

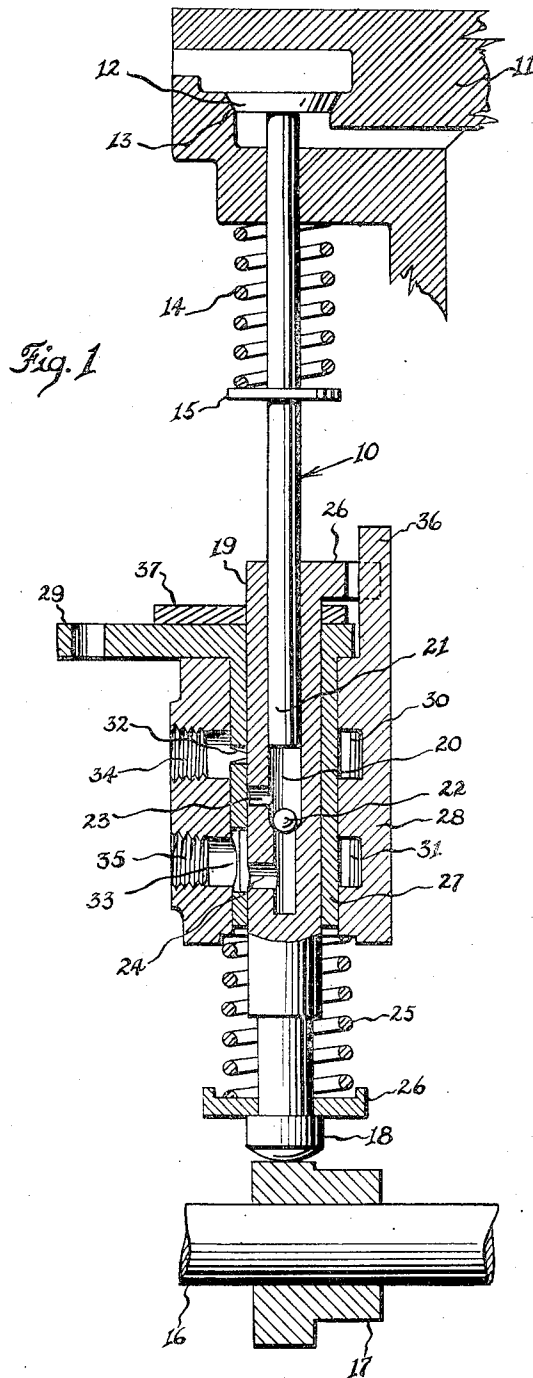
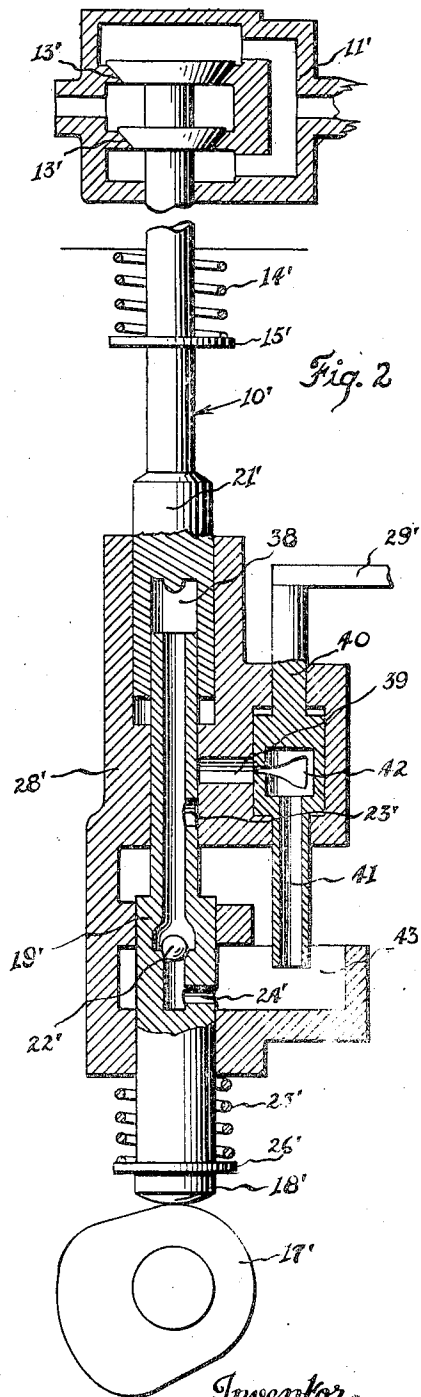
Jan. 10, 1950

