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IDLING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINE

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Fig. 1

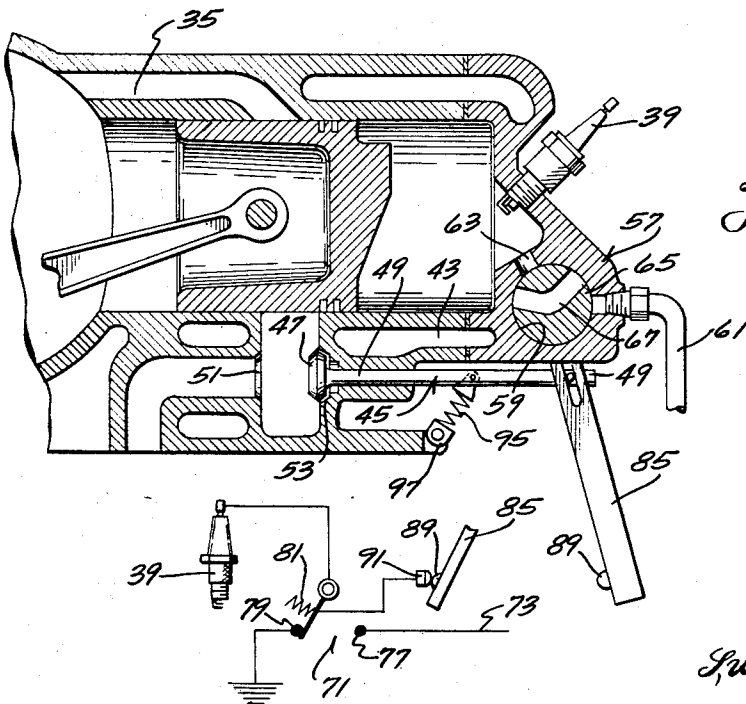
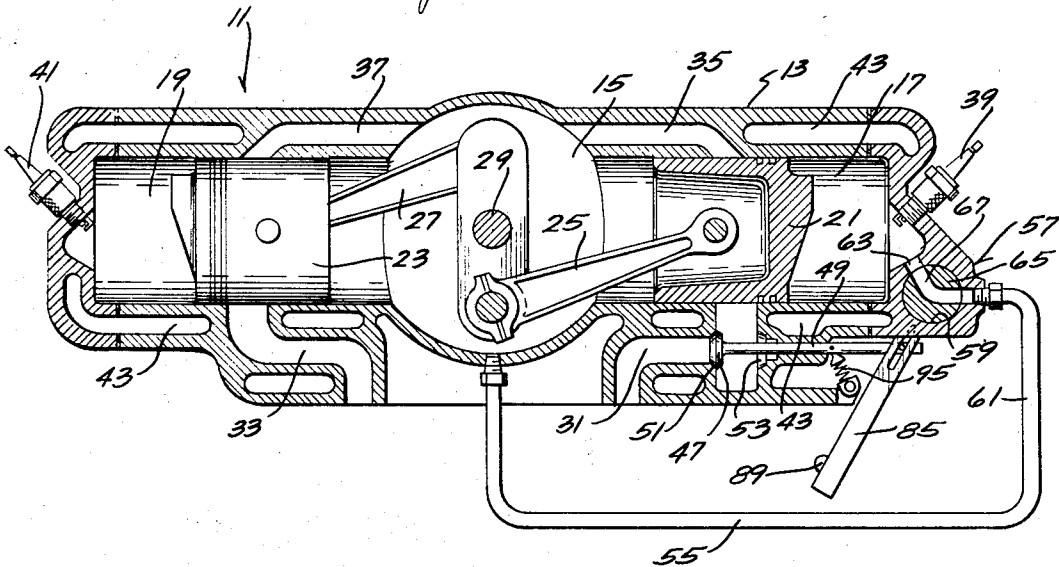


Fig. 2

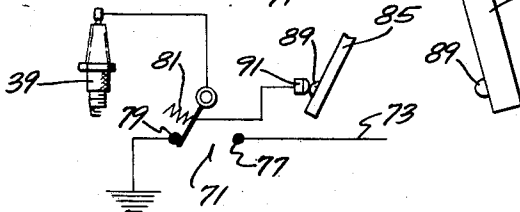


Fig. 3

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IDLING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINE

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ABSTRACT OF THE DISCLOSURE

Disclosed herein is a twin cylinder opposed two cycle engine including a valve in the exhaust passage extending from one of the cylinders, said valve being displaceable between a duct closing and a duct opening position, together with means for selectively displacing the valve between the two positions. Also disclosed herein is an electrical circuit for grounding or otherwise rendering inoperable a spark plug associated with said one cylinder when the exhaust duct is closed. Also disclosed herein is a conduit extending from said one cylinder to the crankcase and valve means for selectively opening and closing the conduit.

