May 15, 1956 A. H. WINKLER, JR 2,745,391

MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINE

Original Filed May 29, 1947 4 Sheets-Sheet 1

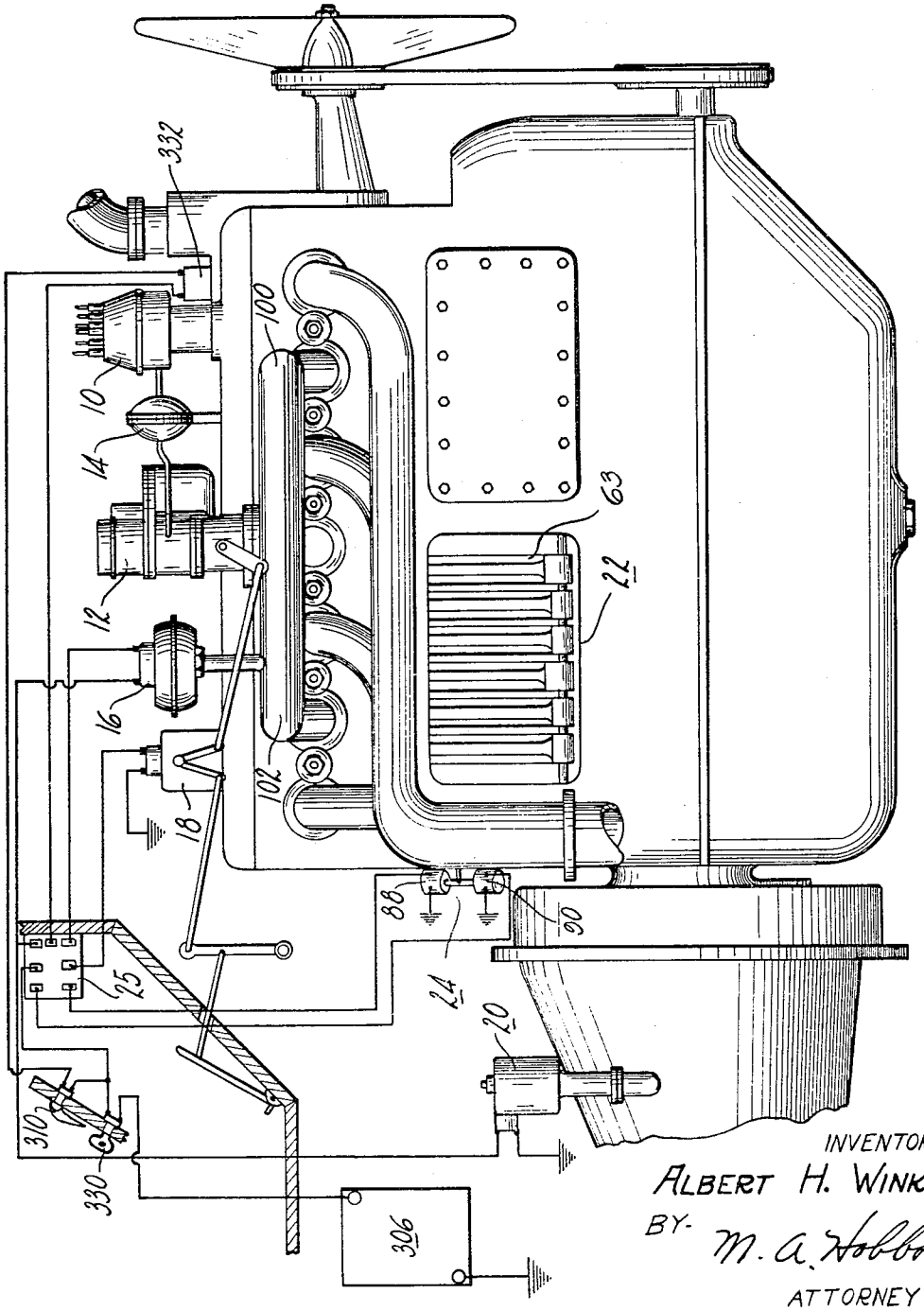


Fig. 1

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Original Filed May 29, 1947 4 Sheets-Sheet 2

