take is illustrated in the accompanying drawing in which:

Fig. 1 is a longitudinal section showing the means for shifting the cams, for changing the cam shaft rotational speed and for actuating the switch from one set of ignition to the other when changing the cycle.

Fig. 2 is a diagram showing the duration of the various periods of the cycle when the cam shaft speed is the same as for the normal power cycle.

Fig. 3 shows the normal cams and the cams for the resistance cycle when the cam shaft rotates at half crank shaft speed.

Fig. 4 is a diagram showing the periods of the various elements of the cycle using the same type of cam and follower as in Fig. 3 but with the cam shaft turning at crank shaft speed.

Fig. 5 shows the normal cams and the cams for the resistance cycle.

1 is the crank shaft of the motor, 2 is the cam shaft, 3 and 4 are the normal timing gears for the four stroke cycle, 5 and 6 are the timing gears for the resistance two-stroke cycle, 7 is a sliding dog clutch mounted on a splined section of the cam shaft whereby either set of timing gears may be engaged with the cam shaft, 8 is a shifting lever for actuating the dog clutch, 9 is a push rod attached to the rack 13 to actuate shifting lever 8, 10 is a switch to control the dual ignition for the two cycles, 11 and 12 are the two distributors for the two cycles, 14 is a push rod to actuate the switch, 15 is a hydraulic cylinder to actuate the rack, 16 are gears meshing with the rack, 17 is a tappet carrier, 18 are the normal cams and 19 are the cams for the resistance cycle. The balance of the structure is conventional and perhaps needs no special description. The gears 16 carry short shafts with flattened ends of a rectangular cross section which engage in a square opening in the tappet carrier whereby when the gears 16 are partially rotated the tappet carrier will first be lifted carrying the tappets with it high enough for the tappets to clear the tops of the cams, then further rotation of the shafts attached to 16 will shift the carrier longitudinally to the new position where the followers register with the cams for the desired cycle. This mechanism is more fully described in my copending application Serial No. 99,924, filed in 1936.

Figs. 2 and 4 show the advantages of rotating the cam shaft at crank shaft speed as compared to turning it at half crank speed. In Fig. 2 with the cam shaft rotating at half crank speed it is necessary to open the exhaust at 70 degrees before top center as the minimum opening of the exhaust with that profile of cam and with the roller follower as shown is 80 degrees, whereas with the cam shaft at crank speed the period is half that or 40 degrees which permits the exhaust to be opened at 30 degrees before top center as is shown in Fig. 4. Also the intake opening can be delayed and thus get a longer depression period which will add considerable partial vacuum resistance. The operation of the device would be about as follows: When the vehicle reaches the crest of a down grade and the operator wishes to resist gravity by the use of the resistance cycle of his motor he would actuate the hydraulic cylinder by means of valve 21 which in turn would actuate the rack and this would turn gears meshing with the rack. The shafts upon which the gears are mounted have cams on their outer ends which by their first rotational motion by the rack and gears will first lift and then longitudinally shift the tappet carriers to the new position where the cam followers will register with the set of cams for the resistance cycle. During the operation just described the push rod on the outer end of the rack will actuate a dog clutch which will first release the normal cycle timing gear and then engage the resistance cycle timing gear by means of the dog 20 engaging the openings in the gear as shown. The positions of these dogs and the openings must be such that they can engage the openings in the gears in one position only so as to assure that the gears will be engaged to the cam shaft in proper phase with the crank shaft. At the same time these other operations just described are taking place the switch will be shifted from the normal cycle ignition to the resistance cycle system, being a two-spark system whereby the cylinders are fired in pairs, 1 and 4 shooting together and 2 and 3 likewise, the pairs at 180 degrees interval. The intensity of the resistance will be under the control of the operator to the same extent and in the same manner as the power of the motor on the normal cycle is under his control. In places where this resistance is still too much for the grade of the highway at that point it would be only necessary to shut off the ignition and have merely the resistance of the motor as a compressor exhausting at top center. The design of the system offers a considerable range in the height of lift of the valves, the duration of the intake, the extent of the compression and the timing of the advance of the spark and the opening of the exhaust.

