May 5, 1925. 1,536,787

J. F. GRACE

ENGINE VALVE

Filed July 14, 1921 2 Sheets-Sheet 1

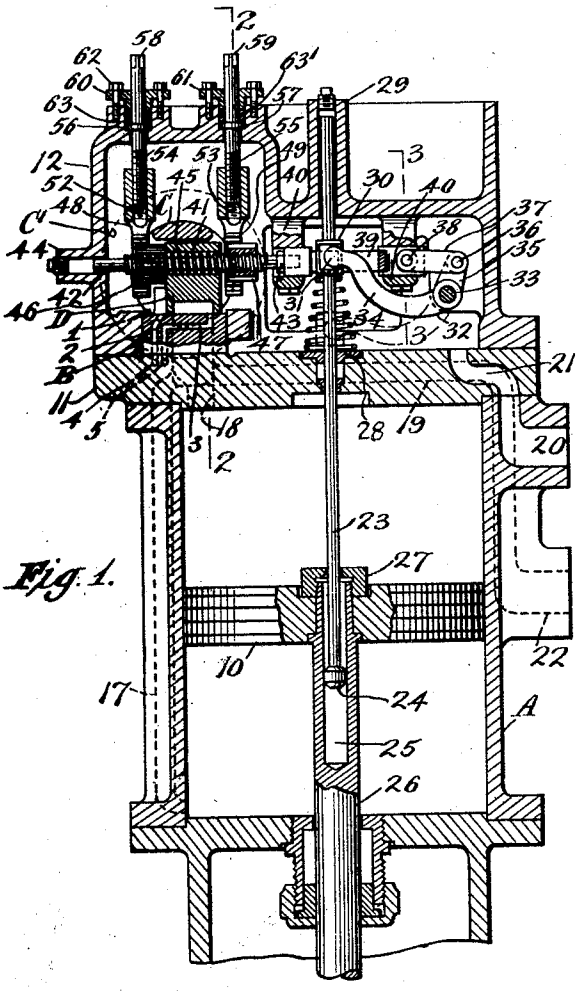
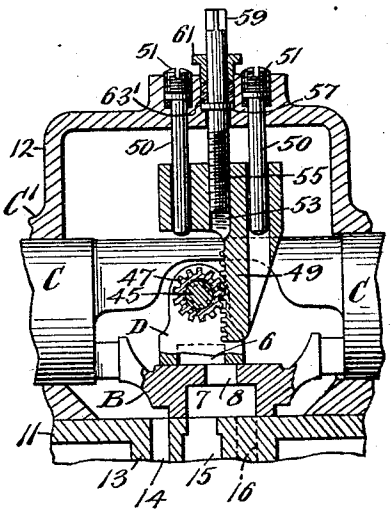


Fig. 1.

Fig. 2.



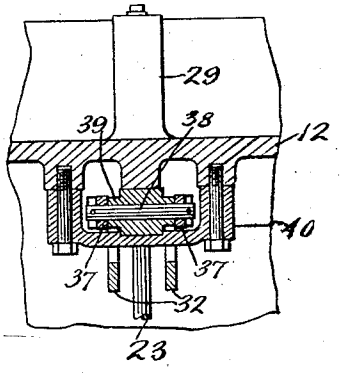
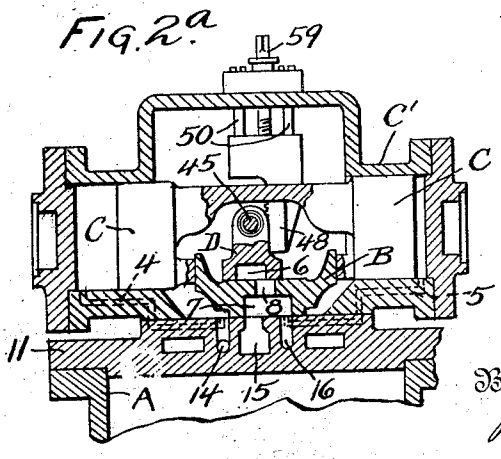


Fig. 3.

