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STEAM ENGINE

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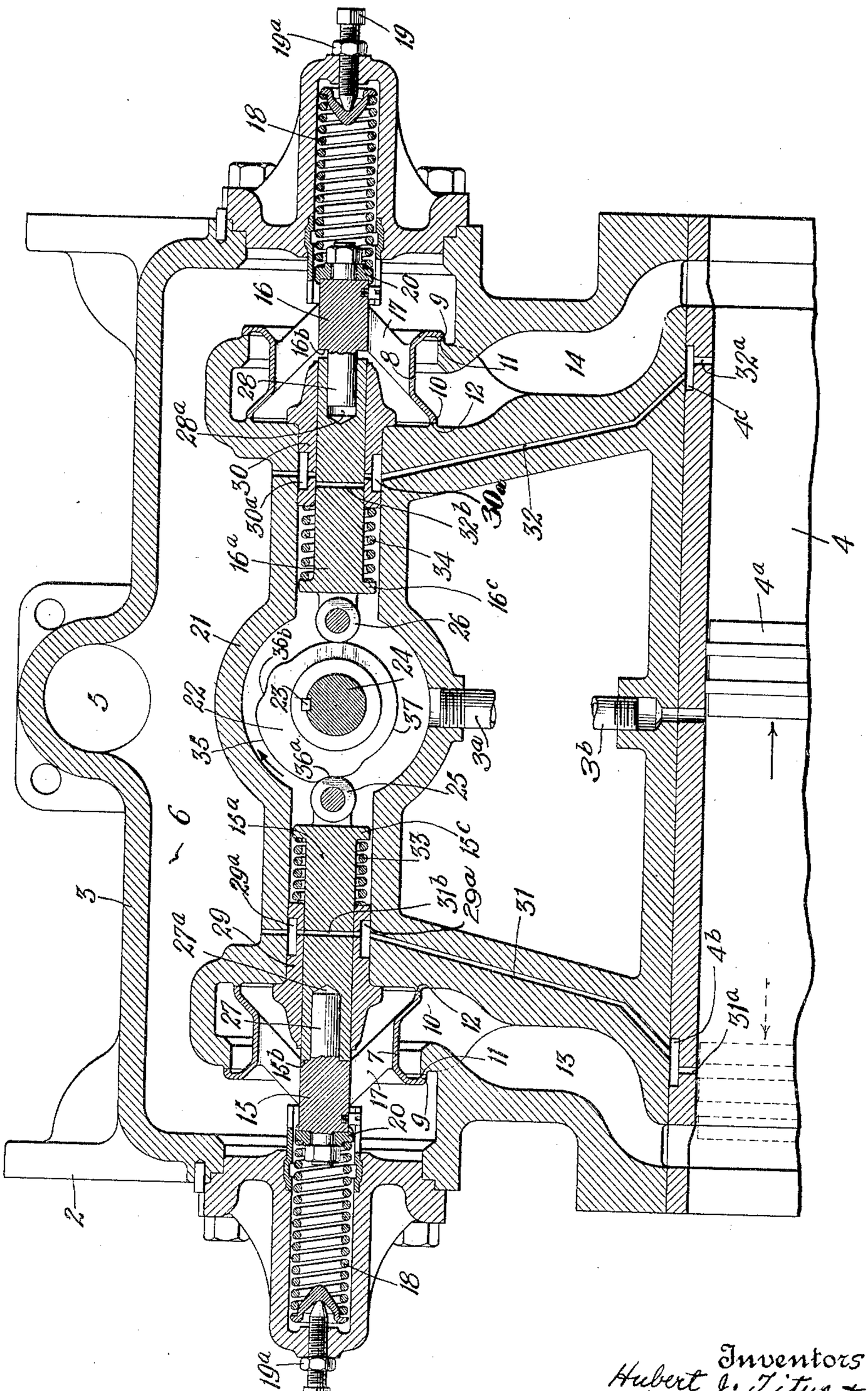

Inventors
Hubert J. Titus +
John S. Wallis
By their Attorneys
Symmestvedt + Lechner

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HUBERT J. TITUS, OF PATERSON, NEW JERSEY, AND JOHN S. WALLIS, OF NEW YORK, N. Y., ASSIGNORS TO FRANKLIN RAILWAY SUPPLY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

STEAM ENGINE

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This invention relates to steam engines and more particularly to valve means therefor, and while it may be used in connection with various types of engines where limited cut-off is desirable but great starting power necessary, it is especially useful in locomotives and will, therefore, herein be described and shown as applied to locomotive valve mechanism.