The invention relates generally to twin-cylinder opposed, two-cycle engines. More particularly, the invention relates to arrangements for improving the idling or low speed performance of such engines.

One of the objects of the invention is to provide a twin-cylinder opposed, two-cycle engine which, during idling or no-load operation, is provided with means for inactivating one of the cylinders including means closing the exhaust duct from said one cylinder so as to prevent loss of fuel. There is also desirably provided means affording continuous fluid flow or connection between said one cylinder and the crankcase, and means grounding or otherwise rendering inoperable the spark plug associated with said one cylinder.

In accordance with the invention, there is provided an operating lever which, in response to shifting from an idling or no-load position to a high speed or load position, serves to open the exhaust duct, serves to close off the continuous fluid connection between the cylinder and the crankcase, and serves to afford normal operation of the spark plug. Preferably, the lever is biased by an over-the-center arrangement so that it is self-retained in either the high speed or low speed positions and so as to reliably seat the valve which closes off the exhaust duct.

Also in accordance with the invention, the continuous fluid flow feature is provided, in part, by a conduit which terminates adjacent to the spark plug in said one cylinder and in position so that gaseous flow to and from the cylinder during idling operation passes the spark plug and serves to keep the spark plug clean. The pulsating flow to and from/between the conduit and the crankcase also serves to increase turbulence in the crankcase, thereby aiding in providing proper lubrication.

From the foregoing, it is obvious that another of the objects of the invention is to provide an idling arrangement for a twin-cylinder opposed, two-cycle engine in which firing operation of one of the cylinders is discontinued during idling operation in such manner that the spark plug in the non-operating cylinder is retained clean and in such manner that increased turbulence is provided in the crankcase so as to maintain effective lubrication notwithstanding relatively slow operating speed. Thus, there is provided an idling arrangement which is economical on fuel and which does not detract from full capacity operation of the engine.

Other objects, advantages, and features of the invention

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will become known by reference to the following description and the accompanying drawings of one embodiment of the invention in which:

FIGURE 1 is a sectional view of an engine incorporating various of the features of the invention and including a diagrammatic showing of the electrical system connected to the spark plug. In FIGURE 1, the various components are shown in the non-load position;

FIGURE 2 is an enlarged, fragmentary sectional view of a portion of the engine illustrated in FIGURE 1 and showing the components in their high-speed or load position; and

FIGURE 3 is a diagrammatic view of a switching circuit embodied in the engine shown in FIGURE 1.

Shown in FIGURE 1 is a two-cylinder opposed, two-cycle engine 11 including an engine block 13 defining a closed crankcase 15 and two cylinders 17 and 19 extending oppositely from the crankcase 15. Respectively reciprocable in the cylinders 17 and 19 are pistons 21 and 23 which are respectively connected to piston rods 25 and 27 rotatably joined to a crankshaft 29 which is suitably journaled in the engine block 13 and extends through the crankcase 15.

As is usual in two-stroke engines, the cylinders 17 and 19 respectively communicate with exhaust ducts 31 and 33 which are open to the atmosphere and with transfer or bypass passages 35 and 37 which communicate with the crankcase and which, during normal operation, supply fuel to the cylinders when the pistons are adjacent to bottom dead center. As is also conventional, the cylinders 17 and 19 have fixed therein respective spark plugs 39 and 41, and the engine block 13 is provided with a water jacket 43 for cooling purposes. As thus far described, the construction is entirely conventional.

In accordance with the invention, there is provided an arrangement whereby during low speed, idling, or no-load conditions, one of the cylinders, i.e. the cylinder 17, is shut down, and engine operation is continued by firing in the other cylinder 19. The disclosed construction provides for preventing loss of fuel through the deactivated cylinder 17 and provides for cessation of normal spark plug operation in the deactivated cylinder 17. Such measures, while desirable enough, may contribute to spark plug fouling. Such fouling is, however, prevented in accordance with the present invention.