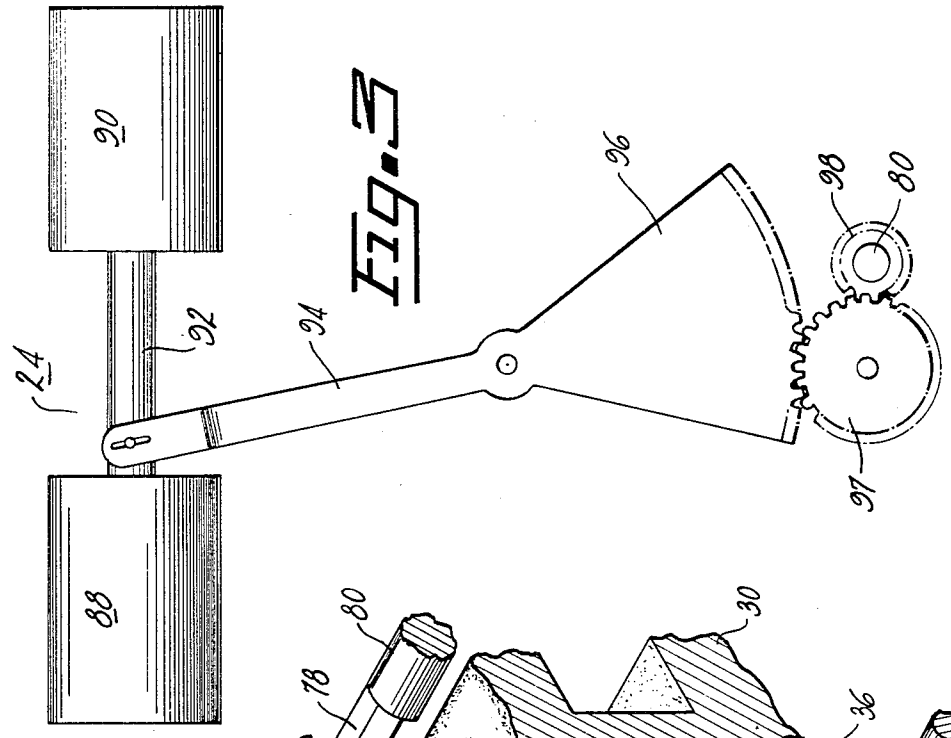


Fig. 3

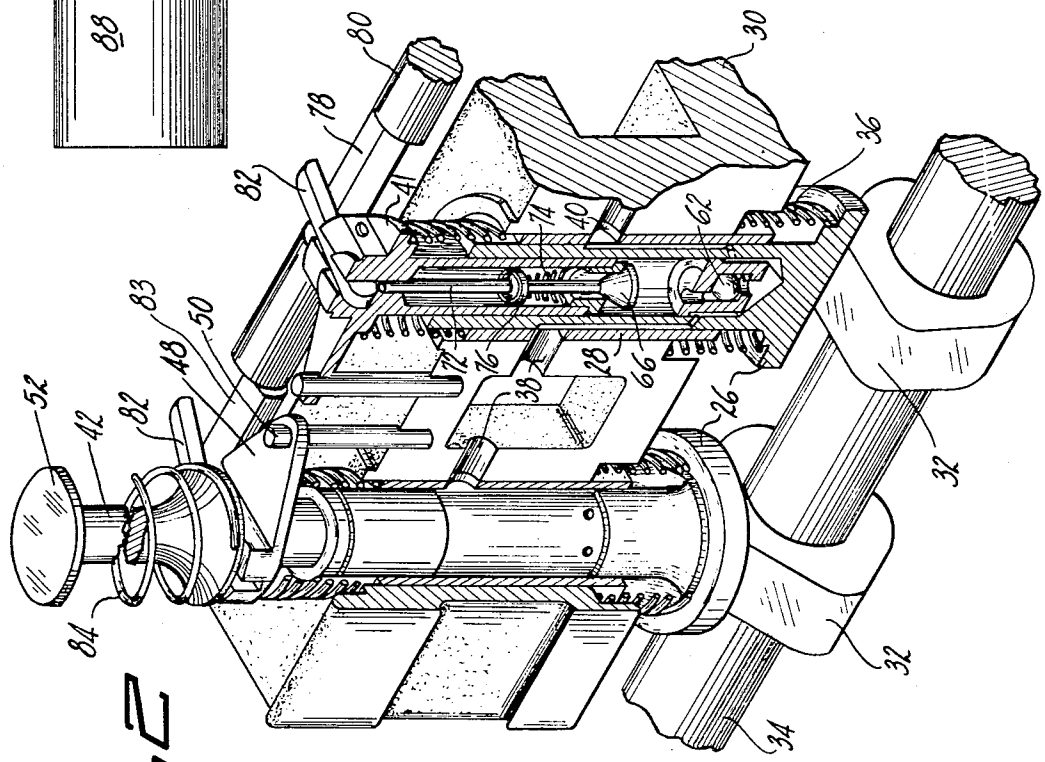


Fig. 2

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MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINE

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Fig. 4

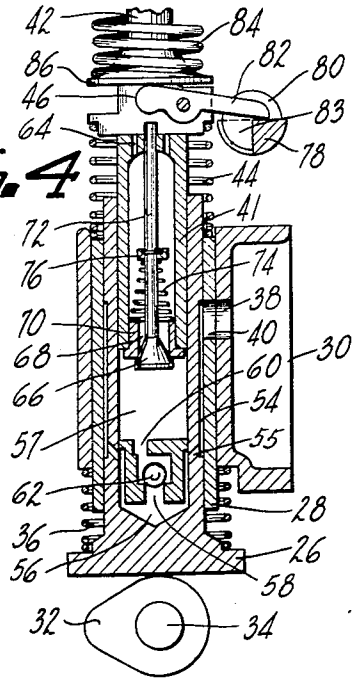


Fig. 5

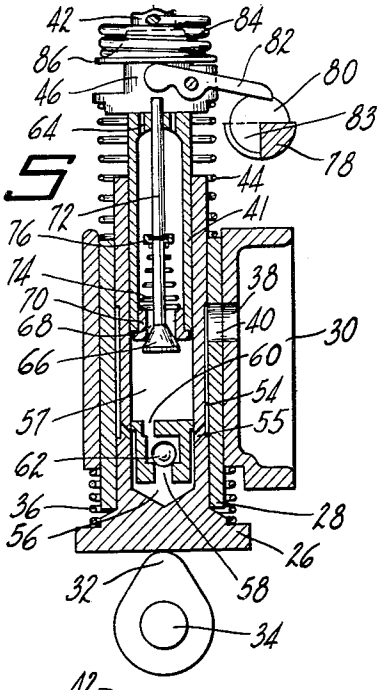


Fig. 6

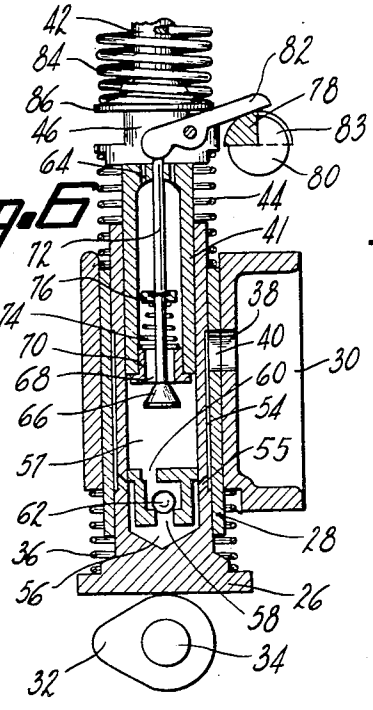
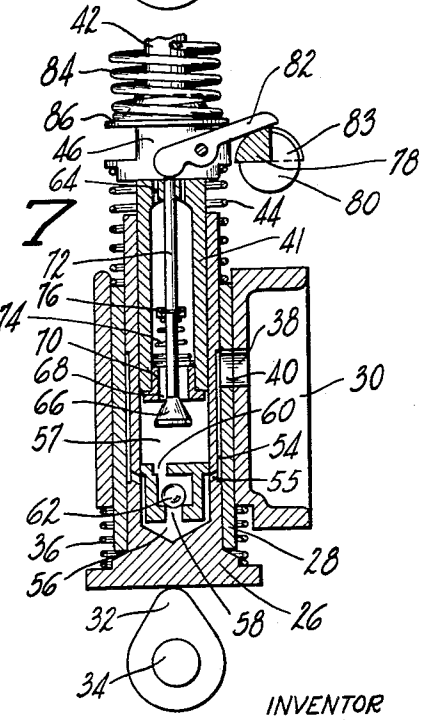


Fig. 7



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MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINE

Original Filed May 29, 1947 4 Sheets-Sheet 4

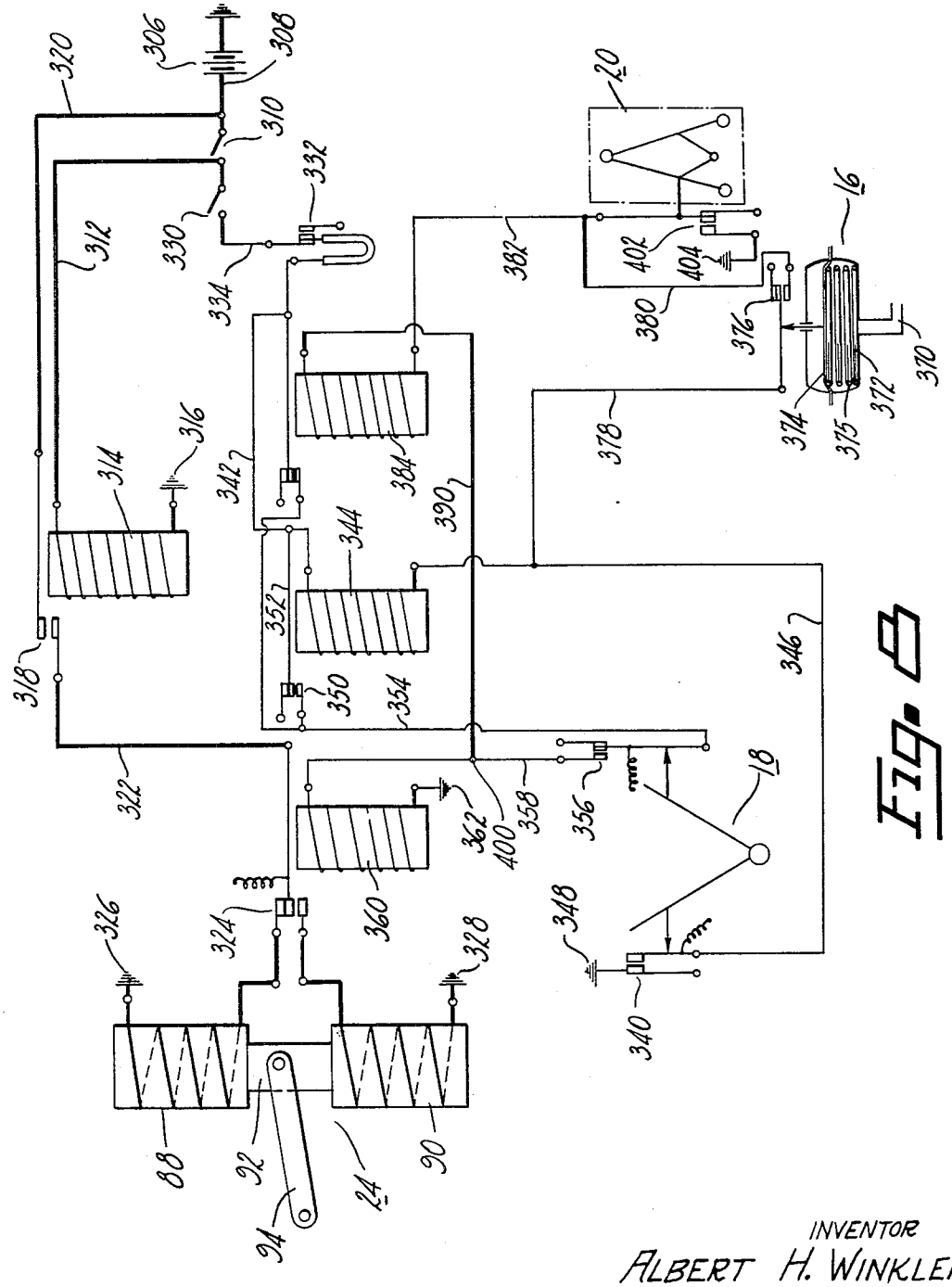


Fig. 8

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MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINE

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Original application May 29, 1947, Serial No. 751,282, now Patent No. 2,652,038, dated September 15, 1953. Divided and this application June 15, 1953, Serial No. 361,604

4 Claims. (Cl. 123—90)

The present invention relates to internal combustion engines and more particularly to a multiple cylinder internal combustion engine in which less than the full number of cylinders may be used to deliver power during certain stages of engine operation. This case is a division of my copending application Serial No. 751,282, now Patent No. 2,652,038.

One of the principal objects of the present invention is to provide a multiple cylinder internal combustion engine in which the effective number of power cylinders varies in accordance with engine power output requirements.

Another object of the present invention is to provide an internal combustion engine for giving high economy during certain stages of engine operation and for giving high power output in other stages of operation.

Another object is to provide a multiple cylinder internal combustion engine wherein less than the full number of cylinders may be employed during idling and cruising and the full number of cylinders employed for starting, during power pick-up and high power output.

Another object of the invention is to provide an internal combustion engine which gives high economy for low power engine output.

Still another object is to provide in a multiple cylinder internal combustion engine a mechanism for rendering a portion of the cylinders inoperable during certain stages of engine operation and for rendering said cylinders operable for other stages of engine operation.