Fig. 2a.



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Fig. 4.

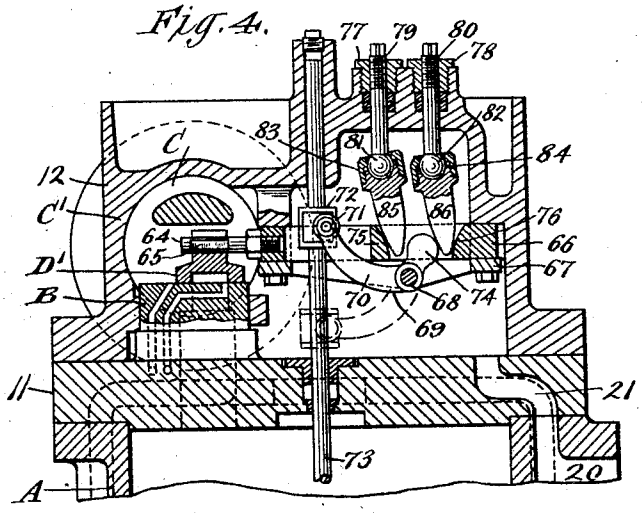


Fig. 5.

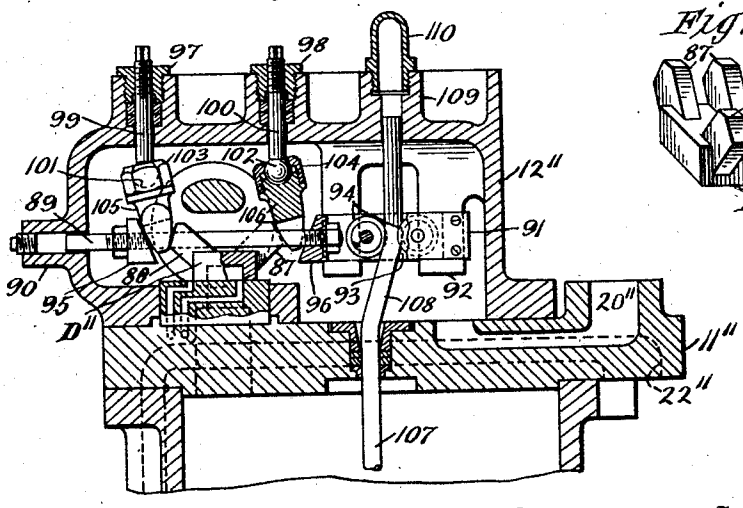


Fig. 6.

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Patented May 5, 1925. 1,536,787

UNITED STATES PATENT OFFICE.

JOHN F. GRACE, OF KEARNY, NEW JERSEY, ASSIGNOR TO WORTHINGTON PUMP AND MACHINERY CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF VIRGINIA.

ENGINE VALVE.

Application filed July 14, 1921. Serial No. 484,565.

To all whom it may concern:

Be it known that I, JOHN F. GRACE, a citizen of the United States, residing at Kearny, county of Hudson, and State of New Jersey, have invented certain new and useful Improvements in Engine Valves, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to a steam engine having fluid actuated valves of the type in which an auxiliary valve controls the admission of fluid to fluid actuated means operating a main valve.

One of the objects of this invention is to provide a valve mechanism of the above mentioned type wherein all valve gear parts having motion are enclosed so as to exclude dirt, and also to protect attendants, thus especially adapting the invention for use on locomotive and marine feed pumps.

Another object consists in the inclusion of a motion translating and reducing means between the auxiliary valve and the actuator therefor, whereby the actuator may reciprocate in one plane and yet move the auxiliary valve at a reduced speed and with smaller travel in another plane, thus avoiding the sudden reversal of the piston of the engine and the consequent shock which occurs with the usual construction of valve mechanism wherein the auxiliary valve is carried or operated directly by the actuator.