J. W. LINCOLN
CONTROL SYSTEM FOR HYDRAULICALLY
ACTUATED VALVES AND THE LIKE

2,494,183

Filed July 6, 1946

2 Sheets-Sheet 1



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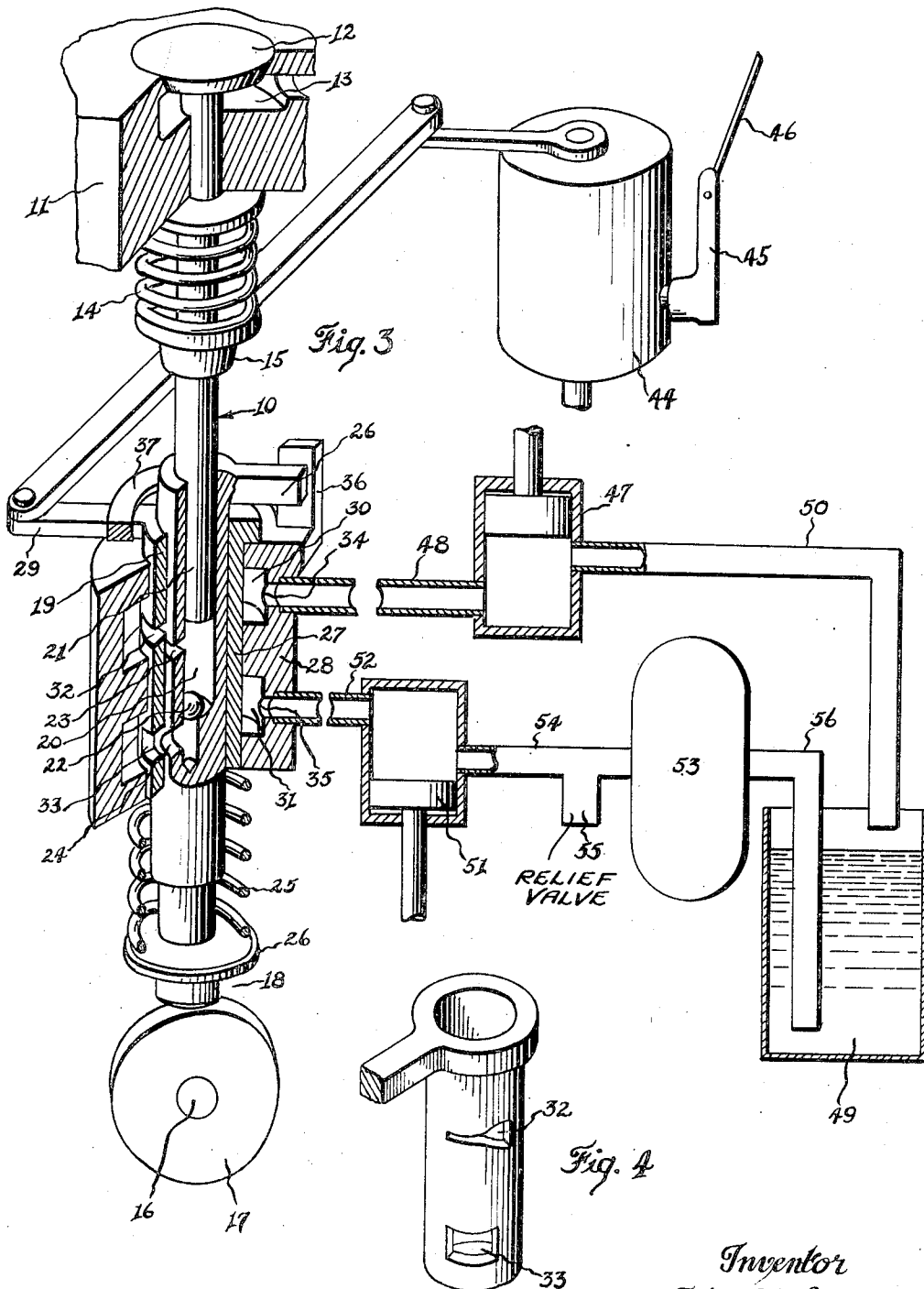
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CONTROL SYSTEM FOR HYDRAULICALLY
ACTUATED VALVES AND THE LIKE