Still another object of the present invention is to provide a mechanism for rendering a portion of a multiple cylinder internal combustion engine inoperable and simultaneously therewith decreasing the source of available fuel and air mixture for said engine.

A further object is to provide a mechanism for automatically cutting in or cutting out a portion of the cylinders of a multiple cylinder internal combustion engine as the requirements of the engine shift between low and high power operation.

A further object is to provide a mechanism for rendering a portion of the cylinders in a multiple cylinder internal combustion engine inoperable, which may be readily installed in or removed from standard automobile engines.

A still further object of the present invention is to provide in the aforementioned multiple cylinder engines a mechanism for rendering a portion of the cylinders inoperative wherein the power loss through said inoperative cylinders is reduced to the minimum.

Additional objects and advantages will appear from the following description and accompanying drawings, wherein one specific embodiment of my invention is disclosed. The engine construction and control mechanism therefor comprising the subject matter of the present invention are not limited to the embodiment disclosed herein nor to any particular type of internal combustion engine, but are understood to be generally adaptable to any of the aforesaid engines having a plurality of cylinders with lift-type intake and exhaust valves. The invention in its broadest aspects contemplates the use of a valve tappet construction and cooperating control mechanism for a portion of the cylinders, which will render the valves for said cylinders and consequently said cylinders inoperable, except during starting, acceleration and high power output. The high economy of engine operation obtained by the present construction results not only from the use of less than the full number of cylinders for low power requirements but also from the complete sealing of the inoperative cylinders by the closing of the intake and exhaust valve to prevent said cylinders from pumping air and thereby placing an undue drag on the operable cylinders. The construction and operation of one means for accomplishing this will be fully described hereinafter.

In the drawings,

Figure 1 is a side elevation of a multiple cylinder internal combustion engine showing schematically the several elements comprising the present invention, the position of said elements being rearranged to more advantageously show the functional relationship thereof;

Figure 2 is an isometric partial cross-section through the valve control mechanism for rendering a portion of the cylinders inoperative;

Figure 3 is an elevation of the actuating means for the valve control mechanism;

Figure 4 is a cross-section through a tappet showing said tappet in operative position when the valve operated thereby is closed;

Figure 5 is a cross-section through a tappet showing the tappet in operative position when the valve operated thereby is opened;

Figure 6 is a cross-section through a tappet showing the tappet in inoperative position;

Figure 7 is a cross-section of a valve tappet similar to Figure 6 showing the tappet in inoperative position when the valve operated thereby would normally be opened; and

Figure 8 is a diagram of the electrical control system of the present invention.

The present invention may be readily understood by referring to the accompanying drawings in which Figure 1 shows a multiple cylinder internal combustion engine in combination with the present engine control mechanism wherein numeral **10** designates a conventional spark distributor, **12** a carburetor, **14** a spark advance mechanism, **16** a vacuum actuated switch for the split engine control, **18** a manually actuated switch for said control, **20** a speed responsive switch for said control and **22** a tappet assembly for controlling the operation of a portion of the cylinders, said tappet assembly being actuated by a solenoid mechanism **24** in response to the aforementioned control switches. The several switches are connected by leads to relays in box **25** which in turn control solenoid mechanism **24**. With the exception of the mechanism for rendering a portion of the cylinders inoperable and the control system for said mechanism, the present engine is a conventional multiple cylinder internal combustion engine. The one shown in Figure 1 is a standard six cylinder, L head motor with lift-type valves. Of the six cylinders, three are part time operating cylinders. For convenience in description throughout the specification and in the appended claims, the cylinders which remain in operation the entire time that the engine is running will be referred to as the "normal" cylinders and the cylinders which are operable only during starting acceleration and high power output will be referred to as the "power" cylinders. In the engine shown in the drawings, the normal cylinders are the front three and the power cylinders are the rear three, although any other suitable arrangement of the power and the normal cylinders may be used, as for example the cylinders of the two sets may be alternated. The tappets for the valves of the power cylinders are shown schematically at numeral

22. The running of the engine on all six cylinders will be referred to as "standard engine operation" and the running of the engine on only the three front cylinders will be referred to as "split engine operation."