More specifically, in accordance with the invention, means are provided for closing the exhaust duct 31 of the cylinder 17 under no-load operation so as to conserve fuel. While various arrangements can be employed, the disclosed construction utilizes a valve member 45 which includes a head 47 and a stem 49 and which is reciprocable between a duct closing position (shown in FIGURE 1) wherein the head 47 is engaged with an annular seat 51 circumferentially extending around a part of the exhaust duct 31, and a duct opening position (shown in FIGURE 2) wherein the head 47 is withdrawn into a seat or cavity 53 adjacently arranged with respect to the water jacket 43 so as to obtain optimum cooling of the valve member 45.

Also in accordance with the invention, means are provided for selectively affording continuous fluid communication between the crankcase 15 and the cylinder 17. While various arrangements can be employed, in the disclosed construction such means includes a conduit 55 which extends between the crankcase 15 and the cylinder 17. Specifically, the conduit 55 terminates at the cylinder 17 in such position as to effect passage of gases flowing into and out of the conduit 55 past the spark plug 39, thereby to maintain the spark plug in clean condition. If desired, the conduit 55 can terminate in an orifice arranged to direct a fluid spray toward the spark plug during

discharge from the conduit. As also shown in FIG. 1, the conduit 55 communicates with the crankcase at the bottom or lowermost part thereof so as to assist in preventing "puddling," i.e. the accumulation of sludges or heavy fluid material in the bottom of the crankcase. It is desirable that the conduit 55 be dimensioned such that, during idling operation, the engine is at least partially loaded as a result of fluid flow through the conduit. However, such loading should not adversely affect cranking during starting operations.

In order to afford fluid flow through the conduit 55 only during no-load operation, i.e., to afford normal firing operation in the cylinder 17 at high speed or load conditions, means are provided for selectively opening and closing the conduit 55. While various means can be employed, in the disclosed construction such means includes a valve 57 comprising a cylindrical cavity 59 communicating with the conduit branches 61 and 63. Rotatably carried in the cavity 59 is a valve body or member 65 having a bore 67 arranged to afford flow through the conduit 55 when the valve body 65 is in one position and arranged to preclude flow through the conduit 55 when the valve member is in an angularly spaced position.

Also in accordance with the invention, means are provided for discontinuing normal operation of the spark plug 39 in the cylinder 17. While various arrangements can be employed, in the disclosed construction such means is in the form of a double throw switch 71 which is selectively operable to connect the spark plug 39 to a conventional ignition system 73 shown fragmentarily in FIGURE 3 or to a ground indicated at 75.

More particularly, the switch 71 is movable between two contacts 77 and 79, the contact 77 being connected to the ignition system 73 and the contact 79 being connected to the ground 75. Normally, the switch 71 is biased by a spring 81 into engagement with the contact 77 to connect the spark plug 39 to the ignition system 73. However, as will be explained, the switch 71 is displaceable against the action of the spring 81 into engagement with the contact 79 so as to ground the spark plug 39.

Means are provided to affect co-ordinated operation of the conduit valve 57, the exhaust duct valve 45 and the switch 71 to afford a normal operating condition or a no-load or idle condition. In the disclosed construction, such means comprises a lever 85 which is fixed to the valve body 65, which is operably joined by a suitable lost motion connection 87 to the valve member 45, and which includes a cam 89 operable to selectively engage switch operating button 91 to actuate the switch 71. Preferably, it is desirable to alternatively and selectively bias the lever 85 toward its load and no-load positions so that the operating condition of the components will remain fixed in the absence of any exterior force on the operating lever. It is also desirable to maintain the valve head 47 against the valve seat 51 during no-load operation and to retain the valve head 47 in the cavity 53 during high-speed operation.

In this regard, there is provided in the disclosed construction a compression spring 95 which is connected to the engine block 13 at 97 and to the stem 49 of the valve member 45, and which provides over-the-center biasing of the valve member 45 toward each of its duct opening and duct closing positions, thereby serving to prevent loss of fuel during the no-load operation and to maintain the head 47 of the valve member 45 in the cavity 53 in adjacent relation to the water jacket 43 so as to afford effective cooling during high speed operation. In addition, the spring also serves to releasably maintain the lever 85 in either of the load or no-load positions.