A further feature comprises simple means whereby independent adjustment of the auxiliary valve may be accomplished at either or both ends of the stroke without interrupting the operation.

In the accompany drawings, forming a part of this specification, there are shown, by way of illustration, three valve mechanisms embodying the preferred forms of the invention.

In the drawings:

Figure 1 is a vertical central section of the preferred form of the invention.

Fig. 2 is a detail section on the line 2—2 of Fig. 1.

Figure 2^a is a detailed section similar to Figure 2 showing the passages for delivery of steam to the auxiliary cylinder ends.

Fig. 3 is a detail section on the line 3—3 of Fig. 1.

Fig. 4 is a vertical central section of a modified form of the invention.

Fig. 5 is a vertical central section of another modified form of the invention; and

Fig. 6 is a perspective view of the auxiliary valve shown in Fig. 5.

With reference to the drawings:

The main engine cylinder A receives the fluid propelled piston 10, said cylinder being closed by a head 11 at one end and to which is secured a combined steam chest and auxiliary valve chamber 12; in the steam chest 12 is located the main valve seat 13 having ports 14, 15 and 16 which are connected with passages 17, 18 and 19 in the cylinder A and head 11 for conveying steam, or other fluid, to and from the opposite ends of cylinder A and to the exhaust.

A side inlet 20 in the cylinder A connects with the passage 21 in the head 11, said passage leading to the interior of the steam chest 12, while the exhaust steam leaves through the passage 19 in the head 11 and which connects with the exhaust outlet 22 in the wall of the cylinder A. While the inlet 20 and exhaust 22 may be located in any suitable position, it is nevertheless desirable to use the arrangement described for the reason that it permits the complete removal of the steam chest or valve chamber 12, as well as the piston 10 and its rod without disturbing the pipe connections to the inlet and exhaust.

Controlling the admission of fluid pressure to the ports 14, 15 and 16 of the main valve seat 13 is a main valve B which has moving therewith the piston C of double ended construction, the two ends being connected by the portion which includes the main slide valve B, said piston C working in the valve piston cylinders C′.

Moving on the upper face of the main slide valve B and controlling the movements of the piston C, which actuates the main slide valve B, is an auxiliary valve D of the well known D-type the direction of movement of which is transverse to the movement of the main slide valve B and piston C.

The valve seat 1 for the auxiliary valve D, and which is on the upper face or back of the main slide valve B is provided with suitable ports and passages 2 and 3 which

connect with the passages 4 and 5, respectively, in the cylinder head 11 for conveying steam to and from the opposite ends of the cylinder C′, whereby movement of the piston C is accomplished; a central exhaust port 6 is connected with the exhaust cavity 7 of the main slide valve B by the port or passage 8. The action of the auxiliary and main valves is or may be substantially that of other valves of this type, as, for instance, the valves of the Hall Patents, Nos. 737609 and 737610, Sept. 1, 1903.

It has been customary, in previous enclosed valve mechanisms of this type, to directly connect a central tappet rod actuated by the main steam piston to the auxiliary valve. The present invention provides a motion translating and reducing means intermediate the tappet valve or auxiliary valve actuator and the auxiliary valve, whereby the travel of the auxiliary valve is less than the movement of the actuator. The actuator comprises a central tappet rod 23 having a head 24 disposed within the axial recess 25 of the piston rod 26 of the piston 10, the piston 10 being secured to the piston rod 26 by means of a nut 27 which is adapted to engage with the head 24 for shifting the central tappet rod 23 on the outstroke of the piston, the end of the recess 25 accomplishing the shift of the central tappet rod on the instroke of the piston.

The actuator or central tappet rod 23 extends through a guide 28 in the form of a packing gland in the cylinder head 11 and up through the steam chest or valve chamber 12 where its end is received in a cylindrical projection 29 which forms a guide for the tappet rod 23. The tappet rod, on the portion thereof within the steam chest or valve chamber 12, carries a block 30 which is recessed to receive the rounded end 31 of a reduction lever 32 pivoted at 33 and comprising a long arm 34 and a short arm 35, the said long arm 34 receiving its motion through its connection or engagement with the block 30.

