Dec. 1, 1959 W. A. GULLEN 2,915,052

HYDRAULIC VALVE OPERATING DEVICE

Filed Oct. 6, 1958 2 Sheets-Sheet 1

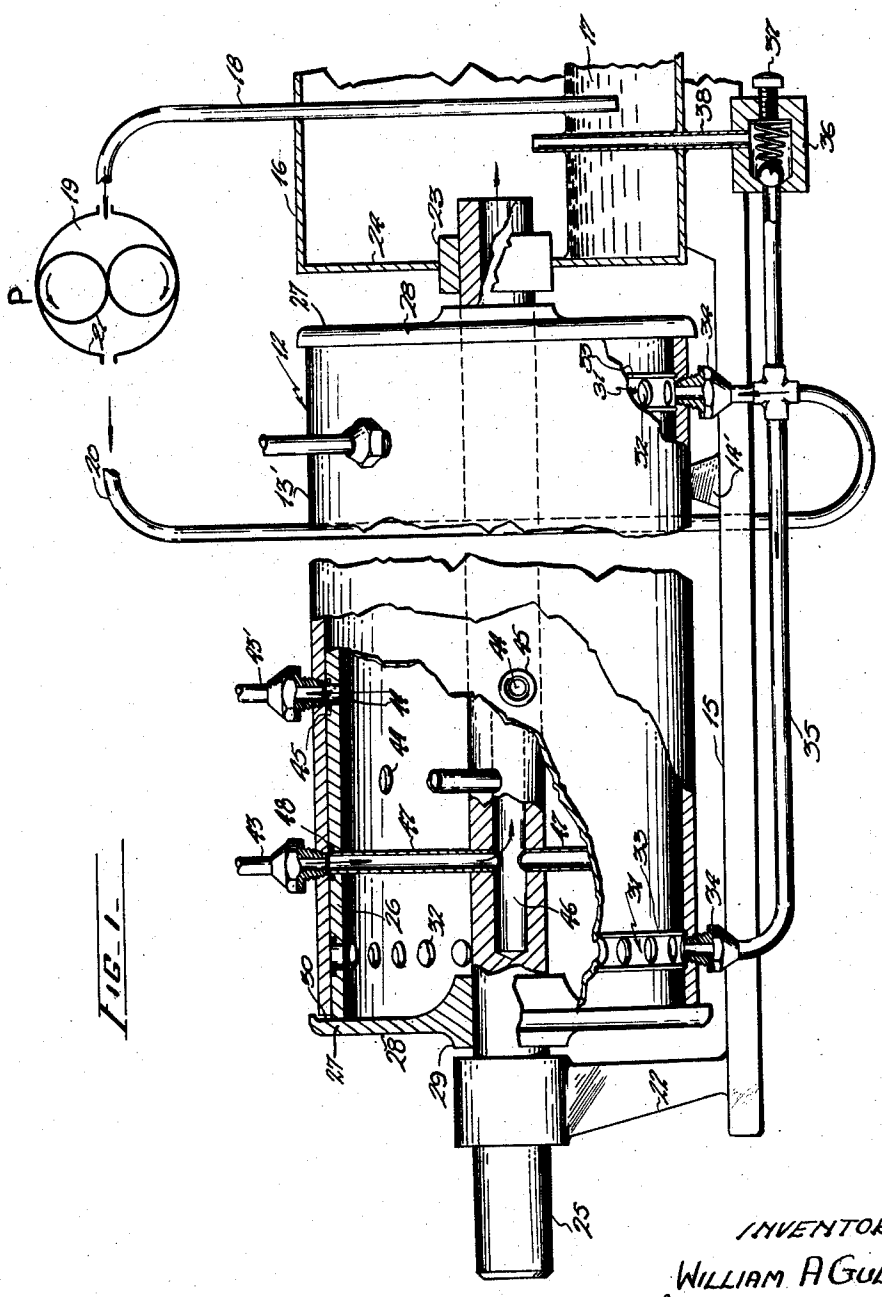

FIG. 1

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HYDRAULIC VALVE OPERATING DEVICE