In operation, when the lever 85 is in the no-load position, the valve 45 is located so that the head 47 is engaged with the circumferential seat 51 around the exhaust duct 31 thereby preventing escape of fuel through the exhaust duct 31, the cam 89 is located to operate the switch 71 so as to connect the spark plug 39 to the ground 75,

thereby preventing firing in the cylinder 17, and the valve body 65 is in position affording fluid flow through the conduit 55 thereby providing continuous fluid flow between the crankcase 13 and the cylinder 17 notwithstanding reciprocating movement of the piston 21 within the cylinder 17. As already noted, such continuous flow serves to keep the spark plug 39 clean and to maintain turbulence in the crankcase 13 even at low speeds.

When the lever 85 is in the load or high speed position, the switch 71 is actuated by the spring 81 to connect the spark plug 39 to the ignition system 73, thereby affording normal firing operation of the spark plug 39. In addition, the lever 85 also serves to locate the valve body 65 so as to preclude flow through the conduit 55 connecting the crankcase 13 and the cylinder 17, and serves to locate the valve member 45 so as to locate the head 47 in the recess 53 adjacent to the water jacket 43 so as to provide for cooling of the valve member. Thus, in the no-load position, firing operation of the cylinder 17 is prevented and loss of fuel through the cylinder 17 is also precluded. In the load or high speed position, the cylinder 17 operates in a normal fashion.

Various of the features of the invention are set forth in the following claims.

What is claimed is:

1. In a twin-cylinder opposed, two-cycle engine having a closed crankcase, a pair of cylinders oppositely extending from said crankcase, respective transfer passages extending from said cylinders to said crankcase, respective exhaust ducts extending from said cylinders to the atmosphere, respective spark plugs operative in said cylinders, and pistons operable in said cylinders to open and close communication between said cylinders and said transfer passages and said ducts, the improvement comprising a valve in said exhaust duct extending from one of said cylinders and displaceable between duct closing and duct opening positions, and means for selectively displacing said valve between said two positions whereby, when said valve is in said duct closing position, fluid flow to the atmosphere through said exhaust duct from said one cylinder is prevented notwithstanding reciprocation of said piston in said one cylinder.

2. An engine in accordance with claim 1 including an electrical switch operable between a first position grounding said spark plug in said one cylinder and a second position affording normal operation of said spark plug in said one cylinder, and wherein said means for selectively displacing said valve between two positions includes a control lever movable between a load and a no-load position and means connecting said lever to said valve and to said switch so that when said lever is in said load position said valve is in said duct opening position and said switch is in said second position and so that when said lever is in said no-load position, said valve is in said duct closing position and said switch is in said first position.

3. In a twin-cylinder opposed, two-cycle engine having a closed crankcase, a pair of cylinders oppositely extending from said crankcase, respective transfer passages extending from said cylinders to said crankcase, respective exhaust ducts extending from said cylinders to the atmosphere, and respective spark plugs operative in said cylinders, the improvement comprising a valve in said exhaust duct extending from one of said cylinders and displaceable between duct closing and duct opening positions, means for selectively displacing said valve between said two positions, and means biasing said valve toward said duct closing position.

4. An engine in accordance with claim 3 wherein said means biasing said valve toward said duct closing position includes a spring mounted to provide an off-center action so as to alternatively bias said valve between said duct closing and duct opening positions.

5. An engine in accordance with claim 1 including a conduit other than one of said transfer passages extending from said crankcase to said one cylinder, a valve dis-

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posed in said conduit and operable between conduit opening and conduit closing positions, and wherein said means for selectively displacing said valve in said exhaust duct between said duct opening and duct closing positions includes a control lever movable between a load and no-load position, and means connecting said lever to said conduit valve and to said exhaust duct valve so that when said lever is in said load position, said conduit valve is in said conduit closing position and said exhaust duct valve is in said duct opening position, and so that when said lever is in said no-load position, said conduit valve is in said conduit opening position and said exhaust duct valve is in said duct closing position.