The change from one cycle to the other is made by the operator through the medium of an oil actuated piston in the cylinder 15 under control of a valve 21 which communicates with a source of fluid pressure. This valve is so designed that when oil is admitted under pressure to one side of the actuating piston it opens a relief valve in the opposite end of the cylinder. This piston as is shown is connected to the rack and the rack is connected with a push rod which actuates the means for shifting the cam shaft gear clutch and actuates also the control switch for the two sets of ignition systems. Thus the transition of the piston from one end of the cylinder to the other shifts the tappets, changes the speed of rotation of the cam shaft and shuts off one ignition system and turns on the other thereby making a complete change in the operating cycle with a single movement of the control lever 22 of the fluid control valve.

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

1. In an internal combustion engine, means to resist the forward rotation of said engine when driven by an external power, said resistance means including the resisting power created by the explosion in one cylinder of said engine per revolution of said engine, said resisting power tending to rotate the engine in an opposite direction of rotaton to that of the external force driving the engine.

2. In an internal combustion engine, means to resist the forward rotation of said engine when driven by an external power, said resistance being due to the force of one explosion and one depression stroke per cylinder per revolution of said engine in opposition to the force driving the engine.

3. A two-stroke cycle for an internal combustion engine whereby to resist the forward

rotation of said engine when driven by an external power said cycle having one stroke for the intake and the other for compression, firing and exhaust.

4. An internal combustion engine capable of operation on the conventional four-stroke cycle or on a two-stroke resistance cycle, said resistance cycle producing a power to resist the forward rotation of said engine when driven forward by an external power, means to change from either cycle to the other under control by the operator.

5. An internal combustion engine having means to be operated on the normal four-stroke cycle or on a two-stroke resistance cycle, said resistance cycle being capable of resisting the forward rotation of the engine when driven by an exterior power.

6. In an internal combustion engine operable on the normal four-stroke cycle or on a two-stroke resistance cycle, separate ignition systems for each cycle, one for the normal four-stroke cycle and the other for the two-stroke resistance cycle, the latter being of the two-spark ignition type whereby to fire the cylinders in pairs.

7. In an internal combustion engine operable on the normal four-stroke cycle or on a two-stroke resistance cycle, means to change the relative rotational speed of the cam shaft with respect to the rotational speed of the crank shaft from the normal one-to-two ratio to one-to-one ratio for the resistance cycle or vice versa, means to shift the relative positions of the tappets to either one of the dual sets of cams on the cam shaft whereby to actuate the valves in proper timing for each cycle, means to actuate a selective control switch as between the separate ignition systems for each cycle, interconnected control means between said separate controls whereby the operator may actuate all three controls with one master control.

8. In an internal combustion engine for driving an element in rotation in one direction, means changing the operating characteristics of said engine to produce explosive power which tends to rotate the element in the opposite direction, said means embodying a change in the cycle of engine operation.

9. In an internal combustion engine for driving an element in rotation in one direction, means changing the operating characteristics of said engine to produce explosive power which tends to rotate the element in the opposite direction, said means embodying a change in the ignition and valve operation timing.

10. In an internal combustion engine means providing four cycle operation in one direction, and means changing the operating characteristics of said engine to produce operation on two cycles in the opposite direction.

11. In an internal combustion engine for driving an element in rotation when the valves thereof are operated in a predetermined manner, means for changing the operation of said valves to produce explosive power which applies a brake load to said element.

12. In an internal combustion engine for driving an element in rotation in one direction, means changing the operating characteristics of said engine to produce explosive power to apply a brake load to said element, and means for controlling the amount of power and resulting brake load produced by said engine.

13. An internal combustion engine having a piston for driving a crank shaft, a cam shaft, and valves, means driven in rotation by said crankshaft when fuel delivered by a valve is fired on the driving side of said piston, and means for changing the period of delivery of said fuel and the firing time to produce explosive power to resist normal movement of said piston to apply a brake load to said driven means.

CLINTON L. WALKER.