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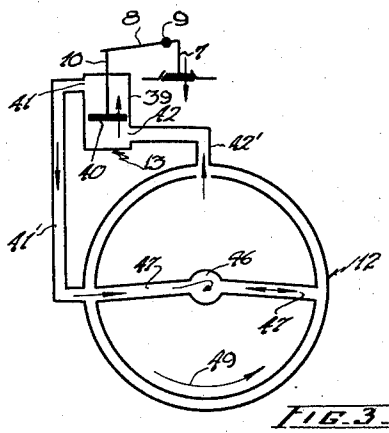


FIG. 3

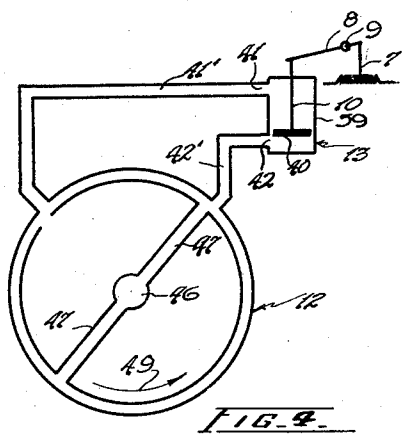


FIG. 4

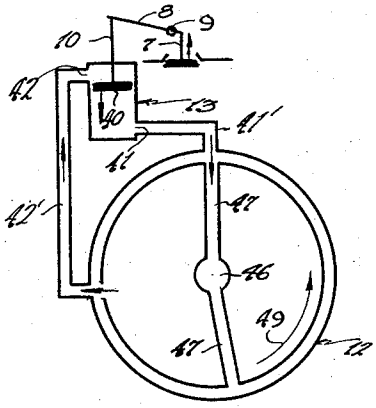


FIG. 5

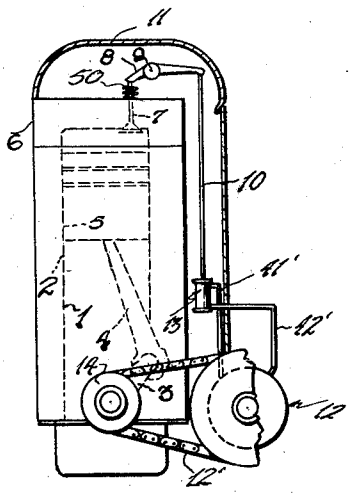


FIG. 2

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United States Patent Office 2,915,052 Patented Dec. 1, 1959



2,915,052

# HYDRAULIC VALVE OPERATING DEVICE

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Application October 6, 1958, Serial No. 765,672

17 Claims. (Cl. 123—92)

My invention relates to new and useful improvements in hydraulic valve systems for 4 cycle engines, either internal combustion engines or diesel engines.

The conventional valve system is normally operated by means of a cam shaft driven at half engine speed, the timing depending upon the positioning of the cam upon the shaft.

This system is in the form of a compromise and includes several disadvantages. The principal disadvantage is the fact that, irrespective of the speed of rotation of the engine, the valves takes a certain radial movement of the cam shaft to open, and a further radial movement of the cam shaft to close, so that it is actually only wide open for a fraction of the time required for efficient intake and scavenging action.

It is well known that if a valve could open to its fullest extent instantaneously and close also instantaneously, an engine would operate far more efficiently at all speeds, and furthermore, less burning of the valve seats would occur during operation.

My invention overcomes these disadvantages by providing a hydraulic valve system wherein the valves open and close instantaneously and without the frictional resistance normally encountered with conventional cam shaft operated valve systems.

I obtain these advantages by providing a stationary cylinder having a sleeve rotatable therein, a source of fluid pressure to the interior of the sleeve, and various ports and conduits which conduct fluid pressure from the sleeve to a slave piston and cylinder assembly which in turn, is connected to the push rod of the valve, said ports and conduits being so positioned as to effect the correct timing of the opening and closing of the valves.