John W. Lincoln, Stonington, Conn.

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6 Claims. (Cl. 121-149)

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My invention relates to control systems for engines and particularly to a variable cut-off for controlling the lift and timing of valves.

An object of my invention is to provide a hydraulic or fluid valve lifter particularly adapted for use in steam engines.

An additional object of my invention is to provide a fluid operated valve lifter and control means whereby infinite adjustment between maximum lift and zero lift is obtainable.

A further object of my invention is to provide an automatic valve and cut-off control mechanism for steam engines.

A still further object of my invention is to provide a combined manual and automatic control device for regulating the degree of valve lift in a steam engine in accordance with load requirements of the engine.

Further objects will be apparent from the specification and drawings, in which:

Fig. 1 is a sectional view of a hydraulic valve lifter constructed in accordance with my invention;

Fig. 2 is a sectional side view of a modified form of valve lift central structure;

Fig. 3 is a diagrammatic sectional view showing the operation of a governor and valve lifting mechanism as applied to the form shown in Fig. 1; and

Fig. 4 is an enlarged perspective view of the control sleeve employed in Figs. 1 and 3.

While certain novel features of the invention are disclosed herein with considerable detail with respect to certain particular forms of the invention, it is not desired to be limited to such details since many changes and modifications may well be made without departure from the spirit of the invention in its broadest aspect.

For the sake of clarity, I have chosen to illustrate my valve structure as divorced from any particular type of engine since it will be understood that my control system may be used to advantage with any type of poppet valve or machine element in which one member is intermittently activated by another member at varying degrees of displacement.

Valve 10 is shown seated in cylinder block 11 (Fig. 1) and has a face 12 adapted to close valve port 13. Valve 10 is normally urged into closed position by spring 14 and keeper 15 as in conventional practice. Also illustrated in accordance with conventional practice is cam shaft 16, cam 17, and cam follower 18, which is the lower portion of push rod 19. Push rod 19 has an interior bore 20 in which valve stem 21 slides. At a point

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below maximum displacement of push rod 19, bore 20 narrows to provide a seat for ball check 22. Push rod 19 is drilled at 23 and at 24 to provide exterior communication with bore 20 on either side of ball check 22. Push rod 19 is urged downwardly in Fig. 1 by spring 25 and retainer 26 which abuts cam follower 18 and is enclosed by annular bushing 27 which serves as a guide for the push rod and also regulates the relative travel of valve stem 21 and push rod 19 in a manner to be more fully explained hereinafter.

Bushing 27 is adapted to turn in housing 28 and for this purpose has an extension or lever 29 formed integrally with it. Housing 28 contains two annular recesses 30 and 31 which register with ports 32 and 33 respectively in bushing 27. Fluid ingress and egress to recess 30 and 31 is provided by tapped holes 34 and 35.

Push rod 19 is prevented from turning with respect to bushing 27 by means of lug 26 which is free to move up and down between guides 36. Up and down movement of bushing 27, however, is prevented by arm 37 attached to housing 28.