One of the primary objects of the invention is to provide, in a limited cut-off engine having poppet admission valves (with their advantage of quick movement, to full open and closed positions), for full power in starting.

Another object of the invention is to accomplish the foregoing without preadmission or waste of steam.

Still another object is to attain such advantages without undue complication of mechanism, and in short to provide means for accomplishing the desired results which shall be readily applicable to existing locomotives and capable of incorporation in existing poppet valve constructions.

How we attain the foregoing, together with other objects and advantages which are incident to our invention or will occur to those skilled in the art, will appear from the following description, taken in conjunction with the accompanying drawing which illustrates a practical embodiment of the invention.

In the figure we have shown in vertical longitudinal section a valve chest mounted on a locomotive cylinder, only a portion of the cylinder being illustrated.

The section is taken through the portion of the chest in which the admission valves are located, it being understood that the exhaust chamber with its valves (which is not a part of the present invention) is positioned alongside the admission chamber, the exhaust outlets being indicated at 2, 2. The chest 3, mounted on the cylinder 4, having a cam chamber drain 3*a* and cylinder lubricating pipe 3*b*, has an inlet 5 to the steam cavity or chamber 6, and at its ends poppet admission valves 7, 8, one for each end of the cylinder, these valves being of annular construction and each having edges or flanges 9, 10, adapted to seat, respectively, on the annular surfaces 11, 12.

Normal closure of the valves to cut off the supply of steam to the inlet passages 13, 14, is effected by the steam pressure, because of the fact that the diameter and consequent effective area of the valve adjacent its flange 9 is greater than the diameter and consequent effective area of the valve adjacent its flange 10. Proper and rapid closure of the valves is further assured by the pressure of the steam on the outer ends of the valve stem members or rods 15, 16, on which stems the valves are mounted as by means of web members 17. Each valve has also a spring 18, adjustable by means of a screw and locknut 19, 19*a*, which bears against a ring or collar 20 mounted on the valve stem to insure seating of the valve when the locomotive throttle is closed.

Midway between the valves, within the housing structure 21 is a cam member 22, fixed as by a key or keys 23 on a shaft 24 positioned transversely of the chest. This shaft is adapted to be oscillated or rocked, through the intermediation of a suitable crank or arm (not shown), by the usual valve motion mechanism of the locomotive, for example by connection to the usual combination lever. The cam, which will be further described hereinafter, is thus rocked or oscillated, to control the valves through the valve stem members 15, 15*a*, and 16, 16*a*, with their respective rollers 25 and 26. The parts or pieces 15, 15*a*, together form the complete stem or rod for valve 7, the portion 15 having an extension 27 slidable longitudinally in an opening or socket 27*a* in portion 15*a*, and the outer end of part 15*a* being adapted to abut against the shoulder 15*b* of the part 15. In like manner the parts 16, 16*a*, together form the stem for valve 8, the extension 28 of part 16 sliding in the socket 28*a* in part 16*a*, and the end of part 16*a* being adapted to abut against shoulder 16*b*. The two stem members 15*a*, 16*a*, are in turn slidable longitudinally in the fixed bushings 29, 30.

Considered in another way, the left hand valve member may be said to comprise the

valve proper 7 and the part 15, and the part 15*a* to be termed the rod or stem; and similarly the right valve member may be considered as comprising the valve proper 8 and the part 16, and the part 16*a* be considered as the stem.

Small auxiliary ports or passages 31, 32, extend from the steam chamber 6 through the housing 21, and the respective bushings 29 and 30 down into the cylinder 4 at the points 31*a* and 32*a*, respectively. Suitable independent pockets or cavities 29*a*, 30*a*, and cavities 4*b* and 4*c*, are provided in bushings 29 and 30 and cylinder 4 in order to insure registry of the several portions of the respective passages 31, 32 upon assembly of the structure. Steam is admitted to the cylinder through these auxiliary passages 31 and 32 when the passages 31*b* and 32*b* in the respective stem members 15*a* and 16*a* are moved into registry therewith. A compression spring 33 is positioned between bushing 29 and flange 15*c* on the inner end of stem member 15*a*, and a similar spring 34 is positioned between bushing 30 and flange 16*c* of stem member 16*a*, these springs constantly exerting a pressure to move their respective stem-members 15*a* and 16*a* inward toward the cam for the closing of the auxiliary ports.

The peripheral surface of the cam member 22 has a low portion 37 and a high portion 35, and intermediate portions 36*a* and 36*b*. It will be seen that in oscillation of the cam the roller 25 will engage or bear against surfaces 35, 36*a* and 37, in turn, or vice versa during opposite movement of the cam. The roller 26 will bear against the surfaces 35, 36*b* and 37.