The principal object and essence of my invention is, therefore, to provide a hydraulic valve system in which the poppet valves of an engine are operated hydraulically without the necessity of a camshaft and associate structure.

A further object of my invention is to provide a device of the character herewithin described which is positive in action and which maintains a constant head of fluid pressure available for the operation of the valves when required.

Yet another object of my invention is to provide a device of the character herewithin described which is easily constructed as a separate unit and which, once installed, requires no adjustment.

A still further object of my invention is to provide a device of the character herewithin described in which the operating parts are situated externally of the engine, thus protecting them from the heat of the engine.

With the foregoing objects in view, and such other objects and advantages as will become apparent to those skilled in the art to which this invention relates as this specification proceeds, my invention consists essentially in the arrangement and construction of parts all as hereinafter more particularly described, reference being had to the accompanying drawings in which:



Figure 1 is a side elevation of my device, fragmented in part, to show the interior thereof.

Figure 2 is a partially schematic end elevation of an engine, showing my device in situ.

Figure 3 is a schematic representation of my device and the inlet valve system of an engine, showing the inlet valve about to open.

Figure 4 is a schematic view similar to Figure 3, but showing the exhaust valve as it has just closed.

Figure 5 is a view similar to Figure 3 but showing the inlet valve about to close.

In the drawings like characters of reference indicate corresponding parts in the different figures.

Although the engine illustrated in the drawings, shows an overhead valve system operated by rocker arms and push rods, it will be appreciated that the device can readily be adapted for operation with a side valve engine. Furthermore, Figure 1 shows a device adapted to operate 4 valves of a 4 cylinder engine, either inlet or exhaust, it being understood that if it is desired to operate all inlet and exhaust valves, a similar device could be situated on the opposite side of the engine or, alternatively, the device could be extended in length to accommodate a further four sets of operating components, so that all eight valves could be operated from the same cylinder and sleeve assembly.

It will also be appreciated that although conventional poppet valves have been illustrated, the device is adapted for use with reciprocating or rotatable sleeve valves, the principles of operation remaining identical.

Proceeding therefore, to describe my invention in detail, reference should first be made to Figure 2, in which I illustrate, in end view, a conventional engine **1** having cylinders **2**, a crankshaft **3**, connecting rods **4** and pistons **5**. The cylinder head **6**, carries poppet valves **7** operated by a rocker arm **8** pivoted as at **9**, and actuated by a vertically reciprocating push rod **10**, all of which is enclosed in valve casing **11**.

My device is collectively designated **12**, and is adapted to be rotated by means of a chain **12'** from the crankshaft sprocket **14**, the reduction being such that my device rotates at half engine speed. The device **12** is adapted to operate slave piston and cylinder assemblies collectively designated **13** which are situated within the valve casing **11** and may be secured to the engine by any suitable means.

In detail, reference should be made to Figure 1, in which my device **12** consists of an open ended stationary cylinder **13'** mounted as by the bracket **14'** to a base plate **15** by which the device may be secured to the engine **1**, in the conventional manner. In this particular embodiment, I have provided a fluid reservoir **16**, also supported upon plate **15**, said reservoir containing fluid **17**, suitable for hydraulic purposes. A pump P, shown schematically, is adapted to be rotated by the engine and a feed conduit **18** extends from one side **19** of the pump to the fluid **17** within the reservoir **16**.

A further conduit **20** extends from the opposite side **21** of the pump P to be connected as hereinafter described.

In this particular embodiment, I provide an upstanding bearing **22** upon one end of plate **15**, a further bearing **23** supported within the end wall **24** of fluid reservoir **16** and a shaft **25** which is adapted to be supported for rotation within the bearings and to be rotated by the sprocket chain **12'** at a speed equal to half the speed of the engine.