Particular attention is directed to the shape of port 32 (Fig. 4). This port tapers longitudinally of the axis of bushing 27 so that as the bushing is rotated with respect to housing 28, the size of the aperture of port 32 registering with orifice 23 can be increased from zero to a predetermined maximum. Further rotation of bushing 27 eliminates all registering thereby closing orifice 24 insofar as fluid communication between bore 20 and chamber 31 is concerned, regardless of the position of cam 17 and rod 19.

Referring now to Fig. 2, a modified structure in which the fluid relief device does not enclose the pushrod is shown. The steam chest of an engine is denoted by 11' and has dual valve ports 13'. Valve 10' is similarly urged to closed position by means of spring 14' and retainer 15'. Valve stem 21' is enlarged and centrally bored at 38. Push rod 19' slidably enters bore 38 of valve stem 21' and terminates in cam follower 18' which is urged against cam 17' by spring 25' and collar 26'. Rod 19' is also centrally bored to provide a fluid passage or chamber and contains a ball check 22' which permits ingress of fluid at port 24' but which prevents egress through this port. Port 23' located above check 22' provides egress for fluid entrapped in the bore and in the hollow stem 21'. At some point during the travel of rod 19', bore 23' will register with port 39 in housing 28'. Also enclosed in housing 28' is control valve 40 centrally bored at 41 and having a V-slot 42 generally similar to port 32 previously described in con-

nection with Fig. 4. Slot 42 registers with port 39 and provides a relief orifice variable in accordance with the position of valve 40 in housing 28. This positioning is accomplished by rotation of valve 40 and control lever 29'. Fluid passing out of orifice 23' through port 39 and slot 42 is discharged through bore 41 into reservoir 43 from whence it will be pumped through orifice 24' and upwardly past check 22'.

Governor 44 (Fig. 3) controls the position of bushing 27 in accordance with the desired speed of the engine and may be of any standard centrifugal or hydraulic type well known to the art. Governor 44 may be controlled manually by means of lever 45 and rod 46.

Hole 34 is connected to valve 47 by means of conduit 48. Valve 47 is also connected to fluid supply reservoir 49 by means of conduit 50.

Hole 35 is similarly connected to valve 51 by conduit 52, and to fluid pump 53 by means of conduit 54. Relief valve 55 is desirably placed between valve 51 and pump 53. Pump 53 draws fluid from supply tank 49 through conduit 56.

Operation

My control system provides periodical actuation of push rod 19 by means of cam 17. This motion in turn compresses fluid in bore 20 above ball check 22 which in turn raises valve 10. When port 23 registers with port 32 in sleeve 27, fluid flows into annular passage 30 permitting valve 10 to drop thereby closing valve port 13. It will be apparent that the rate at which fluid is released from bore 20 will depend upon the setting of sleeve 27 since port 32 is tapered as described above. As engine speed increases, port 32 will be turned to provide greater registering with port 23. This causes valve 10 to seat after the top of its stroke. Should engine speed be faster than is required after maximum opening of port 32 with respect to orifice 23, further rotation of bushing 27 prevents any registering of the port 24 with orifice 33 thereby causing vacuum in bore 20 above ball check 22, since no fluid is admitted to bore 20, either through port 33 or through port 32, after the latter has passed out of register with port 22 on the down stroke of push rod 19. The valve 10 being restrained by its seat from further downward travel, vacuum is created in bore 20 by the continued downward travel of push rod 19 under urging of spring 25. The size of port 33 and its position in sleeve 27 with respect to port 24 are such that port 33 registers with port 24 at all times except under the conditions just described. When bushing 27 is thus turned, as described above, a stop on body 28 prevents further motion of arm 29 and bushing 27, so that port 32 remains open to communication with port 23 at the top of each stroke, serving to release any air or fluid that may have leaked into bore 20. Since no more fluid is permitted ingress through port 24, there will be no fluid compression to raise valve 10 against pressure of spring 14 and the engine will "coast" until lever 29 is rotated either by governor 44 or handle 46 to cause ports 33 and 24 to register with each other.

