2 sheets sheet 1

Norman W. Wheeler's

Hydraulic Valve Gear for Steam Engines.

Sheet A.

PATENTED

DEC 10 1867

Witnesses.

Frank L. Pondle

John E. Cooper

Signature.

Norman W. Wheeler

72139

Fig. II.

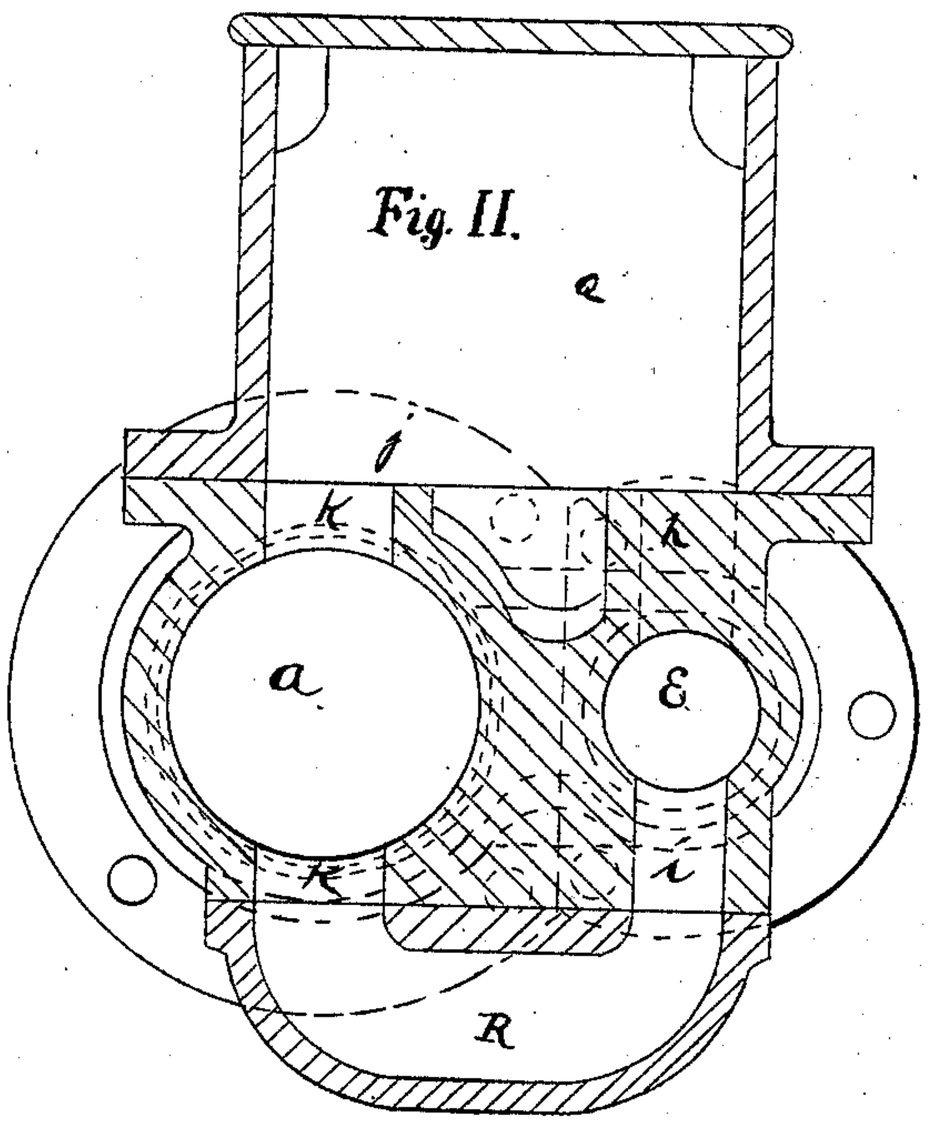


Fig. III

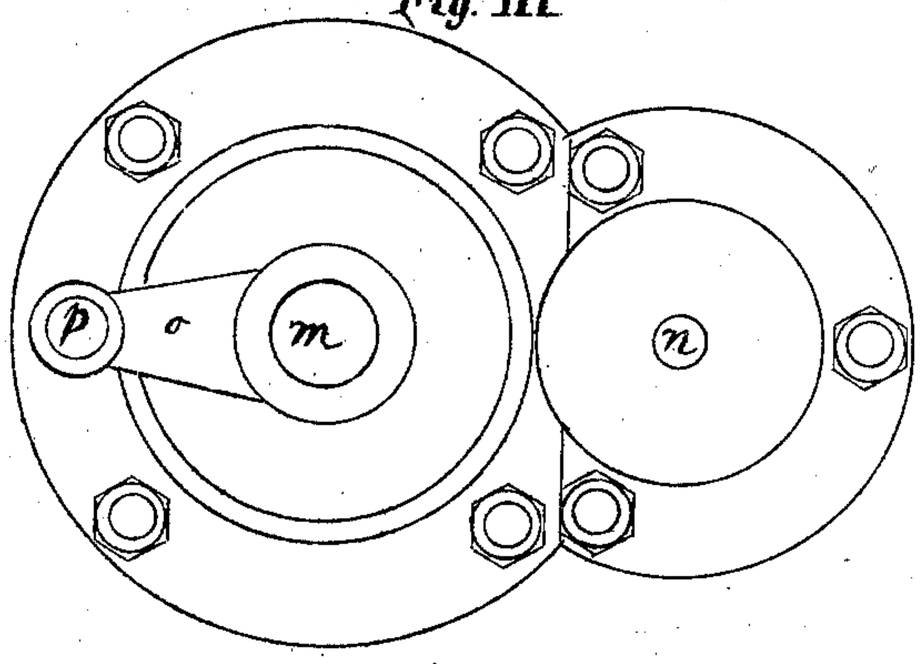
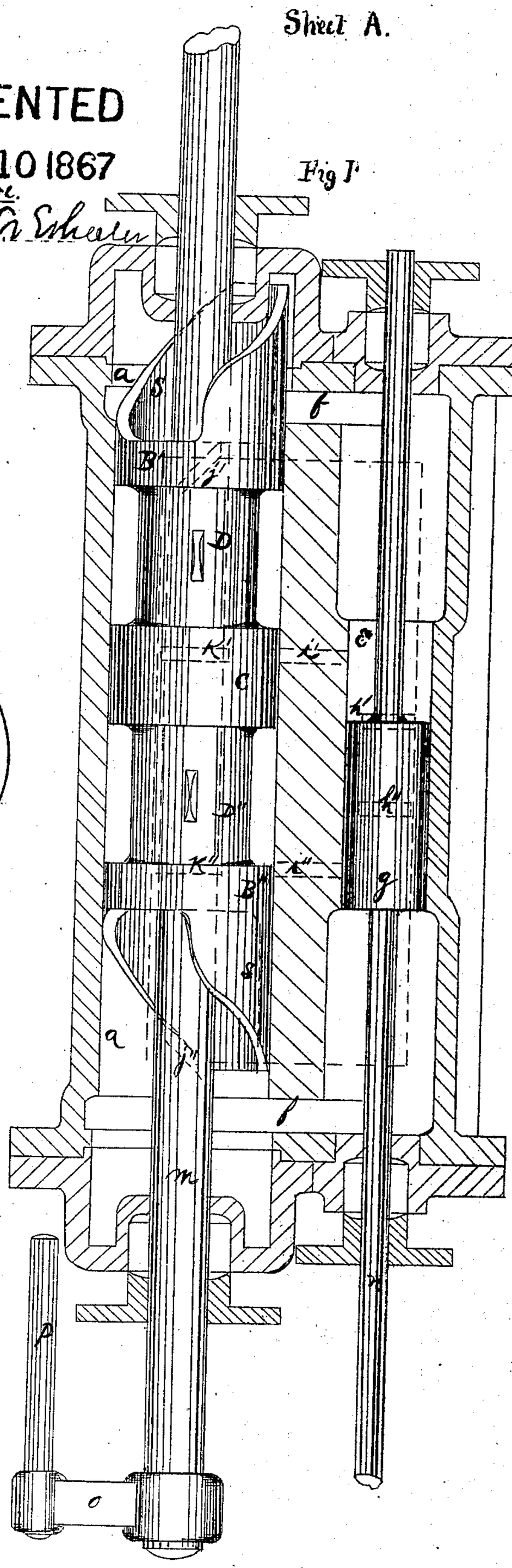


Fig I



United States Patent Office.

NORMAN W. WHEELER, OF BROOKLYN, NEW YORK.