The short arm 35 is connected through suitable motion translatory means to the auxiliary valve D for movement thereof in which, as shown in Figure 1, the arm 35 is pivoted as at 36 to a link 37 pivoted at 38 to the reciprocable member 39 movable at right angles to the movement of the valve actuator or central tappet rod 23 and guided in the depending brackets 40. In this manner a reduced speed and travel are imparted to the auxiliary valve D which is connected with the reciprocable member 39.

The stroke of the main piston is controlled by suitable means operable from the exterior of the valve casing and preferably forming a part of the motion translatory means. The regulating means shown in Figure 1 is a lost motion connection preferably forming the connection between reciprocating member 39 and the auxiliary valve D, which, for this purpose is provided with an opening 41 through which the valve rod 42 is passed, the one end of said valve rod being connected with the reciprocable member 39, as indicated at 43, while the other end is received in the cylindrical projection 44 forming a guide. The valve rod 42 is threaded as shown at 45 to receive suitable lost motion members, in the present instance nuts 46 and 47, on opposite sides of the auxiliary valve D, which are adjustable to time the movement of the auxiliary valve for adjustment of the main piston stroke through suitable means now to be described. The nuts 46 and 47 are provided with teeth whereby they form pinions, as shown. These pinion nuts 46 and 47 are engaged by vertical racks 48 and 49 which are guided on pins 50 and held in the steam chest by screws 51. Each rack 48 and 49 is provided with a threaded aperture 52 and 53 respectively which receive adjusting screws 54 and 55 having collars 56 and 57 and squared upper ends 58 and 59 to receive a wrench or key; suitable glands 60 and 61 on the adjusting screws 54 and 55 prevent leakage of steam, said glands being held in place by bolts 62 and being packed in the usual manner as indicated at 63 and 63′. From this arrangement it will be obvious that adjusting movement of the auxiliary valve D may be accomplished by moving the nuts 46 and 47 through the medium of their respective racks 48 and 49 which, in turn, are raised and lowered by means of the adjusting screws 54 and 55. It is to be noted that the faces of the nuts 46 and 47 are wider than the faces of the racks 48 and 49 thus permitting movement of the auxiliary valve D without ever disengaging the nuts from their respective racks. It will thus be evident that the auxiliary valve D may be adjusted without interrupting operation.

The operation of the construction shown in Figs. 1 to 3 is as follows:

The fluid propelled piston 10, in its downward movement, engages the nut 27 with the actuator or tappet rod 23 also moving it downwardly and the block 30, engaging the rounded end 31 of the reduction lever 32 moves said lever which, through the link 37 displaces the valve rod 42, to the left whereby the pinion nut 47 engages the auxiliary valve D moving it to the left. This movement of the auxiliary valve uncovers the passage 3 thus permitting steam to pass to the right hand end of the cylinder C′ as viewed in Fig. 2 and thereby moving piston C to the left and, at the same time, port 6 is connected with the exhaust cavity 7 of the main slide valve B thereby exhausting steam from the left hand side of the

cylinder C'. Movement of the main slide valve B to the left opens port16 for delivery of steam through passage 17 to the lower end of the main cylinder A for reversing movement of the piston 10 and, at the same time, port 14 connects with passage 15 for exhaust of steam from the upper end of the cylinder A. The opposite stroke of the main piston 10 is accomplished by the reverse of the movements previously described.