6. In a twin-cylinder opposed, two-cycle engine having a closed crankcase, a pair of cylinders oppositely extending from said crankcase, a water jacket about said cylinders, respective transfer passages extending from said cylinders to said crankcase, respective exhaust ducts extending from said cylinders to the atmosphere, and respective spark plugs operative in said cylinders, the improvement comprising a conduit other than one of said transfer passages extending from said crankcase to one of said cylinders, a first valve in said conduit operable between conduit opening and conduit closing positions, a second valve having a head operable between a valve seat in said exhaust duct extending from said one cylinder to thereby afford closing of said last-mentioned exhaust duct and a cavity located in adjacent relation to said water jacket and clear of said last-mentioned exhaust duct thereby affording opening of said last-mentioned exhaust duct, an electrical switch operable between a first position grounding said spark plug in said one cylinder and a second position unaffected normal operation of said spark plug in said one cylinder, a control lever movable between a load and a no-load position, means connecting said lever to said first and second valves and to said switch so that when said lever is in said load position, said first valve is in conduit closing position, said second valve is located in said cavity, and said switch is in said second position, and so that when said lever is in said no-load position, said first valve is in said conduit opening position, said second valve is seated against said seat, and said switch is in said first position, and an over-the-center spring alternatively biasing said lever towards said load and no-load positions and alternatively retaining said valve head against said seat and in said cavity.

7. In a two cycle engine having oppositely acting twin cylinders extending from a closed crank case, respective transfer passages extending from said cylinders to said crankcase, respective exhaust ducts extending from said cylinders to the atmosphere, respective spark plugs operative in said cylinders, and pistons operable in said cylinders to open and close communication between said cylinders and said transfer passages and said ducts, the improvement comprising a conduit other than one of said transfer passages extending from the bottom of said crankcase to one of said cylinders, a valve disposed in said conduit and operable between conduit opening and conduit closing positions, and means for selectively displacing said valve between said conduit opening and conduit closing positions, wherein fluid flow between said one cylinder and the bottom of said crank case through said other conduit is permitted in response to piston reciprocation when said valve is in said conduit opening position.

8. An engine in accordance with claim 7 including an electrical switch operable between a first position grounding said spark plug in said one cylinder and a second position affording normal operation of said spark plug in said one cylinder and wherein said means for selectively displacing said valve between two positions includes a control lever movable between a load and a no-load position, and means connecting said lever to said valve and to said switch so that said lever is in said load position when

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said valve is in said conduit closing position and said switch is in said second position and so that when said lever is in said no-load position said valve is in said conduit opening position and said switch is in said first position.

9. An engine in accordance with claim 7 including means biasing said valve toward said conduit opening position.

10. An engine in accordance with claim 9 wherein said means biasing said valve toward said conduit opening position includes a spring mounted to provide an off-center action so as to alternatively bias said valve between said conduit closing and conduit opening positions.

11. In a two cycle engine having oppositely acting twin cylinders extending from a closed crank case, respective transfer passages extending from said cylinders to said crank case, respective exhaust ducts extending from said cylinders to the atmosphere and respective spark plugs operative in said cylinders, the improvement comprising a first valve in said exhaust duct leading from one of said cylinders and displaceable between duct opening and duct closing positions, a conduit other than one of said transfer passages extending from said crankcase to said one cylinder and terminating adjacent to said spark plug so as to effect passage of gases flowing in said conduit past said spark plug, a second valve disposed in said conduit and operable between conduit opening and conduit closing positions, and means for selectively and concurrently displacing said valves between said opening and closing positions.

12. A two-cycle engine having oppositely acting twin cylinders extending from a closed crankcase, one of said cylinders including, at the head end thereof, a recess, respective transfer passages extending from said cylinders to said crank case, respective exhaust ducts extending from said cylinders to the atmosphere, respective spark plugs operative in said cylinders, said spark plug associated with said one cylinder extending into said recess, and pistons operable in said cylinders to open and close communication between said cylinders and said transfer passages and said ducts, the improvement comprising a conduit other than one of said transfer passages extending from said crankcase to said one cylinder and terminating in said recess and adjacent to said spark plug so as to effect passage of gases flowing in said conduit past said spark plug, a valve disposed in said conduit and operable between conduit opening and conduit closing positions, and means for selectively displacing said valve between said conduit opening and conduit closing positions, whereby gas flow through said other conduit between said one cylinder and said crankcase in response to piston reciprocation is permitted when said valve is in said conduit opening position.

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