When lever 29 is rotated in the opposite direction so that the smallest registering of port 32 with port 23 has been exceeded, egress of fluid from bore 20 through ports 32 and 23 will be completely prevented but in this position ports 33 and 24 continue to register. Therefore, push rod 19 and valve 10 operate as a hydraulically coupled unit without relative movement because of the entrapped fluid in bore 20 above check 22.

Where the engine has been inoperative for some time, fluid in bore 20 of valves which have remained in the raised or open position may escape due to wear or to the vacuum described previously. As a result, it may be that no valves will open to admit steam for starting the engine. Under these conditions, piston valve 47 may be actuated either manually or in combination with governor 44 to compress fluid trapped therein and force it through conduit 48 into bore 20 through passage 30. After one revolution of the engine, valve 10 will be primed automatically and piston valve 47 returns to an inoperative position.

A similar piston valve 51 is employed to open a plurality of engine valves 10 simultaneously regardless of the position of cam 17. It will be apparent that piston valve 47 will raise valve 10 only if cam 17 is at an admission angle causing ports 23 and 32 to register with each other. In warming up an engine, it may be desirable to open all valves at the same time or under some circumstances a steam engine can be employed as an effective brake for the vehicle in which it may be installed. Therefore, I have provided means for raising all the valves at once.

When valve 51 is actuated either by governor 44 or independently, fluid is forced through conduit 52, passage 31, ports 33 and 24 past ball check 22 into bore 20. This in turn raises valve stem 21 in push rod 19 to open valve port 13. It is contemplated that in actual practice, it will be desirable to provide suitable mechanical interlocks for piston valves 47, 51 and governor 44 to lift any combination of valves and to prevent damage to the engine. Pump 53 supplies fluid under pressure to recess 31 through conduits 54 and 52. It will be apparent that when piston valve 51 is in the position illustrated in Fig. 3, no restriction to the passage of fluid occurs.

The operation of the structure of Fig. 2 is substantially the same as that of Figs. 1 and 3 except that the fluid cycle is self-contained in housing 28', it, therefore, being unnecessary to provide independent fluid pumping devices since released fluid returns through bore 41 to reservoir 43 which is at all times above opening 24'. Raising and lowering of cam follower 18' acts to pump fluid upwards past check 22' into chamber 38 from which it will be released as port 23' registers with port 39 and in accordance with the registering of slot 42 with port 39. It will be understood that the form of Fig. 2 does not contemplate the necessity of raising valve 10' except by means of cam 17'.

It will be understood that the variations in the structures of Figs. 1 and 3 have been made for the purposes of clarity, it being immaterial whether ports 34, 35 and lever 29 are in vertical alignment or not.

I have thus described a mechanism for controllably actuating a valve or other similar machine element which when applied to a steam engine greatly simplifies the control of the engine and improves steam economy because the cut-off can be regulated without the necessity of manual control and it supplies optimum valve setting for any desired speed or load over the entire engine range.

Throttling at the valve seats is reduced to a minimum by a combined spring action and steam pressure on the valve itself, and by the complete opening of the valve, under any condition of cut-off, except when over-speeding renders the valve action inoperative. This important feature of

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my design is achieved by properly locating port 32 with respect to the high and low points of cam 17 so that valve 10 will be lifted a distance corresponding to nearly maximum cam displacement before ports 23 and 32 register at all. Furthermore, my construction is admirably adapted to both intake and exhaust valves and considerably simplifies the problem of reversing. Very accurate valve timing is possible because any change in setting due to a change in viscosity of the hydraulic fluid will be automatically compensated in the governor.

Having thus described my invention, I claim:

1. A valve lifter assembly comprising a valve guide housing having upper and lower annular recesses, a bushing rotatably mounted in the housing, means for rotating the bushing in the housing, a hollow push rod adapted to move slidably in the bushing, guide means for preventing rotation of the push rod, a valve stem extending into the hollow push rod, spring means urging the valve stem into the push rod, spring means urging the push rod away from the valve stem and into cooperation with a cam, a check valve in the hollow portion of the push rod, a relatively non-compressible fluid in the hollow push rod for transmitting thrust from the push rod to the valve stem, and control ports in the push rod and in the bushing for selectively permitting fluid ingress and egress to the hollow push rod.