In the construction shown in Fig. 4, the arrangement of the valves, ports and passages is identical with that just previously described, but the auxiliary valve D' is keyed to the valve rod 64 as indicated at 65 and said valve rod is secured to the reciprocating member 66 supported by brackets 67 and which carries a transverse pin 68 mounting a reduction lever 69, the long arm 70 of which has its roller end 71 engaging the block 72 on the actuator or central tappet rod 73. In this construction the lost motion connection is applied between the short arm of the reduction lever 69 and the reciprocatory member 66 and the regulating means therefore is of a different form now to be described. The short arm of the reduction lever 69 is rounded as indicated at 74 and lies between the cam shaped walls 75 and 76 of the reciprocating member 66. Directly above the opening defined by the cam shaped walls 75 and 76 are two gland nuts 77 and 78 which carry adjusting stems 79 shaped at their upper ends to receive a wrench or key, while at their lower ends they carry the balls 81 and 82 and socket nuts 83 and 84 to which are secured the lost motion members shown as dependent wedge shaped members 85 and 86 swingingly held to the said adjusting stems 79 and 80 and lying adjacent and in contact with the inclined walls 75 and 76, respectively. The lost motion members 85 and 86 are engaged by the rounded short arm 74 of the reduction lever 69 with a slight lost motion adjusted by movement of the members 85 and 86 toward and away from the reciprocatory member 66 for regulation of the main piston stroke. This construction also, it will be apparent, permits adjustment without interrupting operation.

With reference now to Figs. 5 and 6 the port arrangement is the same except that the inlet 20'' and exhaust 22'' are located in the cylinder head 11'' which carries the steam chest 12''; the main slide valve construction being identical with that described in connection with the two previous forms will not be again set forth in detail.

But the lost motion connection is applied between the motion translatory means and the auxiliary valve D'' and adjusted by means similar to that described in Figure 4. In this construction auxiliary valve D'' is provided with two sets of angular lugs, said sets being indicated at 87 and 88 and being arranged on either end of the said valve D''. Extending intermediate the lugs of each set, as clearly shown in Fig. 5, is a valve rod 89, the free end of which is guided in the cylindrical projection 90 while the other end is received and held to a reciprocable member 91 carried in depending brackets 92. The reciprocable member has an opening 93 on opposite sides of which are rollers 94 for a purpose to be hereinafter set forth. At each side of the valve D'' is a nut such as indicated at 95 and 96 and having inclined faces which are adjacent similarly inclined faces on the lugs 87 and 88. Directly above the said nuts 95 and 96 are two gland nuts 97 and 98 which carry adjusting stems 99 and 100 shaped at their upper ends to receive a wrench or key, while at their lower ends they are provided with balls 101 and 102 and socket nuts 103 and 104, to which are secured the lost motion members shown as dependent wedge shaped members 105 and 106 swingingly held to the said adjusting stems 99 and 100. Each of these wedge shaped members 105 and 106 are interposed between the lugs 87 and 88 and their respective adjacent nuts 95 and 96. By movement of the members 105, 106 toward and away from the nuts 95 and 96, the movement of the auxiliary valve D'' is properly timed for adjustment of the main piston stroke.

The reciprocable member 91 is operated by a valve actuator 107 which corresponds to and is actuated in the same manner as the central tappet rod described in the other forms of the invention, but instead of the block and reduction lever, the said actuator 107 is provided with an offset portion 108 which, as the actuator reciprocates, engages between the rollers 94 and displaces or reciprocates the member 91 thereby actuating the auxiliary valve D''.

The upper end of the valve actuator 107 is guided in a cylindrical projection 109 closed by the cap nut 110.

It will be understood that the invention is not to be limited to the special construction or arrangement of parts shown, but that these may be modified widely within the invention defined by the claims.

I claim:

1. In combination a valve chest enclosing a slide valve, a valve actuator, a bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, and a lost motion connection between the short arm and the slide valve.

2. In combination a valve chest enclosing a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, an actuator for the auxiliary valve, a

bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, and a lost motion connection between the short arm and the auxiliary valve.

3. In combination, a valve chest enclosing a slide valve, a reciprocating member for moving the valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member, and toothed adjusting means engaging the peripheral teeth and operated from without the valve chest.

4. In combination, a valve chest enclosing a slide valve, a reciprocating member for moving the valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member, and racks engaging the peripheral teeth and operated from without the valve chest.