A cylindrical sleeve **26** is provided which is a bearing fit within the stationary cylinder **13'**, said sleeve being

provided with end caps 27 flanged peripherally as at 28, said end caps being shouldered centrally as at 29, and being secured to the shaft 25 by conventional means, such as a key and keyway (not illustrated). Sealing means, not illustrated, are situated between the end caps and the ends 30 of the stationary cylinder to prevent leakage of high pressure oil therefrom.

Adjacent each end of the rotatable sleeve 26 is means, collectively designated 31, for providing fluid connection to the interior of sleeve 26 and taking the form of a plurality of radially disposed apertures or drillings 32 formed within the wall of the sleeve. Sealing rings 33 extend around the sleeve upon each side of the sets of radial drillings 32 and are adapted to cooperate sealably with the inner wall of the stationary cylinder 13'.

A union 34 is situated adjacent each end of the stationary cylinder 13' and connects through the wall thereof radially in alignment with the aforementioned sets of apertures 32 and a conduit 35 connects these two unions 34 with the aforementioned conduit 20 extending from the pressure side 21 of the pump P.

Conduits 35 extend to pressure release valve assembly 36 which is a conventional spring loaded ball, adjustable by means of screw 37, any excess fluid passing through this release valve being routed back to the fluid reservoir 16 by means of the stand pipe 38.

It should be observed that the radial relationship of the set of apertures or drillings 32 on one end of the sleeve 26, is staggered with relation to the set of apertures on the other end so that only one aperture is over one union 34 at any one time. This not only provides a pulse-free supply of fluid under pressure to the sleeve 26 but prevents back pressure occurring within conduit 35.

From the foregoing, it will be appreciated that rotation of the sleeve 26 within stationary cylinder 13' causes the apertures or drillings 32 to pass progressively over the end of the union 34 so that oil is constantly being pumped under pressure to the interior of the sleeve 26 to be available as will hereinafter be described.

The slave piston and cylinder assemblies 13 are shown schematically in Figures 3, 4 and 5 and are conventional in construction, inasmuch as they each include a cylinder 39, a piston 40 reciprocal therein, said piston being connected to the aforementioned push rod 10, and an aperture or drilling 41 upon one side of the piston with a further aperture or drilling 42 upon the opposite side of said piston 40. Conduits 41' and 42' extend from the apertures or drillings 41 and 42, respectively, to corresponding unions 43 and 43' on the stationary cylinder 13', each pair of conduits terminating in a pair of unions which are in the same radial plane around the periphery of the stationary cylinder wall 13'. From the foregoing it will be appreciated that there are a pair of such unions for each valve being operated by the device 12, and that each union of said pair is spaced radially around the wall depending upon the timing of the device as will hereinafter be described. A pressure ejection aperture or drilling 44 is provided through the wall of said sleeve 26, one for each of said pair of unions 43 and in the same radial plane thereof, said apertures having a sealing ring 45 surrounding same and cooperating with the wall of the cylinder 13 in a sealable manner.

From the foregoing, it will be appreciated that as the sleeve 26 is rotated, fluid under pressure will be ejected through the aperture 44, through the union 43 that it coincides with at that time, and thence through the conduit 41' or 42' to the slave cylinder 39, thereby operating the piston 40 in one direction or the other.

As this piston is operated, it will be appreciated that the poppet valve connected thereto, will also be operated and it will also be appreciated that means must be provided for the return of fluid from the opposite side of the piston 40.

To this end I have provided shaft 25 with a longitudinal



extending drilling or passageway 46 and a pair of radially extending conduits 47 in the same radial plane as the aforementioned ejection apertures or drillings 44, it being understood that there is a pair of such conduits for each drilling 44.

These conduits extend from the drilling 46 within shaft 25 to the wall of the sleeve 26 and therethrough, sealing ring 48 surrounding these conduits where they exit upon the outer surface of the wall of the sleeve 26. These sealing rings cooperate sealably with the stationary cylinder 12 to prevent leakage of fluid therepast.