2. Apparatus according to claim 1 in which the fluid egress port in the bushing is tapered to provide a variable orifice for fluid egress.

3. A valve lifter assembly comprising a valve guide housing having upper and lower annular recesses, a bushing rotatably mounted in the housing, means for rotating the bushing in the housing, a hollow push rod adapted to move slidably in the bushing, guide means for preventing rotation of the push rod, a valve stem extending into the hollow push rod, spring means urging the valve stem into the push rod, spring means urging the push rod away from the valve stem and into cooperation with a cam, a check valve in the hollow portion of the push rod, a relatively non-compressible fluid in the hollow push rod for transmitting thrust from the push rod to the valve stem, control ports in the push rod and in the bushing for selectively permitting fluid ingress and egress to the hollow push rod, and a starting valve for forcing fluid into the upper annular recess through the egress ports in the push rod and bushing to move the valve stem independently of the push rod.

4. A valve lifter assembly comprising a valve guide housing having upper and lower annular recesses, a bushing rotatably mounted in the housing, means for rotating the bushing in the housing, a hollow push rod adapted to move slidably in the bushing, guide means for preventing rotation of the push rod, a valve stem extending into the hollow push rod, spring means urging the valve stem into the push rod, spring means urging the push rod away from the valve stem and into cooperation with a cam, a check valve in the hollow portion of the push rod, a relatively non-compressible fluid in the hollow push rod for transmitting thrust from the push rod to the valve stem, control ports in the push rod and in the bushing for selectively permitting ingress and egress of fluid to the hollow push rod, and a starting valve for forcing fluid into the lower annular recess to force fluid through the ingress ports in the bushing and push rod and past the

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check valve in the push rod to move the valve stem independently of the push rod.

5. A valve lifter assembly comprising a valve guide housing having upper and lower annular recesses, a bushing rotatably mounted in the housing, means for rotating the bushing in the housing, a hollow push rod adapted to move slidably in the bushing, guide means for preventing rotation of the push rod, a valve stem extending into the hollow push rod, spring means urging the valve stem into the push rod, spring means urging the push rod away from the valve stem and into cooperation with a cam, a check valve in the hollow portion of the push rod, a relatively non-compressible fluid in the hollow push rod for transmitting thrust from the push rod to the valve stem, control ports in the push rod and in the bushing for selectively permitting fluid ingress and egress to the hollow push rod, a starting valve for forcing fluid into the upper annular recess through the egress ports in the push rod and bushing, and a starting valve for forcing fluid into the lower annular recess to force fluid through the ingress ports in the bushing and push rod and past the check valve in the push rod to move the valve stem independently of the push rod.

6. A valve lifter assembly comprising a valve guide housing having upper and lower annular recesses, a bushing rotatably mounted in the housing, means for rotating the bushing in the housing, a hollow push rod adapted to move slidably in the bushing, guide means for preventing rotation of the push rod, a valve stem extending into the hollow push rod, spring means urging the valve stem into the push rod, spring means urging the push rod away from the valve stem and into cooperation with a cam, a check valve in the hollow portion of the push rod, a relatively non-compressible fluid in the hollow push rod for transmitting thrust from the push rod to the valve stem, control ports in the push rod and in the bushing for selectively permitting ingress and egress to the hollow push rod, a first starting valve for forcing fluid into the upper annular recess through the egress ports in the push rod and bushing, a second starting valve for forcing fluid into the lower annular recess to force fluid through the ingress ports in the bushing and push rod and past the check valve in the push rod to move the valve stem independently of the push rod, a fluid reservoir, a fluid pump for delivering fluid from the reservoir to the lower annular recess, and a relief valve between the fluid pump and the recess.

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