For the explanation of the operation of the complete device, let us now assume that the piston 4*a* is at the left of cylinder 4 and is about to move to the right, and that the valve motion means of the locomotive is set to give a normal cut-off of about 50%. During 50% of the piston's stroke, the roller 25 of valve 7 will be riding on surface 35 of cam 22, and the cam, driven by the usual valve motion, will be completing its movement to the left and commence turning to the right. During this time valve 7 will be held wide open, the stem portion 15*a* abutting against the shoulder 15*b* of part 15. As the piston 4*a* moves farther to the right, to the position shown in full lines on the drawing, and the cam continues to turn to the right, the roller 25 will ride off of surface 35 onto surface 36*a* of the cam, which is the point of normal cut-off, valve 7 seating tight on the seats 11, 12. At this point, however, the stem has moved far enough to the right to put passage 31*b* in registry with passage 31 (which is the position shown in the drawing) and steam will be admitted through this auxiliary port, which will, in effect, produce an extended cut-off for starting, but which at high speeds will be practically ineffective due to the low rate at which steam will pass through such a restricted port. As the piston moves farther to the right and the cam continues its rotation, the roller 25, under the influence of spring 33, will ride onto surface 37 of the cam, for example, at 80% of stroke, and the passage 31*b* will be moved out of registry with passage 31, cutting off steam entirely. This position of the left-hand valve stem is the one corresponding to that in which the right-hand valve stem is illustrated in the drawing.

When the left valve has reached this position, i. e., with roller 25 riding on surface 37 of the cam, permitting closure both of valve 7 and auxiliary port 31, the roller 26 of the right hand valve 8 will start riding up on portion 36*b* of the cam's surface, and the auxiliary port 32 will open, by virtue of the movement of passage 32*b* into registry therewith, and although the right end of the cylinder is normally on compression at this time, there will be no preadmission through passage 32 to cause excess pressure to be built up ahead of the piston, because the piston 4*a* will cover the port 32*a*, just as it is shown (in dotted lines) covering port 31*a* on the return stroke. As the piston completes its stroke to the right, the cam 22 will turn until roller 26 of the right hand valve 8 rides on cam surface 35. The piston then moves to the left and shortly thereafter the cam commences its reverse rotation, that is, to the left, until at 50% of the stroke the roller 26 rides down again on surface 36*b*, seating valve 8 to cause main cut-off and moving passage 32*b* into registry with the auxiliary port 32 which remains open (in the example under consideration) until the piston has moved 80% of stroke. As the piston and cam move farther to the left the roller 26 rides down on cam surface 37, permitting movement of the portion 16*a* of the valve stem, under the influence of spring 34, which moves passage 32*b* out of registry with auxiliary port 32, closing said port for the remainder of the piston's stroke to the left. During said remainder of the stroke auxiliary port 31 will again open, but preadmission or waste of steam will be prevented because the outlet 31*a* of the port will be covered by the piston, as shown in dotted lines at the left.

It is obvious that, in carrying out our invention the auxiliary port inlets 31*a* and 32*a* are so positioned, with relation to the cylinder ends and the movement of the piston, and with regard to the valve stems 15*a* and 16*a* and the points of main cut-off and auxiliary cut-off determined upon, that preadmission of steam through the auxiliary ports will be obviated, and there will be no wastage of steam to exhaust. In other words, at the end

of the piston's stroke in either direction it acts substantially as a supplemental valve to close the auxiliary port at its lower end, even though the main valve stem has opened it at its upper end. Thus, the main valve stems 15*a*, 16*a*, and the piston 4*a*, form co-operating valve means for the ports 31 and 32.

Although the drawing illustrates the present preferred embodiment of this invention it is obvious that modifications may be made without departing from the purview of the invention.

It will now be apparent that by our invention, involving but slight changes in the general arrangement of the poppet valves and valve chest, we are enabled to obtain, with such poppet valves having their advantage of quick movement between open and closed positions, the advantage of a very short limited cut-off, and in addition the effect of a long cut-off for starting, without loss or preadmission of steam.

What we claim is:—

1. In a steam engine, a cylinder, a main port and valve therefor, an auxiliary port and control means therefor, and cam means operating said valve and said control means, said control means including a member forming part of the stem for the main valve having a passage movable into and out of registry with the auxiliary port.