The tappets or valve lifters of assembly 22, which are shown in detail in Figures 2 and 4 to 6, inclusive, in various steps of operation are of the hydraulic type, and consist of a reciprocable sleeve 26 mounted in the bushing 28 and urged against the periphery of cam 32 on shaft 34 by spring 36, said housing being a hollow casting which forms a conduit for supplying fluid to said tappet through orifices 38 and 40 of housing 30 and bushing 28. Sleeve 26 slips over a hollow piston 41 and during split engine operation is adapted to move axially relative to said piston. Piston 41 butts against the lower end of a valve stem 42 and is constantly urged into engagement therewith by a spring 44 reacting between the lower side of piston head 46 and the top end of bushing 28, said piston being prevented from rotating in sleeve 26 by arm 48 secured to piston head 46 and a guide pin 50 on which said arm is adapted to slide. During normal engine operation, piston 41 moves in unison with sleeve 26 to actuate valve 52 mounted on the upper end of stem 42. The interior of housing 30 communicates with the interior of sleeve 26 through orifices 38 and 40, annular recess 54 in the periphery of said sleeve and one or more ports 55 connecting said recess with chamber 56. This chamber communicates with a second chamber 57 in said sleeve through a fluid passageway having a ball check valve 62 consisting of a small cylindrical chamber having a lower port 58 and an upper port 60 and a freely movable ball 62 adapted to seat over port 58 to prevent backflow of fluid in chamber 57. In standard operation, the volume of chamber 57 will vary as the tappet automatically adjusts its length to that required to properly seat the respective valve.

The hollow interior of piston 41 forms a conduit for fluid flowing from chamber 57 back to the fluid source, the upper end of said piston communicating with the interior of the tappet chamber 63 (Figure 1) through one or more ports 64. In the lower end of piston 41, a conical valve 66 seats over orifice 68 of insert 70 and under certain operating conditions is adapted to retain the fluid in chamber 57. Valve 66 is supported by a valve stem 72 and is urged to its closed position over orifice 68 by a coil spring 74 reacting between the upper end of orifice insert 70 and the lower side of collar 76, said collar being rigidly secured to the central portion of valve stem 72. During split engine operation, valve 66 is opened by a cam 78 on shaft 80 actuating pivoted lever 82 which engages the upper end of stem 72 and urges said stem and valve 66 downwardly against the force of spring 74, thus opening said valve to permit the fluid to flow from chamber 57. A separate cam is provided for the intake valve and one for the exhaust valve. The tappet controlled by cam 78 actuates an exhaust valve. The cam for controlling the tappet of the intake valve is shown at numeral 83 and is positioned one quarter of a revolution ahead of the cam operating the exhaust valve. With this arrangement, the exhaust valve is rendered inoperable after the intake valve so that the combustion products of the last explosion before the cylinders become inoperative will be expelled. This is important since, as previously mentioned, the valves of the power cylinders are completely closed during split engine operation, and the entrapment of combustion products from an explosion would cause undue drag on the engine during split engine operation. In the change from standard to split engine operation, cam 78, controlling the tappet shown in Figures 4 to 7, follows in sequence of time the one shown partially in broken lines. The tappet shown in these figures, therefore, controls an exhaust valve; however, the construction and operation of the tappet for an intake valve are the same as the construction and operation for an exhaust valve so that the description of the tappet shown in said figures is equally applicable to a tappet for an intake valve. A conventional valve spring 84 which reacts between a portion of the cylinder block and collar 86 of valve stem 42 constantly urges valve 52 toward its closed position.

The tappets in the assembly are directly controlled by two solenoids 88 and 90, shown clearly in Figure 3, arranged diametrically opposite to one another and connected by a reciprocable rod 92. The central portion of rod 92 is connected by a lever 94 with a sector gear 96 which meshes with gear 97 which in turn meshes with small gear 98 mounted on the end of shifter rod 80. Movement of the rod 92 to the right by solenoid 90 causes shifter rod 34 to rotate clockwise 180 degrees and to cause cam 78 to actuate lever 82 which opens valve 66, thus rendering the cylinders controlled by said tappets inoperative.

In the present embodiment of the invention, the intake manifold 100 supplying the normal cylinders is functionally independent from intake manifold 102 supplying the cylinders rendered inoperable during split engine operation. These two intake manifolds are preferably supplied with the fuel-air mixture from two independent carburetors or from a single carburetor having two separate induction passages with a main discharge nozzle, power enrichment jet and accelerating pump for each of said induction passages. A carburetor having two separate induction passages suitable for the present invention is disclosed in Patent 2,652,038.

Figure 8 shows a circuit plan of an arrangement particularly adapted for shifting the operation between split and standard engine throughout the operating range of the engine. The main circuit for energizing the two solenoids 88 and 90 of tappet control mechanism 22 includes a grounded storage battery 306 from which the current flows from lead 308 to ignition switch 310, thence through lead 312 to the winding of relay 314 to ground 316. Completion of this circuit by closing the ignition switch in the conventional manner energizes relay 314 which closes switch 318 and completes a second circuit consisting of battery 306, lead 320, switch 318, lead 322, double bolted switch 324, either solenoid 88 or 90, and the respective grounds therefor 326 and 328. The particular solenoid energized depends upon the energization of one or more of the cooperating control circuits to be presently described.