It will therefore be appreciated, that by positioning conduits 47 in the desired radial relationship the end thereof can be made to coincide with the relevant union 43 carrying the return fluid from the slave cylinder 39.

Figures 3, 4 and 5 show schematic cross sections, of the assembly 12 in various positions and the operation of the device hereinafter to be described, will be with reference to these schematic views. In this connection, although the parts are shown schematically, nevertheless, corresponding reference characters have been given thereto for the purpose of clarity.

Figure 3 shows the sleeve 26 within the stationary cylinder 13' and with the ejection aperture 44 in alignment with conduit 42'. At the same time, one of the conduits 47 is in alignment with the union which terminates conduit 41', it being understood that sleeve 26 is rotating in the direction of arrow 49.

At this position, fluid under pressure is ejected through the aperture 44, and through conduit 42' to the underside of piston 40 within the slave cylinder 39, thus forcing the piston upwardly and opening the poppet valve 7 which, in this instance, is classified as an inlet valve. As the piston 40 moves upwardly within cylinder 39, fluid in front of said piston passes out through the conduit 41', and through the wall of the cylinder 13 to the conduit 47 which conveys same to the longitudinal drilling or passageway 46 within the shaft 25 and thence to the fluid reservoir 16 as clearly illustrated in Figure 1.

Due to the relatively high pressure of the fluid within the sleeve 26, the opening of the valve 7 is practically instantaneous. As soon as the sleeve has moved so that ejection aperture 44 is no longer in alignment with conduit 42', the hydraulic system consisting of conduits 41', 42' and the slave cylinder and piston 39 and 40, is in a locked position, thus maintaining the valve in the open position.

As the sleeve moves through 90 degrees, to take up the position shown in Figure 5, fluid from the sleeve 26 passes through the ejection aperture 44, which is now in alignment with the corresponding union of the conduit 41', thus driving the piston 40 downwardly and closing valve 7, the return fluid below piston 40 passing through the conduit 42' which is now a return conduit, and through the opposite leg of conduit 47 which is now in alignment with the union of the conduit 42'.

Once again as soon as the ejection aperture has passed the end of conduit 41' the system is in the locked condition, and the valve remains closed. The next 90 degree rotation of sleeve 26 will bring the other leg of the conduit 47 in alignment with the end of conduit 41' but as no pressure will be exerted upon piston 40, no movement occurs and the relatively light spring 50 around poppet valve 7 is sufficient to maintain it upon its seat at this point.

Figure 4 shows an inlet valve at the position similar to that shown in Figure 3. Here the aperture 44 has just passed conduit 41' thus closing the exhaust valve, fluid returning through the conduit 47 to the central drilling 46 of the shaft 25.

This exhaust valve remains closed until aperture 44 coincides with conduit 42' in Figure 4, at which time the other leg of the conduit 47 is in alignment with the end of conduit 41' and the cycle is reversed thus opening the exhaust valve.

From the foregoing, it will be appreciated that each valve requires a pair of conduits terminating in the same radial plane upon the cylinder 13 and that each valve also requires a pair of return conduits and an ejection aperture within the sleeve 26 in the same radial plane and that the timing and operation of all of the valves are governed by the initial relationship during construction.

Finally, it should be noted that 90 degree rotation of the sleeve 26 equals one stroke of a 4 cycle engine, so that one revolution of the sleeve 26 coincides with a full operating cycle of any one cylinder of the associated engine.