2. In a steam engine, a cylinder, a main port and valve therefor, an auxiliary port and control means therefor, and cam means operating said valve and said control means, said control means including a member forming part of the stem for the main valve having a passage movable into and out of registry with the auxiliary port upon movement of said cam means.

3. In a steam engine, a cylinder, a main port and valve therefor, an auxiliary port and control means therefor, and cam means operating said valve and said control means, said control means including a member forming part of the stem for the main valve having a passage movable into and out of registry with the auxiliary port and resilient means urging the member against said cam means.

4. In engine mechanism of the character described, a valve and valve stem, actuating means therefor, a main inlet port controlled by said valve, and an auxiliary inlet port controlled by said stem, said steam having a passage registrable with the latter port.

5. In combination, in a steam engine, a cylinder, a main inlet port therefor, an auxiliary inlet port, a valve member controlling the main port, a valve rod movably engaging said member and controlling it, and having a passage for controlling said auxiliary port, and actuating means associated with said rod including a cam having a plurality of actuating surfaces, one of which positions the rod to close both ports, another of which positions it to open the main port, and an intermediate of which positions the said rod to bring its passage into registry with said auxiliary port.

6. Valve mechanism comprising in combination a main port and a valve therefor, an auxiliary port, a two-piece valve controlling member, the parts of which have relative movement and one part of which has means to open and close said auxiliary port, and actuating means associated with said part of said member adapted to move it first independently of the other part of the member and then together therewith, the first movement moving the first-mentioned part of the member to open the auxiliary port and further movement moving both parts of the member to close said port and open said valve, together with means causing a reversal of said movements in sequence upon reversal of movement of said actuating means.

7. Valve mechanism comprising in combination a main port and a valve therefor, an auxiliary port, a two-piece valve controlling member, the parts of which have relative movement and one part of which has means to open and close said auxiliary port, and actuating means associated with said part of said member adapted to move it first independently of the other part of the member and then together therewith, the first movement moving the first-mentioned part of the member to open the auxiliary port and further movement moving both parts of the member to close said port and open said valve, together with resilient means urging said first-mentioned part against said actuating means.

8. Valve mechanism comprising in combination a main port and a valve therefor, an auxiliary port, a two-piece valve controlling member, the parts of which have relative movement and one part of which has means to open and close said auxiliary port, and actuating means associated with said part of said member adapted to move it first independently of the other part of the member and then together therewith, the first movement moving the first-mentioned part of the member to open the auxiliary port and further movement moving both parts of the member to close said port and open said valve, together wth resilient means urging said first-mentioned part against said actuating means and means urging said second-mentioned part toward said first-mentioned part.

9. In a steam engine, a cylinder, a valve chest having a steam chamber, a plurality of main ports from said chamber to the cylinder and a valve means for each port, a plurality of auxiliary ports from the chamber to the cylinder, a reciprocable stem member for each of said valve means, having a steam passage, positioned so that upon movement

of said member the passage will move into and out of registry with an auxiliary port, and means between said stem members controlling their movement.

10. In a steam engine, a cylinder, a valve chest having a steam chamber, a plurality of main ports from said chamber to the cylinder and a valve means for each port, a plurality of auxiliary ports from the chamber to the cylinder, a reciprocable stem member for each of said valve means, having a steam passage, positioned so that upon movement of said member the passage will move into and out of registry with an auxiliary port, and means between said stem members controlling their movement comprising a rocking cam.

11. In a steam engine, a cylinder, a valve chest having a steam chamber, a plurality of main ports from said chamber to the cylinder and a valve means for each port, a plurality of auxiliary ports from the chamber to the cylinder, a reciprocable stem member for each of said valve means, having a steam passage, positioned so that upon movement of said member the passage will move into and out of registry with an auxiliary port, and means between said stem members controlling their movement comprising a cam having a low face, a high face and a pair of intermediate faces, said intermediate faces providing for the uncovering of the auxiliary ports.

12. In a steam engine, a cylinder, a valve chest having a steam chamber, a plurality of main ports from said chamber to the cylinder and a valve means for each port, a plurality of auxiliary ports from the chamber to the cylinder, a reciprocable stem member for each of said valve means, having a steam passage, positioned so that upon movement of said member the passage will move into and out of registry with an auxiliary port, and means between said stem members controlling their movement, comprising a cam having a low face, a high face, and a pair of intermediate faces, said intermediate faces providing for the uncovering of the auxiliary ports, each stem member being adapted to engage in sequence the high face, an intermediate face, and the low face, and vice versa.

In testimony whereof we have hereunto signed our names.

HUBERT J. TITUS.
JOHN S. WALLIS.