In the control circuit for the main solenoid actuating circuit, there are six separate control elements which cooperate with one or more of the remaining control elements to shift the engine between standard and split engine operation. The mechanism for shifting the operation between standard and split engine may be manually controlled by the operation of switch 330 which when open renders the remaining control elements inoperative and prevents the solenoid from shifting to split engine or if on split engine, causes said mechanism to shift to standard engine.

In order to prevent the engine from shifting to split operation before the motor has reached normal operating temperatures, a thermostatically controlled switch 332 is placed in lead 334 through which the current flows to the remaining control elements. As the engine becomes warm, switch 332 closes and remains closed as long as the temperature of the engine remains above a predetermined point. The thermostatically controlled switch is preferably located on the cylinder head or in a conduit carrying water from the jacket around the combustion chambers. It is seen that this thermostatically controlled switch will prevent the engine from shifting to split engine operation while the engine is cold and thus prevents undue strain from being placed on the standard cylinders.

While the engine is idling, i. e. when the throttle valve is in closed or substantially closed position, it is preferable to operate on split engine unless the engine is cold as explained in the preceding paragraph. A switch 340 is actuated by the closing movement of the throttle valve to close the circuit consisting of battery 306, switches 310 and 330, lead 334, switch 332, lead 342, relay 344,

lead 346 and ground 348. When this circuit is closed, relay 344 becomes energized and closes switch 350 so that the current flows through leads 352 and 354, switch 356, lead 358 and relay 360 to ground 362, energizes relay 360 and completes the main circuit to solenoid 90, thus shifting the engine to split operation. While and throttle valve is closed or near closed, the intake manifold vacuum is relatively high. This lower pressure is transmitted through conduit 370 to chamber 372 of unit 16 and moves diaphragm 374 downwardly in opposition to spring 375, closing switch 376. The closing movement of switch 376 by manifold vacuum completes the circuit consisting of battery 306, switches 310 and 330, lead 334, switch 332, lead 342, relay 344, lead 378, switch 376, leads 380 and 382, relay 384, lead 390, relay 360 and ground 362. With the main conduit controlled by switches 340 and 376, it is seen that the split engine becomes operable by the closing movement of the throttle valve or by high manifold vacuum, and remains operable as long as the throttle valve is closed or the manifold vacuum remains above a predetermined value.

The operation of the solenoids is also controlled by engine speed. The speed controlled switch 20 is preferably regulated by a fly-ball governor driven from the drive shaft through the speedometer cable. During operation, when the engine reaches a predetermined speed, switch 20 closes, thus closing the circuit beginning with the connection 400 and consisting of lead 390, relay 384, lead 382, switch 402 and ground 404. This circuit will not energize relay 384, however, unless the circuit controlled by switch 340 or the circuit controlled by switch 376 is first closed since the current for the circuit control by switch 402 flows from the circuit for energizing relay 360. After switch 402 has been closed by the governor while either switch 340 or 376 is closed, relay 360 for maintaining the engine on split operation remains energized until all three switches have been opened or until switch 356 has been opened, the latter switch being opened by overtravel of the throttle valve lever for manually shifting the engine to standard operation. The circuit for energizing relay 360 thereafter remains open and the engine remains on standard operation until the throttle valve is moved to closed position, closing switch 340 or until the manifold vacuum is sufficiently high to close switch 376. When the engine is on split operation with the throttle valve open, though not in the overtravel position, and the manifold vacuum low, the engine remains on split operation as long as the speed remains above a certain predetermined value. When the speed decreases to a point below the predetermined rate, switch 402 is opened and relay 360 is de-energized and the engine shifted to standard operation. The return of the speed to a point above a predetermined rate, however, does not again energize relay 360 unless either switch 340 or 376 has been closed.

While in the present electrical system the closing of either switch 340 or 376 will energize relay 360 and thus shift the engine to split engine operation, it may be desirable to so arrange the system that the vacuum actuated switch 376 cannot alone close the circuit to energize relay 360. One way of accomplishing this is to provide relays at 344, 360 and 384 which have electrical characteristics such that the voltage required to operate two or more in series would be greater than the maximum line potential of the electrical system. By this arrangement, the vacuum actuated switch would be unable to energize the circuit for split engine operation unless either switch 356 or 402 were first closed.