Letters Patent No. 72,139, *dated December* 10, 1867.

IMPROVEMENT IN VALVE-GEAR FOR STEAM-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, NORMAN W. WHEELER, of the city of Brooklyn, county of Kings, and State of New York, have invented a new and useful Hydraulic Valve-Gear for Steam and other Engines; and I hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, with letters of reference marked thereon, forming a part of this specification.

Figure 1, in sheet A, represents a mole's-eye section,

Figure 2 a cross-section, and

Figure 3 a partial end view; and

In sheet B are represented diagrams Nos. 1, 2, and 3, to show the operation of the apparatus, and the control had over the steam-valves, like letters indicating the same parts in the different figures and diagrams.

In most steam-engines the valves are actuated by motion derived more or less directly from the working-piston, which motion is usually a continuous reciprocation, and various mechanical devices have been employed for the purpose of changing the reciprocation of the rock-shaft, for instance, to an intermittent reciprocation of the steam-valves, that is to say, moving at successive steps, for purposes well known to engineers.

The essence of my invention consists in impressing such desired intermitting reciprocation upon the valves, through the instrumentality of a hydraulic apparatus, which receives the constant reciprocating motion from the working-piston, and delivers an intermitting reciprocating motion to the valve or valves, the times of complete or partial intermission of motion being variable, when it is so desired, responsive to the action of a governor, or the manipulation of an attendant.

To enable others skilled in the art to construct and use my invention, I will proceed to describe in detail the construction and operation of an example, referring first to sheet B, upon which are drawn three diagrams, for the purpose of illustration merely, without reference to facility of construction, in which—

a a represents a barrel, into which are fitted the plungers B′ C B″, connected to each other by the necks D′ D″; and the plungers are supposed to receive a constant reciprocating motion from an eccentric equivalent to the circle *l*. E represents another barrel, preferably smaller than *a a*, into which is fitted a ram, *g*, which gives motion to the valve or valves, an outline of one variety being drawn above each diagram, in positions corresponding to those of the ram *g*. The two barrels, *a a* and E, are connected together at their ends by the passages *f f*. *h′ h″*, *i′ i″*, *j′ j″*, and *k′ k″*, are ports and passages, the functions of which will be understood from a description of the action of the apparatus, which should be considered as immersed in a body of fluid which fills all the internal cavities of the apparatus.

Now, suppose the eccentric to revolve in the direction indicated by the arrow-head marked on the circle *l*, the fluid will escape from before the plunger B″, as seen in No. 1, through the port *j″*, while it will follow up behind the plunger B′, entering through *k′*, *i′*, E, and *f*, or through *h′*, E, and *f*. This will continue, and no motion be given to the ram *g* until the plunger B″ shall reach and close the port *j″*, when the fluid will be imprisoned, and a pressure generated sufficient to move the ram *g* along in the opposite direction to the motion of B″, the relative velocities of the ram and plungers being inversely as their areas. This motion of *g* will continue until the passage *i″* is opened by the passage beyond it of the ram *g*, when the fluid will escape through the passages *i″* and *k″*, passing across *a*, around the neck D″, and the ram *g* comes to rest with the valve in the position shown in No. 2, with the steam cut off and the exhaust-port partially open. The continued movement of the plungers will impress no motion upon the ram until the central plunger C arrives at and closes the ports *i″* and *k″*, or one of them, when, there being no way of escape for the fluid before B″, the ram *g* must resume its motion, and come again to rest when it shall have passed by and opened the port *h″*, through which the fluid will then flow, leaving the ram and valve in the positions shown in No. 3, during the residue of the stroke of the plungers B′ C and B″, and until the plunger B′ shall have returned and closed the port *j′*, when the continuance of the return-stroke of the plunger will produce movements of the ram *g* equivalent to those described, but in the opposite direction, as is easily seen by inspection of the diagrams. In brief, the functions of this apparatus are to move the steam-valve or valves from a state of rest, in proper position for admitting steam to one end of the working-cylinder, and releasing it from the other, first to a position closing the admission, and leaving the release more or less free, and, after an interval of rest, to again move the valve or valves,

so as to reverse the admission and release. The apparatus may, if preferred, be made in two parts, each operating valves at the respective ends of the working-cylinder. It will be seen that with this apparatus the eccentric should be set a little "late," in reference to the crank, instead of "early," as when the usual valve-gears are used.