Since various modifications can be made in my invention as hereinabove described, and many apparently widely different embodiments of same made within the spirit and scope of the claims without departing from such spirit and scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

What I claim as my invention is:

1. A hydraulic valve operating device for 4 cycle engines which include inlet and exhaust valves and push rods to actuate same; comprising in combination a stationary cylinder mounted adjacent said engine, a hollow shaft bearably supported axially within said cylinder, and a closed ended sleeve secured to said shaft and rotatable sealably within said cylinder, at least one pressure fluid intake in said sleeve, a source of pressure fluid supply to said intake, a slave piston and cylinder assembly secured to said engine for each of said valves operable by said device, said push rods being operatively connected to each of said slave pistons, an aperture in said slave cylinder on each side of said piston, conduits extending from each of said apertures to said stationary cylinder, the two conduits from each of said slave cylinders terminating on said stationary cylinder in the same radial plane but spaced around the perimeter thereof, a pressure fluid ejecting drilling through the wall of said sleeve in the same radial plane as that in which the said conduits terminate, pressure fluid return means in said sleeve extending from the wall thereof to said hollow shaft, and means to rotate said sleeve at a speed of rotation equal to half the speed of rotation of said engine, whereby when said ejection aperture is in alignment with one of said conduits, the other of said conduits is in alignment with said return means and vice versa.

2. The device according to claim 1 in which said pressure fluid intake means comprises a fluid conduit connected to the wall of said stationary cylinder and extending therethrough, a plurality of radially situated apertures in the wall of said sleeve in the same radial plane as said last mentioned fluid condit, said apertures progressively passing over the open end of said fluid conduit when said sleeve is rotated, and sealing rings on said sleeve upon each side of said apertures, cooperating sealably with the wall of said stationary cylinder.

3. The device according to claim 2, which includes a set of radially disposed apertures adjacent each end of said sleeve, the radial position of one set of said apertures being staggered with relationship to the other set thereof whereby constant pressure feed is maintained to said sleeve, and a fluid conduit connected to the wall of said stationary cylinder adjacent each set of apertures.

4. The device according to claim 1 in which said source of pressure fluid supply comprises a fluid pump operable by said engine, a fluid reservoir situated adjacent said engine, and a feed conduit extending from one side of said pump to said reservoir, a further conduit extending from the pressure side of said pump to said pressure fluid intake, said hollow shaft being connected to said reservoir for fluid return therethrough.

5. The device according to claim 2 in which said source of pressure fluid supply comprises a fluid pump operable by said engine, a fluid reservoir situated adjacent said engine, and a feed conduit extending from one side of said pump to said reservoir, a further conduit extending from the pressure side of said pump to said pressure fluid intake, said hollow shaft being connetced to said reservoir for fluid return therethrough.



6. The device according to claim 3 in which said source of pressure fluid supply comprises a fluid pump operable by said engine, a fluid reservoir situated adjacent said engine, and a feed conduit extending from one side of said pump to said reservoir, a further conduit extending from the pressure side of said pump to said pressure fluid intake, said hollow shaft being connected to said reservoir for fluid return therethrough.

7. The device according to claim 1 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

8. The device according to claim 2 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

9. The device according to claim 3 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

10. The device according to claim 4 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

11. The device according to claim 5 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

12. The device according to claim 6 which includes fluid sealing means around each of said ejection drillings cooperating sealably with the wall of said stationary cylinder.

13. The device according to claim 1 in which said pressure fluid return means comprises a pair of conduits extending from the wall of said sleeve, radially inwardly to said hollow shaft, and extending through said wall and through the wall of said shaft to the hollow interior thereof.

14. The device according to claim 2 in which said pressure fluid return means comprises a pair of conduits extending from the wall of said sleeve, radially inwardly to said hollow shaft, and extending through said wall and through the wall of said shaft to the hollow interior thereof.

15. The device according to claim 3 in which said pressure fluid return means comprises a pair of conduits extending from the wall of said sleeve, radially inwardly to said hollow shaft, and extending through said wall and through the wall of said shaft to the hollow interior thereof.

16. The device according to claim 4 in which said pressure fluid return means comprises a pair of conduits extending from the wall of said sleeve, radially inwardly to said hollow shaft, and extending through said wall and through the wall of said shaft to the hollow interior thereof.

17. The device according to claim 7 in which said pressure fluid return means comprises a pair of conduits extending from the wall of said sleeve, radially inwardly to said hollow shaft, and extending through said wall and through the wall of said shaft to the hollow interior thereof.

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