Some of the controls included in the present system are optional and may be omitted without seriously affecting the operation and control of the engine. For example, the circuit controlled by the throttle switch 340 for shifting the engine to split operation could be omitted since the manifold vacuum is usually sufficiently high when the throttle is closed to actuate switch 376 and shift the engine to split operation. Further, omission of the speed controlled switch would not seriously affect the operation of the control system since the degree of manifold pressure in general follows the speed of the engine for any fixed position of the throttle valve. Many more modifications of the control system are possible without causing any substantial overall change in the operation of the present engine.

Operation

In starting the present engine, the operator closes the ignition switch 310 which automatically places a cold engine in position for standard operation, that is, with all six cylinders being operable. After the engine begins to run on its own power, it operates on all six cylinders regardless of speed, manifold vacuum or throttle position until the engine becomes warm enough to close the thermostatically controlled switch 332. While the engine is on standard operation, a fluid such as oil flows from housing 30 through orifices 38 and 40 into chamber 56 and thence through ball check valve 42 into chamber 57 below valve 66, said latter valve being held in closed position during standard operation by spring 74. It is thus seen that the fluid in chamber 57 is prevented from flowing in either direction by the two valves 42 and 66. With the fluid entrapped in chamber 57, sleeve 26 is unable to move relative to piston 41 so that as cam 32 rotates, said sleeve and piston move in unison to operate the inlet or exhaust valve of the engine. Throughout the time valve 66 remains closed, the tappets operate in the conventional manner to open and close the valves for their respective cylinders. This operation is illustrated in Figures 4 and 5 of the drawings.

In the change from standard to split operation, solenoid 90 causes rod 80 to rotate clockwise one-half of a revolution, moving cams 78 and 83 from the position shown in Figures 4 and 5 to the position shown in Figures 6 and 7, in the drawings. Cam 78 rotates lever 82, forcing rod 72 downwardly and opening valve 66 to permit the fluid entrapped in chamber 57 to escape through orifice 68 upwardly through the center of piston 41 and thence through ports 64. Thereafter, as sleeve 26 is lifted by cam 32, it moves axially over piston 41 and consequently is unable to open the exhaust valve. It is thus seen that during split engine operation, the movement of the tappet is confined to sleeve 26.

In the change from split to standard engine operation, solenoid 88 rotates rod 80 counterclockwise for one-half of a revolution, moving cams 78 and 83 from the position shown in Figures 6 and 7 to the position shown in Figures 4 and 5, thus permitting spring 74 to close valve 66 and entrap fluid in chamber 57 to obtain full operation of the tappet.

Although only one embodiment of the invention has been illustrated and described, various changes in the form and relative arrangements of the parts may be made to suit requirements.

I claim:

1. A valve actuating mechanism for an internal combustion engine comprising a stationary cylinder, a fluid inlet port in the side wall of said cylinder, a hollow reciprocable cylinder in said stationary cylinder, an annular recess in the periphery of said reciprocable cylinder adapted to register with said port, a hollow piston in said last mentioned cylinder forming an enclosed chamber therein, a fluid inlet passage connecting the recess with said chamber, a check valve in said passage, a fluid outlet passage for said chamber disposed in said piston, a control valve in said piston, a spring urging said control valve toward closed position, a lever pivoted on said piston and adapted to reciprocate therewith for opening said control valve, and a nonrotatable guide member adapted to be carried by said piston.

2. A valve actuating mechanism for an internal combustion engine comprising a stationary cylinder, a fluid

inlet port in the side wall of said cylinder, a hollow reciprocable cylinder in said stationary cylinder, a hollow piston in said reciprocable cylinder forming an enclosed chamber therein, a fluid inlet passage for said chamber, a fluid outlet passage for said chamber in said piston, a control valve in said passage, a spring urging said control valve toward closed position, a lever for opening said control valve, and a member adapted to be slideably mounted on said engine for guiding said piston.

3. A valve actuating mechanism for an internal combustion engine comprising, a hollow reciprocable cylinder, a piston in said cylinder forming an enclosed chamber therein, a fluid inlet passage for said chamber, a fluid outlet passage for said chamber in said piston, a control valve in said outlet passage, resilient means urging said valve toward closed position and a lever for opening said valve.

4. A valve actuating mechanism for an internal combustion engine comprising, a hollow reciprocable cylinder, a piston in said cylinder forming an enclosed chamber therein, a fluid inlet passage for said chamber, a fluid outlet passage for said chamber in said piston, a control valve in said outlet passage, resilient means urging said valve toward closed position and means for opening said valve.

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