If the plungers and ram be fitted into the barrels so accurately as to prevent leakage, the ports *h' h''* may be omitted, for the ram *g* would come to rest when the plunger reached the extreme of its throw, and be left in the desired position. But it is deemed best to provide for a considerable degree of inaccuracy and leakage, by making the throw of the plunger exceed that theoretically required, and to provide, as shown in the diagrams, for an overflow at the end of each movement of the ram.

The construction may be varied in its mechanical features, to cover a wide range of results, and to present to the superficial observer great variety in appearance. For instance, when extreme accuracy of throw is required, and when it is feared that the precise mode of construction shown in the drawings would result in too great leakage, uncertainty, and wear of parts, the plungers B' and B'' may be omitted, and the remaining plunger, C, and the ram *g*, be tightly packed to fit the barrels, with fibrous or other packing, but in that case, inasmuch as the packing would not readily traverse the ports, the imprisonment and release of the fluid should be performed by slide or other valves, operating in separate chambers, or at least upon separate seats, for each barrel, and attached respectively to the ram and plunger, or other part of the engine, so that the port-closing and opening functions, described as appertaining to the plungers, lips, and ram, shall appertain to these equivalent valves. When it is desirable to make the apparatus in the same general form as shown in the drawings, but of less length, the centre plunger C may be omitted, and also one of the necks, D' or D'', and the functions of the plunger C be devolved upon the inner ends of the plungers B' and B'', and the length of the apparatus be materially reduced; but in that case the ports *k'* and *k''* must be put each in the place of the other, and the passages leading from them to the ports *i'* and *i''* must be crossed, so as to retain the capacity for the desired action. And, for another instance, suppose each end of a working-cylinder to be fitted with a valve having a piston attached by way of a spring, or that the valve is of the disk variety, traversing a port communicating with the end of the working-cylinder, with the live steam, say, above the valve, so that it will fall and admit steam when left without support. Now if a ram equivalent to *g* be attached to each valve, so as to lift it to close the port, and again lift the valve beyond the port to release, the valve may be held up during the time of release by a mechanical or hydraulic latch, and such latch be disengaged, and the valve allowed to fall and admit steam by the action of the opposite valve, when it approaches its highest position; or the latches may be disengaged by the agency of a "cataract," and a "rest" or "hark" of the engine be secured at the end of each stroke, which may be very desirable, if it be fitted as a pumping-engine, and the motion of the plungers B' B'' D' D'' C be derived directly from the motion of the working-piston; and again, if a valve-gear to work puppet-valves be fitted with the "toes" all upon one rock-shaft, and the "steam-toes" set so as to have sufficient idle motion to seat the steam-valves while the exhaust-valves remain partially open, and further, the rock-shaft be fitted with counterpoise, to hold the gear at full open during the early part of the stroke of the plungers, then the intermittent motion to be derived from the apparatus herein described, applied to the rock-shaft, will make a desirable motion for such valve and cut-off gear. The time in the stroke at which the cutting-off movement will take place, depends upon the position of the ports *j' j''*, in relation to the length and throw of the plungers B' B'', and conversely, upon the lengths of the plungers B' B'', in relation to the lengths of their strokes and the longitudinal positions of the ports *j' j''*; hence, any mechanical device which will practically change the lengths of B' B'', may be used to change or regulate the times of cut-off, and the grade of expansion.

Referring now to sheet A, we see drawings of a practical apparatus, lettered to correspond with the diagrams, with the valve-rod *n*, eccentric-rod *m*, which should be connected with the eccentric by means of a cup-and-ball joint, or "spade-handle," in which the part of the rod carrying the plunger may turn upon its own axis, so that, by means of the arm *o* and pin *p*, the plunger may be manipulated so as to regulate the grade of expansion, as hereafter described. Q is a reservoir to contain the fluid; R a bonnet, forming a channel from *k* to *i*; and the dotted lines *i' i''* show the longitudinal position of the passages *i'* and *i''* in the diagrams merely for illustration; whereas the real passages are from *k' k''* to *i' i''*, through bonnets R. S S are cut-off lips or prolongations of the plungers B' B'', cut away at a proper angle, so as to cover the ports *j' j''*, and produce the cut-off movement of the ram *g* at a period of the stroke to correspond with the relative angular positions of the ports *j' j''* and lips S S, which position depends upon the position of the arm *o*, which may be arranged to be operated by hand or by any known governor, attached to the pin *p*; and the "lead" of the steam-valves may be changed to correspond with the grade of expansion, by making the ends of the plunger C at some angle to the axis other than ninety degrees. There may be used various equivalents for the device here shown, to regulate the grade of expansion; for one instance, the lips S S may be simply tongues projecting from the plungers B' B'', and be made to cover the cut-off port *j' j''* at the desired time by means of angular motion given the plungers by fixed or adjustable stops, operating on the arm *o*; and if valves separate from the plunger and ram be used to regulate the overflow of the fluid, they may be "spread" or "contracted" in various ways known to mechanics.