5. In combination a valve chest enclosing a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, auxiliary valve actuating means, lost motion members forming a part of the auxiliary valve actuating means and means for adjusting the lost motion members from outside the valve chest.

6. In combination a valve chest enclosing a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, a reciprocating member for moving the auxiliary valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member, and toothed adjusting means engaging the peripheral teeth and operated from without the valve chest.

7. In combination a valve chest enclosing a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, a reciprocating member for moving the auxiliary valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member and racks engaging the peripheral teeth and operated from without the valve chest.

8. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve in the valve chest, motion reducing means moved by the valve actuator, and a lost motion connection between the motion reducing means and the valve.

9. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve in the valve chest, motion reducing means moved by the valve actuator, a lost motion connection between the motion reducing means and the valve, and means for adjusting the lost motion connection from outside the valve chest.

10. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve in the valve chest, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, motion reducing means moved by the actuator, and a lost motion connection between the motion reducing means and the auxiliary valve.

11. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve in the valve chest, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, motion reducing means moved by the actuator, a lost motion connection between the motion reducing means and the auxiliary valve, and means for adjusting the lost motion connection from outside the valve chest.

12. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve in the valve chest, valve actuating means moved by the actuator and including motion reducing means, and means for adjusting the valve actuating means from outside the valve chest.

13. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve in the valve chest, valve actuating means moved by the actuator and including motion reducing and translating means, and means for adjusting the valve actuating means from outside the valve chest.

14. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into

the valve chest and actuated by the engine piston, of a slide valve in the valve chest, valve actuating means moved by the actuator and including motion reducing means, motion translating means and a lost motion connection, and means for adjusting the lost motion connection from outside the valve chest.

15. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve in the valve chest, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, auxiliary valve actuating means moved by the actuator, and means for adjusting the auxiliary valve actuating means from outside the valve chest.

16. In a steam engine valve gear, the combination with a valve chest mounted on the engine cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve in the valve chest, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, auxiliary valve actuating means moved my the actuator, a lost motion connection forming a part of the auxiliary valve actuating means, and means for adjusting the lost motion connection from outside the valve chest.

17. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, and a lost motion connection between the short arm and the slide valve.

18. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, a lost motion connection between the short arm and the slide valve, and means for adjusting the lost motion connection from outside the valve chest.

19. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, a bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, and a lost motion connection between the short arm and the auxiliary valve.

20. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, a bell crank lever having arms of unequal length and the long arm thereof connected to the valve actuator, a lost motion connection between the short arm and the auxiliary valve, and means for adjusting the lost motion connection from outside the valve chest.

21. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve, a reciprocating member moved by the actuator for moving the valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member, and toothed adjusting means engaging the peripheral teeth and operated from outside the valve chest.

22. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve, a reciprocating member moved by the actuator for moving the valve and having a threaded portion, lost motion members on the threaded portion of the reciprocating member, peripheral teeth on the lost motion members paralleling the reciprocating member, and racks engaging the peripheral teeth and operated from outside the valve chest.

23. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, a reciprocating member moved by the actuator for moving the auxiliary valve and having a threaded portion, lost motion members on said threaded portion, peripheral teeth on the lost motion members paralleling the reciprocating member, and adjusting means engaging the peripheral teeth and operated from outside the valve chest.

24. In a steam engine valve gear, the com-

bination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a main slide valve, an auxiliary piston for moving the slide valve, an auxiliary valve controlling the movement of the auxiliary piston, auxiliary valve actuating means moved by the valve actuator, lost motion members forming part of the auxiliary valve actuating means, and means for adjusting the lost motion members from outside the valve chest.

25. In a steam engine valve gear, the combination with a valve chest mounted on the cylinder head and a valve actuator extending through the cylinder head into the valve chest and actuated by the engine piston, of a slide valve, motion reducing means moved by the valve actuator, motion translating means moved by the motion reducing means, and a lost motion connection forming a part of the motion translating means.

In testimony whereof, I have hereunto set my hand.

JOHN F. GRACE.