The "dash-pots" and analogous devices which have heretofore been used for the purpose of arresting the motion of valves when they approach their seats, differ fundamentally from this invention, in that they do not transmit motion to the valves, but only resist destructive movements of the valves and their attachments; so does the mode of cutting-off, wherein the valve is lifted by mechanical means, and held open, until the proper time for closing, by means of a barrel and plunger, arranged as a hydraulic latch.

The above-described apparatus performs certain functions which have not been performed by any hydraulic apparatus which has heretofore come within my knowledge, to-wit, it receives a continuous reciprocating motion from an eccentric or other moving part of the engine, and delivers an intermittent reciprocating motion

to the valve or valves, or the devices directly actuating them, by means of the instrumentalities indicated below, that is to say—

First, the operation of the moving force upon the valve or valves is suspended at the period when the steam is cut off, and before the exhaust is opened, by reason of the relations of the ports *i' i''* to the ram *g*, which are such that the ram *g* will pass over and open one of the ports *i'* or *i''*, thus relieving the ram *g* from pressure; and, if it be preferred, this operation may be performed by separate valves, constructed so as to operate in an equivalent manner; but I prefer the precise construction described.

Second, the valve or valves are caused to resume its or their movement towards the completion of the throw at the proper period, by reason of the relations of the ports *i' i''* or *k' k''*, which are such that the plunger C will then cover the appropriate one; and, if it be preferred, this may be effected by separate valves, constructed to operate in an equivalent manner.

Third, the operation of the moving force upon the valve or valves is suspended when it or they have arrived at the proper limit of the throw, by reason of the relation of the plunger *g* to the ports *h' h''*, which are such that, at the proper period, the plunger *g* will pass over so as to open the appropriate one, (*h'* or *h''*,) thus relieving the pressure; and, if it be preferred, this operation may be performed by separate valves, constructed to operate in an equivalent manner.

Fourth, the cutting-off movement of the valve or valves is induced at the periods chosen, by reason of the relations of the ports *j' j''* to the plungers D' D'', and the cut-off lips S S, which are such that the appropriate one of the ports *j' j''* will be closed at the period determined by the passage over it at the proper period of the appropriate lip or plunger, and the period of closure may be regulated by turning the plunger so as to bring different parts of the angular lips S S over the ports *j' j''*; and, if it be preferred, this operation may be performed by separate valves, constructed to operate in an equivalent way.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. I claim opening proper ports, as *i' i''*, so as to suspend the operation of the moving force upon the valve or valves at the period when the steam is cut off, and before the exhaust is opened, substantially as and for the purpose herein set forth.

2. I claim the closure of certain ports, as *i' i''* and *k' k''*, so as to cause the valve or valves to resume the movement towards its or their full throw at the proper period, substantially as and for the purpose herein set forth.

3. I claim opening proper ports, as *h' h''*, so as to suspend the moving force operating upon the valve or valves when they or it have reached the proper limit of throw, substantially as and for the purposes herein set forth.

4. I claim regulating the times of closing of passages, so as to induce the cutting-off movement of the valve or valves, at variable periods, substantially in the manner and for the purposes herein set forth.

5. I claim changing a continuous reciprocating motion derived from an eccentric, or equivalent moving part of the engine, to an intermittent reciprocating motion, by means of an hydraulic apparatus, as hereinbefore described, substantially in the manner and for the purposes herein set forth.

In witness whereof, I have hereunto set my name in the presence of two subscribing witnesses.

NORMAN W. WHEELER.

Witnesses:

C. C. LIVINGS,

F. A. HADICKE.